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June 11, 2015

Ms. Jean Wyatt, Technical Contact
U.S. Environmental Protection Agency, Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: **Analytical Results Report for a Site Reassessment Regarding the Ruby District West Site, Crested Butte, Colorado**
EPA ID: COSFN0801684
EPA Region 8 START 8(a) Carve-Out Contract EP-S8-11-05, Task Order 0015
Task Monitor: Jean Wyatt, EPA Region 8, Technical Contact

Dear Ms. Wyatt:

Seagull Environmental Technologies, Inc. (Seagull) is pleased to submit the attached Analytical Results Report for a Site Reassessment regarding the Ruby District West site near Crested Butte, Colorado. Please contact me via email at rlunt@seagullenvirotech.com or at (720) 459-7874 if you have any questions or comments.

Sincerely,

Ryan M. Lunt

Ryan M. Lunt, CHMM
Task Order Project Manager

Hieu Q. Vu, PE
Program Manager

cc: Joseph Byron, Project Officer

Enclosure

ANALYTICAL RESULTS REPORT

For a

SITE REASSESSMENT

Regarding the

RUBY DISTRICT WEST SITE

CRESTED BUTTE, COLORADO

EPA ID: COSFN0801684

Contract No.: EP-S8-11-05
Task Order No.: 0015

Prepared by

SEAGULL ENVIRONMENTAL TECHNOLOGIES, INC.
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June 11, 2015

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List of Acronyms

bgs	Below ground surface
bws	Below water surface
C	Celsius
CCC	Criterion Continuous Concentration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic feet per second
CGS	Colorado Geological Survey
CLP	Contract Laboratory Program
CMC	Criterion Maximum Concentration
CR	Cancer risk screening concentration
CRDL	Contract Required Detection Limit
yd^3	Cubic yards
DO	Dissolved oxygen
DQI	Data quality indicators
DQO	Data quality objectives
EPA	Environmental Protection Agency
ESI	Expanded Site Inspection
FSP	Field sampling plan
HRS	Hazard Ranking System
HNO_3	Nitric acid
ID	Identification
MCL	Maximum Contaminant Level
MD	Matrix duplicate
MS	Matrix spike
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mV	Millivolts
mg/L	Milligrams per liter
NWI	National Wetlands Inventory
ORP	Oxidation reduction potential
PA	Preliminary Assessment
ppb	Parts per billon
PPE	Probable point of entry
ppm	Parts per million
QAPP	Quality assurance project plan
QA/QC	Quality assurance/quality control
r^2	Regression coefficient
RfD	Reference dose screening concentration
RPD	Relative percent difference
Seagull	Seagull Environmental Technologies, Inc.
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
SR	Site Reassessment
SCDM	Superfund Chemical Data Matrix

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List of Acronyms

SQL	Sample Quantitation Limit
START	Superfund Technical Assessment and Response Team
S/m	Siemens per meter
TAL	Target Analyte List
TDL	Target distance limit
UOS	URS Operating Services
USFWS	United States Fish and Wildlife Service
XRF	X-ray fluorescence
%	Percent
<	Less than
°	Degree

1.0 INTRODUCTION

Under the U.S. Environmental Protection Agency (EPA) Region 8 Superfund Technical Assessment and Response Team (START) Carve-Out 8(a) Contract (No. EP-S8-11-05), Task Order No. 0015, Seagull Environmental Technologies, Inc. (Seagull) was tasked to conduct a Site Reassessment (SR) of the Ruby District West site in Crested Butte, Gunnison County, Colorado (see Figure 1). The SR will help determine whether the site poses a threat to human health and the environment, and if further investigation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted.

2.0 SITE OBJECTIVES

The purpose of this SR was to reassess the Ruby District West site by gathering new data and assessing current site conditions. Specific objectives of this SR were to:

1. Assess/document site conditions, gather site-specific information, and evaluate previous sample locations/data and exposure and migration pathways.
2. Evaluate potential threats and support a recommendation regarding need for further assessment decisions and subsequent Hazard Ranking System (HRS) scoring.
3. Verify drinking water intakes and other water uses along the 15-mile downstream surface water pathway.
4. Determine if mine water discharges are entering any surface water bodies near the Ruby District West site.
5. Verify groundwater users within the 4-mile radius of the site including the Ruby Anthracite Creek Watershed, and the associated town of Irwin, Lake Irwin Campground, and summer vacation cabins.
6. Document any evidence of human consumption of fish caught from surface water bodies' downgradient of sources at the Ruby District West site.
7. Verify presence of state and federal endangered species associated with the Ruby District West site.

3.0 SITE LOCATION AND DESCRIPTION

The Ruby Mining District can be reached from the intersection of Colorado Highway 135 and Elk Avenue in Crested Butte by proceeding west on Elk Avenue to County Road 12 and continuing west on County Road 12 toward Coal Creek valley. The Ruby Mining District is split into two different Superfund sites: Ruby District South (EPA Identification [ID] CO0002378230) and Ruby District West (EPA ID COSFN0801684).

The Ruby Ranges are along the western edge of the Colorado Mineral Belt and contain most of the significant metal mine features. These mines are in areas where rich base-metal sulfide veins crop out.

The yellow dumps contain large volumes of waste rock and are visible to the public. The majority of mine features are accessed fairly easily via 4WD roads; however, some mines occur in remote areas that are difficult to reach. This is especially true along the upper slopes of the Ruby Range and in the eastern part of the Raggeds Wilderness (Ruby District West) (CGS 1998).

The Raggeds Wilderness contains significant mine features in remote locations such as Gabarfeich, Swan, Buck, Gold, Silver Basins, and on the western flanks of Augusta Mountain. The western portion of the Oh-Be-Joyful Wilderness, which lies within the Paonia Ranger District near Irwin, Colorado, contains abundant hard rock mine features. Most of these mine sites are located along brecciated and mineralized fault fissures (CGS 1998). The West Elk and Anthracite Range is poorly mineralized and have few mine workings. Metal mine features consist mainly of shallow prospect pits and short adits. The majority of the dumps contain less than 50 cubic yards of waste rock. In general, mine features occur in isolated areas away from public activity and are accessed by foot trail (CGS 1998).

Additionally, in Ruby District West, surface water is diverted from Irwin Lake and piped into the headwaters of Coal Creek. This diversion was made to maintain water rights belonging to Crested Butte. The Coal Creek drainage is the sole source of the town of Crested Butte's municipal water supply. Mines in Ruby District West and other mines in the area may have an impact on the drinking water supply to the town of Crested Butte.

This SR focused on the Ruby District West site and the potentially significant abandoned mine source areas as were identified by the Colorado Geological Survey (CGS) in 1997 (described in detail in Section 3.2). The site encompasses 3,200 acres and includes Anthracite Creek and Ruby Anthracite Creek Watersheds (see Figure 2). Below are the following source areas identified by the CGS and visited during the 2015 sampling event for the Ruby District West Site Reassessment:

Source Area 1

No XRF screening and sampling was collected at source area 1 based on past sampling results and previous descriptions of those areas that indicated they did not contain mining-related materials (Seagull 2014).

Source Area 2

No XRF screening and sampling was collected at source area 2 due to travel time and access in the Raggeds Wildness area. However, the mining features in source area 2 are in the Gabarfeich Basin, west of Angel Pass and between Augusta Mountain and Richmond Mountain in a remote part of the Raggeds Wilderness Area. The nearest stream is Middle Anthracite Creek roughly 0.25 to 0.50 miles

downgradient from source area 2. During the 1998 inventory conducted by CGS, it was estimated that the mine dump volume in source area 2 ranged from 15 to 240 cubic yards.

Source Area 3

Source area 3 is entirely on Forest Service-managed land on the eastern flanks of the Ruby Range. Mine features in the source area consist of mine dumps, adits, and waste rock and occur above and below Green Lake. Green lake is the nearest surface water body in source area 3, other than the unnamed tributaries that lead to Green Lake. Green Lake lies on the eastern edge of a bowl-shaped basin that is referred as Green Lake Basin. Surface and subsurface runoff flows across and below the talus slopes, depositing sediment into the lake. Green Lake is a shallow body of water that freezes solid during the winter. Green Lake Basin is accessed by an old mining road that is partly covered by loose talus. The trail terminates in a saddle (source area 4) along a ridge crest.

During the sample event, Seagull collected source samples from a waste pile next to an adit. It was estimated that the waste pile was 65 cubic yards in size. During the 1998 inventory conducted by CGS, it was estimated that the largest mine dump in source area 3 was 60 cubic yards.

Source Area 4

This source area is near a ridge that forms a saddle between Ruby Peak on the south and Mount Owens on the north. The lowest part of the saddle is at an elevation of 12,030 feet. The source area is accessed by a talus-covered foot trail that once was a mine road. All of the inventoried features are above the timberline on Forest Service-managed lands and Green Lake (CGS 1998). Green lake is the nearest surface water body in source area 4 besides the unnamed tributaries that lead to Green Lake. The saddle is stained dark yellow-brown, and its scree slopes are stained bright red-orange to orange-brown. Light-yellow, clay-rich deposits are found in the saddle and are exposed in the cut banks of the old mine road (CGS 1998).

Several mining features are located along the saddle in source area 4. A back-filled open pit that was filled and leveled by heavy equipment is located on the north portion of the saddle. Heavy equipment, including a drill rig, once traveled up the old mining road from FR #826.1E (CGS 1998). The old road leads to the north side of the filled pit and stops about 10 feet north of a drill hole, where a 4-inch-diameter metal pipe protrudes 1.5 feet out of the ground in the middle of the disturbed area. Its surface is barren of vegetation and contains clayey, light-yellow soil with abundant disseminated pyrite and chalcopyrite (CGS 1998). Several mining dumps and features are along the face of the saddle. The estimated volume of those dumps is 455 cubic yards. The dumps include waste rock that

accumulated on the slopes below the saddle, and the waste rock that was used to back-fill the open pit that was is located on the north portion of the saddle (CGS 1998). During rainstorms and snowmelt, runoff flow downgradient 700 feet, eventually reaching Green Lake.

Source Area 6

Located along the eastern flanks of the lower part of Robinson Basin, this source area contains four adits, two shafts, and a prospect pit (CGS 1998). The nearest surface water body is Robinson Creek. No XRF screening and sampling was not collected at source area 6 due to the mining features being located on private mining claims and access was not obtained. Surface water and sediment samples were collected in this area since the locations were on USFS land. During the 1998 inventory conducted by CGS, it was estimated that the mine dump volumes in source area 6 ranged from 20 to 270 cubic yards.

Source Area 7

The CGS inventory site is at the head of Robinson Basin, which runs in a northeasterly and southwesterly direction. The head of the basin is on the south flank of Scarp Ridge. Scarp Ridge consists of a series of vertical cliffs extending from Purple Peak to Gunsight Pass. Mine features are accessed by well-marked foot trails and follow the west side of Robinson Creek into Robinson Basin. This trail leads to and joins another trail that follows along the crest of Scarp Ridge. Source area 7 contains multiple adits, mine dumps, and waste rock piles. The main focus in this source area was the Robinson mine dump/tailings located at the headwaters of Robinson Creek. The adit located at the Robinson mine does not discharge directly into the Robinson creek and would likely have minimal impact to downstream water users (i.e. Crested Butte). It is estimated that waste at the Robinson mine is roughly 550 cubic yards. CGS also estimated that other mine dumps in source area 7 range from 10 to 63 cubic yards.

Source Area 8

No XRF screening and sampling was not conducted at source area 8 due to travel time and limited access in the Raggeds Wildness area. The nearest stream is Dyke Creek which is located within the source area. During the 1998 inventory conducted by CGS, it was estimated that mine dump volumes in source area 8 ranged from 17 to 20 cubic yards. Additionally, adits were not noted in the Colorado Geological Survey report (see section 3.2) and were not confirmed since sampling was not completed at the source area.

3.1 Site History

Mining in the Ruby Mining District began in 1874, and the majority of the mines ceased production in 1890; however, between 1901 and 1974, small amounts of gold, silver, zinc, lead, and copper ores were

mined. Approximately 30 private mining claims are associated with areas west and northwest of Lake Irwin within the Ruby District West site boundary (Gunnison County Assessor's Office 2014) (see Figure 3); however, none of the mines are presently active.

3.2 Previous Investigations

Colorado Geological Survey

In 1995, the CGS inventoried mines, measured mine adits and waste rock piles, collected water samples, and assigned environmental degradation ratings for mines within the Ruby District West site. Eight mining sites were assigned "significant" or "potentially significant" environmental degradation ratings. These potential sources of environmental contaminants are summarized in Table 1 and shown on Figure 2. The general guidelines for assigning a "significant" or "potentially significant" environmental degradation rating were:

Environmental Degradation Rating	Feature Displays One or More of the Following Characteristics
Significant	• Receiving stream is significantly or obviously adversely affected, but not "dead" or sterile; • Effluent has low pH (<5); • Effluent has high conductivity; • Moderate flows of poor-quality water, relative to the receiving stream; • High flows of moderate-quality water, relative to the receiving stream; • Moderate to abundant precipitate at the mine and/or in the receiving stream; • Large sulfide-rich dumps or tailings piles with evidence of moderate erosion; • Large dumps with sparse or no sulfides, but evidence of significant erosion.
Potentially Significant	• Evidence of degraded water quality, but serious effects are not obvious or detected; • Effluent has low pH (<5.5); • Effluent has moderate conductivity; • Poor-quality water with low or no flow (standing water); • Moderate to low flows of moderate-quality water, relative to the receiving stream; • Minor amounts of precipitate; • Very large dumps with little or no evidence of erosion and sparse or no sulfides; • Small and moderate-sized sulfide-rich dumps or tailings piles with evidence of moderate erosion.

U.S. Environmental Protection Agency

Preliminary Assessment

Site assessments of the Ruby District West site have been completed by URS Operating Services, Inc. (UOS), a START contractor in EPA Region 8. In 1999, UOS completed a Preliminary Assessment (PA)

that included both the Ruby District South and Ruby District West sites (UOS 1999). The PA concluded that a site inspection be completed due that mine water discharges into surface water and tailings erosion could potentially impact wetlands along all streams, trout fisheries, and downstream surface water users including the 1,577 residents of the town of Crested Butte which takes its municipal water from Coal Creek.

Expanded Site Inspection

On February 8, 2001, UOS completed an Expanded Site Inspection (ESI) of the Ruby District West site. As part of the ESI, UOS conducted field work in two phases: (1) Phase I was conducted during the week of June 20-25, 1999, to coincide with high-flow surface water conditions; (2) Phase II was conducted during the week of September 5-10, 1999, to coincide with seasonally low-flow surface water conditions.

Phase I

Samples collected during the Phase I sampling activity were analyzed for Target Analyte List (TAL) metals, volatile organic compounds (VOC), semi volatile organic compounds (SVOC), pesticides, and polychlorinated biphenyls (PCB). No VOCs, SVOCs, pesticides, or PCBs were detected in sediment, surface water, drinking water, or groundwater samples. A summary of analytical results for metals detected in the samples is as follows:

Soil (Source) Samples

A total of six soil (source) samples were collected at the following five locations (two samples were collected at source area 4): Green Lake Basin (source area 3), the summit of Green Lake Basin (source area 4), Robinson Basin (source area 6 and source area 7), and Dyke Creek Basin (source area 8). The Phase I source samples contained arsenic at concentrations ranging from 1.5 milligrams per kilograms (mg/kg) (source area 8) to 218 J mg/kg (source area 7). The J qualifier indicates that the reported value is an estimate. Overall, the highest concentrations of metals found in all the source samples collected during Phase I activity were 1.63 mg/kg of antimony (Source Area 7), 218 mg/kg of arsenic (Source Area 7), 635 mg/kg of barium (Source Area 4), 0.84 mg/kg of beryllium (Source Area 6), 118 mg/kg of copper (Source Area 4), 63,500 mg/kg of iron (Source Area 3), 5,320 mg/kg of lead (Source Area 3), 1.11 mg/kg of mercury (Source Area 7), 21.8 mg/kg of molybdenum (Source Area 4), and 382 mg/kg of zinc (Source Area 3) (UOS 2001).

Seep Samples

A total of four seep samples were collected at the following locations: Green Lake Basin (source area 3), the summit of Green Lake Basin (source area 4), and Robinson Basin (source area 6 and source area 7). The four samples were analyzed for total and dissolved metals. The samples from source areas 3 and 4 analyzed for total metals contained concentrations of the following metals that exceeded Superfund

Chemical Data Matrix (SCDM) Criterion Continuous Concentration (CCC) values: aluminum, cadmium, copper, iron, lead, and zinc. The samples from source areas 3 and 4 analyzed for dissolved metals contained concentrations of the following metals that exceeded SCDM CCC values: aluminum, cadmium, copper, lead, and zinc. No metal concentration detected in samples from source areas 6 and 7 exceeded any SCDM CCC or Criteria Maximum Concentration (CMC) values.

Surface Water and Sediment Samples

Twenty-two surface water and 19 sediment samples were collected at the Ruby District West site. In surface water sample RW-SW-S3-01, a background sample collected at Green Lake Basin, west (upgradient) of Lake Irwin, concentrations of total iron and lead exceeded SCDM CCC benchmarks. In 13 surface water samples, concentrations of total aluminum were detected above the CCC value of 87 micrograms per liter (µg/L), ranging from 89 to 320 µg/L. In surface water samples RW-SW-S3-02 and RW-SW-S8-03, concentrations of total cadmium (0.353 and 0.34 µg/L, respectively) exceeded the SCDM CCC value of 0.25 µg/L. In surface water sample RW-SW-S8-03, dissolved cadmium at 0.32 µg/L exceeded the SCDM CCC benchmark value of 0.25 µg/L.

In sediment sample RW-SE-AC-01, collected at the outlet of Lake Irwin to Ruby Anthracite Creek, arsenic was detected at 18.2 µg/L.

Drinking Water Samples

Sampling occurred at six residential drinking water wells and five springs used for drinking water by residents in the town of Irwin and by visitors to area parks. Except for one sample (USFS Well-Campground North, sample # RW-DW-08)), total arsenic was detected in all drinking water samples (including the background sample) at concentrations exceeding its Cancer Risk (CR) of 0.057 µg/L. One drinking water sample collected during the Phase I investigation (Hochradel well, sample RW-DW-03) contained total arsenic at 22.1 µg/L and dissolved arsenic at 22.8 µg/L, both above the Maximum Contaminant Level (MCL) of 10 µg/L. In the USFS Well-Campground North and USFS Well-Campground South samples, total lead concentrations (124 and 17.5 µg/L, respectively) exceeded the EPA action level of 15 parts per billion (ppb). The USFS Well-Campground North and USFS Well-Campground South wells are transient use wells.

Phase II

Samples collected during Phase II were analyzed only for TAL metals. EPA considered all Phase II results screening-level data because of improper analytical methods and inadequate quality control (QC) practices by the laboratory. Screening-level data provide analyte identification and imprecise quantification, resulting in unknown data quality (UOS 2001). Additionally, screening-level data cannot

be used for HRS scoring purposes. As a result, the analytical results from the Phase II activity are not included in the summary tables attached to this Site Reassessment Report.

Soil (Source) Samples

A total of four soil (source) samples were collected during Phase II at the following locations: the summit of Augusta Mountain (source area 1), Garbarfiech Basin (source area 2), Green Lake Basin (source area 3), and Upper Silver Basin (source area 5). Overall, the highest concentrations of metals found in all these source samples were 3.7 mg/kg of arsenic, 1,076 mg/kg of barium, 0.36 mg/kg of beryllium, 60.5 mg/kg of copper, 38,448 mg/kg of iron, 3,609 mg/kg of lead, 0.06 mg/kg of mercury, and 1,241 mg/kg of zinc (UOS 2001). The soil sample collected at Green Lake Basin during Phase I had been from a different mining dump/pile than the sample collected during Phase II at Green Lake Basin.

Seep Samples

A total of four seep samples were collected during the Phase II activity at the following locations: Green Lake Basin (source area 3), the summit of Green Lake Basin (source area 4), Robinson Basin (source area 6), and Robinson Basin Number 1 (source area 7). Results of total metals analysis of the seep samples from source areas 2, 3, and 5 indicated lead concentrations ranging from 7 to 10.7 µg/L, exceeding the SCDM CCC value of 2.5µg/L. Results of dissolved metals analysis of the seep samples from source areas 2 and 3 indicated lead concentrations (6.2 J and 3.75 J µg/L, respectively) exceeding the SCDM CCC value. No other metal concentration exceeded an SCDM CCC or CMC value.

Surface Water and Sediment Samples

Twenty-six surface water and 20 sediment samples were collected during Phase II at the Ruby District West site. Total lead concentrations in surface water samples RW-SW-S7-01 (6.5 J µg/L), RW-SW-S7-03 (8.2 J µg/L), RW-SW-S8-02 (7.4 µg/L), and RW-S8-03 (5.7 µg/L) exceeded the SCDM CCC benchmark. Dissolved lead concentrations in surface water samples RW-SW-S7-01 (5.3 µg/L), RW-SW-S7-03 (7.5 µg/L), RW-SW-AC-02 (4.9 J µg/L), RW-SW-AC-02 (5.8 J µg/L), RW-SW-S8-02 (7.4 µg/L), and RW-S8-03 (5.1 µg/L) exceeded the SCDM CCC benchmark. Additionally, total zinc concentration in one sample and dissolved zinc concentration in another sample exceeded the SCDM CCC and CMC value of 120 µg/L.

Drinking Water Samples

Twelve drinking water samples were collected during Phase II at the Ruby District West site. Two drinking water samples contained total arsenic concentrations of 37 J and 46.0 J ppb, and dissolved arsenic concentrations of 33.9 J and 38.6 J ppb, respectively. Those arsenic concentrations exceeded the reference dose (RfD) for arsenic of 11 ppb and the MCL for arsenic of 10 ppb. Total lead concentration

exceeded the EPA action level only in the USFS Well-Campground North sample at 32.7 J ppb (UOS 2001).

3.3 Geology and Hydrogeology

The geology of Gunnison County and the Ruby Mining District is complex and represents several periods of intrusion, structural deformation, and mineralization. A thick section of the Upper Cretaceous Mesaverde Formation and Early Tertiary Wasatch Formation are exposed in the Ruby Range. The Mesaverde Formation consists of gray to brown sandstone, siltstone, shale, and coal beds, and conformably overlies the Mancos Shale. Overlying the Mesaverde Formation, the Wasatch Formation comprises a series of alternating shales, marine and continental sandstones, and conglomerates. The Wasatch Formation is intruded by a prominent sill of quartz-monzonite-porphyry that is Oligocene in age. Overlying the Wasatch is the Tertiary Ohio Creek Formation, which consists of thick to massive beds of light-gray to white feldspathic sandstone that locally contains pebble lenses, and subordinate interbeds of sandy siltstone, silty shale, and carbonaceous shale (UOS 1999). These rocks are cut by numerous northeast-trending dikes and small stocks of quartz monzonite, quartz monzonite porphyry, granodiorite porphyry, and biotite granodiorite. The combined thickness of the Wasatch and Ohio Creek Formations is 2,2100 feet. Vein deposits rich in ruby silver minerals are associated with north-northeast-trending faults, dikes, and small stocks along the east side of the Ruby Range. The veins contain zinc, lead, silver, copper, molybdenum, and gold, all of which are mostly disseminated (UOS 1999).

The U-shaped valleys in the Coal Creek drainage were formed by glaciers. A glacier receding in the Coal Creek drainage deposited a moraine at the location of the Irwin town site. Lake Irwin formed, altering the drainage into the Ruby Anthracite Creek. Groundwater wells and springs in the Irwin town site are constructed in the moraine (UOS 2001). No extensive aquifer systems are associated with the Ruby Mining District (UOS 2001). Consolidated and semi-consolidated aquifers include the basalts and tuffs and sandstone in the Wasatch and Ohio Creek Formations, and are likely under unconfined conditions. Groundwater movement is controlled by geometry and permeability of the aquifers, by the amount of precipitation on the recharge areas, and by the degree of hydraulic connection with streams and underlying confined sandstone aquifers. Discharge from the unconfined aquifers is mainly underflow to stream valleys. Groundwater is discharged into the tributaries of Anthracite Creek through numerous springs and seeps, indicating unconfined aquifers consist of coarse, relatively permeable material overlying relatively impermeable rocks. Springs also occur where the unconfined aquifers are fractured. The Mesaverde Formations and Mancos Shale are also aquifers that are confined. The groundwater flow direction in the confined aquifers is controlled primarily by the pattern of hydraulic gradient in the aquifer, which is affected by the hydrogeologic characteristics of the aquifer, the regional

geologic structure, and the relative elevation differences between the recharge and discharge areas (U.S. Geological Survey [USGS] 1980).

3.4 Hydrology

The western part of the Ruby District West site is drained by Anthracite and Ruby Anthracite Creek watersheds. The Ruby Anthracite Creek headwaters start from the southwestern crest of Scarp Ridge and the southeastern crest of the Ruby Range via Green Lake Creek and Robinson Creek. Both Green Lake Creek and Robinson Creek flow into Lake Irwin. From the outlet of Lake Irwin is the start of Ruby Anthracite Creek which continues to flow south, southwest until the confluence of Anthracite Creek. Tributaries to Ruby Anthracite Creek include Dyke Creek, Gold Creek, Silver Creek, Sardine Creek, and Trout Creek. Ruby Anthracite Creek drains approximately 8 square miles of the mining district (UOS 2001). North Anthracite Creek and Middle Anthracite Creek merge near Devil's Stairway in the Raggeds Wilderness to form Anthracite Creek. Anthracite Creek continues to flow west where it merges with Ruby Anthracite Creek. Anthracite Creek continues to flow west merging with the North Fork of the Gunnison River (See Figure 2).

Water is diverted from Lake Irwin into Coal Creek at an average rate of 0.5 cubic feet per second (cfs) to assist in maintaining water rights belonging to Crested Butte (Stantec Consulting Ltd. [Stantec] 2005). The Coal Creek drainage is the sole source of the town of Crested Butte's municipal water supply (UOS 2001).

3.5 Meteorology

The Ruby District West site is in a semi-arid region. The mean annual precipitation is 11.7 inches, with a net annual precipitation (calculated from precipitation and evapotranspiration data) of 3.7 inches (UOS 1999). The average annual snowfall in Crested Butte is 220 inches, while the top of Kebler Pass (10 miles West, Northwest of Crested Butte) receives about 500 inches of snowfall annually (Stantec 2005).

4.0 DATA QUALITY OBJECTIVES PROCESS

The EPA Data Quality Objectives (DQO) process helps develop acceptance or performance criteria for EPA-funded projects, and consists of the following seven steps:

1. Step 1 – State the Problem.
2. Step 2 – Identify the Decision.
3. Step 3 – Identify Inputs to the Decision.
4. Step 4 – Define the Boundaries of the Study.

5. Step 5 – Develop a Decision Rule.
6. Step 6 – Specify Limits on Decision Errors.
7. Step 7 – Optimize the Design for Obtaining Data.

Seagull identified surface water and groundwater as the pathways of most concern at the site, based on information provided by EPA and a site reconnaissance conducted in August 2013 by Seagull. The potential risks and migration pathways are presented in a Conceptual Site Model (Appendix A), and are discussed in the DQO Seven-Step Planning Approach (Table 2). The DQO process was used to develop a field sampling plan (FSP)/quality assurance project plan (QAPP) that was approved on July 8, 2014; sampling for the SR was also conducted in accordance with the DQOs (Seagull 2014).

5.0 FIELD SCREENING AND SAMPLING ACTIVITIES

On July 12, 2014, Seagull employees Ryan Lunt, Greg Dillon, and Alex Bartlett departed Denver, Colorado, and mobilized to Crested Butte, Colorado, to conduct In-situ x-ray fluorescence spectrometer (XRF) screening and water quality sampling at the Ruby District West site. Samples collected during the sampling event were: ten groundwater samples (nine private drinking water wells and one spring); eighteen surface soil samples along with forty-seven samples for XRF screening locations; and twenty-one surface water and sediment samples. Surface water and sediment samples were collocated at each of the 21 locations. Based on the *Field Sampling Plan (FSP)/Quality Assurance Project Plan (QAPP) for a Site Reassessment for the Ruby District West Site dated June 25, 2014,* no XRF screening and sampling was conducted at source area 1 and 5 (Seagull 2014). This is based on past sampling results and previous descriptions of those areas that indicated they did not contain mining-related materials.

A breakdown of the XRF readings and the samples collected by source areas are outlined in the following sections. Sampling-related activities were recorded in a logbook; a copy is included in Appendix B. Photo documentation records associated with the field activities are included in Appendix C.

5.1 X-Ray Fluorescence (XRF) Screening

XRF readings were taken by directly shooting the ground surface/surface soil using an Innov-X XRF (Unit #8656) spectrometer. Standardization of the Innov-X XRF was performed daily by Seagull. The in-situ XRF readings of the surface soil were recorded at source areas 3, 4, and 7, and overland runoff routes leading to Green Lake. These XRF measurements were used to identify areas of elevated metals concentration. Soil samples were then collected at these areas and submitted for laboratory analyses. The soil had low moisture content during the XRF screening, except at source area 7 where the ground was covered by snow. Only one in-situ XRF reading was taken upgradient (Source Area 7) of the Ruby

District West mine site. This is due to difficult access to background locations at the Ruby District West site. Additionally, XRF screening was not conducted at source areas 2, 6, and 8. XRF screening was not conducted at source area 2 and 8 due to the extensive travel time to those source areas and their location in the Raggeds Wilderness Area. XRF screening at source area 6 was not conducted due to not having access to the private mining claims where the mine dumps and exploratory pits were located.

XRF screening data are generally considered valid if a comparison between the XRF values and the corresponding laboratory results yields a regression coefficient (r^2) of at least 0.7. If the r^2 is 0.9 or greater and inferential statistics indicates the XRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria (EPA 2007). The same XRF unit was used throughout the site reassessment. The r^2 values for XRF and laboratory data obtained for this project are 0.205 for arsenic, 0.753 for lead, and 0.198 for zinc. The XRF results for lead are considered valid screening level data, because the r^2 value is above 0.7. XRF soil screening results from source area 3, 4, and 7 are as followed:

Source Area 3

A total of fourteen XRF readings were recorded for this source area. Three XRF readings were collected near the probable point of entry (PPE) to an unnamed creek that eventually flows into Green Lake. At the PPE, the highest lead concentration was 89 parts per million (ppm), zinc' highest concentration was 51 ppm, and arsenic was non-detect. The remaining XRF readings were collected from source area 3. At source area 3, arsenic concentration ranged from non-detect to 323 ppm, lead ranged from 48 to 3,972 ppm, and zinc ranged from 32 to 518 ppm. The XRF soil screening results and locations are shown on Figure 3.

Source Area 4

A total of fifteen XRF readings were recorded at source area 4. Eight XRF readings were collected along the migration pathway from source area 4 to Green Lake. Along the migration pathway, arsenic concentrations ranged from non-detect to 32 ppm, lead ranged from non-detect to 496 ppm, and zinc ranged from 65 to 527 ppm. The remaining XRF reading were collected from source area 4. At the source area (main pile located on the saddle), arsenic concentrations ranged from non-detect to 44 ppm, lead ranged from 126 ppm to 396 ppm, and zinc ranged from 89 to 201 ppm. XRF soil screening results and locations are shown on Figure 3.

Source Area 7

A total of seventeen XRF readings were recorded at source area 7. Fifteen XRF arsenic concentrations ranged from non-detect to 72 ppm, lead ranged from 48 to 324 ppm, and zinc ranged from 26 to 21,199 ppm. A background XRF reading was collected at the source area. The background XRF concentration for arsenic was 16 ppm, lead was 40 ppm, and zinc was 99 ppm. Additionally, one XRF reading was collected along the migration pathway. At this location, arsenic was non-detect, lead was 48 ppm, and zinc was 68 ppm. The XRF soil screening results and locations are shown on Figure 3.

5.2 Soil Sampling

Soil sample locations were selected based on the field XRF results that indicated elevated concentrations of lead, arsenic, and zinc. For each sample location, three XRF readings for arsenic, lead, and zinc were recorded and the results were subsequently averaged for the comparison with their corresponding laboratory result. At each surface soil location, a sample was collected at 0-2 inches below ground surface (bgs) using a hand trowel. The surface soil samples were placed in aluminum pie pans and homogenized with disposable stainless steel spoons. Soil sample locations were selected based on field XRF results that indicated elevated concentrations of lead, aresenic, and zinc.The soil samples were transferred to 8-ounce jars and submitted to a Contract Laboratory Program (CLP) laboratory for analysis for Target Analyte List (TAL) metals (including mercury). All soil samples were stored in coolers maintained at or below 4 degrees Celsius (°C) prior to analysis. Sample location numbers; CLP sample numbers; sampling dates, times, depths, and rationales; and geographic coordinates for sample locations are provided in Table 3. All soil sampling locations are depicted on Figure 4.

Overall, a total of eighteen surface soil samples were collected from source areas, migration pathways (i.e., runoff routes), and background locations for laboratory analysis. The surface soil samples were collocated with the XRF screening locations. Surface soil samples were not collected for source areas 2 and 8 due to the access in the Raggeds Wilderness area and extensive travel time to the source areas. Surface soil samples were collected for the following source areas:

Source Area 3

A total of four surface soil samples (RDW-S3-01, RDW-S3-02, RDW-S3-03, and RDW-S3-04) were collected for this source area. All four soil samples were collected near a small waste pile and mine adit.

Source Area 4

A total of seven surface soil samples were collected for this source area. Five surface soil samples (RDW-S4-01, RDW-S4-02, RDW-S4-03, and RDW-S4-04) including the blind duplicate sample (RDW-

S4-05) were collected to assess source area 4. All source surface soil samples were collected on the tailing pile/waste pile located on the lower portion of the saddle. Two soil samples (RDW-S4-06 and RDW-S4-07) were collected along the migration pathway from source area 4 to Green Lake to assess overland migration pathway.

Source Area 6

The exploratory pits and mine dumps within source area 6 are located on private mining claims (Gunnison County Assessor's Office 2014). Only a background surface soil sample was collected at this source area. Sample RDW-SOBKG-02 was collected upgradient of the exploration pits and small mine dumping source area 6. Surface soil samples were not collected because an access agreement to enter the property was provided by the property owner. .

Source Area 7

A total of six surface soil samples (including a background sample) were collected for this source area. Four surface soil samples (RDW-S7-01, RDW-S7-02, RDW-S7-05) including the blind duplicate sample (RDW-S7-03) were collected to assess source area 7. All source samples were collected on the mine tailings pile located in source area 7. One soil sample (RDW-S7-04) was collected along the migration pathway from source area 7 to Robinson Creek. A background surface soil sample was also collected at this source area. Sample RDW-SOBKG-03 was collected upgradient of the mine tailings pile at source area 7.

5.3 Surface Water and Sediment Sampling

At each surface water location, water samples were collected for analysis for total and dissolved TAL metals (including mercury) by submerging 1-liter polyethylene bottles 6 inches below the surface of the water body and preserving the samples with nitric acid (HNO_3) to a pH <2. The samples for analysis for dissolved TAL metals were filtered in the field using disposable 0.45-micrometer filters. All water samples were stored in coolers maintained at or below 4 °C prior to analysis. The surface water sample locations are illustrated on Figure 5, and Table 4 summarizes the sample location numbers; CLP sample numbers; sampling dates, times, depths, and rationales; field measurements; analyses; and geographic coordinates for sample locations.

For each sediment location, a sample was collected from the top 2 inches of stream sediment using a hand trowel. The samples were collected in 8-ounce jars and submitted to a CLP laboratory for analysis for TAL metals (including mercury). All sediment samples were stored in coolers maintained at or below 4 °C prior to analysis. Sediment sampling locations are depicted on Figure 5, and sample location numbers;

CLP sample numbers; sampling dates, times, depths, and rationales; and geographic coordinates for sample locations are provided in Table 5.

Overall, a total of forty-two surface water samples and twenty-one sediment samples were collected from unnamed tributaries to Green Lake, Green Lake Creek, Robinson Creek, Ruby Anthracite Creek, Middle Anthracite Creek, and Anthracite Creek. Surface water and sediment samples were not collected at the PPE and from the surface water bodies located in the vicinity of source areas 2 and 8, due to the access in the Raggeds Wilderness area and extensive travel time to the source areas. Additional detail concerning the surface water and sediment samples collected within the 15-mile TDL is described below:

Source Area 3

Six surface water samples and three sediment samples (including a background sample) for this source area were collected from an unnamed tributary to Green Lake and Green Lake. The surface water and sediment sample RDW-SW/SD-S3-01 (background sample) was collected from an unnamed tributary to Green Lake, upgradient of source area 3. Surface water and sediment sample RDW-SW/SD-S3-02 (PPE) was collected from Green Lake where the unnamed tributary enters Green Lake. Surface water and sediment samples RDW-SW/SD-S3-03 were collected on Green Lake Creek, downstream of Green Lake and source area 3.

Source Area 4

Two surface water samples and a sediment sample were collected for this source area on an unnamed tributary to Green Lake near the saddle between Mount Owen and Ruby Peak. An adit pipe was extended out of the mine tailings in source area 4. Surface water and sediment sample RDW-SW/SD-S4-01 (PPE) were collected below the adit pipe from an unnamed tributary to Green Lake.

Source Area 6

Four surface water and two sediment samples were collected for this source area along Robinson Creek below Scarp Ridge. All surface water and sediment samples were collected on USFS property. Sample RDW-SW/SD-S6-01 was collected upstream of the exploration pits and mining claims in source area 6. RDW-SW/SD-S6-01 does not qualify as background since the Robinson Mine tailings pile is located upstream on Robinson Creek in source area 7. Sample RDW-SW/SD-S6-02 was collected downstream of the exploration pits and mining claims.

Source Area 7

Six surface water samples and three sediment samples (including a background sample) for this source area were collected from Robinson Creek below Purple Mountain. The surface water and sediment sample RDW-SW/SD-S3-01 (background sample) was collected upgradient of source area 7 from Robinson Creek. Surface water and sediment sample RDW-SW/SD-S7-02 (PPE) was collected from Robinson Creek where the Robinson mine tailings pile enters into the creek. Surface water and sediment sample RDW-SW/SD-S7-03 were collected on Robinson Creek downstream of source area 7.

Lake Irwin

A total of eight surface water and four sediment samples were collected to assess Lake Irwin. The collection of surface water and sediment samples was to assess whether source areas 3, 4, 6, and 7 are impacting Lake Irwin. Potential migration from source areas 3 and 4 to Lake Irwin is via unnamed tributaries to Green Lake which flows out to Green Lake Creek and eventually to Lake Irwin. Potential migration from source areas 6 and 7 to Lake Irwin is via Robinson Creek. Four surface water and two sediment samples including the blind duplicate (RDW-SW/SD-LIV-01 and RDW-SW/SD-LIV-02) were collected at the inlet of Lake Irwin. Also, two surface water and sediment samples (RDW-SW/SD-LI-03) were collected at the inlet of Lake Irwin following a significant rain event that started the previous evening and continued into the morning. The collection of sample RDW-SW/SD-LI-03 was to determine total metal concentrations at the inlet of Lake Irwin after a significant rain event. Two surface water samples and one sediment sample (RDW-SW/SD-DIV-01) were collected at the Lake Irwin diversion into Coal Creek. The Lake Irwin diversion is located in the town of Irwin and diverts water at a rate of 0.5 cfs into the headwaters of Coal Creek.

Ruby Anthracite Creek

A total of twelve surface water and six sediment samples were collected along Ruby Anthracite Creek and its tributaries. The collection of surface water and sediment samples was to help assess whether source areas (i.e. 3, 4, 6, 7, and 8) are impacting fisheries, wetlands and other sensitive environments further downstream. Ruby Anthracite Creek headwaters begin at the outlet of Lake Irwin and continue until it converges with Middle Anthracite Creek in the Raggeds Wildness area. Surface water and sediment samples (RDW-SW/SD-AC-01 and RDW-SW/SD-AC-01 [blind duplicate]) were collected at the outlet of Lake Irwin. Surface water samples and sediment samples (RDW-SW/SD-AC-02 and RDW-SW/SD-AC-03) were collected further downstream of Lake Irwin. A surface water and sediment sample (RDW-SW/SD-OC-01) was collected on Ohio Creek, upstream of the confluence with Ruby Anthracite Creek. This sample was collected to assess the potential to release from the coal mines near Floresta.

Additionally, a surface water and sediment sample (RDW-SW/SD-AC-04) was collected along Ruby Anthracite Creek upstream of the confluence of Middle Anthracite Creek. This sample was collected to help determine if there is potential migration from source area 8.

Middle Anthracite and Anthracite Creek

A total of four surface water and two sediment samples were collected along Middle Anthracite Creek and Anthracite Creek. The collection of the surface water and sediment sample (RDW-SW/SD-AC-05) on Middle Anthracite Creek is to help assess whether source area 2 are potentially migrating further downstream. Sample RDW-SW/SD-AC-05 were collected upstream of the confluence with Ruby Anthracite Creek. The surface water and sediment sample (RDW-SW/SD-AC-06) was collected on Anthracite creek to help assess the 15-mile TDL.

5.4 Groundwater Sampling

Twenty-five private drinking water wells are within the 4-mile TDL of the approximate center of the site. Four wells are within 0 to 0.25 mile of the site, 16 wells are within 0.25 to 0. 5 mile of the site, two wells are within 1 to 2 miles of the site, one well is within 2 to 3 miles of the site, and one well is within 3 to 4 miles of the site (see Figure 4).

Sampling activities included collection of groundwater samples from nine private wells and one spring (plus three blind duplicate samples [RDW-DW-24, RDW-DW-25, and RDW-DW-26]). Three of the private wells and the spring where located with 0 to 0.25 miles of the site; five private wells are within 0.25 to 0.5 miles of the site; and one private well is located within 0.50 to 1 mile of the site. Groundwater samples RDW-DW-07 and RDW-DW-28 were collected after and before an in-house filtration system, respectively, at 331 10th Street in Irwin. Groundwater sample RDW-DW-03 was collected from a spring that supplies water to a drinking water well at 581 H Avenue in Irwin. The well at this location was also sampled (RDW-DW-02). All samples from wells were collected at spigots except for sample RDW-DW-06, which was collected using a disposable bailer.

Water samples for analysis for total and dissolved TAL metals (including mercury) were collected in 1-liter polyethylene bottles and preserved with HNO_3 to a pH<2. The samples for analysis for dissolved TAL metals were filtered in the field using disposable 0.45-micrometer filters. All water samples were stored in coolers maintained at or below 4 °C prior to analysis. Groundwater sample locations are illustrated on Figure 6. Table 6 summarizes the sample location numbers; CLP sample numbers; sampling dates, times, and rationales; field measurements; analyses, and geographic coordinates for sample locations.

5.5 Quality Control Samples

Quality control (QC) samples for soil included collection of extra sample volume for matrix spike/matrix duplicate (MS/MD) analyses at one location (RDW-S7-02), and two blind field duplicate samples (RDW-S4-05, RDW-S7-03).

QC samples for surface water included collection of extra sample volume for MS/MD analyses at three locations (RDW-SW-06, RDW-SW-LI-01, and RDW-SW-S7-02), one rinsate blank sample (RDW-SW-01), two field blank samples (RDW-SW-02, RDW-SW-03, and RDW-03) and two blind duplicate samples (RDW-SW-AC-07 and RDW-SW-LI-02).

QC samples for sediment included collection of extra sample volume for MS/MD analyses at three locations (RDW-SD-AC-06, RDW-SD-LI-01, RDW-SD-S7-02), and two blind duplicate samples (RDW-SD-AC-07 and RDW-SD-LI-02).

QC samples for groundwater included collection of extra sample volume for MS/MD analyses at four locations (RDW-DW-03, RDW-DW-04, RDW-DW-07, and RDW-DW-28), three blind duplicate samples (RDW-DW-24, RDW-DW-25, and RDW-DW-26), and two field blank samples (RDW-FB-1 and RDW-FB-2).

Temperature blanks were placed in the coolers that were shipped to the CLP laboratory. All soil and sediment QC samples were submitted for analysis for TAL metals (including mercury). All surface water and groundwater QC samples were submitted for analysis for total and dissolved metals (including mercury). Sample location numbers; CLP sample numbers; sampling dates, times, depths, and rationales; analyses; and geographic coordinates (if applicable) for the QC samples are provided in Tables 3 through 6.

5.6 Sample Shipment

Mr. Lunt and Mr. Dillon prepared the soil, surface water, sediment, and groundwater samples for shipment to Chemtech in Mountainside, New Jersey, under CLP Case Number 44467. All samples were shipped via FedEx in twelve coolers containing ice to maintain a temperature at or below 4 °C. Copies of the chain-of-custody records are included in Appendix D.

6.0 FSP/QAPP DEVIATIONS

The following are deviations from the FSP and QAPP:

1. No soil, surface water, or sediment samples were collected at source areas 2 and 8 due to difficult access to those locations; also, access was not granted to several private mining claims at source area 6;

2. No soil samples and limited in-situ XRF readings were collected along migration pathways (i.e., runoff routes) from source area 3 due to loose rocks and hazardous climbing conditions. Additional source (soil) samples were collected at source area 3 instead;
3. Only one soil sample (RDW-S7-04) and limited in-situ XRF readings were collected along migration pathways (i.e., runoff routes) from source area 7 due to snow cover;
4. A hand trowel was used to collect sediment samples instead of a hand auger;
5. No seeps were identified during the sampling event; therefore, no seep samples were collected;
6. Groundwater samples were not collected from RDW-DW-05, RDW-DW-09, RDW-DW-11, RDW-DW-12, RDW-DW-13, RDW-DW-14, RDW-DW-16, RDW-DW-17, RDW-DW-19, RDW-DW-20, and RDW-DW-21 due to lack of access to those properties;
7. Groundwater samples were not collected at RDW-DW-22 because the spring could not be located;
8. Groundwater samples at RDW-DW-28 were collected before a household water filter at 331 10th Street, Irwin, Colorado;
9. Groundwater samples at RDW-DW-02 were collected from a spring that supplies a drinking water well at 581 H Avenue, Irwin, Colorado.

Of the deviations from the FSP and QAPP, the groundwater samples not collected from RDW-DW-05, RDW-DW-09, RDW-DW-11, RDW-DW-12, RDW-DW-13, RDW-DW-14, RDW-DW-16, RDW-DW-17, RDW-DW-19, RDW-DW-20, and RDW-DW-21; and no collection of the RDW-DW-22 (spring) for a background sample resulted in a data gap for site characterization. The additional collection of groundwater samples could help identify the source of the high arsenic concentrations from the drinking water wells in the town of Irwin.

7.0 SUMMARY OF 2014 ANALYTICAL DATA

Below is a summary of the analytical data from the 2014 SR sampling event.

7.1 Analytical Data-HRS Review

Analytical data from the 2014 sampling event were reviewed following HRS guidelines (EPA 1990a), and are summarized in Tables 7 through 13. Concentrations of contaminants meeting observed release criteria are shaded in these tables, based on the following guidelines:

- *If the background concentration of an analyte exceeds or equals that analyte's Sample Quantitation Limit (SQL), and the release sample analyte concentration exceeds that analyte's SQL:* An observed release is indicated if the concentration of the analyte in the release sample exceeds three times the background concentration.

- *If the background concentration of an analyte is less than that analyte's SQL, and the release sample analyte concentration exceeds that analyte's SQL:* An observed release is indicated if the concentration of the analyte in the release sample exceeds the Contract Required Detection Limit (CRDL).

The CRDLs represent levels of detection that CLP laboratories are required to achieve for inorganic analytes (EPA 1990b). Analytical results were also compared to Superfund Chemical Data Matrix (SCDM) health-based benchmark values:

- Results from surface soil samples were compared to SCDM reference dose (RfD) and cancer risk (CR) screening concentrations for soil.
- Results from surface water samples were compared to SCDM Criterion Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC) values.
- Analytical results from sediment samples were compared only to background results, because no HRS benchmarks have been established for sediment.
- Results from groundwater samples were compared to SCDM Maximum Contaminant Levels (MCL), along with RfD and CR values.

Results exceeding a SCDM benchmark are indicated by **bold values** in Tables 7 through 12. The following sections summarize analytical data from soil, surface water, sediment, and groundwater samples.

7.2 Background Sample Results

Analytical results from background soil, surface water, sediment, and groundwater samples are summarized as follows:

7.2.1 Soil Samples

Source Area 6

One background surface soil sample (RDW-SOBKG-02) was collected at a location west (upgradient) of exploratory pits and mine dumps, and analyzed for TAL metals (including mercury). The samples were intended to represent soil conditions not impacted in source area 6 by mining activities. The background surface soil sample contained concentrations of TAL metals, but only arsenic exceeded a SCDM benchmark. The arsenic concentration in RDW-SOBKG-02 was 9.5 J milligrams per kilogram (mg/kg) exceeding the SCDM CR value of 0.71 mg/kg.

Source Area 7

One background surface soil sample (RDW-SOBKG-03) was collected at a location upgradient of source area 7 (i.e. Robinson mine tailing pile) and analyzed for TAL metals (including mercury). The samples were intended to represent soil conditions in source area 7 not impacted by mining activities. The background surface soil sample contained concentrations of TAL metals, but only arsenic exceeded a

SCDM benchmark. The arsenic concentration in RDW-SOBKG-03 was14.6 J mg/kg, exceeding the SCDM CR value of 0.71 mg/kg.

The "J" qualifier indicates that the analyte was positively identified and the associated value is the approximate concentration of the analyte in the sample (EPA 2010). A "J" qualifier was applied to the samples due to the soil matrix spike (MS)/matrix duplicate (MD) analyses the laboratory performed. Recoveries for arsenic exceeded the quality control limits, but were within a measurable range. The post-digestion spike also yielded fully acceptable recoveries. Therefore, the detected arsenic concentrations were qualified as estimated and flagged "J". The MD analyses yielded excessive Relative percent difference (RPD) for arsenic which is likely due to sample heterogeneity. Therefore, the detected arsenic concentrations were qualified as estimated and flagged "J". Qualified data may be used to determine an observed release (EPA 1994). Therefore, the background arsenic concentrations that were qualified "J" are acceptable for use to establish an observed release.

The analytical results for TAL metals (including mercury) in soil are summarized in Table 7. Figure 4 shows the soil sample locations.

7.2.2 Surface Water and Sediment Samples

Source Area 3

Two background surface water and a sediment sample (RDW-SW/SD-03-01) were collected from an unnamed tributary to Green Lake, upgradient from source area 3. The samples were analyzed for total and dissolved TAL metals (including mercury); the sediment sample was analyzed for TAL metals (including Mercury). The background surface water samples contained concentrations of metals, but none exceeded a SCDM benchmark.

The following total metals were detected in the background samples with the highest concentrations in parentheses: Barium (18.4 µg/L), calcium (3,670 µg/L), magnesium (528 µg/L), and zinc (1.9 J µg/L).

The following dissolved metals were detected in the background samples with the highest concentrations in parentheses: barium (10.5 micrograms per liter [µg/L]), calcium (3,630µg/L), magnesium (554 µg/L), and zinc (2.6 J+).

The following background sediment sample contained the following metals with the highest concentrations in parentheses: aluminum (13,400 mg/kg), arsenic (14.8 J mg/kg), barium (130 mg/kg), beryllium (0.86 J+ mg/kg), cadmium (2.4 mg/kg), chromium (10.2 mg/kg), cobalt (12.5 mg/kg), copper (45.2 mg/kg), lead (193 mg/kg), manganese (1,620 mg/kg), mercury (0.035 J mg/kg), nickel (7.7 mg/kg), silver (0.29 J mg/kg), vanadium (33.7 mg/kg), and zinc (356 J mg/kg).

The "J" qualifier means the analyte was positively identified and the associated value is the approximate concentration of the analyte in the sample and may be biased high (EPA 2010). The "J+" qualifier means the analyte was positively identified and the associated value may be biased high (EPA 2010). The analytical results are considered acceptable for use in HRS scoring purposes. The analytical results for TAL metals (including mercury) in surface water and sediment are summarized in Tables 8, 9 and 10. Figure 5 shows the surface water and sediment sample locations for source area 3.

Source Area 7

Two background surface water samples and a sediment sample (RDW-SW-S7-01) were collected from an unnamed tributary from Robinson Creek, upgradient of source areas 7. The samples were analyzed for total and dissolved TAL metals (including mercury). The background surface water samples contained concentrations of metals, but none exceeded a SCDM benchmark.

The following total metals were detected in the background samples with the highest concentrations in parentheses: aluminum (65.4 J+ µg/L), barium (18.4 µg/L), calcium (8,080 µg/L), manganese (2.5 µg/L), magnesium (1,500 µg/L), and zinc (1.8 J µg/L).

The following dissolved metals were detected in the background samples with the highest concentrations in parentheses: barium (17 µg/L), calcium (7,900 µg/L), chromium (2 µg/L), cobalt (1 µg/L), lead (1 µg/L), magnesium (1,590 µg/L), and zinc (2.3 J+).

The background sediment sample contained the following metals with the highest concentrations in parentheses: aluminum (20,200 mg/kg), arsenic (30.8 J mg/kg), barium (119 mg/kg), beryllium (0.88 mg/kg), cadmium (0.41 J mg/kg), chromium (10.2 mg/kg), cobalt (9.5 mg/kg), copper (18.1 mg/kg), lead (62.7 mg/kg), manganese (921 J mg/kg), mercury (0.023 J mg/kg), nickel (10.6 mg/kg), vanadium (32mg/kg), and zinc (187 J mg/kg).

The "J" qualifier means the analyte was positively identified and the associated value is the approximate concentration of the analyte in the sample and may be biased high (EPA 2010). The "J+" qualifier means the analyte was positively identified and the associated value may be biased high (EPA 2010). The analytical results for TAL metals (including mercury) in surface water are summarized in Tables 8, 9 and 10. Figure 5 shows the surface water and sediment sample locations for source area 7.

7.2.3 Groundwater Samples

All drinking water wells within the 4-mile TDL of the site are down gradient of the source areas in the Ruby District West site; therefore background locations that are up gradient and/or out of the influence of the source areas were not accessible to sample for the Ruby District West site. However, if background

data are critical to the site screening recommendations and no applicable wells exist, samples from a well potentially less influenced by the site could be used to establish background (EPA 1992). Groundwater samples were collected from a well along 7th street in Irwin. This area along 7th street has been used as a background location in past investigations, is assumed un-impacted by mining activities, and is up gradient from the groundwater wells collected in the town of Irwin.

Four background groundwater samples from one sample location (RDW-DW-26 and RDW-DW-27) were collected along 7th Street in Irwin. RDW-DW-26 was a blind duplicate of RDW-DW-27. At the background location groundwater samples were analyzed for total and dissolved TAL metals (including mercury).

The following total metals were detected in the background samples with the highest concentrations in parentheses: aluminum (76 µg/L), arsenic (0.93 J µg/L), barium (83 µg/L), calcium (18,100 µg/L), copper (24.3 µg/L), lead (1.1 J µg/L), magnesium (1,260 µg/L), manganese (1.5 J µg/L), nickel (0.29 µg/L), potassium (1,110 µg/L), selenium (0.38 µg/L), and zinc (6.2 J µg/L). Of these detected metals, only total arsenic (0.93 J and 0.78 J µg/L) exceeded its SCDM CR value of 0.4 µg/L.

The following dissolved metals (with maximum concentrations) were detected in the background samples: arsenic (0.90 J µg/L), barium (81.8 J µg/L), calcium (18,000 J µg/L), chromium (0.40 J µg/L), copper (36.9 µg/L), magnesium (1,320 J µg/L), potassium (1,070 µg/L), selenium (0.38 J µg/L), and zinc (11.4 J µg/L). Of these detected metals, only dissolved arsenic (0.78 J and 0.90 J µg/L) exceeded its SCDM CR value of 0.4 µg/L.

The analytical results for total and dissolved metals (including mercury) in groundwater are summarized in Tables 11 and 12. Figure 6 shows the groundwater sample locations.

7.3 Site Characterization Results

The following discussions address results from laboratory analyses of soil, surface water, sediment, and groundwater samples collected at/near the Ruby District West site.

7.3.1 Soil Samples

Sixteen surface soil samples (excluding background samples but including two blind duplicates [RDW-S4-05 and RDW-S7-03]) were collected from source areas 3, 4, and 7 and along migration pathways (i.e., runoff routes). The samples were submitted for laboratory analysis for TAL metals (including mercury). Surface soil samples were not collected for source areas 2 and 8 due to the access in the Raggeds Wilderness area and extensive travel time to the source areas. The analytical results for the surface soil samples collected for the following source areas are discussed below:

Source Area 3

Numerous TAL metals were detected in the surface soil samples collected from the source area (RDW-S3-01, RDW-S3-02, RDW-S3-03, and RDW-S3-04); however, concentrations of the metals, except for arsenic, were well below their respective health-based benchmarks. Arsenic was detected in the surface soil samples at concentrations ranging from 0.22.3 to 89.5 mg/kg, all exceeding the SCDM CR value of 0.71 mg/kg. Arsenic concentrations also exceeded the SCDM RfD value (30 mg/kg) in surface soil samples RDW-S3-03 (47.7 mg/kg) and RDW-S3-04 (89.5 mg/kg).

The following metals were detected at levels exceeding three times their background levels or the background sample's Contract Required Detection Limit, if non-detect in the background samples. Sample RDW-S3-04 contained the highest concentrations of the analytes that exceeded three times background. The concentrations are in parentheses: arsenic (RDW-S3-04, 89.5 mg/kg), cadmium (RDW-S3-04, 1.1 mg/kg), copper (RDW-S3-04, 98.6 J mg/kg), lead (RDW-RDW-S3-04, 3,170 mg/kg), mercury (RDW-S3-04, 0.79 J+ mg/kg), silver (RDW-S3-04, 30.2 mg/kg), and zinc (RDW-S7-04, 8,600 mg/kg). Table 7 summarizes the metals detected in the surface soil samples, and Figure 4 shows the soil sample locations.

Source Area 4

TAL metals were detected in the five surface soil samples collected from this sources area (RDW-S4-01, RDW-S4-02, RDW-S4-03, RDW-S4-04, and RDW-S4-05 [blind duplicate]). TAL metals were also detected in the two surface soil samples collected along the migration pathway (RDW-S4-06 and RDW-S4-07). The concentrations of the metals, except for arsenic, were well below their respective health-based benchmarks. Arsenic was detected in all surface soil samples (including the blind duplicate sample) at concentrations ranging from 13.5 to 24.5 mg/kg, all exceeding the SCDM CR value of 0.71 mg/kg.

None of the samples collected from source area 4 contained arsenic at concentrations three times its background level. However, the metals listed below were detected at levels exceeding three times their background levels or the background sample's Contract Required Detection Limit, if non-detect in the background samples. The sample location IDs with the highest concentrations are in parentheses: copper (RDW-S4-06, 376 J mg/kg), lead (RDW-S4-02, 458 mg/kg) and silver (RDW-S3-03, 13.2 mg/kg). Table 7 summarizes the metals detected in the surface soil samples, and Figure 4 shows the soil sample locations.

Source Area 7

Numerous TAL metals were detected in the surface soil samples collected from this source area (RDW-S7-01, RDW-S7-02, RDW-S7-03 [blind duplicate], and RDW-S7-05). TAL metals were also detected in the surface soil sample collected along the migration pathway (RDW-S7-04). Concentrations of the metals, except for arsenic, were well below their respective health-based benchmarks. Arsenic was detected in all of the surface soil samples at concentrations ranging from 0.98 (migration pathway sample) to 231 mg/kg (source sample), all exceeding the SCDM CR value of 0.71 mg/kg. Arsenic concentrations also exceeded the SCDM RfD value (30 mg/kg) in surface soil samples RDW-S7-01(119 mg/kg), RDW-S7-03 (49.8 mg/kg), and RDW-S7-05 (231mg/kg).

The metals listed below were detected at concentrations exceeding three times their background levels or the background sample's Contract Required Detection Limit, if non-detect in the background samples. The sample location IDs with the highest concentrations are in parentheses: arsenic (RDW-S7-05, 231 mg/kg), cadmium (RDW-S7-05, 71.9 mg/kg), copper (RDW-S7-05, 68.3 J mg/kg), lead (RDW-S7-05, 151 mg/kg), mercury (RDW-S7-05, 1.5 J+ mg/kg), silver (RDW-S7-01, 7.5 mg/kg), and zinc (RDW-S7-05, 8,600 mg/kg). Table 7 summarizes the metals detected in the surface soil samples, and Figure 4 shows the soil sample locations.

7.3.2 Surface Water and Sediment Samples

Thirty-eight surface water samples and nineteen sediment samples were collected during the sample event. All surface water samples were submitted for laboratory analysis for total and dissolved TAL metals (including mercury). All sediment samples were submitted for laboratory analysis for TAL metals (including mercury). Surface water and sediment samples were not collected at the PPE and from the surface water bodies located in the vicinity of source areas 2 and 8, due to the access in the Raggeds Wilderness area and extensive travel time to the source areas. The surface water and sediment samples contained concentrations of numerous metals. The analytical results for both total and dissolved surface water were compared against their SCDM CCC and CMC values. For HRS scoring, it is not appropriate to compare total metals concentrations against SCDM CCC and CMC benchmark values. However, since total metals were collected for the surface water pathway, these concentrations were compared to the SCDM CCC and CMC benchmark values. Table 8 summarizes the total metals detected in the surface water samples. Table 9 summarizes the dissolved metals detected in the surface water samples. Table 10 summarizes the total metals detected in the sediment samples. Figure 5 shows the surface water and sediment sample locations. The analytical results for the surface water and sediment samples are discussed below.

Source Area 3

Four surface water samples and two sediment samples from two sample locations (RDW-SW/SD-S3-02 and RDW-SW/SD-S3-03) were collected down gradient of source area 3. RDW-SW/SD-S3-02 was collected at Green Lake where the unnamed tributary along source area 3 merges with Green Lake and RDW-SW/SD-S3-03 is downstream of Green Lake along Green Lake Creek.

Total metals for both samples contained numerous TAL metals, but only one total metal exceeded a SCDM benchmark value. Aresenic was detected above laboratory detection limits in the samples. Total aluminum was detected at 174 µg/L exceeding its SCDM CCC value of 87 µg/L; however, it did not exceed three times background. The following total metals were detected at concentrations exceeding their three times background levels; the highest concentrations are in parentheses: copper (17.2 µg/L), lead (1.1 J + µg/L), manganese (57.8 µg/L), selenium (0.39 J µg/L) and zinc (103 µg/L).

Both samples contained dissolved metals concentrations, but none exceeded a SCDM benchmark value and did not contain arsenic. The following dissolved metals were detected at concentrations that exceeded their three times their background levels; the highest concentrations are in parentheses: copper (8.4 µg/L), manganese (33.5 µg/L), and zinc (70.6 µg/L).

The sediment samples had detectable concentrations of arsenic (4. 6 J mg/kg and 21.5 J mg/kg), but did not exceed its three times background level. Beryllium was at 87.2 mg/kg which exceeded its three times background level.

Source Area 4

Two surface water samples and one sediment sample from one sample location (RDW-SW/SD-S4-01) (PPE) were collected along an unnamed tributary to Green Lake where an adit pipe draining water extended out from the saddle in source area 4.

The sample contained total TAL metals, but did not contain arsenic above laboratory detection limits. Aluminum was detected in the surface water samples at 4, 820 J µg/L, which exceeded its SCDM CMC value of 750 µg/L, as well as it three times background level. Total cadmium was detected at 22 µg/L, exceeding its SCDM CCC and CMC values of 0.25 and 2 µg/L, respectively. The detected concentration of cadmium also exceeded its three times background level. Total copper was detected in sample at 649 µg/L, exceeding its SCDM CMC value of 13 µg/L, as well as its three times background levels. Total zinc was detected at 2,390 µg/L, exceeding its SCDM CCC and CMC values of 120 µg/L, and also exceeding its three times background concentrations. Additionally, the following total metals were detected at concentrations exceeding three times their background concentrations; the highest

concentrations are in parentheses: cobalt (14.4 µg/L), lead (1.9 µg/L), magnesium (7,290 µg/L) manganese (1,570 µg/L), nickel (4.3 µg/L), and selenium (0.39 J µg/L).

The sample contained dissolved metals concentrations, but did not contain arsenic above laboratory detection limits. Aluminum was detected at 4,740 µg/L, exceeding its SCDM CMC value of 750 µg/L, and its three times background concentration. Dissolved cadmium was detected at 21.3 µg/, exceeding its SCDM CCC and CMC values of 0.25 and 2 µg/L, respectively. It also exceeded its three times background concentration. Dissolved copper was detected at 622 µg/L, exceeding its SCDM CMC value of 13 µg/L and also exceeding three times the highest background concentrations. Dissolved zinc was detected at 2,390 µg/L, exceeding SCDM CCC and CMC values of 120 µg/L, and also exceeding three times the highest background concentrations. The following dissolved metals were detected exceeding three times their background concentrations; the highest concentrations are in parentheses: Calcium (23,800 µg/L), cobalt (13.9 µg/L), magnesium (7,340 µg/L), manganese (1,490 µg/L), mercury (0.021 J), and nickel (4.3 µg/L).

The sediment sample contained arsenic concentration (22.9 J µg/L), but did not exceed three time background concentrations. Only one metal was detected in the sediment sample exceeding three times their background concentrations; the highest concentrations are in parentheses: silver (3.9 mg/kg).

Source Area 6

Four surface water samples and two sediment samples from two sample locations (RDW-SW/SD-S6-01 and RDW-SW/SD-S6-02) were collected down gradient of source areas 6 and 7. RDW-SW/SD-S6-01 was collected on Robinson creek upgradient of the exploratory pits and mine dumps, but downstream of the Robinson mine located at the headwaters of Robinson Creek in source area 7. RDW-SW/SD-S6-02 was collected downgradient of the exploratory pits and mine dumps.

Both samples contained numerous TAL metals, but none of the metals were detected at concentrations that exceeded a SCDM benchmark value or were three times the background concentration or the background sample's Contract Required Detection Limit, if non-detect in the background samples. For the dissolved metals samples, only one metal exceeded its SCDM benchmark values and three times background concentration. Sample RDW-SW-S6-02 contained dissolved zinc at 153 µg/L, which exceeded its SCDM CCC and CMC values of 120 µg/L. It also exceeded three times the highest background concentrations. Additionally, arsenic was not detected in the dissolved samples.

In the sediment samples, arsenic was detected at 15 J and 10.7 J mg/kg. The samples also contained detectable concentrations of other TAL metals; however, none of those metals were at concentrations

exceeding three time background or the background sample's Contract Required Detection Limit if non-detect in the background samples.

Source Area 7

Four surface water samples and two sediment samples from two sample locations (RDW-SW/SD-S7-02 and RDW-SW/SD-S7-03) were collected downgradient of source areas 7. RDW-SW/SD-S7-02 (PPE) was collected on Robinson creek where the Robinson mine tailing were in the Robinson Creek. RDW-SW/SD-S7-03 was collected further downstream on Robinson Creek.

Total metals for both samples contained TAL metals, but none of the concentrations exceeded a SCDM benchmark value and only one metal had concentrations three times background. Sample RDW-SW-S7-03, Zinc was detected at 12.9 µg/L, exceeding three times its background concentration. Dissolved metals for both samples contained numerous TAL metals, but none of the concentrations exceeded a SCDM benchmark value or three times background. Additionally, arsenic was not detected in the dissolved samples.

In the sediment samples arsenic was detected at 4.9 J mg/kg and 21.5 J mg/kg, but did not exceed three times background. Additionally, the following metals were detected in the sediment samples exceeding three times their background concentrations; the highest concentrations are in parentheses: Barium (649 mg/kg), mercury (0.12 J mg/kg), and silver (0.89 J mg/kg).

Lake Irwin

Eight surface water samples and four sediment samples from two sample locations (RDW-SW/SD-LI-01, RDW-SW/SD-LI-02[blind duplicate of RDW-SW/SD-LI-01], RDW-SW/SD-LI-03, and RDW-SW/SD-DIV-01) were collected at the inlet of Lake Irwin and the diversion of Lake Irwin into Coal Creek. RDW-SW/SD-LI-01 and RDW-SW/SD-LI-02 was collected on Robinson Creek at the inlet of Lake Irwin. RDW-S7-03 was collected on Robinson Creek at the inlet of Lake Irwin after a significant rain event. RDW-SW/SD-DIV-01 was collected at the diversion from Lake Irwin to the headwaters of Coal Creek.

Total metals for samples RDW-SW-LI-01/02 contained numerous TAL metals, but only one total metal exceeded a SCDM benchmark value. Total aluminum was detected in sample RDW-SW-LI-02 at 127 µg/L exceeding its SCDM CCC value of 87 µg/L; however, it did not exceed three times background. The following total metals at the inlet of Lake Irwin were detected at concentrations exceeding three times their background concentrations; the highest concentrations are in parentheses: arsenic (1.6 µg/L), manganese (13.5 µg/L), selenium (0.34 J µg/L), and zinc (20.7 µg/L). The total metals sample (RDW-

SW-LI-03) collected at the inlet of Lake Irwin after the significant rain event contained detected concentrations of metals, but none of the levels were above a SCDM benchmark for surface water. The following total metals at the inlet of Lake Irwin after a significant rain event were detected at concentrations exceeding three times their background concentrations; the highest concentrations are in parentheses: arsenic (1.1 µg/L) and zinc (16.5 µg/L). The total metals sample (RDW-DIV-LI-01) collected at the diversion from Lake Irwin to the headwaters of Coal Creek contained detected concentrations of metals, but none of the levels were above a SCDM benchmark for surface water. The following total metals at the diversion Lake Irwin were detected at concentrations exceeding three times their background concentrations the highest concentrations are in parentheses: manganese (22 µg/L), selenium (0.34 J µg/L), and zinc (12.9 µg/L).

Dissolved metals for samples RDW-SW-LI-01/02, contained numerous TAL metals, but none exceeded a SCDM benchmark value. The following dissolved metals at the inlet of Lake Irwin were detected at concentrations exceeding three times their background concentrations; the highest concentrations are in parentheses: manganese (6.1 µg/L) and zinc (19.2 µg/L). The dissolved metals sample (RDW-SW-LI-03) collected at the inlet of Lake Irwin after the significant rain event contained detected concentrations of metals, but none of the levels were above a SCDM benchmark for surface water. The following dissolved metals at the inlet of Lake Irwin after a significant rain event were detected at concentrations exceeding three times their background concentrations; the highest concentrations are in parentheses: aluminum (1.1 µg/L), arsenic (1.2 J+ µg/L), and manganese (7.9 µg/L). The dissolved metals sample (RDW-DIV-LI-01) collected at the diversion from Lake Irwin to the headwaters of Coal Creek contained detected concentrations of metals, but none of the levels were above a SCDM benchmark for surface water. The following dissolved metals at the inlet of Lake Irwin were detected at concentrations exceeding three times their background concentrations; the highest concentrations are in parentheses: manganese (8.0 µg/L) and zinc (9.0 J+µg/L).

In the sediment samples (RDW-SD-LI-01/02/03) at the inlet of Lake Irwin, arsenic was detected at 37.4 J mg/kg and 46.5 J mg/kg, but did not exceed three times background concentrations. Additionally, the following metals were detected in the sediment samples exceeding three times their background concentrations; the highest concentrations are in parentheses: selenium (0.84 J mg/kg), and silver (3.2 J mg/kg). The sediment sample collected at the diversion from Lake Irwin to the headwaters of Coal Creek contained detected concentrations of metals, but none of the levels exceeded three times the highest background concentrations.

Ruby Anthracite Creek

Twelve surface water samples and six sediment samples from five sample locations (RDW-SW/SD-AC-01, RDW-SW/SD-AC-02, RDW-SW/SD-AC-03, RDW-SW/SD-AC-04, RDW-SW/SD-AC-07 [blind duplicate of RDW-SW/SD-AC-01], and RDW-SW-OC-01) were collected along Ruby Anthracite and Ohio Creek which located down gradient of source areas 3, 4, 6, and 7.

The samples contained numerous TAL metals, but none of the total metals exceeded a SCDM benchmark value. However, the following total metals were detected at concentrations exceeding three times their background concentrations; the sample id and the highest concentrations are in parentheses: arsenic (1.4 µg/L, RDW-SW-AC-07), manganese (8.5.5 µg/L, RDW-SW-AC-03), nickel (0.23 J µg/L, RDW-SW-AC-03), selenium (0.36 J µg/L, RDW-SW-AC-05), vanadium (0.60 J µg/L, RDW-SW-AC-03) and zinc (10.3 J µg/L, RDW-SW-AC-01).

The samples contained numerous TAL metals, but none of the dissolved metals exceeded a SCDM benchmark value. However, the following dissolved metals were detected at concentrations exceeding three times their background concentrations; the sample ID and the highest concentrations are in parentheses: aluminum (40.4 J+ µg/L, RDW-SW-OC-01), arsenic (1.5 µg/L, RDW-SW-AC-01), manganese (7.9 J µg/L, RDW-SW-AC-01), and zinc (8.8 J+ µg/L, RDW-SW-AC-07).

The following metals were detected in the sediment samples were detected at concentrations exceeding three times background concentrations; the sample ID and the highest concentrations are in parentheses: Antimony (10.3 J mg/kg, RDW-SD-AC-07), arsenic (594 J mg/kg, RDW-SD-AC-07), and Thallium (490 mg/kg, RDW-SD-AC-01).

Middle Anthracite and Anthracite Creek

Four surface water samples and two sediment samples from two sample locations (RDW-SW/SD-AC-05, RDW-SW/SD-AC-06) were collected along Middle Anthracite and Anthracite Creek, downgradient of source areas 2, 3, 4, 6, and 7.

The samples contained numerous TAL metals, but none of the metals exceeded a SCDM benchmark value. However, the following total metals were detected at concentrations exceeding three times their background concentrations; the sample id and the highest concentrations are in parentheses: antimony (13.6 µg/L, RDW-SW-AC-05), beryllium (16,400 µg/L, RDW-SW-AC-05), nickel (0.27 J µg/L, RDW-SW-AC-05), and selenium (0.36 J µg/L, RDW-SW-AC-05). The samples contained TAL metals, but none of the dissolved metals exceeded a SCDM benchmark value or were detected above a concentration exceeding three times their background concentrations.

Only one metal was detected in the sediment samples at concentrations exceeding three times their background concentrations; the sample ID and the highest concentrations are in parentheses: Selenium (0.84 J µg/L, RDW-SW-AC-06).

7.3.3 Groundwater Samples

Twenty-four groundwater samples were collected from the town of Irwin, Colorado. All groundwater samples were submitted for laboratory analysis for total and dissolved TAL metals (including mercury). The groundwater samples contained concentrations of numerous metals, but only arsenic and cobalt exceeded a SCDM benchmark. The analytical results for total and dissolved metals (including mercury) in groundwater are summarized for each drinking water well in Tables 11 and 12, and Figure 6 shows the groundwater sample locations.

As indicated on Table 11 for total metals, the following residential wells have exceedances to one or more SCDM benchmark values: RDW-DW-01(175 feet [ft] below ground surface [bgs]), RDW-DW-02(300 ft bgs), RDW-DW-07/RDW-DW-028 (unknown depth), RDW-DW-08 (220 ft bgs), RDW-DW-10/ RDW-DW-25 (172 ft bgs), and RDW-DW-15(160 ft bgs). For total metals, arsenic was detected in every groundwater sample except RDW-DW-03. In six samples, arsenic exceeded its SCDM MCL value of 10 µg/L; in those samples, arsenic ranged from 10.9 (RDW-DW-02) to 1,520 µg/L (RDW-DW-10). Eight drinking water wells have three times background exceedances for aluminum, arsenic, barium, cobalt, lead, manganese, nickel, potassium, selenium, and zinc. The following total metals were detected at concentrations exceeding three times their background concentrations; the sample ID and the highest concentrations are in parentheses: aluminum (3,070 µg/L, RDW-DW-02), antimony (4.8 J+ µg/L, RDW-DW-10), arsenic (1,520 µg/L, RDW-DW-10), barium (265 µg/L, RDW-DW-10), cobalt (3.4 µg/L , RDW-DW-10), lead (3.7 J µg/L, RDW-DW-02), manganese (1,880 µg/L, RDW-DW-10), nickel (2 µg/L, RDW-DW-02), potassium (18,600 µg/L, RDW-DW-02), selenium (2.2 J µg/L, RDW-DW-10), and zinc (54.9 µg/L, RDW-DW-10).

As indicated on Table 12 for dissolved metals, the following residential wells have exceedances to one or more SCDM benchmark values: RDW-DW-01, RDW-DW-02, RDW-DW-07/RDW-DW-28(unknown depth), RDW-DW-08/RDW-DW-0024, RDW-DW-10/RDW-DW-25, and RDW-DW-15(160 ft bgs). For dissolved metals, arsenic was detected in every groundwater sample except RDW-DW-03 and RDW-DW-04. Arsenic was detected in five groundwater samples above the SCDM MCL of 10 µg/L; those concentrations ranged from 18.1 (RDW-DW-28) to 32.1 µg/L (RDW-DW-15). Also, cobalt was detected in sample RDW-DW-28 at 30.9 µg/L, exceeding its SCDM RfD value of 4 µg/L. Seven drinking water wells have three times background exceedances for aluminum, arsenic, beryllium, cobalt, manganese, and

selenium. The following dissolved metals were also detected exceeding three times their background concentrations; the sample ID and the highest concentrations are in parentheses: aluminum (154 µg/L, RDW-DW-04), arsenic (32.1 µg/L, RDW-DW-15), beryllium (1 µg/L, RDW-DW-02), cobalt (30.9 µg/L, RDW-DW-28), manganese (174 µg/L, RDW-DW-01), and selenium (1.4 J µg/L, RDW-DW-10).

8.0 PATHWAY ANALYSIS

Evaluations of groundwater, surface water, soil exposure, and air migration pathways are discussed below. These pathways represent potential transport routes for site-related contaminants that could pose threats to human health and the environment.

8.1 Sources of Contamination and Waste Characteristics

Ore-bearing units at the Ruby District West site contain quartz-arsenopyrite-pyrargyrite-prousite-calcite-rhodchrosite-tetrahedrite-galena-argentile-pyrite-chalcopyrite-sphalerite veins that produced silver, zinc, lead, copper, and gold (UOS 1999). The sources of hazardous substances associated with the Ruby District West site are contaminated soils, mine tailings, and waste piles at mines, adits, and exploration pits; these sources are within the Garfiech Basin (source area 2), Green Lake Basin (source areas 3 and 4), Robinson Basin (source areas 6 and 7), and Dyke Creek Basin (source area 8).

These could be sources of contaminants, particularly source areas 3, 4, 6, and 7 (i.e., metals) to Lake Irwin and Anthracite Creek, and to groundwater in the town of Irwin, and throughout the surrounding area. A breakdown of the source areas is provided below.

Source	CGS Mine Dump Volumes (Cubic Yards= yd^3)	2014 Mine Dump Volumes (Cubic Yards= yd^3)	Contaminants (3x Background)
Source Area 2	53 yd^3; 240 yd^3; 25 yd^3; 33 yd^3; 14 yd^3; 40 yd^3; 43yd^3;40 yd^3; 15 yd^3; 45 yd^3; and 45 yd^3 (Total= 593yd^3)	Did not estimate or sample	Unknown
Source Area 3	28 yd^3; 30 yd^3; 60 yd^3; 45 yd^3; 25 yd^3; and 15 yd^3 (Total= 203 yd^3)	Estimated that waste pile was 65 cubic yards in size	Arsenic, cadmium, copper, lead, mercury, and silver
Source Area 4	42 yd^3; 455 yd^3; 10 yd^3; and 35 yd^3 (Total= 542 yd^3)	Estimated at 400 cubic yards	Cadmium, copper, lead, mercury, silver, and zinc
Source Area 6	175 yd^3; 155 yd^3; 20 yd^3; 45 yd^3; 23 yd^3; 270 yd^3; and 25 yd^3 (Total= 713 yd^3)	Did not estimate due to mine dumps on private mining claims	Unknown
Source Area 7	63 yd^3; 17 yd^3; 37 yd^3; 10 yd^3;10 yd^3; and 13 yd^3 (Total= 137 yd^3)	Robinson Mine dump/tailing was estimated at 550 cubic yards	Arsenic, cadmium, copper, lead, mercury, silver, and zinc

Source	CGS Mine Dump Volumes (Cubic Yards= yd^3)	2014 Mine Dump Volumes (Cubic Yards= yd^3)	Contaminants (3x Background)
Source Area 8	17 yd^3; 25yd^3; and 20 yd^3 (Total= 62 yd^3)	Did not estimate or sample	Unknown

8.2 Groundwater Pathway and Targets

Twenty-eight private drinking water wells are within the 4-mile TDL of the approximate center of the site. Four wells are within 0 to 0.25 mile of the site, 16 wells are within 0.25 to 0. 5 mile, four wells are within 0.5 to 1 mile, two wells are within 1 to 2 miles, one well is within 2 to 3 miles, and one well is within 3 to 4 miles (see Figure 7).

The U-shaped valleys in the Coal Creek drainage were formed by glaciers. A glacier receding in the Coal Creek drainage deposited a moraine at the location of the Irwin town site. Lake Irwin formed, altering the drainage into the Ruby Anthracite Creek. Groundwater wells and springs in the Irwin town site are constructed in the moraine (UOS 2001). No extensive aquifer systems are associated with the Ruby Mining District (UOS 2001). Groundwater is the exclusive source of drinking water in the town of Irwin and for all other residences in the Ruby District West site vicinity. The Colorado Division of Water Resources database indicates that 20 wells are in the town of Irwin; records indicate no groundwater wells in the Ruby Anthracite Creek Valley or the Anthracite Creek Watershed, or within the Raggeds Wilderness boundary. The average number of persons per household in Gunnison County, Colorado, is 2.27 (U.S. Department of Commerce 2015). Each domestic well serves one household in the town of Irwin; the total number of residents using groundwater can be calculated to be approximately 45 people. Additionally, there are no municipal wells locatedwithin 4 miles of the site. Private well depths in the town of Irwin range from 43 to 540 feet bgs; and static water levels range from 10 to 190 feet bgs (Colorado Division of Water Resources 2014). Based on the groundwater results, the elevated arsenic concentrations in the drinking water wells were mainly located within 600 feet of Lake Irwin, except for RDW-DW-07 and RDW-DW-15. The sample numbers, well depths, static water levels, and dates drilled are provided below. Only the spring and the 540-foot-deep well did not contain detectable concentrations of arsenic.

Sample Number	Well Depth (feet bgs)	Static Water Level (feet bgs)	Date Drilled	Total Arsenic Concentrations (µg/L)	Dissolved Arsenic Concentrations (µg/L)
RDW-DW-01	175	70	7/3/1987	8.2	7.8
RDW-DW-02	300	162	10/13/2006	10.9	6.8
RDW-DW-03	Spring	Spring	Spring	1.0 U	1.0 U
RDW-DW-04	540	54	7/2/2010	1.0 U	1.0 U
RDW-DW-06	180	76	9/20/2005	0.26 J	0.38 J
RDW-DW-07 and RDW-DW-28	380	123	Unknown	19.9 and 19.4	19 And 18.1
RDW-DW-08 and RDW-DW-24	220	55	9/27/2006	0.38 and 0.42 J	0.41 J and 0.50 J
RDW-DW-10	172	37	9/6/2005	1,520	15
RDW-DW-15 and RDW-DW-25	160	15	8/24/2007	31.6 and 31.5	32.1 and 31.8
RDW-DW-27 and RDW-DW-26	Unknown	Unknown	Unknown	0.78 J and 0.93 J	0.90 J and 0.78 J

Notes:

µg/L Micrograms per Liter
J "J" qualifier indicates that the analyte was positively identified and the associated value is the approximate concentration of the analyte in the sample (EPA 2010).
Bgs Below ground surface

8.3 Surface Water Pathway and Targets

The 15-mile TDL for the surface water pathway for the Ruby District West site is shown on Figure 8. From source areas 3 and 4, the PPEs start at unnamed tributaries that drain into Green Lake. A surface water and sediment sample collected at Green Lake for source area 3 indicated an observed releases (i.e. three times background concentrations) for beryllium, copper, lead, manganese, and zinc. The surface water and sediment sample collected at the PPE for source area 4 indicated an observed release for aluminum, cadmium, cobalt, copper, lead, magnesium, manganese, nickel, selenium, and zinc. Additionally, the following metals exceeded a SCDM benchmark value in the surface water pathway: aluminum, cadmium, and copper. From Green Lake, the surface water flows into Green Lake Creek

which flows roughly 2 miles into Lake Irwin. For source area 7, the PPE starts at the headwaters of Robinson creek and flows through source area 6, and drains into Lake Irwin. The surface water and sediment sample collected at the PPE in source area 7 indicated an observed release of arsenic, barium, mercury, and silver. Additionally, aluminum exceeded its SCDM benchmark value in the surface water.

From the outlet of Lake Irwin, Ruby Anthracite Creek flows south and west roughly 4 miles to its confluence with Dyke Creek. At the confluence of Dyke Creek, Ruby Anthracite Creek turns north and flows for 9 miles to its confluence with Middle Anthracite Creek. Runoff from source area 2 drains into Middle Anthracite Creek. Middle Anthracite Creek drains portions of Purple Mountain, Augusta Mountain, and Richmond Mountain, and flows about 10 miles before its confluence with Ruby Anthracite Creek. From that confluence, Ruby Anthracite Creek and Middle Anthracite Creek become Anthracite Creek, which flows west for 5 miles toward Paonia Reservoir.

Additionally, the town of Crested Butte, Colorado, holds water storage rights to Lake Irwin (367.3 acre-feet, with a junior water right of 6 cfs), which provides water to Crested Butte if natural flow of Coal Creek is insufficient, or if a senior water right downstream affects the Crested Butte diversion. Water is diverted from Lake Irwin by Crested Butte at an average flow rate of 0.5 cfs (Stantec 2005). There are no recorded diversions for domestic or commercial use along Anthracite Creek or its tributaries.

8.3.1 Wetlands

National Wetland Inventory (NWI) maps indicate presence of wetland frontage along Anthracite Creek and its tributaries, and also at the inlet to Lake Irwin which is down gradient of source areas 3, 4, 6, and 7. The wetlands are designated as Freshwater Forested/Shrub Wetland and Freshwater Emergent Wetlands (United States Fish and Wildlife Services [USFWS] 2014a). The wetlands meet actual shoreline (frontage) qualifications for evaluation by application of the HRS. The 15-mile TDL with wetlands is shown on Figure 8.

8.3.2 Fisheries and Recreational Use

Lake Irwin, Anthracite Creek, Ruby Anthracite Creek, and Buck Creek—a tributary to Ruby Anthracite Creek—are known recreational fisheries (UOS 2001). Also located within the site boundaries is Lake Irwin Campground. The campground offers several single-family campsites, and each site is equipped with a picnic table and campfire ring. Flush toilets are also provided at the Lake Irwin Campground.

8.3.3 Threatened and Endangered Species

The 15-mile TDL may include habitat for federal- and state-designated threatened or endangered species. The federally endangered bonytail chub, Colorado Pikeminnow, Humpback Chub, Razorback Sucker, and the Uncompahgre Fritillary Butterfly inhabit the 15-mile TDL. The federally threatened Yellow-billed

Cuckoo, greenback cutthroat trout, and Canda Lynx inhabit the 15-mile TDL (IPaC 2015). The Gunnison County State-listed endangered species include the Boreal toad, least tern, Northern Redbelly Dace, Plains Minnow, Rio Grande Sucker, Southern Redbelly Dace, Suckermouth Minnow, Gray Wolf, Grizzly Bear, Kit Fox, and wolverine (Colorado Parks and Wildlife 2015). Table 14 summarizes the federal- and state-designated threatened or endangered species within Gunnison County.

8.4 Soil Exposure and Air Pathways and Targets

All tailings associated with the former mining operations are uncovered, and access to these tailings is unrestricted. Most of the site is accessible to the public for camping, recreational hiking, biking, and all-terrain vehicle off-road use. None of the tailings at the identified source areas are within 200 feet of a residence. The number of residents within 1 mile of the Ruby District West site is approximately 24, mostly in the town of Irwin (Colorado Census 2010).

Most of the mine tailings on the surface are coarse, sparsely vegetated, and exposed to the wind. There are no records of—and the SR sampling event did not identify—any full-time residents within 0.25 mile of any tailings or mine workings. No air samples were collected for the SR.

9.0 DATA VALIDATION

All data were validated by a third-party chemist from Tetra Tech, Inc., following the "EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," dated January 2010. Data from six Sample Delivery Groups (SDG) were validated: MHS008, MHS106, MHW201, MHW207, MHW301, and MHW307. Some data qualifications were applied; however, all data were deemed acceptable for use as qualified in the data validation reports, except for non-detect results for antimony in SDG MHS008, which were rejected and flagged "R". Descriptions for each qualification are summarized in the data validation packages (Appendix E).

10.0 DATA QUALITY ASSESSMENT

Quality attributes include qualitative and quantitative characteristics of acquired data. The principal quality attributes for environmental sampling data are bias, sensitivity, precision, representativeness, comparability, and completeness. Data quality indicators (DQI) are specific indicators of quality attributes. The following DQIs were considered during the review of field collection techniques and field-related quality assurance/quality control (QA/QC) results, as well as laboratory QA/QC data:

10.1 Bias

For this project, calibrations, serial dilutions, interference check samples, matrix spikes (MS), and blanks were reviewed as possible indicators of bias in the data. Potential bias is indicated by J- (estimated, biased low) or J+ (estimated, biased high) qualifiers (see Appendix E).

10.2 Sensitivity

Sensitivity refers to the capability of a method or instrument to discriminate between small differences in analyte concentrations, and is generally represented by detection limits. The detection limits depend, in part, on the selected analytical methods. The analytical methods selected for this project were EPA Methods 6010B and 7471A for soil and sediment. For groundwater and surface water the analytical methods were EPA Methods 6020 and 7470A.

10.3 Precision

For this project, field duplicates and laboratory duplicates were used to evaluate precision. Results are acceptable if the relative percent difference (RPD) between the sample pairs is less than (<) 35 percent (%) for soil and sediment samples, and < 20% for water samples.

Spike recoveries and RPD values were within the laboratory-specified QC limits with the following exceptions:

- In the MS analysis performed on soil sample RDW-S7-02, recoveries of arsenic, lead, manganese, and zinc could not be determined because the sample concentrations exceeded four times the spike levels. In the MS analysis of RDW-S7-02, antimony was not detected, while recovery of copper was 162% and mercury 135%, both above the target range of 75 to 125%. Post-digestion spike recoveries of antimony (71%) and copper (73%) were both below the lower QC limit of 75%.

- The matrix duplicate (MD) analysis performed on soil sample RDW-S7-02 yielded RPDs above the QC limit of 20% for aluminum (39%), barium (66%), chromium (36%), cobalt (44%), iron (34%), lead (22%), magnesium (30%), nickel (47%), potassium (57%) and vanadium (31%). Due to this apparent heterogeneity, all detected results for aluminum, barium, chromium, cobalt, copper, iron, lead, magnesium, nickel, potassium, and vanadium in SDG MHS008 were qualified as estimated and flagged “J”.

- In the MS analysis performed on sediment sample RDW-SD-LI-02, recovery of antimony was 13%, well below the target range of 75 to 125%. The post-digestion spike yielded an acceptable 89% recovery, identifying the problem as matrix interference. Therefore all antimony results in SDG MHS106 were qualified as estimated and flagged “J” or “UJ”, as appropriate. The same MS analysis yielded excessive recoveries for arsenic (164%), manganese (160%) and zinc (136%). The post-digestion spike analysis for these metals yielded acceptable recoveries (85, 95, and 90%, respectively). All detected results for arsenic, manganese, and zinc in SDG MHS106 were qualified as estimated and flagged “J”.

- The MD analysis performed on sediment sample RDW-SD-LI-02 yielded excessive RPDs for arsenic (36%), iron (31%), magnesium (31%), and manganese (29%), likely due to sample heterogeneity. Therefore, all detected results for arsenic, iron, magnesium, and manganese in the SDG were qualified as estimated and flagged "J".

- In the MS analysis performed on groundwater sample RDW-DW-03 (total metals), all recoveries were within acceptable QC limits. However, the MD analysis yielded concentrations of copper, iron, lead, manganese, and zinc 2 to 7 times the concentrations in the primary samples. These results imply significant heterogeneity in the distribution of metals as particulates within and/or between the samples. Therefore, all detected results for copper, iron, lead, manganese, and zinc in SDG MHW201 were qualified as estimated and flagged "J".

- In the MS analysis performed on groundwater sample RDW-DW-07 (total metals), all recoveries were within acceptable QC limits. The only MD irregularity was for aluminum, with an RPD of 35%, above the acceptable QC limit of 25%. Therefore, all detected aluminum results in SDG MHW207 were qualified as estimated and flagged "J".

- In the MS analysis performed on groundwater sample RDW-DW-03 (dissolved metals), all recoveries were within acceptable QC limits, and the only MD irregularity was for zinc, with a 51% RPD. Therefore, all detected zinc results in SDG MHW301 were qualified as estimated and flagged "J" (except for one sample flagged "J+" for blank contamination).

10.4 Representativeness

Representativeness was achieved during the sampling event by (1) adhering to Standard Operating Procedures (SOP) for field and laboratory procedures, (2) ensuring appropriateness of sample material collected, and (3) attaining acceptance criteria specified in the FSP and QAPP for this project. Deviations from the FSP/QAPP are discussed in Section 6.0 of this report.

10.5 Comparability

For this sampling event, all samples were sent to a CLP laboratory, and all data were validated by a third party, Tetra Tech. All samples were collected in accordance with the FSP and approved SOPs, unless otherwise noted in this report (see Section 6.0); therefore, all sample data collected at the Ruby District West site are internally comparable.

10.6 Completeness

Percent completeness for this project was 65%. Some proposed soil, surface water, sediment, and groundwater samples were not collected because of problems with access to those locations. No seep samples were collected, because no seeps were identified in the field. However, completeness of data obtained during this project is sufficient for the intended purpose of the data.

11.0 DATA GAPS

The following deviations from the FSP/QAPP resulted in data gaps: Groundwater samples were not collected from RDW-DW-05, RDW-DW-09, RDW-DW-11, RDW-DW-12, RDW-DW-13, RDW-DW-14, RDW-DW-16, RDW-DW-17, RDW-DW-19, RDW-DW-20, and RDW-DW-21 due to lack of access to those properties; and Groundwater samples were not collected at RDW-DW-22 because the spring could not be located. Sampling of these drinking water wells may further delineate the elevated arsenic concentrations found in drinking water well in the town of Irwin.

Upon completion of field work for this project, the deviations from the FSP/QAPP and after receipt and review of analytical data, the following data gaps were found:

1. Additional groundwater background samples would be beneficial to more accurately determine background concentrations of metals in groundwater;
2. No sampling occurred at private mining claims within source area 6 due to lack of access;
3. Additional investigation on Lake Irwin (i.e., collection of surface water and sediment on Lake Irwin) are needed to determine the source(s) of arsenic in groundwater at the site.
4. Additional investigations (i.e., groundwater sampling in the town of Irwin, soil bore log information) are needed to determine the source(s) of arsenic in groundwater at the site.

12.0 SUMMARY

The Ruby Mining District is in the Rocky Mountains of central Colorado, 25 miles north of Gunnison and 10 miles west of Crested Butte, Colorado. The Ruby Mining District can be reached from the intersection of Colorado Highway 135 and Elk Avenue in Crested Butte by proceeding west on Elk Avenue to County Road 12 and continuing west on County Road 12 toward Coal Creek valley. This SR focused on the Ruby District West site. (EPA ID COSFN0801684). The site encompasses 3,200 acres and includes Anthracite Creek and Ruby Anthracite Creek Watersheds. The aforementioned watersheds include the summit of Augusta Mountain (source area 1), Garfiech Basin (source area 2), Green Lake Basin (source areas 3 and 4), Silver Basin (source area 5), Robinson Basin (source areas 6 and 7), and Dyke Creek Basin (source area 8). The SR did not focus on source areas 1 and 5, based on past sampling results and previous descriptions of those areas that indicated they did not contain mining-related materials. The Ruby District West site is primarily on USFS land (i.e., Raggeds Wilderness Area), with some private land ownership (private mining claims) west and northwest of Lake Irwin.

12.1 Sources

The sources of hazardous substances associated with the Ruby District West site are contaminated soils, mine tailings and waste piles at mines, adits, and exploration pits. The principal metals in the source

areas include arsenic, cadmium, copper, lead, mercury, silver, and zinc. These could be sources of contaminants, particularly in source areas 3, 4, 6, and 7 (i.e., metals) could be contributing contamination to Lake Irwin and Anthracite Creek, and to groundwater in the town of Irwin, and throughout the surrounding area.

Source	CGS Mine Dump Total Volumes	2014 Mine Dump Volumes	Contaminants (3 Times Background)
Source Area 2	593 cubic yards	No estimate	Unknown
Source Area 3	203 cubic yards	65 cubic yards.	Arsenic, cadmium, copper, lead, mercury, and silver
Source Area 4	542 cubic yards	400 cubic yards	Cadmium, copper, lead, mercury, silver, and zinc
Source Area 6	713 cubic yards	No estimate	Unknown
Source Area 7	137 cubic yards	550 cubic yards	Arsenic, cadmium, copper, lead, mercury, silver, and zinc
Source Area 8	62 cubic yards	No estimate	Unknown

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12.2 Soil Exposure Pathway

Ruby District West mine site is located within the Ruby Range and Raggeds Wilderness area in Gunnison County. The mining dumps, adits, and waste rock in the source areas are not restricted to public access. As a result, this open access could attract rock and mineral collectors and other transient populations. Hiking and biking were observed at the source area during the 2014 sample event. Based on the 2010 census data, a total of 15 people are within 4 miles of the site (Mable/Geocorr 2015).
Overall, a total of sixteen surface soil samples were collected from source area 3, 4, and 7 and from the migration pathways from source area 4 and 7. Numerous TAL metals were detected in the surface soil samples. Detected concentrations of the metals, except for arsenic, were well below their respective health-based benchmarks.

12.3 Surface Water Pathway

Surface water runoff from the source areas are as follows: source area 2- runoff flows downgradient (west) toward Middle Anthracite Creek; source area 3- runoff flows downgradient (south) via an unnamed tributary toward Green Lake; source area 4-runnoff flows downgradient (east) via unnamed tributary toward Green Lake; source area 6-runoff flows west, south, and southeast) toward Robinson Creek;

source area 7-runoff flows downgradient (East) from the mountain into the headwaters of Robinson Creek; and source area 8-runoff flows downgradient (West) toward Dike Creek.

The 15-mile TDL for the surface water pathway for the Ruby District West site is shown on Figure 8. From source areas 3 and 4, the PPE start at unnamed tributaries that drain into Green Lake. From Green Lake it flows into Green Lake Creek which flows roughly 2 miles into Lake Irwin. From source area 7, the PPE starts at the headwaters of Robinson creek, flows through source area 6, and drains into Lake Irwin. From the outlet of Lake Irwin, Ruby Anthracite Creek flows south and west roughly 4 miles to its confluence with Dyke Creek, which drains the southwestern portion of Ruby Peak. At the confluence of Dyke Creek, Ruby Anthracite Creek turns north and flows for 9 miles to its confluence with Middle Anthracite Creek. Runoff from source area 2 drains into Middle Anthracite Creek. Middle Anthracite Creek drains portions of Purple Mountain, Augusta Mountain, and Richmond Mountain, and flows about 10 miles before its confluence with Ruby Anthracite Creek. From that confluence, Ruby Anthracite Creek and Middle Anthracite Creek become Anthracite Creek, which flows west for 5 miles toward Paonia Reservoir.

No drinking water intakes are within the 15-mile TDL. Additionally, no groundwater seeps to streams were observed during the 2014 sampling events. The NWI map indicates presence of wetland frontage along Anthracite Creek and its tributaries, and also at the inlet to Lake Irwin and are designated as Freshwater Forested/Shrub Wetland and Freshwater Emergent Wetlands (United States Fish and Wildlife Services [USFWS] 2014a). The wetlands meet actual shoreline (frontage) qualifications for evaluation by application of the HRS. The primary surface water targets of concern are Green Lake, Lake Irwin, Ruby Anthracite Creek, Middle Anthracite Creek and Anthracite Creek located within the 15-mile TDL; they are documented fisheries and are also used for other recreational purposes, such as camping and hiking.

12.4 Groundwater Pathway

No extensive aquifer systems are associated with the Ruby Mining District (UOS 2001). Consolidated and semi consolidated aquifers include the basalts and tuffs and sandstone in the Wasatch and Ohio Creek Formations, and is likely under unconfined conditions. Groundwater movement is controlled by geometry and permeability of the aquifers, by the amount of precipitation on the recharge areas, and by the degree of hydraulic connection with streams and underlying confined sandstone aquifers. Discharge from the unconfined aquifers is mainly underflow to stream valleys. Groundwater is discharged into the tributaries of Anthracite Creek through numerous springs and seeps, indicating unconfined aquifers consist of coarse, relatively permeable material overlying relatively impermeable rocks. Springs also occur where the unconfined aquifers are fractured.

The Mesaverde Formations and Mancos Shale are confined aquifers. The groundwater flow direction in the confined aquifers is controlled primarily by the pattern of hydraulic gradients in the aquifer, which is affected by the hydrogeologic characteristics of the aquifer, by the regional geologic structure, and by relative elevation differences between the recharge and discharge areas (USGS 1980). Small to medium-sized isolated aquifers containing groundwater of variable quality are present in the coarser-grained layers of the Wasatch and Ohio Creek Formations, but consistent lithologic, water quality, and aquifer yield data are not available for most of the mining district (UOS 2001).

Private well depths in the town of Irwin range from 43 to 540 feet bgs; and static water levels range from 10 to 190 feet bgs (Colorado Division of Water Resources 2014). The sample numbers, well depths, static water levels, and dates drilled are provided below. Additionally, included in the table below are all of the wells located within the Town of Irwin. These wells were not sampled during the 2014 sample event.

Sample Number	Well Depth (feet bgs)	Static Water Level (feet bgs)	Date Drilled
RDW-DW-01	175	70	7/3/1987
RDW-DW-02	300	162	10/13/2006
RDW-DW-04	540	54	7/2/2010
RDW-DW-06	180	76	9/20/2005
RDW-DW-07	380	123	Unknown
RDW-DW-08	220	55	9/27/2006
RDW-DW-10	172	37	9/6/2005
RDW-DW-15	160	15	8/24/2007
RDW-DW-27	Unknown	Unknown	Unknown
RDW-DW-03	Spring	Spring	Spring

Well Permit	Well Depth (feet bgs)	Static Water Level (feet bgs)	Date Drilled
128091	220	190	11/19/1982
147637	43	10	9/8/1988
158327	103	12	7/23/1992
178878	306	140	11/1/1994
212101	280	39	10/27/1998
242536	300	50	8/28/2009
252912	172	37	9/6/2005
254695	200	42	5/31/2004
260743	380	123	9/2/2005
263232	300	32	9/12/2005
269449	340	103	9/25/2006
283563	300	58	9/1/2010

Overall, twenty-eight groundwater samples (nine samples from private wells and one sample from a spring) were collected from the town of Irwin, Colorado. The groundwater samples contained concentrations of numerous metals, but only arsenic and cobalt exceeded an SCDM benchmark. Only the spring and the 540-foot-deep well did not contain detectable concentrations of arsenic. Arsenic concentrations exceeded its SCDM benchmarks in sample numbers RDW-DW-01, RDW-DW-02, RDW-DW-07, RDW-DW-10, RDW-DW-15, and RDW-DW-27.

13.0 PRE-REMEDIAL AND REMOVAL CONSIDERATIONS

Using the HRS scoring and assessment approach, the available analytical data indicates that source areas associated with the Ruby District West mine site are not directly associated with the elevated concentrations of arsenic in drinking water wells in the town of Irwin. For example, the soil samples collected from source areas 3 and 7 indicated an observed release of arsenic has occurred. However, surface water and sediment samples collected from the PPEs for source area 3 and 7 (RDW-SW/SD-S3-02 and RDW-SW/SD-S7-02) did not meet observed release criteria for arsenic. Additionally, surface water and sediment samples collected further downstream from source areas 3, 4, 6, and 7, along Green Lake, Green Lake Creek and Robinson Creek (RDW-SW/SD-03, RDW-SW/SD-S6-01, RDW-SW/SD-S6-02, and RDW-SW/SD-03) did not meet observed release criteria for arsenic.

However, the sediment sampling at the inlet (RDW-SD-LI-01, RDW-SD-LI-02[blind duplicate of RDW-SD-LI-01], RDW-SD-LI-03), outlet (RDW-SD-AC-01 and RDW-SD-AC-07) and the diversion from

Lake Irwin to Coal Creek (RDW-SW/SD-DIV-01) did meet observed release criteria. In particular, the sediment samples collected below the outfall of Lake Irwin (RDW-SD-AC-01 and RDW-SD-AC-07) contained arsenic at 351 and 594 J mg/kg, respectively, both exceeding three times background. The elevated concentrations of arsenic could be attributed to sediment from the moraine in Lake Irwin; therefore, additional surface water and sediment sampling should be conducted on Lake Irwin to determine arsenic concentrations. Another cause of the elevated concentrations of arsenic in the inlet and outlet could suggest that while concentrations along the drainages and PPE do not establish an observed release, arsenic and other metals are at higher concentrations in the lake via accrual of water and sediment runoff/discharges and deposition from these sources into the lake.

Additionally, coal mining was once part of the Ruby Anthracite watershed. Located in the Ruby Anthracite watershed is the town of Floresta, Colorado. The town of Floresta, now considered a ghost town, was formerly known as "Ruby-Anthracite" until 1901. Floresta is seven miles west of Crested Butte in the Anthracite Creek area. In 1893, Denver & Rio Grande Railroad built a narrow gauge rail from Crested Butte to this site to haul coal (Floresta 2015). The town of Floresta is not located within the Ruby District West mine site, but the potential for cretaceous coal beds associated with the Colorado Plateau could also be contributing to the high arsenic concentrations in the Town of Irwin. According to a Quality Characterization of Cretaceous coal From the Colorado Plateau, the mean content of arsenic for whole coal ranged 0.39 to 2.6 ppm around Crested Butte (USGS 2013). Since well logs were not available for review for groundwater wells in the Town of Irwin, it is undetermined whether coal beds are present in the subsurface geology in/near the town of Irwin. As a result, additional groundwater sampling of residential wells in/near the Town of Irwin may be warranted.

The available information and analytical data are sufficient for site reassessment and HRS scoring purposes; however due to the many potential different sources in the area and complex hydrogeology in the area a detailed investigation would be needed in order to fully determine sources and contributions to ground water contamination in the town of Irwin.

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TABLES

TABLE 1

POTENTIAL SOURCES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Property/Mine USFS ID	Source Area	Location	Mine Dump Volumes	1997 CGS Environmental Degradation Rating	UOS Source Description
*Summit of Augusta Mountain Panonia R.D. 04-08-317-4315	1	West flank of Augusta Mountain; Headwaters of Anthracite Creek	90, 73, and 4,500 yd^3	Significant	The largest waste pile (4,500 yd^3) was believed to be landslide debris rather than mine waste rock, because no mine structures were identified, and trees were growing on the debris.
Gabarfiech Basin Panonia R.D. 04-08-316-4314-01	2	West of Angel Pass; Headwaters of Middle Anthracite Creek	53, 240, 25, 33, 14, 40, 43, 40, 15, 45, and 45 yd^3	Significant	No description was provided in the Expanded Site Inspection (ESI) report by UOS in 1999.
Green Lake Basin 04-08-315-4307-01	3	Eastern flank of Ruby Range	28, 30, 60, 45, 25, and 15 yd^3	Potentially Significant	No description was provided in the ESI report by UOS in 1999.
Summit of Green Lake Basin 04-08-315-4307-02	4	Between Ruby Peak and Mount Owen on southwest flank of Ruby Range	42, 455, 10, and 35 yd^3	Potentially Significant	The second largest mine dump, 455 yd^3, identified as Summit of Green Lake Basin, is within the saddle. Exploratory or developmental activity may have occurred, because a road/trail for Lake Irwin ends at the saddle, and a vertical pipe from the operations remains on the saddle.
*Upper Silver Basin, Central and Southern Flank Portions 04-08-315-4309-01	5	Remote basin drained to form headwaters of Silver Creek	370, 410, 13, 34, 35, 22, 25, 15, and 15 yd^3	Potentially Significant	One reported mine dump (410 yd^3) was identified as a volcanic rock outcrop.
Robinson Basin 04-08-317-4308-01	6	East flank of lower part of Robinson Basin above Lake Irwin	175, 155, 20, 45, 23, 270, and 25 yd^3	Potentially Significant	No description was provided in the ESI report by UOS in 1999.
Dye Creek Basin West Flank of Ruby Peak 04-08-314-4307-01	7	Head of Robinson Basin on the south flank of Scarp Ridge	63; 17; 37; 10; 10; and 13 yd^3	Potentially Significant	No description was provided in the ESI report by UOS in 1999.

TABLE 1

POTENTIAL SOURCES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Property/Mine USFS ID	Source Area	Location	Mine Dump Volumes	1997 CGS Environmental Degradation Rating	UOS Source Description
Dyke Creek Basin, West Flank of Ruby Peak 04-08-314-4307	8	Upper western flank of Ruby Peak	17; 25; and 20 yd^3	Significant	No description was provided in the ESI report by UOS in 1999.

Notes:

* This SR did not focus on source areas 1 and 5 based on past sampling results and previous descriptions of those areas that indicated they did not contain mining-related materials. Additionally, see Section 3.2 of this report for the general guidelines for assigning Environmental Degradation Rating.

CGS Colorado Geological Survey
ID Identification
UOS URS Operating Services, Inc.
USFS U.S. Forest Service
yd^3 Cubic yards

TABLE 2

DATA QUALITY OBJECTIVES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Problem Statement	Identifying the Decisions	Decision Inputs	Study Boundaries	Decision Rules	Tolerance Limits on Errors	Optimization of Sample Design
The question to be resolved is whether contamination from the eight source areas has been released and is affecting human health and the environment.	The activities of the project in support of the Site Reassessment (SR) are: 1) Determine if contaminants have migrated to drinking water wells within the Ruby Anthracite Creek Watershed. 2) Determine if Target Analyte List (TAL) metals are migrating off site via the surface water pathway. 3) Further define the surface water pathway, including the overland flow path(s) and probable points of entry (PPE). 4) Identify any release to fisheries downstream of the PPE(s) along Ruby Anthracite Creek and Anthracite Creek. 5) Document wetlands along the surface water pathway downstream of the Ruby District West site.	Laboratory data will be acquired from groundwater, soil, surface water, and sediment samples to determine potential extents of impacts on groundwater, fisheries, wetlands, and other sensitive environments. Comparison of analytical results to EPA Superfund Chemical Data Matrix (SCDM) benchmarks will occur. Information from research and field observations will be used to document wetlands and fisheries. If high or low flow surface water conditions are encountered during the sampling event, the conditions will be noted and relayed to EPA.	The site encompasses 3,200 acres in the Ruby Anthracite Creek and Anthracite Creek Watersheds; geographic coordinates at the center of the site are 38.898077 degrees north latitude and 107.127997 degrees west longitude. Surface water from the southeastern Ruby Range and the western portion of Scarp Ridge is directed into Lake Irwin via Green Lake Creek and Robinson Creek. Ruby Anthracite Creek starts from the outlet at Lake Irwin and flows south before turning north and converging with Middle Anthracite Creek to form Anthracite Creek, which flows to the west.	The endpoint of the sampling event will depend on analytical results. Groundwater, soil, surface water, and sediment sample results will be compared to background sample results. If results from target or attribution samples exceed three times background concentrations, a release will be determined to have occurred at those locations. Comparison of results to EPA's SCDM benchmarks will be conducted for Hazard Ranking System (HRS) scoring purposes.	Judgmental sampling will bias sample locations toward areas of potential contamination and/or areas that may require further characterization. Detection limits reported by the laboratory will be no higher than the EPA Method Detection Limits (MDL) in Title 40 *Code of Federal Regulations* (CFR) Parts 403.12 and 136, and will be lower than applicable SCDM benchmarks. Tolerance limits for quality control (QC) samples are included in Seagull's Contract-Wide QAPP for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Site Assessment Activities.	Locations for sampling soil, groundwater, surface water, and sediment were determined during a site visit on August 2-3, 2013. The SR sampling event will occur during the week of July 14, 2014.

TABLE 3

SURFACE SOIL SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Sample Date	Sample Time	Sample Depth (inches bgs)	Sample Rationale	Latitude (° North)	Longitude (° West)
RDW-S3-01	MHS008	7/15/2014	9:55	0-2	To characterize and assess source area 3.	38.90293	107.12551
RDW-S3-02	MHS009	7/15/2014	9:58	0-2	To characterize and assess source area 3.	38.90292	107.12548
RDW-S3-03	MHS010	7/15/2014	10:10	0-2	To characterize and assess source area 3; sample was collected based on XRF readings.	38.90279	107.12541
RDW-S3-04	MHS011	7/15/2014	10:20	0-2	To characterize and assess source area 3; sample was collected based on XRF readings.	38.90289	107.12538
RDW-S4-01	MHS012	7/15/2014	12:00	0-2	To characterize and assess source area 4.	38.90027	107.12720
RDW-S4-02	MHS013	7/15/2014	12:15	0-2	To characterize and assess source area 4.	38.90025	107.12721
RDW-S4-03	MHS014	7/15/2014	12:17	0-2	To characterize and assess source area 4.	38.90019	107.12721
RDW-S4-04	MHS615	7/15/2014	12:20	0-2	To characterize and assess source area 4.	38.90017	107.12745
RDW-S4-05	MHS015	7/15/2014	12:00	0-2	Blind duplicate of RDW-S4-01.	38.90027	107.12720
RDW-S4-06	MHS017	7/15/2014	12:35	0-2	To characterize and assess overland migration pathway for source area 4; sample was collected based on XRF readings.	38.90028	107.12689
RDW-S4-07	MHS018	7/15/2014	12:41	0-2	To characterize and assess overland migration pathway for source area 4; sample was collected based on XRF readings.	38.900529	107.126145

TABLE 3

SURFACE SOIL SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Sample Date	Sample Time	Sample Depth (inches bgs)	Sample Rationale	Latitude (° North)	Longitude (° West)
RDW-S7-01	MHS025	7/14/2014	15:03	0-2	To characterize and assess source area 7.	38.90865	107.11611
RDW-S7-02	MHS026	7/14/2014	15:07	0-2	To characterize and assess source area 7.	38.90859	107.11597
RDW-S7-03	MHS027	7/14/2014	15:03	0-2	Blind duplicate of RDW-S7-01.	38.90865	107.11611
RDW-S7-04	MHS028	7/14/2014	15:09	0-2	To characterize and assess overland migration pathway for source area 7; sample was collected based on XRF readings.	38.90812	107.11597
RDW-S7-05	MHS029	7/14/2014	15:15	0-2	To characterize and assess source area 7; sample was collected based on XRF readings.	38.90865	107.11598
RDW-SOBKG-02	MHS126	7/16/2014	15:07	0-2	Sample collected upgradient of source area 6 to establish background conditions.	38.90514	107.1040270
RDW-SOBKG-03	MHS127	7/14/2014	14:58	0-2	Sample collected upgradient of source area 7 to establish background conditions.	38.90863	107.11661

Notes:

bgs Below ground surface
CLP Contract Laboratory Program
° Degrees
ID Identification
XRF X-ray fluorescence

TABLE 4

SURFACE WATER SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Analyses	Sample Date	Sample Time	Sample Depth (inches bws)	Sample Rationale	Temperature (°C)	pH	Conductivity (S/m)	DO (mg/L)	ORP (mv)	Latitude (° North)	Longitude (° West)
RDW-SW-AC-01	MHW401	TAL Total Metals +Hg	7/14/2014	10:40	0-6	Samples collected from Lake Irwin at outlet to Ruby Anthracite Creek. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	14.27	5.72	2.656	7.3	-167.3	38.87844	107.10584
	MHW501	Dissolved Metals +Hg											
RDW-SW-AC-02	MHW402	TAL Total Metals +Hg	7/13/2014	13:25	0-6	Samples collected from Ruby Anthracite Creek, 2 miles downgradient of the outlet from Lake Irwin. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	16.33	5.39	0.046	7.75	-162	38.86171	107.12015
	MHW502	Dissolved Metals +Hg											
RDW-SW-AC-03	MHW403	TAL Total Metals +Hg	7/13/2014	14:20	0-6	Samples collected from Ruby Anthracite Creek at Horse Ranch Park. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	16.29	5.55	0.057	7.85	-177.1	38.86233	107.16355
	MHW503	Dissolved Metals +Hg											
RDW-SW-AC-04	MHW404	TAL Total Metals +Hg	7/13/2014	18:10	0-6	Samples collected from Ruby Anthracite Creek, upgradient of the convergence of Middle Anthracite and Ruby Anthracite Creeks. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	18.14	7.45	0.063	7.79	-251.7	38.95435	107.21339
	MHW504	Dissolved Metals +Hg											
RDW-SW-AC-05	MHW405	TAL Total Metals +Hg	7/13/2014	17:55	0-6	Samples collected from Middle Anthracite Creek immediately upgradient of the convergence of Middle Anthracite and Ruby Anthracite Creeks. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	12.78	5.42	0.084	9.23	-185.3	38.95439	107.2131
	MHW505	Dissolved Metals +Hg											
RDW-SW-AC-06	MHW406	TAL Total Metals +Hg	7/14/2014	8:55	0-6	Samples collected from Anthracite Creek at campground on the western boundary of the Raggeds Wilderness Area. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	10.71	6.13	4.158	9.66	-186.2	38.95494	107.26965
	MHW506	Dissolved Metals +Hg											
RDW-SW-AC-07	MHW407	TAL Total Metals +Hg	7/14/2014	10:40	0-6	Blind field duplicate of RDW-SW-AC-01.	14.27	5.72	2.656	7.3	-167.3	38.87844	107.10584
	MHW507	Dissolved Metals +Hg											
RDW-SW-DIV-01	MHW426	TAL Total Metals +Hg	7/17/2014	13:55	0-6	Samples collected where surface water is diverted from Lake Irwin into Coal Creek in the town of Irwin. Test for a potential release to the surface water pathway.	10.43	6.3	0.124	2.72	-93.2	38.87571	107.100159
	MHW526	Dissolved Metals +Hg											
RDW-SW-LI-01	MHW408	TAL Total Metals +Hg	7/14/2014	11:50	0-6	Samples collected from Robinson Creek up-gradient of the inlet to Irwin Lake. Test for a potential release to the surface water pathway and site impact on wetlands and other sensitive environments.	8.96	6.34	2.621	10.04	-244.8	38.88262	107.105988
	MHW508	Dissolved Metals +Hg											

TABLE 4

SURFACE WATER SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Analyses	Sample Date	Sample Time	Sample Depth (inches bws)	Sample Rationale	Temperature (°C)	pH	Conductivity (S/m)	DO (mg/L)	ORP (mv)	Latitude (° North)	Longitude (° West)
RDW-SW-LI-02	MHW409	TAL Total Metals +Hg	7/14/2014	11:50	0-6	Blind field duplicate of RDW-SW-LI-01.	8.96	6.34	2.621	10.04	-244.8	38.88262	107.10598
	MHW509	Dissolved Metals +Hg											
RDW-SW-LI-03	MHW424	TAL Total Metals +Hg	7/17/2014	15:30	0-6	Samples collected at location RDW-SW-LI-01 after a significant rain event the previous evening on July 16, 2014. Test for a potential release to the surface water pathway and site impact on wetlands and other sensitive environments.	11.59	5.91	0.066	8.54	-132.2	38.88262	107.10598
	MHW524	Dissolved Metals +Hg											
RDW-SW-OC-01	MHW410	TAL Total Metals +Hg	7/13/2014	12:50	0-6	Samples collected from Ohio Creek, upgradient of confluence with Ruby Anthracite Creek. Test for a potential release to the surface water pathway from coal mines near Floresta, and site impact on fisheries, wetlands, and other sensitive environments.	14.51	5.19	0.039	8.06	-154.3	38.85915	107.12400
	MHW510	Dissolved Metals +Hg											
RDW-SW-S3-01	MHW413	TAL Total Metals +Hg	7/15/2014	9:35	0-6	Samples collected from unnamed tributary to Green Lake and upgradient of source area 3 to document background conditions in Green Lake Basin.	3.25	4.5	1.162	13.11	-209.8	38.90354	107.12472
	MHW513	Dissolved Metals +Hg											
RDW-SW-S3-02	MHW414	TAL Total Metals +Hg	7/15/2014	11:10	0-6	Samples collected from Green Lake. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	2.69	5.5	2.126	9.99	-269.9	38.90200	107.12252
	MHW514	Dissolved Metals +Hg											
RDW-SW-S3-03	MHW425	TAL Total Metals +Hg	7/15/2014	14:50	0-6	Samples collected from Green Lake Creek. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	11.42	5.18	2.947	8.9	-194.9	38.89687	107.11671
	MHW525	Dissolved Metals +Hg											
RDW-SW-S4-01	MHW415	TAL Total Metals +Hg	7/15/2014	12:00	0-6	Samples collected from an unnamed tributary below an adit pipe at source area 4; the tributary led to Green Lake. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	NA	NA	NA	NA	NA	38.90046	107.12731
	MHW515	Dissolved Metals +Hg											
RDW-SW-S6-01	MHW416	TAL Total Metals +Hg	7/16/2014	14:48	0-6	Samples collected from Robinson Creek upgradient of source area 6, and downgradient of Robinson Mine at source area 7. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	7.6	6.1	-205.3	9.43	-205.3	38.90193	107.10719
	MHW516	Dissolved Metals +Hg											
RDW-SW-S6-02	MHW417	TAL Total Metals +Hg	7/16/2014	15:55	0-6	Samples collected from Robinson Creek downgradient of source area 6, and downgradient of Robinson Mine in source area 7. Test for a potential release to the surface water pathway and site impact on wetlands and other sensitive environments.	10.16	6.37	0.041	8.53	-241.9	38.88889	107.10936
	MHW517	Dissolved Metals +Hg											
RDW-SW-S7-01	MHW418	TAL Total Metals +Hg	7/14/2014	14:45	0-6	Samples collected from headwaters of Robinson Creek up-gradient of Robinson Mine and source areas 6 and 7. Document background conditions in Robinson Creek.	2.9	4.85	0.751	10.27	-209	38.90853	107.11670
	MHW518	Dissolved Metals +Hg											

TABLE 4

SURFACE WATER SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Analyses	Sample Date	Sample Time	Sample Depth (inches bws)	Sample Rationale	Temperature (°C)	pH	Conductivity (S/m)	DO (mg/L)	ORP (mv)	Latitude (° North)	Longitude (° West)
RDW-SW-S7-02	MHW419	TAL Total Metals +Hg	7/14/2014	14:55	0-6	Samples collected from Robinson Creek at PPE downgradient of source area 7. Test for a potential release to the surface water pathway and site impact on wetland and sensitive environment targets. Extra volume collected for MS analysis to test accuracy of laboratory results.	3.28	6.95	2.274	11.37	-300.2	38.90855	107.11581
	MHW519	Dissolved Metals +Hg											
RDW-SW-S7-03	MHW420	TAL Total Metals +Hg	7/14/2014	15:55	0-6	Samples collected from Robinson Creek downgradient of source 7. Test for a potential release to the surface water pathway and site impact on wetland and sensitive environment targets.	4.18	4.66	1.833	9.71	-205.3	38.90538	107.11372
	MHW520	Dissolved Metals +Hg											
RDW-SW-01	MHWRB1	TAL Total Metals +Hg	7/18/2014	13:00	NA	Rinsate blank to document thoroughness of decontamination process in the field.	NA	NA	NA	NA	NA	NA	NA
RDW-SW-02	MHWFB3	TAL Total Metals +Hg	7/11/2014	13:00	NA	Field blank.	NA	NA	NA	NA	NA	NA	NA
RDW-SW-03	MHWFB4	TAL Total Metals +Hg	7/11/2014	13:00	NA	Field blank.	NA	NA	NA	NA	NA	NA	NA

Notes:

bws	Below water surface
C	Celsius
CLP	Contract Laboratory Program
°	Degrees
ID	Identification
Hg	Mercury
DO	Dissolved oxygen
ORP	Oxygen reduction potential
mV	Millivolts
mg/L	Milligrams per liter
MS	Matrix spike
NA	Not applicable
PPE	Probable point of entry
S/m	Siemens per meter
TAL	Target Analyze List

TABLE 5

SEDIMENT SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Sample Date	Sample Time	Sample Depth (inches bgs)	Sample Rationale	Latitude (° North)	Longitude (° West)
RDW-SD-AC-01	MHS101	7/14/2014	10:40	0-2	Sample collected from Lake Irwin at outlet to Ruby Anthracite Creek. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.87844	107.10584
RDW-SD-AC-02	MHS102	7/13/2014	13:25	0-2	Sample collected from Ruby Anthracite Creek, 2 miles downgradient of the outlet from Lake Irwin. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.86171	107.12015
RDW-SD-AC-03	MHS103	7/13/2014	14:20	0-2	Sample collected from Ruby Anthracite Creek at Horse Ranch Park. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.86233	107.16355
RDW-SD-AC-04	MHS104	7/13/2014	18:10	0-2	Sample collected from Ruby Anthracite Creek, upgradient of the convergence of Middle Anthracite and Ruby Anthracite Creeks. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.95435	107.21339
RDW-SD-AC-05	MHS105	7/13/2014	17:55	0-2	Sample collected from Middle Anthracite Creek immediately upgradient of the convergence of Middle Anthracite and Ruby Anthracite Creeks. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.95439	107.2131
RDW-SD-AC-06	MHS106	7/14/2014	8:55	0-2	Sample collected from Anthracite Creek at campground on the western boundary of the Raggeds Wilderness Area. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.95494	107.26965
RDW-SD-AC-07	MHS107	7/14/2014	10:40	0-2	Blind duplicate of RDW-SD-AC-01	38.87844	107.10584
RDW-SD-DIV-01	MHS626	7/17/2014	13:55	0-2	Sample collected where surface water is diverted from Lake Irwin into Coal Creek in the town of Irwin. Test for a potential release to the surface water pathway.	38.87571	107.100159
RDW-SD-LI-01	MHS108	7/14/2014	11:50	0-2	Sample collected from Robinson Creek up-gradient of the inlet to Irwin Lake. Test for a potential release to the surface water pathway and site impact on wetlands and other sensitive environments.	38.88262	107.105988
RDW-SD-LI-02	MHS109	7/14/2014	11:50	0-2	Blind duplicate of RDW-SD-LI-01	38.88262	107.105988
RDW-SD-LI-03	MHS125	7/17/2014	15:30	0-2	Sample collected at location RDW-SW-LI-01 after a significant rain event the previous evening on July 16, 2014. Test for a potential release to the surface water pathway and site impact on wetlands and other sensitive environments.	38.88262	107.105988
RDW-SD-OC-01	MHS110	7/13/2014	12:50	0-2	Sample collected from Ohio Creek, upgradient of confluence with Ruby Anthracite Creek. Test for a potential release to the surface water pathway from coal mines near Floresta, and site impact on fisheries, wetlands, and other sensitive environments.	38.85915	107.124

TABLE 5

SEDIMENT SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sampling Location / ID Number	CLP Sample ID Number	Sample Date	Sample Time	Sample Depth (inches bgs)	Sample Rationale	Latitude (° North)	Longitude (° West)
RDW-SD-S3-01	MHS113	7/15/2014	9:35	0-2	Sample collected from unnamed tributary to Green Lake and upgradient of source area 3 to document background conditions in Green Lake Basin.	38.903537	107.124727
RDW-SD-S3-02	MHS114	7/15/2014	11:10	0-2	Sample collected from Green Lake. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.901997	107.122526
RDW-SD-S3-03	MHS115	7/15/2014	14:50	0-2	Samples collected from Green Lake Creek. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.896867	107.116717
RDW-SD-S4-01	MHS116	7/15/2014	12:00	0-2	Sample collected from an unnamed tributary below an adit pipe at source area 4; the tributary led to Green Lake. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.90046	107.127311
RDW-SD-S6-01	MHS117	7/16/2014	14:48	0-2	Sample collected from Robinson Creek upgradient of source area 6, and downgradient of Robinson Mine at source area 7. Test for a potential release to the surface water pathway and site impact on fisheries, wetlands, and other sensitive environments.	38.90193	107.10719
RDW-SD-S6-02	MHS118	7/16/2014	15:55	0-2	Sample collected from Robinson Creek downgradient of source area 6, and downgradient of Robinson Mine in source area 7. Test for a potential release to the surface water pathway and site impact on wetlands and other sensitive environments.	38.888893	107.109364
RDW-SD-S7-01	MHS119	7/14/2014	14:45	0-2	Sample collected from headwaters of Robinson Creek up-gradient of Robinson Mine and source areas 6 and 7. Document background conditions in Robinson Creek.	38.908531	107.1167
RDW-SD-S7-02	MHS120	7/14/2014	14:55	0-2	Sample collected from Robinson Creek at PPE down-gradient of source area #7 near Robinson Mine. Test for a potential release to the surface water pathway and site impact on wetland and sensitive environment targets.	38.90855	107.11581
RDW-SD-S7-03	MHS121	7/14/2014	15:55	0-2	Sample collected from Robinson Creek downgradient of source 7. Test for a potential release to the surface water pathway and site impact on wetland and sensitive environment targets.	38.90538	107.11372

Notes:

bgs Below ground surface
CLP Contract Laboratory Program
° Degrees
ID Identification

TABLE 6

GROUNDWATER SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Location	CLP Sample #	Analyses	Sample Date	Sample Time	Sample Rationale	Temp (°C)	pH	Conductivity (S/m)	DO (mg/L)	ORP (mV)	Latitude (° North)	Longitude (° West)
RDW-DW-01	MHW201	TAL Total Metals+ Hg	7/17/2014	11:35	Groundwater sample collected at 520 10th Street, Irwin, Colorado, downgradient of Ruby District West source areas. Test for potential contamination in drinking water.	6.47	7.61	0.206	0.57	-283.3	38.87780981	107.1014965
	MHW301	Dissolved Metals+ Hg										
RDW-DW-02	MHW202	TAL Total Metals +Hg	7/17/2014	15:10	Groundwater sample collected at 581 H Avenue, Irwin, Colorado, downgradient of Ruby District West source areas. Sample collected from drinking water well. Test for potential contamination in drinking water.	6.41	6.98	0.231	1.3	-257.5	38.87786865	107.1007305
	MHW302	Dissolved Metals +Hg										
RDW-DW-03	MHW203	TAL Total Metals +Hg	7/17/2014	15:05	Groundwater sample collected at 581 H Avenue, Irwin, Colorado, downgradient of Ruby District West source areas. Sample collected a from spring. Test for potential contamination in drinking water source.	6.92	7.55	0.245	0.8	-276.5	38.87786865	107.1007305
	MHW303	Dissolved Metals +Hg										
RDW-DW-04	MHW204	TAL Total Metals +Hg	7/17/2014	12:16	Groundwater sample collected at 691 H Avenue, Irwin, Colorado, downgradient of Ruby District West source areas. Test for potential contamination in drinking water.	4.54	4.78	0.04	9.56	-160.4	38.87925517	107.1012901
	MHW304	Dissolved Metals +Hg										
RDW-DW-06	MHW206	TAL Total Metals +Hg	7/17/2014	10:30	Groundwater sample collected at 7th Street, Irwin, Colorado, downgradient of Ruby District West source areas. Test for potential contamination in drinking water.	7.69	8.03	0.018	8.47	-283.6	38.87444776	107.1038157
	MHW306	Dissolved Metals +Hg										
RDW-DW-07	MHW207	TAL Total Metals +Hg	7/17/2014	8:57	Groundwater sample collected at 331 10th Street, Irwin, Colorado, downgradient of Ruby District West source areas. This sample was collected post-filtration. Test for potential contamination in drinking water. A pre-filtration sample was also collected (RDW-DW-28).	10.01	7.34	107	6.26	-188.2	38.87576679	107.0968591
	MHW307	Dissolved Metals +Hg										
RDW-DW-08	MHW208	TAL Total Metals +Hg	7/17/2014	9:30	Groundwater sample collected at 560 8th Street, Irwin, Colorado, downgradient of Ruby District West source areas. Test for potential contamination in drinking water.	5.44	7.28	0.093	5.78	-242.6	38.87534719	107.102904
	MHW308	Dissolved Metals +Hg										
RDW-DW-10	MHW210	TAL Total Metals +Hg	7/17/2014	10:06	Groundwater sample collected at 151 H Avenue, Irwin, Colorado, downgradient of Ruby District West source areas. Test for potential contamination in drinking water.	5.51	7.42	0	3.64	-321.4	38.87450331	107.1034831
	MHW310	Dissolved Metals +Hg										
RDW-DW-15	MHW215	TAL Total Metals +Hg	7/16/2014	8:41	Groundwater sample collected at 795 County Road 826A, Irwin, Colorado, downgradient of Ruby District West source areas. Test for potential contamination in drinking water.	8.44	6.91	0.289	0.36	336	38.87033887	107.0970672
	MHW315	Dissolved Metals +Hg										

TABLE 6

GROUNDWATER SAMPLE SUMMARY
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Location	CLP Sample #	Analyses	Sample Date	Sample Time	Sample Rationale	Temp (°C)	pH	Conductivity (S/m)	DO (mg/L)	ORP (mV)	Latitude (° North)	Longitude (° West)
RDW-DW-24	MHW224	TAL Total Metals +Hg	7/17/2014	9:30	Blind duplicate of RDW-DW-08.	5.44	7.28	0.093	5.78	-242.6	38.87534719	107.102904
	MHW324	Dissolved Metals +Hg										
RDW-DW-25	MHW225	TAL Total Metals +Hg	7/17/2014	8:41	Blind duplicate of RDW-DW-15.	8.44	6.91	0.289	0.36	336	38.87033887	107.0970672
	MHW325	Dissolved Metals +Hg										
RDW-DW-26	MHW226	TAL Total Metals +Hg	7/17/2014	13:30	Blind duplicate of RDW-DW-27.	6.1	6.3	0.124	2.72	-169.5	38.872947	107.097763
	MHW326	Dissolved Metals +Hg										
RDW-DW-27	MHW227	TAL Total Metals +Hg	7/17/2014	13:30	Groundwater sample collected on 7th Street, Irwin, Colorado (background sample).	6.1	6.3	0.124	2.72	-169.5	38.872947	107.097763
	MHW327	Dissolved Metals +Hg										
RDW-DW-28	MHW228	TAL Total Metals +Hg	7/17/2014	14:28	Groundwater sample collected pre-filtration at 331 10th Street, Irwin, Colorado.	11.59	6.05	0.151	6.69	-147.1	38.87576679	107.0968591
	MHW328	Dissolved Metals +Hg										
RDW-FB-1	MHWFB1	TAL Total Metals +Hg	7/11/2014	13:00	Field blank.	NA	NA	NA	NA	NA	NA	NA
RDW-FB-2	MHWFB2	Dissolved Metals+ Hg	7/11/2014	13:00	Field blank.	NA	NA	NA	NA	NA	NA	NA

Notes:

CLP	Contract Laboratory Program
°	Degrees
Hg	Mercury
DO	Dissolved oxygen
ORP	Oxygen reduction potential
mV	Millivolts
mg/L	Milligrams per liter
S/m	Siemens per meter
TAL	Target Analyze List
NA	Not applicable
#	Number

TABLE 7

ANALYTICAL DATA SUMMARY FOR METALS IN SURFACE SOIL SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in milligrams per kilogram (mg/kg)																	
RDW-S3-01	Source area 3	MHS008	5,980 J	5.5 R	**28.2**	81.9	0.45 U	0.97	1.4 J	9.6	45.9	1,180 J	1,310 J	0.096 J+	1.9 J	0.69 J	8	2.3 U	13.5 J	226
RDW-S3-02	Source area 3	MHS009	9,820 J	5.1 R	**22.3**	104 J	0.5 U	0.51	2.9 J	6.8	49.6 J	712 J	657	0.042 J+	2.5 J	1.3 J	4.2	2.1 U	25.5 J	142
RDW-S3-03	Source area 3	MHS010	8.020 J	5.8 R	**47.7**	186	0.58 U	1.1	3.1	11.3	72.9 J	2,340 J	1,500 J	0.13 J+	3.8 J	1.6 J	16.4	2.4 U	21.8 J	342
RDW-S3-04	Source area 3	MHS011	8,350 J	5.7 R	**89.5**	165 J	0.57 U	1.1	2.2 J	9.5	98.6 J	3,170 J	1,680 J	0.79 J+	2.9 J	2.0 J	30.2	2.4 U	26.1 J	388
RDW-S4-01	Source area 4	MHS012	974 J	4.5 R	**13.5**	181 J	0.45 U	0.45 U	0.24 J	0.54 J	101 J	312 J	37.1 J	0.016 J+	0.20 J	0.50 J	5.4	1.9 U	3.1 J	223
RDW-S4-05	Duplicate of RDW-S4-01	MHS015	1,330 J	5.1 R	**15.6**	185 J	0.51 U	0.51 U	0.42 J	0.60 J	211 J	336 J	35.8 J	0.011 J+	0.37 J	0.57 J	5.4	2.1 U	3.9 J	259
RDW-S4-02	Source area 4	MHS013	1,200 J	5.5 R	**23.6**	239 J	0.46 U	0.55 U	0.44 J	0.70 J	193 J	458 J	62.1	0.015 J+	0.29 J	0.78 J	13.2	2.3 U	4.7 J	311
RDW-S4-03	Source area 4	MHS014	1,550 J	5.4 R	**19.5**	220 J	0.54 U	0.54 U	0.34 J	0.69 J	160 J	289 J	46.5 J	0.023 J+	0.39 J	3.2 U	5.9	2.3 U	4.5 J	322
RDW-S4-04	Source area 4	MHS615	1,520	5.2 UJ	**18.1 J**	283	0.44 U	0.21 J	0.88 U	4.4 U	126	335	35.8 J	0.011 J	3.5 U	3.0 U	5.4	2.2 U	4.0 J	274 J
RDW-S4-06	Migration pathway	MHS017	2,880 J	4.5 R	**23.8**	233 J	0.45 U	0.39	0.84 J	1.0 J	376 J	256	79.7	0.041 J+	0.66 J	0.93 J	10.1	1.9 U	7.2 J	340
RDW-S4-07	Migration pathway	MHS018	2,690 J	4.8 R	**24.5**	224	0.48 U	0.48 U	1.1 J	1.3 J	250 J	337 J	90.2 J	0.026 J+	0.81	0.64 J	10.1	2 U	6.1	335
RDW-S7-01	Source area 7	MHS025	4,910 J	5.2 R	**119**	34.3 J	0.52 U	31.2	2.1 J	12.9	68.9 J	1,660 J	562 J	1.3 J+	14.9 J	0.52 J	7.5	2.2 U	11.6 J	4,090
RDW-S7-03	Duplicate of RDW-S7-01	MHS027	5,810 J	4.6 R	**49.8**	70.0 J	0.46 U	17.5	3.1 J	8.3	50.7 J	624 J	634 J	1.3 J+	9.2 J	2.7 U	1.4	1.9 U	15.4 J	2,280
RDW-S7-02	Source area 7	MHS026	5,290 J	4.2 R	**25.5**	32.2 J	0.42 U	5.6	4.3 J	6	31.2 J	149 J	280 J	0.60 J+	5.1 J	2.5 U	0.66 J	1.8 U	13.6 J	848
RDW-S7-05	Source area 7	MHS029	3,020 J	6.5 R	**231**	68.1 J	0.6	71.9	2.6	15.2 J	68.3 J	151 J	999 J	1.5 J+	14.9 J	3.8 U	4.2	2.7 U	11.0 J	8,600

TABLE 7

ANALYTICAL DATA SUMMARY FOR METALS IN SURFACE SOIL SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in milligrams per kilogram (mg/kg)																	
RDW-S7-04	Migration pathway	MHS028	5,240 J	5.5 R	**0.98**	23.2 J	0.55 U	0.55 U	1.4 J	2.8 J	9.2 J	13.5 J	249 J	0.31 J+	1.4 J	3.2 U	0.16 J	2.3 U	12.7 J	34.8
RDW-SOBKG-02	Source area 6 background	MHS126	8,830	5.7 UJ	**9.5 J**	133	0.48 U	0.23 J	5.5	4.8 U	7.3	24.5	451 J	0.027	6	3.3 U	0.81 J	2.4 U	12.9	44.9 J
RDW-SOBKG-03 (Background)	Source area 7 background	MHS127	15,800	6.9 UJ	**14.6 J**	119	0.72 J+	0.49 J	11.9	8.8	15.5	49.2	654 J	0.055 J	10.8	4.0 U	1.8	2.9 U	30.4	120
SCDM RfD			70,000	30	30	10,000	100	30	200	20	3,000	NE	10,000	20	1,000	300	300	0.7	700	20,000
SCDM CR			NE	NE	0.71	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Notes:

Bold value exceeds at least one health-based benchmark.
Shaded cell indicates a concentration that exceeds three times the background concentration or the background sample's Contract Required Detection Limit if non-detect in the background samples.

CR	Cancer risk screening concentration
CLP	Contract Laboratory Program
ID	Identification
J	The associated numerical value is an estimated quantity
J+	The associated numerical value is an estimated quantity; the result may be biased high
NE	Not established
R	The sample result is rejected as unusable due to serious deficiencies in one or more quality control (QC) criteria. The analyte may or may not be present in the sample.
RfD	Reference dose screening concentration
SCDM	Superfund Chemical Data Matrix (EPA 2014)
U	Analyte not detected above the reporting limit
UJ	The analyte was not detected at or above the associated value (RL), which is considered approximate due to deficiencies in one or more QC criteria.

TABLE 8

ANALYTICAL DATA SUMMARY FOR TOTAL METALS IN SURFACE WATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-SW-AC-01	Outlet of Lake Irwin	MHW401	31.3 J+	2.0 U	1.2	10 U	1.0 U	1.0 U	7,130	2.0 U	1.0 U	2.0 U	1.0 U	751	8.4 J	0.20 U	0.19 J	500 U	5.0 U	1.0 U	1.0 U	5.0 U	10.3 J
RDW-SW-AC-07	Duplicate of RDW-SW-AC-01	MHW407	34.8 J+	2.0 U	1.4	9.8 U	1.0 U	1.0 U	7,140	2.0 U	1.0 U	2.0 U	1.0 U	748	8.5 J	0.20 U	0.17 J	500 U	5.0 U	1.0 U	1.0 U	5.0 U	10.2 J
RDW-SW-AC-02	Ruby Anthracite Creek-2 miles downgradient of Lake Irwin	MHW402	28.2 J+	2.0 U	1.2	13.7	1.0 U	1.0 U	7,560	2.0 U	1.0 U	2.0 U	1.0 U	728	3.7	0.20 U	0.16 J	500 U	0.33 J	1.0 U	1.0 U	5.0 U	4.9 J+
RDW-SW-AC-03	Ruby Anthracite Creek at Horse Ranch Park	MHW403	68.5	2.0 U	0.65 J	33.1	1.0 U	1.0 U	9,090	2.0 U	1.0 U	2.0 U	1.0 U	1,120	23.8 J	0.20 U	0.23 J	500 U	5.0 U	1.0 U	1.0 U	0.60 J	2.0 U
RDW-SW-AC-04	Ruby Anthracite Creek-upgradient of Middle Anthracite Creek confluence	MHW404	59.0 J+	2.0 U	0.27 J	34.5	1.0 U	1.0 U	9,660	2.0 U	1.0 U	2.0 U	1.0 U	1,160	5.9 J	0.20 U	0.19 J	500 U	5.0 U	1.0 U	1.0 U	0.50 J	2.4 U
RDW-SW-AC-05	Middle Anthracite Creek-upgradient of Ruby Anthracite Creek confluence	MHW405	2.0 U	13.6	1.0 U	1.0 U	16,400	2.0 U	1.0 U	2.0 U	1.0 U	2.0 U	1.0 U	2,000	1.0 U	0.20 U	0.27 J	500 U	0.36 J	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-AC-06	Anthracite Creek at campground	MHW406	34.5 J+	2.0 U	1.0 U	22	1.0 U	1.0 U	13,200	2.0 U	1.0 U	2.0 U	1.0 U	1,540	2.3 J	0.20 U	0.24 J	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-LI-01	Inlet of Lake Irwin	MHW408	47.3 J	2.0 U	1.4	12	1.0 U	1.0 U	8,010	2.0 U	1.0 U	2.0 U	1.0 U	926	11.3	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	20.1
RDW-SW-LI-02	Duplicate of RDW-SW-LI-01	MHW409	**127 J**	2.0 U	1.6	12.6	1.0 U	1.0 U	8,010	2.0 U	1.0 U	2.0 U	1.0 U	938	13.5	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	20.7
RDW-SW-LI-03	Inlet of Lake Irwin-following a rain event	MHW424	33.6 J	2.0 U	1.1	12.4	1.0 U	1.0 U	8,430	2.0 U	1.0 U	2.0 U	1.0 U	963	7.1	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	16.5
RDW-SW-OC-01	Ohio Creek-tributary to Ruby Anthracite Creek	MHW410	62.1 J	2.0 U	1.0 U	15.5	1.0 U	1.0 U	5,820	2.0 U	1.0 U	2.0 U	1.0 U	921	1.7	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	1.1 J
RDW-SW-S3-02	Green Lake	MHW414	**174 J**	2.0 U	1.0 U	11.2	1.0 U	1.0 U	7,400	2.0 U	1.0 U	17.2	1.1 J+	1,000	57.8	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	103
RDW-SW-S3-03	Green Lake Creek-downgradient of source areas 3 and 4	MHW425	43.6 J	2.0 U	1.0 U	11.7	1.0 U	1.0 U	8,840	2.0 U	1.0 U	**3.8**	1.0 U	915	16.8	0.20 U	1.0 U	500 U	0.39 J	1.0 U	1.0 U	5.0 U	53.7
RDW-SW-S4-01	Below an adit pipe in an unnamed tributary at source area 4	MHW415	**4,820 J**	2.0 U	1.0 U	19.9	1.0 U	**22**	23,800	2.0 U	14.4	**649**	1.9	7,290	1,570	0.20 U	4.3	500 U	0.39 J	1.0 U	1.0 U	5.0 U	**2,390**
RDW-SW-S6-01	Robinson Creek-downgradient of Robinson Mine and upgradient of source area 6	MHW416	20 U	2.0 U	1.0 U	13.1	1.0 U	1.0 U	6,740	2.0 U	1.0 U	2.0 U	1.0 U	1,010	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	0.93 J
RDW-SW-S6-02	Robinson Creek-downgradient of Robinson Mine and upgradient of source area 6	MHW417	20 U	2.4 U	1.0 U	11.2	1.0 U	1.0 U	7,080	2.0 U	1.0 U	2.0 U	1.0 U	888	1.3	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	1.1 J

TABLE 8

ANALYTICAL DATA SUMMARY FOR TOTAL METALS IN SURFACE WATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-SW-S7-02	Headwaters of Robinson Creek-downgradient of Robinson Mine	MHW419	**138 J**	2.0 U	0.38 J	18.7	1.0 U	1.0 U	7,780	2.0 U	1.0 U	2.0 U	1.0 U	1,480	6.1	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	3.9
RDW-SW-S7-03	Headwaters of Robinson Creek-downgradient of Robinson Mine	MHW420	37.0 J	2.0 U	0.32 J	14.2	1.0 U	1.0 U	6,070	2.0 U	1.0 U	2.0 U	1.0 U	1,030	1.7	0.20 U	1.0 U	500 U	0.37 J	1.0 U	1.0 U	5.0 U	1.4 J
RDW-SW-DIV-01	Diverson point from Lake Irwin into Coal Creek	MHW426	76.3 J	2.0 U	3	13.1	1.0 U	1.0 U	7,200	2.0 U	1.0 U	2.0 U	1.0 U	749	22	0.20 U	1.0 U	500 U	0.34 J	1.0 U	1.0 U	5.0 U	12.9
RDW-SW-S3-01	Unnamed tributary to Green Lake-background sample	MHW413	20 U	2.0 U	1.0 U	10.8	1.0 U	1.0 U	3,670	2.0 U	1.0 U	2.0 U	1.0 U	528	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	1.9 J
RDW-SW-S7-01	Headwaters of Robinson Creek-background sample	MHW418	65.4 J+	2.0 U	1.0 U	18.4	1.0 U	1.0 U	8,080	2.0 U	1.0 U	2.0 U	1.0 U	1,500	2.5	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	1.8 J
Criterion Maximum Concentration (acute)			750	NE	340	NE	NE	2	NE	NE	NE	13	65	NE	NE	1.4	470	NE	NE	3.2	NE	NE	120
Criterion Continuous Concentration (chronic)			87	NE	150	NE	NE	0.25	NE	NE	NE	9	2.5	NE	NE	0.77	52	NE	5	NE	NE	NE	120

Notes:

Bold value exceeds at least one health-based benchmark.
Shaded cell indicates a concentration that exceeds three times the background concentration or the background sample's Contract Required Detection Limit if non-detect in the background samples.
CLP Contract Laboratory Program
ID Identification
J The associated numerical value is an estimated quantity
J+ The associated numerical value is an estimated quantity; the result may be biased high
NE Not established
U Analyte not detected above the reporting limit

TABLE 9

ANALYTICAL DATA SUMMARY FOR DISSOLVED METALS IN SURFACE WATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-SW-AC-01	Outlet of Lake Irwin	MHW501	20 U	2.0 U	1.5	10 U	1.0 U	1.0 U	6,980 J	0.39 J	1.0 U	2.0 U	1.0 U	785 J	7.9 J	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	8.2 J+
RDW-SW-AC-07	Duplicate of RDW-SW-AC-01	MHW507	20 U	2.0 U	1.3 J	10 U	1.0 U	1.0 U	7,120 J	0.35 J	1.0 U	2.0 U	1.0 U	798 J	4.4 J	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	8.8 J+
RDW-SW-AC-02	Ruby Anthracite Creek-2 miles downgradient of Lake Irwin	MHW502	20 U	2.0 U	0.93 J	12.8 J	1.0 U	1.0 U	7,320 J	0.45 J	1.0 U	2.0 U	1.0 U	753	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	4.3 J+
RDW-SW-AC-03	Ruby Anthracite Creek at Horse Ranch Park	MHW503	22.2 J+	2.0 U	0.46 J	31.1 J	1.0 U	1.0 U	8,960 J	0.41 J	1.0 U	2.0 U	1.0 U	1,180 J	18.4 J	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-AC-04	Ruby Anthracite Creek-upgradient of Middle Anthracite Creek confluence	MHW504	20 U	2.0 U	0.30 J	32.2 J	1.0 U	1.0 U	9,490 J	0.41 J	1.0 U	2.0 U	1.0 U	1,220 J	1.8 J	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-AC-05	Middle Anthracite Creek-upgradient of Ruby Anthracite Creek confluence	MHW505	20 U	2.0 U	1.0 U	12.9 J	1.0 U	1.0 U	16,100 J	0.37 J	1.0 U	2.0 U	1.0 U	2,060 J	1.0 U	0.24 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.0 U
RDW-SW-AC-06	Anthracite Creek at campground	MHW506	20 U	2.0 U	1.0 U	21.5 J	1.0 U	1.0 U	13,000 J	0.37 J	1.0 U	2.0 U	1.0 U	1,650 J	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-LI-01	Inlet of Lake Irwin	MHW508	20 U	2.0 U	1.0 U	11.1	1.0 U	1.0 U	7,800	2.0 U	1.0 U	2.0 U	1.0 U	948	6.1	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	18.4
RDW-SW-LI-02	Duplicate of RDW-SW-LI-01	MHW509	20 U	2.0 U	1.0 U	11.1	1.0 U	1.0 U	7,840	2.0 U	1.0 U	2.0 U	1.0 U	965	5.7	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	19.2
RDW-SW-LI-03	Inlet of Lake Irwin-following a rain event	MHW524	48.3	2.0 U	1.2 J+	12.4 J+	1.0 U	1.0 U	8,070	2.0 U	1.0 U	2.0 U	1.0 U	1,000	7.9	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	17
RDW-SW-OC-01	Ohio Creek-tributary to Ruby Anthracite Creek	MHW510	40.4 J+	2.0 U	1.0 U	14.5	1.0 U	1.0 U	5,640	2.0 U	1.0 U	2.0 U	1.0 U	951	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.0 U
RDW-SW-S3-02	Green Lake	MHW514	20 U	2.0 U	1.0 U	10 U	1.0 U	1.0 U	6,520	2.0 U	1.0 U	8.4	1.0 U	878	33.5	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	70.6

TABLE 9

ANALYTICAL DATA SUMMARY FOR DISSOLVED METALS IN SURFACE WATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-SW-S3-03	Green Lake Creek-downgradient of source areas 3 and 4	MHW525	25.2 J+	2.0 U	1.0 U	10.9	1.0 U	1.0 U	8,040	2.0 U	1.0 U	2.5 J+	1.0 U	922	13.4	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	50.8
RDW-SW-S4-01	Below an adit pipe in an unnamed tributary at source area 4	MHW515	**4,740**	2.0 U	1.0 U	19	1.0 U	**21.3**	23,800	2.0 U	13.9	**622**	1.0 U	7,340	1,490	0.021 J	4.3	500 U	5.0 U	1.0 U	1.0 U	5.0 U	**2,390**
RDW-SW-S6-01	Robinson Creek-downgradient of Robinson Mine and upgradient of source area 6	MHW516	20 U	2.0 U	1.0 U	12.9	1.0 U	1.0 U	6,480	2.0 U	1.0 U	2.0 U	1.0 U	1,030	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-S6-02	Robinson Creek-downgradient of Robinson Mine and upgradient of source area 6	MHW517	20 U	2.0 U	1.0 U	11	1.0 U	1.0 U	6,920	2.0 U	1.0 U	2.0 U	1.0 U	915	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	**153**
RDW-SW-S7-02	Headwaters of Robinson Creek-downgradient of Robinson Mine	MHW519	20 U	2.0 U	1.0 U	16.5	1.0 U	1.0 U	7,420	2.0 U	1.0 U	2.0 U	1.0 U	1,320	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-SW-S7-03	Headwaters of Robinson Creek-downgradient of Robinson Mine	MHW520	20 U	2.0 U	1.0 U	13.3	1.0 U	1.0 U	5,820	2.0 U	1.0 U	2.0 U	1.0 U	1,060	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.0 U
RDW-SW-DIV-01	Diverson point from Lake Irwin into Coal Creek	MHW526	20 U	2.0 U	1.0 U	10.7 J+	1.0 U	1.0 U	6,830	2.0 U	1.0 U	2.0 U	1.0 U	755	8	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	9.0 J+
RDW-SW-S3-01	Unnamed tributary to Green Lake- background sample	MHW513	2.0 U	5.0 U	1.0 U	10.5	1.0 U	1.0 U	3,630	2.0 U	1.0 U	2.0 U	1.0 U	554	1.0 U	0.20 U	1.0 U	500 U	1.0 U	1.0 U	1.0 U	5.0 U	2.6 J+

TABLE 9

ANALYTICAL DATA SUMMARY FOR DISSOLVED METALS IN SURFACE WATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-SW-S7-01	Headwaters of Robinson Creek-background sample	MHW518	20 U	2.0 U	1.0 U	17	1.0 U	1.0 U	7,900	2	1	2.0 U	1	1,590	1.0 U	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	2.3 J+
Criterion Maximum Concentration (acute)			750	NE	340	NE	NE	2	NE	NE	NE	13	65	NE	NE	1.4	470	NE	NE	3.2	NE	NE	120
Criterion Continuous Concentration (chronic)			87	NE	150	NE	NE	0.25	NE	NE	NE	9	2.5	NE	NE	0.77	52	NE	5	NE	NE	NE	120

Notes:

Bold value exceeds at least one health-based benchmark.
Shaded cell indicates a concentration that exceeds three times the background concentration or the background sample's Contract Required Detection Limit if non-detect in the background samples.

CLP Contract Laboratory Program
ID Identification
J The associated numerical value is an estimated quantity
J+ The associated numerical value is an estimated quantity; the result may be biased high
NE Not established
U Analyte not detected above the reporting limit

TABLE 10

ANALYTICAL DATA SUMMARY FOR METALS IN SEDIMENT SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in milligrams per kilogram (mg/kg)																	
RDW-SD-AC-01	Outlet of Lake Irwin	MHS101	8,460 J	4.9 R	351	85.7 J	0.49 U	1	2.6 J	6.4	8.2 J	33.3	1,350 J	0.11 U	3.8 J	2.9 U	0.86	490	16.2 J	193
RDW-SD-AC-07	Duplicate of RDW-SD-AC-01	MHS107	10,700	10.3 J	594 J	115	0.52 U	1.1	2.1	7.6	9.3	196	1,860 J	0.021 J	4.2 U	3.6 U	0.46 J	2.6 U	19.4	201 J
RDW-SD-AC-02	Ruby Anthracite Creek-2 mile downgradient of Lake Irwin	MHS102	7,610 J	4.8 R	3.6	125 J	0.46	0.48	2.3 J	5.8	3.4 J	8.1 J	436 J	0.0064 J+	2.7 J	2.8 U	0.80 U	2.0 U	24.3 J	74.8
RDW-SD-AC-03	Ruby Anthracite Creek at Horse Ranch Park	MHS103	7,360 J	6.3 R	3.4	99.8 J	0.63 U	0.63 U	5.0 J	5.0 J	5.7 J	10.1 J	274 J	0.0040 J+	6.1 J	3.7 U	1.0 U	2.6 U	23.1 J	46.8
RDW-SD-AC-04	Ruby Anthracite Creek-upgradient of Middle Anthracite Creek Confluence	MHS104	9,140 J	7.1 R	4.1	146 J	0.71 U	0.71 U	4.9 J	5.8 J	6.0 J	10.7	440 J	0.0038 J+	6.1 J	4.2 U	1.2 U	3.0 U	27.7 J	60
RDW-SD-AC-05	Middle Anthracite Creek-upgradient of Ruby Anthracite Creek Confluence	MHS105	12,500 J	5.3 R	6.5	92.4 J	0.6	0.53 U	11.3 J	5.3	10.5 J	16.0 J	293 J	0.11 U	9.5 J	3.1 U	0.88 U	2.2 U	26.2 J	76.1
RDW-SD-AC-06	Anthracite Creek at campgrounds	MHS106	11,400	4.8 UJ	4.9 J	57.3	0.47 J+	0.11 J	9.2	4.8 U	7.8	13.3	236	0.11 U	7	0.84 J	0.80 U	2.0 U	22.5	45.3
RDW-SD-LI-01	Inlet of Lake Irwin	MHS108	9,470	9.0 UJ	37.4 J	89.4	0.53 U	1.2	4.6	5.3 U	13	20.8	328 J	0.021 J	8	5.3 U	2.5	3.8 U	14.6	176
RDW-SD-LI-02	Duplicate of RDW-SD-LI-01	MHS109	12,500	10 UJ	46.5 J	133	0.84 U	2.2	6.2	8.4 U	27.6	38.2	331 J	0.068 J	8.1	5.8 U	2	4.2 U	18.5	222 J
RDW-SD-LI-03	Inlet of Lake Irwin-Following a rain event	MHS125	13,300	11.1 UJ	34.3 J	144	0.94 U	1.3	6.9	9.5	19.2	32.5	329 J	0.058 J	7.9	1.6 J	3.2	4.6 U	18.1	169 J
RDW-SD-OC-01	Ohio Creek-Tributary to Ruby Anthracite Creek	MHS110	10,800	6.2 UJ	2.8 J	297	0.56 J+	0.073 J	4.9	5.6	6.1	10.1	370 J	0.099 U	5.3	3.6 U	1.0 U	2.6 U	37.9	68.7 J
RDW-SD-S3-02	Collected from Green Lake	MHS114	13,200	7.6 UJ	21.5 J	21.5 J	87.2	0.66 J+	7.3	16.2	65.6	151	1,390 J	0.0063 J	9.1	4.4 U	0.46 J	3.2 U	26.7	426 J
RDW-SD-S3-03	Collected from Green Lake Creek-downgradient of Source Areas # 3 and #4	MHS115	13,200	5.4 UJ	4.6 J	78.9	0.49 J+	2	6.4	12.4	76.6	25.1	554 J	0.0013 J	12.3	3.2 U	0.90 U	2.3 U	17	281 J
RDW-SD-S4-01	Below an adit pipe in an Unnamed at source area #4	MHS116	4,430	6.9 UJ	22.9 J	154	0.58 U	0.62	2	14.1	352	164	1,010	0.011 J	4.6 U	4.0 U	3.9	2.9 U	8.4	302
RDW-SD-S6-01	Robinson Creek-downgradient of Robinson Mine and upgradient of Source Area #6	MHS117	11,700	5.6 UJ	15 J	93	0.47 J+	0.18	3.9	8.5	9.7	15.4	614 J	0.10 U	7.5	3.3 U	0.94 U	2.3 U	13.3	86.6 J

TABLE 10

ANALYTICAL DATA SUMMARY FOR METALS IN SEDIMENT SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in milligrams per kilogram (mg/kg)																	
RDW-SD-S6-02	Robinson Creek-downgradient of Robinson Mine and upgradient of Source Area #6	MHS118	11,200	6.3 UJ	10.7 J	93.1	0.52 U	0.24 J	4.2	8.9	7.7	19.6	506 J	0.12 U	8.8	3.7 U	1.0 U	2.6 U	14.8	101 J
RDW-SD-S7-02	Headwaters of Robinson Creek-downgradient of Robinson Mine	MHS120	17,200	6.9 UJ	52.8 J	649	0.96	2.8	10.1	12.4	31.4	136	1,400 J	0.12 J	11.8	4.0 U	0.89 J	2.9 U	34.9	441 J
RDW-SD-S7-03	Headwaters of Robinson Creek-downgradient of Robinson Mine	MHS121	13,600	5.4 UJ	4.9 J	86.6	0.45 U	0.39 J	10.6	8.7	7.8	25.1	390 J	0.0018 J	15.6	3.2 U	0.91 U	2.3 U	23.7	103 J
RDW-SD-DIV-01	Diverson point from Lake Irwin into Coal Creek	MHS626	9,370	5.7 UJ	63.8 J	90.9	0.48	0.15 J	4.8	6.8	7.1	15.5	499 J	0.11 U	6.8	3.3 U	0.95 U	2.4 U	16	96.3 J
RDW-SD-S3-01 (Background)	Unnamed Tributary to Green Lake-Background Sample	MHS113	13,400	7.6 UJ	14.8 J	130	0.86 J+	2.4	4.9	12.5	45.2	193	1,620	0.035 J	7.7	4.4 U	0.29 J	3.2 U	33.7	356 J
RDW-SD-S7-01 (Background)	Headwaters of Robinson Creek-Background Sample	MHS119	20,200	6.1 UJ	30.8 J	119	0.88	0.41 J	10.2	9.5	18.1	62.7	921 J	0.023 J	10.6	3.6 U	1.0 U	2.5 U	32	187 J

Notes:
Shaded cell indicates a concentration that exceeds three times the background concentration or the background sample's Contract Required Detection Limit if non-detect in the background samples.

CLP	Contract Laboratory Program
ID	Identification
J	The associated numerical value is an estimated quantity
J+	The associated numerical value is an estimated quantity; the result may be biased high
R	The sample result is rejected as unusable due to serious deficiencies in one or more quality control (QC) criteria. The analyte may or may not be present in the sample.
U	Analyte not detected above the reporting limit
UJ	The analyte was not detected at or above the associated value (RL), which is considered approximate due to deficiencies in one or more QC criteria.

TABLE 11

ANALYTICAL DATA SUMMARY FOR TOTAL METALS IN GROUNDWATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-DW-01	520 10th Street, Irwin, Colorado	MHW201	171	2.4 U	**8.2**	32.5	1.4 U	1.0 U	34,200	2.4 U	1.4 U	2.4 U	1.4 U	2,240	190 J	0.20 U	0.47 J	1,300	5.0 U	1.0 U	1.0 U	5.0 U	2.4 U
RDW-DW-02	581 H Avenue, Irwin, Colorado (drinking water well)	MHW202	3,070	2.4 U	**10.9**	77.2	1.0 U	1.0 U	23,800	2.4 U	1.4	7.3 J	3.7 J	1,650	100 J	0.20 U	2	18,600	5.0 U	1.0 U	1.0 U	3.4 J	14.7
RDW-DW-03	581 H Avenue, Irwin, Colorado (spring)	MHW203	100	2.0 U	1.0 U	12.3	1.0 U	1.0 U	9,780	2.4 U	1.4 U	7.5 J	1.0 U	1,090	5.7 J	0.20 U	0.29 J	564 U	5.0 U	1.0 U	1.0 U	5.0 U	4.8 J+
RDW-DW-04	691 H Avenue, Irwin, Colorado	MHW204	90.3	2.0 U	1.0 U	6.7 J	1.0 U	1.0 U	7,900	2.0 U	1.0 U	37.8	1.0 U	1,130	1.2 J	0.20 U	0.19 J	500 U	5.0 U	1.0 U	1.0 U	5.0 U	5.1 J
RDW-DW-06	7th Street, Irwin, Colorado	MHW206	28.1 J+	2.0 U	0.26 J	151	1.0 U	1.0 U	24,300	2.0 U	1.0 U	2.0 U	1.0 U	684	2.2 J	0.20 U	0.78 J	500 U	0.43 J	1.0 U	1.0 U	1.6 J	3.5 J
RDW-DW-07	331 10th Street, Irwin, Colorado (post-filtration)	MHW207	111 J	2.0 U	**19.9**	18.2	1.0 U	1.0 U	20,000	2.0 U	1.0 U	50.2	1.0 U	1,560	18.6	0.2	1.0 U	922	5.0 U	1.0 U	1.0 U	5.0 U	5.7
RDW-DW-28	331 10th Street, Irwin, Colorado (pre-filtration)	MHW228	53.6 J+	2.0 U	**19.4**	17.9	1.0 U	1.0 U	19,800	2.0 U	1.0 U	41.5 J	1.0 U	1,580	18.2	0.20 U	0.41 J	901	5.0 U	1.0 U	1.0 U	5.0 U	9.6 J
RDW-DW-08	560 8th Street, Irwin, Colorado	MHW208	20 U	2.0 U	0.38	76.5	1.0 U	1.0 U	23,900	2.0 U	1.0 U	2.0 U	1.0 U	821	1.1 J	0.20 U	0.31 J	506	0.87	1.0 U	2.5 U	1.2 J	2.0 U
RDW-DW-24	Blind duplicate of RDW-DW-08	MHW224	20 U	2.0 U	**0.42 J**	75.2	1.0 U	1.0 U	23,400	2.0 U	1.0 U	2.0 U	1.0 U	808	1.2 J	0.20 U	0.34 J	566 U	0.81 J	1.0 U	1.0 U	1.0 J	2.0 U
RDW-DW-10	151 H Avenue, Irwin, Colorado	MHW210	1,140	4.8 J+	**1,520**	265	1.0 U	1.0 U	33,800	2.0 U	3.4	3.1 J	1.8 J	688	1,880	0.20 U	0.94 J	1,510	2.2 J	1.0 U	1.0 U	2.3 J	54.9 J
RDW-DW-15	795 County Road 826A, Irwin, Colorado	MHW215	20 U	2.0 U	**31.6**	27.8	1.0 U	1.0 U	17,000	2.0 U	1.0 U	2.0 U	1.0 U	1,990	48.9 J	0.20 U	0.35 J	2,200	5.0 U	1.0 U	1.0 U	5.0 U	2.1 J+
RDW-DW-25	Blind duplicate of RDW-DW-15	MHW225	20 U	2.4 U	**31.5**	27.8	1.0 U	1. 0 U	17,100	2.0 U	1.0 U	2.0 U	1.0 U	2,000	48.8 J	0.20 U	0.44 J	2,190	5.0 U	1.0 U	1.0 U	5.0 U	2.0 U

TABLE 11

ANALYTICAL DATA SUMMARY FOR TOTAL METALS IN GROUNDWATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-DW-27 (Background)	P.O. Box 3532 (7th Street), Irwin, Colorado	MHW227	29.1 J+	2.0 U	**0.78 J**	83	1.0 U	1.0 U	18,000	2.0 U	1.0 U	19.9 J	1.0 U	1,240	1.2	0.20 U	0.29	1,100	0.38	1.0 U	1.0 U	5.0 U	4.1 J+
RDW-DW-26 (Background)	Blind duplicate of RDW-DW-27	MHW226	76	2.0 U	**0.93 J**	83	1.0 U	1.0 U	18,100	2.0 U	1.0 U	24.3	1.1 J	1,260	1.5 J	0.20 U	0.29 J	1,110	0.37 J	1.0 U	1.0 U	5.0 U	6.2 J
		SCDM MCL	NE	6	10	2,000	4	5	NE	100	NE	1,300	15	NE	NE	2	NE	NE	50	NE	2	NE	NE
		SCDM RfD	10,000	6	4	3,000	30	7	NE	40	4	600	NE	NE	2,100	4	300	NE	70	70	0.1	100	4,000
		SCDM CR	NE	NE	0.4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Notes: Bold value exceeds at least one health-based benchmark.
Shaded cell indicates a concentration that exceeds three times the background concentration or the background sample's Contract Required Detection Limit if non-detect in the background samples.

CR Cancer risk screening concentration
CLP Contract Laboratory Program
ID Identification
J The associated numerical value is an estimated quantity
J+ The associated numerical value is an estimated quantity; the result may be biased high
NE Not established
RfD Reference dose screening concentration
SCDM Superfund Chemical Data Matrix (EPA 2014)
U Analyte not detected above the reporting limit

TABLE 12

ANALYTICAL DATA SUMMARY FOR DISSOLVED METALS IN GROUNDWATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-DW-01	520 10th Street, Irwin, Colorado	MHW301	2.0 U	2.0 U	**7.8**	28.9 J	1.0 U	1.0 U	33,000	0.29 J	1.0 U	2.0 U	1.0 U	2,180 J	174 J	0.20 U	1.0 U	1,190 J	5.0 U	1.0 U	1.0 U	5.0 U	3.0 J+
RDW-DW-02	581 H Avenue, Irwin, Colorado (drinking water well)	MHW302	2.0 U	2.0 U	**6.8**	35.0 J	1	1.0 U	21,300 J	0.33 J	1.0 U	2.0 U	1.0 U	1,180 J	20.8 J	0.20 U	1.0 U	841 J	5.0 U	1.0 U	1.0 U	5.0 U	2.8 J+
RDW-DW-03	581 H Avenue, Irwin, Colorado (spring)	MHW303	88.5	2.0 U	1.0 U	12.0 J	1.0 U	1.0 U	9,640 J	0.42 J	1.0 U	5.5	1.0 U	1,120 J	6.3 J	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	7.3 J+
RDW-DW-04	691 H Avenue, Irwin, Colorado	MHW304	154	2.0 U	1.0 U	10 U	1.0 U	1.0 U	7,840 J	0.43 J	1.0 U	74.3	1.0 U	1,190 J	1.2 J	0.20 U	1.0 U	500 U	5.0 U	1.0 U	1.0 U	5.0 U	10.9 J
RDW-DW-06	7th Street, Irwin, Colorado	MHW306	2.0 U	2.0 U	0.38 J	147 J	1.0 U	1.0 U	24,000 J	0.88 J	1.0 U	2.0 U	1.0 U	713 J	1.0 U	0.20 U	1.0 U	500 U	0.51 J	1.0 U	1.0 U	1.6 J	3.2 J+
RDW-DW-07	331 10th Street, Irwin, Colorado (post-filtration)	MHW307	36.0 J+	2.0 U	**19**	17	1.0 U	1.0 U	19,300	2.0 U	1.0 U	45.5	1.0 U	1,680	14.9	0.0087 J	1.0 U	878	5.0 U	1.0 U	1.0 U	5.0 U	6.5 J+
RDW-DW-28	331 10th Street, Irwin, Colorado (pre-filtration)	MHW328	23.0 J+	2.0 U	**18.1**	16.6 J	1.0 U	1.0 U	19,300 J	0.43 J	**30.9**	30.9	1.0 U	1,660 J	13.7	0.20 U	1.0 U	855 J	5.0 U	1.0 U	1.0 U	5.0 U	8.8 J+
RDW-DW-08	560 8th Street, Irwin, Colorado	MHW308	20 U	2.0 U	**0.41 J**	73.7 J	1.0 U	1.0 U	23,200 J	0.38 J	1.0 U	2.0 U	200 U	862 J	1.0 U	0.20 U	1.0 U	500 U	0.90 J	1.0 U	1.0 U	1.2 J	2.0 U
RDW-DW-24	Blind duplicate of RDW-DW-08	MHW324	20 U	2.0 U	**0.50 J**	75.5 J	1.0 U	1.0 U	22,900 J	0.39 J	1.0 U	2.0 U	1.0 U	847	1.0 U	0.20 U	1.0 U	500 U	0.94 J	1.0 U	1.0 U	0.98 J	2.2 J+
RDW-DW-10	151 H Avenue, Irwin, Colorado	MHW310	21.7 J+	2.0 U	**15**	40.8 J	1.0 U	1.0 U	29,900 J	0.38 J	1.0 U	2.0 U	1.0 U	664 J	31.6 J	0.20 U	1.0 U	518 J	1.4 J	1.0 U	1.0 U	5.0 U	3.7 J+
RDW-DW-15	795 County Road 826A, Irwin, Colorado	MHW315	20 U	2.0 U	**32.1**	28.1 J	1.0 U	1.0 U	17,400 J	0.37 J	1.0 U	2.0 U	1.0 U	2,140 J	49.2 J	0.20 U	1.0 U	2,190 J	5.0 U	1.0 U	1.0 U	5.0 U	2.0 U
RDW-DW-25	Blind duplicate of RDW-DW-15	MHW325	20 U	2.0 U	**31.8**	28.1 J	1.0 U	1.0 U	17,100 J	0.34 J	1.0 U	2.0 U	1.0 U	2,110 J	48.3 J	0.20 U	1.0 U	2,210 J	5.0 U	1.0 U	1.0 U	5.0 U	2.5 J+

TABLE 12

ANALYTICAL DATA SUMMARY FOR DISSOLVED METALS IN GROUNDWATER SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	Location	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
			Results in micrograms per liter (µg/L)																				
RDW-DW-27 (Background)	P.O. Box 3532 (7th Street), Irwin, Colorado	MHW327	2.0 U	2.0 U	**0.90 J**	81.3 J	1.0 U	1.0 U	18,000 J	0.40 J	1.0 U	22.6	1.0 U	1,320 J	1.0 U	0.20 U	1.0 U	1,070	0.38 J	1.0 U	1.0 U	5.0 U	9.0 J+
RDW-DW-26 (Background)	Blind duplicate of RDW-DW-27	MHW326	2.0 U	2.0 U	**0.78 J**	81.8 J	1.0 U	1.0 U	17,900 J	0.38 J	1.0 U	36.9	1.0 U	1,300 J	1.0 U	0.20 U	1.0 U	1,060 J	5.0 U	1.0 U	1.0 U	5.0 U	11.4 J
SCDM MCL			NE	6	10	2,000	4	5	NE	100	NE	1,300	15	NE	NE	2	NE	NE	50	NE	2	NE	NE
SCDM RfD			10,000	6	4	3,000	30	7	NE	40	4	600	NE	NE	2,100	4	300	NE	70	70	0.1	100	4,000
SCDM CR			NE	NE	0.4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Notes:

Bold value exceeds at least one health-based benchmark.
Shaded cell indicates a concentration that exceeds three times the background concentration or the background sample's Contract Required Detection Limit if non-detect in the background samples.

CR	Cancer risk screening concentration
CLP	Contract Laboratory Program
ID	Identification
J	The associated numerical value is an estimated quantity
J+	The associated numerical value is an estimated quantity; the result may be biased high
NE	Not established
RfD	Reference dose screening concentration
SCDM	Superfund Chemical Data Matrix (EPA 2014)
U	Analyte not detected above the reporting limit

TABLE 13

ANALYTICAL DATA SUMMARY FOR QUALITY ASSURANCE/QUALITY CONTROL SAMPLES
RUBY DISTRICT WEST SITE, CRESTED BUTTE, COLORADO

Sample location ID	CLP Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Thallium	Vanadium	Zinc
		Results in micrograms per liter (µg/L)																				
RDW-FB-1	MHWFB1	20 U	2.0 U	0.57 J	12.9	1.0 U	1.0 U	10,600	2.0 U	1.0 U	4.3	1.0 U	2,320	1.0 U	0.20 U	1.0 U	767	5.0 U	1.0 U	1.0 U	0.54 J	7.5
RDW-FB-2	MHWFB2	20 U	2.0 U	0.49 J	13	1.0 U	1.0 U	10,600	2.0 U	1.0 U	4.1	1.0 U	2,320	1.0 U	0.20 U	1.0 U	760	5.0 U	1.0 U	1.0 U	0.57 U	7.4
RDW-SW-02	MHWFB3	20 U	2.0 U	1.0 U	13.2	1.0 U	1.0 U	10,800	2.0 U	1.0 U	4.1	1.0 U	2,440	1.0 U	0.20 U	1.0 U	872	5.0 U	1.0 U	1.0 U	0.55 J	9.1 J+
RDW-SW-03	MHWFB4	20 U	2.0 U	1.0 U	13.1	1.0 U	1.0 U	10,600	2.0 U	1.0 U	4	1.0 U	2,420	1.0 U	0.20 U	1.0 U	887	5.0 U	1.0 U	1.0 U	5.0 U	8.7 J+
RDW-SW-01	MHWRB1	20 U	2.0 U	0.61 J	13.1	1.0 U	1.0 U	10,700	2.0 U	1.0 U	4.2	1.0 U	2,350	1.0 U	0.20 U	1.0 U	768	5.0 U	1.0 U	1.0 U	5.0 U	7.4

Notes:

CLP Contract Laboratory Program
ID Identification
J The associated numerical value is an estimated quantity
J- The associated numerical value is an estimated quantity but the result may be biased low
U Analyte not detected above the reporting limit

TABLE 14

**THREATENED AND ENDANGERED SPECIES
RUBY DISTRICT WEST SITE
CRESTED BUTTE, COLORADO**

Common Name	Scientific Name	Status
Bonytail chub	*Gila elegans*	Federally Endangered
Colorado Pikeminnow	*Ptychocheilus lucius*	Federally Endangered
Humpback Chub	*Gila cypha*	Federally Endangered
Razorback Sucker	*Xyrauchen texanus*	Federally Endangered
Uncompahgre Fritillary Butterfly	*Boloria acrocnema*	Federally Endangered
Yellow-billed Cuckoo	*Coccyzus americanus*	Federally threatened
Greenback cutthroat trout	*Oncorhynchus clarki stomias*	Federally threatened
Canada Lynx	*Lynx canadensis*	Federally threatened
Boreal Toad	*Bufo boreas boreas*	State Endangered
Least Tern	*Sterna antillarum*	State Endangered
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	
Plains Minnow	*Hybognathus placitus*	State Endangered
Rio Grande Sucker	*Catostomus plebeius*	State Endangered
Southern Redbelly Dace	*Phoxinus erythrogaster*	State Endangered
Suckermouth Minnow	*Phenacobius mirabilis*	State Endangered
Gray Wolf	*Canis lupus*	State Endangered
Grizzly Bear	*Ursus arctos*	State Endangered
Kit Fox	*Vulpes macrotis*	State Endangered
Wolverine	*Gulo gulo*	State Endangered

Source: United States Fish & Wildlife Service 2014b, IPaC 2015, Colorado Wildlife and Parks 2105

FIGURES

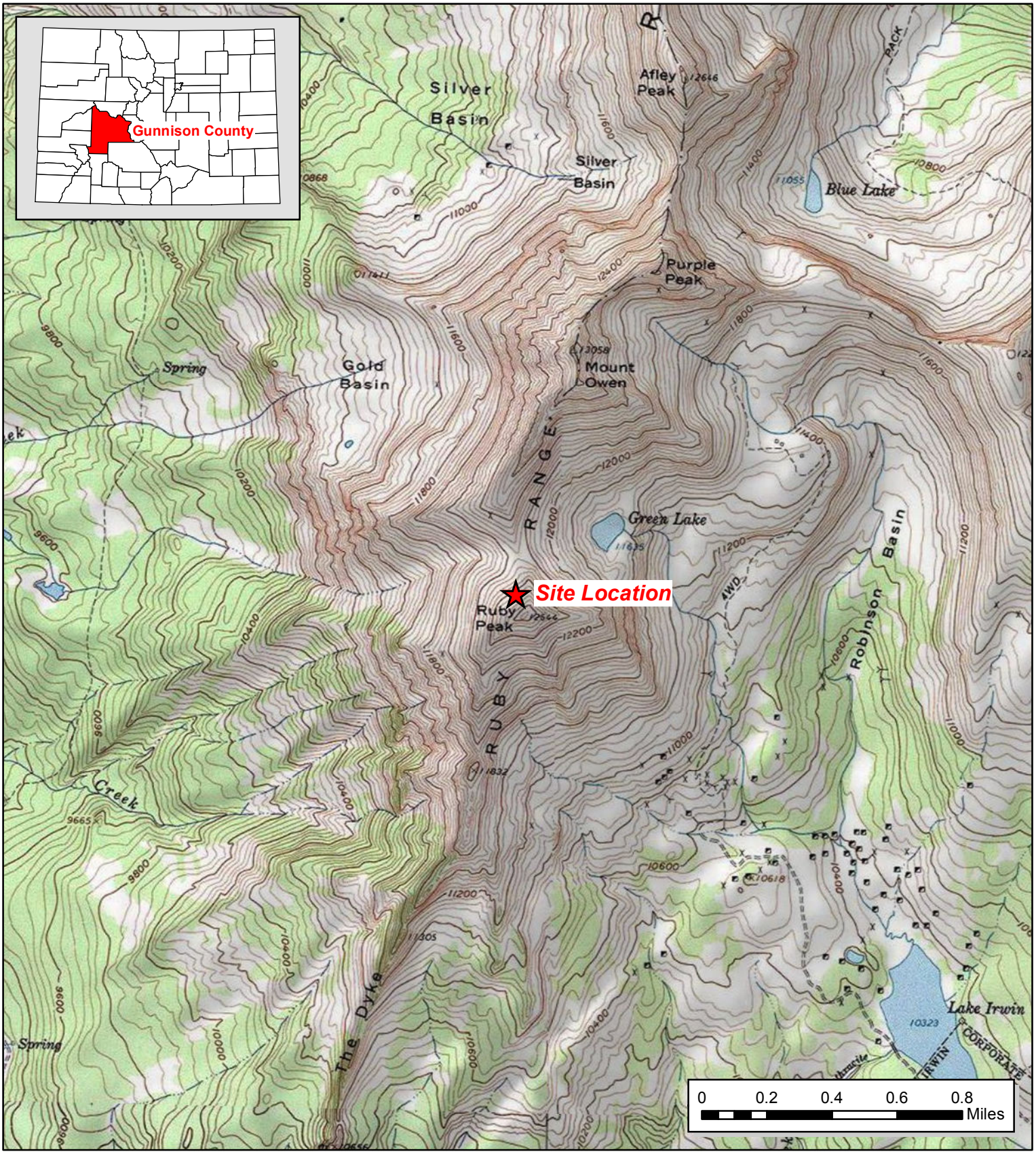

Figure 1
Site Location Map

Ruby District West
Crested Butte, Colorado

Seagull Environmental Technologies, Inc.

Source: USGS Oh-be-joyful, CO 7.5 Minute Topo Quad, 1973;
USGS Marcellina Mountain, CO 7.5 Minute Topo Quad, 1973

Date: November 2014

Project No: EPS81105.0015

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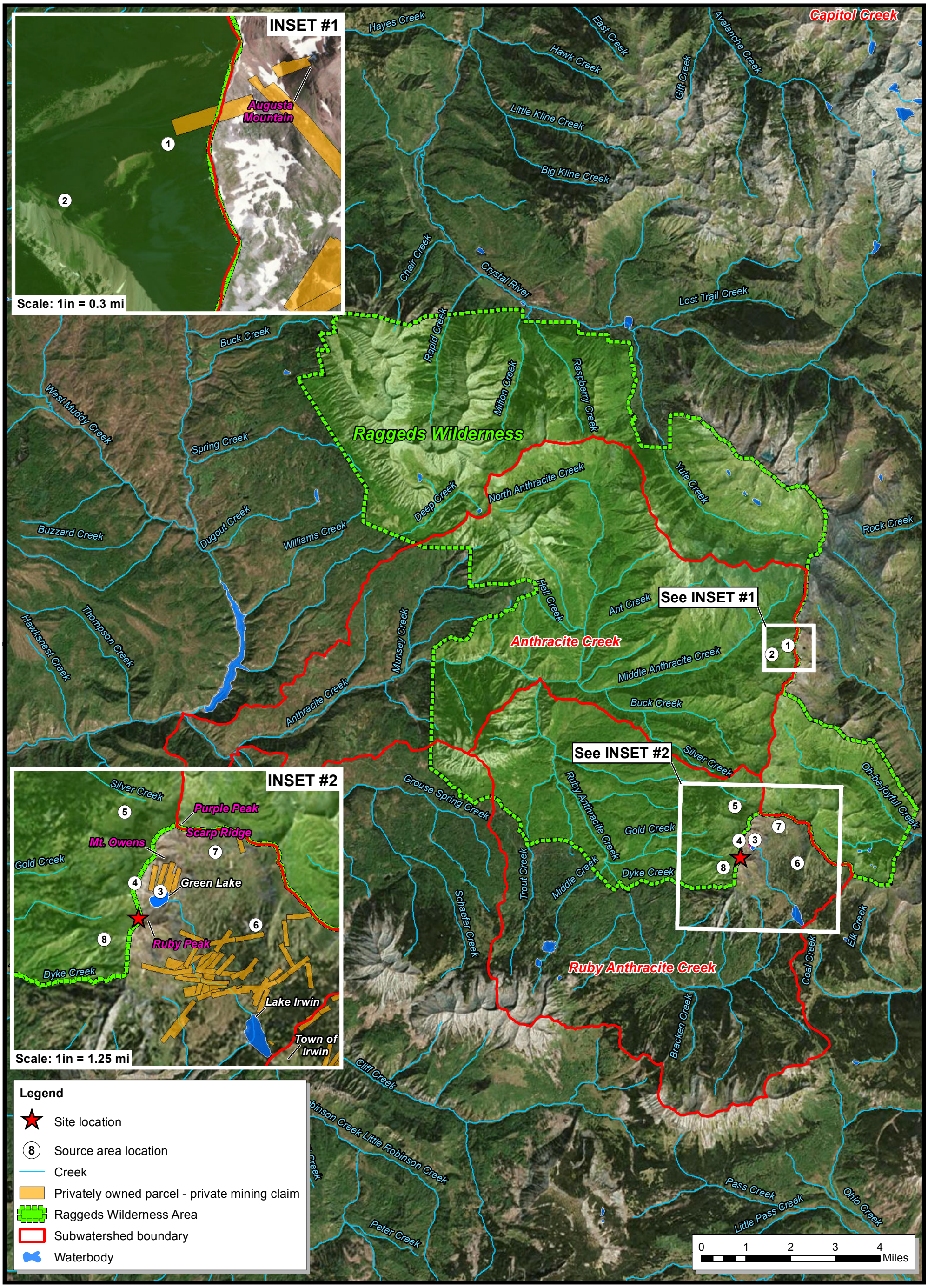

Figure 2
Site Layout Map

Ruby District West
Crested Butte, Colorado

Seagull Environmental Technologies, Inc.

Date: November 2014 Source: ArcGIS Online Imagery, 2013; HSIP, 2007; URS, Source Area Map, 2000; USGS, NHDPlus, 2013 Project No: EPS81105.0015

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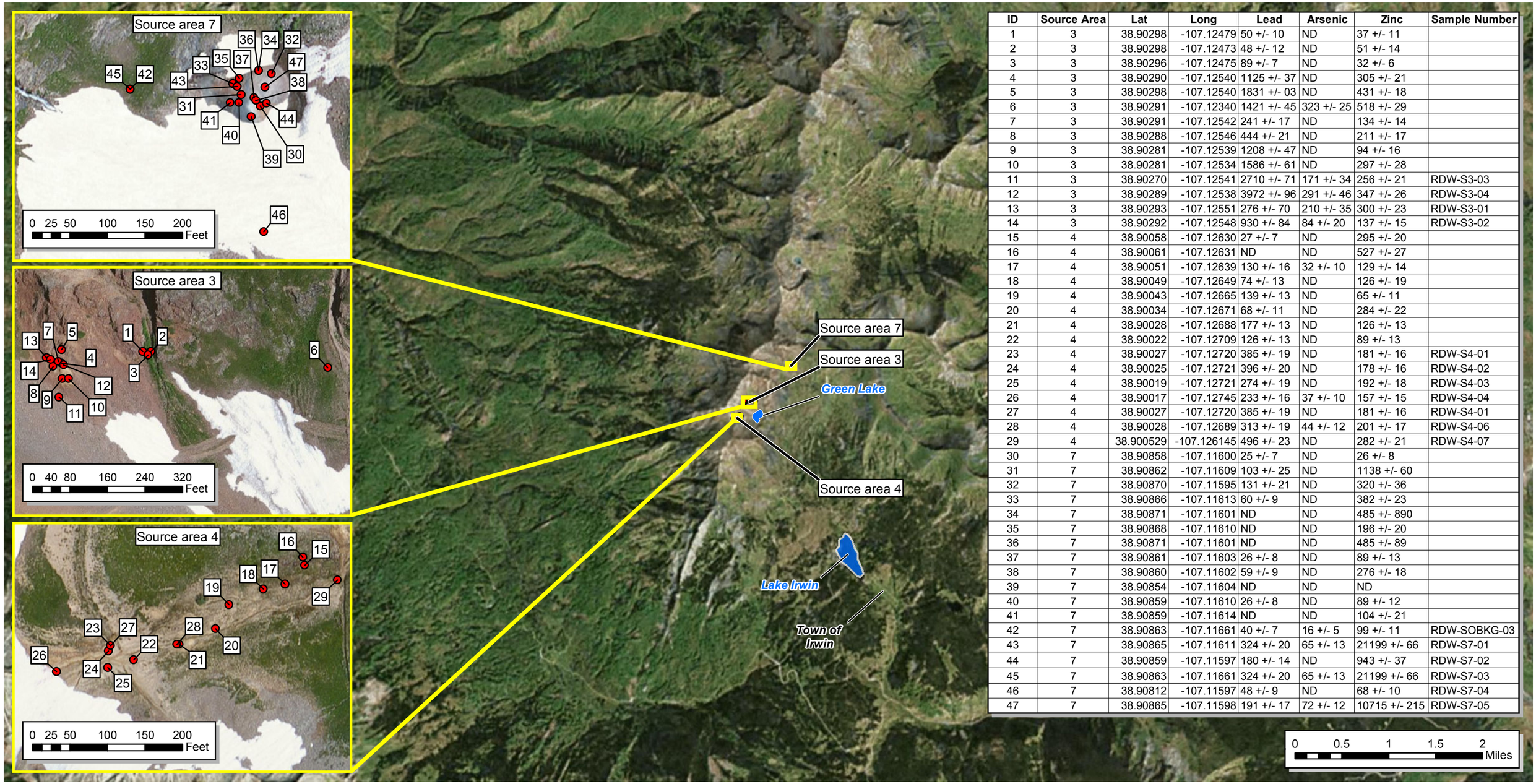

ID	Source Area	Lat	Long	Lead	Arsenic	Zinc	Sample Number
1	3	38.90298	-107.12479	50 +/- 10	ND	37 +/- 11	
2	3	38.90298	-107.12473	48 +/- 12	ND	51 +/- 14	
3	3	38.90296	-107.12475	89 +/- 7	ND	32 +/- 6	
4	3	38.90290	-107.12540	1125 +/- 37	ND	305 +/- 21	
5	3	38.90298	-107.12540	1831 +/- 03	ND	431 +/- 18	
6	3	38.90291	-107.12340	1421 +/- 45	323 +/- 25	518 +/- 29	
7	3	38.90291	-107.12542	241 +/- 17	ND	134 +/- 14	
8	3	38.90288	-107.12546	444 +/- 21	ND	211 +/- 17	
9	3	38.90281	-107.12539	1208 +/- 47	ND	94 +/- 16	
10	3	38.90281	-107.12534	1586 +/- 61	ND	297 +/- 28	
11	3	38.90270	-107.12541	2710 +/- 71	171 +/- 34	256 +/- 21	RDW-S3-03
12	3	38.90289	-107.12538	3972 +/- 96	291 +/- 46	347 +/- 26	RDW-S3-04
13	3	38.90293	-107.12551	276 +/- 70	210 +/- 35	300 +/- 23	RDW-S3-01
14	3	38.90292	-107.12548	930 +/- 84	84 +/- 20	137 +/- 15	RDW-S3-02
15	4	38.90058	-107.12630	27 +/- 7	ND	295 +/- 20	
16	4	38.90061	-107.12631	ND	ND	527 +/- 27	
17	4	38.90051	-107.12639	130 +/- 16	32 +/- 10	129 +/- 14	
18	4	38.90049	-107.12649	74 +/- 13	ND	126 +/- 19	
19	4	38.90043	-107.12665	139 +/- 13	ND	65 +/- 11	
20	4	38.90034	-107.12671	68 +/- 11	ND	284 +/- 22	
21	4	38.90028	-107.12688	177 +/- 13	ND	126 +/- 13	
22	4	38.90022	-107.12709	126 +/- 13	ND	89 +/- 13	
23	4	38.90027	-107.12720	385 +/- 19	ND	181 +/- 16	RDW-S4-01
24	4	38.90025	-107.12721	396 +/- 20	ND	178 +/- 16	RDW-S4-02
25	4	38.90019	-107.12721	274 +/- 19	ND	192 +/- 18	RDW-S4-03
26	4	38.90017	-107.12745	233 +/- 16	37 +/- 10	157 +/- 15	RDW-S4-04
27	4	38.90027	-107.12720	385 +/- 19	ND	181 +/- 16	RDW-S4-01
28	4	38.90028	-107.12689	313 +/- 19	44 +/- 12	201 +/- 17	RDW-S4-06
29	4	38.900529	-107.126145	496 +/- 23	ND	282 +/- 21	RDW-S4-07
30	7	38.90858	-107.11600	25 +/- 7	ND	26 +/- 8	
31	7	38.90862	-107.11609	103 +/- 25	ND	1138 +/- 60	
32	7	38.90870	-107.11595	131 +/- 21	ND	320 +/- 36	
33	7	38.90866	-107.11613	60 +/- 9	ND	382 +/- 23	
34	7	38.90871	-107.11601	ND	ND	485 +/- 890	
35	7	38.90868	-107.11610	ND	ND	196 +/- 20	
36	7	38.90871	-107.11601	ND	ND	485 +/- 89	
37	7	38.90861	-107.11603	26 +/- 8	ND	89 +/- 13	
38	7	38.90860	-107.11602	59 +/- 9	ND	276 +/- 18	
39	7	38.90854	-107.11604	ND	ND	ND	
40	7	38.90859	-107.11610	26 +/- 8	ND	89 +/- 12	
41	7	38.90859	-107.11614	ND	ND	104 +/- 21	
42	7	38.90863	-107.11661	40 +/- 7	16 +/- 5	99 +/- 11	RDW-SOBKG-03
43	7	38.90865	-107.11611	324 +/- 20	65 +/- 13	21199 +/- 66	RDW-S7-01
44	7	38.90859	-107.11597	180 +/- 14	ND	943 +/- 37	RDW-S7-02
45	7	38.90863	-107.11661	324 +/- 20	65 +/- 13	21199 +/- 66	RDW-S7-03
46	7	38.90812	-107.11597	48 +/- 9	ND	68 +/- 10	RDW-S7-04
47	7	38.90865	-107.11598	191 +/- 17	72 +/- 12	10715 +/- 215	RDW-S7-05

Legend

- XRF in situ screening location (July 14th and 15th, 2014)
- ND Not detected
- XRF X-ray fluorescence

Seagull Environmental Technologies, Inc.

Figure 3
XRF In Situ Screening Locations and Results Map

Ruby District West
Crested Butte, Colorado

N
W E
S

Date: November 2014

Source: ESRI Online Maps, World Imagery, 2013; URS, Area of Influence Map, 1999

Project No: EPS81105.0015

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Figure 4
Surface Soil Sample Location Map

Ruby District West
Crested Butte, Colorado

Seagull Environmental Technologies, Inc.

N
W
E
S

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Date: November 2014

Source: ArcGIS Online, World Imagery, 2011; URS, Sample Location Map, 1999; USGS, NHDPlus, 2013

Project No: EPS81105.0015

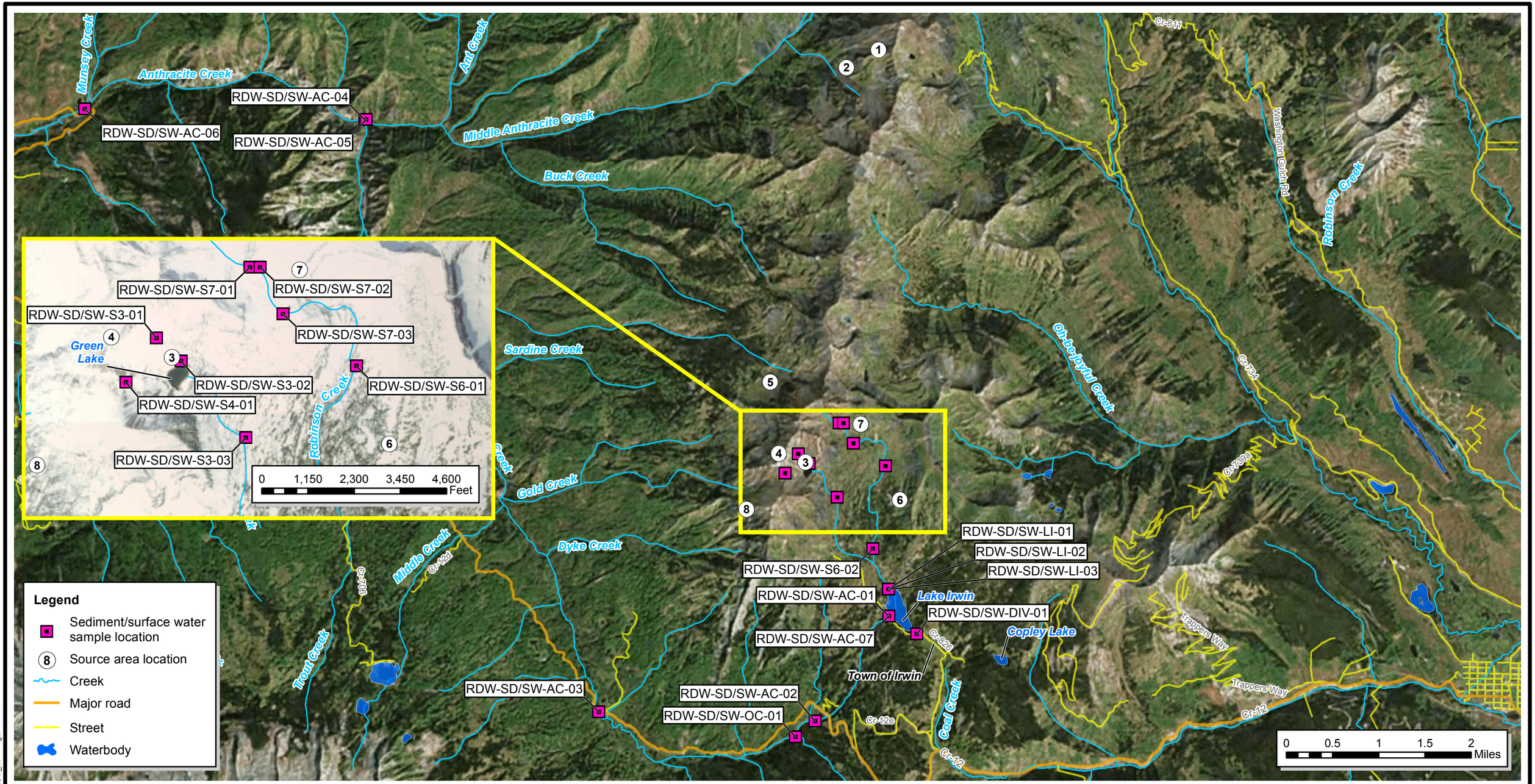

Figure 5
Sediment and Surface Water Sample Location Map

Ruby District West
Crested Butte, Colorado

Seagull Environmental Technologies, Inc.

N
W
E
S

X:\S\2722\0015_Ruby_Mining_District_West\Projects\mxd\Oct_2014\Figure5.mxd

Date: November 2014

Source: ArcGIS Online, World Imagery, 2011; HSIP Gold, 2007; URS, Sample Location Map, 1999; USGS, NHDPlus, 2013

Project No: EPS81105.0015

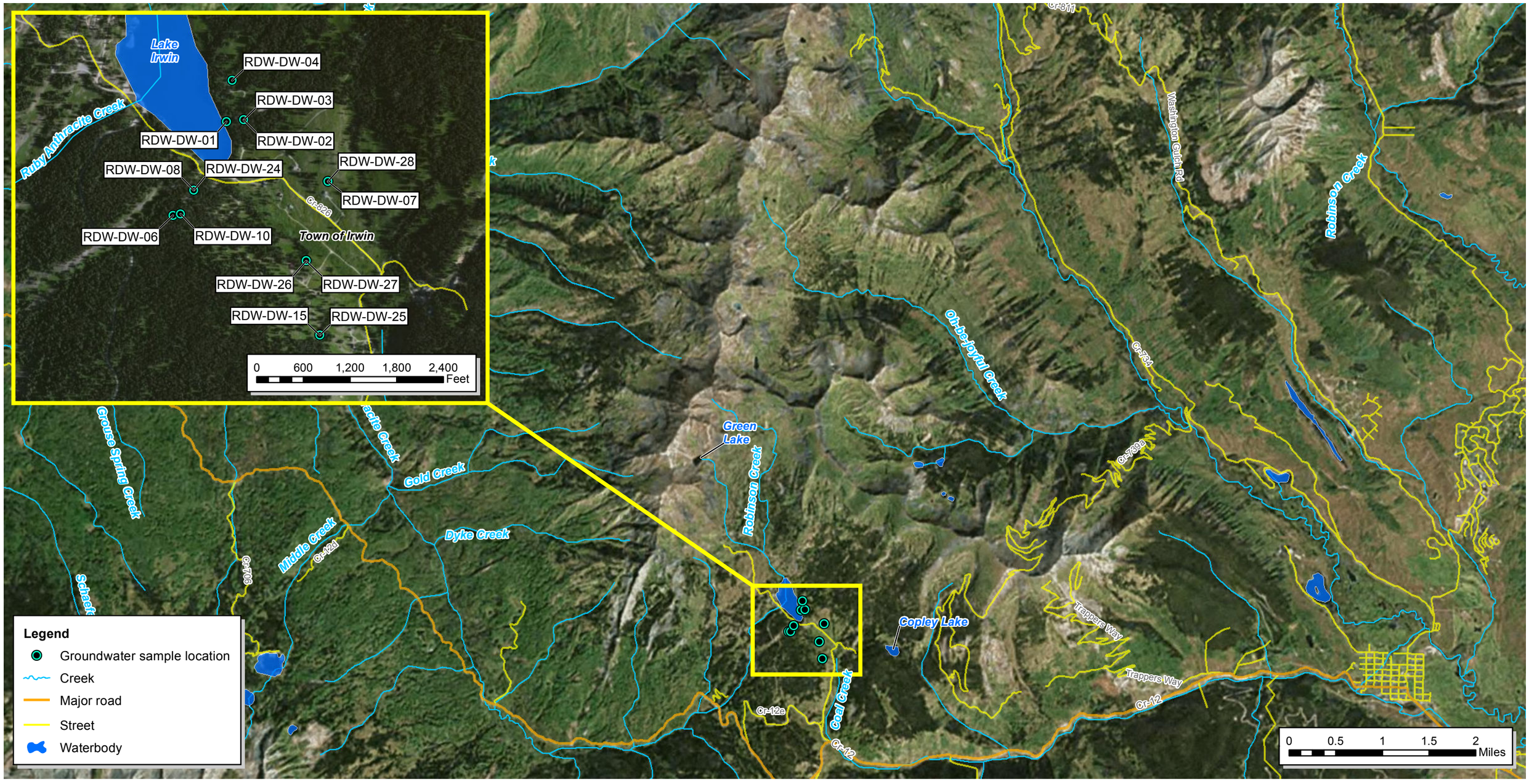

Figure 6
Groundwater Sample Location Map

Ruby District West
Crested Butte, Colorado

N
W E
S

Seagull Environmental Technologies, Inc.

Date: November 2014

Source: ArcGIS Online, World Imagery, 2011; HSIP Gold, 2007; URS, Sample Location Map, 1999; USGS, NHDPlus, 2013

Project No: EPS81105.0015

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Figure 7
4-Mile Groundwater Radius Map

Ruby District West
Crested Butte, Colorado

Seagull Environmental Technologies, Inc.

Date: November 2014

Source: ArcGIS Online, World Imagery, 2011; HSIP Gold, 2007; Colorado Division of Water Resources, Water Well Applications, 2013; USGS, NHDPlus, 2013

Project No: EPS81105.0015

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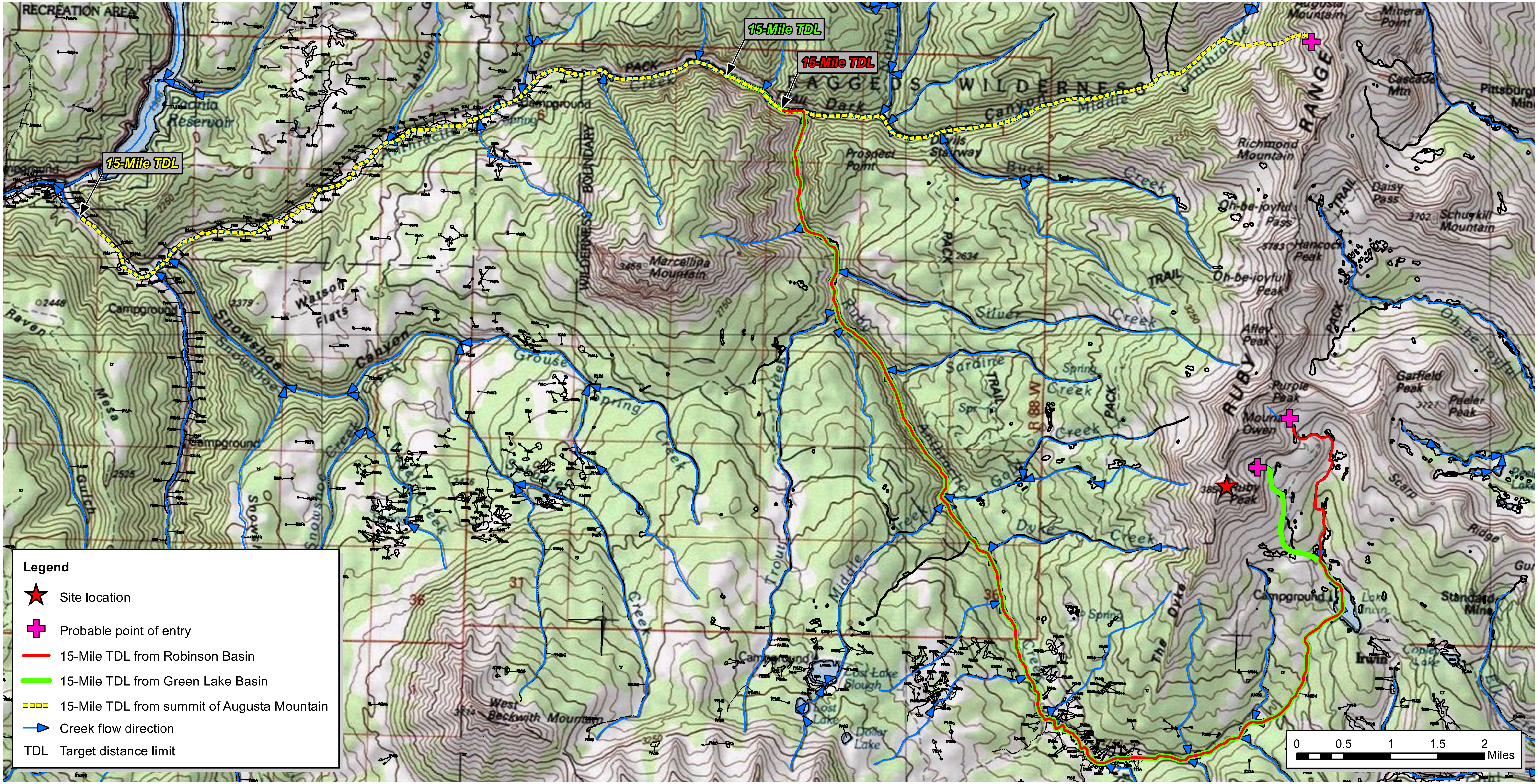


Figure 8
Area of Influence and 15-Mile TDL Map

Ruby District West
Crested Butte, Colorado

N W E S

Seagull Environmental Technologies, Inc.

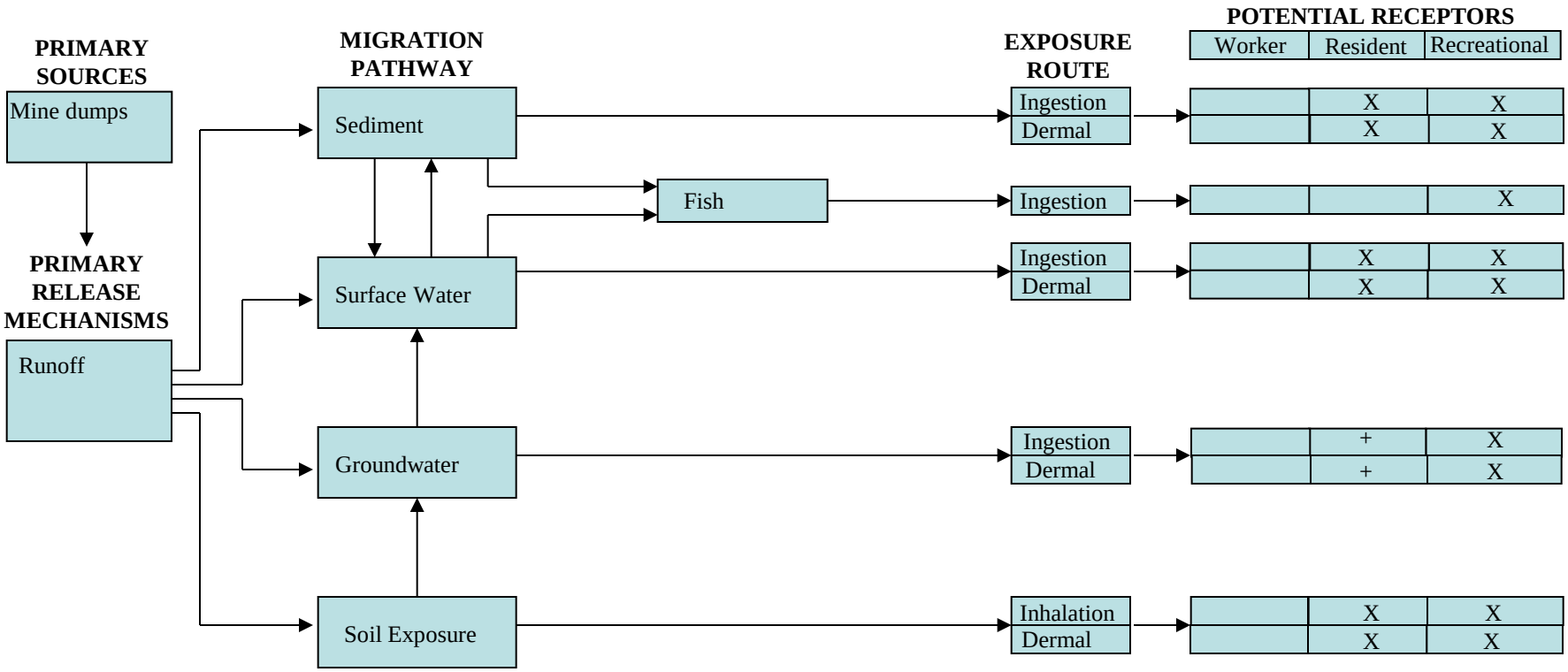
X:\S\2722\0015_Ruby_Mining_District_West\Projects\mxd\Oct_2014\Figure8.mxd

Date: November 2014 | Source: URS, Area of Influence Map, 1999; USGS, CO 7.5 Minute Topo Quads; USGS, NHDPlus, 2013; USFWS, NWI, 2013 | Project No: EPS81105.0015

APPENDIX A

CONCEPTUAL SITE MODEL

SITE CONCEPTUAL MODEL
RUBY DISTRICT WEST
CRESTED BUTTE, COLORADO

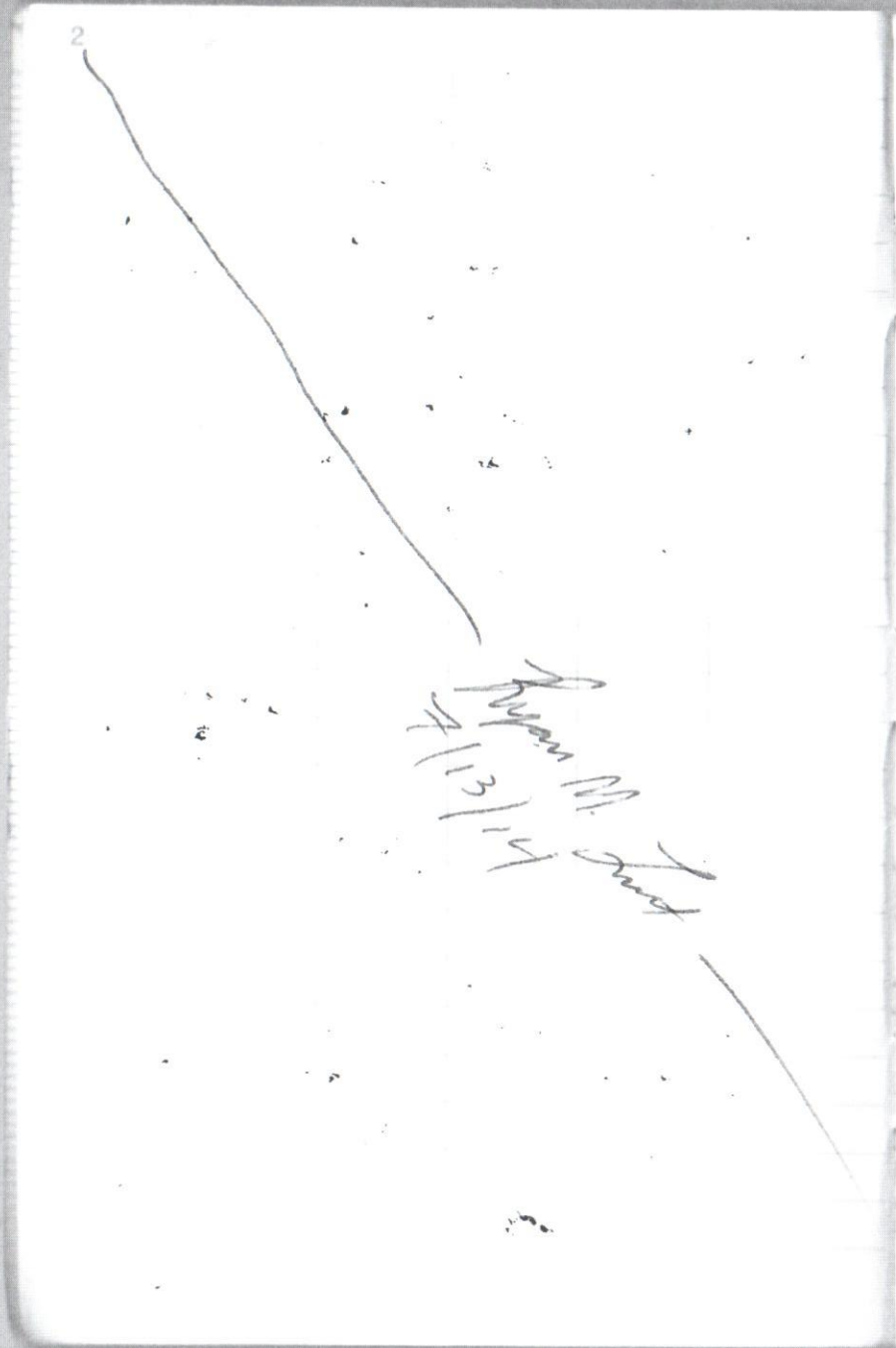


Legend

	No evaluation required.
O	Pathway is not complete.
X	Pathway is or might be complete but is judged to be minor.
+	Pathway is or might be complete and could be significant.

APPENDIX B

LOGBOOK



JULY 13, 2014 RDW SAMPLE EVENT

11:00 - DEPART GUNNISON. DRIVE TO CR 12 IN CRESTED BUTTE, THEN WEST

11:45 - ARRIVE TO SITE RDW-SW/SD-AC-02. WEATHER IS CLEAR, SUNNY 79°F.

1150 - CONDUCTED TAILGATE MEETING. CALIBRATED YSI USING CALIBRATION SOLUTIONS:

BUFFER pH 4.0 @ 25°C
pH 7.0 @ 25°C
pH 10.0 @ 25°C

CONDUCTIVITY STANDARD
1409 µMho/cm @ 25°C

1240 ARRIVE TO RDW-SW/SD-AC-0

LAT: 038.85915° N
LONG: 107.12400° W
PHOTO # 1: UPSTREAM
PHOTO # 2: DOWNSTREAM
WATER QUALITY: TEMP: 14.51°C
COND: 0.039 mS/cm D.O.: 8.06 mg/L (79%)
pH: 5.19
-154.3 ORP

→

July 13, 2014 RDW SAMPLE EVENT

1258 - COLLECTED ~~SOIL/SEDIMENT~~ SEDIMENT & WATER SAMPLES
CLP # SW = MHW410, D = MHW510
CLP # SD = MHS110

1315: ARRIVE AT SITE RDW-SW/SD-AC-02
LAT: 38.86171° N
LONG: 107.12015° W
PHOTO # 3: UPSTREAM PHOTO #5: UP
PHOTO #4: DOWNSTREAM
WATER QUALITY: TEMP: 16.33°C
COND: 0.046 mS/cm
D.O.: 7.75 mg/L (79.2%)
pH: 5.39 ORP: -162.0

1325: COLLECTED SEDIMENT AND WATER SAMPLES
CLP # SW = MHW402, D = MHW502
CLP # SD = MHS102

1400: ARRIVE TO SITE RDW-SW/SD-AC-03
LAT: 38.86233° N
LONG: 107.16555° W

July 13, 2014 RDW sample event

RDW-SW/SD-AC-03 CONTINUED
PHOTO #6: DOWNSTREAM
PHOTO #7: UPSTREAM
NOTE ONE FISHERMAN IN STREAM WITH SEVERAL FISH KEPT
WATER QUALITY: TEMP: 16.29°C
COND: 0.057 mS/cm
D.O.: 7.45 mg/L (80.1%)
pH: 5.55 ORP: -177.1
1420: COLLECTED SEDIMENT AND WATER SAMPLES
CLP# SW=MWH403, D=MWH503; SD=MHS103
1745: ARRIVE TO RDW-SW/SD-AC-05.
LAT: 38.95439°N
LONG: 107.21310
WATER QUALITY: TEMP: 12.78°C
COND: 0.084 mS/cm D.O.: 9.23 mg/L (87.1%) pH: 5.42 ORP: -185.5
PHOTO #8: UPSTREAM
PHOTO #9: DOWNSTREAM
1755: COLLECTED SEDIMENT AND WATER SAMPLES
CLP# SW=MHW405, D=MHW505; SD=MHS105

July 13, 2014 RDW Sample Event

1800: ARRIVE TO RDW-SW/SD-AC-04
LAT: 38.95435°N
LONG: 107.21339°W
WATER QUALITY: 18.14°C - TEMP.
COND.: 0.063 mS/cm
D.O.: 7.79 mg/L (92.4%)
pH: 7.45 ORP: -251.7
PHOTO #10: UPSTREAM
PHOTO #11: DOWNSTREAM
1810: COLLECTED SEDIMENT AND WATER SAMPLES
CLP #: SW=MHW504, D=MHW504
SD=MHS104
1945: ARRIVE BACK TO VEHICLE; OFFSITE, END OF DAY

End of Day

July 14, 2014 RDW SAMPLE EVENT

0815: ARRIVE TO RDW-SW/SD-AC-06
CONDUCTED TAILGATE MEETING
0820: CALIBRATED YSI USING CALIBRATION SOLUTIONS:
BUFFER pH 4.0 @ 25°C
pH 7.0 @ 25°C
pH 10.0 @ 25°C
CONDUCTIVITY STANDARD: 1409 µmho/cm @ 25°C.
0825: RDW-SW/SD-AC-06; CLP SW/SED HG D=SED
LAT: 38.95494° N
LONG: 107.26965° W CLP SED/MHS 10:10
WATER QUALITY: TEMP: 10.71°C
COND: 4.158 mS/cm (APPEARS UNUSUALLY HIGH - PERHAPS CALIBRATION ERROR)
D.O 9.66 mg/L (88.8%)
pH = 6.13 ORP: -186.2
SUBSTRATE IS ~ 70% 2-6" COBBLE
30% BOULDER ≥ 6"
0855: COLLECTED SEDIMENT AND WATER SAMPLES. MATRIX SPIKE. HAND TROWEL & PAN DECONTAMINATED.
0915 - Depart for Lake Irwin.
1015 - Arrive at Lake Irwin - prepare to sample and decon sampling equipment.

July 14, 2014

1040 - Collect RDW-SW/SD-AC-01 & AC-07 LAT: 39.87644 LONG: 107.10584
TEMP: 14.27°C PH: 5.72
COND: 2.650 ORP: -167.3
DO: 7.30 mg/L (72.8%)
Sample AC-07 Blind Duplicate
Photo # 12 & 13
GLP: SW = MHW401 D = MHW501; SD = MHS101, MHS107
1140: ARRIVE TO RDW-SW/SD-21-01
LAT:
LONG:
WATER QUALITY: TEMP 8.96°C
COND 2.621 mS/cm DO 10.04 mg/L
PH 6.34 ORP -244.8
SEDIMENT/SUBSTRATE AT SITE IS UNCONSOLIDATED SAND & SILT.
1150: COLLECTED SEDIMENT & WATER SAMPLES. Collect Duplicate & MS.
GLP: SW = MHW408 D = MHW508. SW = MHW409, 509
PHOTO # 13 & 14, SD = MHS108, 109
1415: ARRIVED TO RDW-SW/SD-SI-02 (PPE). MET LANDOWNER JOHN DENEYS ON-SITE.

July 14, 2014

LAT: 38.90855°N
LONG: 107.11581°W
1425: RYAN WENT CALIBRATING XRF
WATER QUALITY: TEMP: 3.28°C
D.O.: 11.37mg/L COND.: 2.274ms/cm
pH: 6.95 ORP: -300.2
PHOTOS# 15-17
1435: COLLECTED SEDIMENT AND WATER SAMPLES (MS) @ RDW-57-02, LLP
1440: ARRIVE TO RDW-52/SD-57.01
LAT:
LONG:
WATER QUALITY: TEMP: 2.90°C
COND: 0.751 mS/cm D.O.: 10.27mg/L (76.0%) pH: 4.35 ORP: 209.0
PHOTOS# 18 & 19-23
~~1445: COLLECTED SEDIMENT AND WATER SAMPLES UNABLE TO COLLECT SEDIMENT SAMPLE. SUBSTRATE IS LARGE COBBLE. NO SEDIMENT PRESENT. COLLECTED SOIL SAMPLE.~~

July 14, 2014 Collect sample RDW-SD-57-02
CLP: SW: MH417, SED17 SD: MHS119

1445: SEDIMENT CONSISTS of LARGE COBBLE. VERY LITTLE SEDIMENT PRESENT. COLLECTED SEDIMENT & WATER SAMPLES.

1455: DECON SAMPLE EQUIPMENT. COLLECTING SOURCE AREA #7 SOIL SAMPLES.

1458: Collect Soil sample RDW-SOIL-03
CLP# MHS127
LONG:
LAT:

1503 Collect Soil sample RDW-57-01, RDW-57-03
CLP# MHS025
LAT:
LONG:
Duplicate Sample collected

1507 Collect Soil sample RDW-57-02 (MS)
CLP# MHS026
LAT:
LONG:

1509 Collect Soil sample RDW-57-04
LAT: LONG
CLP: MHS026

1513 Collect Soil sample RDW-57-05
LAT: LONG:
CLP# MHS029

July 14 2014

1545 ARRIVE TO SITE RDW-SW/SD-ST-03
LAT: 38.90538
LONG: 107.11372
WATER QUALITY: TEMP: 4.18°C
COND: 1.833 mS/cm D.O.: 9.71 mg/L
(75.1%) pH: 4.66 ORP: 205.3
SUBSTRATE CONSISTS OF 50%
1-3" COBBLE, 30% GRAVEL
AND ~20% FINES.
SITE IS BELOW MODERATE SNOW
FIELD & SMALL FRINGE
WETLANDS. PHOTOS ± 24 & 25
1555 COLLECTING SEDIMENT &
WATER SAMPLES. HAND
TROWEL DECONNED
CLP #
1615 Depart Source Area # 7,
En Route to CAMpground Irwin
1700 ARRIVE @ Campground unload
& package Equipment, finish
paperwork
1745 END OF Day

Ryan M. Lunt

July 15, 2014 RDW SAMPLE EVENT

WEATHER: Partly Cloudy, 55~
Forcast calls for 60% rain in afternoon
0730 Depart camp site, start hiking to Source Area #3, 4
0906 Arrive at Green Lake near source area 3 & 4,
Calibrate YSI & XRF,
DECON Sampling trowels for Sediment/Soil
0930 SEAgull Greg Dillon starts collecting water Quality parameters at RDW-53-01 (Background): TEMP: 3.25°C
COND: 1.162 DO: 13.11 mg/L
pH 4.5 ORP -209.8

0935 Collect ~~Soil~~ Rd. Sediment/Surface water Samples @ RDW-53-01
CLP #
LAT: Long:

0936 SEAgull Ryan Lunt Shooting potential migration pathway to Source Area #3 from the unnamed creek. SEE XRF Reading in back of logbooks Also due to steep incline and Loose Rocks FEW XRF readings were taken

0955 SEAgull collect Soil SAMPLE RDW-53-01
CLP #
LAT. Long:

July 15, 2014 RDW SAMPLE EVENT

0958 SEAgull collect RDW-53-02
CLP #
LAT Long:

1010 SEAgull collect RDW-53-03
CLP #
LAT Long
This sample reflects overland migration pathway.

1020 SEAgull collect RDW-53-04
CLP #
LAT: Long:
This sample reflect overland migration pathway

1040 SEAgull Ryan Lunt heading to source area #4.

1100 SEAgull Dillon ~~does not~~ R.L. Arrives ~~collects~~ Rich @ sample RDW-SW/SD-53-02 @ Green Lake. It should be noted that NO PPE was identified from the unnamed creek to Green Lake. ~~CLP #~~ R.L. SEAgull Dillon collects Water quality parameters from Green Lake. TEMP: 2.69 COND: 2.42e ~~TEMP~~ RL: DO: 9.99 mg/L pH: 5.5 ORP: -269.9

July 15, 2014 RDW Sample Event

1110 SEAgull collects Surface Water & Sediment @ RDW-SD/SW-53-02
CLP #
LAT: Long

1130 SEAgull Ryan Lunt arrive @ ~~RDW-54~~ R.L. Source Area #4. Majority of source area #4 covered in snow, but some tailings are visible. SEAgull Ryan Lunt starts XRFing overland Migration pathway. SEE XRF reading in back of Logbook.

1152 Arrive @ tailing @ Source Area #4 Began XRF tailing.

1200 SEAgull Ryan Lunt collects RDW-54-01 and Duplicate Sample RDW-54-05

1204 SEAgull Ryan Lunt identifies a pipe coming out of tailing & water is being discharged into unnamed creek.

1200 SEAgull Ryan Lunt collects Surface Water & Sediment samples from unnamed creek below the pipe. No water Quality parameters were collected @ the Location.
RDW-SW/SD-54-01 & -05
CLP #
LAT: Long:

July 15, 2014 RDW Sampling Event

1205 Seagull Ryan Lunt collects Soil Sample RDW-S4-02 CLP#

1217 Seagull Ryan Lunt collects Soil Sample RDW-S4-03 CLP#

1220 Seagull Ryan Lunt collects Soil Sample RDW-S4-04 CLP#

1235 Seagull Ryan Lunt Collects Soil sample RDW-S4-06 CLP#
This is a overland migration pathway.

1241 Seagull Ryan Lunt Collects Soil Sample RDW-S4-07 CLP#
This is a overland migration pathway.

1255 Seagull Ryan Lunt departs Source area #4 to meet Seagull Greg Dillon @ Green Lake

1320 Seagull Ryan Lunt & Greg Dillon depart Green Lake enroute to Source area #6

July 15, 2014 RDW sampling Event

1400 Seagull Ryan Lunt & Dillon having trouble finding a route to source area #6. Too many cliffs. In addition, light rain starting to fall. Seagull Ryan Lunt make decision to collect last sample @ along Green Lake creek.

1445 Seagull arrives @ Green Lake creek RDW-SW/SD-S3-03. Dillon collects water Quality samples
TEMP: 11.42 DO: 8.90 mg/L
COND: 2.947 ORP: ~~00~~-194.9 pH: 5.18

1450 Seagull Dillon collects Surface Water and Sediment @ Green Lake creek.
CLP#
~~Lat~~: Long:

1500 Depart Location en Route to Vehicles

1520 Arrive @ vehicle and depart site En Route Gunnison to Hotel

1630 Arrive @ hotel, unload samples & begin packaging.

1800 END OF Day

Ryan M. Lunt

July 16, 2014 RDW Sample Event

WEATHER: Partly cloudy mid 50's forecast calling for 60% chance of thunderstorms.

0705 Seagull Ryan Lunt & Greg Dillon depart Lawnison's En route to Irwin, Colorado to collect Drinking water Samples.

0805 Arrive @ Town of Lake Irwin @ John Rellos residence RDW-DW-15.

0826 START Purge from Tap located inside the house.

0930 Seagull prepare sample containers & calibrate YSI.

0836 Greg Dillon collecting Water Quality parameters
Temp: 8.44°C pH: 6.91
DO: .36 mg/L COND: 0.289 ORP: -336

0841 Start collecting Samples RDW-DW-15 also collecting Duplicate Sample RDW-DW-25 collected as well.
CLP#
CLP#

0859 Depart RDW-DW-15.

0930 Seagull Ryan M. Lunt & Greg Dillon prepping drinking water

1015 Seagull meets with EPA Technical Contact John Wyatt, EPA Robyn Blackburn, Forest Service, Tara Tarif, & Coal Creek Watershed Group to show the group Ruby District West

1025 Seagull Ryan Lunt providing overview of Ruby District West.

1040 En Route to show group the town of Irwin. additional Alpine Environmental shows Seagull the Diversion from Lake Irwin to Coal Creek. Also Ryan Seagull points out Source Area

1130 En route to Private mining claim area

1255 Group is done with Ruby District West Seagull en route to collect Surface water/ Sediment Samples from Source area #6

1445 Seagull arrives @ ~~RDW-56-01~~ R.C. RDW-SW/SD-56-01. Seagull Ryan Lunt Collecting Water Quality parameters
Temp 7.60°C pH 6.10 ORP-205.3
DO: 9.43 mg/L Cond: 0.037 mg/cm

July 16, 2014

1448 SEAgull Greg Dillon collecting surface water / sediment from RDW-SW/SD-S6-01
CLP #
LAT: 39.90193 Long 107.60719

1507 SEAgull Ryan Lunt collects a background soil sample from source area #6 for HRS purposes EVEN though source samples WERE not collected for #6. All mining activities in source area #6 are on private mining claims & SEAgull does not have access to these properties.

1515 En Route to RDW-SW/SD-S6-02 to collect surface water and sediment samples

1555 Arrive @ RDW-SW/SD-S6-02 to collect SAMPLES. SEAgull Ryan Lunt collecting water Quality parameters
Temp: 10.16°C pH: 6.37
COND 0.041 ms/cm DO 8.53 mg/L ORP -241.9

1620 Arrive @ Vehicle, En Route to Gunnison

17:30 Arrive in Gunnison

July 17, 2014

forecast: Sunny - 70-85 with chance of late afternoon thunderstorms

0716 Depart Gunnison, Enroute to Crested Butte to MEET EPA Kerry Guy

0904 MEET with Kerry Guy to drop off ether

0832 Arrive @ Irwin

0835 START Purge @ RDW-DW-07 at Sink Tap

0840 SEAgull Greg Dillon calibrating YSI & prepping sample Equipment

0855 Collect Water Quality parameters
Temp: 10.01 pH 7.34
COND: 107 ms/cm DO 6.26 mg/L ORP: -198.2

0857 Collect Water sample. additional a MS is collected.

0905 Depart RDW-DW-07; En Route to RDW-DW-08

0908 Arrive @ RDW-DW-08

0914 START Purge; well is southeast of house It should be Noted that Mr. Light Brown pumped 500 gallons into the cistern.

0927 Collect Water Quality Samples from hose. Temp: 5.44 pH 7.28
ORP: -242.6 DO: 5.78 mg/L
COND: 0.093 ms/cm

July 17, 2014

0930 Collect SAMple from RDW-DW-06 & RDW-DW-24 (Duplicate)
CLP #
Well Depth 220
0-5 Clay
5-220 Hard-Shale
RED & GREEN
SANDSTONE
STREAKS

0947 Arrive @ RDW-DW-10.

0949 START Purge @ RDW-DW-10

1003 Collect Water Quality parameters @ RDW-DW-10.
Temp: 5.51°C pH 7.42 COND: ms/cm
ORP: -321.4 DO: 3.64 mg/L

1006 Collect Water SAMple from RDW-DW-10
CLP #

1020 Arrive @ RDW-DW-06. Well has no power or pump SEAGull will bail to collect surface Water

1032 collect Water Quality Parameters
Temp: 7.69 pH: 8.03
ORP: -283.6 COND: 0.018 DO: 8.47

July 17, 2014

1035 Collect Water Sample RDW-DW-06
CLP #

1110 Arrive @ RDW-DW-01.

1118 START Purge; WELL located Northwest of house. WELL @ depth of 180 ft.

1132 Collect Water quality parameters
pH. 7.61 Temp: 6.47 COND: 0.206
DO: 0.57 ORP: -283.3

1135 Collect water Sample from RDW-DW-01
CLP #

1200 Arrive @ RDW-DW-04; start Purge Spigot under Porch.

1216 Collect Water Quality Parameters @ RDW-DW-04 & water SAMple (MS)
pH 4.78 Temp 4.54 COND 0.040
ORP -166.4 DO 9.56 mg/L.

1315 Arrive @ RDW-DW-26. Granted Access & will be a background sample.
Landowner: Olivia & Brent Topper
P.O. Box 3532
Crested Butte, CO 970-390-4253
START Purge; Spigot on Northwest Side

35

33

July 17, 2014
Collect Water Sample RDW-DW-06

#
RDW-DW-01.
E; well located Northeast
ELL @ depth of 180 ft.
quality parameters
: 6.47 COND: 0.206
-283.3
S/E from

Arrive @
START
Collect purge
@

July 17, 2014
0930 Collect SAMPLE from RDW-DW-01
RDW-DW-24C (Duplicate)
CLP #
Well Depth 180
0-5 Clay
5-220 Hard SHALE/ROCK & SAND
S/E

32

APPENDIX C

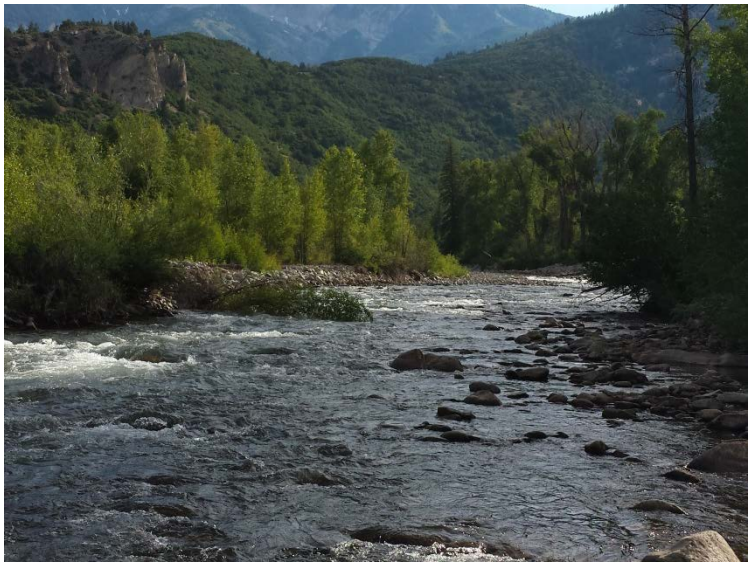
PHOTOGRAPHIC LOG

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Ryan Lunt collecting sediment sample RDW-SD-OC-01 from Ohio Creek.	Photograph Number: 1
Direction: Southeast	Photographer: Greg Dillon	Date: 7/13/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting dissolved metals sample	Photograph Number: 2
Direction: North-Northeast	Photographer: Ryan Lunt	Date: 7/13/2013

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting surface water sample RDW-SW-AC-03 from Anthracite creek.	Photograph Number: 3
Direction: Southeast	Photographer: Ryan Lunt	Date: 7/13/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of the confluence of Ruby Anthracite creek and Middle Anthracite creek.	Photograph Number: 4
Direction: South	Photographer: Ryan Lunt	Date: 7/13/2014



Client: Environmental Protection Agency Region 8	Description: Photograph of surface water/sediment sample location RDW-SW/SD-AC-06 along Anthracite creek.	Photograph Number: 5
Direction: East	Photographer: Ryan Lunt	Date: 7/14/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Ryan Lunt collecting surface water sample RDW-SW/SD-AC-01 located at the outlet outfall? from Lake Irwin.	Photograph Number: 6
Direction: South	Photographer: Greg Dillon	Date: 7/14/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting surface water sample RDW-SW-LI-01 located at near the inlet of Lake Irwin.	Photograph Number: 7
Direction: North	Photographer: Ryan Lunt	Date: 7/14/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of the Robinson Mine near source area #7 sample locations.	Photograph Number: 8
Direction: Northwest	Photographer: Ryan Lunt	Date: 7/14/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Ryan Lunt conducting X-ray fluorescence (XRF) in situ screening at the Robinson Mine.	Photograph Number: 9
Direction: North	Photographer: Greg Dillon	Date: 7/14/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting surface water sample RDW-SW-S7-02.	Photograph Number: 10
Direction: Northwest	Photographer: Ryan Lunt	Date: 7/14/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of on a mine adit located at source area #3.	Photograph Number: 11
Direction: North	Photographer: Ryan Lunt	Date: 7/15/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of source area #4 .	Photograph Number: 12
Direction: West	Photographer: Ryan Lunt	Date: 7/15/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting surface water sample RDW-SW-S3-03 located at Green Lake Creek.	Photograph Number: 13
Direction: North	Photographer: Ryan Lunt	Date: 7/15/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting dissolved metals sample at RDW-SW-S6-01 located up gradient of mining influences in source area #6.	Photograph Number: 14
Direction: South	Photographer: Ryan Lunt	Date: 7/16/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting dissolved metals sample at RDW-DW-07.	Photograph Number: 15
Direction: Northwest	Photographer: Ryan Lunt	Date: 7/17/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting dissolved metals sample at RDW-DW-10.	Photograph Number: 16
Direction: North-Northeast	Photographer: Ryan Lunt	Date: 7/13/2013

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon bailing from sample location RDW-DW-06.	Photograph Number: 17
Direction: Southwest	Photographer: Ryan Lunt	Date: 7/17/2014

Client: Environmental Protection Agency Region 8	Description: Photograph of Seagull Greg Dillon collecting dissolved metals sample at sample location RDW-DW-27.	Photograph Number: 18
Direction: North	Photographer: Ryan Lunt	Date: 7/17/2014

APPENDIX D

CHAIN-OF-CUSTODY RECORDS

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHS008	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0003	07/15/2014 09:55		
MHS009	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0097	07/15/2014 09:58		
MHS010	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0098	07/15/2014 10:10		
MHS011	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0099	07/15/2014 10:20		
MHS012	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0004	07/15/2014 12:00		
MHS013	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0100	07/15/2014 12:15		
MHS014	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0101	07/15/2014 12:17		
MHS015	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0103	07/15/2014 12:00		
MHS017	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0104	07/15/2014 12:35		
MHS018	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0105	07/15/2014 12:41		
MHS025	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0007	07/14/2014 15:03		

Sample(s) to be used for Lab QC: MHS026 — No Tags for all samples; Please disregard

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHS026	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0111	07/14/2014 15:07		
MHS027	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0112	07/14/2014 15:03		
MHS028	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0113	07/14/2014 15:09		
MHS029	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0114	07/14/2014 15:15		
MHS101	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0061	07/14/2014 10:40		
MHS102	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0062	07/13/2014 13:25		
MHS103	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0063	07/13/2014 14:20		
MHS104	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0064	07/13/2014 18:10		
MHS105	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0065	07/13/2014 17:55		
MHS106	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0066	07/14/2014 08:55		
MHS107	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0067	07/14/2014 10:40		

Sample(s) to be used for Lab QC: MHS026

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHS108	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0068	07/14/2014 11:50		
MHS109	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0069	07/14/2014 11:50		
MHS110	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0071	07/13/2014 12:50		
MHS113	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0075	07/15/2014 09:35		
MHS114	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0076	07/15/2014 11:10		
MHS115	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0077	07/15/2014 14:50		
MHS116	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0078	07/15/2014 12:00		
MHS117	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0081	07/16/2014 14:48		
MHS118	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0082	07/16/2014 15:55		
MHS119	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0083	07/14/2014 14:45		
MHS120	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0084	07/14/2014 14:55		

Sample(s) to be used for Lab QC: MHS109, MHS120

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHS121	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0085	07/14/2014 15:55		
MHS125	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0121	07/17/2014 15:30		
MHS126	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0011	07/16/2014 15:07		
MHS127	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0012	07/14/2014 14:58		
MHS615	Soil/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0102	07/15/2014 12:20		
MHS626	Sediment/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (4 C) (1)	COSFN0801684 -0124	07/17/2014 13:55		
MHW201	Ground Water/ Ryan Lunt		TAL Total Metals+Hg	1002 (HNO3 pH<2) (1)	COSFN0801684 -0013	07/17/2014 11:35		
MHW202	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	1003 (HNO3 pH<2) (1)	COSFN0801684 -0014	07/17/2014 15:10		
MHW203	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg, TAL Total Metals +Hg	1004 (HNO3 pH<2), C (HNO3 pH<2) (2)	COSFN0801684 -0015	07/17/2014 15:05		
MHW204	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg, TAL Total Metals +Hg	1005 (HNO3 pH<2), C (HNO3 pH<2) (2)	COSFN0801684 -0016	07/17/2014 12:16		
MHW206	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	1007 (HNO3 pH<2) (1)	COSFN0801684 -0018	07/17/2014 10:30		

Sample(s) to be used for Lab QC: MHW203, MHW204, MHW207

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	7/18/14 Ryan McLunt										

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHW207	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg, TAL Total Metals +Hg	1008 (HNO3 pH<2), B (HNO3 pH<2) (2)	COSFN0801684 -0019	07/17/2014 08:57		
MHW208	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	1009 (HNO3 pH<2) (1)	COSFN0801684 -0020	07/17/2014 09:30		
MHW210	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	1011 (HNO3 pH<2) (1)	COSFN0801684 -0022	07/17/2014 10:06		
MHW215	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	1016 (HNO3 pH<2) (1)	COSFN0801684 -0027	07/16/2014 08:41		
MHW224	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0080	07/17/2014 09:30		
MHW225	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0088	07/17/2014 08:41		
MHW226	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0090	07/17/2014 13:30		
MHW227	Ground Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0118	07/17/2014 13:30		
MHW228	Ground Water/ Ryan Lunt	Grab	TAL Total Metals+Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0119	07/17/2014 14:28		
MHW301	Ground Water/ Ryan Lunt		Dissolved Metals+Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0013	07/17/2014 11:35		
MHW302	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0014	07/17/2014 15:10		

Sample(s) to be used for Lab QC: MHW207, MHW303

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHW303	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg, Dissolved Metals +Hg	A (HNO3 pH<2), D (HNO3 pH<2) (2)	COSFN0801684 -0015	07/17/2014 15:05		
MHW304	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg, Dissolved Metals +Hg	A (HNO3 pH<2), D (HNO3 pH<2) (2)	COSFN0801684 -0016	07/17/2014 12:16		
MHW306	Ground Water/ Ryan Lunt	Grab	dissolved Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0018	07/17/2014 10:30		
MHW307	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg, Dissolved Metals +Hg	A (HNO3 pH<2), C (HNO3 pH<2) (2)	COSFN0801684 -0019	07/17/2014 08:57		
MHW308	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0020	07/17/2014 09:30		
MHW310	Ground Water/ Ryan Lunt	Grab	DissolvedTotal Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0022	07/17/2014 10:06		
MHW315	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0027	07/16/2014 08:41		
MHW324	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0080	07/17/2014 09:30		
MHW325	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0088	07/17/2014 08:41		
MHW326	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0090	07/17/2014 13:30		
MHW327	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0118	07/17/2014 13:30		

Sample(s) to be used for Lab QC: MHW303, MHW304, MHW307

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHW328	Ground Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	C (HNO3 pH<2) (1)	COSFN0801684 -0119	07/17/2014 14:28		
MHW401	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0033	07/14/2014 10:40		
MHW402	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0034	07/13/2014 13:25		
MHW403	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0035	07/13/2014 14:20		
MHW404	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0036	07/13/2014 18:10		
MHW405	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0037	07/13/2014 17:55		
MHW406	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg, TAL Total Metals +Hg	A (HNO3 pH<2), C (HNO3 pH<2) (2)	COSFN0801684 -0038	07/14/2014 08:55		
MHW407	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0060	07/14/2014 10:40		
MHW408	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg, TAL Total Metals +Hg	A (HNO3 pH<2), C (HNO3 pH<2) (2)	COSFN0801684 -0039	07/14/2014 11:50		
MHW409	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0040	07/14/2014 11:50		
MHW410	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0042	07/13/2014 12:50		

Sample(s) to be used for Lab QC: MHW406, MHW408, MHW409

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHW413	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0046	07/15/2014 09:35		
MHW414	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0047	07/15/2014 11:10		
MHW415	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0048	07/15/2014 12:00		
MHW416	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0051	07/16/2014 14:48		
MHW417	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0052	07/16/2014 15:55		
MHW418	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0053	07/14/2014 14:45		
MHW419	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg, TAL Total Metals +Hg	A (HNO3 pH<2), C (HNO3 pH<2) (2)	COSFN0801684 -0054	07/14/2014 14:55		
MHW420	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0055	07/14/2014 15:55		
MHW424	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0120	07/17/2014 15:30		
MHW425	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0122	07/15/2014 14:50		
MHW426	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0123	07/17/2014 13:55		

Sample(s) to be used for Lab QC: MHW419

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHW501	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0033	07/14/2014 10:40		
MHW502	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0034	07/13/2014 13:25		
MHW503	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0035	07/13/2014 14:20		
MHW504	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0036	07/13/2014 18:10		
MHW505	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0037	07/13/2014 17:55		
MHW506	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg, Dissolved Metals +Hg	B (HNO3 pH<2), D (HNO3 pH<2) (2)	COSFN0801684 -0038	07/14/2014 08:55		
MHW507	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0060	07/14/2014 10:40		
MHW508	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg, Dissolved Metals +Hg	B (HNO3 pH<2), D (HNO3 pH<2) (2)	COSFN0801684 -0039	07/14/2014 11:50		
MHW509	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0040	07/14/2014 11:50		
MHW510	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0042	07/13/2014 12:50		
MHW513	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0046	07/15/2014 09:35		

Sample(s) to be used for Lab QC: MHW506, MHW508, MHW509

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHW514	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0047	07/15/2014 11:10		
MHW515	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0048	07/15/2014 12:00		
MHW516	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0051	07/16/2014 14:48		
MHW517	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0052	07/16/2014 15:55		
MHW518	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0053	07/14/2014 14:45		
MHW519	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg, Dissolved Metals +Hg	B (HNO3 pH<2), D (HNO3 pH<2) (2)	COSFN0801684 -0054	07/14/2014 14:55		
MHW520	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0055	07/14/2014 15:55		
MHW524	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0120	07/17/2014 15:30		
MHW525	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0122	07/15/2014 14:50		
MHW526	Surface Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	B (HNO3 pH<2) (1)	COSFN0801684 -0123	07/17/2014 13:55		
MHWFB1	Surface Water/ Ryan Lunt	Grab	TAL Total Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0125	07/11/2014 13:00		

Sample(s) to be used for Lab QC: MHW519

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
shipping to CLP	Ryan M. Lunt	7/18/14									

USEPA CLP Inorganics COC (LAB COPY)

DateShipped: 7/18/2014
CarrierName: FedEx
AirbillNo: 8577 5944 6049

CHAIN OF CUSTODY RECORD

Case # 44467
Cooler # 11

No: 8-071814-155305-0003

Lab: ALS Laboratory Group
Lab Contact: Roxy Olson
Lab Phone: 801-266-7700

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MHWFB2	Surface Water/ Ryan Lunt	Grab	TAL Total Metals+Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0126	07/11/2014 13:00		
MHWFB3	Water/ Ryan Lunt	Grab	Dissolved Metals +Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0128	07/11/2014 13:00		
MHWFB4	Water/ Ryan Lunt	Grab	Dissolved Metals+Hg	A (HNO3 pH<2) (1)	COSFN0801684 -0129	07/11/2014 13:00		
MHWRB1	Water/ Ryan Lunt	Grab	TAL Total Metals	A (HNO3 pH<2) (1)	COSFN0801684 -0127	07/18/2014 13:00		

Special Instructions:

Shipment for Case Complete? Y

Samples Transferred From Chain of Custody #

Analysis Key

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time
Shipping to CLP	Ryan M. Lunt	7/18/14									

APPENDIX E

LABORATORY RESULTS AND DATA VALIDATION REPORTS
(Under separate cover)