Ruby Mines
Removal Site Evaluation Report

Prepared for
Western Nuclear, Inc.

November 2015

CH2MHILL®

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Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Mr. Stuart Brown
Freeport Minerals Corporation

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Acronyms and Abbreviations

ANSI	American National Standards Institute
ASAOC	Administrative Settlement Agreement and Order on Consent
ASL	Applied Sciences Laboratory
bgs	below ground surface
BIA	Bureau of Indian Affairs
Bi-214	bismuth-214
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COPC	constituent of potential concern
cpm	counts per minute
DTM	digital terrain model
GPS	global positioning system
GM	Geiger-Muller
HMOSP	Hazardous Mine Openings Safety Program
ID	identification
J	The analyte was detected, but the reported concentration should be considered estimated.
LIDAR	light detection and ranging
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
mg/kg	milligrams per kilogram
MMD	Mining and Minerals Division of the New Mexico Energy, Minerals, and Natural Resources Department
NaI	sodium iodide
NNEPA	Navajo Nation Environmental Protection Agency
Pb-214	lead-214
pCi/g	picocuries per gram
Perma-Fix	Perma-Fix Environmental Services
PID	photoionization detector
PPE	personal protective equipment
PRG	preliminary remediation goal
PUF	polyurethane foam
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
Ra-226	radium-226
RSE	Removal Site Evaluation
RSL	Regional Screening Levels
Site	Ruby Mines Site

SOP	standard operating procedure
TPH	total petroleum hydrocarbons
UTL	Upper Tolerance Limit
U	Data flag indicating an analyte was not detected above the method detection limit
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compound
WNI	Western Nuclear, Inc.

Executive Summary

This Removal Site Evaluation (RSE) Report is submitted in accordance with the U.S. Environmental Protection Agency (USEPA) Administrative Settlement Agreement and Order on Consent (ASAOC), Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Docket No. 2013-07, dated July 15, 2013 on behalf of Western Nuclear, Inc. (WNI). The RSE describes three phases of activities performed to initially fence and close open mine features and summarizes the results of investigations conducted to characterize chemical and radiological conditions at the Ruby Mines Site (Site).

The Site is located on Navajo Nation trust and allotment lands located in northwestern New Mexico in McKinley County near the Smith Lake Chapter of the Navajo Nation. The Site consists of four inactive, contiguous, underground mines (Ruby Mines Nos. 1, 2, 3, and 4) and associated surface features. There was no surface disturbance at Ruby Mines Nos. 2 and 4 other than the shafts constructed to ventilate the underground mines (that is, vents). Ore from the mines was transported offsite for processing. Waste rock generated at the mines was placed outside the adits of Ruby Mines Nos. 1 and 3 and reclaimed through capping shortly after mining ceased in February 1985.

WNI performed reclamation efforts at the Ruby Mines between June and December 1985. Reclamation efforts were approved by the New Mexico Mining and Minerals Division, Bureau of Land Management, and the Bureau of Indian Affairs (BIA) and were designed to satisfy requirements of the Nuclear Regulatory Commission. As part of the efforts, the Ruby Mines Nos. 1 and 3 adits were physically closed and waste rock piles were capped with compacted fill and revegetated. Known vents were sealed with concrete and buildings were removed. The Site was subsequently inspected and maintained. WNI made repairs to the waste rock cap at Ruby Mines No. 1 in 1993 and 1995 and made improvements to a drainage diversion at Ruby Mines No. 3 in 1993.

Removal Site Evaluation Investigation Field Activities (2012 to 2014)

The following preliminary field activities were performed between October 2012 and April 2014:

- Performed site reconnaissance, fenced, and posted signs at open mine features.
- Conducted a cultural resource assessment and reviewed protected biological resources.
- Obtained permits and access agreements.
- Met with residents and the Smith Lake Chapter.

From April through October 2014, WNI performed Phase 1, 2, and 3 field activities.

Phase 1 of the RSE work occurred in April and May 2014 and included physical closures of several open mine features that were identified during site reconnaissance, including the adits at the Ruby Mines Nos. 1 and 3, three vents, two shafts, and two prospects.

Phase 2, which occurred in April and May 2014, and Phase 3, which occurred in October 2014, included a background study, a radiation survey of mine features, and soil sampling. The background study, consisting of radiation measurements and soil sampling, was performed to determine background radiation levels and metals concentrations for comparison with Site radiological and soil analytical data collected at the Ruby Mines Nos. 1 and 3 capped waste rock piles and other former mine features. Three background reference areas were selected to represent the predominant geologic formations (Colluvium, Mancos Shale Formation, and Dakota Sandstone Formation) found at the Site.

The radiological characterization of surface soils was performed by walkover and drive-over surveys of various mine features. Features surveyed included adits, capped waste rock piles, work areas, drainages, former haul roads, select areas where exploration drilling occurred, vents, prospects, and shafts. Residences located near Ruby Mines Nos. 1 and 3 were also surveyed. Both continuous and static (timed, direct) measurements were collected.

Surface and subsurface soil sampling was performed according to the work plans to meet the following three objectives: (1) provide data for a correlation of radium-226 (Ra-226) measurements in surface soil with field gamma-radiation survey results; (2) provide data to evaluate the nature and extent of contaminants of potential concern (COPCs) identified in the ASAOC; and (3) provide information on the engineering and agronomic properties of soils used to cap the waste rock piles. Field screening of soil samples was performed visually and by radiological meters and photoionization detectors. Laboratory analysis of the COPCs, as well as engineering and agronomic parameters, were performed. Primary COPCs include Ra-226 and six metals (arsenic, mercury, molybdenum, selenium, uranium, and vanadium). Secondary COPCs include volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls, total petroleum hydrocarbons, perchlorate, and explosives.

Light detection and ranging (LIDAR) remote sensing technology was used at the Ruby Mines Nos. 1 and 3 capped waste rock piles and adjacent areas to develop detailed topographic information to support volume estimates for the capped waste rock piles.

Results of Removal Site Evaluation Investigations

RSE investigation results are described as follows:

- Nine open mine features were closed and warning signs were posted. There are no known open mine features associated with the Site.
- Radiation survey measurements ranged from background to less than two times background in soils around the three residences near Ruby Mines No. 1 and the one residence near Ruby Mines No. 3.
- At a number of the former mine features, radiation survey measurements also ranged from background to less than two times background, including: areas where exploration drilling occurred, three shafts referred to as RUBY-011, RUBY-017, and RUBY-021, three vents referrred to as RUBY-015, RUBY-018, and RUBY-022, and two prospects referred to as RUBY-016 and RUBY-020.
- At three vents (RUBY-002, RUBY-004, and RUBY-019), survey measurements exceeded three times background in localized areas up to 50 feet downwind from the vents. Radiation levels ranged from background to less than two times background levels at distances greater than 50 feet downwind at each of the three vents.
- In the drainages leading from the two capped waste rock piles, radiation survey measurements ranged from background to less than two times background, except in two drainages that run along the north side of the Ruby Mines No. 1 capped waste rock pile. The relatively low radiation levels in drainages leading from Ruby Mines Nos. 1 and 3 is most likely due to the fact that the waste rock piles were capped shortly after mining ceased.
- The maintained section of the Ruby Mines No. 1 former haul road, which is called Wolf Canyon Road, had radiation survey measurements that ranged from background to less than two times background, except for two isolated locations, one near the intersection with BIA Route 49 and the other near the intersection with the unmaintained former haul road that leads to the capped waste rock pile. The unmaintained former haul road at Ruby Mines No. 1 had radiation survey measurements that were generally above two times background near the capped waste rock pile and decreased to levels that ranged from background to less than two times background near the intersection with Wolf Canyon Road.
- The Ruby Mines No. 3 former haul road, which is called Mount Powell Road and Horseshoe Pond Road where it is maintained, had radiation survey measurements that generally ranged from background to less than two times background.
- Most of the soils where radiation survey measurements exceeded three times background were in areas around the Ruby Mines Nos. 1 and 3 where historical mining-related or reclamation activities

occurred. The locations included areas within and immediately around the capped waste rock piles; the work areas, where offices, maintenance buildings, and parking areas were historically located; and the area where water pumped to dewater underground workings was discharged at Ruby Mines No. 3. Site characterization activities characterized the lateral and vertical extent of soils and waste rock with Radium-226 concentrations above the preliminary remediation goal.

- The volume of waste rock was estimated for each waste rock pile through subsurface soil sampling. The estimated volumes for the Ruby Mines No. 1 and 3 waste rock piles are 81,000 and 93,000 cubic yards, respectively.
- Soil samples were collected at 53 locations and analyzed for metals. Metals concentrations in soil samples were generally below the USEPA Regional Screening Levels (RSLs) or background concentrations throughout the Site, including the soil samples collected from the two capped waste rock piles. A few isolated soil sample locations had exceedances for one or more metals at several mine features, including: five locations from the Ruby Mines No. 1 former haul road; two locations near the Ruby Mines No. 1 capped waste rock pile; one location at the Ruby Mines No. 3 drainage; one location at the Ruby Mines No. 3 work area; and one location at one vent, referred to as RUBY-004.
- Volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls, total petroleum hydrocarbons, perchlorate, and explosives concentrations in soil samples collected in the work areas at Ruby Mines Nos. 1 and 3 were either not detected or detected at concentrations below USEPA RSLs.
- The existing caps on the Ruby Mines Nos. 1 and 3 waste rock piles are generally intact with some areas of erosion. Erosion of the capped waste rock piles was limited to areas where the piles sloped to drainages, which was on the north and west sides of the cap at Ruby Mines No. 1 and on the east and south sides of the cap at Ruby Mines No. 3. The cap thinknesses ranged from 0.5 to 2.0 feet at Ruby Mines No. 1 and from 0.5 to 1.5 feet at Ruby Mines No. 3.

SECTION 1

Introduction

This Removal Site Evaluation (RSE) report describes the following: (1) activities to initially fence and close mine openings; and (2) the activities and results of investigations to characterize chemical and radiological conditions at the Ruby Mines Site (Site) on behalf of Western Nuclear, Inc. (WNI). The activities were performed in accordance with the U.S. Environmental Protection Agency (USEPA) Administrative Settlement Agreement and Order on Consent (ASAOC), CERCLA Docket No. 2013-07, dated July 15, 2013 (USEPA, 2013). Physical hazard mitigation work was performed according to the Phase 1 work plan (CH2M HILL, 2013a). Site characterization work was performed according to the Phase 2 work plan (CH2M HILL, 2013b), the addendum to the Phase 2 work plan (CH2M HILL, 2014a), and the Phase 3 work plan (CH2M HILL, 2014b), collectively referred to hereafter as “the site characterization work plans.” This report presents the RSE results and combines the information from the three work phases. The site characterization work plans were approved by both USEPA and the Navajo Nation Environmental Protection Agency (NNEPA), prior to commencement of each phase of work.

1.1 Objectives

The objectives of the activities performed at the Site are to mitigate physical hazards and to characterize chemical and radiological conditions. The following were the specific objectives of the work:

- Identify historical mine features and close those that posed physical hazards.
- Identify cultural resources and fence those adjacent to RSE work areas.
- Review protected biological resources potentially present within the Site and consult with the Navajo Natural Heritage Program to confirm that no field studies were required.
- Post bilingual warning signs at each of the mine sites.
- Characterize background concentrations of primary constituents of potential concern (COPCs).
- Characterize surface radiological conditions near Ruby Mines features, including capped waste rock piles, adits, vents, work areas, exploratory borehole areas, drainages, and former haul roads.
- Characterize surface radiological conditions at residences near Ruby Mines Nos. 1 and 3.
- Provide a correlation between surface gamma radiation survey readings and radium-226 (Ra-226) concentrations in surface soil.
- Characterize the lateral and vertical extent of COPC concentrations in soil at the Site.
- Estimate the volume of waste rock in the Ruby Mines Nos. 1 and No. 3 capped waste rock piles.

The primary COPCs at the Ruby Mines are Ra-226 and naturally occurring metals associated with geologic formations in the area including arsenic, vanadium, molybdenum, selenium, uranium, and mercury.

1.2 Site Management and Organization

Management and organization of the project is described in detail in the site characterization work plans (CH2M HILL. 2013a, 2013b, 2014a, and 2014b). A brief synopsis is provided in the following paragraphs. Mr. Stuart Brown provided project management and oversight services to CH2M HILL. Specialized services were subcontracted as necessary.

The project manager, Ms. Liz Dodge/CH2M HILL, and field investigation task manager, Ms. Jennifer Laggan/CH2M HILL, managed activities of the work plans for the fieldwork. Upon Ms. Dodge’s retirement in November 2014, Ms. Laggan assumed the role of project manager and oversaw compilation of the RSE report. Ms. Kira Sykes/CH2M HILL served as the radiation health physicist and Mr. Jason Hubler/Perma-Fix Environmental Services (Perma-Fix) acted as the radiation safety officer. Mr. Jeff Hilgaertner/CH2M HILL acted as the health and safety officer.

The adit and vent closure activities were performed by Freeport-McMoRan's (Freeport) Hazardous Mine Openings Safety Program (HMOSP) staff. Radiation survey fieldwork was performed by Perma-Fix. Dinétahdóó Cultural Resources Management performed the cultural resource assessment. Subsurface investigation boreholes were drilled by National Exploration Wells and Pump, Inc.

The following personnel were responsible for USEPA Region 9 and Navajo Nation regulatory oversight and interaction:

- The USEPA remedial project manager and on-scene coordinator was Mr. Mark Ripperda.
- The NNEPA representative was Mr. Stanley Edison.

1.3 Report Organization

This report documents the activities performed during Phases 1, 2, and 3. The report is structured as follows:

- Section 1 summarizes the closure activity and site investigation objectives, site management and organization, and report organization.
- Section 2 provides site description, site history, regulatory history, and ownership and land use information.
- Section 3 provides background information on the physical setting of the Site and information on cultural resources, environmental compliance, and wildlife protection.
- Section 4 provides a summary of mine feature closure and site characterization methodology.
- Section 5 includes results of site investigations, including mine feature closure, characterization activities, and presents preliminary remediation goals, Ra-226 correlation for surface soil, and waste volume estimates.
- Section 6 provides the costs associated with performing the RSE.
- Section 7 provides conclusions of the RSE.
- Section 8 provides references used in the report.

SECTION 2

Site Description and Background

2.1 Site Description

The Site consists of four inactive, related underground mines (Ruby Mines Nos. 1, 2, 3, and 4) located in northwestern New Mexico in McKinley County near the Smith Lake Chapter of the Navajo Nation (Figure 2-1). The Smith Lake Chapter is approximately 8 miles north of the town of Thoreau, which is located at the intersection of Interstate Highway 40 and New Mexico Highway 371. Ruby Mines Nos. 1 and 2 were connected by underground tunnels, and ore was produced through the adit at Ruby Mines No. 1 (at 35.518986 degrees [°] North, -108.222483° West). Similarly, Ruby Mines Nos. 3 and 4 were connected by underground tunnels, and ore was produced through the adit at Ruby Mines No. 3 (at 35.506703° North, -108.163614° West). Each underground mine had a main haulage drift at an approximate 21° decline, which was between 9 and 10 feet high by 10 to 14 feet wide. Cross cuts were driven from the drift laterally to intersect the ore at 400 foot intervals. Continued development of the ore zone included 7-foot by 8-foot drifts at 50 foot intervals, driven from the cross-cuts (WNI, 1977 and 1979a, b, and c).

The Ruby Mines and locations of known surface features are within the boundary of Navajo Nation trust and allotment lands, in Township 15 North, Range 13 West, Sections 21, 27, 26, and 25 (New Mexico Energy, Minerals, and Natural Resources Department, Mining and Minerals Division [MMD], 1995).

2.2 Mining Operations and Reclamation Activities

The Ruby Mines operated between September 1975 and February 1985. Table 2-1 of this report contains a summary of mining operations and reclamation dates. The four mines were contiguous and were mined by underground methods. Operating plans for Section 26, where Ruby Mines No. 4 is located, indicate the ore body would be developed by a modified room and pillar mining system (WNI, 1979a, b). Ore production at Ruby Mines Nos. 1 and 2 was estimated at 495,360 tons between 1976 and 1981. Ore production at Ruby Mines Nos. 3 and 4 from 1980 to 1982 was reported at 223,985 tons and was estimated in 1984 and 1985 at 295,000 tons. No production was reported from Ruby Mines Nos. 3 and 4 in the first half of 1983, and the production in the second half of 1983 is unknown (New Mexico Bureau of Mines and Mineral Resources, 1991).

Ores from Ruby Mines Nos. 2 and 4 were transported through Ruby Mines Nos. 1 and 3, respectively. Ruby Mines features are presented in Figure 2-2. There was no surface disturbance at Ruby Mines Nos. 2 and 4, other than the shafts constructed to ventilate the underground mines (that is, vents). Ore from the mines was transported offsite for processing. Waste rock generated at the mines was placed outside the adits of Ruby Mines Nos. 1 and 3.

WNI performed reclamation efforts at the Ruby Mines between June and December 1985. The efforts were approved by the U.S. Department of the Interior Bureau of Land Management (BLM, 1991) and U.S. Department of the Interior Bureau of Indian Affairs (BIA, 1996). As part of the efforts, the Ruby Mines No. 1 adit was sealed with a concrete wall and backfilled, and the Ruby Mines No. 3 adit was closed and capped with fill (MMD, 1995). According to operating plans for the mines, topsoil was removed from the waste rock pile areas and building sites prior to initiation of mining (WNI, 1979b). The stockpiled topsoil was used to cap the waste rock when mining ceased. The capped waste rock piles were revegetated with annual rye grass for stabilization in December 1985. Waste rock at Ruby Mines No. 1 was reportedly capped by a minimum of 10 feet of compacted fill. Waste rock at Ruby Mines No. 3 was capped with a minimum of 12 inches of compacted fill. Known vents were filled and sealed with concrete. Associated buildings were removed, with the exception of the shop building at Ruby Mines No. 1, which was left at the request of the Navajo Nation (MMD, 1995). No information could be found about the disposition of the shop building; however, it was not present during an October 2012 site visit. Power lines were salvaged by subcontractors to or predecessors of the Navajo Tribal Utility Authority in 1987 (MMD, 1995). A historical document makes mention of Continental Divide Electric of WNI negotiating with Continental Divide Electric for supply of power (WNI, 1977). Water systems were turned over to unnamed subcontractors or predecessors of the Navajo Tribal Utility Authority. In 1993, erosion of the waste rock cap was repaired at Ruby Mines No. 1. A drainage diversion around Ruby Mines No. 3 was incised into bedrock to prevent erosion of the capped waste rock. In September 1995, WNI inspectors observed that the cap at Ruby Mines No. 1 had erosional rills. The rills were filled with rock, and the deeper rills were capped with geotextile fabric and backfilled (WNI, 1995).

Mine features associated with Ruby Mines Nos. 1 and 3 are shown in Figures 2-3 and 2-4, respectively. The following is a description of the features:

- **Drainages:** Drainages that convey runoff from the capped waste rock piles at Ruby Mines Nos. 1 and 3 were evaluated in the site characterization process. Four distinct drainages are present at Ruby Mines No. 1 and were labeled A, B, C, and D. Drainages A, B, and C traverse the northern edge of the capped waste rock pile, are typically 1 to 2 feet deep, and convey runoff to the west toward drainage D. Drainage D traverses the western edge of the capped waste rock pile, is incised to depths of 20 feet in places, and conveys runoff to the north. The drainages at Ruby Mines No. 3 run along the north and south perimeter of the capped waste rock pile and discharge to a small pond and broad flat area east and south of the capped waste rock pile along the unmaintained former haul road.
- **Dewatering area**: The dewatering area associated with Ruby Mines No. 3 is located topographically lower than the adjacent work area and capped waste rock pile. Water that was pumped from a nearby well (RUBY-006) that dewatered underground mine workings was reportedly discharged to this area.
- **Exploratory Borehole Areas:** Prior to conducting mining activities, ore bodies were identified by drilling exploratory boreholes. The boreholes were usually abandoned and marked with a square wooden stake with a metal label attached. Historical maps and visual observations in the field indicate a number of exploratory boreholes drilled in the area between Ruby Mines Nos. 1 and 3. For the purposes of the site characterization process, two representative areas, one each near Ruby Mines No. 1 and 3, were identified. The representative exploratory borehole areas were each approximately one to two acres in size and contained a number of former borehole locations.
- **Former Haul Roads:** The former haul road at Ruby Mines No. 1 begins at the capped waste rock pile and ends at the intersection with BIA Route 49, with a total length of approximately 11,000 feet. A short unmaintained section of the former haul road extends from the capped waste rock pile to Wolf Canyon Road. The longer stretch of the former haul road (Wolf Canyon Road) is graveled and maintained to the intersection with BIA Route 49 (Figure 2-2). The former haul road at Ruby Mines No. 3 begins at the eastern side of the capped waste rock pile and ends at the intersection with New Mexico Highway 371, with a total length of approximately 13,000 feet. A short unmaintained section of the former haul road starts at the capped waste rock pile and extends to the maintained gravel roads (Horseshoe Pond Road and Mount Powell Road). These maintained gravel roads travel to New Mexico Highway 371.
- **Work Area:** The work areas associated with Ruby Mines Nos. 1 and 3 are areas where mining support activities occurred historically. The work areas include office areas, machine/maintenance buildings, and parking areas. The work area at Ruby Mines No. 1 has a large concrete building foundation present. A few smaller concrete building foundations are apparent at the work area at Ruby Mines No. 3.

2.3 Regulatory History

The Ruby Mines were constructed, operated, and reclaimed in compliance with federal and state regulatory agency requirements as follows:

- In 1971 and 1972, mining leases were obtained from BIA for Navajo-allotted lands in Section 26 (U.S. Department of the Interior BIA, 1971, 1972).
- In 1973, WNI obtained archeological clearance for a power line and eight vents at the Ruby Mines (U.S. Department of the Interior, National Park Service, 1980 a, b, c).
- In 1980, the U.S. Geological Survey (USGS) approved WNI's Section 26 Mining and Reclamation Plan (USGS, 1980).
- On September 11, 1984, the Navajo Nation performed a site inspection at Ruby Mines No. 1 and recommended implementation of reclamation and site restoration activities. Reclamation efforts were initiated shortly after completion of mining operations at the Ruby Mines. Reclamation activities addressed concerns of the Navajo Nation and the Nuclear Regulatory Commission by closing vents and adits and by capping waste rock piles (Navajo Nation, 1984).
- On October 25, 1985, BLM reviewed WNI documents on reclamation activities. BLM approved the measures in a letter dated May 8, 1991. BLM recommended continued inspections but no further reclamation (U.S. Department of the Interior BLM, 1991).
- On July 10, 1986, the New Mexico Environmental Improvement Division performed inspections at Section 21, where Ruby Mines No. 1 is located, and proposed no further action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA; New Mexico Environmental Improvement Division, 1986).
- On September 27, 1995, MMD performed inspections of Ruby Mines Nos. 1 and 3, and approved reclamation efforts on September 29 (MMD, 1995). Subsequent to the BLM and MMD assessments, BIA released Surety Bond No. 8084-08-04 for WNI, and liability under the bond was released (U.S. Department of the Interior BIA, 1996).
- In May 2009, USEPA performed preliminary radiation surveys of Ruby Mines Nos. 1 and 3 (Weston Solutions, Inc., 2009a, 2009b).
- From October 2012 through May 2014, WNI performed site reconnaissance to locate and secure (with fencing) open mine features, perform fence inspections, perform cultural resource assessments, interface with residents to obtain signatures on access agreements, and meet with Smith Lake Chapter officials to update them about ongoing activities.
- On July 15, 2013, USEPA and WNI signed an ASAOC for RSE and Interim Removal Action (USEPA, 2013).
- In May 2014, WNI performed mine feature closure activities, initial radiation surveys, and background studies. The activities were documented in Phase 1 and Phase 2 reports submitted to USEPA and are summarized in this report (CH2M HILL, 2014 c, d).
- In October and November 2014, WNI conducted additional radiation surveys and collected surface and subsurface soil borings. The Phase 3 activities are documented in this report.

2.4 Ownership and Surrounding Land Use

During site visits, current land ownership and use information in the Ruby Mines area was gathered from historical site documents, in consultation with Mr. Edmund Henry, Smith Lake Chapter Land Board representative, and from discussions with the Navajo Nation Land Department in Crownpoint, New Mexico. The surface ownership of Sections 21, 27, and 25 (where Ruby Mines Nos. 1, 2, and 3 are located, respectively) is vested in the United States government as lands held in trust for the Navajo Nation. Surface ownership of Section 26, where Ruby Mines No. 4 is located, is vested in four Navajo allottees. BIA and USGS are charged with managing the land surface on behalf of the allotment owners. The following summarizes the use of surface land in Sections 21, 25, 26, and 27:

- Portions of Section 21 that are associated with known mine features of Ruby Mines No. 1 are designated as tribal trust lands. Grazing permits are also located near Ruby Mines No. 1, as are two homesite leases, and a residential lease (located in Section 20 on allotment land).
- According to the Navajo Nation Land Department (Navajo Nation, 1984), portions of Section 25 that are associated with known mine features of Ruby Mines No. 3 are held as tribal trust lands. Reportedly, two grazing permits are held in this area. A homesite lease is also held approximately one-quarter mile to the east of Ruby Mines No. 3.
- Section 26, where Ruby Mines No. 4 is located, is divided into four allotments.
- Portions of Section 27 that are associated with known mine features of Ruby Mines No. 2 are tribal trust lands. There are known grazing permits in this area.

Access agreements were obtained prior to commencement of work.

SECTION 3

Physical Setting

3.1 Description of Mine Features

Twenty-two features associated with the Ruby Mines were initially identified based upon information contained in historical site documents, conversations with local residents during site visits, and observations by field personnel. Each of the features was an assigned unique identifier: RUBY-001 through RUBY-022.

Of the 22 features, nine features were excluded and 13 were carried through to site characterization. The nine features excluded included eight potential vent locations (RUBY-005, RUBY-007, RUBY-008, RUBY-009, RUBY-010, RUBY-012, RUBY-013, and RUBY-014) that were shown on historical maps, but that could not be positively identified in the field. They may have been closed historically or not constructed as documented in historical plans. The other feature is a former dewatering well (RUBY-006), which is no longer operational.

The nine features were not included in site characterization investigations or closure activities. The 13 features carried forward into the site characterization process are listed in Table 3-1 and shown in Figure 2-2. Of these 13 features, visual observations during site visits indicated that four were closed (that is, covered with a concrete pad and/or filled to ground surface) during historical mine reclamation activities. The remaining nine features include two adits, three vents, two shafts, and two prospects (that is, shallow exploration trenches or pits). These nine features were observed to be open (that is, a depression or hole in the ground surface) that required closure. After identification, temporary fencing and warning signs were erected at the nine open mine features. Inspected were performed approximately quarterly while temporary fences were in place in 2013 and 2014, and photographic logs and fence inspection reports are included in Appendix A. The open features were physically closed during May 2014 field activities as described in Section 4. WNI will inspect the closed features annually for 3 years and then reevaluate the inspection frequency depending on the condition of closures.

3.2 Climate and Geology

The climate at the Ruby Mines is semiarid, with large daily and seasonal temperature fluctuations and high winds. The area is characterized by broken terrain and includes steep mountains, plateaus, mesas, incised valleys, and dry arroyos. Surface drainage from the Ruby Mines area is typically along incised drainage channels. Surface flow in the channels occurs intermittently during and after high rainfall events, and during rapid snowmelt events. Average annual runoff is less than 5 percent of annual precipitation in this area due to the dry air and vegetation uptake (Fizber, 2013).

The regional geology includes Mesozoic and Cenozoic sedimentary units (Figure 3-1). Unconsolidated Quaternary alluvium and colluvium are present along incised drainage features and surrounding prominent topographic features, including Hosta Butte north of the Site. Alluvial and colluvial deposits are present on the weathered upper Cretaceous sedimentary rocks, from which they are largely derived (USGS, 1990). Cretaceous sandstones of the Point Lookout and Crevasse Canyon formations, which form Hosta Butte to the north, overlie the Mancos Shale. The Mancos Shale overlies the Cretaceous-age Dakota Sandstone. The Dakota Sandstone unconformably overlies the Jurassic-age Morrison Formation (USGS, 1990). The Morrison Formation includes lithologic units with uranium ore and contains aquifers that supply agricultural and domestic water to users in the area (USGS, 1968; Myers, 2010). The basement rocks that underlie Mesozoic sedimentary units consist of Precambrian granite and quartzite (Brister and Hoffman, 2002).

The surficial geology near the Ruby Mines includes the following three formations (Table 3-2 and Figure 3-1):

- Colluvium is the unconsolidated Quaternary-age sediment mapped at the location of several historical mine features. Colluvium consist of sediments of various textures from silt to gravel that are recently or actively weathering from upland bedrock units. The materials are mapped on steep declines and adjacent to rocky outcrops (USGS, 1990). Colluvium units are present in narrow discontinuous bands in low areas of large topographic relief. The thickness of the colluvium is variable, ranging from a few feet to 100 feet, with the greatest thicknesses present on slopes of valleys and ravines (USGS, 1990). Features where the colluvium is the predominant surface geologic unit are the Ruby Mines No. 1 capped waste rock pile and adjacent areas, drainages, former haul road, and work area; the Ruby Mines No. 3 drainages; RUBY-018 and RUBY-019 vents; and the RUBY-011 shaft.

- The Cretaceous-age Mancos Shale Formation consists of three members, which are predominantly composed of shale, mudstone, and siltstone, but also include layers of limestone and sandstone. The Mancos Shale is a lithified unit ranging up to 100 feet thick. The Mancos Shale weathers readily, has eroded away from upland areas, and is covered by soils and vegetation across much of the mapped extent (USGS, 1990). The Whitewater Member of the Mancos Shale is present at the surface at the RUBY-001 adit, RUBY-004 vent, and RUBY-016 prospect. The Mancos Shale Unit B is the surface geologic unit at the Ruby Mines No. 3 adit (RUBY-003), capped waste rock pile, exploratory borehole area, dewatering area, former haul road, and work area; the RUBY-017 shaft and RUBY-020 prospect; and the residence near the Ruby Mines No. 3.
- The Cretaceous-age Dakota Sandstone Formation consists of fine-to-medium-grained, well-sorted sandstone with inter-bedded siltstone and shale (USGS, 1990). Uranium roll-front deposits have been noted in a few regions within the Dakota Sandstone (Myers, 2010). The Dakota Sandstone formation is present beneath the entire Ruby Mines Site and is overlain in some areas by Mancos Shale, alluvium, colluvium, and other formations. Dakota Sandstone is relatively resistant to erosion; therefore, it forms much of the rocky outcrops and is exposed on many of the upland areas. The Dakota Sandstone is folded, and the thickness of the main body ranges between approximately 140 and 190 feet (USGS, 1990). The Twowells Tongue Member of the Dakota Sandstone is exposed at the surface across large upland areas of the Site, but it is thinner, with thicknesses up to approximately 60 feet (USGS, 1990). The Twowells Tongue of the Dakota Sandstone is the surface geologic unit at the Ruby Mines No. 1 exploratory borehole area; the RUBY-002, RUBY-015, and RUBY-022 vents; the RUBY-021 prospect; and the residences near Ruby Mines No. 1.

3.3 Cultural Resource Assessment

Cultural resource surveys were performed by Dinétahdóó Cultural Resources Management and overseen by CH2M HILL at the Ruby Mines Nos. 1 and 3 mine features prior to performing closure and site characterization activities. For each mine feature to be closed, a 50-foot-radius area centered on each feature was surveyed.

The cultural resources assessment included archival literature search and interviews with local residents, workers, and Smith Lake Chapter officials, as well as a field survey. A Class I literature search was conducted using archives of the New Mexico Historic Preservation Division and the New Mexico Cultural Resources Information System database to capture previous survey data and previously recorded resources within 1 mile of the Sites. The cultural resources investigation was conducted in a manner sufficient to meet the federal standards for compliance with Section 106 of the National Historic Preservation Act, 36 *Code of Federal Regulations* 800.

A Class III intensive cultural resources survey was conducted to identify prehistoric and historical cultural resources. Fieldwork for the surveys was conducted in August and November of 2013. The field surveys were performed by a crew of two or three qualified archaeologists walking parallel transects spaced at a maximum of 15-meter intervals. Appendix A contains the two cultural resources inventory reports that were filed with the Navajo Nation Historic Preservation Division and BIA, as well as the Cultural Resource Compliance Forms that were issued by the agencies.

The following four significant findings were reported (Figure 2-2):

1. Site No. NM-Q-26-19: Anasazi Habitation and Artifact Scatter and Unknown Historic (1920s to 1960s). The Site is located on a bluff adjacent to the Ruby Mines No. 3 capped waste rock pile. It was fenced under the oversight of a trained archaeologist in April 2014 prior to the May field mobilization. The fence was repaired because of wind damage during September 2014, prior to the October 2014 field mobilization.
2. Site No. NM-Q-26-20: Anasazi Habitation and Artifact Scatter. The Site is located atop a bluff on the southern side of the former haul road leading to Ruby Mines No. 3.
3. Site No. NM-Q-39-212: Anasazi Habitation and Artifact Scatter. The Site is located in a field adjacent to the Ruby Mines No. 3 former haul road.
4. Jishcháá: A funerary item is located at the junction of the Ruby Mines No. 3 former haul road and New Mexico Highway 371.

In addition to the significant findings, isolated occurrences were reported by Dinétahdóó Cultural Resources Management at several locations and consisted largely of ceramic sherds. Field staff were instructed not to disturb cultural items. No cultural items were discovered or unearthed during RSE activities.

3.4 Environmental Compliance and Wildlife Protection

A Navajo Natural Heritage Program resource review identified the golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), and Heil's milkvetch (*Astragalus heilii*) as the three protected species potentially occurring in the project area. A review of suitable habitat for the three species determined that it is highly unlikely that Heil's milkvetch is present, or that golden eagles or peregrine falcons would nest within the protective buffer for the RSE activities. Based on the lack of anticipated effects on any protected resources, and verbal consultations with Chad Smith and Andrea Hazelton at Navajo Natural Heritage Program, a Biological Resource Compliance Form was not needed for the proposed activities. Supporting documentation is provided in Appendix A.

Bats were potentially identified to use the mine adits as habitat. Therefore, mine closure design included bat gates to allow access to the subsurface.

Although not required under CERCLA, a permit was obtained for water used in dust control at the request of the Navajo Nation, and dust suppression was instituted during mine feature closure activities. Disposal of trash from the RUBY-018 vent was reported to USEPA as specified in the ASAOC. Stormwater protection permits were not required under CERCLA, and would not have been required at a non-CERCLA project because minimal areas, less than 1-acre total, were disturbed by large equipment.

SECTION 4
Field Activities and Methods

Field investigations proceeded from reconnaissance and identification of mine features to site characterization. The following sections summarize the methodology that was used to perform the work. A more detailed description of the work performed can be found in the site characterization work plans.

4.1 Adit and Vent Closure

The following nine features were closed by HMOSP during the April and May 2014 mobilization:

- Two adits (RUBY-001 and RUBY-003)
- Three vents (RUBY-002, RUBY-004, and RUBY-018)
- Two shafts (RUBY-017, and RUBY-021)
- Two prospects (RUBY-016 and RUBY-020)

The closure process selected was tailored to the characteristics of each individual feature. Closure materials were transported to the mine features by truck, utility vehicle, and backpack. Dust suppression equipment, excavator, and fill soil were transported to the Ruby Mines No. 1 adit through minor improvements to the unmaintained section of the former haul road. Access to other features was through existing roads or trails. The access road to RUBY-004 (vent) and RUBY-016 (prospect) required minor improvements, which were performed by hand.

Polyurethane foam (PUF), native fill, and borrow fill was used to close features. PUF is a very stable compound that adheres to the existing structure and, upon solidification, is very resistant to decay or erosion. The PUF consists of foam material that is poured over a bulkhead and allowed to set. The PUF material was supplied and manufactured by Foam Concepts and mixed onsite from a two-part liquid formula. The material was delivered in easily transportable boxes and sets of 55-gallon drums. PUF is 50 times lighter than concrete, inert, and able to form a permanent positive seal. Depth requirements for the PUF were determined by the foam manufacturer's recommendations. The depth of the PUF installed within an opening was not less than the smallest diameter of the opening, with a minimum of a 4-foot depth for adits. The PUF is sensitive to degradation by ultraviolet, so backfilling was performed as soon as possible after the PUF had set. Bat gates, where necessary, were installed to provide access to ecologically sensitive species.

Borrow material adjacent to the mine feature was used as backfill where practicable. Backfill was placed in the mine feature manually or with small excavation equipment. At RUBY-001, where significant quantities of backfill material were required, and where use of local material would create disturbance or potential erosion, offsite clean backfill was imported. Five potential sources of offsite backfill material were identified and tested for geotechnical parameters, metals, and Ra-226 (Appendix B). Offsite backfill material was obtained from the Schumacher Pit in Thoreau, New Mexico. Backfilling was accompanied by selective grading to address unstable slopes and improve surface water drainage, as needed.

Per Appendix A, Section 5.1.2, of the ASAOC, four bilingual (English and Navajo) warning signs were installed at likely access locations to Ruby Mines Nos. 1 and 3 capped waste rock piles during the April and May 2014 field event. The exact location of each sign was set in the field in consultation with USEPA (see Appendix C, photograph 20). Smaller warning signs were also left in place directly adjacent to the closed features RUBY-001 and RUBY-003. Damaged warning signs at Ruby Mines No. 3 capped waste rock pile were observed in October 2014 and replaced in November 2014.

4.2 Background Reference Areas—Radiation Survey and Soil Sampling

Radiation measurements from background reference areas were collected for calibration and for comparison with radiation data from mine features. Section 2.2 of *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (USEPA, 2000) defines a background reference area as "a geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units. The background reference area is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the survey unit(s) being investigated to be surveyed but has not been affected by site activities."

Three background reference areas were selected as described in the approved site characterization work plans to characterize the three predominant geologic formations on which field radiation surveys and soil analytical samples were collected. The Dakota Sandstone formation is the geologic unit in which the ore body lies. Overlying the Dakota Sandstone formation is the Mancos Shale formation, which underlies some surface mine features. Alluvial sediments making up the colluvium formation are present largely in low-lying areas and drainage channels, are derived from various materials, and are heterogeneous in composition. The Mancos Shale and Dakota Sandstone background reference areas were selected based on USGS geologic maps and were verified in the field to be free of anthropogenic interference. The background reference areas were selected at higher elevations with relatively low topographical relief where they would be subject to less interference by drainage and wind-blown dust. The background reference areas were selected upgradient or cross-gradient of prevailing wind from the Ruby Mines and nearby unassociated mine sites. The colluvium background reference area was selected at the head of one drainage feature that formed over both Mancos Shale and Dakota Sandstone materials. The three background reference areas each cover an area of approximately 2 acres.

Before the radiation surveys were performed, the 2-acre survey area and 25 predetermined soil sample locations at each background reference area were logged using a handheld Trimble XT Pro GPS unit and marked using orange pin flags. Background reference areas and soil sample locations are shown in Figure 4-1 (Mancos Shale), Figure 4-2 (colluvium), and Figure 4-3 (Dakota Sandstone). A radiation technician traversed 6-foot transects at a rate of 1 to 2 feet per second, holding the detector 6 inches above the ground surface. At each marked soil sample location, a 1-minute static gamma radiation measurement was collected. A soil sample was collected from 0 to 0.5 foot below ground surface (bgs) at each location and placed in a disposable bag. Prior to placement of soil into the sample container, a 1-minute static gamma radiation measurement was collected by placing the detector probe directly on top of the disposable bag containing the soil sample. Additionally, the soil sample at each location was logged according to Unified Soil Classification System methods. In situ and disposable bag readings were recorded on the soil sample logs (Appendix C). Soil samples were then placed in unpreserved glass jars and labeled with the sample identification (ID), date, and time. Samples were stored in coolers and kept on ice. Samples collected from background reference areas were submitted for laboratory analysis to ALS Environmental Laboratory in Fort Collins, Colorado (ALS) and analyzed for Ra-226 by USEPA Method 901.1. Twelve of the 25 samples collected from each background reference area were analyzed at ALS for metals (arsenic, mercury, molybdenum, selenium, uranium, and vanadium) by USEPA Method 6020.

4.3 Mine Features—Radiation Surveys

The radiological characterization of surface soils was performed by walkover and drive-over surveys of selected areas following the requirements of the site characterization work plans. Both continuous and static (timed, direct) measurements were collected. Initial radiation surveys were performed in April and May 2014. The areas covered by radiation surveys were significantly larger than originally included in the site characterization work plans based on field observations and in consultation with USEPA and NNEPA.

Subsequent to data processing and review, additional surveys were performed at Ruby Mines Nos. 1 and 3 in October 2014 to provide additional coverage.

A Ludlum Model 44-10 2-inch-by-2-inch sodium iodide (NaI) gamma scintillation detector connected to a Ludlum Model 2221 scaler/ratemeter, coupled with a Tremble XT Pro GPS handset for automated data logging was used to collect survey measurements. The Ludlum Model 44-10 detects gamma radiation in the soil that exceeds a specific selected energy, including gamma radiation emitted from bismuth-214, a decay product of Ra-226. The instruments were maintained and operated in accordance with their respective technical manuals and approved operating procedures. Each detector and scaler/ratemeter set was calibrated in accordance with American National Standards Institute (ANSI) N323A: *Radiation Protection Instrumentation Test and Calibration—Portable Survey Instruments* (ANSI, 1997). Testing was performed for each instrument set daily before use to document a reproducible response to a radioactive check source. Instrument and calibration documentation is included in Appendix C.

A radiation technician traversed each transect at a rate of 1 to 2 feet per second, holding the detector 6 inches above the ground surface. A secondary survey method was used for the former haul roads and capped waste rock piles that were accessible by vehicle. For this method, a trailer-hitch attachment was connected to the rear of the vehicle and equipped with two sets of surveying equipment mounted approximately 3 feet apart. The method was approved by USEPA and NNEPA in the field. The vehicle speed was maintained at a rate of 3 to 5 feet per second, and the detector height was set 6 inches above the ground surface. Radiation surveys were performed primarily along transects 6 feet apart; however, depending on the specific survey area or location, transects varied due to buffer area overlap and field conditions (steep slopes, dense tree cover, steep rock ledges, and deep incised ravines that limited the potential for contaminant migration and that created safety issues for field staff). In addition, transect density was decreased in areas far from mine features. The survey was extended laterally at the discretion of field staff and regulatory agency representatives to delimit the extent of the areas. Detector collimators were used during the radiation surveys on the former haul road from the Ruby Mines No. 1 capped waste rock pile north to the intersection of Wolf Canyon Road to collect a secondary data set to document sufficient detection sensitivity in areas where ambient background levels of radioactivity were elevated. The collimated data was segregated from the uncollimated data.

4.3.1 Field Screening Level

The ASAOC scope of work defined the term "investigation level" for Ra-226 as 1.24 picocuries per gram (pCi/g) above background, which would be used during fieldwork implementation (in equivalent counts per minute [cpm]) to decide when additional survey coverage was necessary. However, background levels for the three background reference areas had not been established prior to initiating the Phase 2 investigation in April and May 2014. Thus, the investigation level could not be calculated prior to Phase 2 mobilization. Measured values at the background reference areas ranged from 6,367 cpm to 13,493 cpm. Therefore, a new term, called the field screening level, was set at 13,000 cpm, which was consistent with the approximate maximum of the measured cpm in the background reference areas. Note that this field screening level is not equivalent to the investigation level defined in the ASAOC. The field screening value is simply a value used during the fieldwork to evaluate when additional surveying was required.

4.3.2 Adits, Capped Waste Rock Piles, and Work Areas

Radiation surveys were conducted over the capped waste rock piles and adjacent adits and work areas along 6-foot transects. Flat, unvegetated sections of the capped waste rock piles were surveyed using the vehicle and trailer system, and other areas were walked. The surveys also included a minimum 100-foot buffer around the perimeter of each capped waste rock pile. Additional survey measurements were collected beyond the 100-foot buffer until the field screening level was consistently observed, where field conditions permitted. Transect density was decreased (width between transects was wider) in areas far from the capped waste rock piles after consultation with USEPA and NNEPA.

4.3.3 Drainages

Continuous radiation surveys were performed along surface water drainages that convey runoff from the Ruby Mines No. 1 and No. 3 capped waste rock piles. Per the approved site characterization work plans, surveys were performed along the centerline of the drainage, along the top of the bank on each side of the drainage, and approximately 8 feet away from top of bank on both sides of the drainage, except where noted.

At Ruby Mines No. 1, drainages A, B, and C were surveyed as specified above. The centerline survey of drainage D was completed only at the section downgradient of the capped waste rock pile to the intersection with Wolf Canyon Road. The section closest to the cap was not surveyed for safety reasons due to steep rock ledges and deep incised ravines. The top bank survey and 8-foot step-out was performed only along the east-side bank of drainage D because the extreme depth of the drainage would prevent migration through runoff to the area west of the drainage channel.

The survey of the Ruby Mines No. 3 drainages was performed along the center of the drainage, the top of the banks, and along 8-foot step-outs from and parallel to the banks. At the drainages, additional step-out measurements were collected in accessible areas until the field screening level of 13,000 cpm was consistently observed.

4.3.4 Former Haul Roads

Continuous radiation surveys were performed on the former haul roads from Ruby Mines No. 1 and No. 3. Survey measurements were collected along the centerline, shoulders, and along 8-foot step-outs parallel to each former haul road, where accessible. The vehicle and detector systems were used to collect measurements for the centerline surveys. For the surveys performed on the shoulders of the road and the 8-foot step-outs, measurements were collected by walkover survey.

4.3.5 Exploratory Borehole Areas

Continuous radiation surveys were performed at exploratory borehole areas near Ruby Mines Nos. 1 and 3. Exploration activities were conducted prior to mining in an area extending from Ruby Mines No. 1 to Ruby Mines No. 3. To evaluate if surface soils near the former boreholes were impacted, two representative areas were selected for surveying. Each area was approximately 1 acre in size and contained a number of former borehole locations. The radiation surveys were conducted along transects 6 feet apart over each 1-acre area.

4.3.6 Vents, Prospects, and Shafts

Radiation surveys were performed at each feature. For open mine features (vents, prospects, and shafts), the radiation surveys were completed following closure. The surveys were performed by walking in concentric circles from the center to the perimeter of each closed feature. Radiation survey measurements were also collected at a 10-to-15-foot radius from the perimeter. Step-out measurements were collected at locations until the field screening level of 13,000 cpm was observed. Additionally, survey measurements were collected by surveying 100-foot north–south and east–west transects from the center of each feature.

4.4 Nearby Residences—Radiation Surveys

Radiation surveys were performed at three residences near Ruby Mines No. 1 and at one residence near Ruby Mines No. 3. Radiation surveys were performed on the outside of building foundations and a 15-foot radius around the homes and structures. Additional survey measurements were collected beyond the 15-foot buffer until the field screening level of 13,000 cpm was consistently observed.

4.5 Soil Characterization

A surface and subsurface soil sampling investigation was conducted in April, May and October 2014 to characterize the extent of COPCs. The COPCs were divided into a list of primary COPCs (Ra-226 and metals [arsenic, vanadium, molybdenum, selenium, uranium, and mercury]) and secondary COPCs (volatile organic compounds [VOCs], total petroleum hydrocarbons [TPH] diesel range organics [DRO], gasoline range organics [GRO], and motor oil range organics [MRO], semivolatile organic compounds [SVOCs], perchlorate, explosives, and polychlorinated biphenyls [PCBs]). The secondary list of COPCs was only analyzed in soil samples from the work areas associated with Ruby Mines Nos. 1 and 3.

Soil sampling was performed according to the approved site characterization work plans. Radiation measurements were used to select final soil sample locations and sample depths, and to provide additional characterization information. Static, walkover, and sample on-contact radiation measurements were collected in association with soil sampling. Soil samples were collected and analyzed in laboratories for the primary and secondary COPCs, agronomic parameters, and engineering parameters. The field sample methods, soil screening readings, and laboratory analysis are summarized in the following subsections.

4.5.1 Soil Sample Radiation Survey

For surface samples, static radiation measurements were collected prior to soil sample collection to identify sample locations. Static radiation measurements were collected at 6 inches above the ground for 1 minute, and locations were documented by GPS. Collimated (shielded) and uncollimated (unshielded) static radiation measurements were recorded with a Ludlum Model 44-10 2-inch-by-2-inch NaI scintillation detector. The detector was connected to a Ludlum Model 2221 scaler/ratemeter. Readings are recorded in the surface soil logs in Appendix C.

For soil borings, on-contact gamma radiation measurements were collected along the soil cores. Sample depth selection was determined by lithology, as well as radiation measurements. In areas with elevated background radiation measurements, core screening was performed on truck tailgates in lower radiation areas. Three distinct measurements were used to screen soil borings. Field radiation measurements were collected using collimated and uncollimated direct gamma measurements using the 2-inch-by-2-inch NaI detector. In addition, total radiation measurements were collected with a Geiger-Muller (GM) Ludlum 44-9 pancake probe to provide additional data that was less subject to background gamma radiation. The total radiation measurements were not originally planned, but provided useful information for the site characterization. Soil radiation measurements are presented in the boring logs in Appendix C. Soil borings were also screened visually and with a photoionization detector (PID) during sampling and logging. Visual screening included observing the soil core for staining and/or mottled colorations. Core with coloration or mottling uncharacteristic of native soils was screened with a PID in the field prior to sample collection. PID readings are presented in the boring logs in Appendix C.

4.5.2 Soil Sampling

Surface and subsurface soil sampling was performed according to the approved site characterization work plans to meet the following three objectives: (1) provide data for a correlation of Ra-226 measurements in surface soil with field gamma radiation survey results, (2) provide data to evaluate the nature extent of impact of COPCs at the associated mine features, and (3) provide information for use in evaluating soil used in waste rock caps.

For surface soil samples, a static reading (collimated and uncollimated) was collected and the location was recorded with GPS. Surface vegetation and debris were removed, and a discrete grab surface soil sample was collected using manual methods, such as a disposable trowel, a decontaminated garden trowel, and/or a decontaminated hand auger. The sample materials were placed in disposable bags to allow for field screening and logging. Where possible, soil materials were collected using plastic, disposable trowels with gloved hands and dedicated sample jars to prevent contact with metal implements. In dense, rocky, or indurated soils, decontaminated hand augers or digging bars were used to loosen and collect samples.

For soil borings, soil cores were collected using a GeoProbe 7730DT direct-push rig. The direct-push tool was a MacroCore with 2.25-inch-diameter core barrel with standard drive point and sand catchers, where necessary. Cores were advanced in 5-foot intervals. Static radiation measurements were taken along the length of each soil core to assist the field team in assessing when unimpacted soil was reached. Unimpacted soil was evaluated using professional judgment and the following three criteria: (1) measurements below

100 cpm on a GM probe, (2) measurements below the field screening level (13,000 cpm) on a NaI detector, and (3) visual observation of oxidized clayey soils native to the area. Both surface and subsurface soil samples were collected from soil borings. Soil boring logs are presented in Appendix C.

Primary COPCs for the Site included Ra-226 and select metals, including arsenic, mercury, molybdenum, selenium, uranium, and vanadium. Ra-226 was analyzed by USEPA Method 901.1, with a standard 21-day in-growth. In a closed system, the Ra-226 daughters are in equilibrium (equal activity concentrations) with their parent radionuclide. However, during sampling activities, Ra-226 and its daughters are partially depleted due to the emanation of radon-222, which is a noble gas at standard temperature and pressure. The loss of radon-222 creates an unequilibrated lead-214 (Pb-214)/bismuth-214 (Bi-214) concentration. The fraction emanated varies with the containing matrix and atmospheric conditions. The typical emanation is in the range of 20 to 30 percent. That is, results of analysis of Pb-214/Bi-214 would indicate a 20 to 30 percent lower Ra-226 concentration. Once a sample is sealed, daughter product in-growth follows the 3.8-day half-life. After 3.8 days, half of the daughter products are restored. After 7.6 days, three-fourths of the daughter products have grown in, and at 20 days, about 97 percent have grown in. After 20 days, Pb-214/Bi-214 can be considered to be in equilibrium with parent Ra-226. At equilibrium, the higher-abundance Pb-214/Bi-214 provides a quantitative result for Ra-226, having less uncertainty than quantification from the lower-abundance 186-kiloelectron-volt gamma ray directly from Ra-226. Arsenic, molybdenum, selenium, uranium, and vanadium were analyzed by Method 6020, and mercury was analyzed by Method 7470.

Secondary COPCs included analysis of volatile organic compounds by Method 8260B, semivolatile organic compounds by Method 8270C, polychlorinated biphenyls by Method 8082, total petroleum hydrocarbons (TPH) diesel range organics and TPH gasoline range organics by Method 8015-E, perchlorate by Method 6850, and explosives by Method 8330B.

Soil sampling was performed in areas where the radiation survey measurements were more than the field screening level based on the following rationale:

- **Capped waste rock piles:** Soil samples of the cap, waste rock, and soil underlying the waste rock were collected at eight locations at Ruby Mines No. 1 and seven locations at Ruby Mines No. 3. Although the cap at Ruby Mines No. 1 was reported to be 10 feet thick, visual observations in the field indicated that the cap averaged 1 foot thick; therefore, soil samples of the cap were collected at a depth of 0 to 0.5 foot bgs. The cap at Ruby Mines No. 3 was reported to be 1 foot thick and was sampled at 0 to 0.5 foot bgs. Waste rock was sampled every 5 feet until the bottom of the waste rock pile was encountered. Soil beneath the waste rock was sampled from 1 to 1.5 feet below the waste rock. The boring was advanced until field screening indicated that unimpacted soil had been encountered and a sample was collected. Capped waste rock pile soil samples were analyzed for primary COPCs.
- **Drainages and former haul roads:** Soil samples were collected at select locations that exhibited radiation survey measurements above the field screening level along the drainages and two former haul roads. Soil samples were collected from 0 to 0.5, 1 to 1.5, and 5 to 5.5 feet bgs at each location, except for an isolated location on Wolf Canyon Road near BIA 49 where only surface samples were collected. Drainage and former haul road soil samples were analyzed for primary COPCs.
- **Work areas at Ruby Mines Nos. 1 and 3:** Soil samples were collected at locations where historical information and current physical evidence indicated structures such as the mechanics shop, changing rooms, and offices were located. Samples were collected at 0 to 0.5, 1 to 1.5, and 5 to 5.5 feet bgs. Work area soil samples were analyzed for primary and secondary COPCs.
- **The Ruby Mines No. 1 Stepout Area:** Stepout areas were designated as areas outside of known mine-related-impacted areas that exhibited high radiation survey measurements. While there was no available historical information about mine-related activities in these areas, the areas were evaluated in the site characterization process similarly to mine-related areas based on the radiation survey

measurements. Soil samples were collected at 0 to 0.5, 1 to 1.5, and 5 to 5.5 feet bgs. Stepout area samples were analyzed for primary COPCs.

- **Vents (RUBY-002, RUBY-004, and RUBY-019):** Each vent area was sampled at three locations to estimate the aerial extent of COPCs. Because surface deposition of COPCs is unlikely to have impacted soil at depth, samples were collected at typical depths of 0 to 0.5 and 1 to 1.5 feet bgs, and slightly modified as needed in the field based on access with hand tools. Vent soil samples were analyzed for primary COPCs.
- **Correlation samples:** Correlation soil samples were analyzed for Ra-226 to develop a correlation between radiation survey measurements and Ra-226 concentrations measured in the laboratory. For correlation samples, static radiation survey measurements were collected with collimated and uncollimated direct gamma-radiation-level measurements using the 2-inch-by-2-inch NaI detector. Surface soil samples were collected at locations where soil was most likely to provide representative samples that could be correlated to radiation survey measurements.

  During the April and May 2014 sampling event, 16 correlation samples were collected. Surface soil samples (0 to 4 inches) were collected at locations where surface radiation survey readings were approximately 1.0 to 20 times the field screening level. During the October sampling event, a surface soil sample (0 to 6 inches) was collected for inclusion in the correlation study from each of the above-described site characterization soil borings. To provide more resolution in the lower range of the correlation, 30 surface samples (0 to 6 inches) were collected during the October 2014 sampling event at various locations with radiation survey readings between 1.5 and 3.0 times the field screening level.

4.5.3 Supplemental Sampling

Four samples, two from each of the capped waste rock piles, were collected and analyzed for agronomic and engineering parameters to evaluate the soils used to cap the waste rock piles. Surface soil was collected with the Geoprobe to provide intact core for analysis of engineering parameters. Samples were analyzed for the following:

- **Agronomic parameters:** total organic carbon by Method ASA-9 90-3, cations (calcium, magnesium, phosphorus, potassium, and sodium) by Method 6010, anions (chloride, nitrate, and sulfate) by Method 9056, pH by Method 9045C.
- **Engineering parameters:** bulk density by method ASTM International D7263; liquid limit, plastic limit, and plasticity index by Method ASTM International D4318; Unified Soil Classification System classification by Method D2487, and particle size distribution by Method D422.

4.6 Light Detecting and Ranging (LIDAR)

LIDAR (light detecting and ranging) remote sensing technology was used at Ruby Mines Nos. 1 and 3 capped waste rock piles and adjacent areas to develop detailed topographic information to support volume estimates, particularly for the waste rock piles. This technology uses optical reflection to survey the land surface.
The LIDAR equipment was mobilized to the Site during the October field investigation, but heavy rains prevented completion of the survey. The LIDAR survey was completed between November 4 and 6, 2014. Laser arrays were shot from multiple locations to create coverages for the Ruby Mines Nos. 1 and 3 capped waste rock pile and surrounding areas. This data were tied to GPS ground station information and were processed and corrected to remove noise from vegetation, dust, and site activity. The survey data were converted to 1-foot contoured digital terrain models (DTM).

4.7 Health and Safety

The fieldwork at the Site was conducted in accordance with the health and safety plans included in the approved site characterization work plans, which identified and outlined necessary safety precautions and nearby medical facilities and resources. Daily safety briefings were conducted with field staff. A safety audit was conducted by a Freeport Safety Officer during the May 2014 field mobilization and by CH2M HILL during the October 2014 field event with positive results and no major deficiencies reported. In addition to routine safety precautions for heavy equipment operation and rugged field conditions, radiation exposure monitoring was performed for workers entering and leaving mine feature areas. The results of radiation exposure monitoring indicated that no field staff were exposed to significant health risks. Air monitoring performed upwind and downwind of closure activities demonstrated that offsite transport of dust did not occur during closure activities.

Fugitive dust was controlled as follows:

- Vehicle speed was limited on unpaved surfaces to minimize dust generated. At the request of local residents, vehicles were driven on vegetated areas rather than dirt roads, where possible.
- Water was used for dust control during closure of RUBY-001.
- Work was suspended during and after heavy rainfall until roads were accessible.

4.8 Quality Assurance/Quality Control

The quality of laboratory data was assured by following standard laboratory and field sampling methods, by collection of quality assurance (QA)/quality control (QC) samples, and by validation of the laboratory data. Laboratory and field sampler compliance with the quality assurance project plan (QAPP) was verified by field oversight, project chemist laboratory review, and data validation. Field duplicates, matrix spike, and matrix spike duplicate samples were collected according to the QAPP. USEPA did not request replicate split samples.

Field screening data quality was assured by following the standard operating procedures (SOPs) and routine inspection of instrument calibration records. The instrumentation used during this effort was maintained per manufacturer's specifications and calibrated in accordance with ANSI N323A: *Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments* (ANSI, 1997). Daily QC checks were performed for the instrumentation used to collect radiation data. The QC checks were consistent with the MARSSIM guidance and SOPs for the project. The daily QC checks confirmed that the instrumentation was operating within acceptable tolerances and in accordance with the SOPs.

4.9 Decontamination, Investigation-derived Waste, and Personnel Monitoring

Decontamination procedures were designed to minimize health risk for field staff and to minimize transport of potential radiation containing materials. Non-disposable field sampling equipment and radiation meters were thoroughly decontaminated. Gross decontamination was performed on reusable personal protective equipment (PPE) and field equipment not used for sampling and field measurements, to mitigate the transport of, and minimize exposure to dust and soil with potentially elevated radiation levels. Soil sampling equipment such as hand auger, trowels, and scoops that contacted soils were decontaminated prior to sampling, between each sample location, and daily after sampling. Sampling equipment was thoroughly decontaminated by removing sediment and dust with decontamination wipes and disposable towels. Reusable PPE, such as boots and hardhats, was decontaminated after field staff exited areas with potential for elevated radiation levels.

Investigation-derived waste (IDW) generated during fieldwork activities included household garbage and PPE. Waste was segregated, screened, and disposed based on radiation survey measurements. The majority of the waste was disposed as household waste or managed in a manner to prevent waste accumulation. Household garbage included food, water bottles, packaging material, used disposable sampling equipment, and wooden stakes or pin flags. This material was bagged or otherwise containerized during field activities, and disposed in a container for municipal garbage.

Soil was managed in a way that mitigated waste accumulation. Excess sample material was returned to the borehole or ground surface location from which it was initially collected after samples were placed in containers, and no material was accumulated. Non-disposable sampling equipment and PPE were decontaminated near sample locations so soil particles were returned to the general location from which they came.

Disposable PPE and decontamination wipes (including materials such as gloves, chemical wipes, and paper towels) were placed with like materials in appropriately labeled 55-gallon drums, or 5-gallon buckets with lids. At the end of the field event, the PPE was surveyed and found to be consistent with background readings at 0.02 to 0.04 milliroentgen per hour. The material was disposed of as household waste.

SECTION 5

Investigation Results

The RSE objective was to evaluate the nature and extent of radionuclides and chemical constituents at the Site. To achieve this, radiation surveys were performed and surface and subsurface soil samples were collected and analyzed. The results of the background investigation, radiation surveys, soil sampling, and soil correlation, are presented in the following subsections.

5.1 Adit and Vent Closure

A team composed of HMOSP, CH2M HILL, and Perma-Fix staff mobilized on April 28, 2014, to perform physical closure of open mine features to mitigate physical hazards. HMOSP staff performed the physical closures using manual and mechanical methods. Perma-Fix staff performed radiological monitoring, and CH2M HILL coordinated field staff. Coordination and training meetings were held on April 29, 2014, and the physical closure of open mine features was performed from April 30 to May 7, 2014. Temporary fencing was removed, and nine features were closed according to the Phase 1 work plan (CH2M HILL, 2013a). Two field teams were used to perform the physical closure. One field team worked predominantly at the Ruby Mines No. 1 adit (RUBY-001), which required the greatest amount of earth moving and PUF installation activities. The opening of RUBY-001 was enlarged to allow for safe access of staff and heavy equipment along under-cut edges of the opening, which resulted in the use of additional PUF and fill soil. The second team performed physical closures at the Ruby Mines No. 3 adit (RUBY-003) and other open features (see Table 3-1 and photographs in Appendix C). Bat gates were installed at RUBY-001 and RUBY-003, and a vent tube was installed at the RUBY-017 shaft. Non-hazardous waste (that is, household and farm trash) was removed from the RUBY-018 vent prior to closure activities and disposed at an offsite landfill. Waste manifests are provided in Appendix D. Additional details of mine feature closure activities are presented in the Phase 1 report (CH2M HILL, 2014c).

5.2 Background Reference Areas

The background investigation provided data to assess background conditions using radiation survey measurements and surface soil concentrations for Ra-226 and metals. The background reference areas were selected at three geologic units (colluvium, Mancos Shale, and Dakota Sandstone) in which the underlying geology was representative of conditions at the Ruby Mines Site and that were not impacted by historical mining activities.

5.2.1 Background Reference Area Soil Sample Results

The laboratory analytical results for soil samples collected within the three background reference areas are summarized in Table 5-1. Laboratory reports are provided in Appendix B and soil sample logs are provided in Appendix C.

The background data sets were evaluated for statistical integrity and usability. The evaluation was performed for each analyte population within each geologic unit. The process included the following three steps:

1. Summary statistical calculations were reviewed to assess the range of values.
2. Data sets were assessed for distribution of concentrations.
3. Potential outliers were identified using standard statistical outlier calculations available in the USEPA ProUCL version 5.0.00 (USEPA, 2013) statistical calculation software tool.

Documentation of statistical calculations is provided in Appendix E.

Summary statistics (Table 5-2)**:** A review of Table 5-2 metals indicates that the data collected within the three background areas was consistent with literature values. Typical concentrations of metals in non-ore grade geologies are typically below 30 milligrams per kilogram (mg/kg) for arsenic, mercury, and molybdenum, and below 100 mg/kg for selenium, uranium, and vanadium (USGS, 1968; Myers, 2010). The range in detected concentrations was generally around one order of magnitude for each analyte, which is consistent with random sampling of heterogeneous material. Distinct populations were apparent at the three background reference areas, with the lowest metal concentrations generally found in the soils sampled from Dakota Sandstone. Low metals concentrations in the Dakota Sandstone are due to the abundance of felsic minerals and lesser amount of mafic minerals[1]. Higher concentrations and higher variability in concentrations were generally found in the colluvium and soils developed from Mancos Shale due to the higher prevalence of fine soil textures and mafic minerals in the source rocks.

Assessment of distribution (Appendix E-1, summarized in Table 5-2): ProUCL indicated that metals data sets were consistent with normal distributions, with the exception of mercury in the Mancos Shale background reference area. Mercury detections in Mancos Shale soils did not fit any known pattern; therefore, nonparametric methods were used as recommended in Section 3.4.4 of the ProUCL technical guidance.

Identification of Outliers (Appendix E-2): Mathematical outliers were identified using the Dixon's test for the metal analytes (Dixon, 1953) and Rosner's test for Ra-226 (Rosner, 1983). The data sets for arsenic, molybdenum, selenium, uranium, vanadium, and Ra-226 were representative of the expected range of concentrations, given the known site conditions, and no outliers were identified. For mercury, two data points appeared to be potential outliers. The mathematical outliers identified for the mercury data sets were separated from the other data by two standard deviations. However, the range of detections for mercury was 0.013 to 0.031 mg/kg, and inclusion of the outliers was not expected to skew the data significantly. Therefore, the full data set for mercury was used.

5.2.2 Background Reference Area Radiation Survey Results

Table 5-2 presents the summary statistics for the background reference area radiation survey results. The data within each background reference area were indicative of a separate background population. The radiation survey data were plotted over an aerial image for each geologic unit and the data were color-coded based on variability from the mean. The following is a description of each area with relation to the survey conducted:

- **Mancos Shale background reference area** (Figure 5-1): The Mancos Shale background reference area was very flat, with low brush and minimal trees. A dirt road that bisected the area was excluded from the walkover radiation survey because of potential anthropogenic impacts. The radiation survey measurements in the Mancos Shale background reference area ranged from 9,028 to 13,132 cpm, with an average of 11,036 cpm.
- **Colluvium background reference area** (Figure 5-2): During the survey, visual observations of the area included powdery native soils and no evidence of mine-impacted materials. A deep incised drainage channel was encountered and was not surveyed due to safety concerns. The radiation survey measurements in the colluvium background reference area ranged from 9,102 to 13,493 cpm, with an average of 11,290 cpm.
- **Dakota Sandstone background reference area** (Figure 5-3): The Dakota Sandstone background reference area was located in an area densely populated with trees; therefore, it was not possible to perform transects in parallel lines as specified in the work plan. The radiation technician used professional judgment to provide adequate coverage. Additionally, an incised drainage channel that transected the background reference area was avoided for health and safety reasons. The radiation survey measurements in the Dakota Sandstone background reference area ranged from 6,367 to 11,504 cpm, with an average of 9,272 cpm.

[1] Mafic minerals have heavy metals in their atomic structures as opposed to felsic minerals, which are abundant in sandstones and are composed largely of silicon, oxygen, and aluminum.

5.2.3 Calculation of Background Comparison Values

A background comparison value, that is "background", was calculated for each geologic unit because the analytical data were found to have separate and distinct populations. The background for primary COPCs and radiation survey measurements are summarized in Table 5-3. For radiation measurements (cpm), the background for each geologic unit was calculated as the mean plus two standard deviations. For metals and Ra-226 concentrations in soil, the background comparison value was calculated using the 95-95 Upper Tolerance Limit (UTL) for each analyte in each geologic unit based on the distribution of the data set. Statistics were calcuated using ProUCL. The ProUCL supporting documentation is provided in Appendix E. The background comparison values were used to determine the ASAOC criteria for arsenic and for Ra-226, as described in Section 5.5.

5.3 Mine Feature – Radiation Surveys

The radiation survey results for each mine feature were compared to multiples of the geology-specific background in that area (see Table 5-3). The following levels are used for data comparisons:

Geology	Mancos Shale	Dakota Sandstone	Colluvium
<2 times background	<23,892 cpm	<20,636 cpm	<24,808 cpm
2 to 3 times background	23,892 to 35,838 cpm	20,636 to 30,954 cpm	24,808 to 37,212 cpm
>3 times background	>35,838 cpm	>30,954 cpm	>37,212 cpm

5.3.1 Ruby Mines No. 1

An overview of Ruby Mines No. 1 is shown in Figure 5-4.0. Detailed subarea maps are provided for smaller sets of mine features for ease of review. Each subarea is described in detail in the following paragraphs.

RUBY-001 Adit, Capped Waste Rock Pile, Work Area, and Stepout Area

Figure 5-4.1 presents a detailed view of the RUBY-001 adit, capped waste rock pile, and work areas.

- **RUBY-001 Adit:** Approximately 90 percent of the RUBY-001 adit area, which is described as the former adit opening and the slope to the capped waste rock pile, had radiation measurements that were less than two times the Mancos Shale background. This was expected since the adit was closed and filled with clean backfill in May 2014. The remaining 10 percent of the area, on the slope to the capped waste rock pile, had radiation measurements that were between two and three times the Mancos Shale background.
- **Capped Waste Rock Pile:** Approximately 20 percent of the Ruby Mines No. 1 capped waste rock pile had radiation measurements that were greater than three times the colluvium background, especially in localized areas where the soil cap had eroded and waste rock was exposed. Approximately 30 percent of the capped waste rock pile had radiation measurements that were between two and three times the colluvium background. The remainder of the capped waste rock pile, specifically in the southeast portion, had radiation measurements that were less than two times the colluvium background.
- **Work Area:** The Ruby Mines No. 1 work area was characterized by radiation measurements that were greater than two times the Mancos Shale background, with the exception of the concrete pad. The concrete pad was consistently below two times the Mancos Shale background. The work area is bounded topographically on the east by a sheer cut. Radiation activities on top of the cut were below two times the Mancos Shale background.
- **Stepout Area:** During May 2014 field activities, an area to the north of the capped waste rock pile was identified as having gamma radiation activity consistently above two times the Mancos Shale background. The stepout area is characterized by flat colluvial deposits in the central southern portion of the area, and

steep rocky slopes (Mancos Shale formation) in the northern portion of the area. Radiation measurements greater than two times background were concentrated in the southern portion of the stepout area and decreased to below two times the Mancos Shale background on the rocky slopes.

Drainages

The drainages receiving runoff from the capped waste rock pile and surrounding area are labeled and shown in Figure 5-4.2. Radiation measurements in the area nearest to the capped waste rock pile in Drainages A and B were two to three times the colluvium background and exceeded three times the colluvium background in a few isolated locations. The drainage located on the northern edge of the cap (Drainage C) had radiation survey results consistent with the colluvium background. The survey was performed between the cap and the drainage in areas where surface runoff from the cap would flow toward into the drainage channel (Drainage D). The radiation survey results for this area were consistent with the colluvium background, indicating that the surface runoff from the cap likely had not impacted the drainage channel (Drainage D). Drainage D is characterized by several deeply incised channels (up to 20 feet deep in places), with steep banks near the capped waste rock pile. These deeply incised areas of Drainage D could not be accessed by field personnel because of health and safety concerns and Occupational Safety and Health Administration regulations on confined space entry. An approximately 300-foot long section of Drainage D closest to Wolf Canyon Road was safely accessed. Radiation measurements in the accessible portion of Drainage D were less than two times the colluvium background, further supporting that surface runoff from the cap did not impact the drainage channel.

Former Haul Road

The Ruby Mines No. 1 former haul road is shown in Figure 5-4.3. A detailed view of the unmaintained portion of the former haul road, nearest the capped waste rock pile is shown in Figure 5-4.2. Most of the former haul road at Ruby Mines No. 1 was consistently below two times the colluvium background, except at isolated areas. Radiation measurements exceeding two times the colluvium background were sporadic on the shoulders of the unmaintained section of the former haul road. The remainder of the former haul road from the intersection with Wolf Canyon Road to BIA Route 49 had radiation measurements consistently below two times the colluvium background, except for an isolated location adjacent to BIA Route 49. Figure 5-4.4 shows a comparison of uncollimated and collimated data collected along a portion of the unmaintained section of Ruby Mines No. 1 former haul road.

5.3.2 Ruby Mines No. 3

An overview of Ruby Mines No. 3 is shown in Figure 5-5.0. Detailed subarea maps are provided for smaller sets of mine features for ease of review.

RUBY-003 Adit, Capped Waste Rock Pile, Dewatering Area, Drainages, and Work Area

The RUBY-003 Adit, Capped Waste Rock Pile, Dewatering Area, Drainages, and Work Area are shown in Figure 5-5.1.

- **RUBY-003 Adit:** The RUBY-003 adit is adjacent to the southwest edge of the Ruby Mines No. 3 capped waste rock pile. The RUBY-003 adit had radiation survey measurements greater than two times the Mancos Shale background.
- **Capped Waste Rock Pile:** A majority of the capped waste rock pile on the northwest side of the cap was consistently below two times the Mancos Shale background, with isolated occurrences above two times the Mancos Shale background. The capped waste rock pile in this area was relatively flat, and did not appear to have eroded. The remaining areas of the capped waste rock pile to the south and east were consistently above two times the Mancos Shale background in areas where the cap was eroded. An area approximately 50 feet by 125 feet on the southern edge of the capped waste rock pile was not surveyed. This area was fenced after a deeply incised (greater than five feet in places) channel was observed and determined to be a health and safety risk.

- **Dewatering Area:** The radiation measurements in the western portion of the dewatering area were less than two times the Mancos Shale background. The eastern portion of the dewatering area had radiation survey measurements that were generally mostly greater than two times the Mancos Shale background, with the highest radiation measurements closest to the capped waste rock pile.
- **Drainages:** Two drainage areas were included in the Ruby Mines No. 3 survey. One drainage begins to the west of the capped waste rock pile, travels around the north and east, and terminates in a wash to the southeast of the capped waste rock pile. The other drainage starts to the southwest of the capped waste rock pile, continues along the southern border of the pile and empties into a small pond at the southeastern toe of the capped waste rock pile. Neither of the drainage channels, nor the drainage ponds and washes to the east of the capped waste rock pile, had radiation survey measurements above two times the colluvium background.
- **Work Area:** The work area is located south and west of RUBY-003 where historical mine-related activities (for example, maintenance and storage) occurred. The radiation surveys in the work area indicated a wide range of measurements distributed throughout. Although there is limited historical information about the activities that occurred in the work area, the areas of higher measurements appear to be located around an access road/parking area and building foundations. The areas to the west, south, and east of the work area were bounded by radiation survey measurements less than the Mancos Shale background.

Former Haul Roads

The Ruby Mines No. 3 former haul road is shown in Figure 5-5.2. Generally, radiation measurements along the former haul road from the mine to New Mexico Highway 371 were less than two times the Mancos Shale background. Sporadic radiation measurements from two to three times the Mancos Shale background are present in the area where the unmaintained portion of the former haul road nearest the capped waste rock pile makes a turn to the south.

5.3.3 Exploratory Boreholes, Vents, Shafts, and Prospects

The radiation survey results for the exploratory boreholes, vents, shaft, and prospects are presented in Figures 5-6.1 through 5-6.5, as follows:

- **Figure 5-6.1:** RUBY-018, RUBY-021, and the exploratory borehole area near Ruby Mine No. 1 had radiation measurements that were less than two times their respective backgrounds. RUBY-002 and RUBY-019 had radiation measurements greater than three times their respective backgrounds near the vent that decreased as the survey moved away from the vent.
- **Figure 5-6.2:** RUBY-016 had no radiation measurements greater than two times the Mancos Shale background. RUBY-004 had the highest radiation measurements near the vent, which decreased as the survey moved away from the vent.
- **Figure 5-6.3:** RUBY-017, RUBY-020, and the exploratory borehole area near Ruby Mine No. 3 had no radiation measurements that were greater than two times their respective backgrounds.
- **Figures 5-6.4 through 5-6.6:** The field surveys at RUBY-011, RUBY-015, and RUBY-022 were completed without GPS; therefore, a standard survey form is provided for each feature. There were no radiation measurements at the three features that were above two times their respective backgrounds.

5.4 Nearby Residences – Radiation Surveys

The soil areas surrounding three residential homes near Ruby Mines No. 1 were surveyed, as shown in Figure 5-7. The three residential properties east of the capped waste rock pile had no detectable radiation survey measurements that were greater than two times the Dakota Sandstone background. The soil surrounding the one residence near Ruby Mines No. 3 had radiation measurements that were less than two times the Mancos Shale background.

5.5 Preliminary Remediation Goals

Section 4.5 in the ASAOC defines the preliminary remediation goals (PRGs) for the Site as the USEPA Region 9 Regional Screening Levels (RSLs) for metals and 1.24 pCi/g above the background concentration for Ra-226. The background concentrations for Ra-226 were 1.85, 1.65, and 1.44 pCi/g in the Mancos Shale, Colluvium, and Dakota Sandstone background areas. Metals concentrations were compared to USEPA RSLs or site-specific background (in Table 5-2), whichever was higher.

There are three distinct geologies present at mine features throughout the Site. The majority of mine features, including the larger ones associated with the Ruby Mines Nos. 1 and 3 are located in the Mancos Shale and/or colluvium geologic units. The colluvium is derived from surrounding source rock, including the Mancos Shale and Dakota Sandstone and is thus the most representative of site conditions. For this reason, the colluvium PRG for Ra-226 (2.89 pCi/g), which is a primary risk driver, was used for comparison purposes.

Background concentrations for arsenic in the three background reference areas were higher than its RSL. For consistency, the background arsenic concentration for the colluvium was used for comparison purposes. USEPA RSLs for the other metals were used for comparison, as they are higher than their respective background concentrations. Table 5-3 presents PRG for Ra-226, background concentrations, and RSLs.

5.6 Soil Sampling Results

The following sections discuss the results of the correlation and soil sampling that was completed at mine features. Reported concentrations were compared against the RSLs and background concentrations presented in Table 5-3. For ease of review, the results are organized by COPC and then by mine feature area. Radiation survey measurements and laboratory analytical results for primary COPCs are summarized in Table 5-4. Laboratory analytical results for secondary COPCs and agronomic and engineering parameters are summarized in Tables 5-5 and 5-6, respectively. Laboratory analytical reports are provided in Appendix B. Soil sample logs and soil boring logs are presented in Appendix C.

Sample identifiers were in the following format:

AAAA-BBBBBBBB-CC

A: The first four digits indicated the mine feature location such as RM01 for Ruby Mines No. 1.

B: The next four to eight digits were the specific sample identifiers, which included the mine feature and a consecutive numerical identifier for each boring location. For example, CWRP04 for the fourth soil boring in the capped waste rock pile.

C: The last two digits indicated the top of the interval of collection for the sample. Examples are 00 for surface soil samples and 05 for samples at 5 feet below ground surface.

5.6.1 Radium-226 Correlation for Surface Soil

A correlation study was performed by comparing 1-minute static radiation survey measurements to collocated surface soil Ra-226 concentrations (Appendix F). The purpose of the correlation was to estimate Ra-226 concentrations in surface soils using the walkover radiation survey data in locations where laboratory analytical results were not collected. The relationship between the detector count rates in cpm and the surface soil Ra-226 concentrations in pCi/g generally follows a linear trend—as count rates increase, soil concentration of gamma-emitting radionuclides also increase. The correlation is meant to provide an estimate of Ra-226 concentrations in the absence of laboratory data. The correlation is not intended to convert directly walkover survey data in cpm to Ra-226 soil concentrations in pCi/g.

ProUCL was used to evaluate the correlation data set. The correlation indicates a moderate relationship between radiation survey measurements and Ra-226 concentrations in surface soils. Several factors account for this variability, including:

- The lack of uniform distribution of contaminants in the surface soil.

- Influence of adjacent areas with elevated count rates (shine).
- Uncertainty in laboratory results (for example, incomplete homogenization of composite samples, slight errors in sample weights, etc.).
- Uncertainty in results due to sampling (for example, inconsistencies in soil densities, sampling depths, slight differences in volumes of each sub-sample that make up the sample, laboratory requirements to avoid collecting larger rocks, etc.).

There are likely other sources of variability as well. However, the scanning/correlation methodology is generally effective and reliable when filling in data gaps between soil sample locations. This means that estimates of soil Ra-226 from the walkover radiation survey will not agree perfectly with direct soil sampling results, but differences should not affect decision making. For these reasons, the data set used for the correlation excluded outliers that may have adversely affected the relationship between radiation survey measurements and soil concentrations. The data set specifically excluded concentration values greater than 20 pCi/g and radiation survey measurements greater than 50,000 cpm in an effort to develop a correlation at lower concentrations. The Ruby Mines correlation study yielded a linear fit of cpm, and the resulting estimation of Ra-226 concentrations at a 95 percent prediction interval (Appendix F, Table 6).

The results of the linear regression for the uncollimated data set resulted in an R-squared value of 0.86. Therefore, the mean detector output was able to explain 86 percent of the observed variability in mean Ra-226 concentration. The following is the equation of the linear fit:

{Ra-226 in pCi/g} = -4.0952+0.00043752 x Gamma Count Rate

As examples:

- 13,931 cpm correlates to 2.0 pCi/g of Ra-226 concentration.
- 16,216 cpm correlates to 3.0 pCi/g of Ra-226 concentration.
- 32,228 cpm correlates to 10.0 pCi/g of Ra-226 concentration.

5.6.2 Radium-226 in Soils

The following subsection summarizes the Ra-226 results at each feature for surface soils for lateral extent and for subsurface soil for vertical extent. For mine features, with the exception of the capped waste rock piles, the extent of mine-impacted soil was evaluated based on the soil sample analytical results. For the two capped waste rock piles, the extent of Ra-226 in soils was evaluated based on soil sample analytical results and Ra-226 concentrations calculated from radiation survey measurements using the correlation equation. The capped waste rock piles were evaluated using calculated Ra-226 concentrations to provide a more reliable estimate of waste rock volumes.

Ruby Mines No. 1

Capped Waste Rock Pile: The Ruby Mines No. 1 capped waste rock pile soil concentrations are shown in Figure 5-8.1. Figure 5-9.1 provides a view of the calculated Ra-226 concentrations in surface soil for the capped waste rock pile. Visual observations of the cap material at the eight borings indicated that the cap averages approximately one foot thick. In general, the cap is relatively flat to the southeast and slopes off to the north and west following the natural drainage patterns in the area. Erosional channels were apparent on the north and west slopes of the cap. Several of the soil samples from the cap material had Ra-226 concentrations slightly above the PRG, the highest being 8.6 pCi/g at RM01-CWRP02-C-00, which is approximately three times the PRG. A review of Figure 5-9.1 indicates that the flat section of the cap had lower calculated Ra-226 concentrations than the north and west sections of the cap. The eight Ruby Mines No. 1 capped waste rock pile soil borings were advanced until unimpacted soil was observed. Ra-226 was reported above the PRG at the Ruby Mines No. 1 capped waste rock pile at depths up to 25 feet bgs in the center of the pile (RM01-CWRP07). Generally, the thickest part of the waste rock was in the center and western portion of the pile. The eastern area of the pile, RM01- CWRP04, showed minimal evidence of waste rock. Although some waste rock was observed at this location, Ra-226 concentrations were below the PRG, which may indicate that this area may not be part of the capped waste rock pile. Native soil beneath the waste rock was below the PRG in each of the eight borings.

- **Drainages:** The Ruby Mines No. 1 drainages soil Ra-226 concentrations are shown in Figure 5-8.2. Soil samples were collected from each of the three drainages (A, B, and C) where radiation survey measurements were above two times the colluvium background. Six surface soil samples were collected from the drainages adjacent to the cap, and Ra-226 concentrations ranged from 5.73 to 18.9 pCi/g. Three soil borings were advanced to a depth of 5 feet bgs, and the concentrations were less than the PRG at depth. Two surface soil samples were collected from Drainage D near Wolf Canyon Road (Figure 5-8.3), and one result was 391 pCi/g, while the other result was less than the PRG.
- **Former Haul Road:** Nine locations were sampled along the Ruby Mines No. 1 former haul road where radiation survey measurements were above two times the colluvium background (Figure 5-8.3). Six of the locations were along the unmaintained former haul road near the capped waste rock pile and three were at an isolated location near the intersection of the former haul road and BIA 49. The six locations along the unmaintained former haul road were surface soil only samples (2 locations) and soil borings (4 locations) that were advanced to a depth of 5 feet bgs. The surface soil samples exceeded the PRG, with a maximum Ra-226 concentration of 1,680 pCi/g at RM01-HR02-00. The Ra-226 concentrations were less than the PRG at depth. The three soil samples at the isolated location near BIA 49 were sampled for surface soil only, and each exceeded the PRG, with a maximum Ra-226 concentration of 412 pCi/g.
- **Stepout Area:** The Ruby Mines No. 1 step out area is located in the buffer area around the capped waste rock pile (Figure 5-8.2). Surface soil samples were collected at 18 locations, and the Ra-226 concentrations exceeded the PRG, except at three locations (RM-COR19-00, RM-COR22-00, and RM-COR43-00). Soil boring samples were collected to evaluate vertical extent at five locations to the north of the capped waste rock pile that had radiation survey measurements greater than two times background. The five soil borings were advanced to a depth of 5 feet bgs where Ra-226 concentrations were found to be less than the PRG at depth.
- **Work Area:** The Ruby Mines No. 1 work area soil borings were collected at four locations where historical information and visual observations indicated mine-related structures, such as a mechanics shop, changing room, and office. The surface concentrations for Ra-226 range from 2.99 to 39.9 pCi/g (Figure 5-8.2). Three of the four soil borings were advanced to a final depth of 5 feet bgs, where Ra-226 concentrations were less than the PRG. The other soil boring (RM01-WRK01) was also advanced to 5 feet bgs, and the soil concentration was slightly above the PRG at depth.

Ruby Mines No. 3

- **Capped Waste Rock Pile:** The Ruby Mines No. 3 capped waste rock pile soil concentrations are shown in Figure 5-8.4. Figure 5.9-2 provides a view of the calculated Ra-226 concentrations in surface soil for the capped waste rock pile. Visual observations of the cap material at the seven soil borings and two surface soil samples suggest that the cap averages approximately 1 foot thick. In general, the cap is relatively flat in the west and slopes off to the north, south, and east. The eastern portion of the cap is bifurcated into two lobes located north and south of the former haul road and a natural topographic high, which is characterized by trees and rocky soil. Erosional channels were apparent on the south and southeast slopes of the cap.

  The Ruby Mines No. 3 capped waste rock pile soil samples were collected at nine locations that included two surface soil only locations and seven soil boring locations. Only one soil sample from the cap material had Ra-226 concentrations above the PRG, which was visually confirmed to be a piece of exposed waste rock. Figure 5-9.2 indicate that the majority of the cap, especially to the north, had a calculation of Ra-226 concentrations less than two times the PRG. Ra-226 was reported above the PRG at depths up to 13 feet bgs in the western portion of the pile (RM03-CWRP06). The native soil beneath the waste rock was below the PRG in five of the seven borings. The remaining two soil borings, RM03-CWRP01 and RM03-CWRP03, had Ra-226 concentrations of 6.21 and 7.9 pCi/g at the bottom of the borings, respectively.

- **Dewatering Area:** Six surface soil only samples and three soil borings were collected from the Ruby Mines No. 3 dewatering area (Figure 5-8.5). Seven of the nine samples collected from surface soil exceeded the Ra-226 PRG, with a maximum concentration adjacent to the capped waste rock pile at RM03-DTWR03-00, of 50.7 pCi/g. Samples collected from two of the three soil borings had concentrations of Ra-226 below the PRG at depth. The other soil borings did not reach a concentration below PRG, despite radiation measurements at depth below the field screening level.
- **Drainages:** Three soil borings were collected from the Ruby Mines No. 3 drainages (Figure 5-8.5). RM03-DRN01, located in the northwest drainage, was extended to a depth of 5 feet bgs and had reported concentrations below the PRG throughout. For RM03-DRN02 and RM03-DRN03, located in the southeast drainage, the concentrations were above the PRG at 0 and 1-foot bgs and the concentrations at depth (5 feet bgs) were below the PRG.
- **Work Area:** The Ruby Mines No. 3 work area soil samples were collected at four locations (Figure 5-8.5). Concentrations exceeding the PRG were reported at two locations (RM03-WRK03 and RM03-WRK04) at the surface and one location (RM03-WRK01) at 1-foot bgs. The other samples from the work area, including the four collected at depth, were below the PRG.

RUBY-002

The RUBY-002 samples were collected at three locations (Figure 5-8.6). Concentrations close to the vent (RM02-VENT03) were reported above the PRG at the ground surface and at 1-foot bgs. The sandy silt clay was hard-packed, and deeper sampling with available hand tools was not possible. RM02-VENT02 exceeded the PRG at surface, but was below the PRG at 1-foot bgs. RM02-VENT01, furthest from the vent, was reported below the PRG at the surface and at 1-foot bgs.

RUBY-004

The RUBY-004 soil samples were collected at three locations (Figure 5-8.7). Sample location RM04-VENT03, closest to the vent, had a Ra-226 concentration of 111 pCi/g at the surface and 24.3 pCi/g at 2 feet bgs, which was the maximum depth possible with hand tools. RM04-VENT02 had an exceedance of the PRG at the surface, but was reported below the PRG at 1-foot bgs. RM04-VENT01, furthest from the vent, was below the PRG at surface and at depth.

RUBY-019

RUBY-019 soil samples were collected at three locations (Figure 5-8.8). Sample locations RM19-VENT03 and RM19-VENT02 had Ra-226 concentrations above the PRG at surface and at depth. The Ra-226 concentrations tapered off away from the vent at RM19-VENT01, where both depths were below the PRG.

5.6.3 Metals COPCs in Soils

A total of 170 samples from various locations at mine features were analyzed for the primary COPCs arsenic, mercury, molybdenum, selenium, uranium, and vanadium. The metals laboratory analytical results presented in Table 5-4 were compared to the RSLs or site-specific background, whichever was higher (Table 5-3).

To assess trends in concentrations and look for correlations between analytes, concentration versus depth charts were developed for the soil borings within the two capped waste rock piles (see Figure 5-10).
A review of Figure 5-10 indicates that there appears to be some correlation between Ra-226, selenium, vanadium and uranium. Trends in concentrations of arsenic, mercury, and molybdenum did not correlate with those of Ra-226 or the concentrations of other metals.

The extent of metals COPC concentration by area is summarized as follows:

Ruby Mines No. 1

- **Capped waste rock pile, drainages, and work area:** No metals concentrations exceeded the background for arsenic or RSLs for other metals.
- **Former haul road:** Arsenic exceeded its background and/or uranium exceeded its RSL in surface samples from borings RM01-HR02, RM01-HR03, RM01-HR05, RM01-HR06, and RM01-HR07. Concentrations decreased sharply with depth at the locations where subsurface samples were collected. These samples also had Ra-226 concentrations in excess of the PRG.
- **Stepout area:** Arsenic exceeded its background and uranium and vanadium exceeded their RSLs in three out of 15 samples. The highest detections of uranium and vanadium were in the surface sample collected at boring RM01-STEP05, which also had an elevated Ra-226 concentration. Uranium concentrations exceeded the RSL in the 1-foot sample from RM01-STEP05. No metals or Ra-226 exceedances occurred in the 1-foot and 5-foot sample from RM01-STEP05. One arsenic exceedance of the background that occurred in the 5-foot sample of boring RM01-STEP02 was not associated with elevated Ra-226 or other elevated metals concentrations, and it may represent natural variability in soil mineralogy. No other analytical detections indicated soil contamination in the 5-foot sample of boring RM01-STEP02.

Ruby Mine No. 3

- **Capped waste rock pile and dewatering area**: No metals concentrations exceeded the arsenic background or the other metals RSLs.
- **Drainages:** Arsenic was detected at 13 mg/kg (slightly above the background) in the surface sample from RM03-DRN01. Other metals did not exhibit elevated concentration in the same sample. Metals COPC concentrations did not exceed the RSLs or background in any other drainage samples. This sample was not associated with an elevated Ra-226 concentration or other elevated metals concentrations and it may represent natural variability in soil mineralogy.
- **Work Areas:** At one location, RM03-WRK04, the concentration of uranium in surface soil (440 mg/kg) exceeded its RSL. This sample also had a Ra-226 concentration in excess of the PRG.

Ruby Mines Vents

- RUBY-002 and RUBY-019: No metals exceeded the arsenic background or the other metals RSLs.
- RUBY-004: One surface soil sample (RM04-VENT03) had metals concentrations of selenium and uranium above their respective RSLs. This sample also had a Ra-226 concentration in excess of the PRG.

5.6.4 Organic COPCs in Soils

Eight surface soil samples, four in each of the Ruby Mines Nos. 1 and 3 work areas, were analyzed for a secondary list of COPCs. The analytical results are consistent with minor releases of petroleum fuels and explosives (see Table 5-5).

Organic contaminants were most frequently detected as TPH. Diesel range TPH was detected in five of the eight samples at concentrations near detections limits, ranging from 2.7 J to 4.1 J mg/kg, significantly below the RSL of 96 mg/kg. Motor oil range TPH was detected in the eight samples at concentrations from 3.0 J to 32 mg/kg, two orders of magnitude below the RSL of 2,500 mg/kg. The VOCs benzene and toluene were detected at trace concentrations and below their respective RSLs. Acetone was the only other VOC detected at concentrations much lower than the 61,000 mg/kg RSL (at between 0.032 and 0.130 mg/kg). Chlorinated VOCs, polychlorinated biphenyls, semivolatile organic compounds, and TPH gasoline were not detected in the samples.

Three compounds related to explosives were detected at concentrations below RSLs. Explosive compound 1,3,5-trinitrobenzene is related to the degradation of trinitrotoluene (a component of dynamite). 1,3,5-trinitrobenzene was detected in three of the eight samples at concentrations ranging from 0.0061 J to 0.0077 J mg/kg. The concentrations were below the RSL of 2,200 mg/kg. Two other explosives compounds were detected at concentrations near detection limits. Pentaerythritol tetranitrate was detected in one sample at 0.071 J mg/kg (below the RSL of 120 mg/kg). Perchlorate was detected in one sample at 0.0018 J mg/kg, below the RSL of 55 mg/kg.

5.6.5 Agronomic and Engineering Parameters

Agronomic and engineering parameters were performed on two surface samples collected from cap material at each of the Ruby Mines Nos. 1 and 3 capped waste rock piles (Table 5-6). This information was collected to evaluate the soils used to cap the waste rock piles. The overall results indicate that sufficient nutrients are present in the soil to sustain vegetative cover and the texture is sufficiently fine to impede infiltration. The cap soils were dry with relatively low organic carbon.

5.7 Capped Waste Rock Volume Estimation

To calculate the volume of waste rock in each of the capped waste rock piles, the following procedure was completed:

1. The digital terrain model (DTM) that was created from the LIDAR survey was taken as the top surface of the capped waste rock pile.
2. The DTMs for each of the Ruby Mines were cropped to the size of the capped waste rock pile, which was surveyed with GPS in the field in May 2014.
3. For Ruby Mines Nos. 1 and 3, 1 foot of elevation was subtracted from the DTM throughout the capped waste rock pile to account for the approximate 1-foot-thick cap observed.
4. For the bottom surface of the waste rock, another DTM was created. The parameter for this DTM included the maximum depth of waste rock from each of the soil borings collected at the capped waste rock piles. It was assumed that the waste rock pinches out at the edge of the capped waste rock pile; therefore, the perimeter of the DTM was set as equal to the top surface DTM.
5. The volume between the two DTMs was calculated.

   The following were the results of the waste volume calculations:

   Ruby Mines No. 1: 81,000 cubic yards
   Ruby Mines No. 3: 93,000 cubic yards

5.8 Quality Assurance/Quality Control

Quality controls were put into place as described in the site characterization work plans. Quality of field data collection was assured by use of a QAPP and SOPs that included daily instrument calibration and checks and subcontractor oversight. Quality of laboratory data was assured by use of the QAPP, which specifies analytical methods, laboratory instrument checks, QC sampling, and reporting limits. Additionally, the laboratory data were validated by an experienced chemist.

5.8.1 Field Data Quality

RSE activities included collection of large quantities of field screening data. SOPs were developed for the field activities, and contractor experience and credentials were verified prior to mobilization. Field staff calibrated the instrumentation, verified the compliance with SOPs, and reviewed preliminary data during the field activities. The data collected from field activities was documented and preserved for archives. The data were reviewed for completeness, errors, and accuracy. Only the final validated data are presented in this report.

5.8.1.1 Field Instrumentation Calibration and Checks

The counting systems and instruments used in support of the RSE fieldwork were calibrated in accordance with ANSI N323A (ANSI,1997), with a source traceable through National Institute of Standards and Technology, at intervals not exceeding 12 months for laboratory counting systems and not exceeding 6 months for portable field survey instruments (as recommended by the MARSSIM). The source used was appropriate for the type and energy of the radiation to be detected.

The field survey instruments used to collect survey data were found to operate within acceptable tolerances and in accordance with the SOPs. Each meter used in the field was source-checked daily. One exposure-monitoring meter failed the source check. This meter was used to collect data for the health and safety of field staff, and it was replaced with another device. Each morning prior to collection of radiation survey data, the equipment system's response was source-checked. The GPS field instrumentation was also checked each morning for satellite capture lateral accuracy and data logging. The following procedures were followed:

- Field radiation instrumentation, source check acceptance criteria (for example, ± 2 sigma for direct [integrated] measurements and ±20 percent for rate measurements) were achieved prior to beginning the work.
- Source check results were documented on appropriate forms.
- The GPS devices were checked for minimum accuracy of thee exposure-monitoring meters and a minimum capture of 10 satellites each morning prior to beginning of data collection work.
- The GPS data logging and correlation with radiation instruments were checked daily.

5.8.1.2 Field Confirmation

Field staff verified the compliance with the SOPs, and reviewed preliminary data during the field activities. Field staff were experienced and versed in the use of field equipment. No significant deviations were observed during fieldwork. Minor corrections were communicated, and field staff was responsive and made the corrections. The following QA/QC practices were performed by field oversight staff:

- Field equipment was inspected by a radiological engineer during mobilization and initiation of fieldwork. At this time, equipment calibration logs were reviewed and confirmed. The source was confirmed to be of appropriate type and energy.
- Transect survey areas were verified by GPS and field maps. Area boundaries were marked with flagging and other markers.
- Probe height was inspected for walking surveys and driving surveys. Allowances were made for uneven ground.
- Preliminary field data were observed and checked on a data logger intermittently.
- Static counts were collected and recorded on separate GPS devices and field log books for verification of subcontractor data reports.

No significant deficiencies were observed. Minor corrections for probe height and transect spacing were made in the field.

5.8.2 Laboratory Data Quality

RSE activities included collection of soil samples for laboratory analysis. The QAPP was provided to the analytical laboratory. The reported data were evaluated according to QAPP requirements, USEPA method guidance, and the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (USEPA, 2010). The Ruby Mines QAPP identifies the method-specific QC requirements for each analytical parameter and matrix and defines a plan to test that the correct sampling, analytical, and data reduction procedures were followed. The Data Quality Evaluation Summary Report is included in Appendix B. The reported field data were found to be of sufficient quality for inclusion in this report. No data were removed from the data set. The data were reviewed in digital format graphically and statistically for outliers. QC static count data were reviewed and were consistent with reported data.

For the Ra-226 concentration results, there were many instances where the sample density did not meet the associated calibration standard density and was greater than ± 15 percent, denoting a significant density difference between the sample and calibration standard. Consequently, the results for these locations are estimated. The affected sample results were qualified as estimated and flagged “J.” This affected 258 sample results for Ra-226.

SECTION 6

Costs

The Ruby Mines RSE was performed in accordance with the requirements of the ASAOC to characterize existing site conditions. Project costs are associated with the planning and implementation of the scope of work stipulated in the ASAOC. The total cost associated with the Ruby Mines RSE is $1.5M.

SECTION 7

Conclusions

The results of the RSE investigations are as follows:

- Nine open mine features were closed and warning signs were posted. There are no remaining known open mine features associated with the Site.
- Radiation survey measurements ranged from background to less than two times background in soils around the three residences near Ruby Mines No. 1 and the one residence near Ruby Mines No. 3.
- At a number of the former mine features, radiation survey measurements ranged from background to less than two times background, including: (a) areas where exploration drilling occurred; (b)three shafts referred to as RUBY-011, RUBY-017, and RUBY-021; (c) three vents referrred to as RUBY-015, RUBY-018, and RUBY-022; and (d) two prospects referred to as RUBY-016 and RUBY-020.
- At three vents (RUBY-002, RUBY-004, and RUBY-019), survey measurements exceeded three times background in localized areas up to 50 feet downwind from the vents. Radiation levels ranged from background to less than two times background levels at distances greater than 50 feet downwind at each of the three vents.
- In the drainages leading from the two capped waste rock piles, radiation survey measurements ranged from background to less than two times background, except in two drainages that run along the north side of the Ruby Mines No. 1 capped waste rock pile. The relatively low radiation levels in drainages leading from Ruby Mines Nos. 1 and 3 is most likely due to the fact that the waste rock piles were capped shortly after mining ceased.
- The maintained section of the Ruby Mines No. 1 former haul road (Wolf Canyon Road) had radiation survey measurements ranging from background to less than two times background, except for two isolated locations, one near the intersection with BIA Route 49 and the other near the intersection with the unmaintained former haul road that leads to the capped waste rock pile. The unmaintained former haul road at Ruby Mines No. 1 had radiation survey measurements that were generally above two times background near the capped waste rock pile and decreased to levels that ranged from background to less than two times background near the intersection with Wolf Canyon Road.
- The maintained portion of the Ruby Mines No. 3 former haul road (Mount Powell Road and Horseshoe Pond Road) had radiation survey measurements generally ranging from background to less than two times background.
- Most of the soils where radiation survey measurements exceeded three times background were in areas around the Ruby Mines Nos. 1 and 3 where historical mining-related or reclamation activities occurred. The locations included areas within and immediately around the capped waste rock piles; the work areas, where offices, maintenance buildings, and parking areas were historically located; and the area where water pumped to dewater underground workings was discharged at Ruby Mines No. 3. Site characterization activities characterized the lateral and vertical extent of soils and waste rock with Radium-226 concentrations above the preliminary remediation goal.
- The volume of waste rock was estimated for each waste rock pile through subsurface soil sampling. The estimated volumes for the Ruby Mines Nos. 1 and 3 waste rock piles are 81,000 and 93,000 cubic yards, respectively.
- Soil samples were collected at 53 locations and analyzed for metals. Metals concentrations in soil samples were generally below the USEPA Regional Screening Levels (RSLs) or background concentrations throughout the Site, including the soil samples collected from the two capped waste rock piles. A few

isolated soil sample locations had exceedances for one or more metals at several mine features, including: (a) five locations from the Ruby Mines No. 1 former haul road; (b) two locations near the Ruby Mines No. 1 capped waste rock pile; (c) one location at the Ruby Mines No. 3 drainage; (d) one location at the Ruby Mines No. 3 work area; and (e) one location at one vent, RUBY-004.

- Volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls, total petroleum hydrocarbons, perchlorate, and explosives concentrations in soil samples collected in the work areas at Ruby Mines Nos. 1 and 3 were either not detected or detected at concentrations below USEPA RSLs.
- The existing caps on the Ruby Mines Nos. 1 and 3 waste rock piles are generally intact with some areas of erosion. Erosion of the capped waste rock piles was limited to areas where the piles sloped to drainages, which was on the north and west sides of the cap at Ruby Mines No. 1 and on the east and south sides of the cap at Ruby Mines No. 3. The cap thinknesses ranged from 0.5 to 2.0 feet at Ruby Mines No. 1 and from 0.5 to 1.5 feet at Ruby Mines No. 3. Upon approval of this report, WNI will have completed the scope of work set forth in the ASAOC.

SECTION 8

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Tables

TABLE 2-1
Ruby Mines Site Operation Dates
Ruby Mines Removal Site Evaluation Report

Location	Mining Started	Mining Ended	Reclaimed
Ruby Mine No. 1 (Section 21)	September 1975	September 1981	October 1985
Ruby Mine No. 2 (Section 27)	April 1979	November 1981	October 1985
Ruby Mine No. 3 (Section 25)	December 1980	February 1985	October 1985
Ruby Mine No. 4 (Section 26)	May 1982	February 1985	October 1985

TABLE 3-1
Ruby Mines Features
Ruby Mines Removal Site Evaluation Report

Feature Description	Unique Identifier[1]	Section	Latitude [2]	Longitude [2]	Elevation [3]	Status
Ruby Mine No. 1 adit	RUBY-001	21	35.518986	-108.222483	7,563	Closed during Phase 1
Ruby Mine vent	RUBY-002	21	35.512575	-108.222508	7,696	Closed during Phase 1
Ruby Mine No. 3 adit	RUBY-003	25	35.506703	-108.163614	7,429	Closed during Phase 1
Ruby Mine vent	RUBY-004	27	35.506847	-108.205456	7,674	Closed during Phase 1
Shaft	RUBY-011	26	35.504572	-108.184583	7,685	Historically Closed
Ruby Mine vent	RUBY-015	26	35.5042230	-108.1839730	7,691	Historically Closed
Prospect	RUBY-016	27	35.5080816	-108.2045652	7,668	Closed during Phase 1
Shaft	RUBY-017	25	35.5031995	-108.1697609	7,512	Closed during Phase 1
Ruby Mine vent	RUBY-018	21	35.5145391	-108.2257116	7,694	Closed during Phase 1
Ruby Mine vent	RUBY-019	21	35.5147800	-108.2252240	7,686	Historically Closed
Prospect	RUBY-020	25	35.5040040	-108.1681720	7,501	Closed during Phase 1
Shaft	RUBY-021	21	35.5131260	-108.2232210	7,691	Closed during Phase 1
Ruby Mine vent	RUBY-022	27	35.5067480	-108.2039330	7,633	Historically Closed

Notes:

[1] "RUBY-XXX" is a unique location identifier assigned by the Freeport-McMoRan Historic Mine Opening Safety Program (HMOSP).

[2] Location coordinates are in geographic coordinate system WGS 84, decimal degrees. Longitudes west of the Prime Meridian are designated as negative.

[3] Elevations are in feet above mean sea level estimated to the nearest foot based on a 1 minute Digital Elevation Model.

TABLE 3-2
Predominant Geology for Ruby Mines Features
Ruby Mines Removal Site Evaluation Report

Mine Feature Designation	Feature Description	Predominant Geology	Background Comparison Value (counts per minute) [1]
RUBY-001	Adit	Mancos Shale	11946
Ruby Mine No. 1	Capped waste rock pile	Colluvium	12404
	Drainages A, B, C	Colluvium	12404
	Exploratory borehole area	Dakota Sandstone	10318
	Former haul road to Wolf Canyon Road	Colluvium	12404
	Former haul road at Wolf Canyon Road - isolated location near BIA Route 49	Colluvium	12404
	Residences	Dakota Sandstone	10318
	Step out area	Colluvium	12404
	Work area	Colluvium	12404
RUBY-002	Ruby Mine vent	Dakota Sandstone	10318
RUBY-003	Adit	Mancos Shale	11946
Ruby Mine No. 3	Capped waste rock pile	Mancos Shale	11946
	Dewatering area	Mancos Shale	11946
	Drainages	Colluvium	12404
	Exploratory borehole area	Mancos Shale	11946
	Former haul road to New Mexico Highway 371	Mancos Shale	11946
	Residence	Mancos Shale	11946
	Work Area	Mancos Shale	11946
RUBY-004	Ruby Mine vent	Mancos Shale	11946
RUBY-011	Ruby Mine vent	Colluvium	12404
RUBY-015	Ruby Mine vent	Dakota Sandstone	10318
RUBY-016	Prospect	Mancos Shale	11946
RUBY-017	Shaft	Mancos Shale	11946
RUBY-018	Ruby mine vent	Colluvium	12404
RUBY-019	Ruby Mine vent	Colluvium	12404
RUBY-020	Prospect	Mancos Shale	11946
RUBY-021	Shaft	Dakota Sandstone	10318
RUBY-022	Ruby Mine vent	Dakota Sandstone	10318

Notes:

[1] The background comparison value was calculated as the mean plus two standard deviations of the background sample concentrations collected in the background reference area for the given geologic unit.

TABLE 5-1

Soil Sample Laboratory Results - Background Reference Areas

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Arsenic (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)
RMMB-A19	Mancos Shale	35.53870	-108.21813	4.6	0.018	0.59	0.86	0.51	16	1.07 J
RMMB-AN17	Mancos Shale	35.53913	-108.21815	5.5	0.020	0.68	0.80	0.51	21	1.24 J
RMMB-AN71	Mancos Shale	35.53919	-108.21704	- -	- -	- -	- -	- -	- -	1.15
RMMB-C56	Mancos Shale	35.53877	-108.21737	- -	- -	- -	- -	- -	- -	1.4
RMMB-CN72	Mancos Shale	35.53922	-108.21702	3.9	0.020	0.51	0.99	0.62	21	1.5
RMMB-DN38	Mancos Shale	35.53920	-108.21772	- -	- -	- -	- -	- -	- -	1.3
RMMB-E15	Mancos Shale	35.53876	-108.21820	4.8	0.022	0.74	1.1	0.61	20	1.4
RMMB-EN63	Mancos Shale	35.53924	-108.21720	6.9	0.025	0.61	1.2	0.86	18	1.52 J
RMMB-F49	Mancos Shale	35.53881	-108.21751	- -	- -	- -	- -	- -	- -	1.32
RMMB-FN46	Mancos Shale	35.53924	-108.21755	- -	- -	- -	- -	- -	- -	1.22 J
RMMB-GN55	Mancos Shale	35.53927	-108.21737	3.8	0.020	0.46	0.79	0.50	17	1.3
RMMB-HN65	Mancos Shale	35.53930	-108.21716	- -	- -	- -	- -	- -	- -	1.63 J
RMMB-I23	Mancos Shale	35.53884	-108.21804	4.9	0.020	0.62	0.92	0.48	18	0.97
RMMB-I28	Mancos Shale	35.53884	-108.21794	- -	- -	- -	- -	- -	- -	1.45 J
RMMB-K56	Mancos Shale	35.53890	-108.21736	4.5	0.018	0.39	0.66	0.40	20	1.33
RMMB-L26	Mancos Shale	35.53889	-108.21797	- -	- -	- -	- -	- -	- -	1.1
RMMB-L32	Mancos Shale	35.53890	-108.21785	4.3	0.020	0.51	0.65 J	0.52	18	0.85 J
RMMB-L70	Mancos Shale	35.53894	-108.21707	- -	- -	- -	- -	- -	- -	1.3 J
RMMB-Q10	Mancos Shale	35.53896	-108.21830	4.0	0.020	0.63	0.88	0.52	17	1.64 J
RMMB-Q30	Mancos Shale	35.53898	-108.21789	- -	- -	- -	- -	- -	- -	1.22 J
RMMB-R70	Mancos Shale	35.53904	-108.21707	3.6	0.022	0.54	0.78	0.65	17	1.26
RMMB-T43	Mancos Shale	35.53904	-108.21762	- -	- -	- -	- -	- -	- -	1.7
RMMB-W05	Mancos Shale	35.53905	-108.21840	3.7	0.030	0.71	1.1	0.76	20	1.71 J
RMMB-W52	Mancos Shale	35.53910	-108.21743	- -	- -	- -	- -	- -	- -	1.05
RMCB-A02	Colluvium	35.515348	-108.160773	- -	- -	- -	- -	- -	- -	1.29 J
RMCB-A14	Colluvium	35.515348	-108.160575	8.4	0.015	0.55	1.2	0.68	12	1.26 J
RMCB-DN33	Colluvium	35.515753	-108.160261	10	0.020	0.62	1.4	0.74	16	1.31 J
RMCB-DN44	Colluvium	35.515753	-108.160080	- -	- -	- -	- -	- -	- -	1.43 J
RMCB-EN34	Colluvium	35.515767	-108.160245	9.5	0.018	0.59 J	1.3	0.67	14	1.48 J
RMCB-EU38	Colluvium	35.516131	-108.160179	7.7	0.015	0.54	1.0	0.61	13	1.36 J
RMCB-F57	Colluvium	35.515418	-108.159865	- -	- -	- -	- -	- -	- -	1.28 J
RMCB-FN34	Colluvium	35.515781	-108.160245	- -	- -	- -	- -	- -	- -	1.12 J
RMCB-GU26	Colluvium	35.516159	-108.160377	- -	- -	- -	- -	- -	- -	1.29 J

TABLE 5-1

Soil Sample Laboratory Results - Background Reference Areas

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Arsenic (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)
RMCB-H45	Colluvium	35.515446	-108.160063	8.1	0.014	0.51	1.1	0.63	12	1.2 J
RMCB-J12	Colluvium	35.515474	-108.160608	- -	- -	- -	- -	- -	- -	0.93 J
RMCB-KN49	Colluvium	35.515851	-108.159997	9.1	0.017	0.55	1.1	0.64	14	1.56 J
RMCB-L10	Colluvium	35.515502	-108.160641	8.1	0.016	0.53	1.1	0.63	12	1.22 J
RMCB-L45	Colluvium	35.515502	-108.160063	- -	- -	- -	- -	- -	- -	1.32 J
RMCB-N52	Colluvium	35.515530	-108.159948	6.0	0.018	0.43	0.85	0.56	15	1.25 J
RMCB-038	Colluvium	35.515544	-108.160179	- -	- -	- -	- -	- -	- -	1.43 J
RMCB-ON49	Colluvium	35.515907	-108.159997	- -	- -	- -	- -	- -	- -	0.91 J
RMCB-P10	Colluvium	35.515557	-108.160641	8.6	0.015	0.51	0.93	0.59	12	1.24 J
RMCB-P54	Colluvium	35.515558	-108.159915	- -	- -	- -	- -	- -	- -	1.41 J
RMCB-R59	Colluvium	35.515585	-108.159832	5.6	0.019	0.37	0.94	0.48	14	1 J
RMCB-RN06	Colluvium	35.515949	-108.160707	5.7	0.018	0.47	1.0	0.62	14	1.13 J
RMCB-X18	Colluvium	35.515669	-108.160509	- -	- -	- -	- -	- -	- -	1.1 J
RMCB-X24	Colluvium	35.515669	-108.160410	9.7	0.019	0.71	1.0	0.82	12	1.18 J
RMCB-YN15	Colluvium	35.516047	-108.160558	- -	- -	- -	- -	- -	- -	0.83 J
RMCB-Z46	Colluvium	35.515697	-108.160047	- -	- -	- -	- -	- -	- -	0.99 J
RMDB-AN55	Dakota Sandstone	35.51182	-108.164892	4.0	0.020	0.39	0.60	0.49	15	0.88 J
RMDB-AU44	Dakota Sandstone	35.51219	-108.165073	3.2	0.013	0.28	0.67	0.38	12	1.05
RMDB-B60	Dakota Sandstone	35.51147	-108.164810	- -	- -	- -	- -	- -	- -	0.63 J
RMDB-BN03	Dakota Sandstone	35.51184	-108.165750	- -	- -	- -	- -	- -	- -	1.03 J
RMDB-C44	Dakota Sandstone	35.51149	-108.165070	4.2	0.021	0.38	0.70	0.54	13	1.18 J
RMDB-CN44	Dakota Sandstone	35.51185	-108.165073	3.8	0.017	0.36	0.68	0.47	15	0.79 J
RMDB-CN53	Dakota Sandstone	35.51185	-108.164925	- -	- -	- -	- -	- -	- -	1.2 J
RMDB-DN28	Dakota Sandstone	35.51186	-108.165337	5.0	0.031	0.45	0.78	0.58	16	1.23 J
RMDB-EU24	Dakota Sandstone	35.51224	-108.165403	- -	- -	- -	- -	- -	- -	1.05
RMDB-F64	Dakota Sandstone	35.51153	-108.164790	- -	- -	- -	- -	- -	- -	0.88 J
RMDB-GN36	Dakota Sandstone	35.51191	-108.165205	- -	- -	- -	- -	- -	- -	0.85 J
RMDB-H40	Dakota Sandstone	35.51156	-108.165139	4.6	0.018	0.35	0.85	0.41	16	0.71 J
RMDB-HN56	Dakota Sandstone	35.51192	-108.164875	3.3	0.013	0.35	0.63 J	0.44	13	0.92
RMDB-I10	Dakota Sandstone	35.51157	-108.165634	- -	- -	- -	- -	- -	- -	1.16 J
RMDB-ID10	Dakota Sandstone	35.51157	-108.165634	- -	- -	- -	- -	- -	- -	1.22 J
RMDB-LN40	Dakota Sandstone	35.51198	-108.165139	- -	- -	- -	- -	- -	- -	1.29 J
RMDB-MN51	Dakota Sandstone	35.51199	-108.164958	3.7	0.015	0.38	0.52	0.47	15	1.11

TABLE 5-1

Soil Sample Laboratory Results - Background Reference Areas

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Arsenic (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)
RMDB-O50	Dakota Sandstone	35.51165	-108.164974	3.8	0.018	0.35	0.75	0.54	15	0.95 J
RMDB-R16	Dakota Sandstone	35.51170	-108.165535	- -	- -	- -	- -	- -	- -	0.76 J
RMDB-R53	Dakota Sandstone	35.51170	-108.164925	6.0	0.020	0.35	0.99	0.51	14	1.17 J
RMDB-SN52	Dakota Sandstone	35.51207	-108.164941	- -	- -	- -	- -	- -	- -	0.83
RMDB-TN46	Dakota Sandstone	35.51209	-108.165040	4.9	0.018	0.42	0.75	0.56	19	0.86
RMDB-UN18	Dakota Sandstone	35.51210	-108.165502	- -	- -	- -	- -	- -	- -	1.26 J
RMDB-V20	Dakota Sandstone	35.51175	-108.165469	- -	- -	- -	- -	- -	- -	0.82 J
RMDB-VN27	Dakota Sandstone	35.51212	-108.165354	3.9	0.017	0.40	0.72	0.44	16	1.29 J
RMDB-XN59	Dakota Sandstone	35.51214	-108.164826	- -	- -	- -	- -	- -	- -	0.77 J

Notes:

[1] Location coordinates are in geographic coordinate system WGS 84, decimal degrees. West longitudes are designated as negative.

- - = Not analyzed

Laboratory Analytical Qualifier:

J = Estimated. This qualifier indicates that the analyte was detected, but should be considered estimated.

Acronyms and Abbreviations:

mg/kg = milligrams per kilogram

pCi/g = picocurie(s) per gram

TABLE 5-2

Statistics of Background Reference Area Soil Sample Results

Ruby Mines Removal Site Evaluation Report

Statistic	Arsenic (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)	Radiation Count Rate (cpm)
Mancos Shale Background Reference Area								
Distribution of Data	Normal	Non-parametric	Normal	Normal	Normal	Normal	Normal	Normal
Minimum	3.6	0.018	0.39	0.65	0.40	16	0.85	9028
Maximum	6.9	0.030	0.74	1.20	0.86	21	1.71	13132
Mean	4.5	0.021	0.6	0.9	0.6	18.6	1.30	11036
Standard Deviation	0.9	0.003	0.1	0.2	0.1	1.7	0.24	455
Colluvium Background Reference Area								
Distribution of Data	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Minimum	5.6	0.014	0.37	0.85	0.48	12	0.83	9102
Maximum	10.0	0.020	0.71	1.40	0.82	16	1.56	13493
Mean	8.0	0.017	0.5	1.1	0.6	13.3	1.22	11290
Standard Deviation	1.5	0.002	0.1	0.2	0.1	1.4	0.19	557
Dakota Sandstone Background Reference Area								
Distribution of Data	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Minimum	3.2	0.013	0.28	0.52	0.38	12	0.63	6367
Maximum	6.0	0.031	0.45	0.99	0.58	19	1.3	11504
Mean	4.2	0.018	0.37	0.72	0.49	15	0.99	9272
Standard Deviation	0.8	0.0047	0.043	0.12	0.06	1.8	0.20	523

Notes:

Statistics were calculated using ProUCL Version 5.0.00 (USEPA, released Spetember 13, 2013).

Acronyms and Abbreviations

cpm = counts per minute

mg/kg = milligrams per kilogram

pCi/g = picocurie(s) per gram

TABLE 5-3

Background Comparison Values and ASAOC Criteria for the Ruby Mines

Ruby Mines Removal Site Evaluation Report

	Arsenic (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Radium-226 (pCi/g)	Radiation Count Rate (cpm)
Background Comparison Values[1,2]								
Mancos Shale	6.0	0.030	0.87	1.37	0.93	23.3	1.85	11946
Colluvium	12.2	0.022	0.77	1.51	0.87	17.1	1.65	12404
Dakota Sandstone	6.4	0.031	0.49	1.05	0.66	19.9	1.44	10318
ASAOC Criteria								
USEPA RSL[3]	0.67	23	390	390	230	390	--	--
ASAOC value	--	--	--	--	--	--	1.24 + background	--

Notes:

[1] The background comparison value for radiation activity (cpm) for each geologic unit was calculated as the mean plus two standard deviations.

[2] Background comparison values for metal and Ra-226 concentrations were calculated using the 95-95 Upper Tolerance Limit (UTL).

[3] USEPA Regional Screening Levels are based on a Hazard Quotient of 1.0 and a residential exposure scenario. http://www.epa.gov/region9/superfund/prg/

-- Not applicable

Acronyms and Abbreviations:

ASAOC = Administrative Settlement Agreement and Order on Consent

cpm = counts per minute

mg/kg = milligrams per kilogram

pCi/g = picocuries per gram

RSL = Regional Screening Levels

USEPA = U.S. Environmental Protection Agency

TABLE 5-4
Soil Sample Laboratory Results - Primary COPCs
Ruby Mines Removal Site Evaluation Report

Sample Identification	Top of Sample Interval (feet)	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Surface Radiation Readings: Uncollimated (cpm)[2]	Surface Radiation Readings: Collimated (cpm)[3]	Soil Radiation Readings: Gamma/Total Core Screening (cpm)[4]	Soil Radiation Readings: On-Contact Jar (cpm)[5]	RSL or PRG -->	Arsenic (mg/kg)[6]	Mercury (mg/kg)[6]	Molybdenum (mg/kg)[6]	Selenium (mg/kg)[6]	Uranium (mg/kg)[6]	Vanadium (mg/kg)[6]	Radium-226 (pCi/g)[6]
											12.2	**23**	**390**	**390**	**230**	**390**	**2.89**
RM01-CWRP01-C-00	0	Colluvium	35.51928012	-108.22403658	10/12/2014	27,214	9,124	13,600-13,800 / 100-200	- -		7.7	0.014	0.72	3.1	3.8	18.0	2.61 J
RM01-CWRP01-R-05	5	Colluvium	35.51928012	-108.22403658	10/12/2014			16,000-16,800 / 180-220	- -		8.1 J	0.0097	8.1 J	81 J	140	96	**37.7** J
RM01-CWRP01-R-10	10	Colluvium	35.51928012	-108.22403658	10/12/2014			14,100-14,500 / 140-160	- -		4.3	0.009	2.1	27	83	74	**53.4** J
RM01-CWRP01-R-15	15	Colluvium	35.51928012	-108.22403658	10/12/2014			15,800-16,000 / 100-140	- -		4.9 J	0.012	1.9 J	37 J	77	97 J	**49.8** J
RM01-CWRP01-R-20	20	Colluvium	35.51928012	-108.22403658	10/12/2014			16,200-17,100 / 300-380	- -		5.2	0.012 U	1.7	78	110	72	**46.9** J
RM01-CWRP01-S-22.5	22.5	Colluvium	35.51928012	-108.22403658	10/12/2014			13,400-13,700 / 100-140			7.3	0.017	0.52	2.0	3.4	9.2	1.1 J
RM01-CWRP02-C-00	0	Colluvium	35.51921340	-108.22343136	10/12/2014	25,779	8,558	16,900-17,600 / 90-160	- -		8.2	0.015	0.69	5.7	9.8	23.0	**8.6** J
RM01-CWRP02-R-05	5	Colluvium	35.51921340	-108.22343136	10/12/2014			21,310-21,320 / 100-120	- -		3.3	0.01 U	0.85	12	43	60	**24.5** J
RM01-CWRP02-R-10	10	Colluvium	35.51921340	-108.22343136	10/12/2014			19,340-20,090 / 140-180	- -		8.1	0.0096 U	1.1	11	35	29	**18.6**
RM01-CWRP02-R-15	15	Colluvium	35.51921340	-108.22343136	10/12/2014			19,520-20,830 / 120-150	- -		3.4	0.011 U	0.48	61	22	8.6	**15.8** J
RM01-CWRP02-S-21	21	Colluvium	35.51921340	-108.22343136	10/12/2014			18,970-19,120 / 90-110	- -		7.7	0.012 U	0.53	1.5	0.66	8.5	1.32 J
RM01-CWRP03-C-00	0	Mancos Shale	35.51917637	-108.22274675	10/12/2014	25,028	7,469	18,700-19,200 / 60-100	- -		10	0.013	1.4	7.7	9.9	14.0	**7.30** J
RM01-CWRP03-R-05	5	Mancos Shale	35.51917637	-108.22274675	10/12/2014			16,700-17,200 / 120-140	- -		5.7	0.36	0.54	0.99	1.10	11.0	**9.40** J
RM01-CWRP03-R-10	10	Mancos Shale	35.51917637	-108.22274675	10/12/2014			17,300-17,700 / 180-240	- -		3	0.011 U	0.77	0.76	2.10	10.0	**4.05** J
RM01-CWRP03-R-15	15	Mancos Shale	35.51917637	-108.22274675	10/12/2014			16,300-16,600 / 80-120	- -		4.7	0.0099 U	1.6	2.0	8.3	13.0	1.90 J
RM01-CWRP03-S-16.5	16.5	Mancos Shale	35.51917637	-108.22274675	10/12/2014			18,400-19,100 / 80-100	- -		6.2	0.012 U	0.42	0.69	0.46	12.0	1.10 J
RM01-CWRP04-C-00	0	Colluvium	35.51962435	-108.22221811	10/12/2014	21,887	6,514	13,700-13,900 / 60-80	- -		8.5	0.026	0.68	3.2	6.6	21.0	**7.1** J
RM01-CWRP04-R-05	5	Colluvium	35.51962435	-108.22221811	10/12/2014			12,900-13,200 / 80-100	- -		2.1	0.011 U	0.22	0.28	2.0	1.80	0.59 J
RM01-CWRP04-R-10	10	Colluvium	35.51962435	-108.22221811	10/12/2014			12,500-12,70 / 80-100	- -		1.2	0.011 U	0.31	0.82	9.0	14.0	1.65 J
RM01-CWRP04-S-15	15	Colluvium	35.51962435	-108.22221811	10/12/2014			12,700-13,000 / 80-100	- -		10	0.015	0.72	1.1	0.89	9.4	1.31 J
RM01-CWRP05-C-00	0	Colluvium	35.51993156	-108.22252387	10/12/2014	19,328	5,765	15,800-16,200 / 60-100	- -		6.0	0.011 U	0.64	1.3	6.0	17.0	2.33 J
RM01-CWRP05-R-01	1	Colluvium	35.51993156	-108.22252387	10/12/2014			16,500-16,700 / 100-140	- -		3.5	0.01 U	1.1	9.4	38.0	15.0	**38.2**
RM01-CWRP05-R-05	5	Colluvium	35.51993156	-108.22252387	10/12/2014			19,600-20,100 / 60-100	- -		6	0.0099 U	4.6	4.0	110 J	9.4	**15.4**
RM01-CWRP05-R-10	10	Colluvium	35.51993156	-108.22252387	10/12/2014			22,100-22,600 / 140-160	- -		2.9 J	0.01	2.4 J	2.9 J	9.3	11.0 J	**12.5** J
RM01-CWRP05-S-15	15	Colluvium	35.51993156	-108.22252387	10/12/2014			17,400-17,800 / 60-100	- -		10	0.01 U	0.8	1.4	20.0	12.0	1.5 J
RM01-CWRP06-C-00	0	Colluvium	35.51976311	-108.22344545	10/13/2014	29,301	9,149	12,900-13,200 / 60-80	- -		7.8	0.017	0.61	2.0	2.4	14.0	**3.62** J
RM01-CWRP06-R-05	5	Colluvium	35.51976311	-108.22344545	10/13/2014			15,700-16,000 / 100-140	- -		6.6	0.016	3.3	27.0	92	53.0	**48.7** J
RM01-CWRP06-S-6.5	6.5	Colluvium	35.51976311	-108.22344545	10/13/2014			13,200-13,800 / 100-120	- -		9.4	0.015	0.66	1.8	1.8	10.0	1.87 J
RM01-CWRP06-S-11.5	11.5	Colluvium	35.51976311	-108.22344545	10/13/2014			13,100-13,400 / 80-120	- -		7.0	0.015	0.49 J	1.0	0.96	12.0	1.53 J
RM01-CWRP07-C-00	0	Colluvium	35.51954322	-108.22296825	10/12/2014	39,423	14,130	15,200-15,900 / 60-100	- -		7.1	0.014	0.52	3.2	2.7	14.0	**4.09** J
RM01-CWRP07-R-05	5	Colluvium	35.51954322	-108.22296825	10/12/2014			15,600-15,900 / 80-120	- -		4.1	0.035	0.93	40	64	34.0	**27.1** J
RM01-CWRP07-R-10	10	Colluvium	35.51954322	-108.22296825	10/12/2014			16,000-16,200 / 80-100	- -		4.2	0.011 U	0.87	11	31	26.0	**22.8** J
RM01-CWRP07-R-15	15	Colluvium	35.51954322	-108.22296825	10/12/2014			16,400-16,800 / 120-160	- -		3.9	0.011 U	1.0	68	56	26.0	**19.0** J
RM01-CWRP07-R-20	20	Colluvium	35.51954322	-108.22296825	10/12/2014			16,500-16,800 / 140-160	- -		2.4	0.0081 U	0.34	160	38	27.0	**38.1** J
RM01-CWRP07-R-25	25	Colluvium	35.51954322	-108.22296825	10/12/2014			15,300-15,700 / 120-160	- -		4.9	0.01 U	1.0	28	75	19.0	**46.0** J
RM01-CWRP07-S-26.5	26.5	Colluvium	35.51954322	-108.22296825	10/12/2014			15,300-15,700 / 100-140	- -		9.2	0.012 U	0.63	2.4	3.2	17.0	1.31 J
RM01-CWRP07-S-31.5	31.5	Colluvium	35.51954322	-108.22296825	10/12/2014			15,500-16,100 / 80-100	- -		7.7	0.0096	0.64	1.7	1.9 J	16.0	1.32 J
RM01-CWRP08-C-00	0	Colluvium	35.51953545	-108.22281929	10/12/2014	18,098	5,523	12,400-13,000 / 80-100	- -		6.5	0.016	0.55	12	5	27	**7** J
RM01-CWRP08-R-05	5	Colluvium	35.51953545	-108.22281929	10/12/2014			12,600-12,900 / 100-140	- -		4.1	0.029	2.6	3.5	120	15.0	**8.9** J
RM01-CWRP08-R-10	10	Colluvium	35.51953545	-108.22281929	10/12/2014			13,700-14,000 / 100-140	- -		3.3	0.012	0.92	0.84	1.10	6.30	1.11 J
RM01-CWRP08-R-15	15	Colluvium	35.51953545	-108.22281929	10/12/2014			13,700-14,200 / 60-100	- -		6	0.045	0.78	0.94	0.77	6.60	0.62 J
RM01-CWRP08-S-18.5	18.5	Colluvium	35.51953545	-108.22281929	10/12/2014			13,100-13,300 / 60-80	- -		9.9	0.016	0.66	1.1	0.8	14.0	1.01 J
RM01-DRNA1-00	0	Colluvium	35.52013463	-108.22208345	10/11/2014	30,924	8,365	10,900-11,300 / 80-120	- -		8.9	0.017	1.0	3.9	17.0	26.0	**18.9** J
RM01-DRNA1-01	1	Colluvium	35.52013463	-108.22208345	10/11/2014			10,700-10,800 / 80-110	- -		9.5	0.0099 U	0.99	1.1	7.7	8.6	2.1 J
RM01-DRNA1-05	5	Colluvium	35.52013463	-108.22208345	10/11/2014			10,700-10,900 / 80-100	- -		4.1	0.011 U	0.43	0.59	2.70	5.60	0.66 J
RM01-DRNB1-00	0	Colluvium	35.51994811	-108.22312501	10/13/2014			13,700-14,000 / 80-100	- -		8	0.015	0.68	3.9	7.1	17.0	**12.5** J
RM01-DRNB1-01	1	Colluvium	35.51994811	-108.22312501	10/13/2014			13,500-13,800 / 80-120	- -		11	0.013	0.9	1.1	2.0	9.9	1.3 J
RM01-DRNB1-05	5	Colluvium	35.51994811	-108.22312501	10/13/2014			14,600-15,200 / 80-100	- -		7.3	0.01 U	0.54	0.78	0.97	9.20	0.99 J
RM01-DRNC1-00	0	Colluvium	35.51982563	-108.22356640	10/12/2014	18,214	5,775	13,700-14,000 / 100-120	- -		6.5	0.012	0.6	4.5	5.9	16.0	**10.1** J
RM01-DRNC1-01	1	Colluvium	35.51982563	-108.22356640	10/12/2014			13,500-13,800 / 60-90	- -		6.7	0.011	0.66	2.6	4.9	15.0	**8.6** J
RM01-DRNC1-05	5	Colluvium	35.51982563	-108.22356640	10/12/2014			13,600-13,800 / 60-90	- -		9.4	0.012 U	0.79	1.4	1.3	16.0	1.4 J
RM01-HR01-00	0	Colluvium	35.52049169	-108.22413184	10/13/2014	25,600	9,665	9,200-9,400 / 100-140	- -		6.8	0.02	0.67	3.5	11.0	25.0	**14.6** J
RM01-HR01-01	1	Colluvium	35.52049169	-108.22413184	10/13/2014			9,100-9,500 / 100-120	- -		8.2	0.015	0.51	1.1	5.5	11.0	**3.6** J
RM01-HR01-05	5	Colluvium	35.52049169	-108.22413184	10/13/2014			8,800-9,100 / 60-100	- -		8.4	0.019	0.58	0.92	1.00	8.30	1.10 J

TABLE 5-4
Soil Sample Laboratory Results - Primary COPCs
Ruby Mines Removal Site Evaluation Report

Sample Identification	Top of Sample Interval (feet)	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Surface Radiation Readings Uncollimated (cpm)[2]	Surface Radiation Readings Collimated (cpm)[3]	Soil Radiation Readings Gamma/Total Core Screening (cpm)[4]	Soil Radiation Readings On-Contact Jar (cpm)[5]	RSL or PRG -->	Arsenic (mg/kg)[6]	Mercury (mg/kg)[6]	Molybdenum (mg/kg)[6]	Selenium (mg/kg)[6]	Uranium (mg/kg)[6]	Vanadium (mg/kg)[6]	Radium-226 (pCi/g)[6]
											12.2	23	390	390	230	390	2.89
RM01-HR02-00	0	Mancos Shale	35.52111344	-108.22446822	10/13/2014	67,130	40,753	21,600-22,900 / 24,000-31,000	- -		35	0.23	15.0	12.0	2,600	310	1,680
RM01-HR02-01	1	Mancos Shale	35.52111344	-108.22446822	10/13/2014			16,800-19,000 / 11,000-21,100	- -		11	0.04	5.0	1.6	200	36.0	222.0 J
RM01-HR02-05	5	Mancos Shale	35.52111344	-108.22446822	10/13/2014			10,200-10,400 / 80-100	- -		8.7	0.018	0.74	0.93	2.10	9.10	1.92 J
RM01-HR03-00	0	Mancos Shale	35.52261279	-108.22426613	10/13/2014	77,079	37,264	11,000-13,600 / 240-450	- -		8.6	0.021	3.8	38 J	250	120	218
RM01-HR03-01	1	Mancos Shale	35.52261279	-108.22426613	10/13/2014			9,600-10,300 / 100-140	- -		10	0.048	0.94	1.5	2.0	9.4	2.31 J
RM01-HR03-05	5	Mancos Shale	35.52261279	-108.22426613	10/13/2014			10,300-10,600 / 100-120	- -		7.8	0.026	0.78	1.5	1.7	7.6	1.67 J
RM01-HR04-00	0	Colluvium	35.53505241	-108.20817575	10/10/2014	30,157	13,126	30,157 / - -	- -		6.9	0.022	0.87	3.2	19.0	31.0	28.6 J
RM01-HR05-00	0	Colluvium	35.53509467	-108.20810048	10/10/2014	89,648	33,068	89,648 / - -	- -		16	0.11	5.4	10	1,000	160	412 J
RM01-HR06-00	0	Colluvium	35.53514685	-108.20800107	10/10/2014	50,010	19,402	50,010 / - -	- -		14	0.036	15	15	120	130	129 J
RM01-HR07-00	0	Colluvium	35.52019176	-108.22327303	10/11/2014	176,269	72,600	13,400-14,000 / 140-200	- -		20 J	0.083	16 J	29 J	3,500	280	1,160 J
RM01-HR07-01	1	Colluvium	35.52019176	-108.22327303	10/11/2014			11,500-12,000 / 80-110	- -		9.3	0.018	2.6	3.3	12.0	13.0	10.2 J
RM01-HR07-05	5	Colluvium	35.52019176	-108.22327303	10/11/2014			10,800-11,000 / 60-100	- -		10	0.036	0.78	1.2	2.1	14.0	1.97 J
RM01-STEP01-00	0	Colluvium	35.51965026	-108.22435796	10/12/2014	24,593	8,403	11,970-12,150 / 90-110	- -		5.4	0.011 U	0.72	17	21	40	21.3 J
RM01-STEP01-01	1	Colluvium	35.51965026	-108.22435796	10/12/2014			11,860-12,100 / 90-110	- -		7.8	0.02	0.64	1.2	8.2	15.0	7.90 J
RM01-STEP01-05	5	Colluvium	35.51965026	-108.22435796	10/12/2014			11,970-12,200 / 90-110	- -		8	0.013	0.61	1.2	0.9	16.0	2.06 J
RM01-STEP02-00	0	Mancos Shale	35.52066313	-108.22269878	10/11/2014	97,827	40,360	15,000-16,500 / 100-220	- -		12	0.035	5.9	32	110	160	281 J
RM01-STEP02-01	1	Mancos Shale	35.52066313	-108.22269878	10/11/2014			13,100-14,100 / 100-120	- -		7.6	0.011 U	1.8	1.4	110	12.0	2.18 J
RM01-STEP02-05	5	Mancos Shale	35.52066313	-108.22269878	10/11/2014			12,100-12,300 / 60-80	- -		27 J	0.011 U	2.0 J	0.92 J	0.74 J	22.0 J	0.980 J
RM01-STEP03-00	0	Colluvium	35.52001544	-108.22144950	10/11/2014	59,471	21,694	13,200-13,700 / 100-120	- -		7	0.028	2.1	40	100	100	122 J
RM01-STEP03-01	1	Colluvium	35.52001544	-108.22144950	10/11/2014			12,400-13,100 / 100-100	- -		6.2	0.014	0.96	0.97	31.0	14.0	7.34 J
RM01-STEP03-05	5	Colluvium	35.52001544	-108.22144950	10/11/2014			12,500-12,100 / 80-100	- -		5.9	0.0092 U	0.88	1.6	6.1	9.2	2.13 J
RM01-STEP04-00	0	Colluvium	35.51946005	-108.22161970	10/12/2014	134,792	57,437	16,800-18,500 / 350-450	- -		7.8	0.018	1.3	6.6	57.0	22.0 J	20.9 J
RM01-STEP04-01	1	Colluvium	35.51946005	-108.22161970	10/12/2014			14,200-15,000 / 120-180	- -		9.9	0.029	0.77	0.70	2.3	7.5	1.16 J
RM01-STEP04-05	5	Colluvium	35.51946005	-108.22161970	10/12/2014			12,900-13,300 / 80-110	- -		7.3	0.017	0.64	0.66	1.80	6.50	1.28 J
RM01-STEP05-00	0	Colluvium	35.52035784	-108.22270497	10/11/2014	102,246	73,119	16,700-17,000/ 1,000-1,600	- -		20	0.026	6.6	19	3,100	720	846 J
RM01-STEP05-01	1	Colluvium	35.52035784	-108.22270497	10/11/2014			13,200-16,300 / 140-300	- -		8.5	0.018	1.2	3.4	360	110	50.7 J
RM01-STEP05-05	5	Colluvium	35.52035784	-108.22270497	10/11/2014			11,400-11,700 / 60-80	- -		11	0.019	1.0	0.84	3.30	9.50	2.45 J
RM01-WRK01-00	0	Colluvium	35.51991910	-108.22193262	10/11/2014	26,190	8,284	13,100-14,300 / 60-140	- -		3.9	0.014 J	0.42	2.8	9.4	15.0	6.80 J
RM01-WRK01-01	1	Colluvium	35.51991910	-108.22193262	10/11/2014			13,500-14,800 / 140-180	- -		7.9	0.018	2.3	16.0	110	45	149 J
RM01-WRK01-05	5	Colluvium	35.51991910	-108.22193262	10/11/2014			12,000-12,100 / 100-120	- -		8.1	0.019	0.64	1.6	7.6	10.0	4.84 J
RM01-WRK02-00	0	Colluvium	35.51979114	-108.22176407	10/11/2014	42,278	14,159	12,200-12,400 / 80-110	- -		6.8	0.023 J	0.9	9.3 J	20.0	31.0	39.9 J
RM01-WRK02-01	1	Colluvium	35.51979114	-108.22176407	10/11/2014			11,500-11,800 / 100-120	- -		9.2	0.016	1	1.6	28.0	12.0	2.23 J
RM01-WRK02-5.5	5.5	Colluvium	35.51979114	-108.22176407	10/11/2014			10,700-11,100 / 80-120	- -		6.9	0.026	0.44	0.65	3.00	8.40	1.11 J
RM01-WRK03-00	0	Colluvium	35.51968501	-108.22193452	10/11/2014	30,130	9,360	18,900-19,500 / 60-80	- -		3.7	0.012 J	0.34	1.4	5.0	13.0	3.08 J
RM01-WRK03-01	1	Colluvium	35.51968501	-108.22193452	10/12/2014			19,600-22,600 / 80-220	- -		9	0.022	2.9	35 J	95	88.0	126 J
RM01-WRK03-05	5	Colluvium	35.51968501	-108.22193452	10/12/2014			15,500-16,100 / 80-110	- -		10	0.022	0.7	1.5	0.9	11.0	1.15 J
RM01-WRK04-00	0	Colluvium	35.51943460	-108.22188727	10/12/2014	17,374	4,890	18,600-19,00 / 100-140	- -		4.0	0.017 J	0.35	1.3	2.4	13.0	2.99 J
RM01-WRK04-01	1	Colluvium	35.51943460	-108.22188727	10/12/2014			18,300-19,000 / 100-140	- -		7.8	0.038	2.7	21	120	71	38.0 J
RM01-WRK04-05	5	Colluvium	35.51943460	-108.22188727	10/12/2014			14,400-15,400 / 60-100	- -		9.3	0.048	0.71	1.2	1.2	9.3	1.92 J
RM02-VENT01-00	0	Dakota Sandstone	35.51255708	-108.22251640	10/12/2014	9,167	3,164	see surface reading	- -		3.3	0.018	0.68	1.1	0.7	20.0	1.39 J
RM02-VENT01-01	1	Dakota Sandstone	35.51255708	-108.22251640	10/12/2014			14,107 / - -	- -		3.5	0.01 U	0.43	0.93	0.79	19.00	0.94 J
RM02-VENT02-00	0	Dakota Sandstone	35.51248804	-108.22252460	10/12/2014	30,995	12,495	see surface reading	- -		3.4	0.016	1.6	2.8	55.0	17.0	5.69 J
RM02-VENT02-01	1	Dakota Sandstone	35.51248804	-108.22252460	10/12/2014			14,079 / - -	- -		2	0.011 U	2.1	1.4	48.0	11.0	1.36 J

TABLE 5-4
Soil Sample Laboratory Results - Primary COPCs
Ruby Mines Removal Site Evaluation Report

Sample Identification	Top of Sample Interval (feet)	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Surface Radiation Readings: Uncollimated (cpm)[2]	Surface Radiation Readings: Collimated (cpm)[3]	Soil Radiation Readings: Gamma/Total Core Screening (cpm)[4]	Soil Radiation Readings: On-Contact Jar (cpm)[5]		Arsenic (mg/kg)[6]	Mercury (mg/kg)[6]	Molybdenum (mg/kg)[6]	Selenium (mg/kg)[6]	Uranium (mg/kg)[6]	Vanadium (mg/kg)[6]	Radium-226 (pCi/g)[6]
										RSL or PRG -->	**12.2**	**23**	**390**	**390**	**230**	**390**	**2.89**
RM02-VENT03-00	0	Dakota Sandstone	35.51247430	-108.22252574	10/12/2014	113,882	47,869	see surface reading	- -		5.7	0.016	3.8	20.0	230	56.0	**159** J
RM02-VENT03-01	1	Dakota Sandstone	35.51247430	-108.22252574	10/12/2014			13,457 / - -	- -		2.8	0.016	2.8	4.3	110	15.0	**10.3** J
RM03-CWRP01-C-00	0	Colluvium	35.50840798	-108.16320831	10/8/2014	15,909	5,297	10,600-11,100 / 100-110	- -		6.4	0.017	0.2	1.5	1.2	7.8	1.72
RM03-CWRP01-R-05	5	Colluvium	35.50840798	-108.16320831	10/8/2014			12,000-12,200 / 80-110	- -		3.4	0.0092 U	0.77	6.9	19.0	17.0	**24.4** J
RM03-CWRP01-S-06	6	Colluvium	35.50840798	-108.16320831	10/8/2014			11,600-11,800 / 80-100	- -		5.6	0.023 J	0.47	1.3	1.2 J	26.0 J	**6.21** J
RM03-CWRP02-C-00	0	Mancos Shale	35.50816608	-108.16252582	10/9/2014	18,141	5,935	11,400-11,700 / 60-80	- -		6	0.016	0.19	1.3	0.8	9.7	1.61 J
RM03-CWRP02-R-05	5	Mancos Shale	35.50816608	-108.16252582	10/9/2014			11,500-12,000 / 100-140	- -		2.8	0.012 U	0.59	27	22.0	25.0	**13.7** J
RM03-CWRP02-R-10	10	Mancos Shale	35.50816608	-108.16252582	10/9/2014			10,900-11,200 / 100-140	- -		6.2	0.022	2.1	180	38.0	72.0	**23.7** J
RM03-CWRP02-S-13.5	13.5	Mancos Shale	35.50816608	-108.16252582	10/9/2014			12,000-13,400 / 80-100	- -		4.5	0.019	0.13	2.9	50.0	15.0	1.13
RM03-CWRP03-C-00	0	Mancos Shale	35.50795564	-108.16171587	10/9/2014	19,634	7,124	18,700-19,200 / 60-100	- -		6.2	0.017	0.2	1.7	0.98	8.8	1.71 J
RM03-CWRP03-R-05	5	Mancos Shale	35.50795564	-108.16171587	10/9/2014			17,000-17,400 / 100-120	- -		6.9	0.022	2.2	44	110	97.0	**74.3** J
RM03-CWRP03-S-10	10	Mancos Shale	35.50795564	-108.16171587	10/9/2014			17,300-17,700 / 180-240	- -		8.0	0.032	0.19	3.1	1.0	13.0	**7.90** J
RM03-CWRP04-C-00	0	Colluvium	35.50700167	-108.16143713	10/8/2014	31,942	10,925	12,200-13,200 / 100-200	- -		7.2	0.018	0.6	2.3	3.0	12.0	1.62
RM03-CWRP04-R-03	3	Colluvium	35.50700167	-108.16143713	10/8/2014			11,900-12,300 / 110-180	- -		4.4	0.015 J	2.0	18.0	83.0	61.0	**39.8** J
RM03-CWRP04-R-08	8	Colluvium	35.50700167	-108.16143713	10/8/2014			12,900-13,800 / 140-180	- -		3.7	0.013	1.8	15.0	71.0	51.0	**42.8** J
RM03-CWRP04-S-14	14	Colluvium	35.50700167	-108.16143713	10/8/2014			11,800-12,400 / 80-100	- -		6.5	0.016	0.55	1.6	4.2	11.0	1.82 J
RM03-CWRP05-C-00	0	Colluvium	35.50717090	-108.16254931	10/8/2014	24,347	8,078	10,900-11,300 / 60-80	- -		6.8	0.016 J	1.1	5.0 J	11.0 J	14.0 J	2.27
RM03-CWRP05-R-02	2	Colluvium	35.50717090	-108.16254931	10/8/2014			10,400-11,000 / 120-180	- -		- -	- -	- -	- -	- -	- -	**1,950** J
RM03-CWRP05-R-05	5	Colluvium	35.50717090	-108.16254931	10/8/2014			10,500-10,800 / 80-120	- -		1.4	0.016	0.46	4.4	10.0	10.0	**8.7**
RM03-CWRP05-R-10	10	Colluvium	35.50717090	-108.16254931	10/8/2014			10,800-11,200 / 80-110	- -		9.0	0.018	1.5	1.1	0.9	8.7	2.4 J
RM03-CWRP05-S-15	15	Colluvium	35.50717090	-108.16254931	10/8/2014			9,000-10,400 / 60-80	- -		2.6	0.009 U	0.16	0.33	0.14	1.90	0.65
RM03-CWRP06-C-00	0	Mancos Shale	35.50751233	-108.16297810	10/9/2014	31,320	10,834	12,100-12,600 / 120-180	- -		6.7	0.013	0.56	2.6	1.5	13.0	2.04
RM03-CWRP06-R-05	5	Mancos Shale	35.50751233	-108.16297810	10/9/2014			13,600-13,800 / 120-180	- -		8.1	0.018	4.8	38.0	110	130	**43.0**
RM03-CWRP06-R-10	10	Mancos Shale	35.50751233	-108.16297810	10/9/2014			12,100-12,400 / 100-140	- -		6.4	0.014	3.6	38.0	88.0	110	**46.9** J
RM03-CWRP06-S-13	13	Mancos Shale	35.50751233	-108.16297810	10/9/2014			12,700-13,000 / 120-160	- -		2.6	0.012 U	0.98	5.8	6.8	110	**10.8** J
RM03-CWRP06-S-18	18	Mancos Shale	35.50751233	-108.16297810	10/9/2014			12,300-12,600 / 80-100	- -		8.1	0.019	0.48	1.3	0.7	19.0	1.66 J
RM03-CWRP07-C-00	0	Mancos Shale	35.50773918	-108.16250762	10/9/2014	14,380	6,044	13,000-13,300 / 60-80	- -		7.2	0.018	0.53	1.9	1.2	13.0	2.23 J
RM03-CWRP07-R-05	5	Mancos Shale	35.50773918	-108.16250762	10/9/2014			11,300-11,500 / 120-160	- -		7.3	0.012	8.2	58.0	130	230	**81.2** J
RM03-CWRP07-S-6.5	6.5	Mancos Shale	35.50773918	-108.16250762	10/9/2014			11,700-12,100 / 140-180	- -		5.8	0.011 U	3.0	31.0	56.0	70.0	**39.2** J
RM03-CWRP07-S-10	10	Mancos Shale	35.50773918	-108.16250762	10/9/2014			10,500-10,800 / 80-100	- -		4.7	0.013	0.3	0.83	0.60	16.0	1.07 J
RM03-DRN01-00	0	Mancos Shale	35.50852907	-108.16340798	10/7/2014	13,376	4,182	10,800-11,300 / 80-100	- -		**13**	0.018	1.4	1.2	1.5	8.2	2.35 J
RM03-DRN01-01	1	Mancos Shale	35.50852907	-108.16340798	10/7/2014			9,700-11,100 / 80-110	- -		11	0.029	1.1	1.2	1.4	12.0	1.52 J
RM03-DRN01-05	5	Mancos Shale	35.50852907	-108.16340798	10/7/2014			8,500-9,100 / 60-80	- -		6.7	0.012	1.7	0.93	0.80	13.0	0.83 J

TABLE 5-4
Soil Sample Laboratory Results - Primary COPCs
Ruby Mines Removal Site Evaluation Report

Sample Identification	Top of Sample Interval (feet)	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Surface Radiation Readings: Uncollimated (cpm)[2]	Surface Radiation Readings: Collimated (cpm)[3]	Soil Radiation Readings: Gamma/Total Core Screening (cpm)[4]	Soil Radiation Readings: On-Contact Jar (cpm)[5]	RSL or PRG -->	Arsenic (mg/kg)[6]	Mercury (mg/kg)[6]	Molybdenum (mg/kg)[6]	Selenium (mg/kg)[6]	Uranium (mg/kg)[6]	Vanadium (mg/kg)[6]	Radium-226 (pCi/g)[6]
											12.2	23	390	390	230	390	2.89
RM03-DRN02-00	0	Colluvium	35.50678115	-108.16119405	10/7/2014	19,784	5,626	10,900-11,800 / 60-80	- -		6.2	0.01 U	0.53	4.1	6.1	12.0	**8.9**
RM03-DRN02-01	1	Colluvium	35.50678115	-108.16119405	10/7/2014			10,500-11,200 / 80-100	- -		6.6	0.021	0.48	2.2	6.3	13.0	**6.8**
RM03-DRN02-05	5	Colluvium	35.50678115	-108.16119405	10/7/2014			10,700-11,300 / 80-100	- -		5.7	0.012	0.47	1.3	2.7	12.0	2.8 J
RM03-DRN03-00	0	Mancos Shale	35.50682375	-108.16058633	10/7/2014	16,378	5,635	12,500-13,200 / 60-80	- -		7 J	0.018 J	0.53	6.4 J	10.0	25.0	**10.2** J
RM03-DRN03-01	1	Mancos Shale	35.50682375	-108.16058633	10/7/2014			10,500-11,200 / 80-110	- -		8.7	0.031	0.61	3.5	8.7	25.0	**4.6** J
RM03-DRN03-05	5	Mancos Shale	35.50682375	-108.16058633	10/7/2014			10,600-11,300 / 80-110	- -		7	0.011	0.46	0.98	1.60	9.60	1.11 J
RM03-DWTR01-00	0	Mancos Shale	35.50725973	-108.16412418	10/7/2014	15,978	4,745	11,100-11,600 / 80-100	- -		9.4	0.033	0.53	1.7	2.2	20.0	2.58 J
RM03-DWTR01-01	1	Mancos Shale	35.50725973	-108.16412418	10/7/2014			11,700-12,500 / 80-100	- -		6.9	0.017	0.77	2.4	3.0	18.0	**11.90** J
RM03-DWTR01-05	5	Mancos Shale	35.50725973	-108.16412418	10/7/2014			11,600-12,100 / 100-110	- -		6.6	0.015	0.5	2.4	2.8	17.0	**4.39** J
RM03-DWTR02-00	0	Mancos Shale	35.50722708	-108.16350647	10/7/2014	24,524	8,178	13,200-13,700 / 80-100	- -		7	0.013	1.1	5.3	12.0	23.0	**6.69** J
RM03-DWTR02-01	1	Mancos Shale	35.50722708	-108.16350647	10/7/2014			13,200-14,200 / 100-160	- -		7.9	0.019	3.9	35.0	77.0	110	**51.6** J
RM03-DWTR02-05	5	Mancos Shale	35.50722708	-108.16350647	10/7/2014			14,800-16,200 / 160-180	- -		11	0.043	2.2	69.0	110	200	**75.4** J
RM03-DWTR02-6.5	6.5	Mancos Shale	35.50722708	-108.16350647	10/7/2014			11,600-13,000 / 160-200	- -		8	0.023	1.1	5.0	23.0	26.0	**32.0** J
RM03-DWTR03-00	0	Mancos Shale	35.50723849	-108.16335532	10/7/2014	41,483	14,453	14,200-15,800 / 100-120	- -		11	0.018	4.7	46.0	85.0	130	**50.7** J
RM03-DWTR03-01	1	Mancos Shale	35.50723849	-108.16335532	10/7/2014			13,800-14,400 / 150-220	- -		11	0.017	3.5	25.0	66.0	100	**40.3** J
RM03-DWTR03-05	5	Mancos Shale	35.50723849	-108.16335532	10/7/2014			12,700-14,000 / 250-300	- -		9.1	0.024	4.6	24.0	86.0	77.0	**47.0** J
RM03-DWTR03-10	10	Mancos Shale	35.50723849	-108.16335532	10/7/2014			12,400-12,900 / 80-100	- -		8.4	0.013	1.1	1.4	1.3	20.0	1.39 J
RM03-WRK01-00	0	Mancos Shale	35.50680650	-108.16339085	10/8/2014	15,295	4,815	10,000-10,200 / 60-80	- -		6.6	0.015	0.48	2.1	1.4	18.0	2.70 J
RM03-WRK01-01	1	Mancos Shale	35.50680650	-108.16339085	10/8/2014			10,200-10,600 / 100-120	- -		8.5	0.018	2.6	13.0	51.0	53.0	**12.3** J
RM03-WRK01-05	5	Mancos Shale	35.50680650	-108.16339085	10/8/2014			9,800-10,100 / 80-110	- -		6.3	0.012	0.42	0.98	0.83	13.00	1.38 J
RM03-WRK02-00	0	Mancos Shale	35.50659736	-108.16404576	10/8/2014	14,067	4,247	10,200-10,400 / 60-80	- -		6	0.014	0.43	1.8	1.9	13.0	2.66 J
RM03-WRK02-01	1	Mancos Shale	35.50659736	-108.16404576	10/8/2014			9,900-10,000 / 60-80	- -		8.2	0.025	0.50	0.95	0.66	15.0	1.29 J
RM03-WRK02-05	5	Mancos Shale	35.50659736	-108.16404576	10/8/2014			9,800-10,100 / 80-110	- -		3.4	0.0098 U	0.2	0.9	1.1	21.0	1.49
RM03-WRK03-00	0	Mancos Shale	35.50634705	-108.16392051	10/8/2014	24,140	8,430	10,800-11,500 / 60-80	- -		6	0.014	0.76	11.0	9.2	31.0	**20.0**
RM03-WRK03-01	1	Mancos Shale	35.50634705	-108.16392051	10/8/2014			10,800-11,200 / 60-100	- -		6.2	0.023	0.63	1.4	13.0	17.0	1.35
RM03-WRK03-05	5	Mancos Shale	35.50634705	-108.16392051	10/8/2014			11,100-11,300 / 80-110	- -		1.9	0.011 U	0.45	0.77	0.77	10.0	0.88
RM03-WRK04-00	0	Mancos Shale	35.50628205	-108.16448069	10/8/2014	104,266	40,982	104,266 / - -	- -		10	0.067	3.1	140	**440**	260	**590**
RM03-WRK04-01	1	Mancos Shale	35.50628205	-108.16448069	10/8/2014			12,400-15,100 / 220-380	- -		4.3 J	0.0098 U	6.3	1.8 J	130.0 J	11.0	1.74
RM03-WRK04-04	4	Mancos Shale	35.50628205	-108.16448069	10/8/2014			12,100-12,400 / 80-100	- -		8.2	0.017 J	0.52	1.2	1.1	24.0	1.62
RM04-VENT01-00	0	Mancos Shale	35.5067822	-108.2055966	10/7/2014	13,279	4,256	see surface reading	- -		8.9	0.015	0.56	1.0	1.4	9.0	1.10 J
RM04-VENT01-01	1	Mancos Shale	35.5067822	-108.2055966	10/7/2014			11,081 / - -	- -		9.1	0.014	0.58	1.0	0.9	8.6	1.15 J
RM04-VENT02-00	0	Mancos Shale	35.5068450	-108.2055350	10/7/2014	23,252	8,397	see surface reading	- -		9.6	0.012	0.85	3.8	11.0	12.0	**6.38** J
RM04-VENT02-01	1	Mancos Shale	35.5068450	-108.2055350	10/7/2014			11,117 / - -	- -		8.7	0.014	0.54	1.1	2.1	11.0	2.38 J
RM04-VENT03-00	0	Mancos Shale	35.5068284	-108.2054093	10/6/2014	97,183	43,463	see surface reading	- -		9.8	0.016	1.4	**600**	**350**	130	**111**
RM04-VENT03-02	2	Mancos Shale	35.5068284	-108.2054093	10/6/2014			11,327 / - -	- -		9.6	0.016	1.1	81.0	56.0	25.0	**24.3**
RM19-VENT01-00	0	Colluvium	35.5151521	-108.2251507	10/11/2014	12,716	3,889	see surface reading	- -		7.7	0.02	0.6	0.86	1.10	15.00	1.37 J
RM19-VENT01-01	1	Colluvium	35.5151521	-108.2251507	10/11/2014			11,327 / - -	- -		8.5	0.017	0.55	1.0	0.73	13.0	1.19 J
RM19-VENT02-00	0	Colluvium	35.5150691	-108.2250925	10/11/2014	77,944	31,787	see surface reading	- -		7.3	0.033	1.3	130	100	210	**107** J
RM19-VENT02-01	1	Colluvium	35.5150691	-108.2250925	10/11/2014			13,000 / - -	- -		9.5	0.016	0.8	5.0	76.0	20.0	**8.40** J
RM19-VENT03-00	0	Colluvium	35.5149550	-108.2251007	10/11/2014	33,329	12,254	see surface reading	- -		7.6	0.024	1.2	40.0	34.0	89.0	**32.2** J
RM19-VENT03-01	1	Colluvium	35.5149550	-108.2251007	10/11/2014			13,000 / - -	- -		8.7	0.015	0.7	4.1	7.5	21.0	**4.24** J
RM01-8MAY14-01	0	Dakota Sandstone	35.5185001	-108.2220700	5/8/2014	38,876	11,774	see surface reading	11,776		NS	NS	NS	NS	NS	NS	143
RM01-8MAY14-02	0	Dakota Sandstone	35.5184085	-108.2221653	5/8/2014	79,193	35,235	see surface reading	14,687		NS	NS	NS	NS	NS	NS	299
RM01-8MAY14-03	0	Colluvium	35.5198176	-108.2244555	5/8/2014	19,947	5,787	see surface reading	9,558		NS	NS	NS	NS	NS	NS	5.73 J
RM01-8MAY14-04	0	Colluvium	35.5204376	-108.2224782	5/8/2014	34,094	10,226	see surface reading	9,304		NS	NS	NS	NS	NS	NS	17.3 J
RM01-8MAY14-05	0	Colluvium	35.5205569	-108.2224392	5/8/2014	122,269	91,084	see surface reading	43,536		NS	NS	NS	NS	NS	NS	1,330
RM01-8MAY14-06	0	Colluvium	35.5224196	-108.2241946	5/8/2014	26,512	8,423	see surface reading	10,331		NS	NS	NS	NS	NS	NS	15.8 J

TABLE 5-4

Soil Sample Laboratory Results - Primary COPCs

Ruby Mines Removal Site Evaluation Report

Sample Identification	Top of Sample Interval (feet)	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Surface Radiation Readings		Soil Radiation Readings			Arsenic (mg/kg)[6]	Mercury (mg/kg)[6]	Molybdenum (mg/kg)[6]	Selenium (mg/kg)[6]	Uranium (mg/kg)[6]	Vanadium (mg/kg)[6]	Radium-226 (pCi/g)[6]	
						Uncollimated (cpm)[2]	Collimated (cpm)[3]	Gamma/Total Core Screening (cpm)[4]	On-Contact Jar (cpm)[5]	RSL or PRG -->	12.2	23	390	390	230	390	2.89	
RM01-8MAY14-07	0	Colluvium	35.5224421	-108.2240677	5/8/2014	268,857	112,974	see surface reading	40,655		NS	NS	NS	NS	NS	NS	1,440	
RM01-8MAY14-08	0	Colluvium	35.5227091	-108.2250849	5/8/2014	13,094	3,889	see surface reading	10,708		NS	NS	NS	NS	NS	NS	2.77	
RM03-8MAY14-01	0	Mancos Shale	35.5063502	-108.1647186	5/8/2014	12,877	3,804	see surface reading	8,508		NS	NS	NS	NS	NS	NS	1.19	
RM03-8MAY14-02	0	Mancos Shale	35.5067222	-108.1637377	5/8/2014	23,023	7,488	see surface reading	8,260		NS	NS	NS	NS	NS	NS	4.17	J
RM03-8MAY14-03	0	Mancos Shale	35.5071681	-108.1639460	5/8/2014	17,167	5,116	see surface reading	8,394		NS	NS	NS	NS	NS	NS	3.27	J
RM03-8MAY14-04	0	Mancos Shale	35.5064281	-108.1645422	5/8/2014	38,876	11,774	see surface reading	11,301		NS	NS	NS	NS	NS	NS	141	
RM03-8MAY14-05	0	Colluvium	35.5085730	-108.1623570	5/8/2014	30,597	10,838	see surface reading	7,956		NS	NS	NS	NS	NS	NS	3.27	J
RM03-8MAY14-06	0	Mancos Shale	35.5077736	-108.1615589	5/8/2014	47,897	18,852	see surface reading	9,320		NS	NS	NS	NS	NS	NS	220	J
RM03-8MAY14-07	0	Mancos Shale	35.5065111	-108.1640419	5/8/2014	109,898	41,707	see surface reading	28,208		NS	NS	NS	NS	NS	NS	1,000	
RM03-8MAY14-08	0	Mancos Shale	35.5062005	-108.1636982	5/8/2014	171,019	89,326	see surface reading	16,798		NS	NS	NS	NS	NS	NS	391	
RM03-8MAY14-09 [7]	0	Colluvium	35.5073561	-108.1624775	5/8/2014	[6] Max Meter >999,999	313,782	see surface reading	44,070		NS	NS	NS	NS	NS	NS	1,240	J
RM-COR18-00	0	Colluvium	35.5197178	-108.2215697	10/8/2014	20,411	5,990	see surface reading	8,417		NS	NS	NS	NS	NS	NS	4.14	
RM-COR19-00	0	Colluvium	35.5204134	-108.2231135	10/8/2014	16,546	5,052	see surface reading	8,824		NS	NS	NS	NS	NS	NS	2.56	
RM-COR20-00	0	Colluvium	35.5198719	-108.2237010	10/8/2014	18,114	5,439	see surface reading	8,838		NS	NS	NS	NS	NS	NS	7.7	J
RM-COR21-00	0	Colluvium	35.5202168	-108.2218508	10/8/2014	17,964	5,074	see surface reading	8,400		NS	NS	NS	NS	NS	NS	4.03	J
RM-COR22-00	0	Mancos Shale	35.5188262	-108.2236257	10/8/2014	16,809	5,116	see surface reading	8,012		NS	NS	NS	NS	NS	NS	1.49	J
RM-COR23-00	0	Mancos Shale	35.5190879	-108.2217875	10/8/2014	20,456	6,117	see surface reading	8,319		NS	NS	NS	NS	NS	NS	5.77	J
RM-COR24-00	0	Mancos Shale	35.5067382	-108.1637461	10/8/2014	15,050	4,467	see surface reading	10,011		NS	NS	NS	NS	NS	NS	1.54	J
RM-COR25-00	0	Mancos Shale	35.5073522	-108.1637772	10/7/2014	17,355	5,326	see surface reading	11,625		NS	NS	NS	NS	NS	NS	2.13	J
RM-COR26-00	0	Colluvium	35.5084014	-108.1627698	10/8/2014	15,753	5,081	see surface reading	11,071		NS	NS	NS	NS	NS	NS	1.7	J
RM-COR27-00	0	Mancos Shale	35.5067331	-108.1607533	10/7/2014	13,996	3,505	see surface reading	12,319		NS	NS	NS	NS	NS	NS	1.38	J
RM-COR28-00	0	Mancos Shale	35.5074210	-108.1615060	10/7/2014	17,957	4,808	see surface reading	10,129		NS	NS	NS	NS	NS	NS	1.99	J
RM-COR29-00	0	Colluvium	35.5070483	-108.1630800	10/8/2014	18,719	5,456	see surface reading	10,559		NS	NS	NS	NS	NS	NS	3.34	J
RM-COR30-00	0	Mancos Shale	35.5073266	-108.1638812	10/7/2014	15,436	4,839	see surface reading	11,152		NS	NS	NS	NS	NS	NS	2.9	J
RM-COR31-00	0	Mancos Shale	35.5072085	-108.1636579	10/7/2014	17,341	4,884	see surface reading	11,914		NS	NS	NS	NS	NS	NS	3.42	J
RM-COR32-00	0	Mancos Shale	35.5071929	-108.1635577	10/7/2014	19,368	5,633	see surface reading	11,735		NS	NS	NS	NS	NS	NS	6.71	J
RM-COR33-00	0	Colluvium	35.5069660	-108.1633435	10/8/2014	20,175	6,084	see surface reading	10,196		NS	NS	NS	NS	NS	NS	3.01	
RM-COR34-00	0	Colluvium	35.5069288	-108.1635919	10/8/2014	17,119	4,937	see surface reading	10,459		NS	NS	NS	NS	NS	NS	1.95	J
RM-COR35-00	0	Mancos Shale	35.5068007	-108.1638891	10/8/2014	15,485	4,998	see surface reading	10,191		NS	NS	NS	NS	NS	NS	1.5	J
RM-COR36-00	0	Mancos Shale	35.5065530	-108.1636489	10/8/2014	20,280	6,344	see surface reading	10,159		NS	NS	NS	NS	NS	NS	6.23	J
RM-COR37-00	0	Mancos Shale	35.5060939	-108.1635526	10/8/2014	16,561	5,087	see surface reading	10,207		NS	NS	NS	NS	NS	NS	7.5	J
RM-COR38-00	0	Mancos Shale	35.5063058	-108.1643131	10/8/2014	18,409	5,955	see surface reading	10,242		NS	NS	NS	NS	NS	NS	8.8	J
RM-COR39-00	0	Mancos Shale	35.5072812	-108.1636952	10/7/2014	18,845	5,761	see surface reading	10,682		NS	NS	NS	NS	NS	NS	3.19	J
RM-COR40-00	0	Mancos Shale	35.5065268	-108.1598311	10/7/2014	14,482	4,310	see surface reading	11,173		NS	NS	NS	NS	NS	NS	1.82	J
RM-COR41-00	0	Colluvium	35.5205561	-108.2228955	10/8/2014	21,636	6,839	see surface reading	8,566		NS	NS	NS	NS	NS	NS	9.3	
RM-COR42-00	0	Colluvium	35.5204892	-108.2229318	10/8/2014	24,359	7,575	see surface reading	8,677		NS	NS	NS	NS	NS	NS	19.2	
RM-COR43-00	0	Colluvium	35.5203480	-108.2229117	10/8/2014	19,182	5,721	see surface reading	8,813		NS	NS	NS	NS	NS	NS	1.7	J
RM-COR44-00	0	Colluvium	35.5225850	-108.2249219	10/8/2014	13,437	4,292	see surface reading	8,252		NS	NS	NS	NS	NS	NS	1.5	J
RM-COR45-00	0	Colluvium	35.5197664	-108.2241976	10/8/2014	20,154	5,935	see surface reading	8,366		NS	NS	NS	NS	NS	NS	7.9	J
RM-COR46-00	0	Mancos Shale	35.5189433	-108.2225523	10/8/2014	20,369	6,292	see surface reading	8,309		NS	NS	NS	NS	NS	NS	5.57	J
RM-COR47-00	0	Colluvium	35.5192561	-108.2217416	10/8/2014	18,008	5,171	see surface reading	8,259		NS	NS	NS	NS	NS	NS	3.38	

Notes:

[1] Location coordinates are in geographic coordinate system WGS 84, decimal degrees. West longitudes are designated as negative.

[2] Gamma radiation measurement from uncollimated 1 minute static reading from Ludlum 2221 2x2 NaI detector at 6 inches above ground prior to collection.

[3] Gamma radiation measurement from collimated 1 minute static reading from Ludlum 2221 2x2 NaI detector at 6 inches above ground prior to collection.

[4] Gamma radiation measurements from uncollimated screening reading with Ludlum 2221 2x2 NaI detector/Total radiation measurements with a Geiger Muller Ludlum 44-9 detector above core or sample prior to collection.

[5] Gamma radiation measurement from uncollimated 1 minute static reading from Ludlum 2221 2x2 NaI detector on contact from sample jar (ambient air ~9,000 counts per minute).

[6] Laboratory analytical method SW846 6020 was used to analyze samples for metals arsenic, molybdenum, selenium, uranium, and vanadium. Method SW846 7471A was used for mercury analysis. Method EPA 901.1 was used for radium-226 analysis.

TABLE 5-4

Soil Sample Laboratory Results - Primary COPCs

Ruby Mines Removal Site Evaluation Report

Sample Identification	Top of Sample Interval (feet)	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Surface Radiation Readings Uncollimated (cpm)[2]	Surface Radiation Readings Collimated (cpm)[3]	Soil Radiation Readings Gamma/Total Core Screening (cpm)[4]	Soil Radiation Readings On-Contact Jar (cpm)[5]		Arsenic (mg/kg)[6]	Mercury (mg/kg)[6]	Molybdenum (mg/kg)[6]	Selenium (mg/kg)[6]	Uranium (mg/kg)[6]	Vanadium (mg/kg)[6]	Radium-226 (pCi/g)[6]
										RSL or PRG -->	12.2	23	390	390	230	390	2.89

[7] Sample from cap material is not applicable for correlation of radium-226 with detector readings because the material could be waste rock, not mine affected soil. The data is provided for information only.

Bold Grey Data = Analytical detections exceeding the RSL or PRG

- - = Not analyzed

Laboratory Analytical Qualifers:

J = Estimated. This qualifier indicates that the analyte was detected, but should be considered estimated.

U = The analyte was not detected above the indicated method detection limit.

UJ = The analyte was not detected above the indicated estimated method detection limit.

Acronyms and Abbreviations:

COPC = constituent(s) of potential concern

cpm = counts per minute

EPA = U.S. Environmental Protection Agency

mg/kg = milligrams per kilogram

NaI = sodium iodide

NS = not sampled

pCi/g = picocurie(s) per gram

PRG = Preliminary Remediation Goal

RSL = USEPA Regional Screening Levels are based on a Hazard Quotient of 1.0 and a residential exposure scenario

TABLE 5-5

Soil Sample Laboratory Results - Secondary COPCs

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Analytical Method	Analyte	USEPA RSL [2]	Result	Validation Flag	Units
RM01-WRK01-00	Colluvium	35.5199191	-108.2219326	10/11/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/11/2014	SW8015-E	DIESEL RANGE ORGANICS	96	2.7	J	mg/kg
				10/11/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	24		mg/kg
				10/11/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/11/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/13/2014	SW8260B	VOC analytes were not detected	--	--	--	--
				10/11/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/11/2014	SW8330B	1,3,5-TRINITROBENZENE	2,200	0.0070	J	mg/kg
RM01-WRK02-00	Colluvium	35.5197911	-108.2217641	10/11/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/11/2014	SW8015-E	DIESEL RANGE ORGANICS	96	2.7	J	mg/kg
				10/11/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	12		mg/kg
				10/11/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/11/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/11/2014	SW8260B	VOC analytes were not detected	--	--	--	--
				10/11/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/11/2014	SW8330B	1,3,5-TRINITROBENZENE	2,200	0.0061	J	mg/kg
RM01-WRK03-00	Colluvium	35.5196850	-108.2219345	10/12/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/12/2014	SW8015-E	DIESEL RANGE ORGANICS	96	2.2	J	mg/kg
				10/12/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	11		mg/kg
				10/12/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/12/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/13/2014	SW8260B	ACETONE	61,000	0.032		mg/kg
				10/12/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/12/2014	SW8330B	Explosive analytes were not detected	--	--	--	--
RM01-WRK04-00	Colluvium	35.5194346	-108.2218873	10/12/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/12/2014	SW8015-E	DIESEL RANGE ORGANICS	96	2.5	J	mg/kg
				10/12/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	6.5		mg/kg
				10/12/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/12/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/12/2014	SW8260B	ACETONE	61,000	0.10		mg/kg
				10/12/2014	SW8260B	TOLUENE	4,900	0.0012	J	mg/kg
				10/12/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/12/2014	SW8330B	Explosive analytes were not detected	--	--	--	--
RM03-WRK01-00	Mancos Shale	35.506806	-108.163391	10/9/2014	SW6850	PERCHLORATE	55	0.0018	J	mg/kg
				10/9/2014	SW8015-E	Diesel Range Organics were not detected	--	--	--	--
				10/9/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	3.0	J	mg/kg
				10/9/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/9/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/9/2014	SW8260B	ACETONE	61,000	0.13		mg/kg

TABLE 5-5

Soil Sample Laboratory Results - Secondary COPCs

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Analytical Method	Analyte	USEPA RSL [2]	Result	Validation Flag	Units
				10/9/2014	SW8260B	TOLUENE	4,900	0.0013	J	mg/kg
				10/9/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/9/2014	SW8330B	Explosive analytes were not detected	--	--	--	--
RM03-WRK02-00	Mancos Shale	35.506597	-108.164046	10/9/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/9/2014	SW8015-E	Diesel Range Organics were not detected	--	--	--	--
				10/9/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	4.5	J	mg/kg
				10/9/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/9/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/9/2014	SW8260B	BENZENE	1.2	0.0015	J	mg/kg
				10/9/2014	SW8260B	TOLUENE	4,900	0.0029	J	mg/kg
				10/9/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/9/2014	SW8330B	Explosive analytes were not detected	--	--	--	--
RM03-WRK03-00	Mancos Shale	35.506347	-108.163921	10/9/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/9/2014	SW8015-E	Diesel Range Organics were not detected	--	--	--	--
				10/9/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	8.9		mg/kg
				10/9/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/9/2014	SW8260B	BENZENE	1.2	0.0016	J	mg/kg
				10/9/2014	SW8260B	TOLUENE	4,900	0.0031	J	mg/kg
				10/9/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/9/2014	SW8330B	Explosive analytes were not detected	--	--	--	--
RM03-WRK04-00	Mancos Shale	35.506347	-108.163921	10/9/2014	SW6850	Perchlorate was not detected	--	--	--	--
				10/9/2014	SW8015-E	DIESEL RANGE ORGANICS	96	4.1	J	mg/kg
				10/9/2014	SW8015-E	MOTOR OIL RANGE ORGANICS	2,500	32		mg/kg
				10/9/2014	SW8015-P	Gasoline Range Organics were not detected	--	--	--	--
				10/9/2014	SW8082	PCB analytes were not detected	--	--	--	--
				10/9/2014	SW8260B	TOLUENE	4,900	0.0015	J	mg/kg
				10/9/2014	SW8270C	SVOC analytes were not detected	--	--	--	--
				10/9/2014	SW8330B	1,3,5-TRINITROBENZENE	2,200	0.0077	J	mg/kg
				10/9/2014	SW8330B	PENTAERYTHRITOL TETRANITRATE	120	0.071	J	mg/kg

Notes:

[1] Location coordinates are in geographic coordinate system WGS 84, decimal degrees. West longitudes are designated as negative.

[2] USEPA Regional Screening Levels are based on a Hazard Quotient of 1.0, a 1 x 10^{6} target risk, and a residential exposure scenario. http://www.epa.gov/region9/superfund/prg/

- - = Not analyzed

Laboratory Analytical Qualifier:

J = Estimated. This qualifier indicates that the analyte was detected, but should be considered estimated.

Acronyms and Abbreviations:

COPC = constituent(s) of potential concern

USEPA = U.S. Environmental Protection Agency

RSL = Regional Screening Levels

mg/kg = milligrams per kilogram

PCB = polychlorinated biphenyl

SVOC = semivolatile organic compound

TPH = total petroleum hydrocarbon

VOC = volatile organic compound

TABLE 5-6

Soil Sample Laboratory Results - Agronomic and Engineering Parameters

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Analytical Method	Analyte	Result	Validation Flag	Units
RM01-AGR01	Colluvium	35.5194095	-108.2225243	10/12/2014	ASA-9 90-3	Total Organic Carbon	7,000		mg/kg
					SW6010	Calcium	12,000		mg/kg
					SW6010	Magnesium	6,200		mg/kg
					SW6010	Phosphorus	420		mg/kg
					SW6010	Potassium	2,000		mg/kg
					SW6010	Sodium	100	U	mg/kg
					SW9045C	pH	8.20		pH
					SW9056	Chloride	2.1	U	mg/kg
					SW9056	Nitrate as N	2.5		mg/kg
					SW9056	Sulfate	11	U	mg/kg
					ASTM D7263	Bulk Density	1.35		g/cm3
					ASTM D4318	Liquid Limit	29		none
					ASTM D4318	Plastic Limit	20		none
					ASTM D4318	Plasticity Index	10		none
					ASTM D2487	USCS classification	Lean clay with sand		none
					ASTM D422	Particle Size Distribution	*See lab report*		
RM01-AGR02	Colluvium	35.5194148	-108.2242869	10/12/2014	ASA-9 90-3	Total Organic Carbon	5,000		mg/kg
					SW6010	Calcium	13,000		mg/kg
					SW6010	Magnesium	6,300		mg/kg
					SW6010	Phosphorus	340		mg/kg
					SW6010	Potassium	1,900		mg/kg
					SW6010	Sodium	92	U	mg/kg
					SW9045C	pH	8.40		pH
					SW9056	Chloride	5.6		mg/kg
					SW9056	Nitrate as N	5.4		mg/kg
					SW9056	Sulfate	11	U	mg/kg
					ASTM D7263	Bulk Density	1.38		g/cm3
					ASTM D4318	Liquid Limit	33		none
					ASTM D4318	Plastic Limit	19		none
					ASTM D4318	Plasticity Index	13		none
					ASTM D2487	USCS classification	Lean clay with sand		none
					ASTM D422	Particle Size Distribution	*See lab report*		

TABLE 5-6

Soil Sample Laboratory Results - Agronomic and Engineering Parameters

Ruby Mines Removal Site Evaluation Report

Sample Identification	Background Reference Area	Latitude [1]	Longitude [1]	Sample Date	Analytical Method	Analyte	Result	Validation Flag	Units
RM03-AGR01	Mancos Shale	35.507895	-108.162247	10/9/2014	ASA-9 90-3	Total Organic Carbon	3,900		mg/kg
					SW6010	Calcium	24,000		mg/kg
					SW6010	Magnesium	10,000		mg/kg
					SW6010	Phosphorus	440		mg/kg
					SW6010	Potassium	1,900		mg/kg
					SW6010	Sodium	100	U	mg/kg
					SW9045C	pH	8.30		pH
					SW9056	Chloride	2.2	U	mg/kg
					SW9056	Nitrate as N	3.9		mg/kg
					SW9056	Sulfate	11	U	mg/kg
					ASTM D7263	Bulk Density	1.45		g/cm3
					ASTM D4318	Liquid Limit	28		none
					ASTM D4318	Plastic Limit	19		none
					ASTM D4318	Plasticity Index	9		none
					ASTM D2487	USCS classification	Lean clay with sand		none
					ASTM D422	Particle Size Distribution	*See lab report*		
RM03-AGR02	Colluvium	35.508447	-108.162528	10/9/2014	ASA-9 90-3	Total Organic Carbon	4,200		mg/kg
					SW6010	Calcium	26,000		mg/kg
					SW6010	Magnesium	12,000		mg/kg
					SW6010	Phosphorus	460		mg/kg
					SW6010	Potassium	2,000		mg/kg
					SW6010	Sodium	98	U	mg/kg
					SW9045C	pH	8.40		pH
					SW9056	Chloride	2.3	U	mg/kg
					SW9056	Nitrate as N	4.7		mg/kg
					SW9056	Sulfate	11	U	mg/kg
					ASTM D7263	Bulk Density	1.32		g/cm3
					ASTM D4318	Liquid Limit	31		none
					ASTM D4318	Plastic Limit	19		none
					ASTM D4318	Plasticity Index	13		none
					ASTM D2487	USCS classification	Lean clay with sand		none
					ASTM D422	Particle Size Distribution	*See lab report*		

Notes:

[1] Location coordinates are in geographic coordinate system WGS 84, decimal degrees. West longitudes are designated as negative.

Laboratory Analytical Qualifiers:

U = The analyte was not detected above the indicated method detection limit.

UJ = The analyte was not detected above the indicated estimated method detection limit.

Acronyms and Abbreviations:

g/cm3 = grams per cubic centimeter

mg/kg = milligrams per kilogram

Figures

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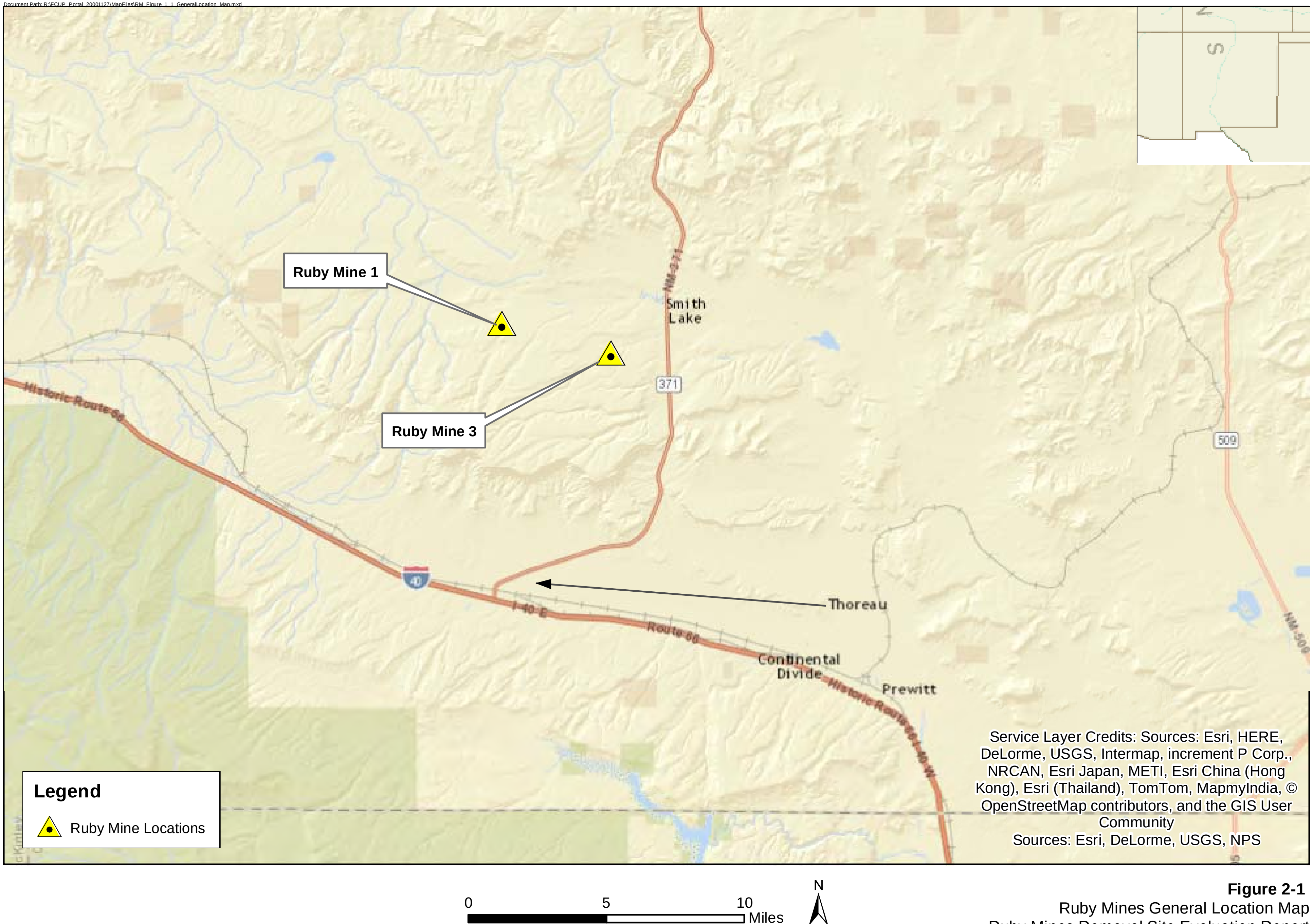

Figure 2-1
Ruby Mines General Location Map
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

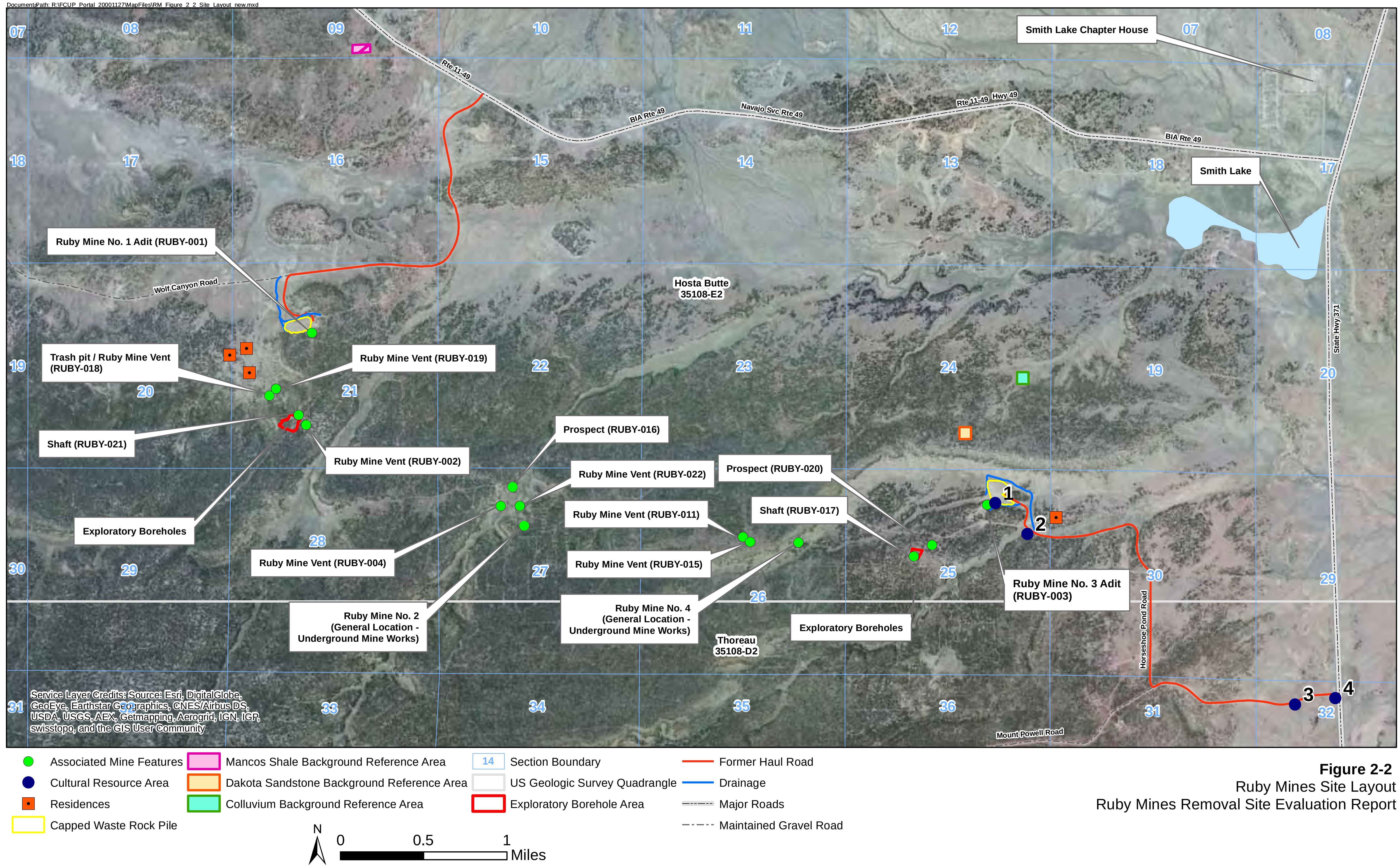

Figure 2-2
Ruby Mines Site Layout
Ruby Mines Removal Site Evaluation Report

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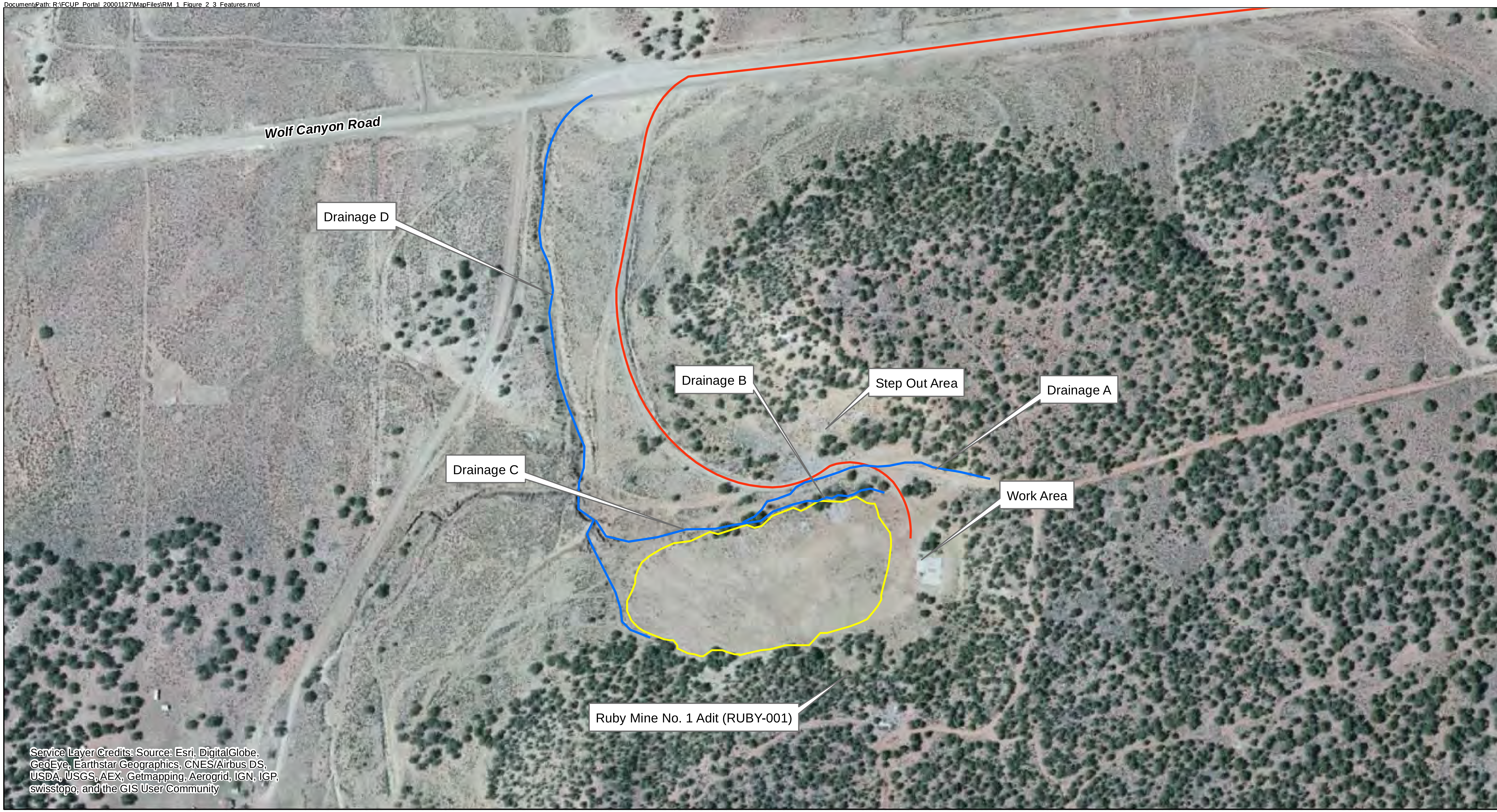

Capped Waste Rock Pile
Former Haul Road
Drainage

N
0 220 440 880 Feet

Figure 2-3
Ruby Mine No. 1 Features
Ruby Mines Removal Site Evaluation Report

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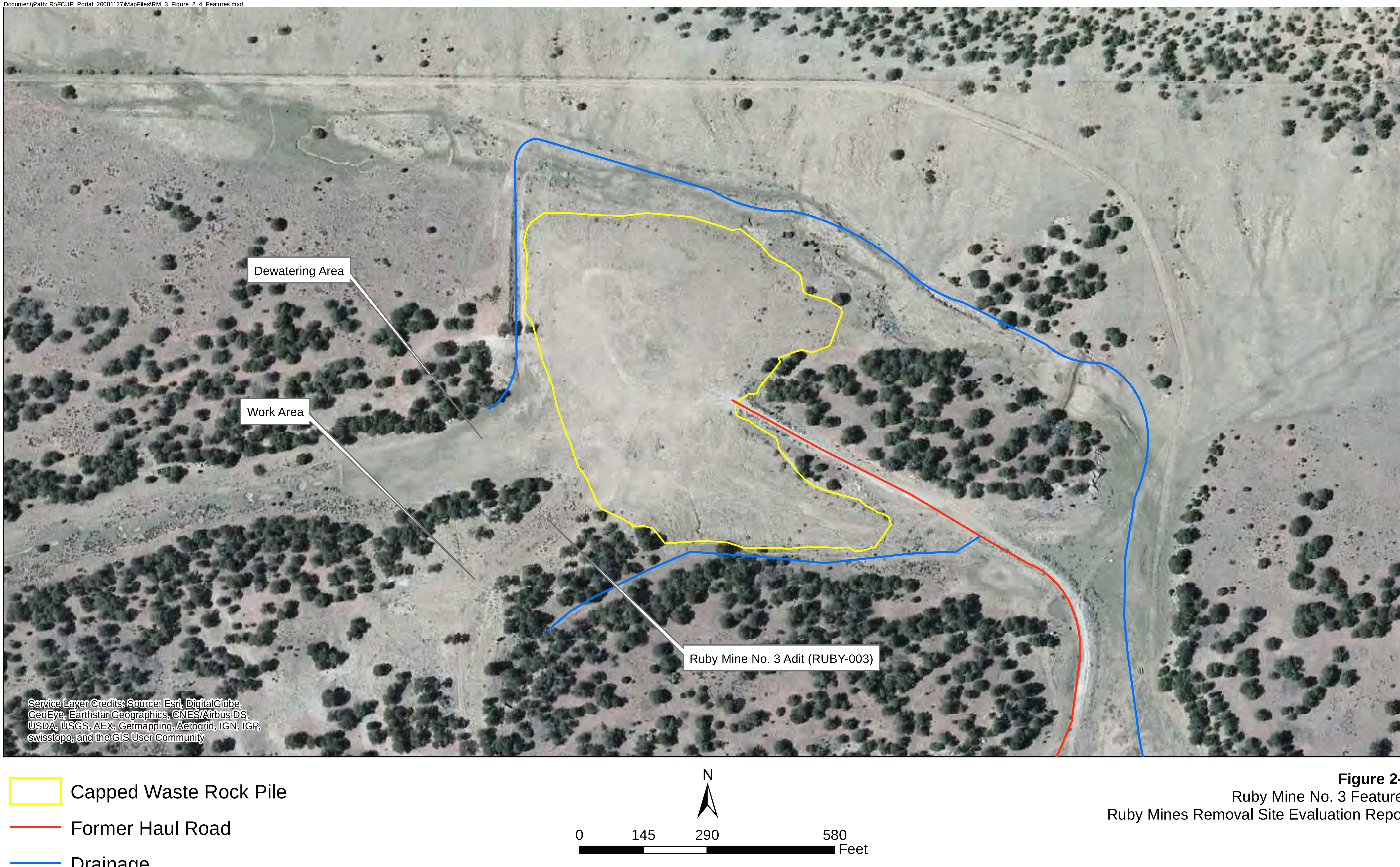

Figure 2-4
Ruby Mine No. 3 Features
Ruby Mines Removal Site Evaluation Report

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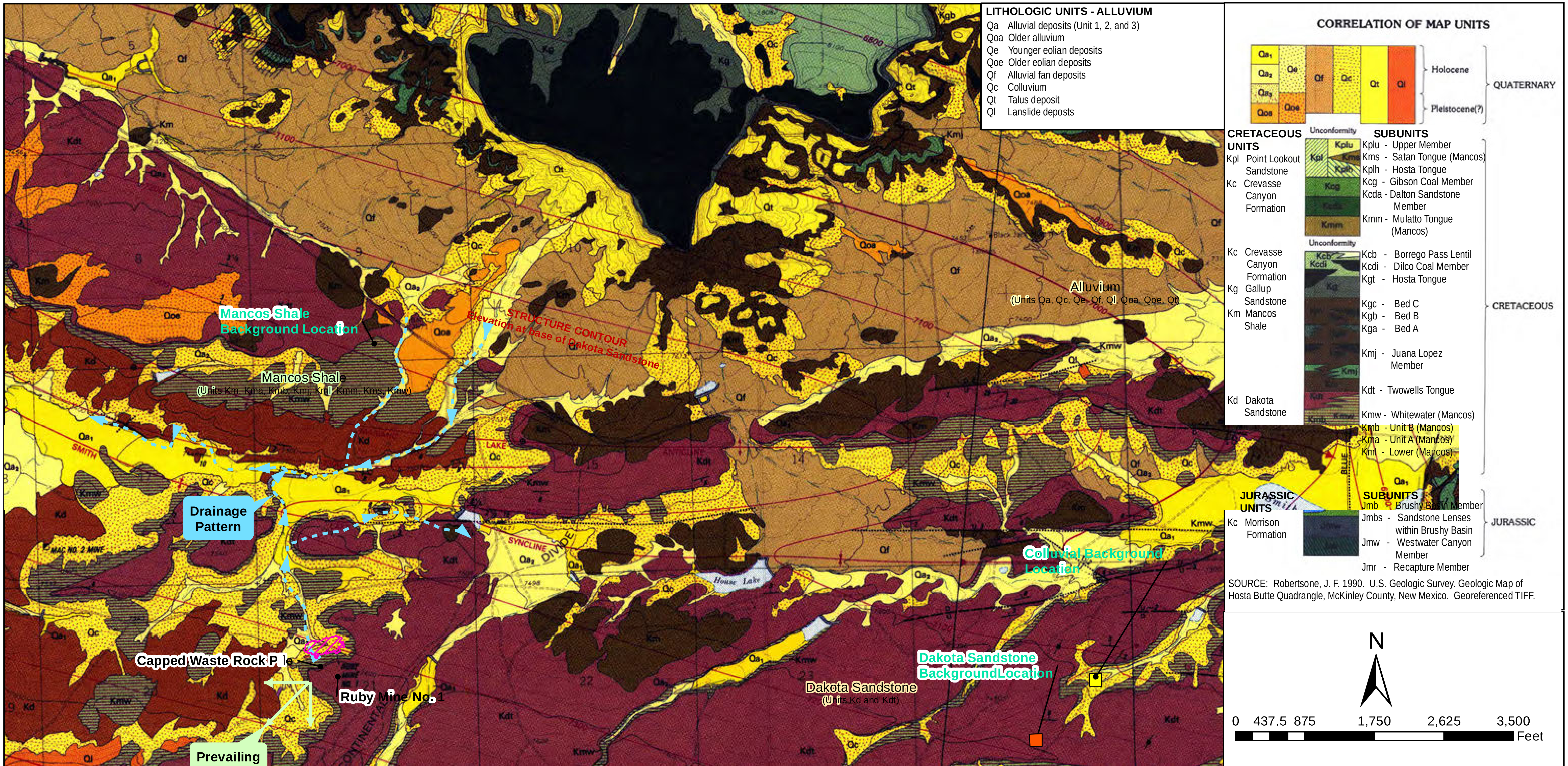

Figure 3-1
Geologic Map of Ruby Mine Area
With Wind Direction and Surface Water
Drainage Overlays
Ruby Mines Removal Site
Evaluation Report

Document Path: Q:\Av_Proj\RubyMines\MapFiles\GeologicMapFig3-1Phase3Rpt.mxd

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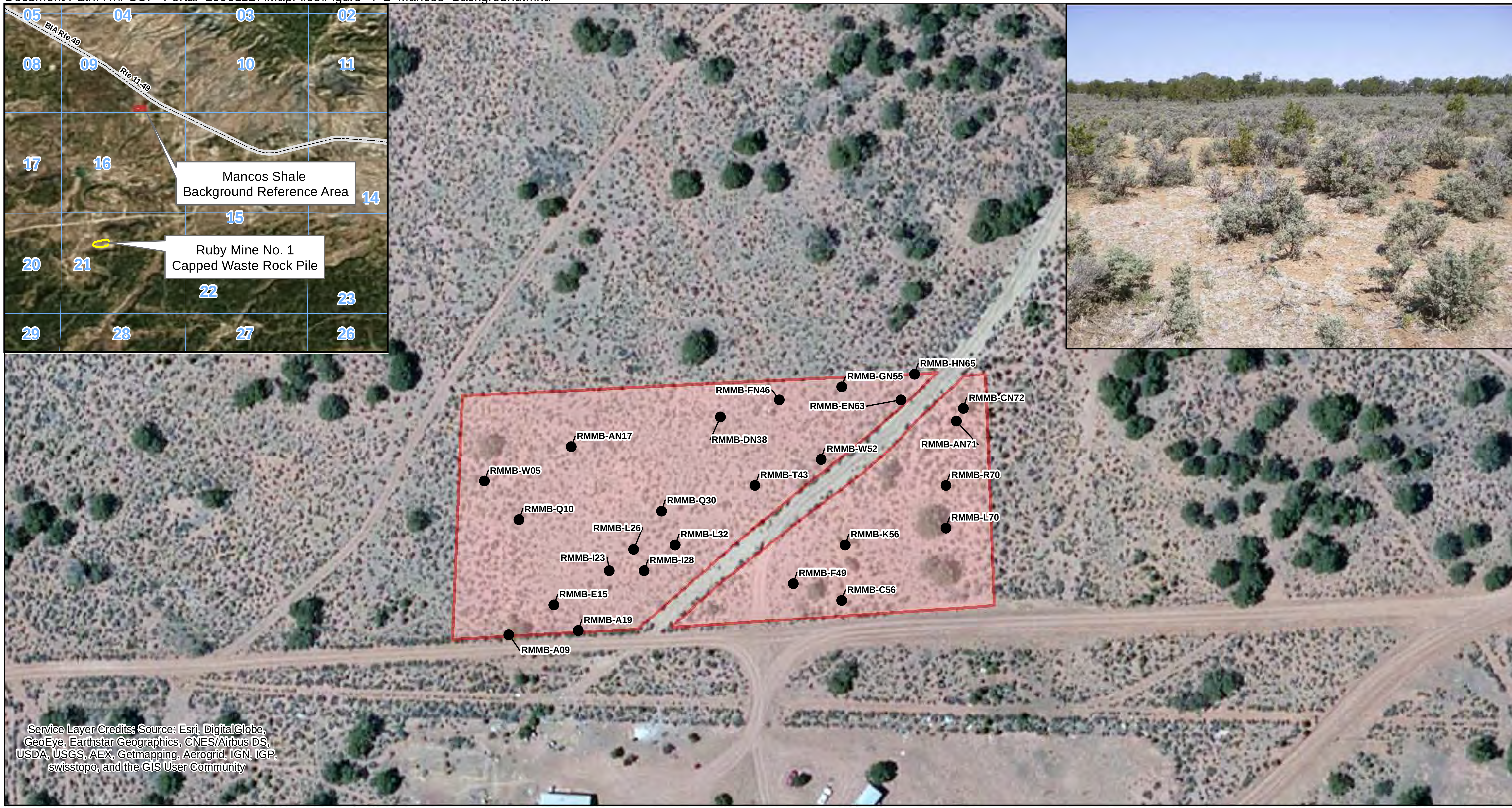

- ● Mancos Shale Area Sample Locaton
- Mancos Shale Background Reference Area
- Major Roads

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 4-1
Mancos Shale Background Reference Area
Background Soil Sample Locations
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

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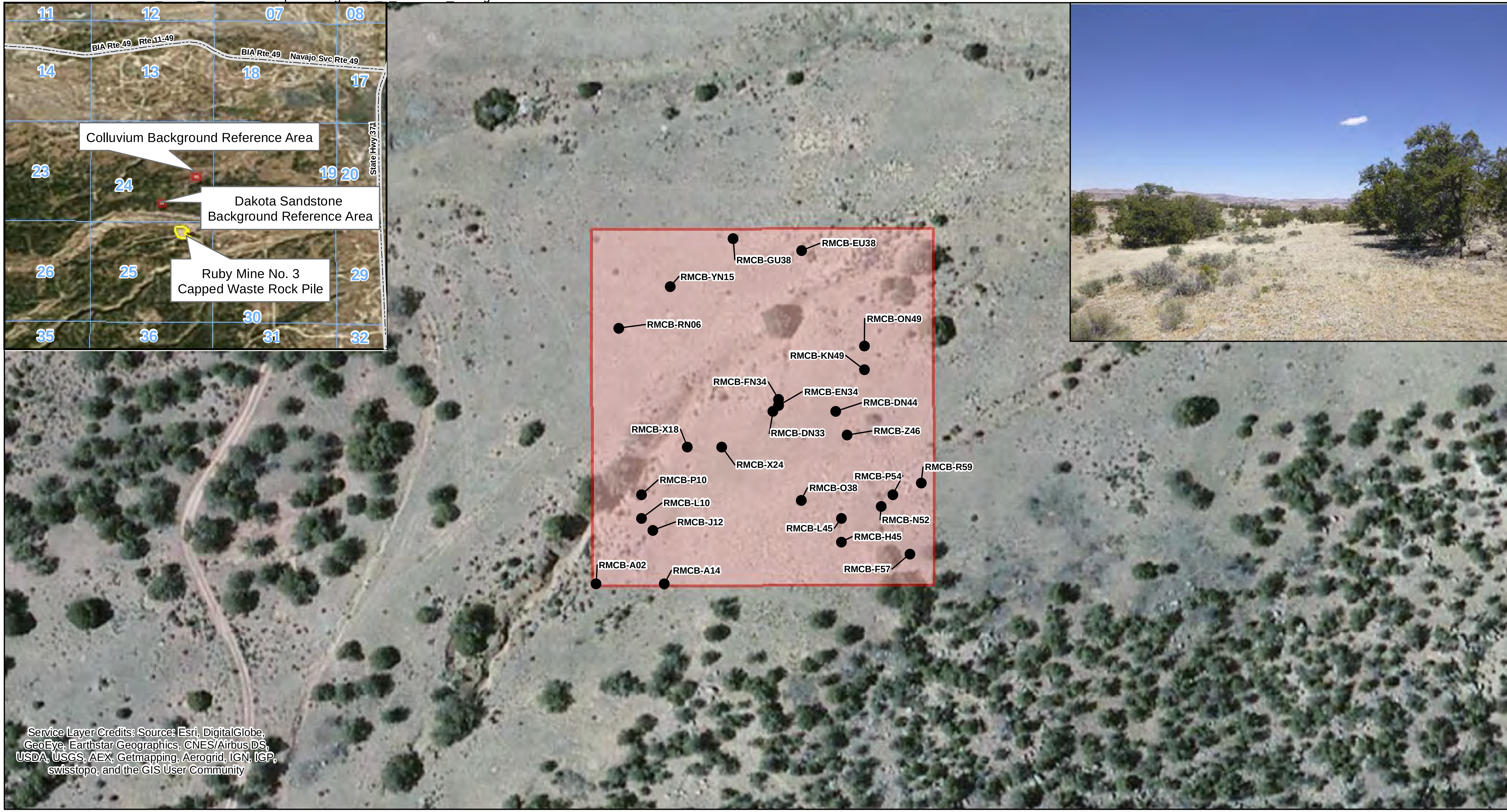

● Colluvium Area Sample Location

Colluvium Background Reference Area

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 4-2
Colluvium Background Reference Area
Background Soil Sample Locations
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

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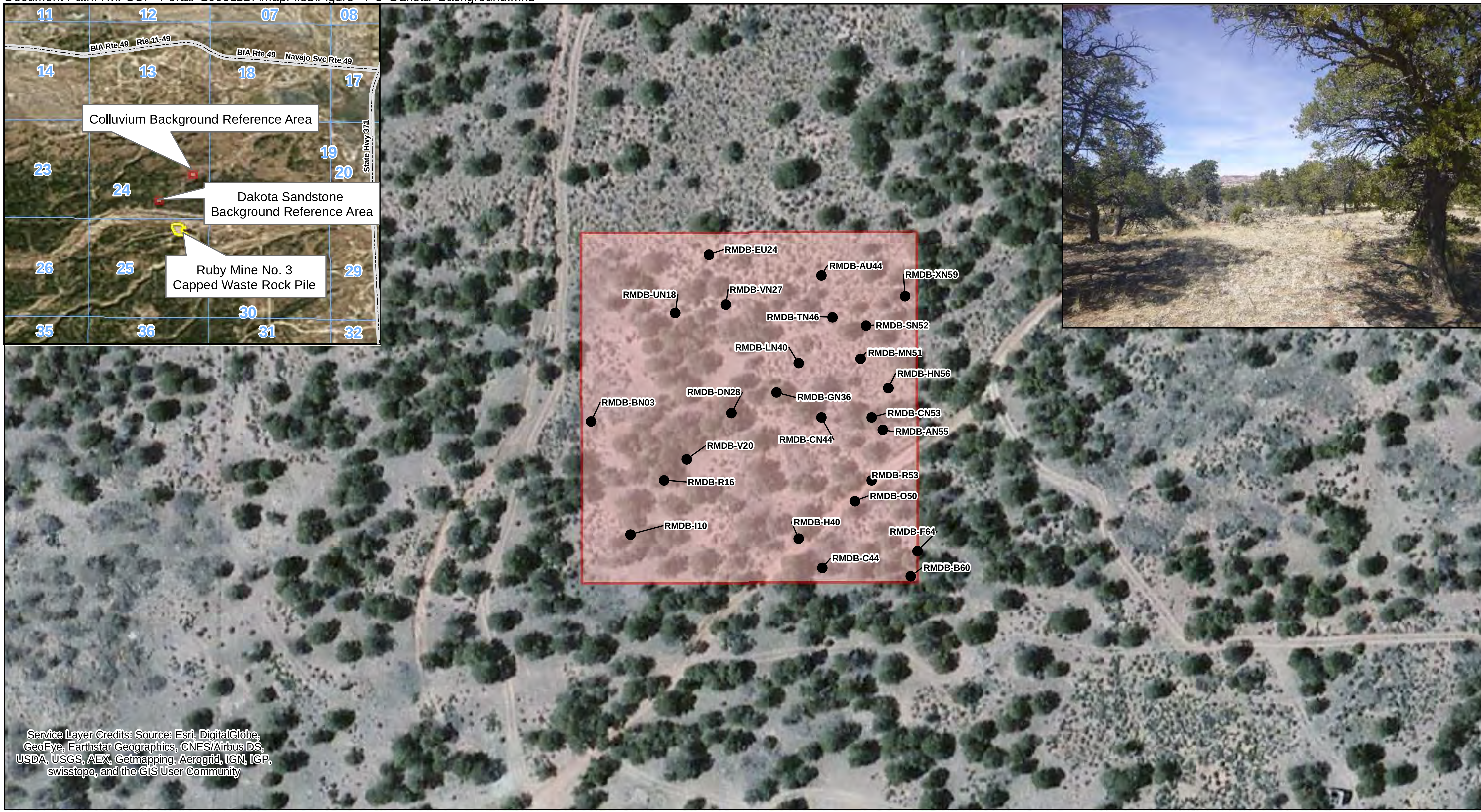

● Dakota Sandstone Area Sample Location

Dakota Sandstone Background Reference Area

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 4-3
Dakota Sandstone Background Reference Area
Background Soil Sample Locations
Ruby Mines Removal Site Evaluation Report

CH2MHILL

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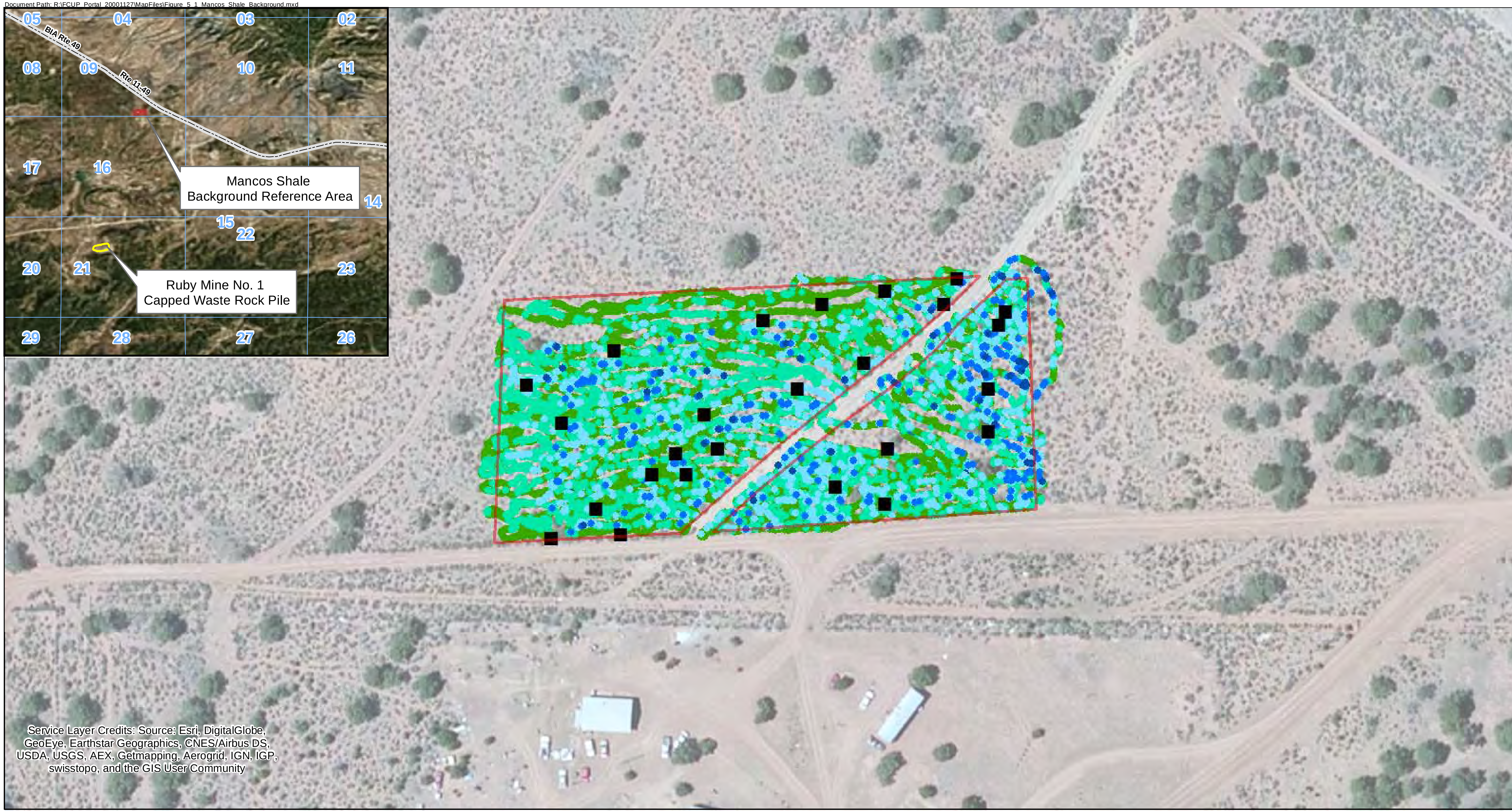


Radiation Survey Results

- < Mean (11036 cpm)
- Mean + 1 Std Dev (11037 - 11491 cpm)
- Mean + 2 Std Dev (11492 - 11946 cpm)
- Mean + 3 Std Dev (11947 - 12401 cpm)
- > Mean + 3 Std Dev (>12401 cpm)

Mancos Shale Background Reference Area

Mancos Shale Sample Location

N

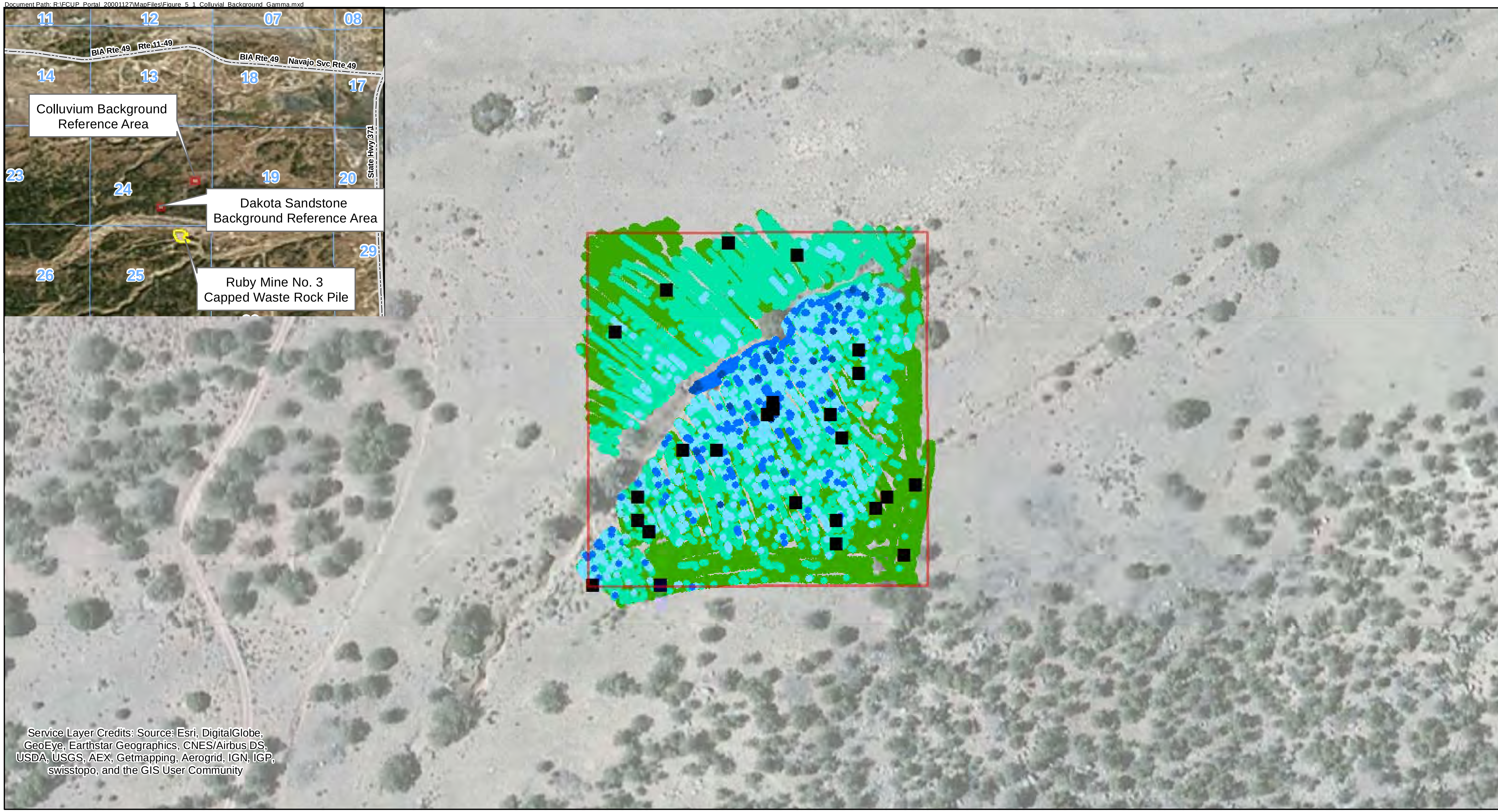
0 50 100 200 Feet

1 inch = 100 feet

Figure 5-1
Mancos Shale Background Reference Area
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

Document Path: R:\FCUP_Portal_20001127\MapFiles\Figure_5_1_Colluvial_Background_Gamma.mxd



Radiation Survey Results

- < Mean (11290 cpm)
- Mean + 1 Std Dev (11290 - 11847 cpm)
- Mean + 2 Std Dev (11848 - 12404 cpm)
- Mean + 3 Std Dev (12405 - 12961 cpm)
- > Mean + 3 Std Dev (>12961 cpm)

Colluvium Background Reference Area

Colluvium Background Sample Location

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 5-2
Colluvium Background Reference Area
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

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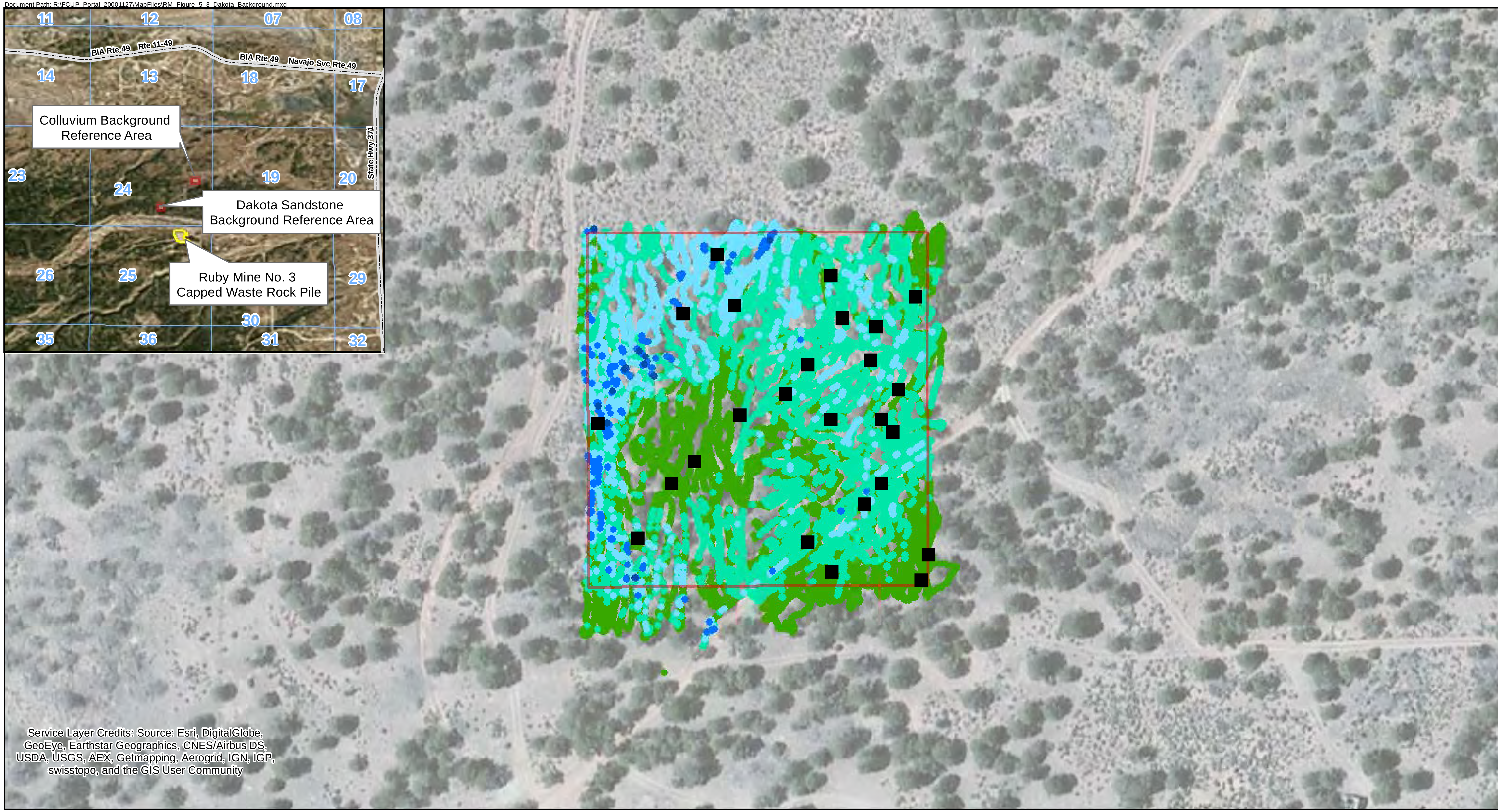

Radiation Survey Results

- < Mean (9272 cpm)
- Mean + 1 Std Dev (9273 - 9795 cpm)
- Mean + 2 Std Dev (9796 - 10318 cpm)
- Mean + 3 Std Dev (10319 - 10841 cpm)
- Mean + 3 Std Dev (>10842 cpm)

- Dakota Sandstone Background Reference Area
- Dakota Sandstone Sample Location

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 5-3
Dakota Sandstone Background Reference Area
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

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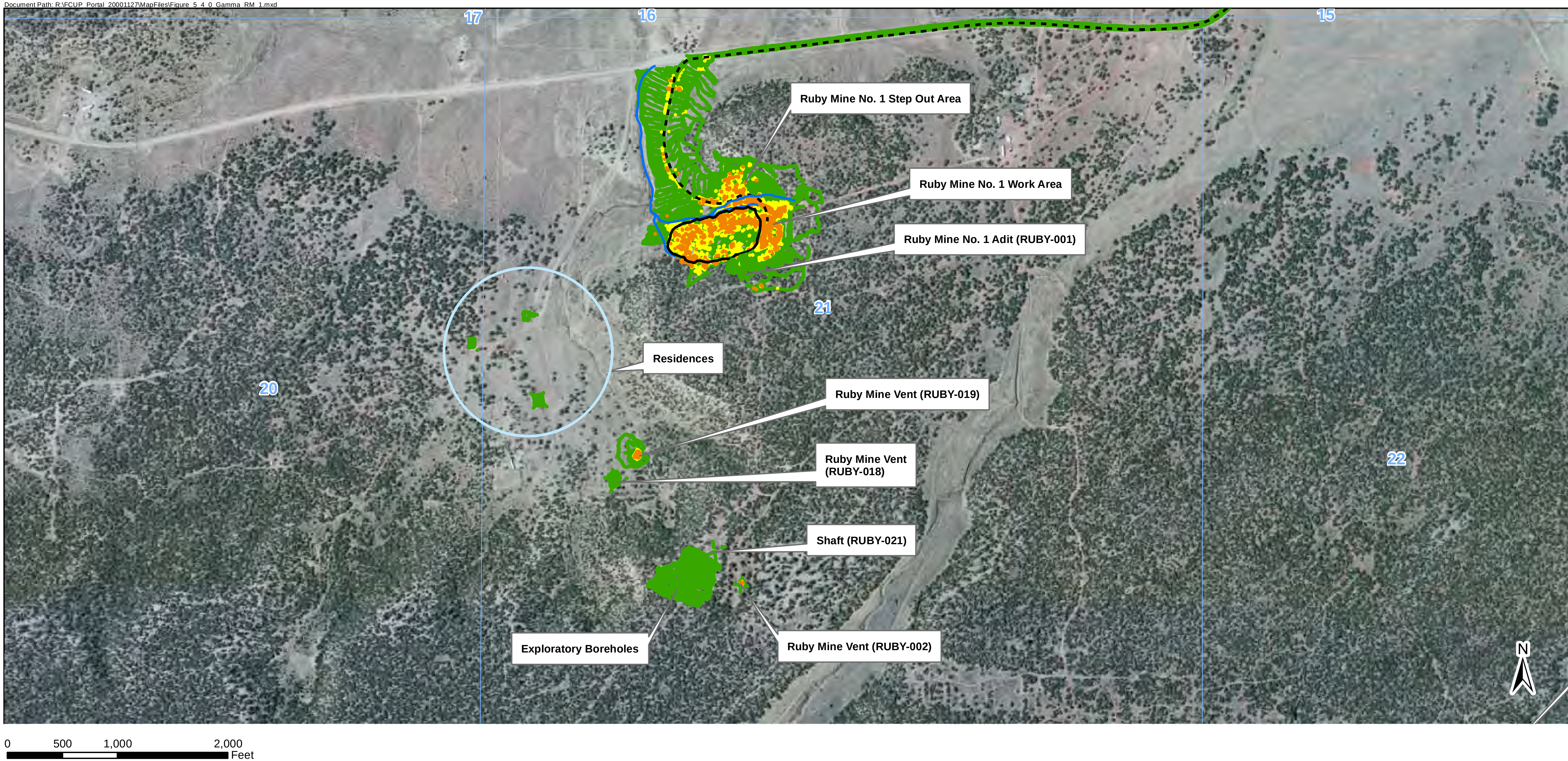


Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background
- Former Haul Road
- Drainage
- 14 Section Boundary
- Capped Waste Rock Pile

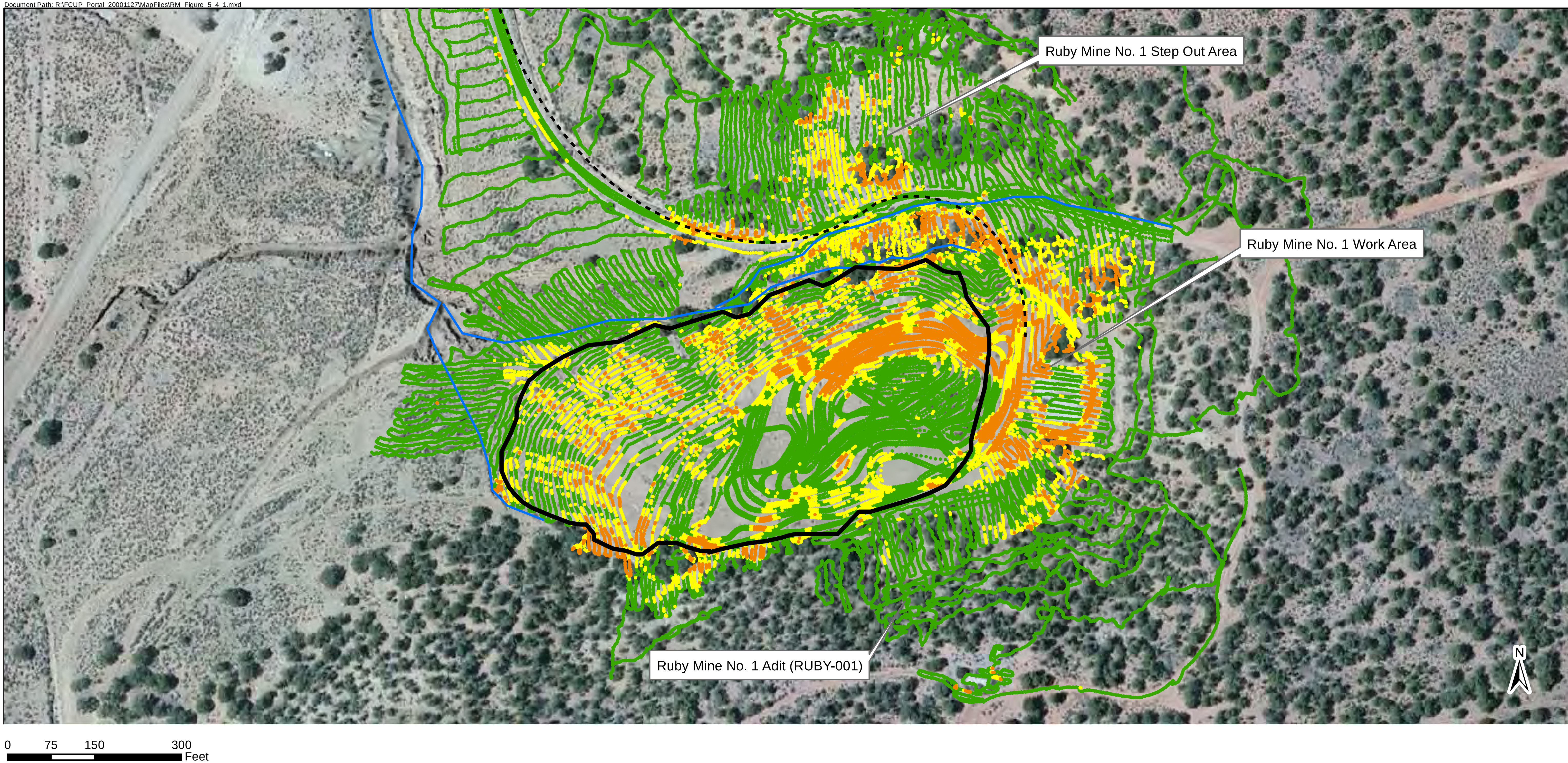
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES RUBY-021 RUBY-002 EXPLORATORY BOREHOLES	RUBY-019 RUBY-018 CAPPED WASTE ROCK PILE DRAINAGES FORMER HAUL ROAD WORK AREA STEP OUT AREA
< 2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	>35838 CPM	>30954 CPM	>37212 CPM

Figure 5-4.0
Ruby Mine No. 1 - Overview
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

CH2MHILL.

Document Path: R:\FCUP Portal 20001127\MapFiles\RM Figure 5 4 1.mxd



Legend

- < 2 x Background
- 2 x Background - 3 x Background
- > 3 x Background
- Former Haul Road
- Drainage
- 14 Section Boundary
- Capped Waste Rock Pile

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES	RUBY-019
		RUBY-021	RUBY-018
		RUBY-002	CAPPED WASTE ROCK PILE
		EXPLORATORY BOREHOLES	DRAINAGES
			FORMER HAUL ROAD
			WORK AREA
			STEP OUT AREA
<2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
>3X	>35838 CPM	>30954 CPM	>37212 CPM

Figure 5-4.1
Ruby Mine No. 1 Adit, Capped Waste Rock Pile, Work Area, and Stepout Area
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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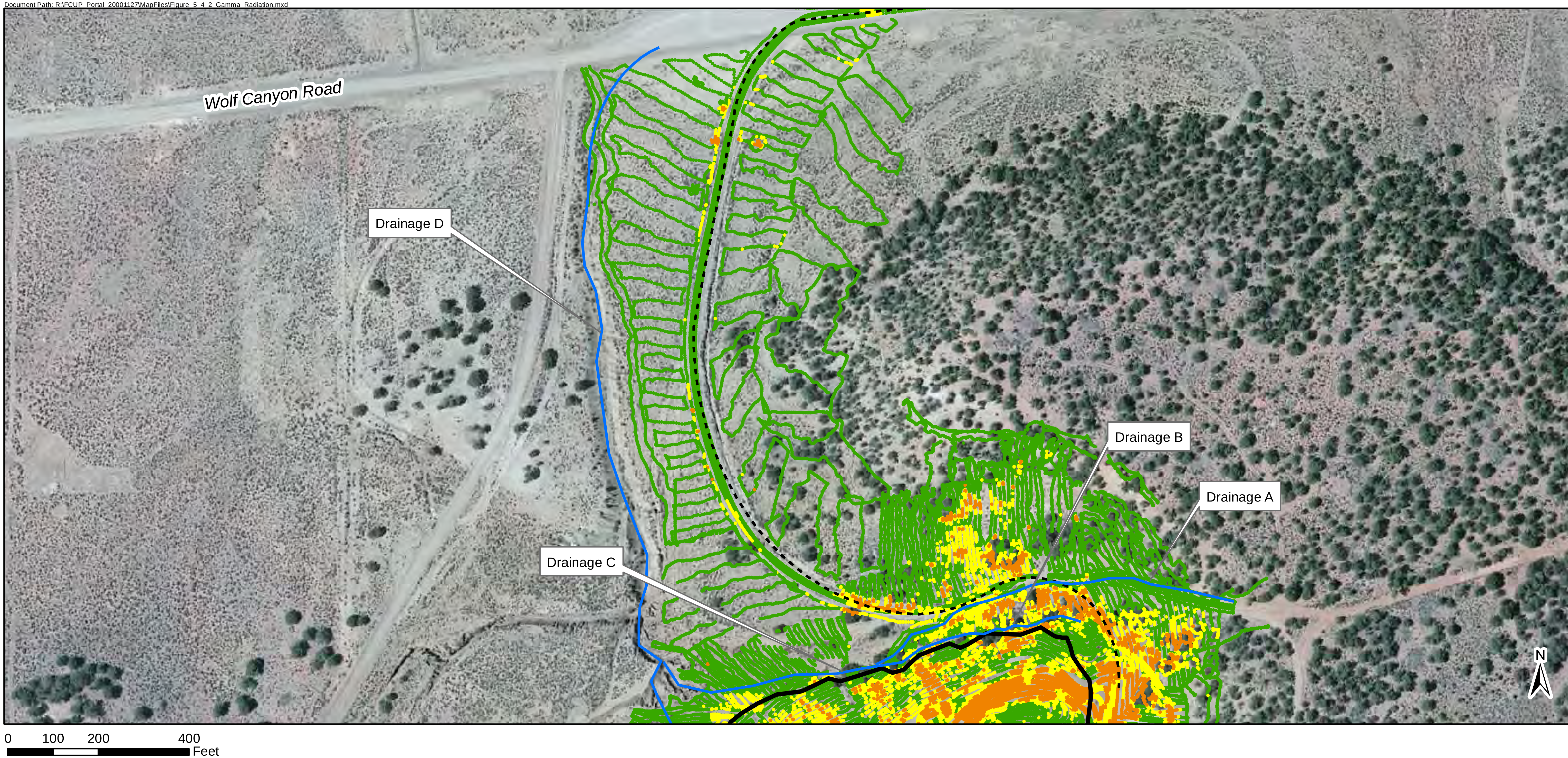

Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background
- Former Haul Road
- Drainage
- Capped Waste Rock Pile

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES RUBY-021 RUBY-002 EXPLORATORY BOREHOLES	RUBY-019 RUBY-018 CAPPED WASTE ROCK PILE DRAINAGES FORMER HAUL ROAD WORK AREA STEP OUT AREA
< 2X	< 23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	> 35838 CPM	>30954 CPM	>37212 CPM

Figure 5-4.2
Ruby Mine No. 1 -D rainages and Unmaintained
Section of Former Haul Road
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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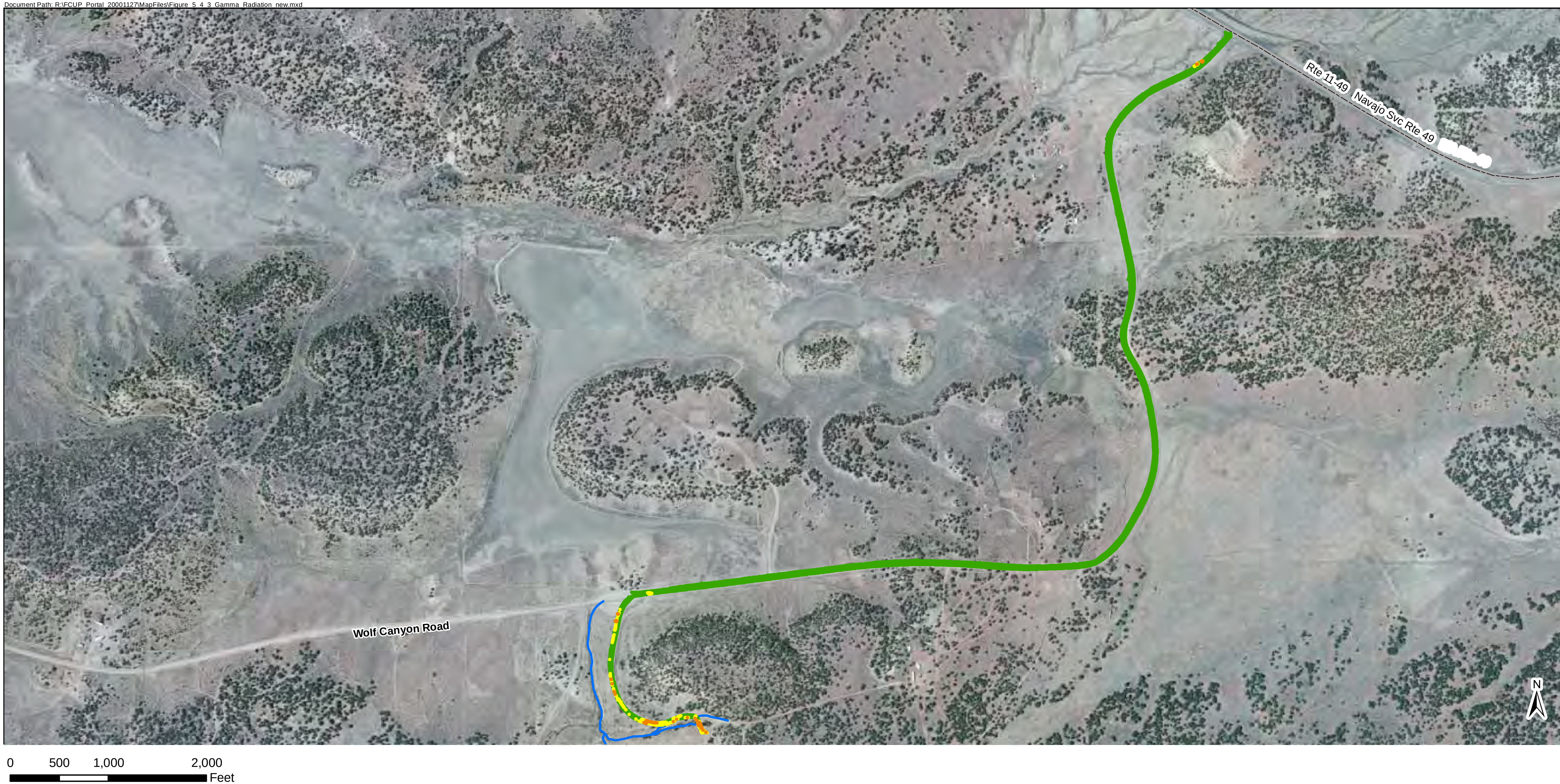

Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background
- Drainage
- Major Road

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES RUBY-021 RUBY-002 EXPLORATORY BOREHOLES	RUBY-019 RUBY-018 CAPPED WASTE ROCK PILE DRAINAGES FORMER HAUL ROAD WORK AREA STEP OUT AREA
< 2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	>35838 CPM	>30954 CPM	>37212 CPM

Figure 5-4.3
Ruby Mine No. 1 Haul Road
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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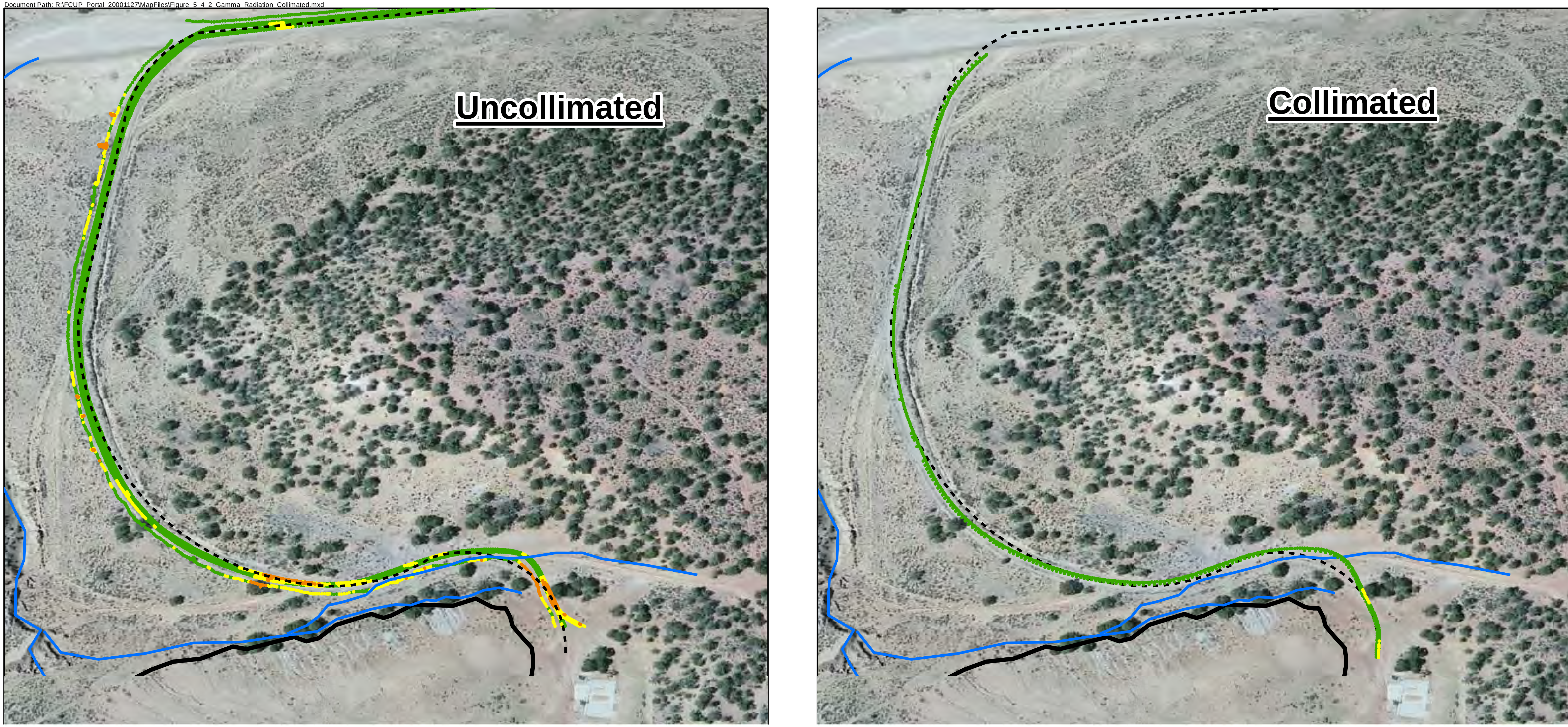

0 87.5 175 350
Feet

Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background
- Former Haul Road
- Drainage
- Capped Waste Rock Pile

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES RUBY-021 RUBY-002 EXPLORATORY BOREHOLES	RUBY-019 RUBY-018 CAPPED WASTE ROCK PILE DRAINAGES FORMER HAUL ROAD WORK AREA STEP OUT AREA
< 2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	> 35838 CPM	>30954 CPM	>37212 CPM

Figure 5-4.4
Ruby Mine No. 1 -ᴜ nmaintained
Section of Former Haul Road
Uncollimated and Collimated Gamma
Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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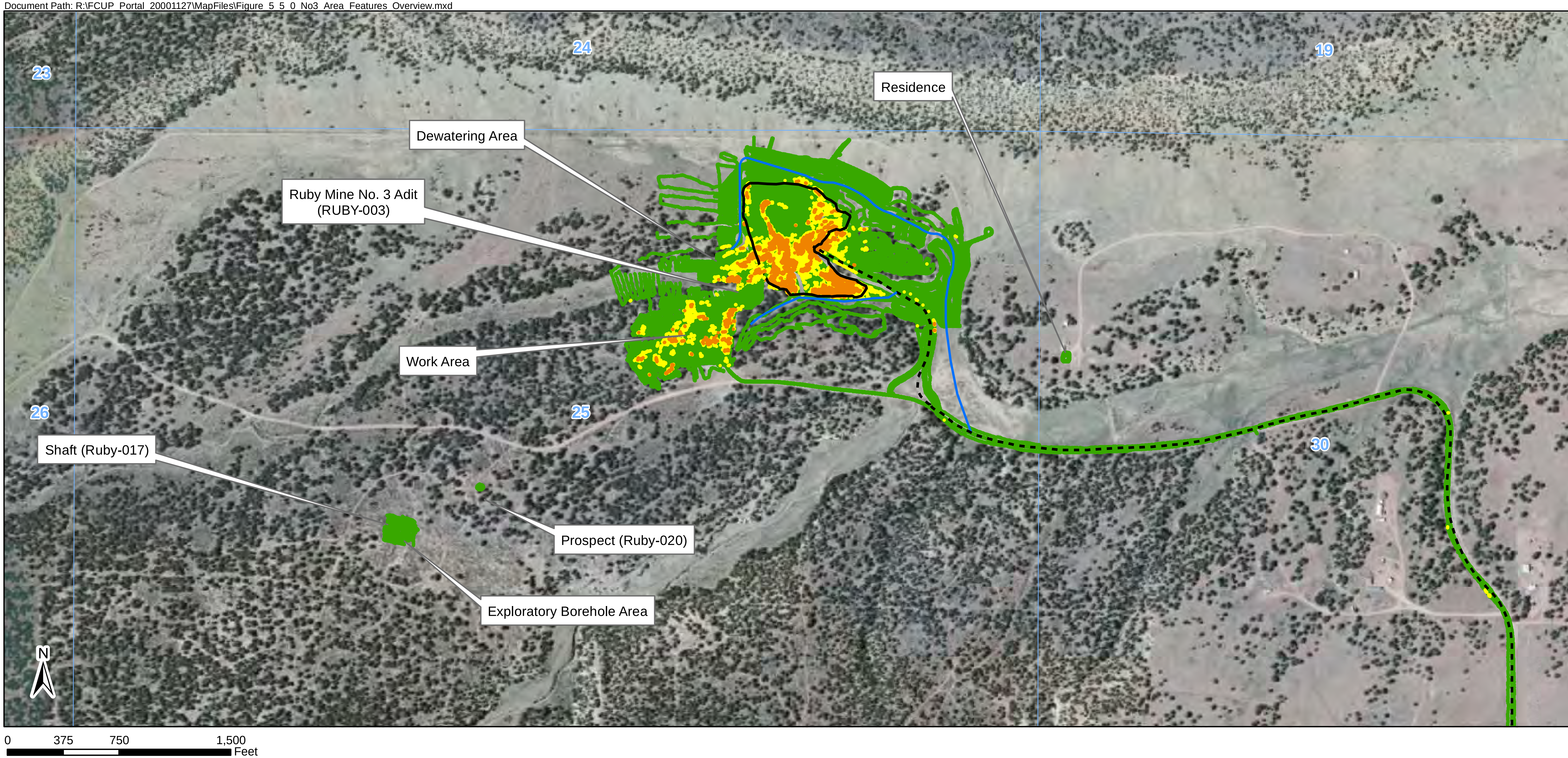

Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background
- Former Haul Road
- Drainage
- Capped Waste Rock Pile
- 14 Section Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-003	NONE	DRAINAGES
	CAPPED WASTE ROCK PILE		
	DEWATERING AREA		
	WORK AREA		
	FORMER HAUL ROAD		
	RESIDENCE		
	RUBY-017		
	RUBY-020		
<2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 -35838 CPM	20636 -30954 CPM	24808-37212 CPM
>3X	>35838 CPM	>30954 CPM	>37212 CPM

Figure 5-5.0
Ruby Mine No. 3 - Overview
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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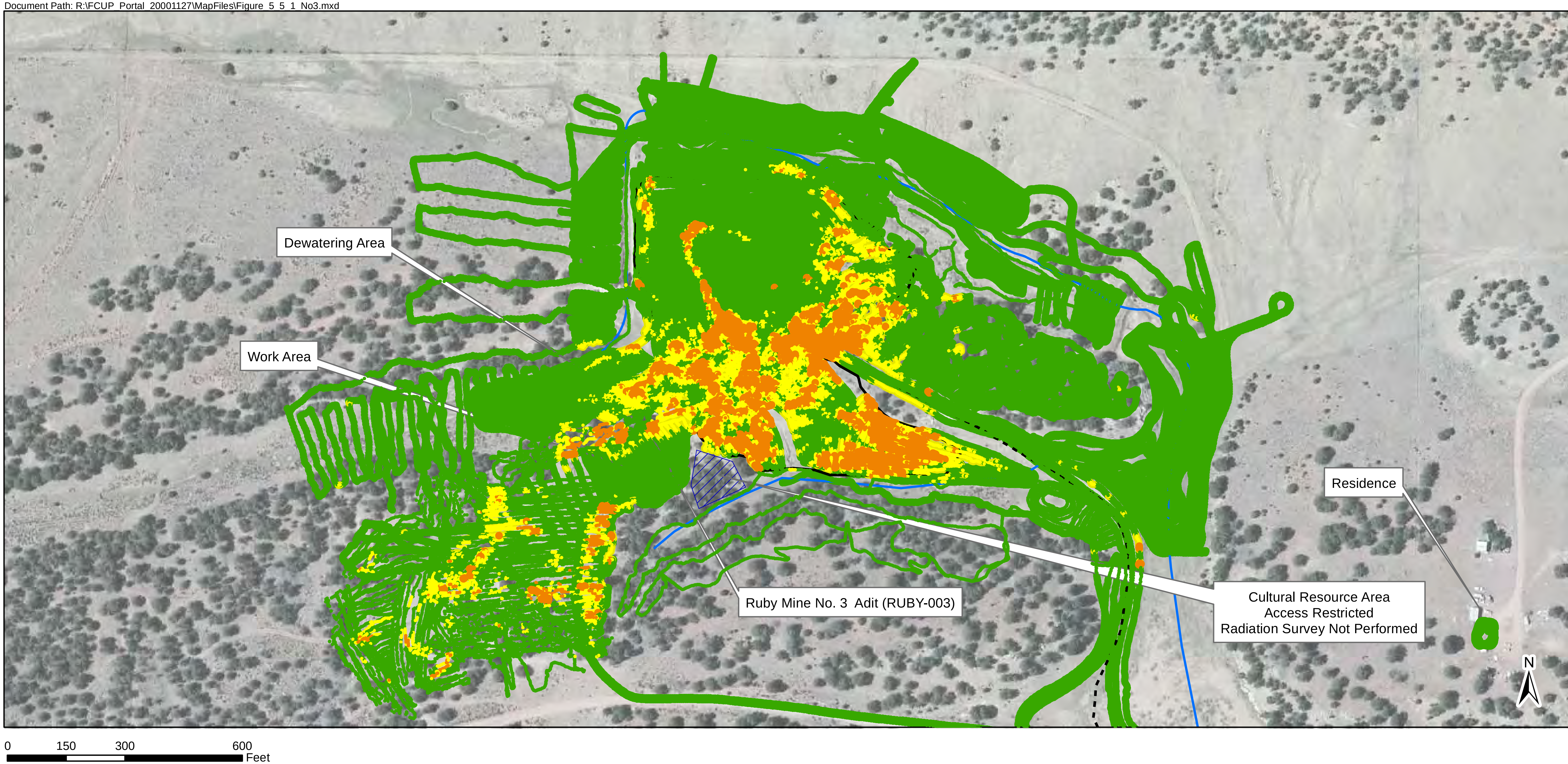
Document Path: R:\FCUP_Portal_20001127\MapFiles\Figure_5_5_1_No3.mxd



Legend

- < 2x Background
- 2x Background -3x Background
- > 3x Background
- Former Haul Road
- Drainage
- Capped Waste Rock Pile

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-003 CAPPED WASTE ROCK PILE DEWATERING AREA WORK AREA FORMER HAUL ROAD RESIDENCE RUBY-017 RUBY-020	NONE	DRAINAGES
< 2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	>35838 CPM	>30954 CPM	>37212 CPM

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 5-5.1
Ruby Mine No. 3 - Adit, Capped Waste Rock Pile, Drainages, Dewatering Area, and Work Area
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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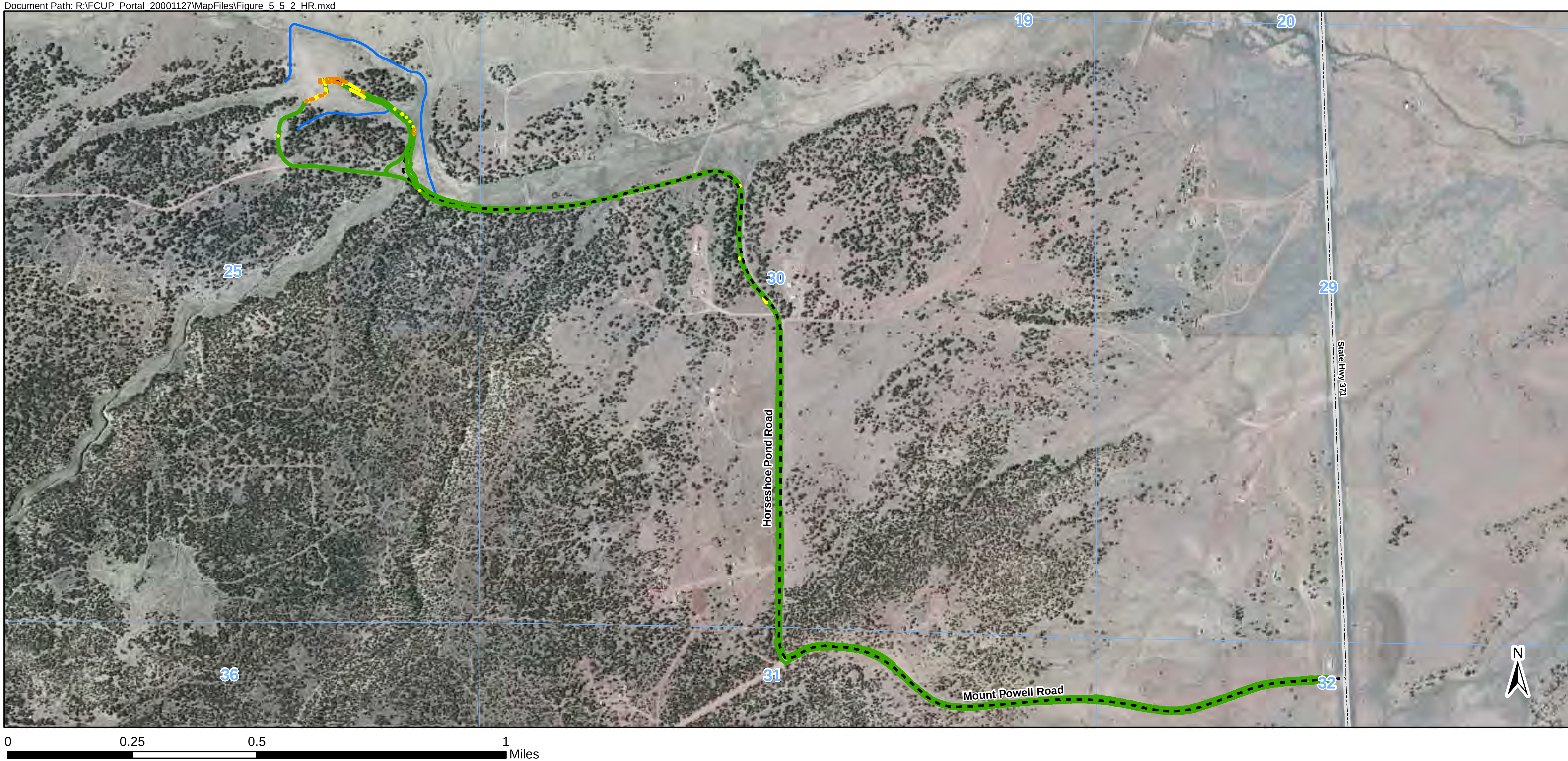

Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background
- Former Haul Road
- Drainage
- Capped Waste Rock Pile
- 14 Section Boundary

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-003 CAPPED WASTE ROCK PILE DEWATERING AREA WORK AREA FORMER HAUL ROAD RESIDENCE RUBY-017 RUBY-020	NONE	DRAINAGES
< 2X	< 23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	> 35838 CPM	>30954 CPM	>37212 CPM

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 5-5.2
Ruby Mine No. 3 - Former Haul Road
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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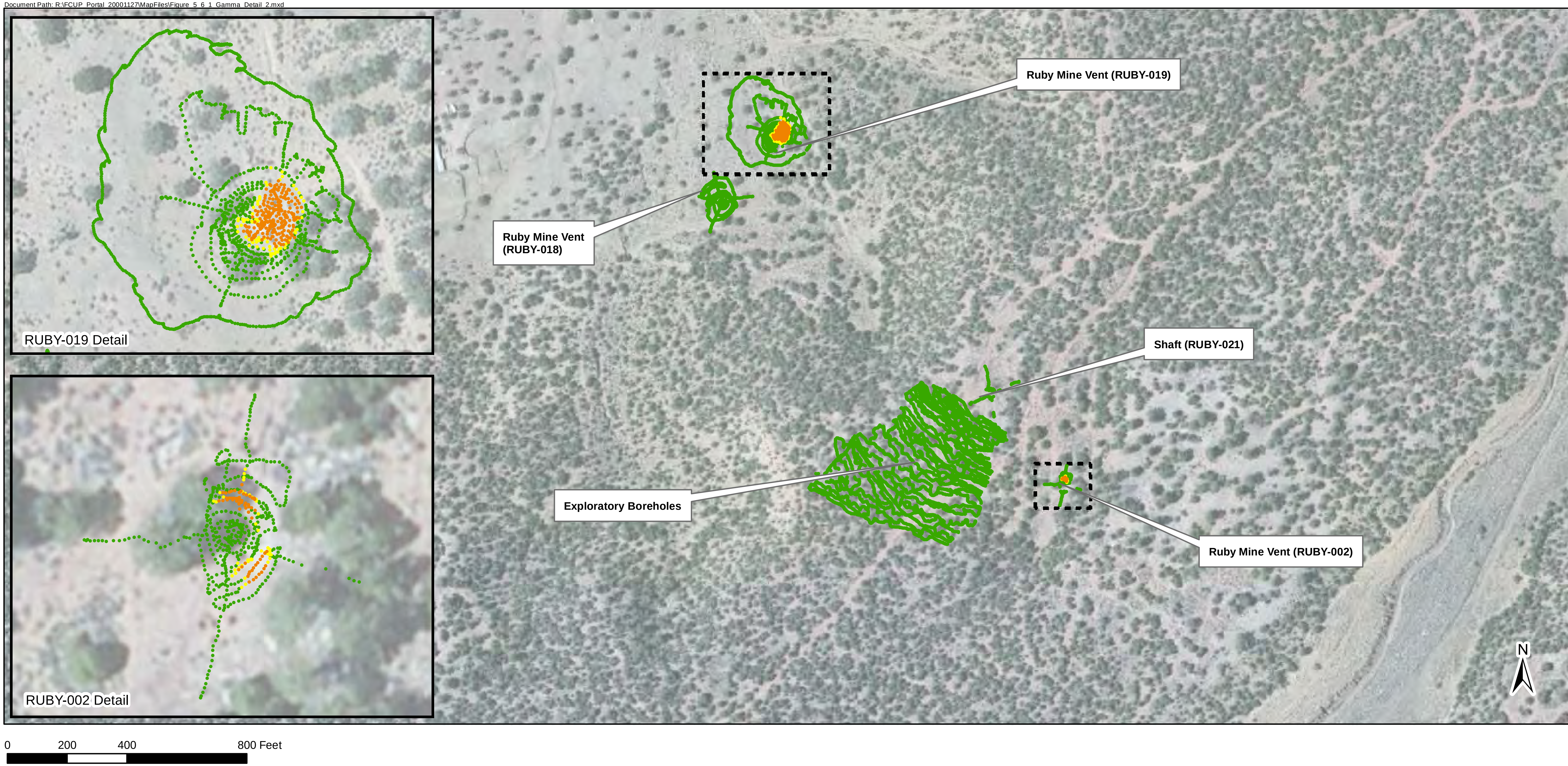
Document Path: R:\FCUP_Portal_20001127\MapFiles\Figure_5_6_1_Gamma_Detail_2.mxd



Legend

- < 2x Background
- 2x Background - 3x Background
- > 3x Background

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES RUBY-021 RUBY-002 EXPLORATORY BOREHOLES	RUBY-019 RUBY-018 CAPPED WASTE ROCK PILE DRAINAGES FORMER HAUL ROAD WORK AREA STEP OUT AREA
< 2X	< 23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	> 35838 CPM	>30954 CPM	>37212 CPM

Figure 5-6.1
Associated Mine Features
Exploratory Borehole Area, Vents, and Shafts - Detail 1
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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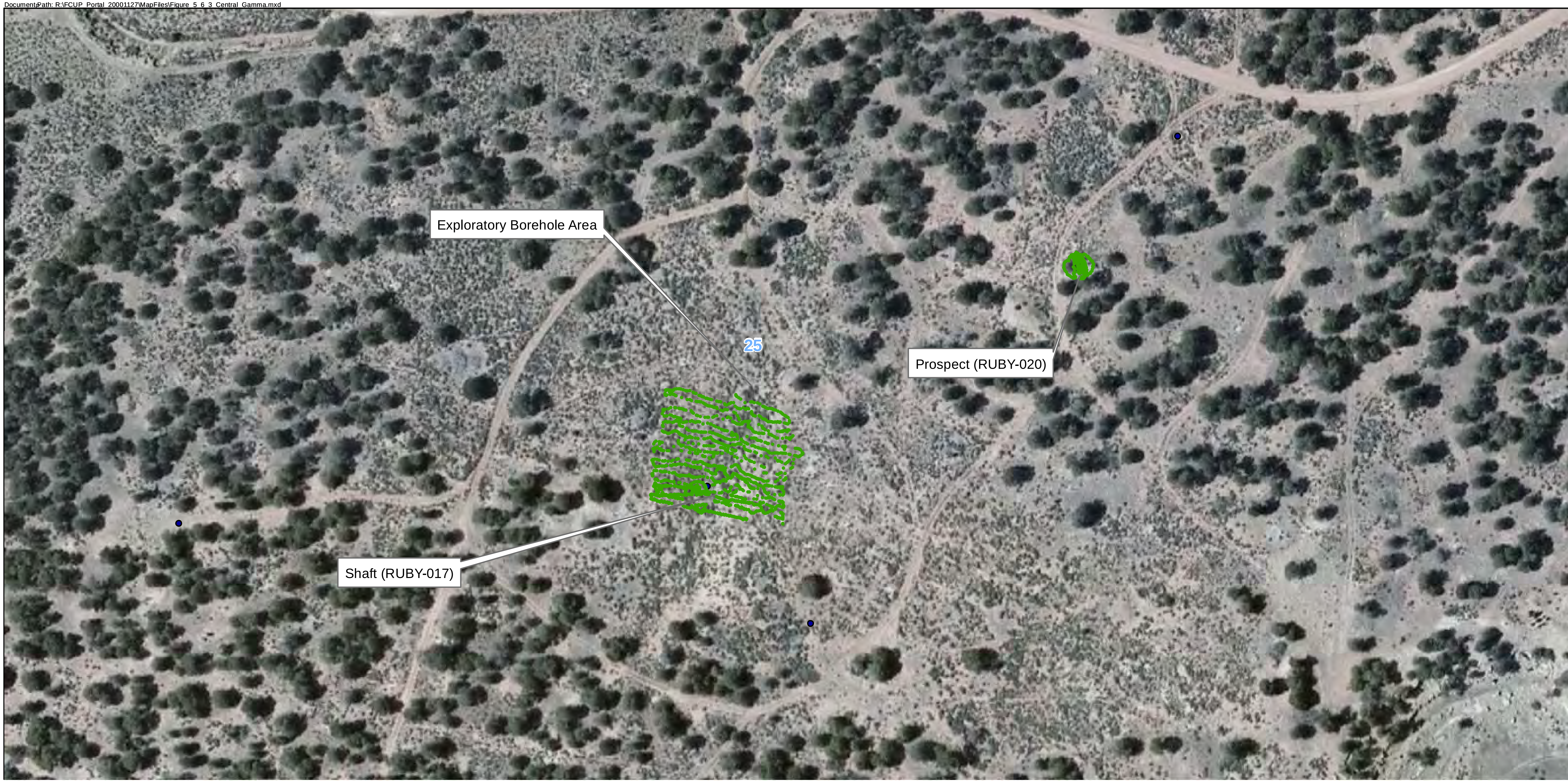
DocumentPath: R:\FCUP_Portal_20001127\MapFiles\Figure_5_6_3_Central_Gamma.mxd



0 100 200 400 Feet

- < 2 x Background
- 2 x Background - 3 x Background
- > 3 x Background
- 14 Section Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-016 RUBY-017 RUBY-020 EXPLORATORY BOREHOLE AREA	RUBY-022	RUBY-004
< 2X	< 23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
> 3X	> 35838 CPM	>30954 CPM	>37212 CPM

Figure 5-6.3
Assciated Mine Features - Exploratory Borehole Area, Vents, and Shafts - Detail 3
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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Figure 5-6.4

RUBY-011 Mine Vent (Standard Survey Form)

Ruby Mines Removal Site Evalution Report

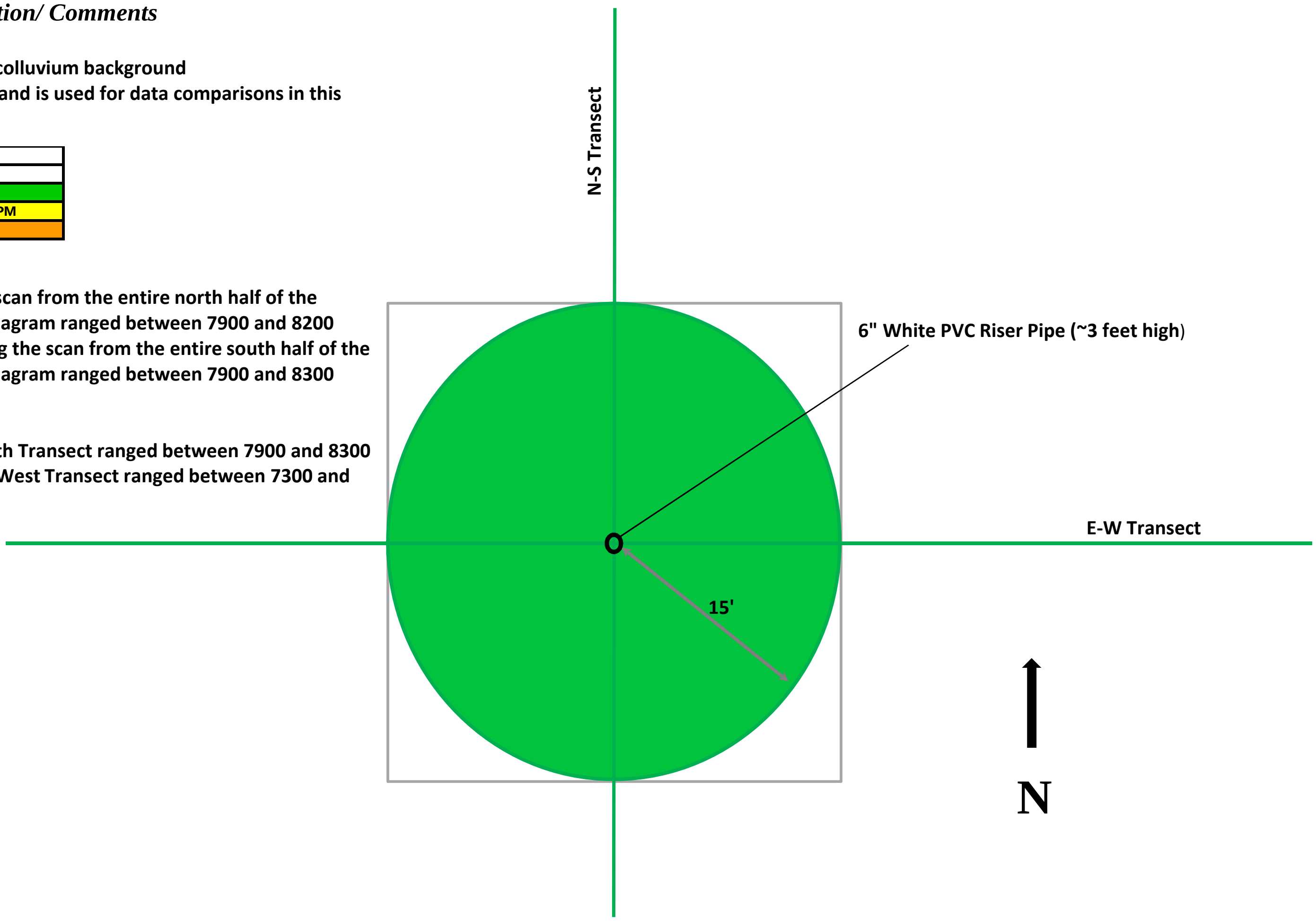
Survey Drawing/ Description/ Comments

The background value in the colluvium background reference area is 12,404 cpm and is used for data comparisons in this figure.

GEOLOGY	COLLUVIUM
FEATURE	RUBY-011
< 2X	< 24808 CPM
2 - 3	24808 - 37212 CPM
> 3X	>37212 CPM

Activity observed during the scan from the entire north half of the survey area depicted in the diagram ranged between 7900 and 8200 cpm. Activity observed during the scan from the entire south half of the survey area depicted in the diagram ranged between 7900 and 8300 cpm.

Activity along the North-South Transect ranged between 7900 and 8300 cpm. Activity along the East-West Transect ranged between 7300 and



General Information

Site: **(Ruby Mines) RUBY-011 Mine Vent**

Tech(s): **Darin McEleney**

Date: **5/1/14**

Comments: **The instrumention used was a Ludlum Model 2221 ser# 172013 with a Ludlum Model 44-10 ser# PR242839 Cal Due 4/22/15. There is no GPS documentation for this feature.**

Figure 5-6.5

RUBY-015 Mine Vent (Standard Survey Form)

Ruby Mines Removal Site Evalution Report

Survey Drawing/ Description/ Comments

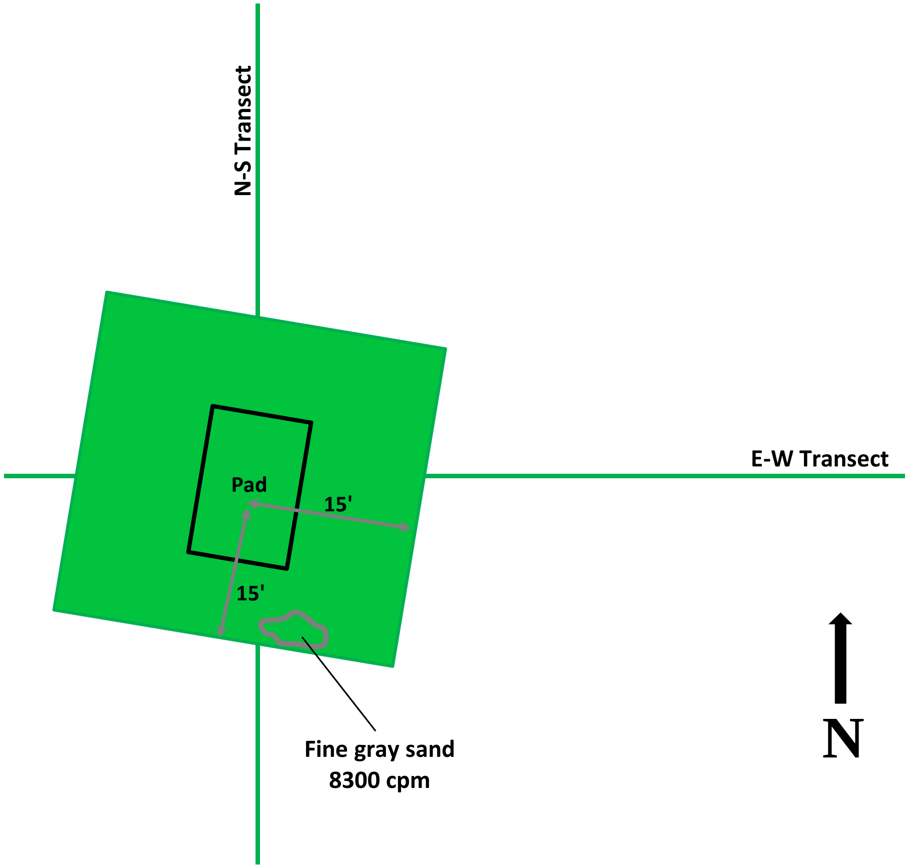
The background value in the Dakota Sandstone background reference area is 12,404 cpm and is used for data comparisons in this figure.

GEOLOGY	DAKOTA SANDSTONE
FEATURE	RUBY-015
< 2X	< 20636 CPM
2 - 3	20636 - 30954 CPM
> 3X	> 30954 CPM

Activity observed during the scan from the center of the concrete pad to the perimeter of the 15' buffer surrounding the pad ranged between 7000 and 8000 cpm with one small area location at 8300 cpm in the SE corner of survey area. The 8300 cpm activity appeared to be originating from a small area of fine gray sand as depicted in the diagram.

Activity along the North-South Transect ranged between 7300 and 8300 cpm. Activity along the East-West Transect ranged between 6400 and 8000 cpm.

Transects extended out 50' in the four cardinal directions from the center of the pad.



General Information

Site: (Ruby Mines) RUBY-015 Mine Vent

Tech(s): Darin McEleney

Date: 5/1/14

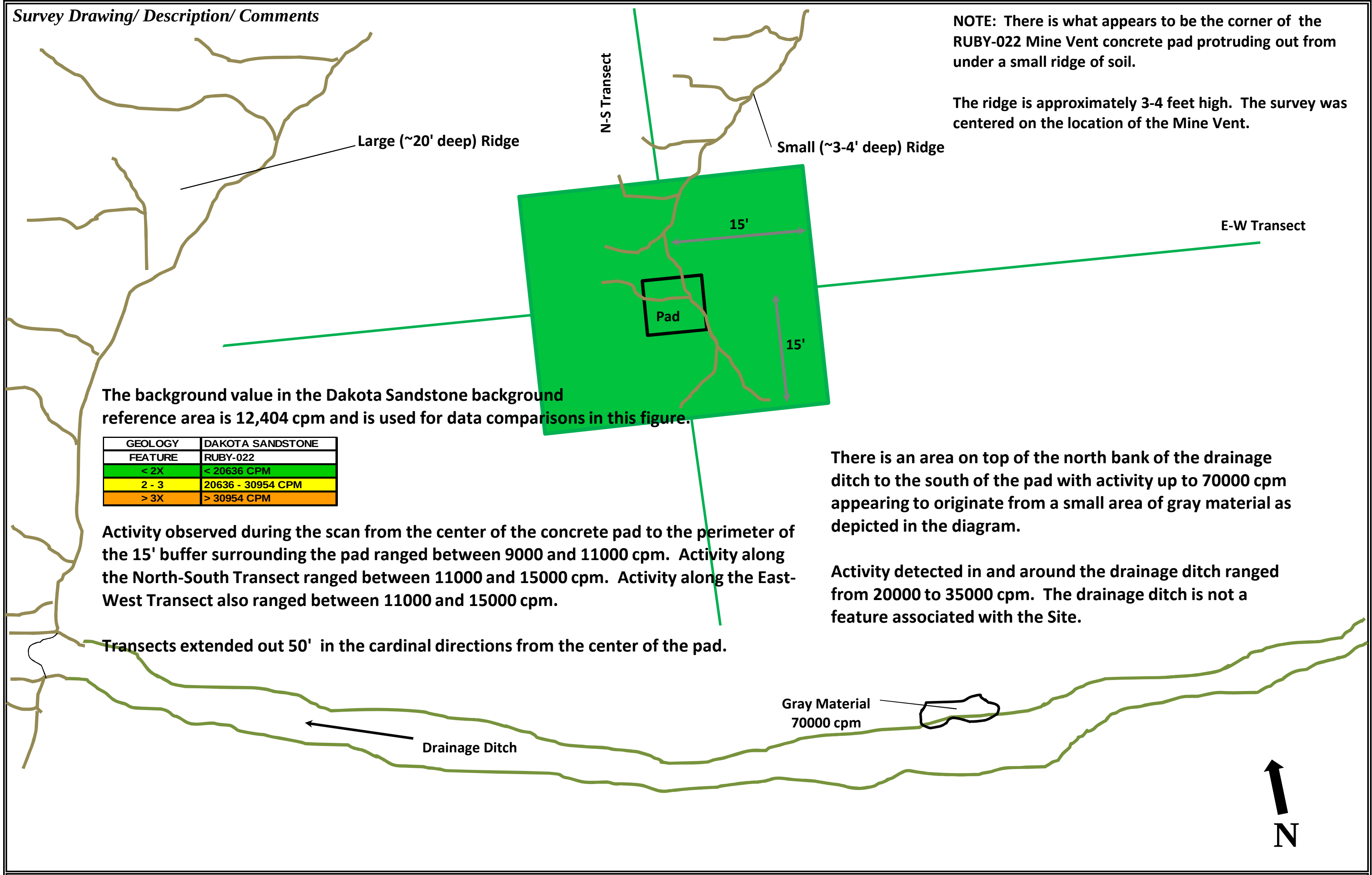
Comments: The instrumention used was a Ludlum Model 2221 ser# 172013 with a Ludlum Model 44-10 ser# PR242839 Cal Due 4/22/15. There is no GPS documentation for this feature.

Figure 5-6.6

RUBY-022 Mine Vent (Standard Survey Form)

Ruby Mines Removal Site Evalution Report

Survey Drawing/ Description/ Comments



NOTE: There is what appears to be the corner of the RUBY-022 Mine Vent concrete pad protruding out from under a small ridge of soil.

The ridge is approximately 3-4 feet high. The survey was centered on the location of the Mine Vent.

The background value in the Dakota Sandstone background reference area is 12,404 cpm and is used for data comparisons in this figure.

GEOLOGY	DAKOTA SANDSTONE
FEATURE	RUBY-022
< 2X	< 20636 CPM
2 - 3	20636 - 30954 CPM
> 3X	> 30954 CPM

Activity observed during the scan from the center of the concrete pad to the perimeter of the 15' buffer surrounding the pad ranged between 9000 and 11000 cpm. Activity along the North-South Transect ranged between 11000 and 15000 cpm. Activity along the East-West Transect also ranged between 11000 and 15000 cpm.

Transects extended out 50' in the cardinal directions from the center of the pad.

There is an area on top of the north bank of the drainage ditch to the south of the pad with activity up to 70000 cpm appearing to originate from a small area of gray material as depicted in the diagram.

Activity detected in and around the drainage ditch ranged from 20000 to 35000 cpm. The drainage ditch is not a feature associated with the Site.

General Information

Site: (Ruby Mines) RUBY022 Mine Vent

Tech(s): Darin McEleney

Date: 5/1/14

Comments: The instrumention used was a Ludlum Model 2221 ser# 172013 with a Ludlum Model 44-10 ser# PR242839 Cal Due 4/22/15. There is no GPS documentation for this feature.

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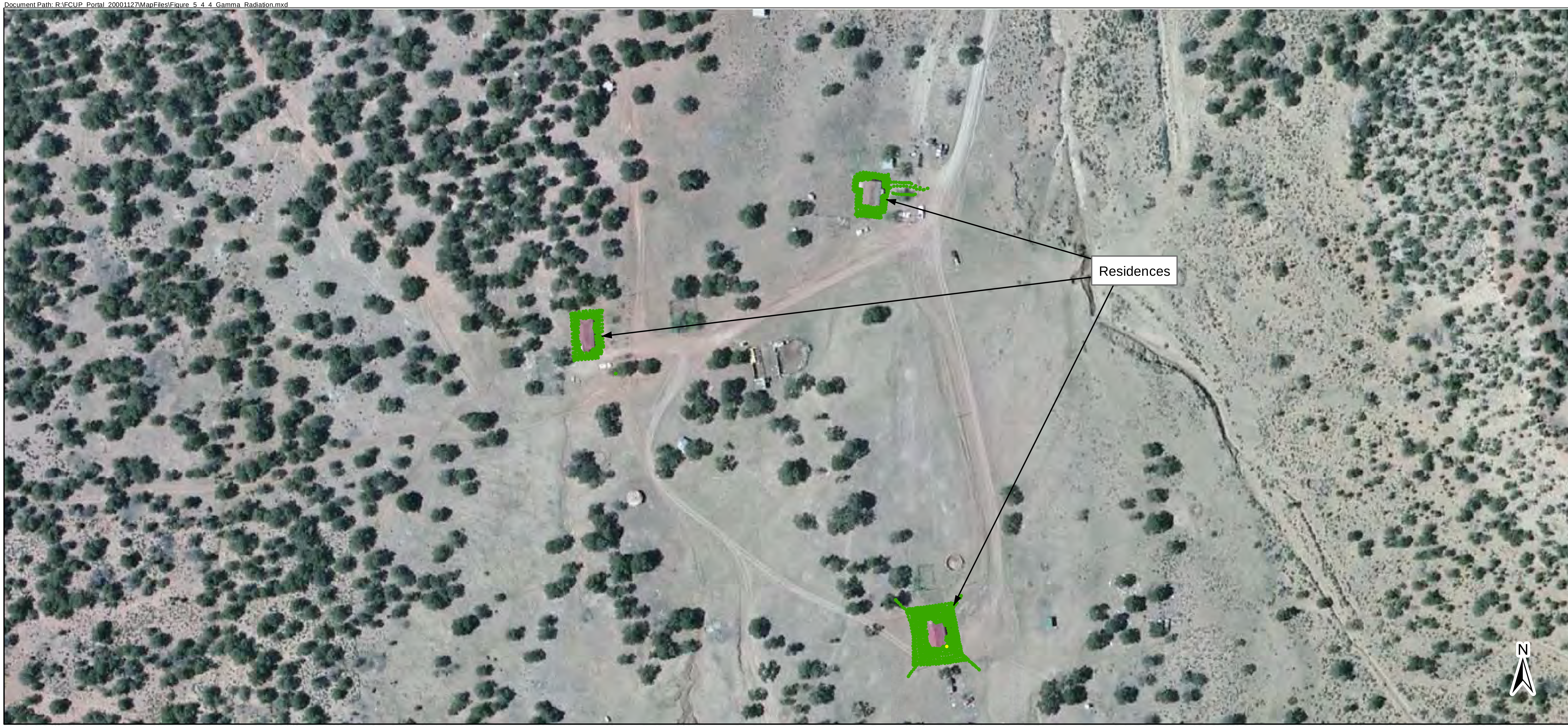

0 100 200 400 Feet

Legend

- < 2 x Background
- 2 x Background - 3 x Background
- > 3 x Background

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GEOLOGY	MANCOS SHALE	DAKOTA SANDSTONE	COLLUVIUM
FEATURE	RUBY-001	RESIDENCES RUBY-021 RUBY-002 EXPLORATORY BOREHOLES	RUBY-019 RUBY-018 CAPPED WASTE ROCK PILE DRAINAGES FORMER HAUL ROAD WORK AREA STEP OUT AREA
<2X	<23892 CPM	<20636 CPM	<24808 CPM
2 - 3	23892 - 35838 CPM	20636 - 30954 CPM	24808-37212 CPM
>3X	>35838 CPM	>30954 CPM	>37212 CPM

Figure 5-7
Ruby Mine No. 1 - Residences
Gamma Radiation Survey Results
Ruby Mines Removal Site Evaluation Report

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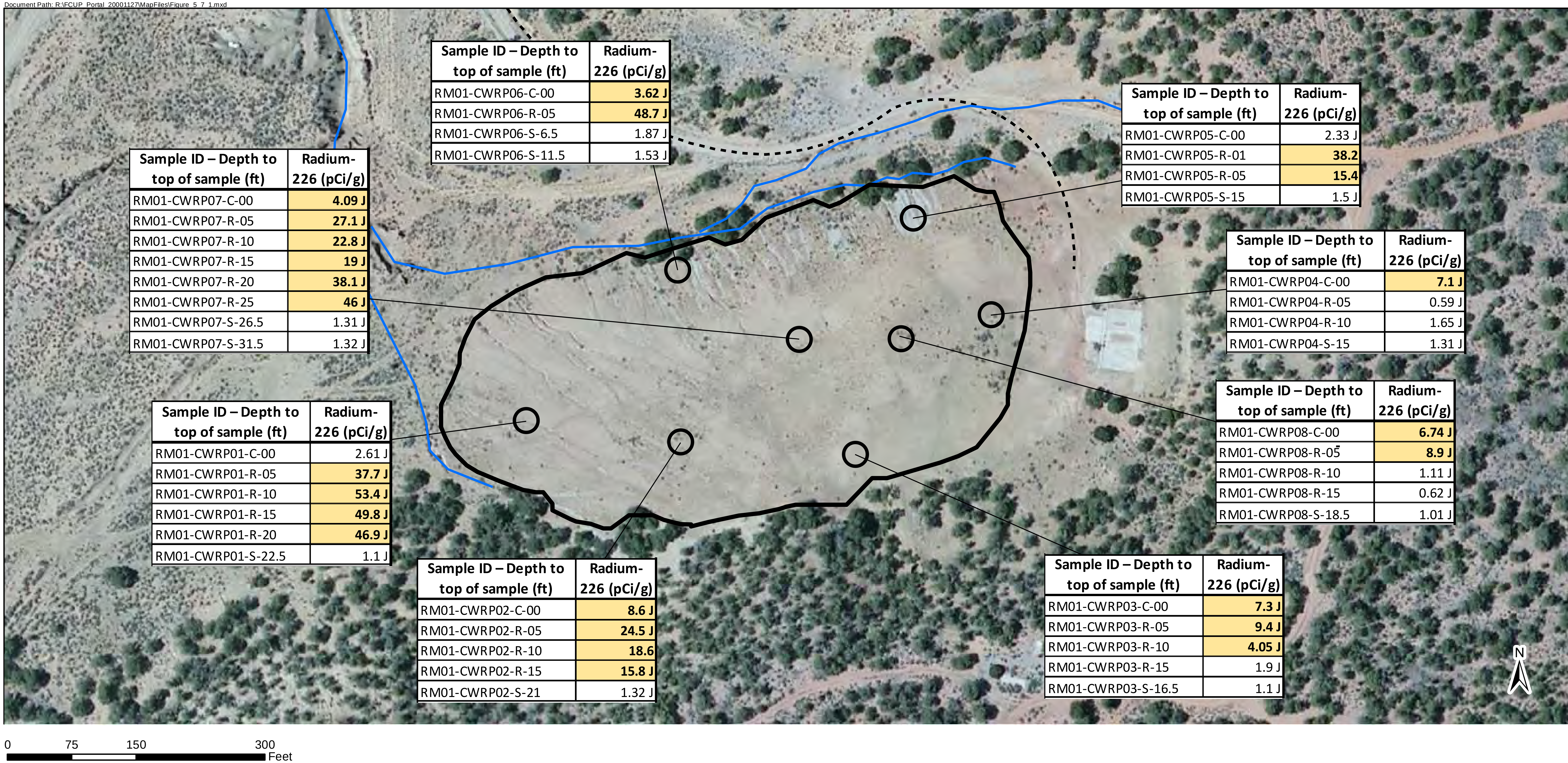
Document Path: R:\FCUP_Portal_20001127\MapFiles\Figure_5_7_1.mxd



Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP06-C-00	3.62 J
RM01-CWRP06-R-05	48.7 J
RM01-CWRP06-S-6.5	1.87 J
RM01-CWRP06-S-11.5	1.53 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP05-C-00	2.33 J
RM01-CWRP05-R-01	38.2
RM01-CWRP05-R-05	15.4
RM01-CWRP05-S-15	1.5 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP07-C-00	4.09 J
RM01-CWRP07-R-05	27.1 J
RM01-CWRP07-R-10	22.8 J
RM01-CWRP07-R-15	19 J
RM01-CWRP07-R-20	38.1 J
RM01-CWRP07-R-25	46 J
RM01-CWRP07-S-26.5	1.31 J
RM01-CWRP07-S-31.5	1.32 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP04-C-00	7.1 J
RM01-CWRP04-R-05	0.59 J
RM01-CWRP04-R-10	1.65 J
RM01-CWRP04-S-15	1.31 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP08-C-00	6.74 J
RM01-CWRP08-R-05	8.9 J
RM01-CWRP08-R-10	1.11 J
RM01-CWRP08-R-15	0.62 J
RM01-CWRP08-S-18.5	1.01 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP01-C-00	2.61 J
RM01-CWRP01-R-05	37.7 J
RM01-CWRP01-R-10	53.4 J
RM01-CWRP01-R-15	49.8 J
RM01-CWRP01-R-20	46.9 J
RM01-CWRP01-S-22.5	1.1 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP02-C-00	8.6 J
RM01-CWRP02-R-05	24.5 J
RM01-CWRP02-R-10	18.6
RM01-CWRP02-R-15	15.8 J
RM01-CWRP02-S-21	1.32 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM01-CWRP03-C-00	7.3 J
RM01-CWRP03-R-05	9.4 J
RM01-CWRP03-R-10	4.05 J
RM01-CWRP03-R-15	1.9 J
RM01-CWRP03-S-16.5	1.1 J

Legend

- Soil Boring Location for Primary COPCs
- Capped Waste Rock Pile
- Former Haul Road
- Drainage

Concentrations that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g.
J = Analyte was detected, but the given concentration should be considered estimated.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 5-8.1
Ruby Mine No. 1 - Capped Waste Rock Pile
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

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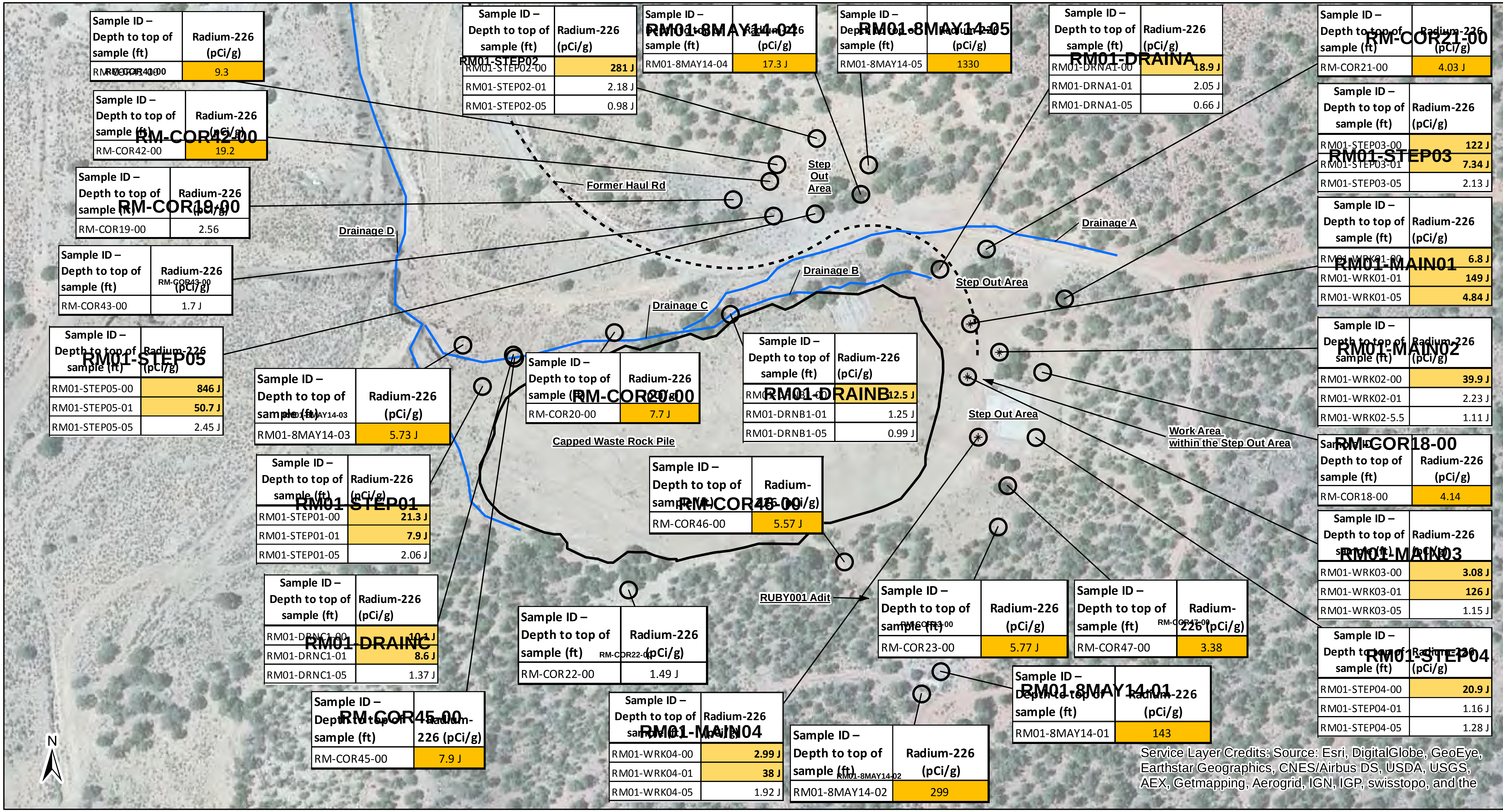

Legend

- Capped Waste Rock Pile
- Former Haul Road
- Drainage
- *Soil Boring Location for Primary COPCs*
- *Soil Boring Location for Primary and Secondary COPCs*

0 100 200 400 Feet

Figure 5-8.2
Ruby Mine No. 1 - Drainages, Stepout Area, and Work Area Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

Note: Concentrations that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g
J = Analyte was detected, but the given concentration should be considered estimated.

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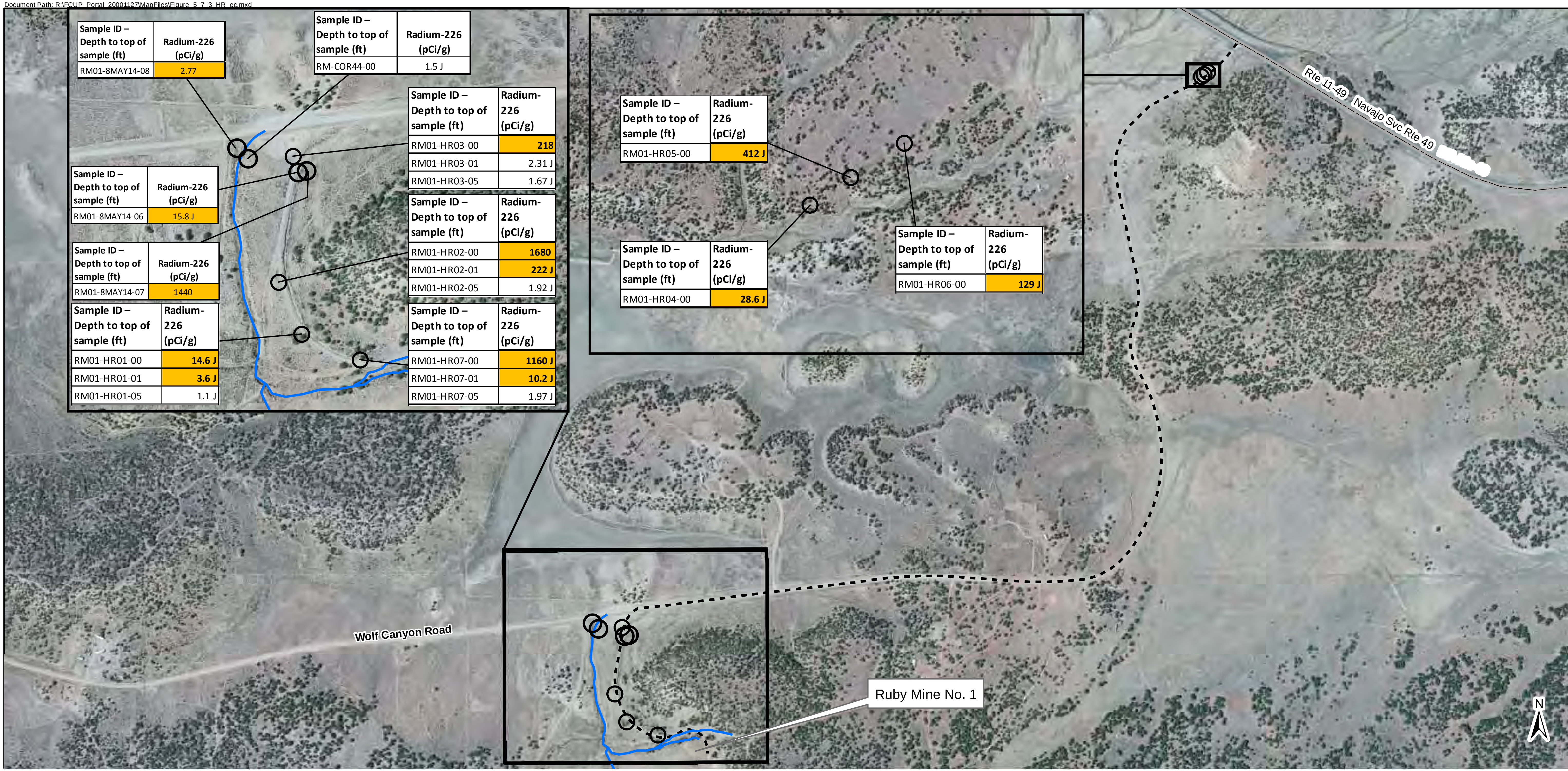

Legend

- Soil Boring Location for Primary COPCs
- Former Haul Road
- Major Road
- Drainage

0 750 1,500 3,000 Feet

Figure 5-8.3
Ruby Mine No. 1 - Former Haul Road
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Notes:
J = Analyte was detected, but the given concentration estimated.
Concentrations that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g.

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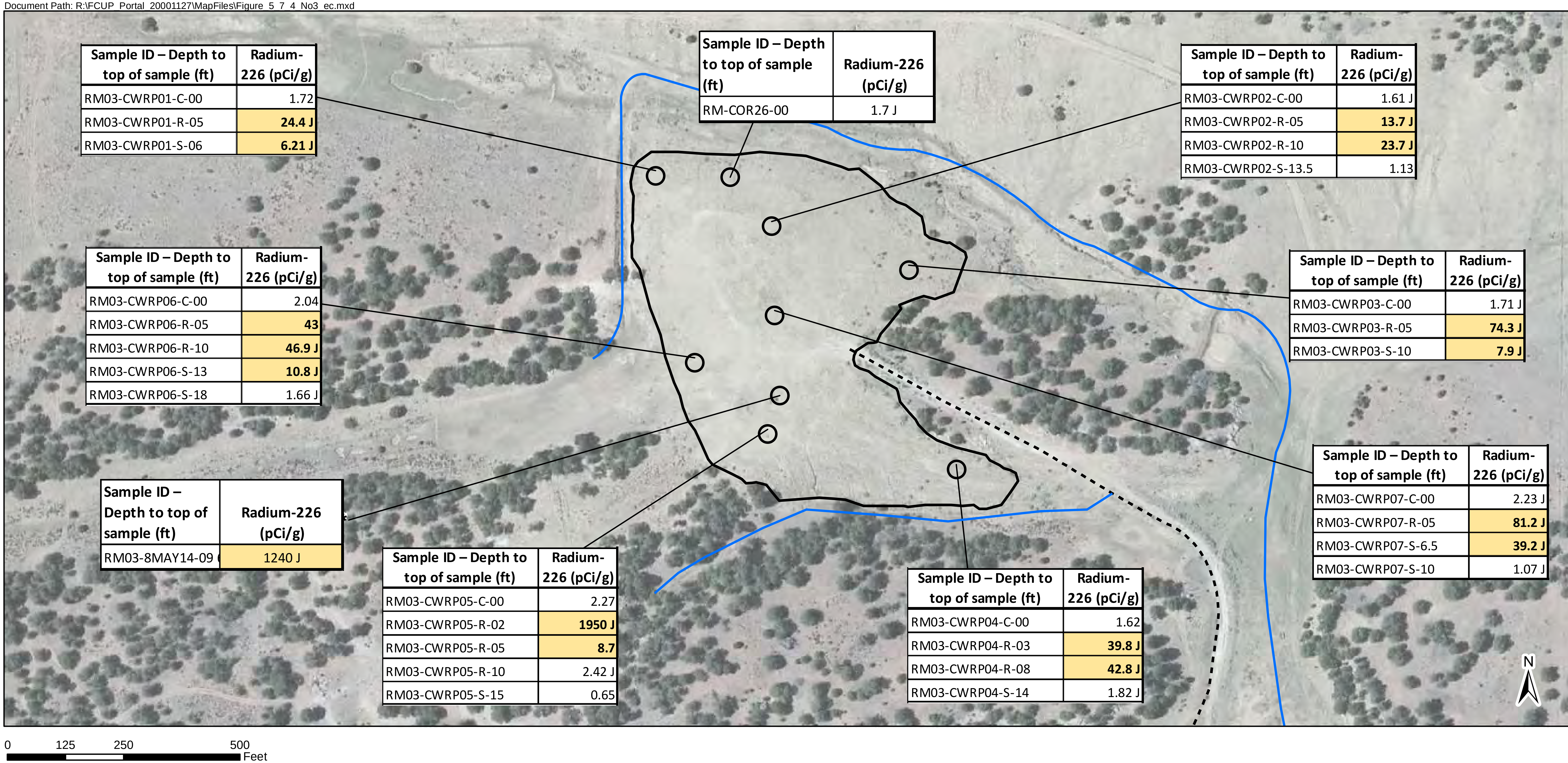
Document Path: R:\FCUP_Portal_20001127\MapFiles\Figure_5_7_4_No3_ec.mxd



Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP01-C-00	1.72
RM03-CWRP01-R-05	**24.4 J**
RM03-CWRP01-S-06	**6.21 J**

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM-COR26-00	1.7 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP02-C-00	1.61 J
RM03-CWRP02-R-05	**13.7 J**
RM03-CWRP02-R-10	**23.7 J**
RM03-CWRP02-S-13.5	1.13

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP06-C-00	2.04
RM03-CWRP06-R-05	**43**
RM03-CWRP06-R-10	**46.9 J**
RM03-CWRP06-S-13	**10.8 J**
RM03-CWRP06-S-18	1.66 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP03-C-00	1.71 J
RM03-CWRP03-R-05	**74.3 J**
RM03-CWRP03-S-10	**7.9 J**

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-8MAY14-09 (	1240 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP07-C-00	2.23 J
RM03-CWRP07-R-05	**81.2 J**
RM03-CWRP07-S-6.5	**39.2 J**
RM03-CWRP07-S-10	1.07 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP05-C-00	2.27
RM03-CWRP05-R-02	**1950 J**
RM03-CWRP05-R-05	**8.7**
RM03-CWRP05-R-10	2.42 J
RM03-CWRP05-S-15	0.65

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM03-CWRP04-C-00	1.62
RM03-CWRP04-R-03	**39.8 J**
RM03-CWRP04-R-08	**42.8 J**
RM03-CWRP04-S-14	1.82 J

Legend

- Soil Boring Location for Primary COPCs
- Former Haul Road
- Capped Waste Rock Pile
- Drainage

Figure 5-8.4
Ruby Mine No. 3 - Capped Wate Rock Pile
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

Notes:
Concentrations that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g.
J = Analyte was detected, but the given concentration should be considered estimated.

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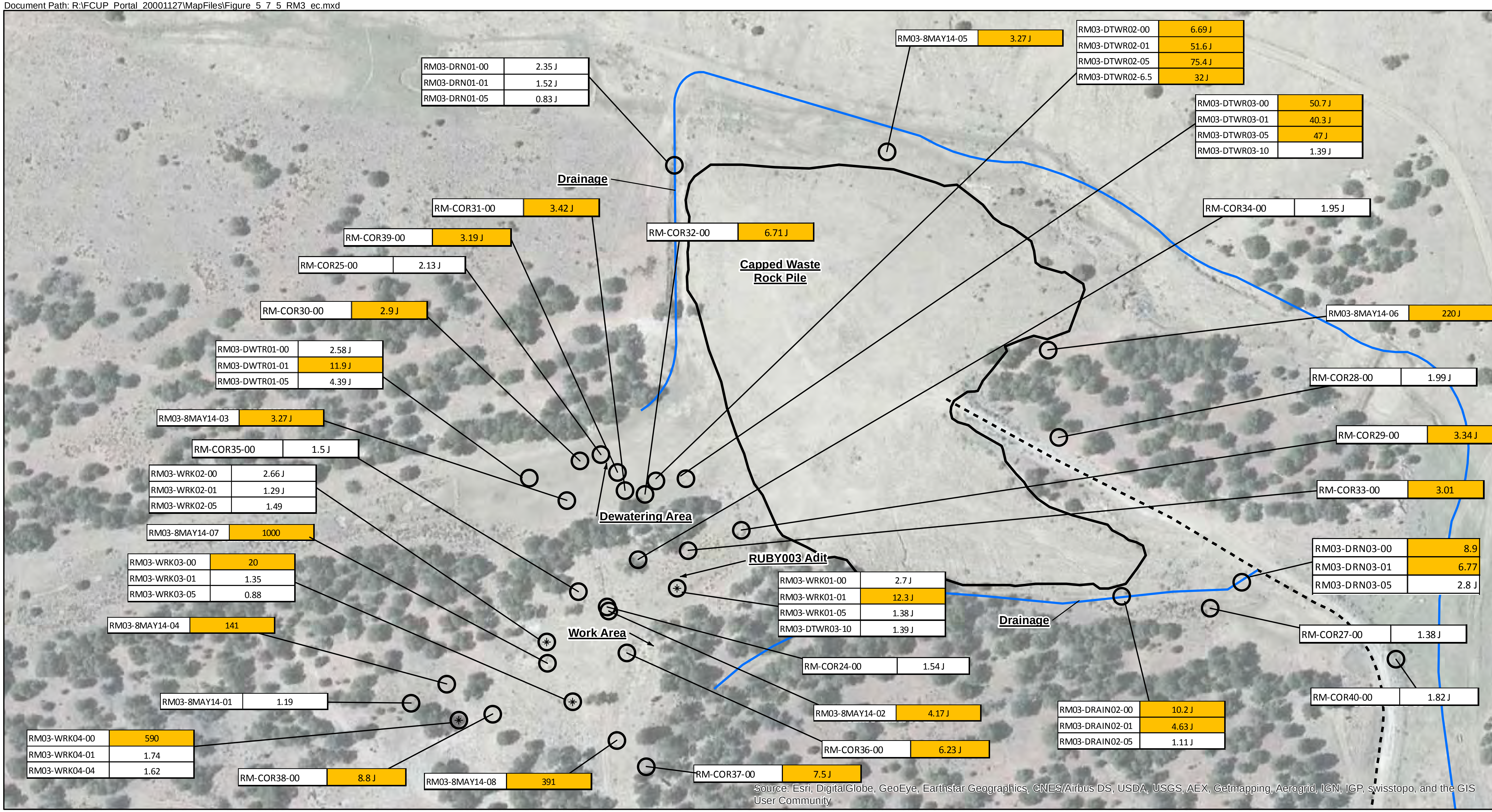
Document Path: R:\FCUP_Portal_20001127\MapFiles\Figure_5_7_5_RM3_ec.mxd



Legend

- Capped Waste Rock Pile
- Former Haul Road
- Drainage
- *Soil Boring Location for Primary COPCs*
- *Soil Boring Location for Primary and Secondary COPCs*

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)

0 125 250 500 Feet

Note: J = Analyte was detected, but the given concentration should be considered estimated.
Concentrations that are highlighted yellow exceed the Preliminary Remediation.

N

Figure 5-8.5
Ruby Mine No. 3 - Drainages, Dewatering Area, Work Area
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Work Report

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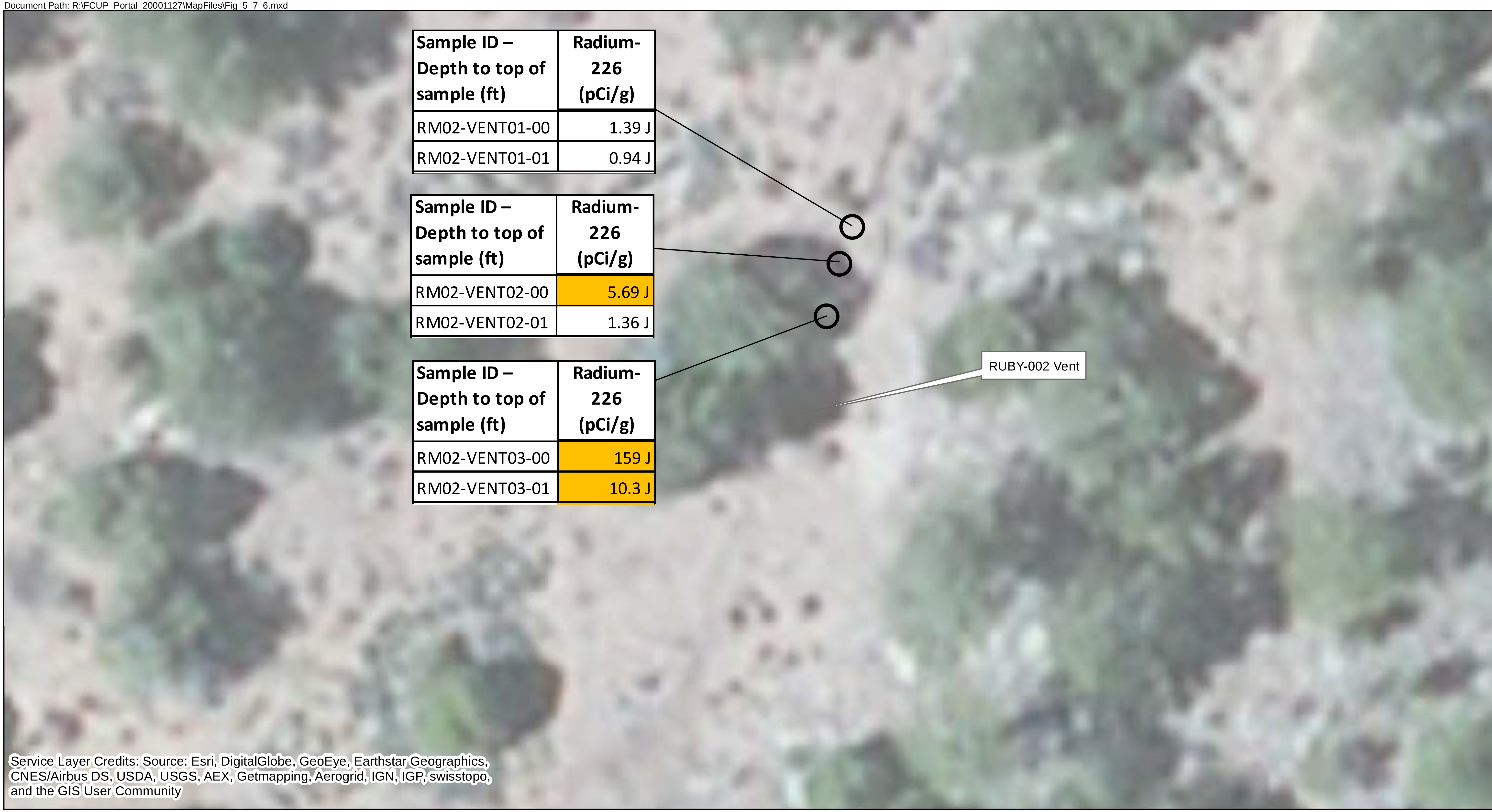

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM02-VENT01-00	1.39 J
RM02-VENT01-01	0.94 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM02-VENT02-00	5.69 J
RM02-VENT02-01	1.36 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM02-VENT03-00	159 J
RM02-VENT03-01	10.3 J

Legend

○ Soil Boring Location for Primary COPCs

Notes:
J = Analyte was detected, but the given concentration should be considered estimated.
Concentration that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g.

N

0 12.5 25 50 Feet

Figure 5-8.6
RUBY-002 Vent
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

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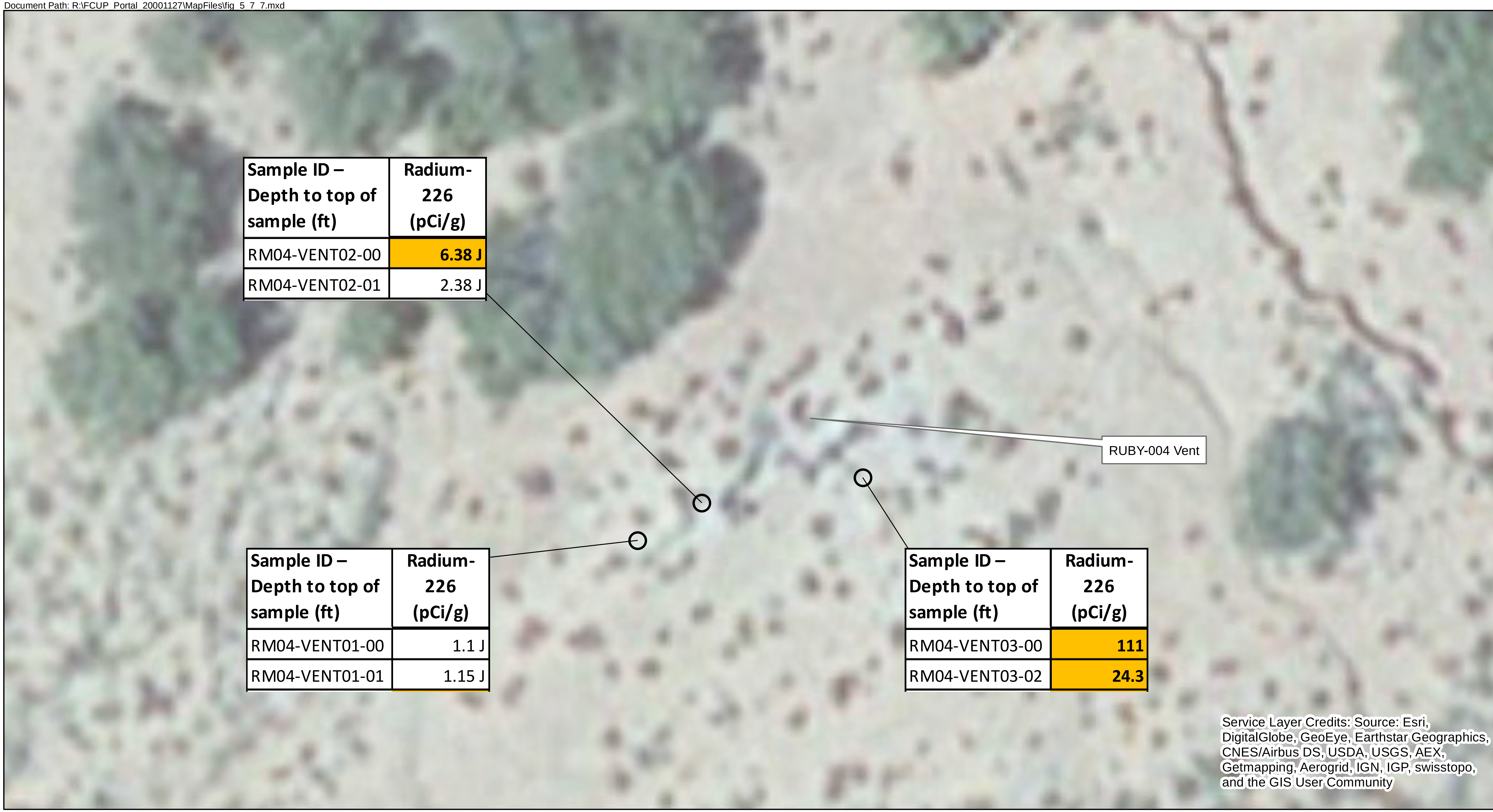

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM04-VENT02-00	6.38 J
RM04-VENT02-01	2.38 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM04-VENT01-00	1.1 J
RM04-VENT01-01	1.15 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM04-VENT03-00	111
RM04-VENT03-02	24.3

Legend

○ Soil Boring Location for Primary COPCs

N

0 12.5 25 50 Feet

Notes:
Concentrations that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g.
J = Analyte was detected, but the given concentration should be considered estimated.

Figure 5-8.7
RUBY-004
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

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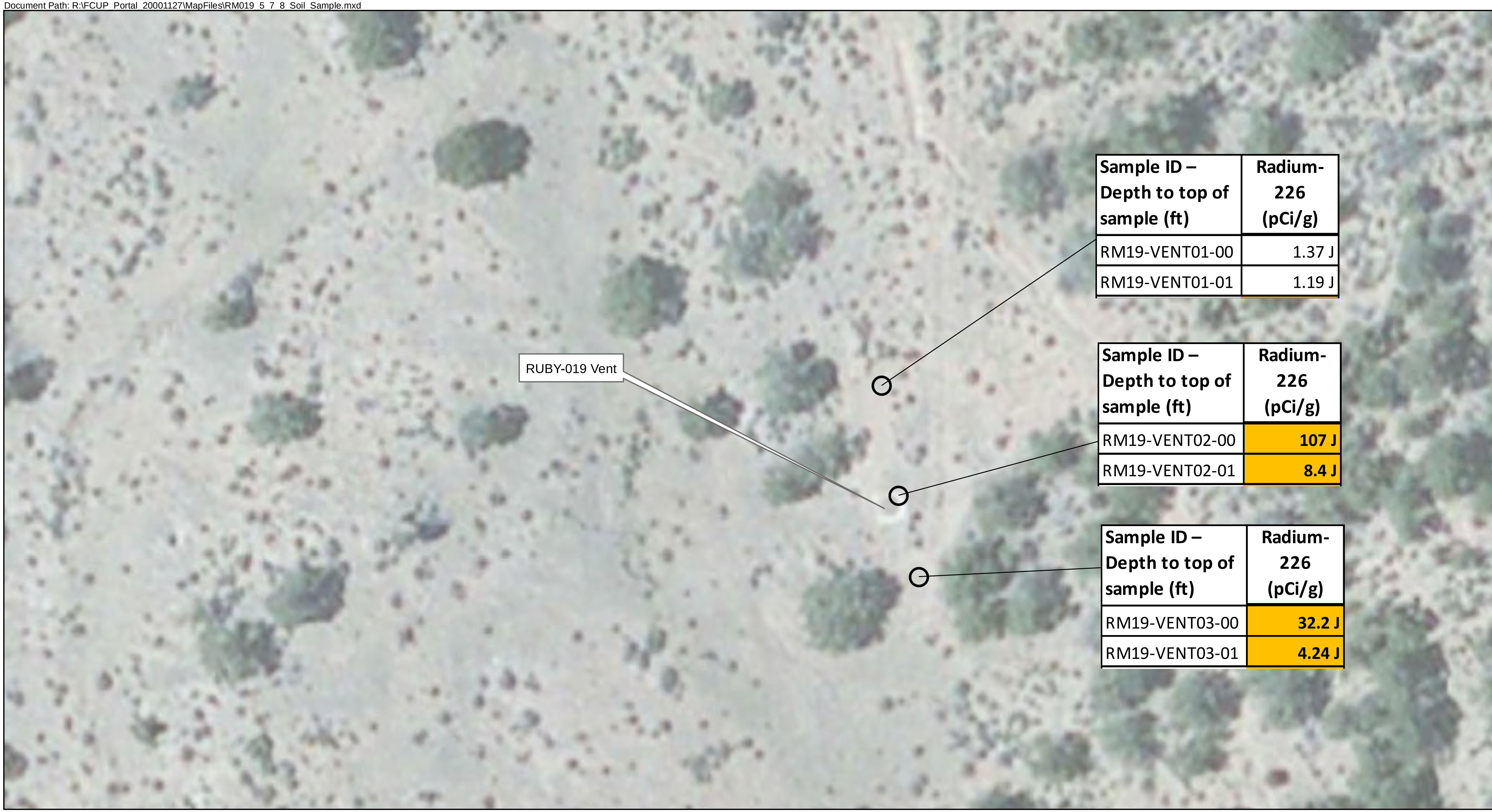

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM19-VENT01-00	1.37 J
RM19-VENT01-01	1.19 J

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM19-VENT02-00	**107 J**
RM19-VENT02-01	**8.4 J**

Sample ID – Depth to top of sample (ft)	Radium-226 (pCi/g)
RM19-VENT03-00	**32.2 J**
RM19-VENT03-01	**4.24 J**

Legend

Soil Boring Location for Primary COPCs

N

0 25 50 100 Feet

Notes:
Concentrations that are highlighted yellow exceed the Preliminary Remediation Goal of 2.89 pCi/g.
J = Analyte was detected, but the given concentration should be considered estimated.

Figure 5-8.8
RUBY-019 Vent
Radium-226 Results in Soil
Ruby Mines Removal Site Evaluation Report

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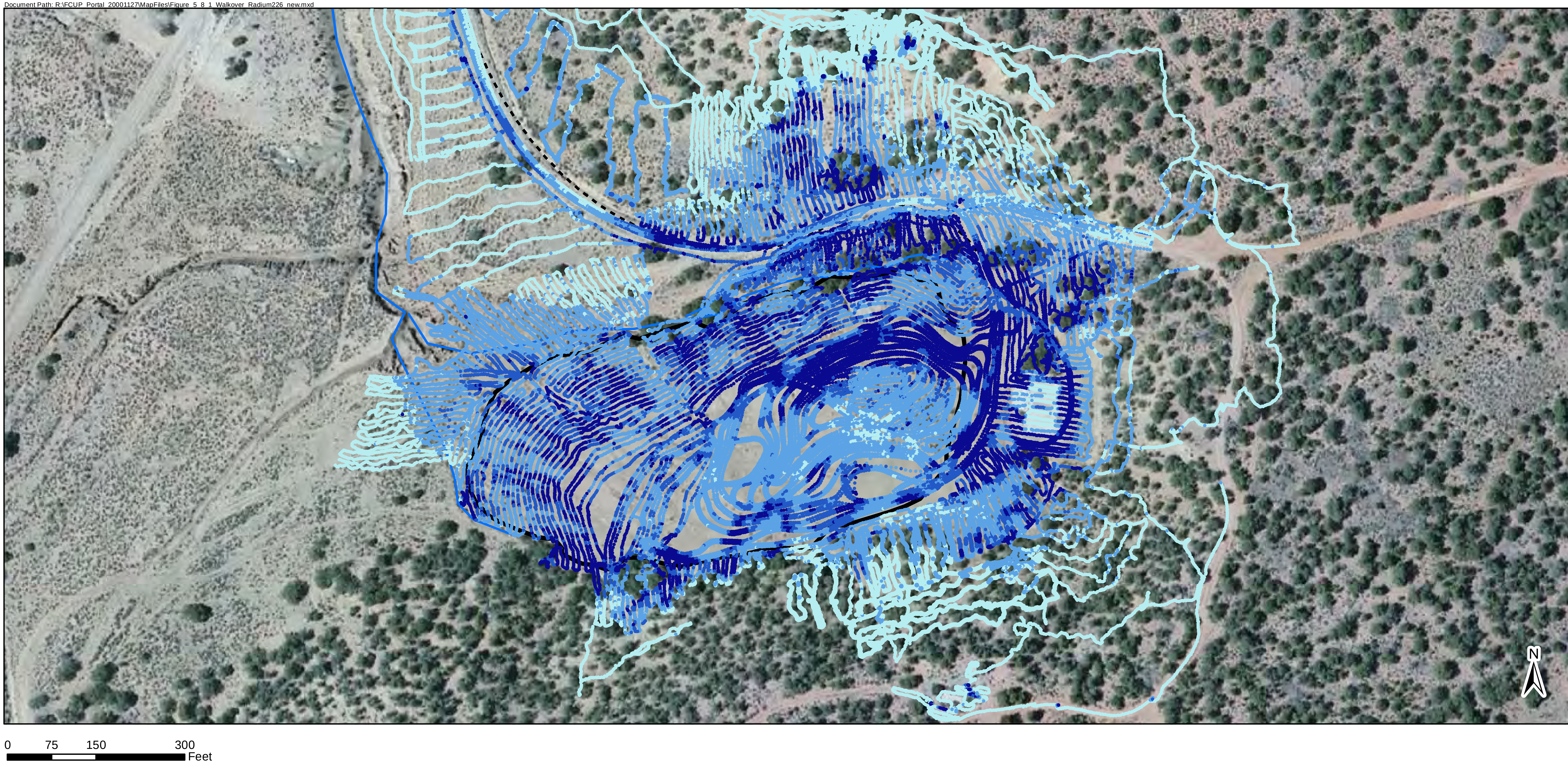

Legend

- < PRG
- PRG - 2 xPRG
- 2xPRG - 3xPRG
- > 3xPRG
- Capped Waste Rock Pile
- Former Haul Road
- Drainage

Note: PRG = 2.89 picoCuries/gram

Figure 5-9.1
Ruby Mine No. 1
Calculated Radium-226 Concentrations in Surface Soil
Ruby Mines Removal Site Evaluation Report

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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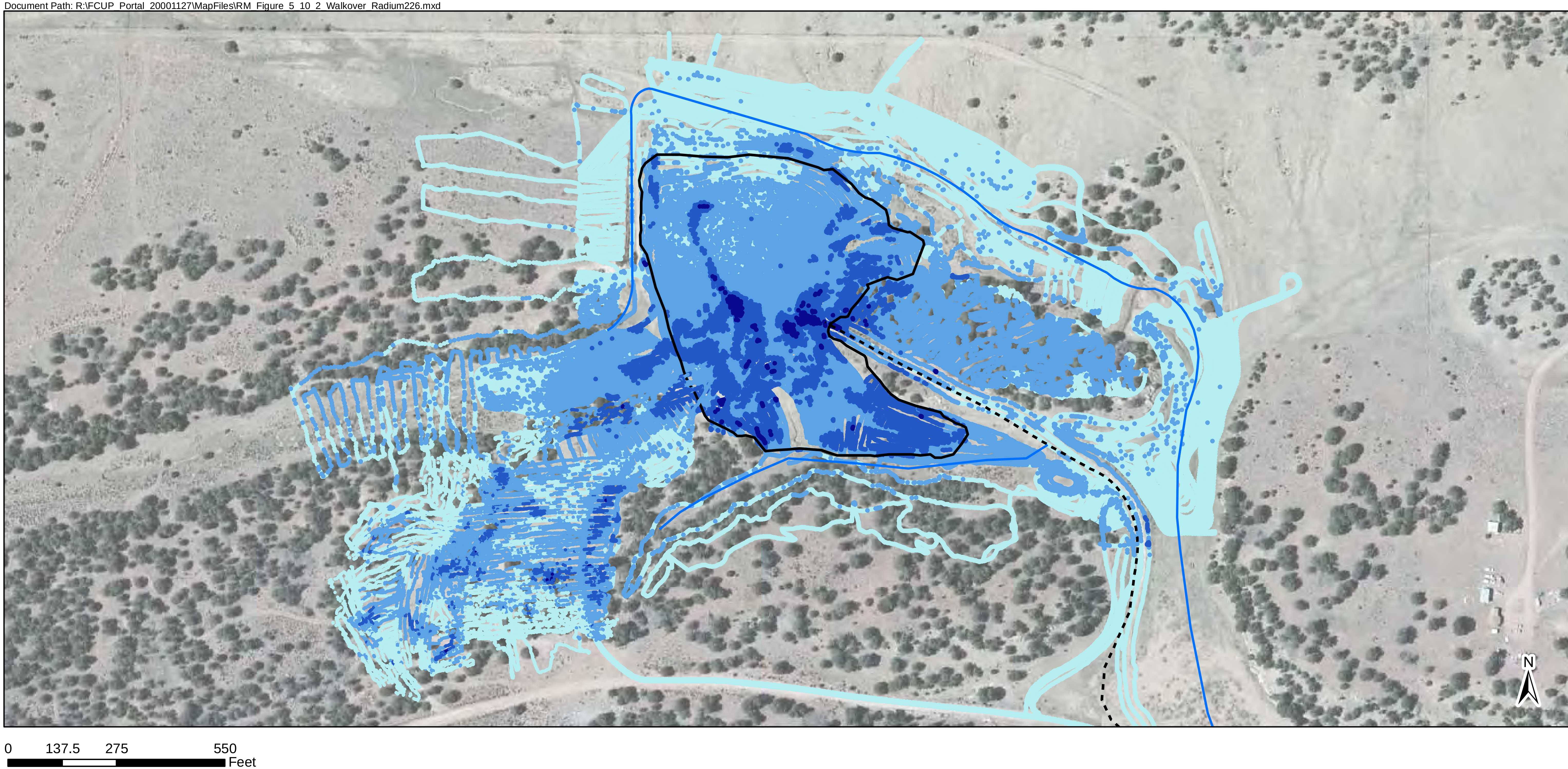

Legend

- < PRG
- PRG -2 x PRG
- 2 x PRG -3 x PR G
- > 3 x PRG
- Former Haul Road
- Drainage
- Capped Waste Rock Pile

Note: PRG = 2.89 picoCuries/gm

Figure 5-9.2
Ruby Mine No. 3
Calculated Radium-226 Concentrations in Surface Soil
Ruby Mines Removal Site Evaluation Report

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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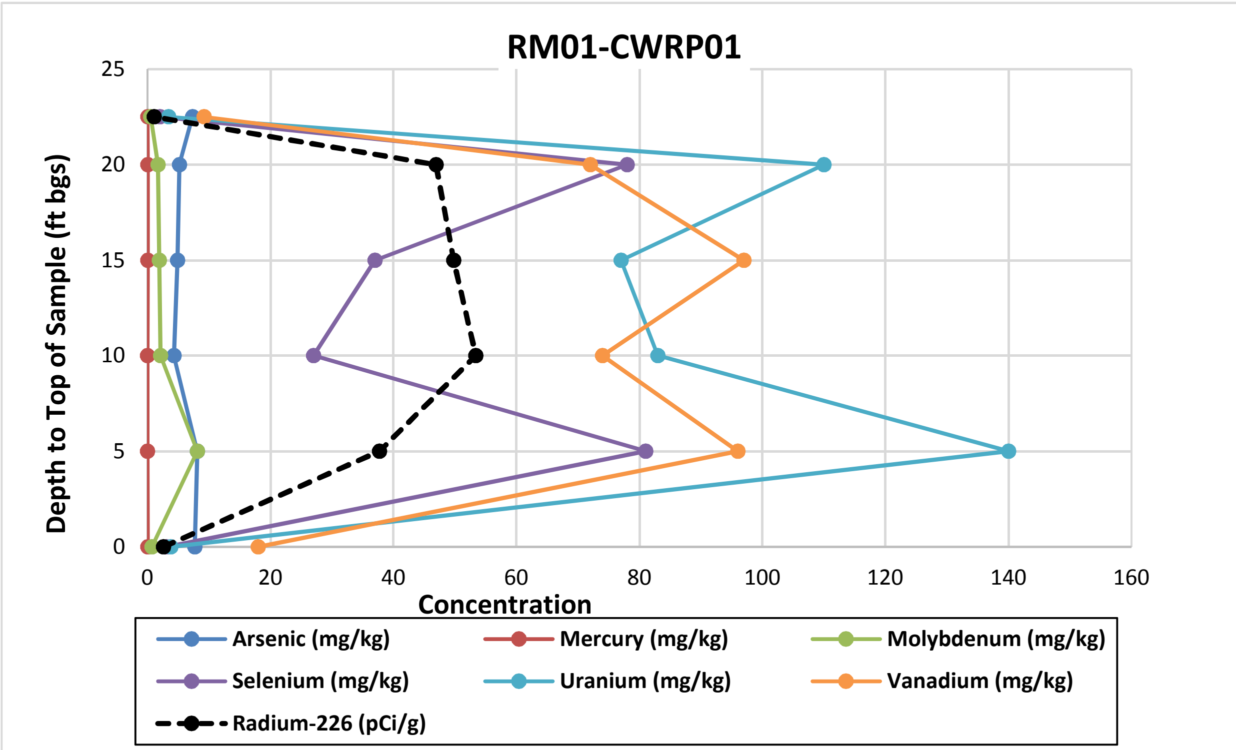
FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



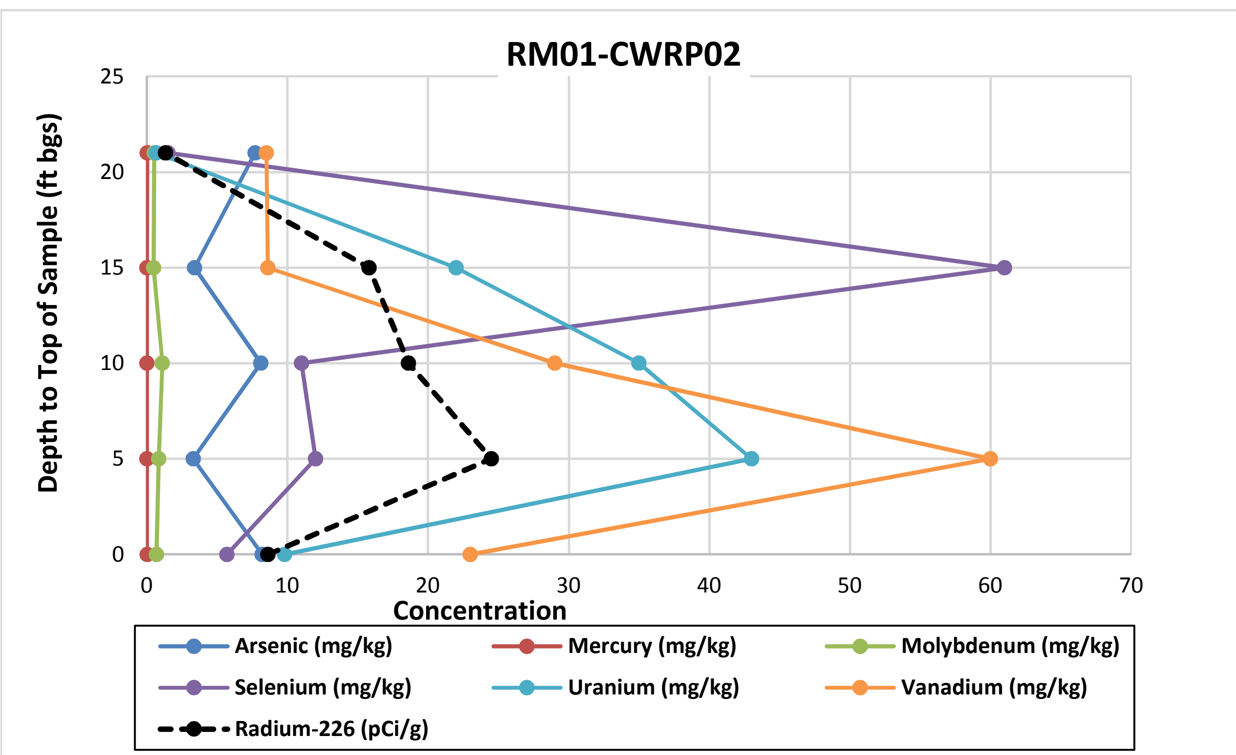
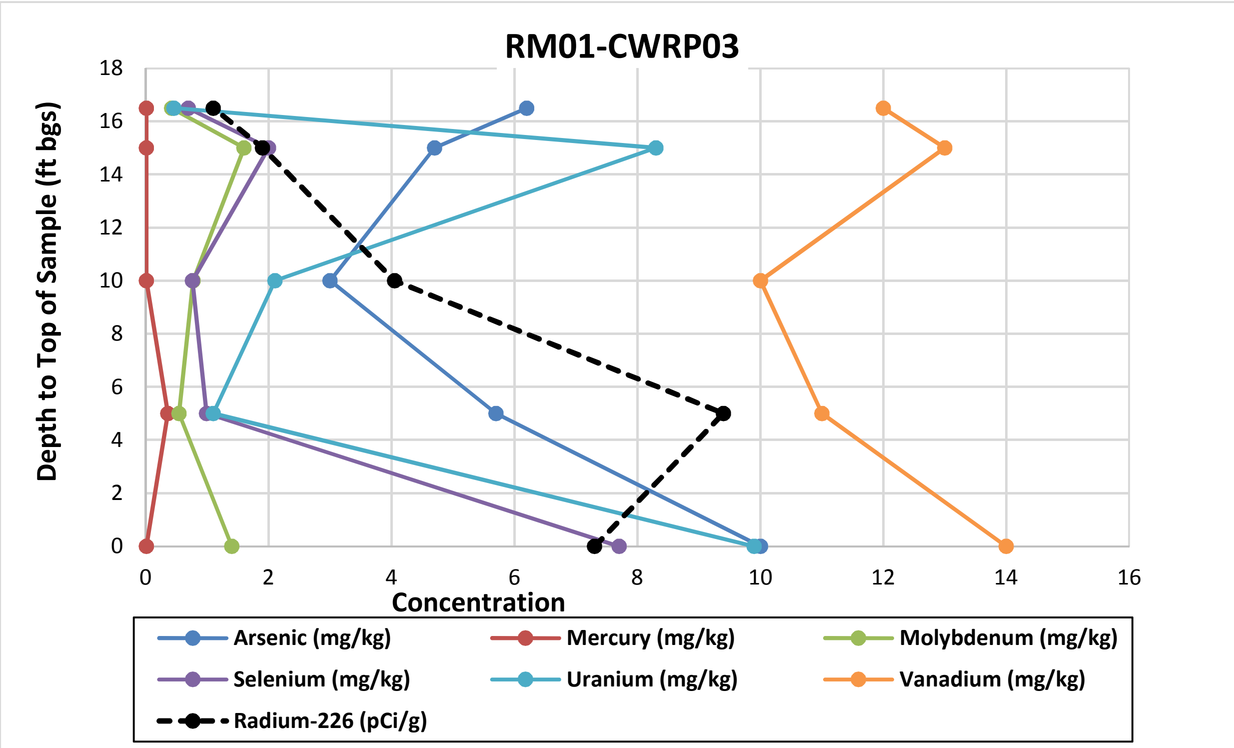


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



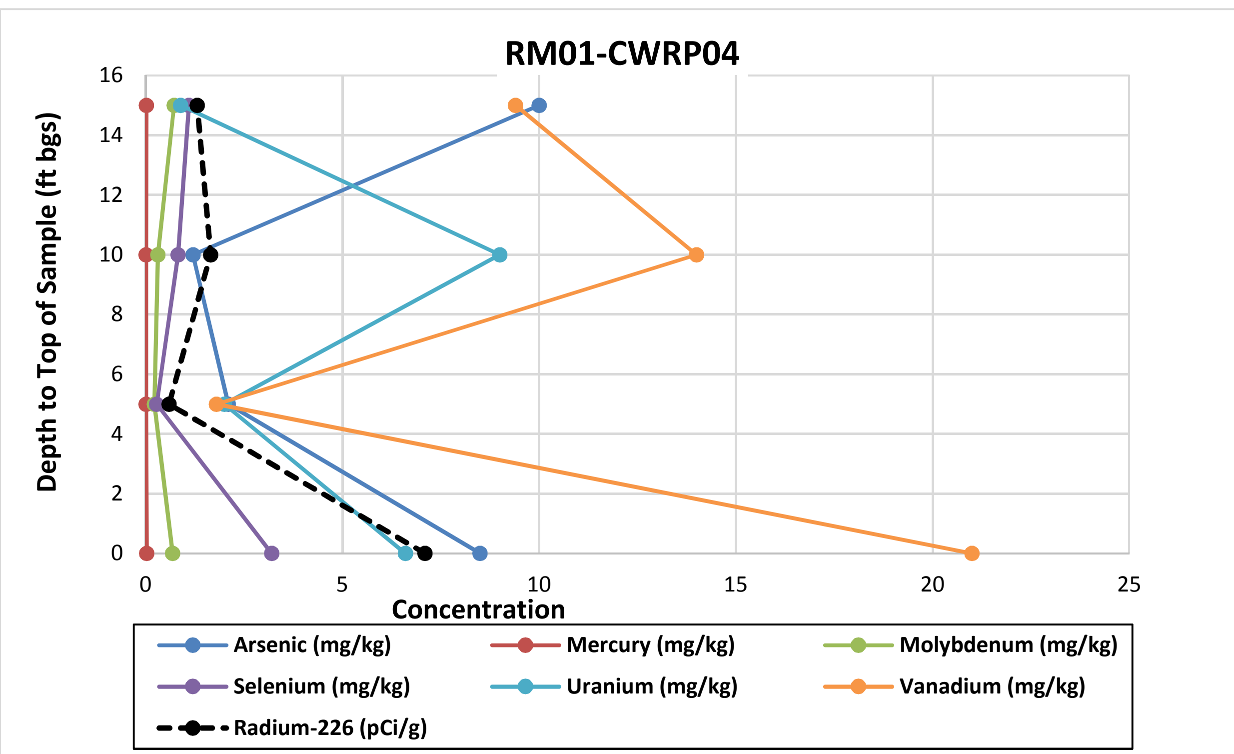
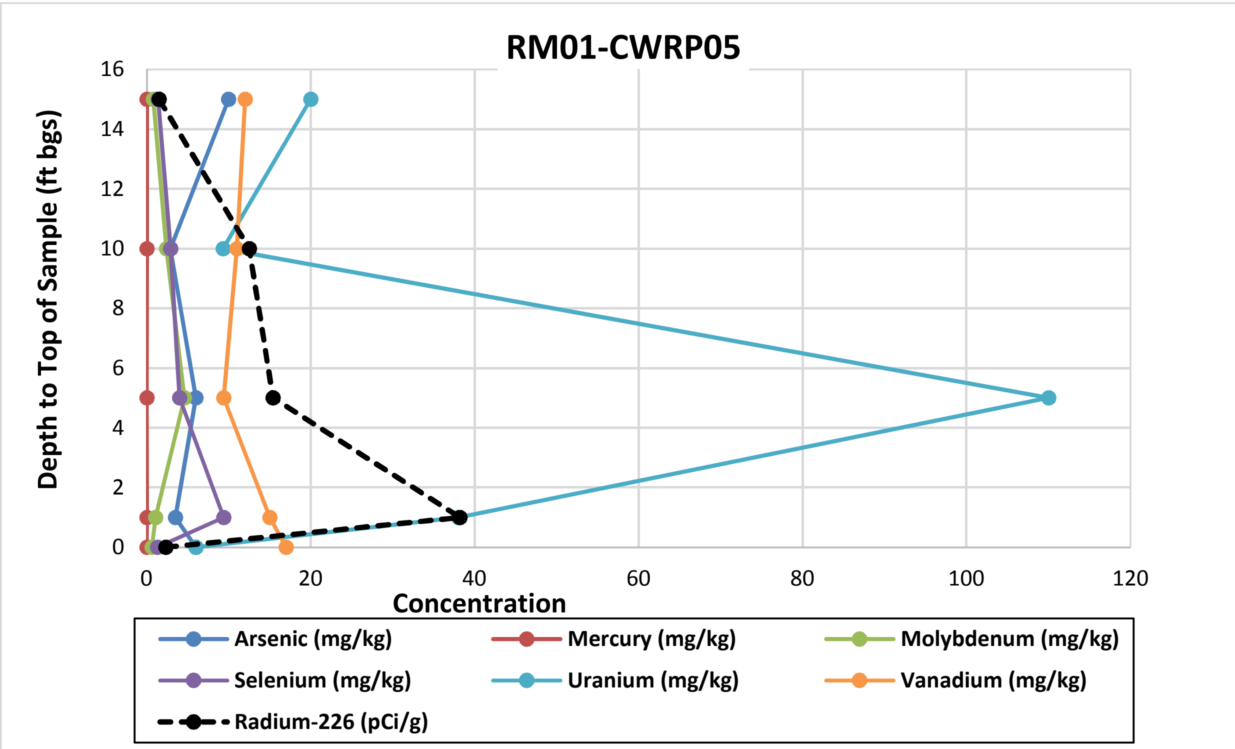


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



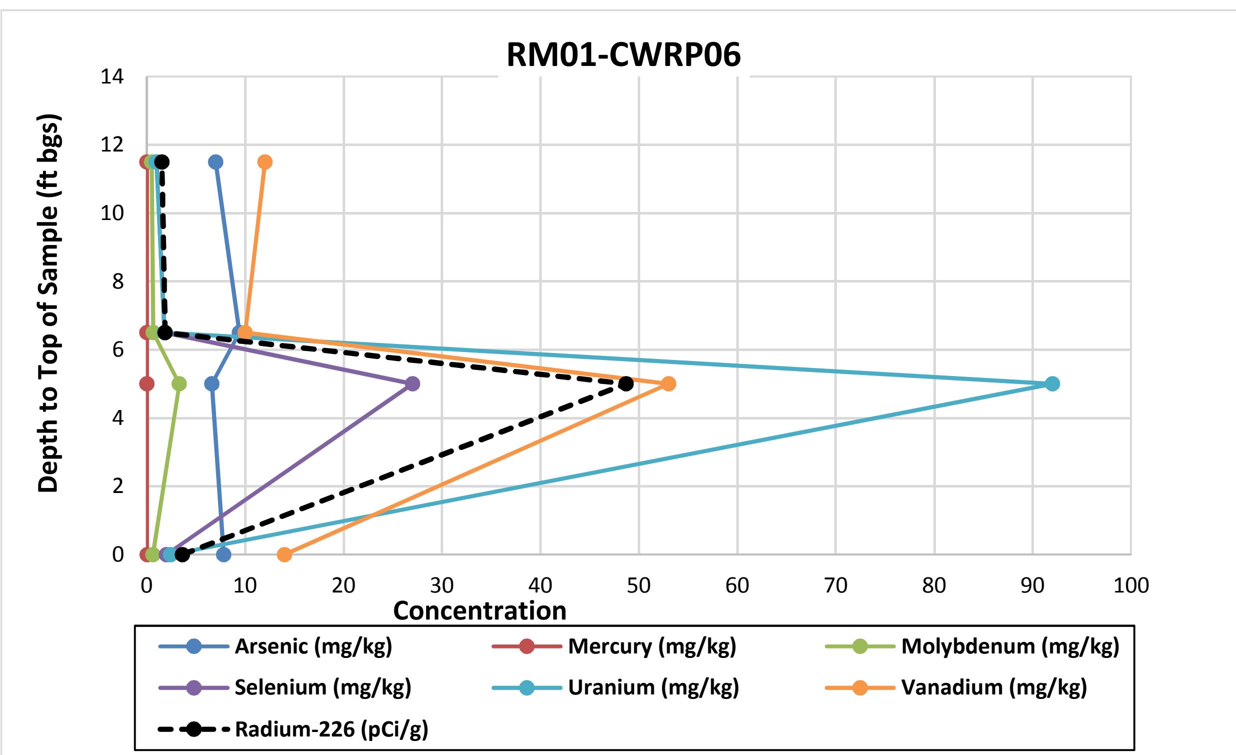
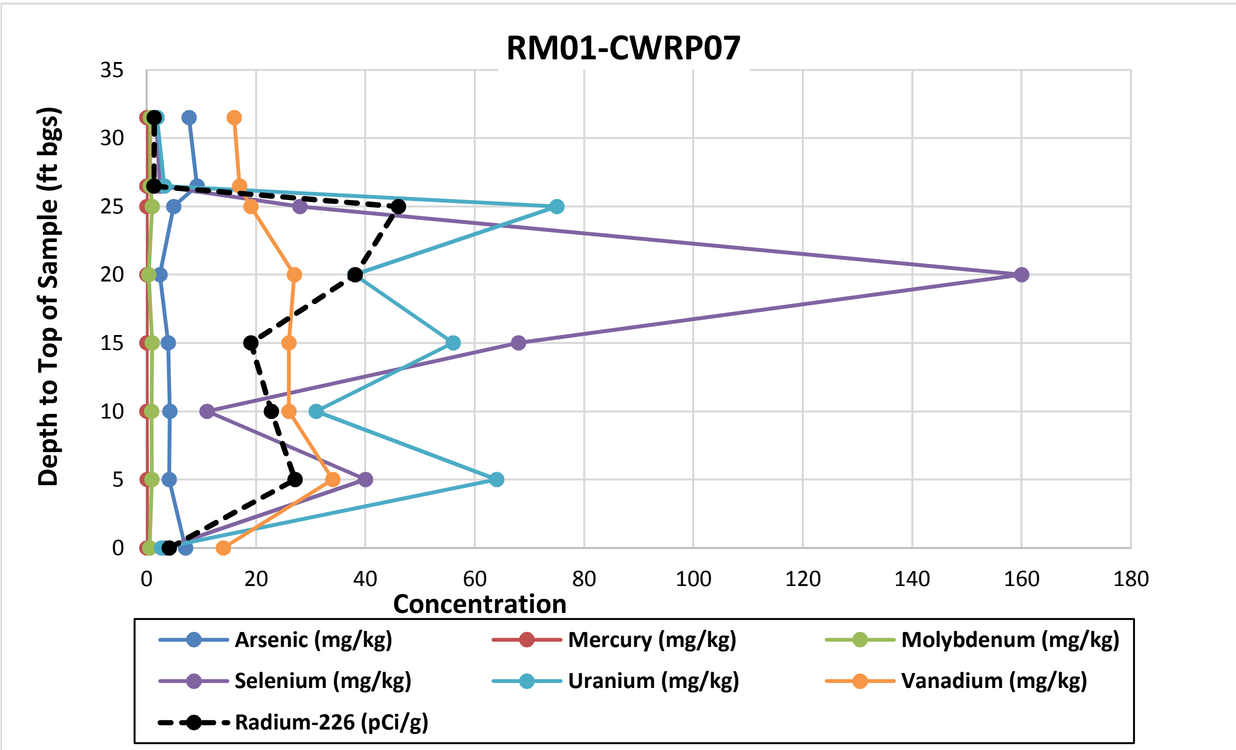


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



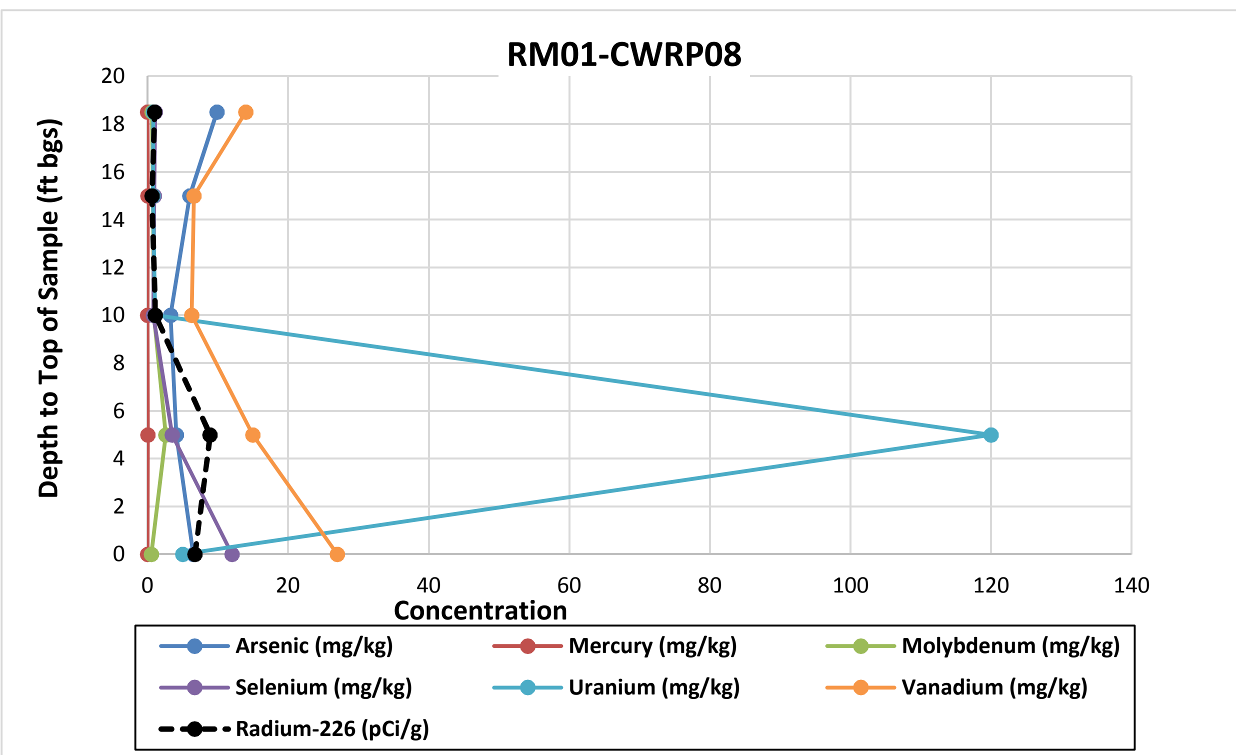
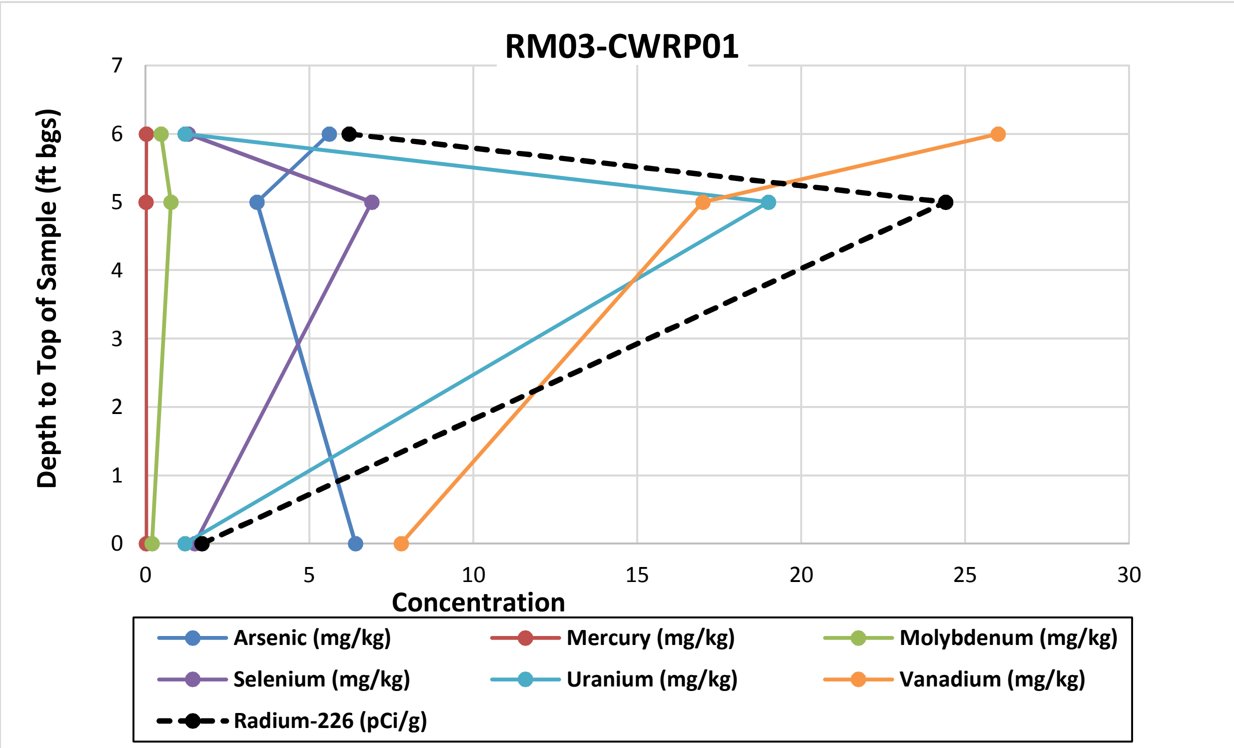


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



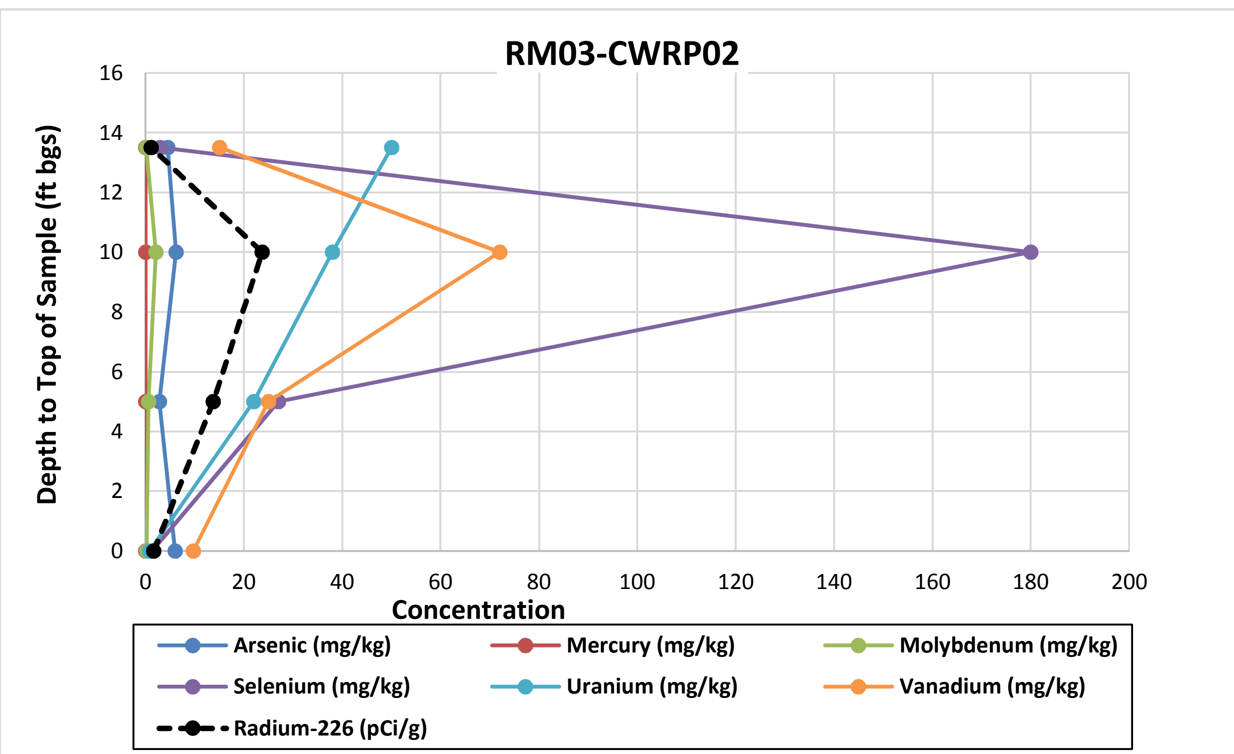
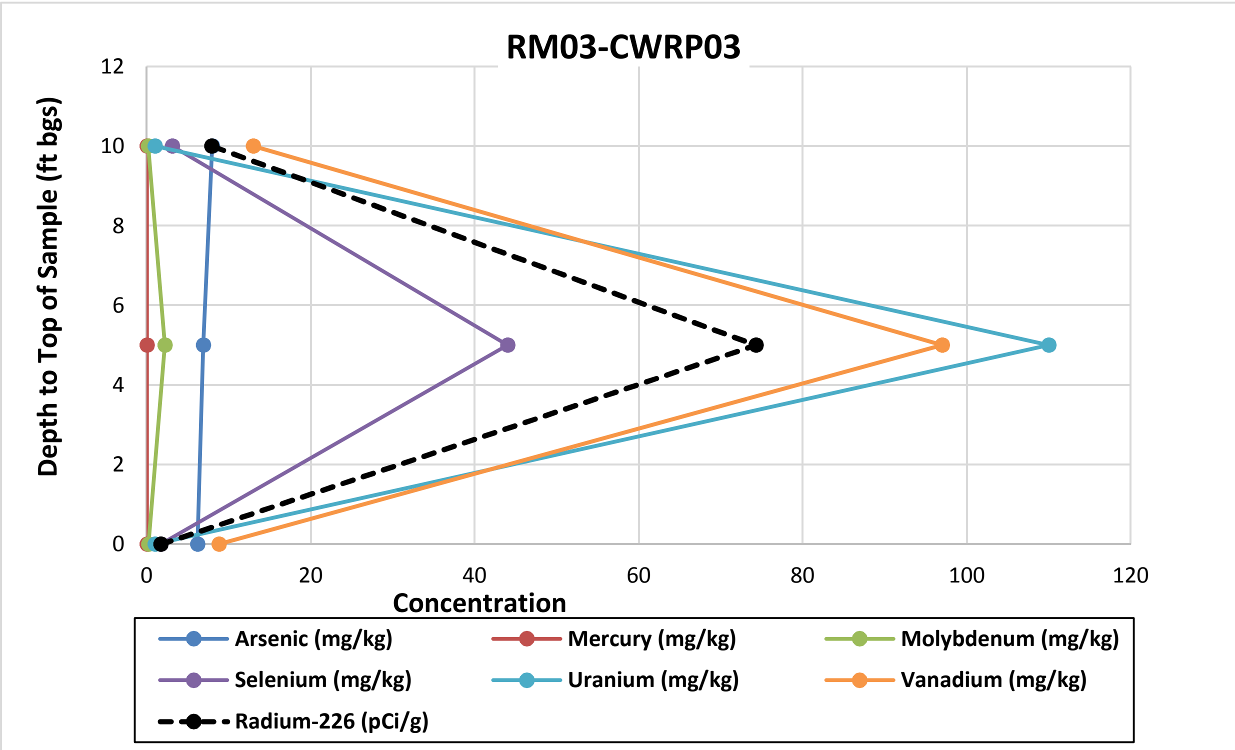


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



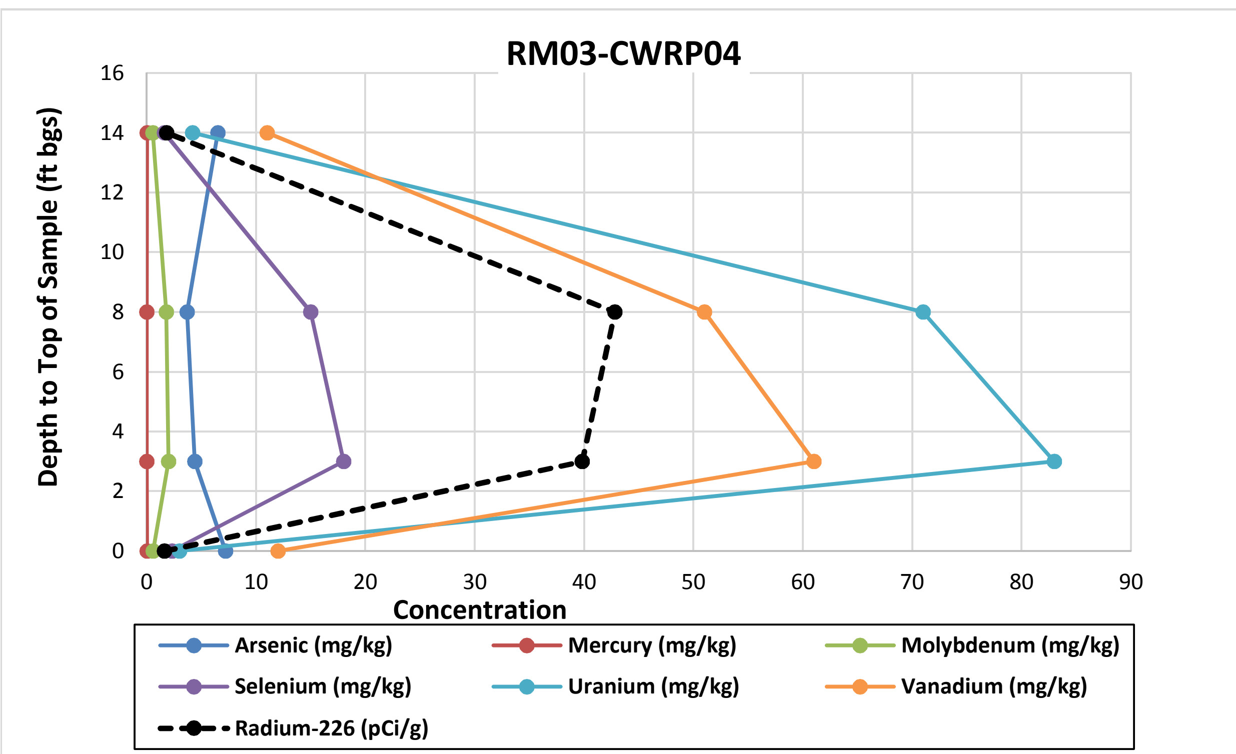
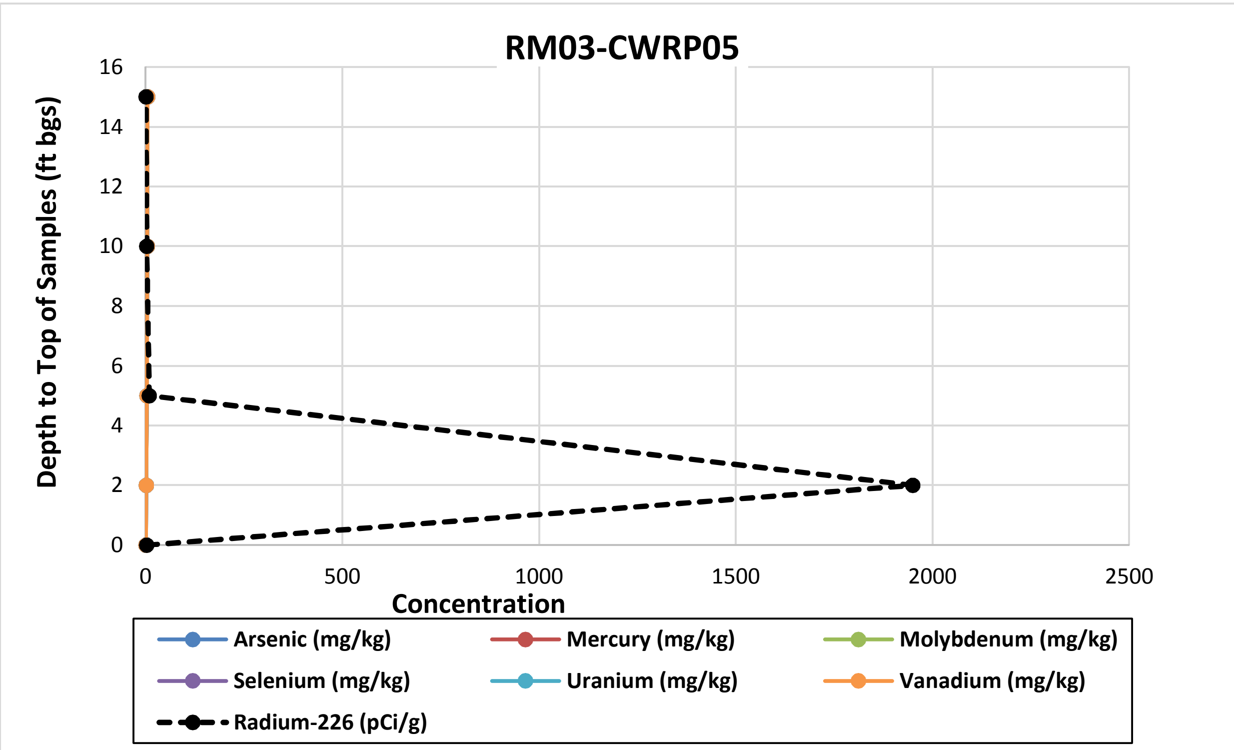


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report



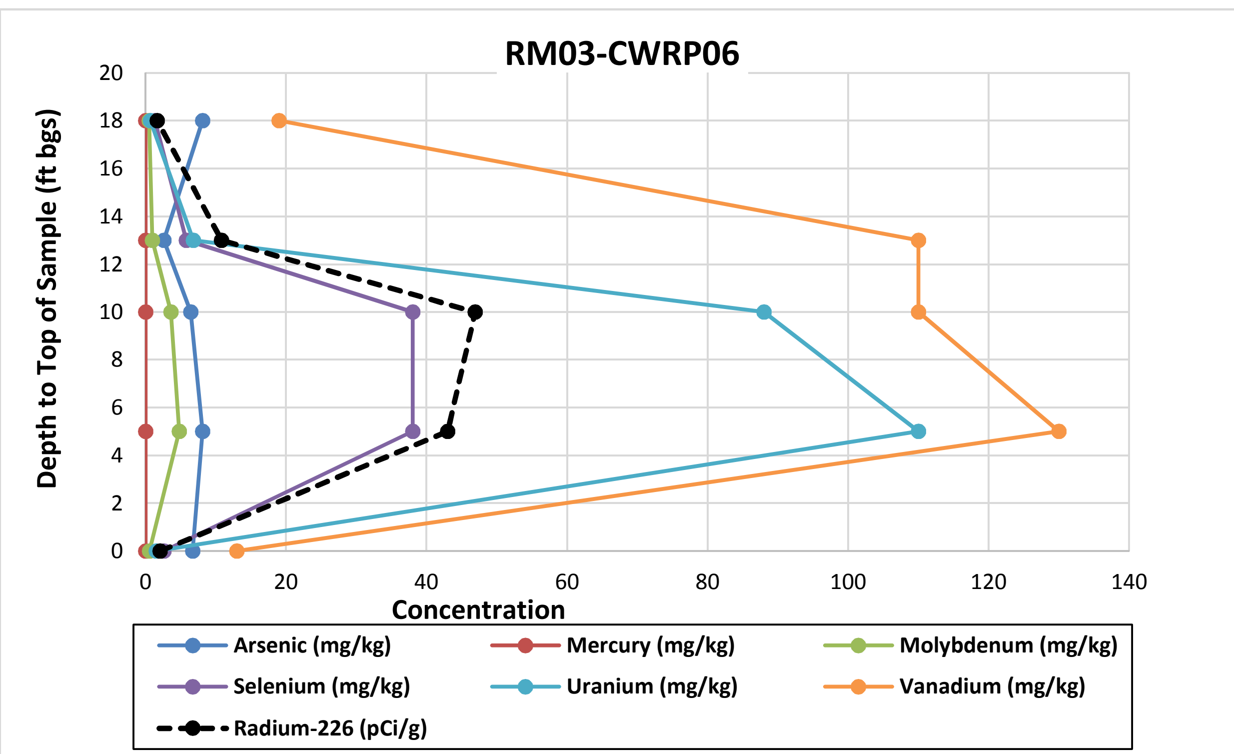


FIGURE 5-10

Concentration of Metals with Depth - Capped Waste Rock Piles

Ruby Mines Removal Site Evaluation Report