Removal Site Evaluation and Interim Removal Action

Black Jack and Mac Mines

McKinley County, New Mexico

Phase 1 Summary Report

Revision 1

Prepared for:

Homestake Mining Company of California

2270 Corporate Circle, Suite 100
Henderson, Nevada 89074

Prepared by:

Environmental Restoration Group, Inc.

8809 Washington St. NE, Suite 150
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505-298-4224

And

Alan Kuhn Associates LLC

with support from
EL Engineering Services LLC

August 22, 2017

Homestake Mining Company of California
2270 Corporate Circle, Suite 100
Henderson, Nevada 89074

August 22, 2017

Mark Ripperda
U.S. Environmental Protection Agency
610 W Ash Street, St # 703,
San Diego, CA 92101

Re: U.S. EPA Region 9, CERCLA Docket No. 2014-06, Black Jack and Mac Mines

Dear Mr. Ripperda,

Please find the enclosed revised Phase 1 Summary Report (Revision 1) documenting the results of radiological and geomorphological characterization surveys conducted in support of a Removal Site Evaluation (RSE) and Interim Removal Action for the Black Jack No.1 and No.2 and the Mac No.1 and No. 2 mine sites (Sites) in the Mariano Lake and Smith Lake areas of the Navajo Nation within McKinley County, New Mexico. These surveys were conducted pursuant to Phase 1 of the Scope of Work identified in the Administrative Settlement Agreement and Order on Consent (AOC) for Interim Removal Action under the jurisdiction of the U.S. Environmental Protection Agency (EPA) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA Docket No. 2014-06).

This Report has been revised in accordance with Homestake Mining Company of California (HMC) responses to comments from the EPA and Navajo Nation EPA on the initial draft Phase 1 Summary Report (Revision 0, submitted June 30, 2017). Responses to Agency comments are provided separately in conjunction with this submittal. A redline version showing all changes from the original draft Report can be provided upon request. Hard copies of the revised Phase 1 Summary Report (Revision 1) will follow by mail.

If you have questions regarding this Report, please contact me at (702) 522-6938 or by email at cburton@barrick.com.

Regards,

Clark Burton
Head of Operations, Asset Development
Homestake Mining Company of California

cc: Jacob Phipps (U.S. EPA)
Binod K. Chaudhary (Navajo Nations EPA)

PREFACE

This Report documents the results of radiological and geomorphological characterization surveys conducted in support of a Removal Site Evaluation (RSE) and Interim Removal Action for the Black Jack No.1 and No.2 and the Mac No.1 and No. 2 mine sites (Sites) in the Mariano Lake and Smith Lake areas of the Navajo Nation within McKinley County, New Mexico. These surveys were conducted by Environmental Restoration Group, Inc. (ERG) and Alan Kuhn Associates, LLC (AKA) on behalf of Homestake Mining Company of California (HMC) pursuant to the Scope of Work (SOW) identified in the Administrative Settlement Agreement and Order on Consent (AOC) for Interim Removal Action under the jurisdiction of the U.S. Environmental Protection Agency (EPA) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA Docket No. 2014-06).

This Phase 1 Summary Report is presented in the form of two separate sub-reports organized as two major component Parts of this overall Report:

Part 1 – Radiological Characterization Surveys	(Environmental Restoration Group, Inc.)
Part 2 – Geomorphic Characterization and Assessment	(Alan Kuhn Associates, LLC)

Each component Part of the Phase 1 Summary Report as noted above represent stand-alone documents that include a main report and corresponding appendices and/or attachments. A complete electronic file of this Report will be provided to EPA. Three hard copies of this overall Report will be compiled and submitted to the Agencies as specified in the AOC, with Level IV analytical laboratory data provided only in electronic format on an attached CD.

Removal Site Evaluation and Interim Removal Action

Black Jack and Mac Mines

McKinley County, New Mexico

Phase 1 Summary Report

Part 1: Radiological Characterization Surveys

Revision 1

Prepared for:

Homestake Mining Company of California

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8809 Washington St. NE, Suite 150
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August 22, 2017

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1. INTRODUCTION

This report documents radiological characterization surveys conducted in support of a Removal Site Evaluation (RSE) and Interim Removal Action for the Black Jack No.1 and No.2 and the Mac No.1 and No. 2 mine sites (Sites) in the Mariano Lake and Smith Lake areas of the Navajo Nation within McKinley County, New Mexico (Figure 1). These surveys were conducted by Environmental Restoration Group, Inc. (ERG)[1] on behalf of Homestake Mining Company of California (HMC or Respondent) pursuant to the Scope of Work (SOW) identified in an Administrative Settlement Agreement and Order on Consent (AOC) for Interim Removal Action under the jurisdiction of the U.S. Environmental Protection Agency (EPA) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA Docket No. 2014-06) (EPA, 2014). Specifically, this report covers the following Phase 1 SOW items:

4.1.1 – Transect Gamma Scan

4.1.3 – Background Study

4.1.5 – Radiation Measurements in Buildings

A report addressing Phase 1 SOW item 4.1.2 (Geomorphologic Study) is provided as Part 2 of this overall Summary Report. Sampling for a Gamma Scan/Soil Concentration Correlation (SOW item 4.1.4) was deferred to Phase 3 of the SOW as stated in the EPA-approved Phase 1 Work Plan (ERG, 2014). Phase 1 item 4.1.6 in the SOW (backfilling Open Hole at Black Jack No. 1) was deferred to Phase 2 of the SOW (filling, closing and reclaiming mine features that present physical hazards and placement of signage).

2. OBJECTIVES

The objectives of the Phase 1 SOW items described above include:

- Characterization of terrestrial gamma radiation exposure rates across the Sites and adjacent areas to identify the horizontal (areal) extent of mine-related material.
- Characterization of existing local background gamma exposure rates and concentrations of specified radionuclides and metals in local soils to be used in identifying areas impacted by mine-related material containing potential contaminants of concern (PCOC) as specified in the SOW (Appendix A of the AOC), along with two additional radionuclides not related to PCOCs that could influence gamma radiation readings as specified in the Phase 1 Work Plan [including thorium-232 (Th-232) and potassium 40 (K-40)].[2]

[1] Initial gamma radiation surveys and background soil sampling was conducted between April 20-25, 2015. Due to subsequent discussions between EPA, Navajo Nations EPA (NNEPA), and the Bureau of Indian Affairs (BIA) regarding proper procedure for notification/approval of access to Sites located on lands allotted by the BIA to individual members of the Navajo Nation ("Allottees"), or on lands subject to grazing permits, Phase I work was suspended pending resolution of this matter. The Respondent (HMC) was given permission to resume Phase I field work at the Sites in December 2016, and respective field work was completed in early May 2017.

[2] Th-232 and K-40 are naturally occurring radionuclides typically found at low levels in all soils and rocks. In some areas, these radionuclides can be naturally elevated and influence the terrestrial gamma radiation field. While not required by the SOW, analysis of these radionuclides was included in the Phase 1 Work Plan as a potential diagnostic tool for evaluation of Ra-226 levels in soil based on gamma radiation readings. Th-232 levels were

- Determination of ambient indoor radon-222 (Rn-222) gas concentrations within existing onsite structures.
- Characterization of geomorphological features in the vicinity of the Sites to evaluate active and potential erosion processes and pathways for transport of mine-related materials to support potential removal actions and evaluation of reclamation and Site closure options.
- Mitigation of imminent safety hazards associated with the mine Sites until permanent remedy of these hazards occurs in later phases of the work.

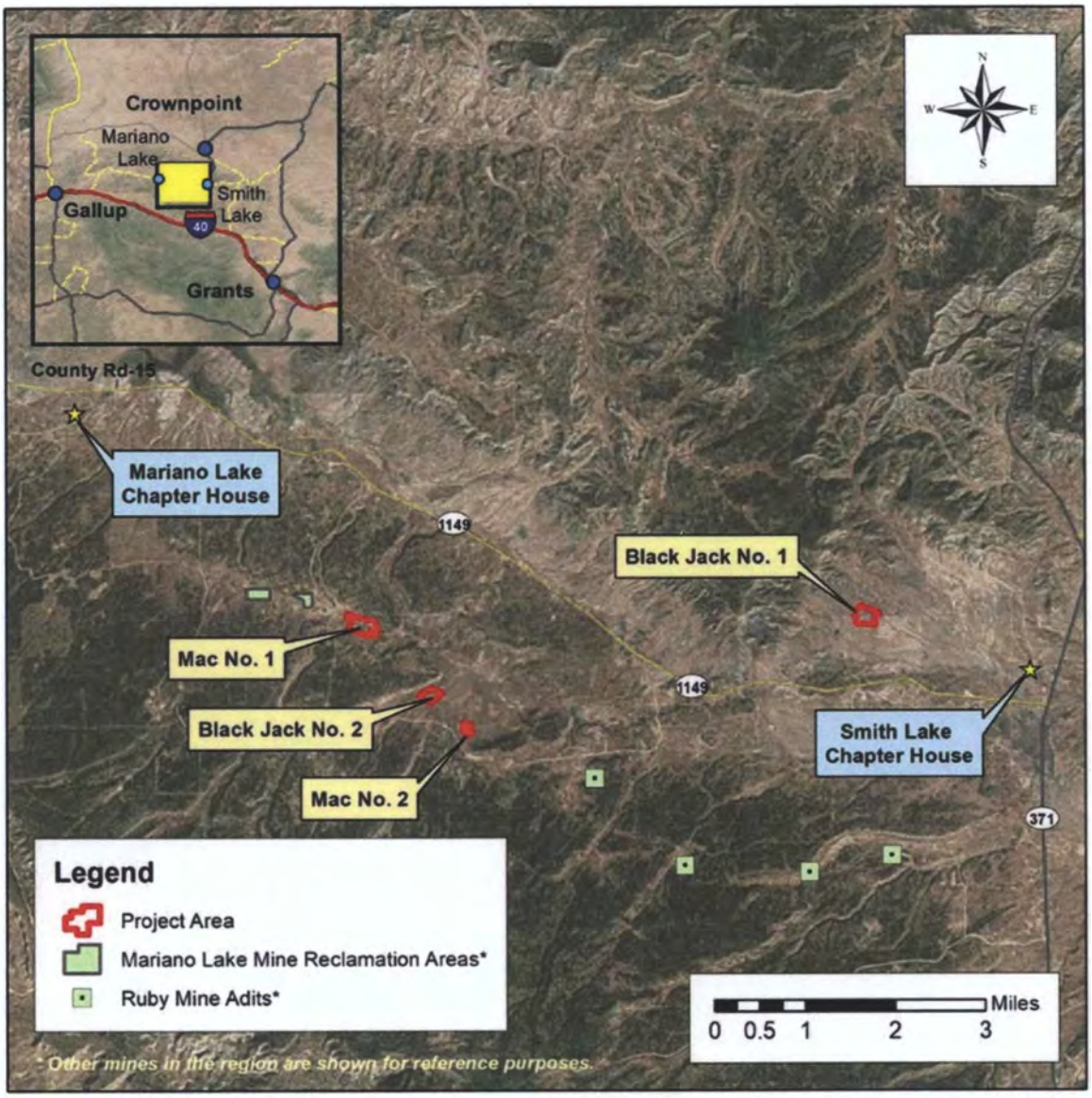


Figure 1: Black Jack and Mac Mine Site locations relative to local Navajo Nation Chapter Houses and other abandoned uranium mines in this region of the Navajo Nation in New Mexico.

indirectly estimated based on measurements of actinium-228 (Ac-228) and an assumption of secular equilibrium between Ac-228 and its Th-232 precursor.

3. METHODS

The SOW items described above were implemented in accordance with the methods outlined in the Phase 1 Work Plan and accompanying standard operating procedures (SOPs). Details of the methods employed in the field for the SOW items covered by this portion (Part 1) of the Phase 1 Summary Report are provided below.

3.1 Gamma Radiation Surveys

The gamma radiation surveys were largely completed April 20-25, 2015, with follow-up scanning performed December 6-7, 2016 and May 3, 2017 (see Footnote 1). Instrumentation included Ludlum Model 44-10 sodium iodide (NaI)-based scintillation detectors connected to Ludlum Model 2221 ratemeter/scalers, along with a Trimble global positioning system (GPS) receiver and handheld data logger. Operation of the GPS-based scanning system followed the method described in Standard Operating Procedure (SOP) 5.11 as presented in the Phase 1 Work Plan (ERG, 2014). Gamma radiation levels were recorded in units of counts per minute (cpm) along with corresponding GPS coordinates for each individual gamma reading. These data were collected at 1-second intervals while scanning.

The gamma detector was positioned at a height of approximately 18 inches above the ground surface while scanning, with a scan speed of about 0.5 – 1.5 m/s (typical walking speeds) depending on terrain. The estimated minimum detectable concentration of radium-226 (Ra-226) in surface soil for a single individual gamma radiation measurement while scanning (scan MDC) was calculated to be 1 pCi/g based on model parameters consistent with the scanning method used in the field, and the apparent spatial distributions of radiological surface impacts at the Sites (Figure 2).[3]

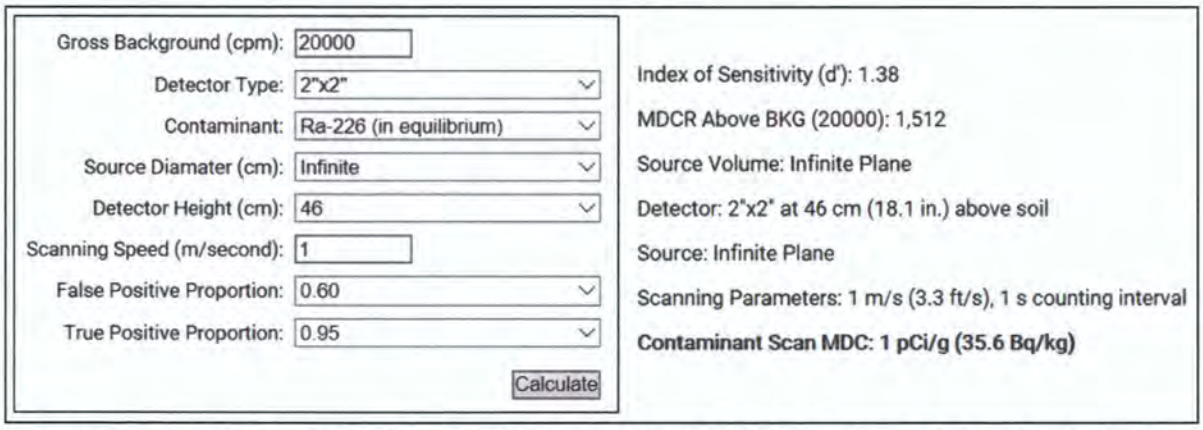


Figure 2: Retrospectively calculated scan MDC for detection of Ra-226 in surface soils based on background gamma radiation readings, scanning procedures specified in the Phase 1 Work Plan, and the observed spatial distributions of radiological impacts in surface soils at the Sites.

[3] The estimated scan MDC was retrospectively calculated based on a recently published method (Alecksen and Whicker, 2016) and online calculator (ERG, 2017) designed specifically for electronically recorded, GPS-based gamma surveys, along with measured Site-specific background gamma readings. An assumption of infinite plane conditions is appropriate for broadly dispersed contamination (versus small hot spots), and this assumption is generally supported by gamma survey results for these Sites. The SOW defines an investigation level of 1.24 pCi/g Ra-226 above background (totaling about 2.24 pCi/g at these Sites). The calculated scan MDC meets the SOW specification of being able to detect 50% of the investigation level (i.e. a maximum scan MDC of 1.12 pCi/g).

Target gamma survey transects were spaced 15 meters apart, though closer spacing was typically observed within mine permit boundaries. Constraints on access (vegetative cover, steep slopes, etc.) sometimes affected the coverage attained. Haul roads, the centerline of each arroyo leading away from the site (to a distance of 100 meters), and identified mine-related features in the vicinity of the mine (shafts, vents, utility raises, etc.) were also scanned. Target transect spacing for vent holes was 8 meters apart. Scan data were downloaded per the Work Plan, SOP 5.12, "Download, Correction, and Export of GPS Survey Data", and were subsequently mapped with commercially available GIS software (Blue Marble, 2014).

3.1.1 Exposure Rate Cross-calibration

The NaI detectors used for the gamma surveys described above have energy-dependent response characteristics and cannot directly measure the gamma exposure rate in air, defined as the amount of electrostatic charge created per unit time in a defined volume of air due to ionizations, and commonly expressed in units of micro-Roentgen per hour (μR/hr). Knowledge of exposure rate allows estimation of 1) external radiation dose to humans, and 2) calibration of instrument response against a common basis of measure to allow valid comparisons of site data with other sites and/or data from different instruments (Whicker and Chambers, 2015). Because NaI detectors provide a relative measure of photon flux density, these measurements can be calibrated to provide accurate estimates of the true exposure rate based on the site-specific statistical relationship between measured count rate with the NaI detector and measurements of true exposure rate performed with an energy-independent High Pressurized Ion Chamber (HPIC). The HPIC directly measures ionizations in a pressurized gas (usually argon) with an ionization potential similar to that of air.

Cross-calibration of NaI readings against the HPIC was performed in accordance with the Phase 1 Work Plan (ERG, 2014). Because gamma readings in each of the two background areas are statistically different from one another (T-test p-value < 0.001), it is assumed that the local background for Black Jack 1 is characteristically different than that for the other three "western" mine Sites. Ten representative NaI/HPIC measurement pairs were collected at select locations representative of each mine region [i.e. the eastern mine region (Black Jack 1 and vicinity) and the western mines region (Black Jack 2 and Mac 1 and 2 Mines)]. Locations (Figure 3) were selected to range from the local background count rate to the upper range of count rates measured across impacted areas.

Linear regressions for paired NaI/HPIC data each of the two mine regions (eastern and western) were statistically compared with analysis of covariance (ANCOVA) testing. Slopes were not statistically different at the 95% confidence level (p-value = 0.4), but the intercept was (p-value = 0.01). The difference in intercepts was due to a single anomalous and statistically influential measurement pairing collected at Black Jack 1 (cross-calibration location BJ1-8). Omission of this single data point from the cross-calibration data set results in statistically equivalent (coincident) regression lines, meaning that the NaI/HPIC relationship does not vary by mine region location. For this reason, the data sets were combined (minus the data point for location BJ1-8) to create a single final cross-calibration relationship as shown in Figure 4. This relationship was used to convert all gamma survey data (cpm) into predicted exposure rates (μR/hr). All gamma survey data presented/mapped in this report represent estimated true exposure rates as

calibrated against the HPIC.[4] A correlation between gamma exposure rate and Ra-226 concentrations in soil will be developed in Phase 3 per the Phase 1 Work Plan (ERG, 2014).

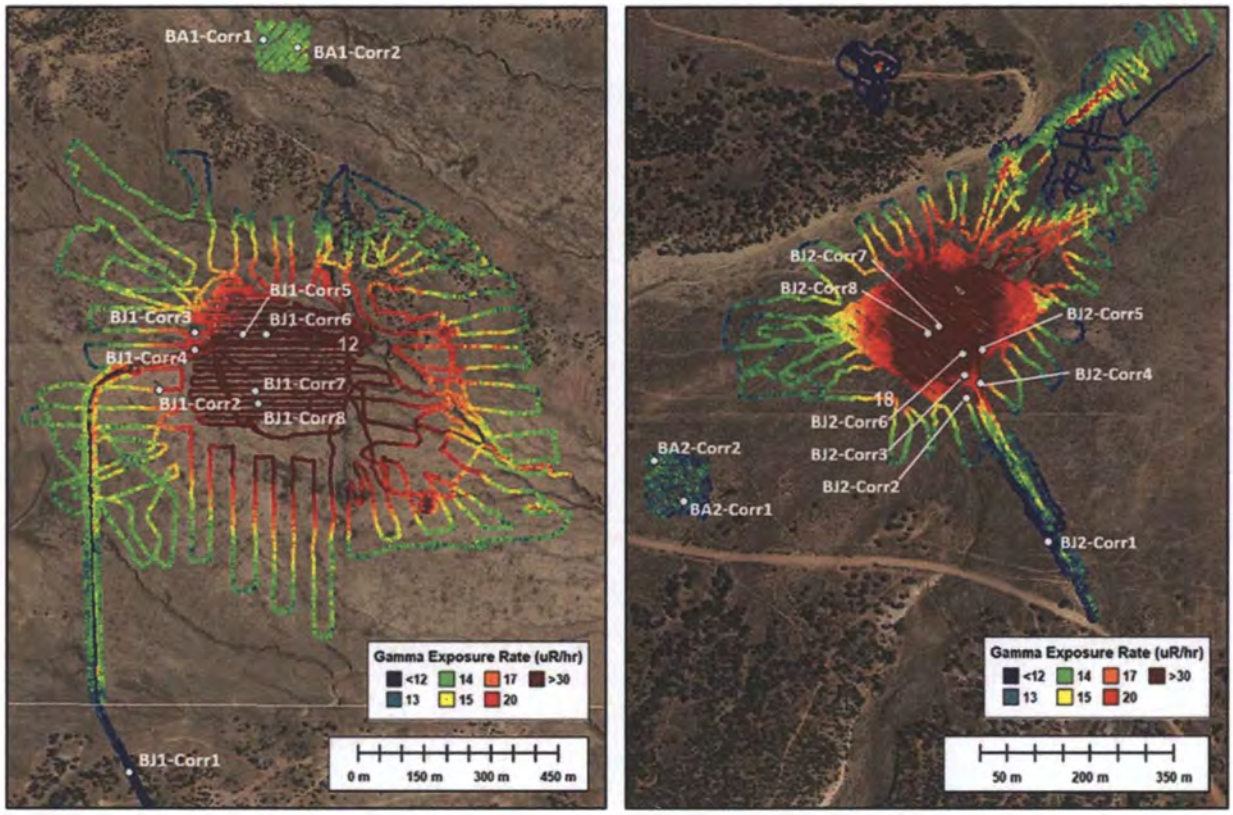


Figure 3: Locations of instrument cross-calibration locations to develop the linear regression used to convert raw gamma survey count rate data (CPM) into units of exposure rate (µR/hr), including 10 locations at the Black Jack No. 1 Mine Site and BA1 (left), and 10 at the Black Jack No. 2 Mine Site and BA2 (right).

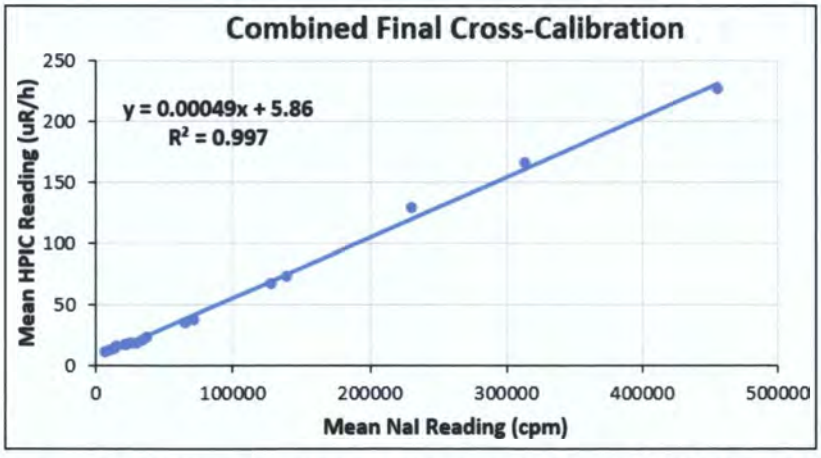


Figure 4: Final cross-calibration equation used to convert NaI readings to predicted exposure rates across the Black Jack and Mac mine Sites.

[4] To convert any reported gamma exposure rate value (µR/hr) presented in this report into an equivalent count rate reading (cpm), the following equation may be used: **Count Rate (cpm) = [(µR/hr) – 5.86]/0.00049**

3.2 Background Area Soil Sampling

Potential contaminants of concern (PCOC) identified in the SOW for these Sites are naturally occurring and ubiquitous at low levels in background geologic materials, including inorganic components of associated soils. For this reason, the Phase 1 Work Plan calls for background soil sampling to assess the magnitude and variability of these constituents in native soils at the Sites. This information was used to evaluate the areal extent of contamination (levels in excess of local background), and will also be used to estimate the vertical extent (to be evaluated in the Phase 3 SOW).

Representative background reference areas were selected based on locations situated upwind and hydrologically upgradient relative to nearby mine Sites, and where the background area has geology and soil types in common with applicable mine Sites as indicated in the Phase 1 Work Plan (ERG, 2014). Two separate background areas were sampled, including Background Area 1 (BA1) to represent background conditions at the Black Jack No. 1 Site, and Background Area 2 (BA2) to represent background conditions at the other three mine Sites (collectively referred to as the "Western Mine Sites" region). Background soil samples were collected per SOP 2.22, "Surface and Shallow Subsurface Soil Sampling" as provided in the Phase 1 Work Plan.

Sampling of soil within each Background Area included collection of surface samples (0-15 cm depth) and shallow subsurface samples (15-60 cm) at 10 representative locations (for a total of 20 locations across BA-1 and BA-2). Soil samples were collected with a hand auger, and the bulk sample collected was manually homogenized in the field inside of a plastic tub prior to being placed in labeled plastic baggies (Figure 5). Two locations, one in each of the two Background Areas, included collection of a field duplicate per the Phase 1 Work Plan.

Figure 5: Photos of the soil sampling process at Background Area 1 (near Black Jack No. 1 Mine).

In addition to soil sampling, "downhole" gamma radiation measurements were taken within each soil sampling borehole with a 2" x 2" NaI detector positioned with the NaI crystal approximately centered at soil depths of 0, 30 and 60 cm. Individual gamma readings were manually recorded in the field logbook for subsequent use in the Phase 3 investigation of the vertical extent of soil impacts.

Background soil samples were subsequently analyzed at an approved analytical laboratory (Energy Laboratories Inc., Casper, Wyoming) for the following constituents:

- Ra-226
- Ac-228
- K-40
- Selenium
- Molybdenum
- Uranium
- Arsenic
- Vanadium

Laboratory analysis of the above soil constituents was performed in accordance with the analytical methods specified in Table 2 of the Phase 1 Work Plan. Two of the above analytes, Ac-228 and K-40, were not required by the SOW, but were included in the Phase 1 Work Plan for potential diagnostic purposes with respect to gamma readings in relation to Ra-226 levels. Ac-228 results were considered an equivalent measure of Th-232 concentrations based on an assumption of secular radiological equilibrium. Energy Laboratories Inc. (ELI) is accredited by the National Environmental Laboratory Accreditation Council (NELAC) and EPA Region 8.

3.3 Radon Monitoring

Short-term sampling of indoor radon gas levels in structures were collected in the two buildings at the Mac No. 1 Mine. The radon sampling test kit used was the AccuStar PicoCan Open Face Charcoal Canister, Model 400. In each building, two radon test kits from AccuStar Labs were deployed after all windows/doors had been closed for at least 12 hours (note that these deteriorating structures had some broken windows and visible holes or openings in walls, windows or doors.). The two detectors were placed side-by-side within a representative room on the lowest level of the building and on top of level surfaces found on available structures (a bench and a livestock feed trough, with the kits situated at a height of several feet above the floor) (Figure 6). The kits remained undisturbed for 48 hours prior to kit retrieval per supplied instructions on sealing and returning to AccuStar Labs for analysis.

4. RESULTS

4.1 Background Investigation

4.1.1 Background Gamma Radiation

The background radiation surveys were conducted April 20 – 22, 2015. The raw gamma data were converted to predicted exposure rate values based on cross-calibration against a HPIC as previously indicated. Respective descriptive statistics are shown in Figure 7. Both data sets appear normally distributed, and a statistical comparison (t-test) (Figure 8) indicates that background gamma exposure rates in the two Background Areas are significantly different from one another (p-value < 0.0001). However, the numerical magnitude of the difference between respective average background gamma

exposure rate values is small (≈ 1.4 µR/hr difference). The 95% upper tolerance limits (UTL) on gamma exposure rates in BA1 and BA2 (15 and 13.7 µR/hr respectively), expressed in approximately equivalent units of count rate (≈ 18,500 cpm and 16,000 cpm), were used to guide the extent of scanning in the field in order to bound the areal extent of potential "impacts" at the mine Sites.

Figure 6: Short-term radon test kits as deployed in the west building (left) and east building (right) at the Mac No. 1 Mine Site.

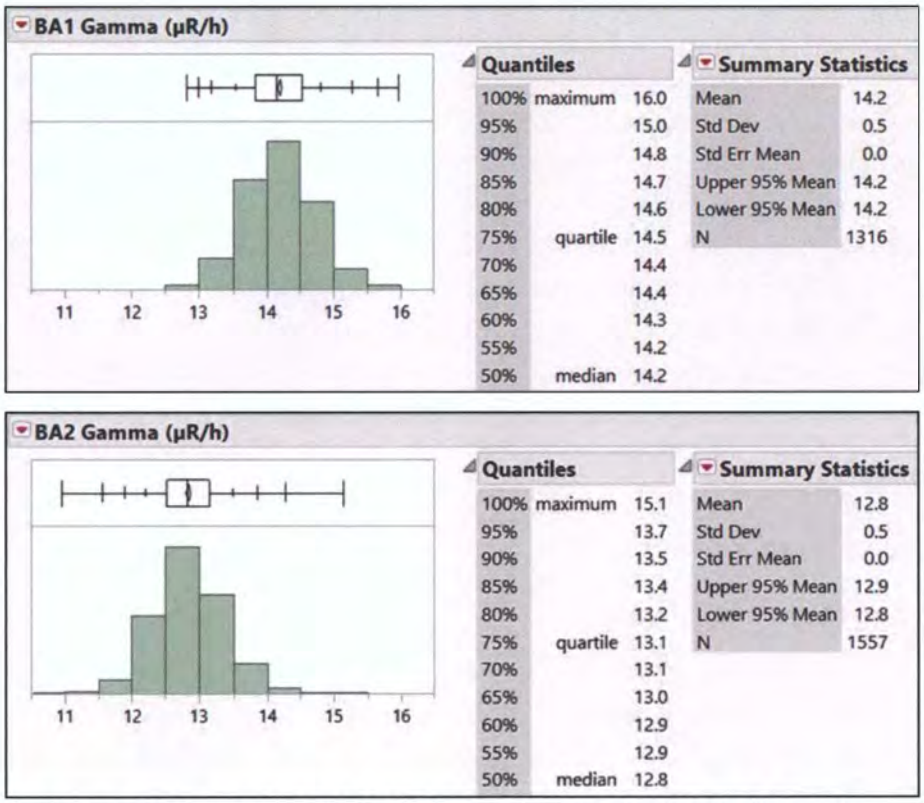


Figure 7: Gamma survey results for Background Areas 1 (top) and 2 (bottom).

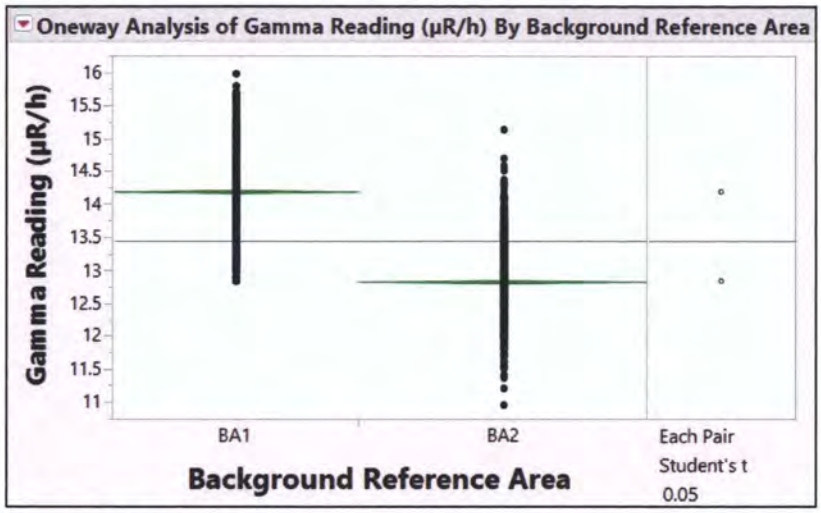


Figure 8: Statistical comparison of average gamma readings in Background Areas 1 and 2.

4.1.2 Background Soil Properties

A summary of analytical results for analytes specified in the Phase 1 Work Plan for soil samples collected in Background Areas 1 and 2 is provided in Table 1. Detailed data results are compiled in Appendix A (Attachment A1) and official Level IV laboratory data reports are provided in Appendix B (Attachment B1). Results for radiological constituents are consistent with typical naturally occurring levels in soil across the U.S. (NCRP, 1987; Myrick et al., 1983). Results for metals are also consistent with typical ranges of concentrations reported for soils in the U.S. (USGS, 1984).

Table 1: Summary statistics for analyte concentrations in soil at Background Areas 1 and 2.

Analyte	Depth (cm)	Background Area 1					Background Area 2				
		Mean	S.D.	Median	Min	Max	Mean	S.D.	Median	Min	Max
Uranium (mg/kg)	0-15	1.3	0.2	1.5	1.2	1.8	0.9	0.2	1.0	0.5	1.1
	15-60	1.3	0.2	1.4	1.2	1.7	0.9	0.2	0.9	0.5	1.2
Uranium (pCi/g)*	0-15	0.9	0.1	1.0	0.8	1.2	0.6	0.1	0.7	0.3	0.7
	15-60	0.9	0.1	0.9	0.8	1.2	0.6	0.1	0.6	0.3	0.8
Ra-226 (pCi/g)	0-15	1.1	0.2	1.3	0.9	1.5	0.9	0.2	1.0	0.7	1.2
	15-60	1.1	0.3	1.1	0.8	1.8	0.8	0.2	0.9	0.6	1.2
Ac-228 (pCi/g)	0-15	1.8	0.8	2.1	0.6	3.0	1.3	0.6	1.4	0.0	2.2
	15-60	1.9	0.6	1.9	1.5	2.9	1.3	0.9	1.5	0.0	2.5
K-40 (pCi/g)	0-15	19.5	3.4	22.6	13.9	24.9	13.7	2.6	15.5	10.7	18.6
	15-60	18.1	2.3	20.2	16.0	23.7	14.8	1.8	16.7	13.1	19.6
Molybdenum (mg/kg)	0-15	0.4	0.05	0.4	0.4	0.5	0.3	0.06	0.3	0.2	0.4
	15-60	0.4	0.04	0.4	0.4	0.5	0.3	0.1	0.3	0.2	0.7
Vanadium (mg/kg)	0-15	17.9	6.1	21.2	3.8	26.4	13.1	1.9	14.8	9.7	16.8
	15-60	19.8	2.1	22.7	18.4	24.2	13.9	2.3	15.4	10.7	17.9
Selenium (mg/kg)	0-15	0.6	0.1	0.7	0.6	0.7	0.3	0.1	0.4	0.3	0.4
	15-60	0.7	0.1	0.7	0.6	0.8	0.4	0.1	0.4	0.3	0.8
Arsenic (mg/kg)	0-15	5.9	0.7	6.5	5.2	7.7	2.9	0.4	3.3	2.3	4.0
	15-60	6.0	0.4	6.6	6.0	7.1	3.3	0.7	3.7	2.2	4.8
Moisture (%)	0-15	11.6	2.5	13.2	8.4	16.6	4.1	0.8	4.4	3.1	5.8
	15-60	13.6	1.6	14.4	13.2	18.1	6.3	0.9	6.8	5.3	8.2

*Calculated based on a conversion factor of 0.677 pCi/g per mg/kg.

Background concentrations of specified analytes in soil within each reference area generally appear to follow approximately normal (Gaussian) data distributions, and statistical T-tests indicate that average concentrations for each constituent at BA1 are statistically higher (p-values < 0.05) than at BA2 (Figure 9). T-testing also revealed no statistically significant differences in concentrations between surface (0-15 cm) and subsurface (15-60 cm) soils at either Background Area (p-values > 0.05). Background concentrations of these analytes in subsurface soils are also statistically higher at BA1 versus BA2 (p-values < 0.05), with the exception of molybdenum (p-value = 0.8). Assuming that deposition of mine-related materials at the ground surface was the primary mechanism for impacts to soils at the mine Sites, the lack of statistical differences in analyte concentrations between surface and subsurface soils at either Background Area suggests that mine-related soil contamination is not present at either Background Area.

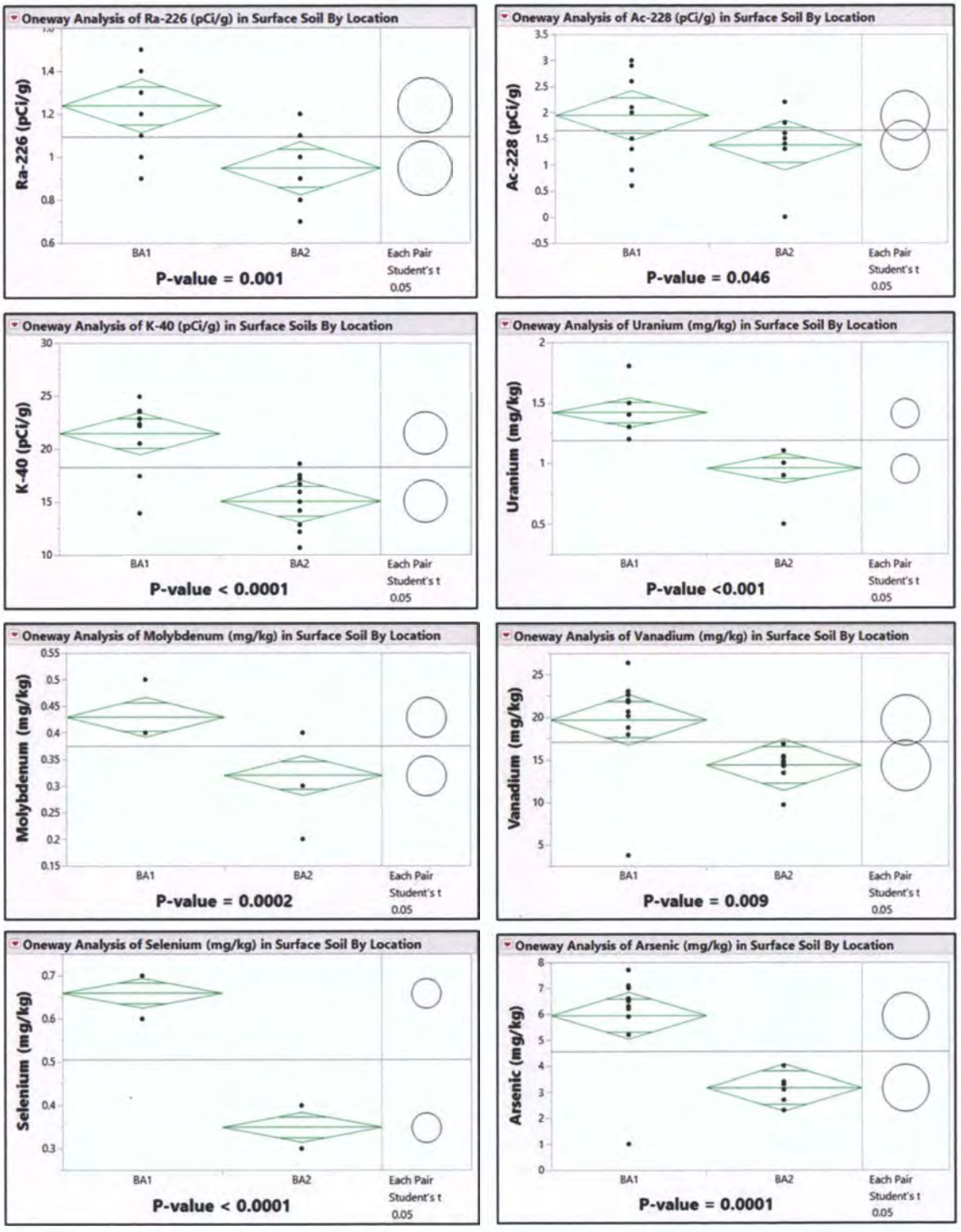


Figure 9: Statistical comparisons of average analyte concentrations in surface soil within Background Areas 1 and 2.

4.2 Gamma Radiation at Black Jack No. 1 Mine

Gamma radiation exposure rates in the vicinity of the Black Jack No. 1 Mine and adjacent Background Area (BA1) are shown in Figure 10. These data are based on measured count rates (cpm) and conversion to exposure rate (µR/hr) using the cross-calibration equation provided in Figure 4. The converted data were mapped with an interpolated color format for values falling between the discrete legend values as indicated in the legend. Summary statistics for the Black Jack No. 1 Mine are also shown in Figure 10. An example of the data in Figure 10, shown in energy-dependent units of cpm, is provided in Attachment A6.

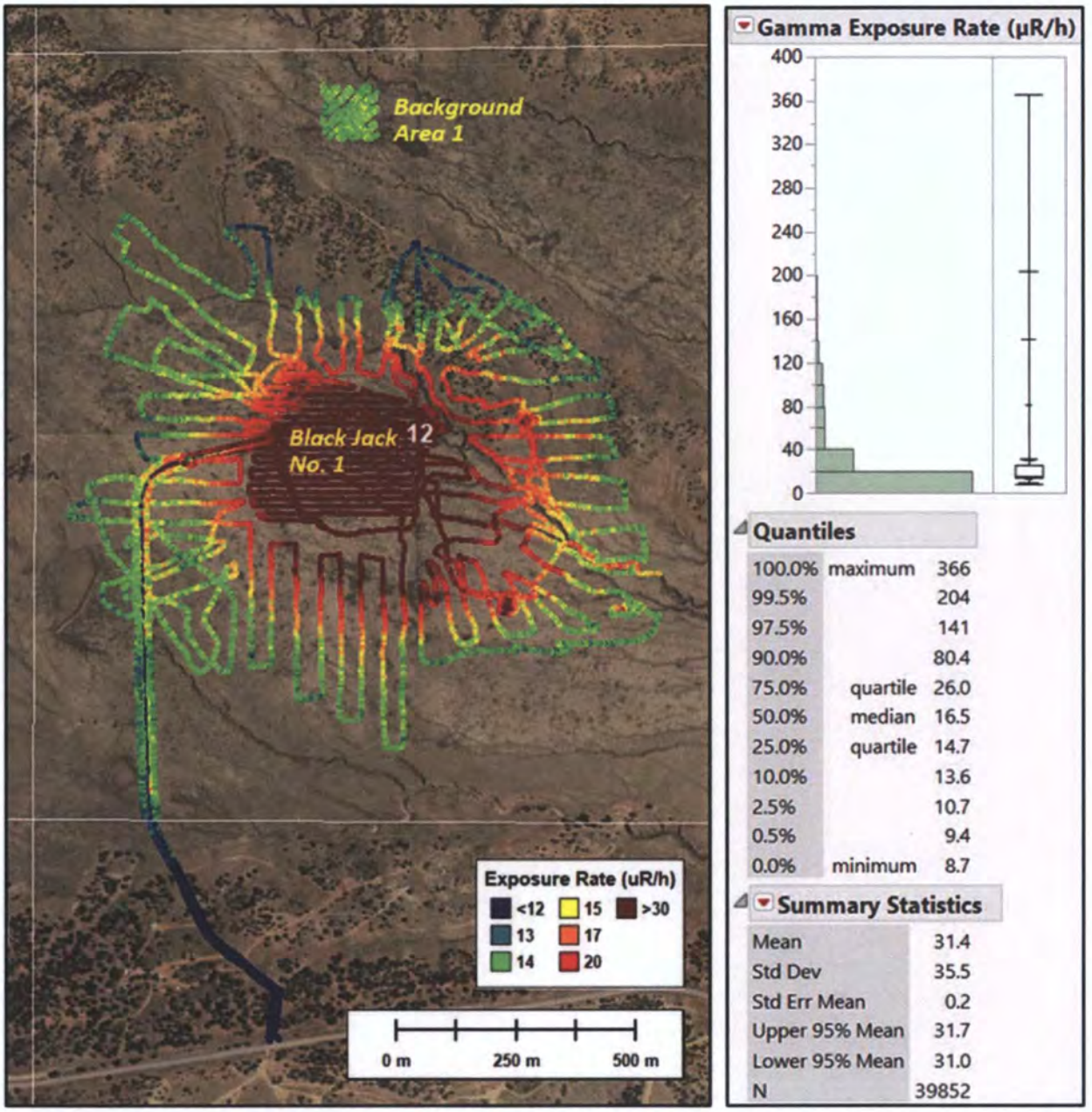


Figure 10: Gamma Exposure Rates at Black Jack 1 and BA1 (left) and summary statistics for Black Jack 1 (right).

Based on the gamma survey data shown in Figure 10, along with the upper 95% tolerance interval on background gamma radiation readings in BA1 (15 µR/hr), the estimated total areal extent of surface soils in the vicinity of the Black Jack No. 1 Mine that consistently exceeds background gamma radiation levels is 159 acres (Figure 11). Surface soils within this area are assumed to have been impacted by historic mining activities at the Black Jack No. 1 Mine Site. Near the boundaries of this delineated area, this assumption sometimes has greater uncertainty because readings that exceed background tend to be intermittent.

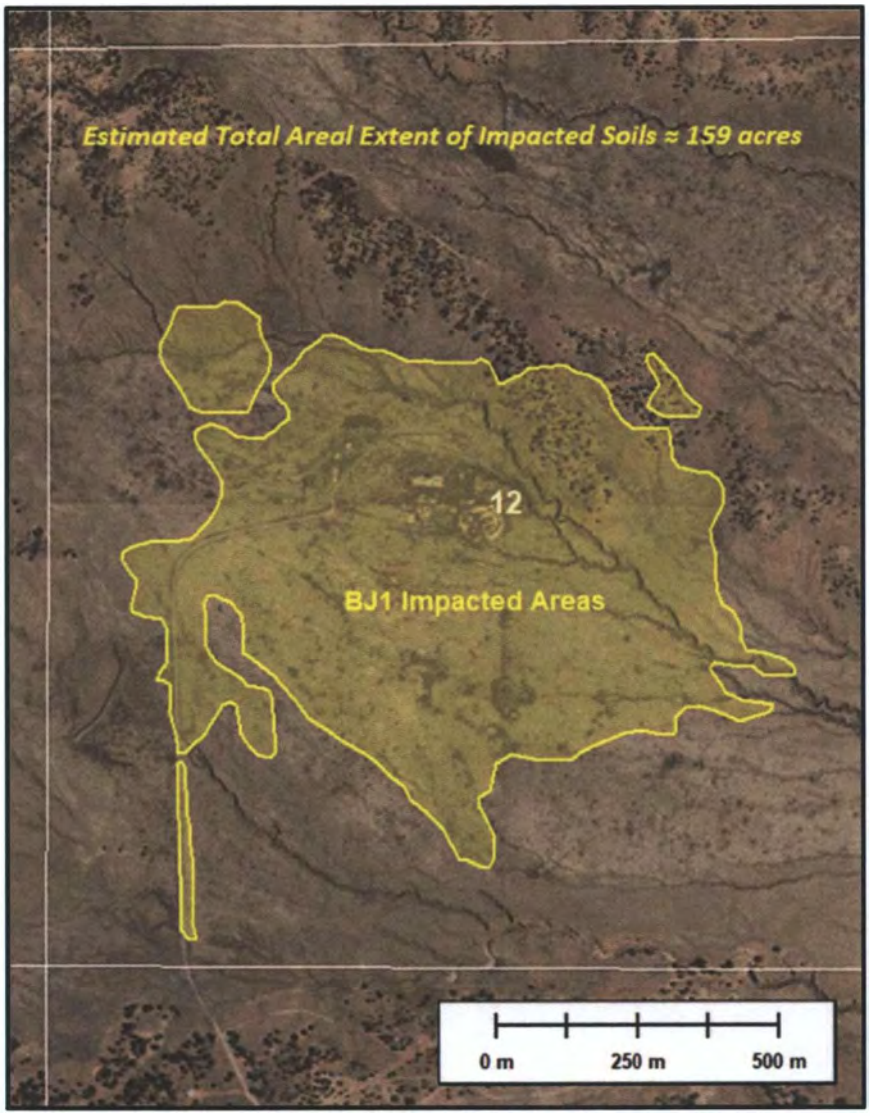


Figure 11: Estimated areal extent of mine-related impacts to surface soils in the vicinity of the Black Jack No. 1 Mine Site.

4.3 Gamma Radiation at Black Jack No. 2 Mine

Gamma radiation exposure rates in the vicinity of the Black Jack No. 2 Mine and adjacent Background Area (BA2) are shown in Figure 12. These data are based on measured count rates (cpm) and conversion to exposure rate (µR/hr) using the cross-calibration equation provided in Figure 4. The converted data were mapped with an interpolated color format for values falling between the discrete legend values as indicated in the legend. Summary statistics for the Black Jack No. 2 Mine are also shown in Figure 12.

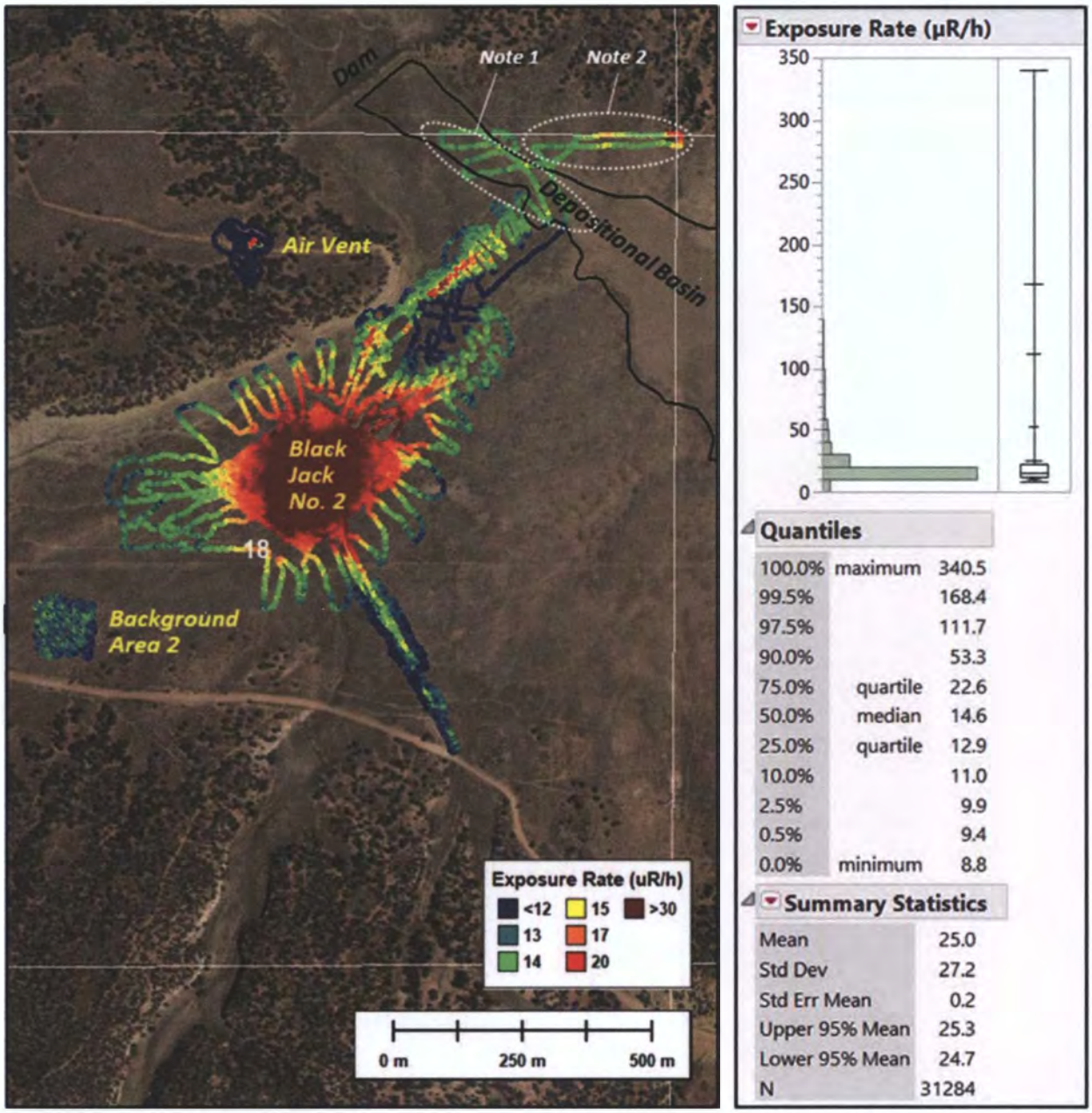


Figure 12: Gamma Exposure Rates at Black Jack 2 and BA2 (left) and summary statistics for Black Jack 2 (right). Annotated areas labeled "Notes 1 and 2" are discussed later in this Section of the Phase 1 Summary Report.

Based on the gamma survey data shown in Figure 12, along with the upper 95% tolerance interval on background gamma radiation readings in BA2 (13.7 µR/hr), the estimated total areal extent of surface soils in the vicinity of the Black Jack No. 2 Mine that consistently exceeds local background gamma radiation levels is 65 acres (Figure 13). Surface soils within this area are assumed to have been impacted by historic mining activities at the Black Jack No. 2 Mine Site. Near the boundaries of this delineated area, this assumption sometimes has greater uncertainty because readings that exceed background tend to be intermittent. In addition, there are two related areas of significance that are delineated in Figure 12 as Notes 1 and 2. These special survey notes are discussed further below.

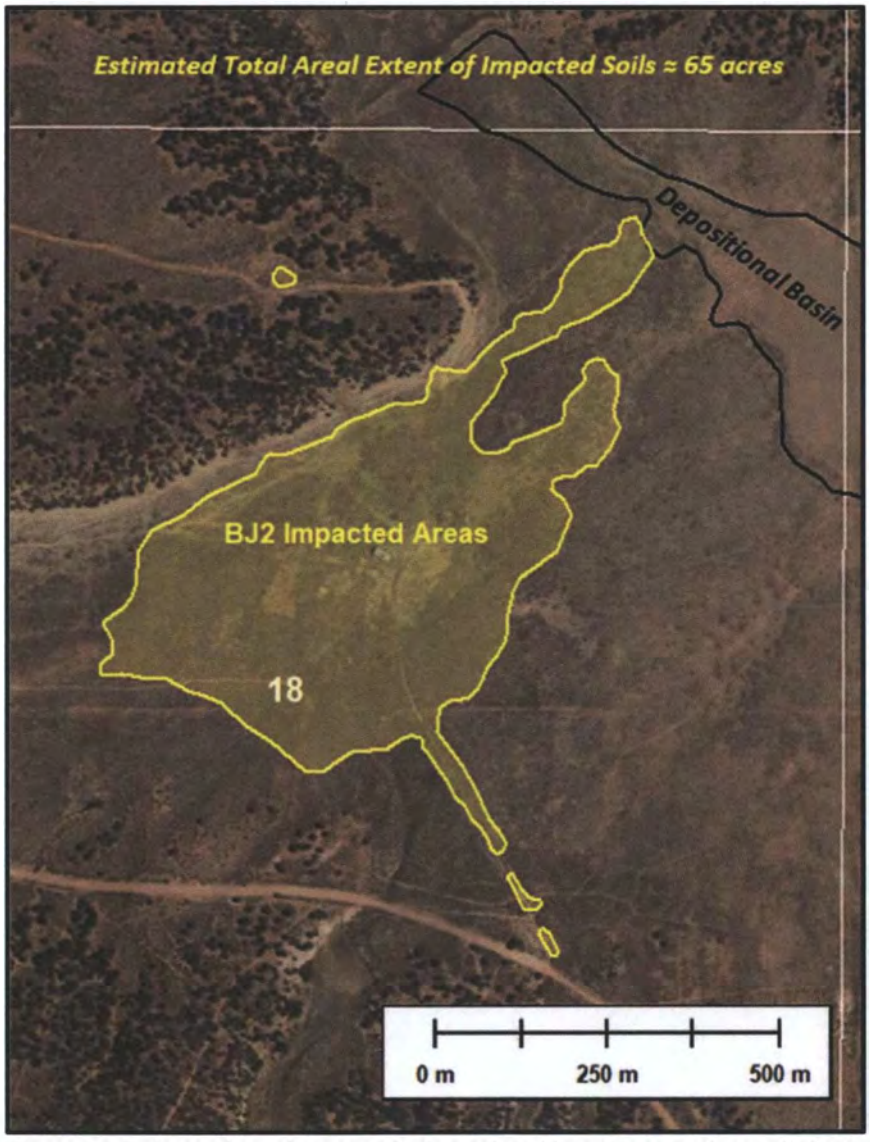


Figure 13: Estimated areal extent of mine-related impacts to surface soils in the vicinity of the Black Jack No. 2 Mine Site.

Note 1 (from Figure 8): During the gamma survey at Black Jack No. 2, field personnel attempted to bound elevated gamma readings along a drainage to the northeast of the Site that terminates in a naturally occurring depositional basin on the floor of the valley in this area (Figure 12). This basin is identified by the U.S. Geological Survey (USGS) as upper Holocene alluvial deposits, representing more than a century of local arroyo cutting (USGS, 1990). This depositional basin appears anthropogenically influenced in the vicinity of a nearby dam and ephemeral reservoir, presumably constructed for livestock watering purposes (Figure 12). When surveyor's reached this basin, gamma readings became relatively uniform at levels slightly in excess of the upper 95% tolerance interval on background gamma radiation readings in BA2 (13.7 µR/hr). These gamma emissions appear to be naturally characteristic of sediments accumulated within the basin.

Note 2 (from Figure 8): Unaware of the geologic features described in Note 1, or of their potential significance with respect to survey objectives, field personnel followed gamma readings slightly in excess of local "background" (BA2) to the northeast of the Black Jack No. 1 Mine and continued the survey onto the lower slopes of the opposite side of the valley. This scanning covered limited upgradient areas, terminating along a fenceline representing the northeast corner of Section 18 (Figure 12). Gamma readings in the northeast corner of Section 18 increased over several small, localized areas. These preliminary gamma survey data were reviewed by EPA, and on May 3, 2017, representatives of HMC, EPA and Navajo Nation EPA (NNEPA) conducted a joint field visit to investigate elevated readings in this area. It was discovered that the elevated readings are naturally occurring, the result of arroyo cutting down to local bedrock comprised of sandstone with gamma radiation emissions in excess of 40 µR/hr on contact (Figure 14).

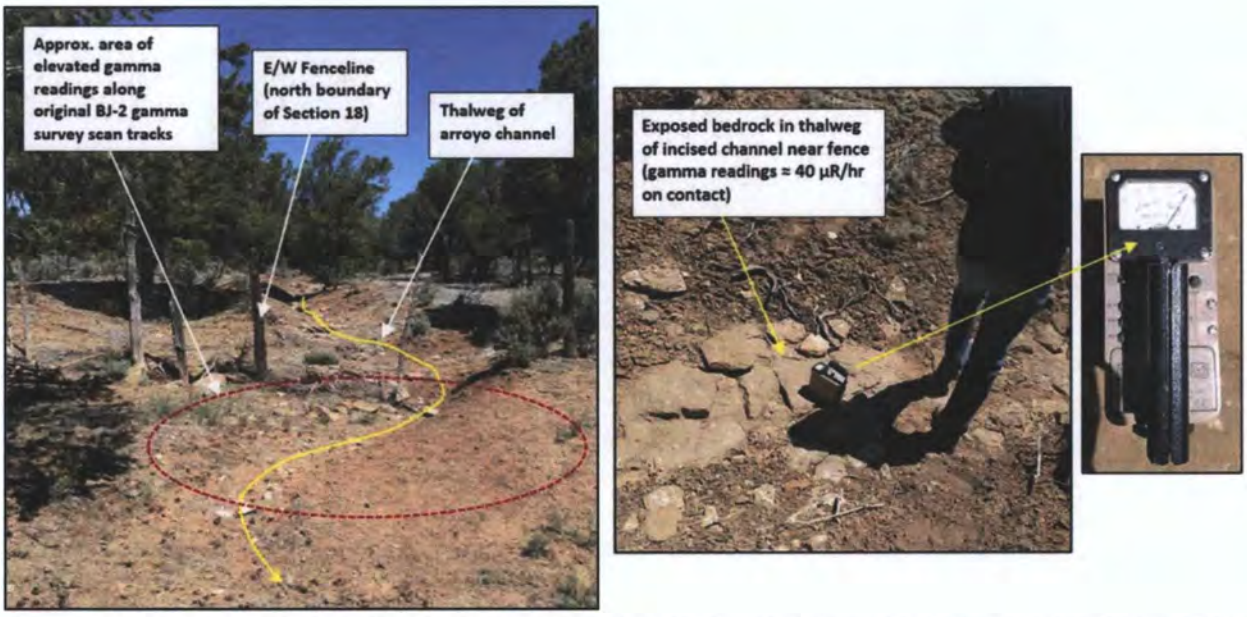
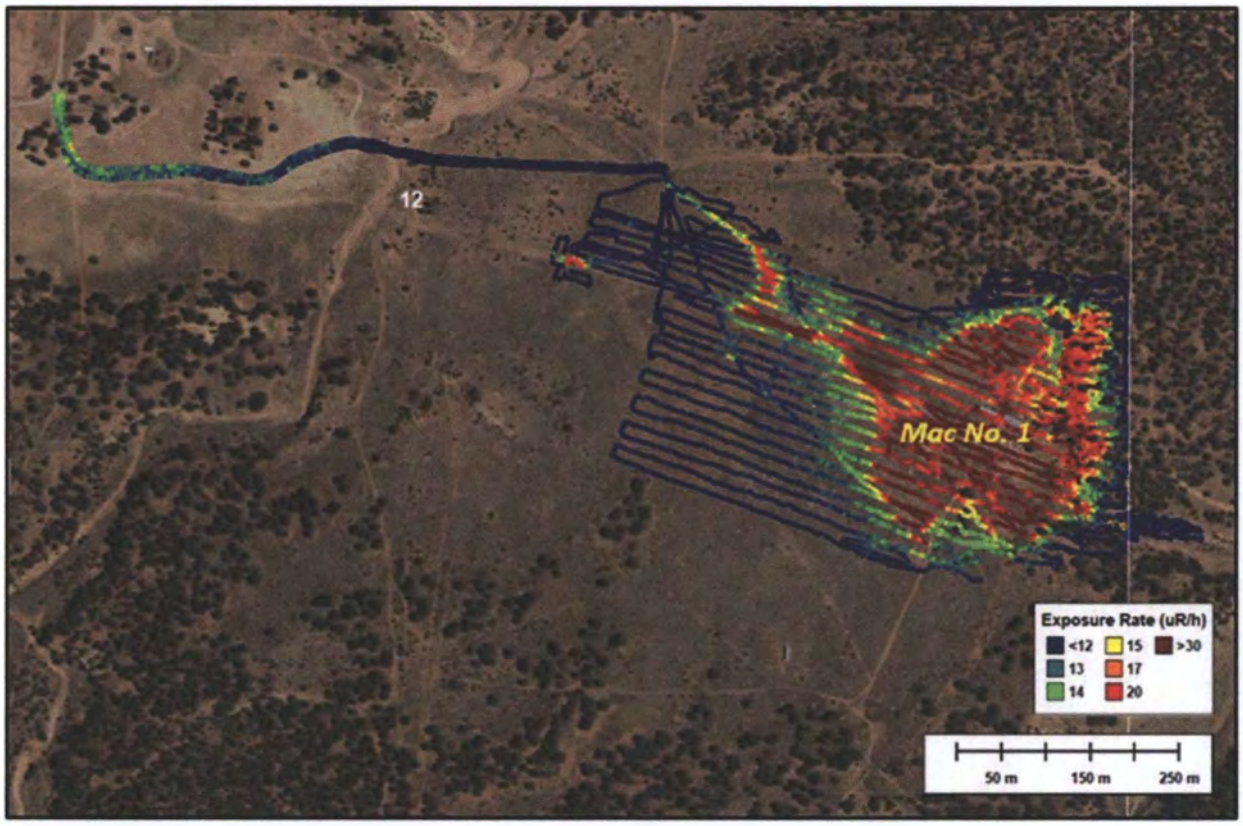


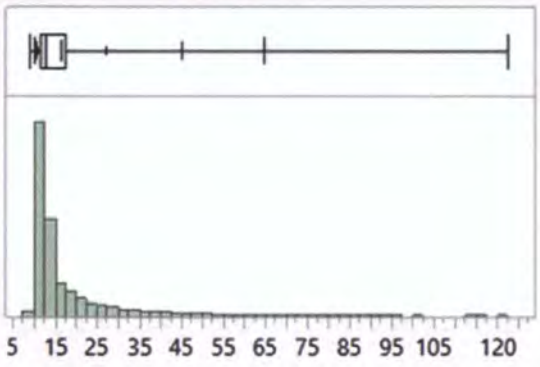
Figure 14: Photo diagrams of geologic features responsible for elevated gamma radiation readings found on the opposite side of the valley from the Black Jack No. 2 Mine, an area situated on an upgradient hillside in the northeast corner of Section 18.

4.4 Gamma Radiation at Mac No. 1 Mine

Gamma radiation exposure rates in the vicinity of the Mac No. 1 Mine are shown in Figure 15. These data are based on measured count rates (cpm) and conversion to exposure rate (µR/hr) using the cross calibration equation provided in Figure 4. The converted data are mapped with an interpolated color format for values falling between the discrete legend values as indicated in the legend. Summary statistics for the Mac No. 1 Mine are also shown in Figure 15.



Exposure Rate (µR/h)



Quantiles		
100.0%	maximum	122.3
99.5%		64.8
97.5%		45.0
90.0%		27.3
75.0%	quartile	17.1
50.0%	median	12.7
25.0%	quartile	11.6
10.0%		10.9
2.5%		10.3
0.5%		9.9
0.0%	minimum	9.3

Summary Statistics	
Mean	16.5
Std Dev	9.4
Std Err Mean	0.1
Upper 95% Mean	16.6
Lower 95% Mean	16.3
N	22461

Figure 15: Gamma Exposure Rates at Mac No. 1 Mine (top) and corresponding summary statistics (bottom).

Based on the gamma survey data shown in Figure 15, along with the upper 95% tolerance interval on background gamma radiation readings in BA2 (13.7 µR/hr), the estimated total areal extent of surface soils in the vicinity of the Mac No. 1 Mine that consistently exceeds local background gamma radiation levels is 22 acres (Figure 16). Surface soils within this area are assumed to have been impacted by historic mining activities at the Mac No. 1 Mine Site. Near the boundaries of this delineated area, this assumption sometimes has greater uncertainty because readings that exceed background tend to be intermittent.

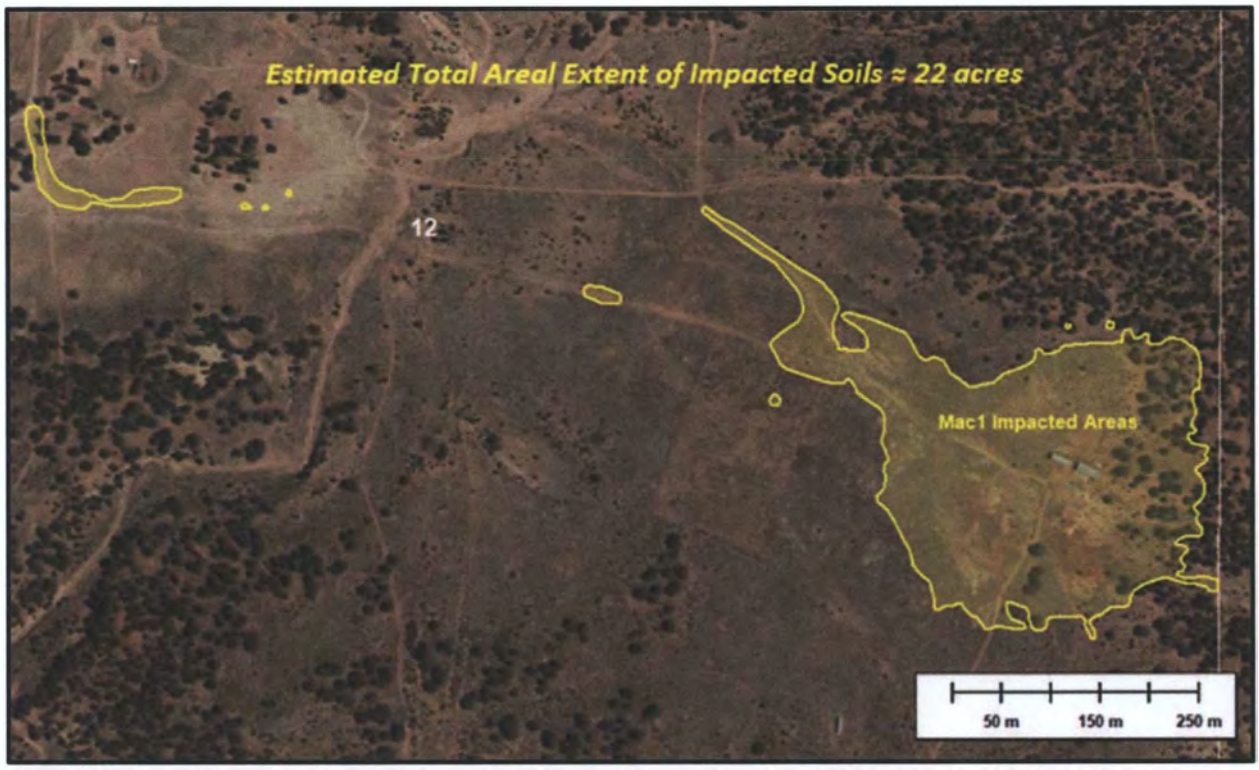


Figure 16: Estimated areal extent of mine-related impacts to surface soils in the vicinity of the Mac No. 1 Mine Site.

4.5 Gamma Radiation at Mac No. 2 Mine

Gamma radiation exposure rates in the vicinity of the Mac No. 2 Mine are shown in Figure 17. These data are based on measured count rates (cpm) and conversion to exposure rate (µR/hr) using the cross calibration equation provided in Figure 4. The converted data are mapped with an interpolated color format for values falling between the discrete legend values as indicated in the legend. Summary statistics for the Mac No. 2 Mine are also shown in Figure 17.

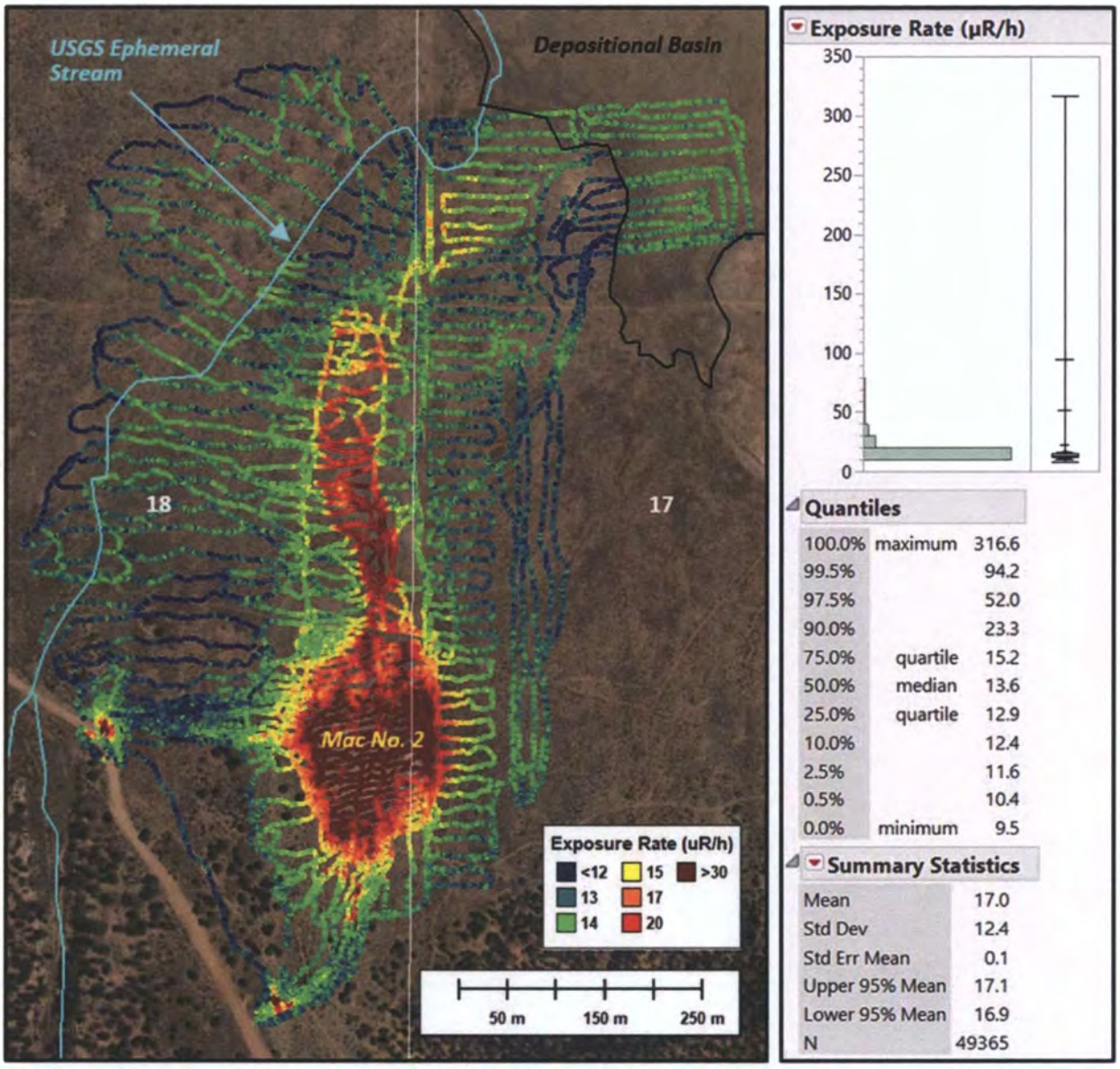


Figure 17: Gamma Exposure Rates at Mac No. 2 Mine (left) and corresponding summary statistics (right).

Based on the gamma survey data shown in Figure 17, along with the upper 95% tolerance interval on background gamma radiation readings in BA2 (13.7 µR/hr), the estimated total areal extent of surface soils in the vicinity of the Mac No. 2 Mine that consistently exceeds local background gamma radiation levels is 42 acres (Figure 18). Surface soils within this area are assumed to have been impacted by historic mining activities at the Mac No. 2 Mine Site. Although intermittent readings slightly greater than assumed background (i.e. > 13.7 µR/hr) are relatively pervasive to north and west of clearly impacted areas (Figure 17), this area appears hydrologically separated from those impacted areas, and lies near a historic ephemeral stream channel and zone of deposition potentially comprised of material with radiological properties similar to that found in the depositional basin as shown in Figures 12 and 13, and as discussed in Section 4.3 of this Report.

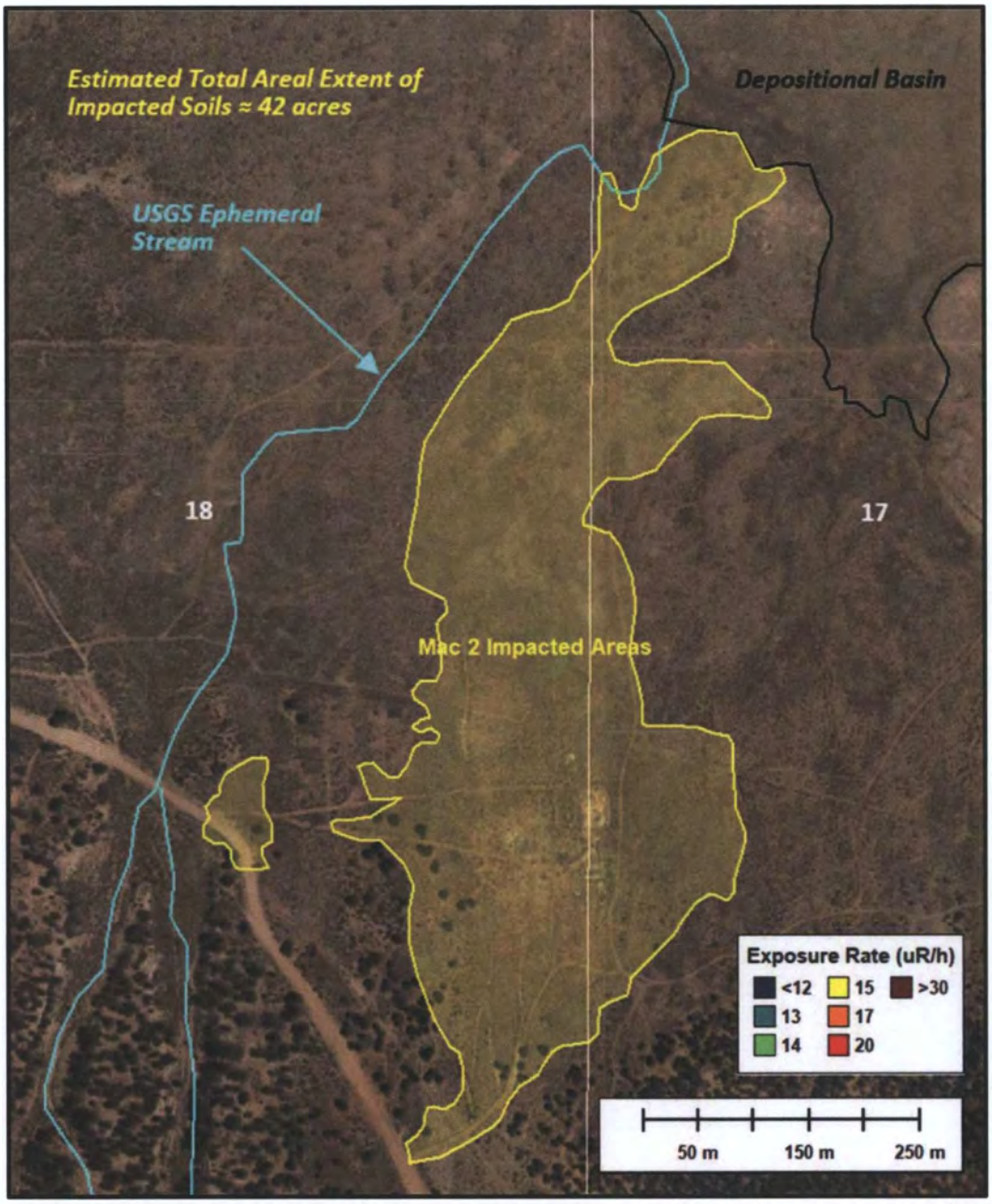


Figure 18: Estimated areal extent of mine-related impacts to surface soils in the vicinity of the Mac No. 2 Mine Site.

The consistent step-change in gamma readings at the boundary of the depositional basin in the northwest portion of Figure 17, including areas hydrologically upgradient of the confluence between mine-impacted material and the valley floor, is indicative of sediments with slightly higher natural gamma radiation emissions relative to surface soil in background reference area BA2. For this reasons, intermittent gamma readings slightly in excess of 13.7 µR/hr in this area are unlikely to be associated with mine impacts and were thus not included in the respective delineation provided in Figure 18.

4.6 Indoor Radon Levels in Mine Buildings

The two buildings at the Mac No. 1 Mine were found to have considerable ventilation within these deteriorating structures due to broken windows, visible holes or openings in walls, windows or doors. Nevertheless, radon monitoring was conducted per the Phase 1 Work Plan as described in Section 3.3. Radon levels inside of these structures were consistent with typical outdoor background levels. Specifically, average results for the west and east buildings at Mac No. 1 Mine were 1.1 pCi/L and 0.8 pCi/L respectively. Data reports are provided in Appendix A (Attachment A2).

5. QUALITY ASSURANCE / QUALITY CONTROL

Quality assurance and quality control (QA/QC) protocols were observed throughout the Phase 1 investigation to meet the data objectives outlined in Section 3.0 of the Phase 1 Work Plan (ERG, 2014). All work conducted in accordance with QA/QC specifications detailed in the Phase 1 Work Plan and associated SOPs.

5.1 Instrumentation Quality Control

Radiological instrumentation used for the gamma surveys detailed in this report were calibrated at least 1 year prior to use in the field. Calibration was in accordance SOP 1.01 (Calibration of Scaler, Ratemeter) as provided in the Phase 1 Work Plan. Calibration certificates are provided in Appendix A (Attachment A3). Ratemeter/scalers were each paired with a specific detector for calibration, and these pairings were maintained for use in the field in accordance with SOP 1.04 (High Energy Gamma Scintillation Detection and Checkout). Because detector response can vary among calibrated instruments, all detectors used for gamma scanning in the field were comparatively evaluated prior to deployment to verify approximate equivalency of readings. Proper instrument performance in the field was verified daily in accordance with the Phase 1 Work Plan, SOP 1.30 (Function Check of Equipment). Daily function check forms are provided in Appendix A (Attachment A4). The set-up and use of the HPIC was performed in accordance with SOP 1.13 (Setup and Operation of RSS-131 HPIC). Operation of GPS instruments was performed per SOP 5.11 (Setup and Operation of Trimble ProXRS GPS Receiver with Trimble TSCe Datalogger).

5.2 Sample Control and Documentation

Soil and radon samples collected in the Phase 1 investigation were handled per the Work Plan, SOP 2.15 (Sample Control and Documentation). Sample ID's follow the nomenclature format found in Section 3.5.3 of the Work Plan. Field documentation including data sheets and logbook notes for each sample Appendix A (Attachment A4) were completed at the time of sample collection or field measurements. Documentation of the field work will be retained by ERG per SOP 4.10 (Technical Quality Control).

5.3 Soil Sampling Data Validation

Analytical laboratory results for soil samples from the Background Areas (BA1 and BA2) were reviewed in accordance with SOP 4.12 (Data Validation). Fully-documented (Level IV) data packages were issued by the laboratory (ELI) to include raw data for all analyses and electronic data deliverables (EDDs) for each work order (in the form of MS Excel files). The EDDs were reviewed to verify that the QA/QC requirements

specified in SOP 4.12 were met. Aside from one instance of a suspect analytical result for Ac-228 in surface soil at Location BA2-10 (0 pCi/g), and a clearly erroneous corresponding counting precision value (± 583 pCi/g), all other laboratory data were verified/validated and are considered usable for Phase 1 evaluation objectives under the SOW. Data validation check sheets are provided in Appendix A (Attachment 5). These data have been uploaded into an MS Access database in accordance with SOP 4.12 (Data Validation) and the Data Management Plan (Appendix B of the Phase 1 Work Plan).

6. CONCLUSIONS

Radiological investigations were conducted between April 2015 and early May 2017 across four abandoned uranium mines (Black Jack Mines Nos. 1 and 2, and Mac Mines Nos. 1 and 2) on the Navajo Nation in the vicinity of the Smith Lake and Mariano Lake areas of McKinley County, NM. These investigations included gamma surveys, Background Area soil sampling, and indoor radon gas measurements inside of two historical mine buildings at the Mac No. 1 mine.

Terrestrial background gamma radiation and associated radionuclide concentrations in soil, along with concentrations of select metals, at the two Background Area locations (BA1 and BA2) are in the range of typical background levels for most soils. The levels of all of these soil parameters are slightly higher at BA1 (near Black Jack No. 1 mine) versus BA2 (near the three other three Sites in the "western mines region").

The areal extent of mine-related impacts to soil at each mine Site, based on gamma radiation exposure rates in excess of locally representative background levels (consistently exceeding the upper 95% tolerance interval on local background readings), are as follows:

Mine Site	Estimated Areal Extent of Impacted Soils
Black Jack No. 1	159 acres
Black Jack No. 2	65 acres
Mac No. 1	22 acres
Mac No. 2	42 acres

The vertical extent of mine-related impacts to soil at each Site will be investigated and characterized in Phase 3 of the SOW as specified in the AOC.

Ambient indoor radon concentration in air inside of the two historic mine buildings at Mac No. 1 are in the range of typical outdoor background levels (≈ 1 pCi/L).

7. REFERENCES

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APPENDIX A

Attachment A1: Background Soil Sampling Data

Laboratory Analysis Results for Background Area 1 Soil Samples

Sample ID	Location	Depth (cm)	Ra-226 (pCi/g)			Ac-228 (pCi/g)			K-40 (pCi/g)			Uranium (mg/kg)		Molybdenum (mg/kg)		Vanadium (mg/kg)		Selenium (mg/kg)		Arsenic (mg/kg)		Moisture (%)	
			Final Result	MDC	Precision (±)	Final Result	MDC	Precision (±)	Final Result	MDC	Precision (±)	Final Result	PQL	Final Result	PQL	Final Result	PQL	Final Result	PQL	Final Result	PQL	Final Result	PQL
BA1-01-S-0015-04202015	BA1-01	0-15	1.5	0.5	0.4	2.6	1.2	1.3	23.5	1.8	4.0	1.2	0.1	0.4	0.1	17.9	1.0	0.6	0.1	5.2	1.0	8.4	0.1
BA1-01-S-1560-04202015	BA1-01	15-60	1.1	0.5	0.4	1.6	1.4	0.5	16.0	4.2	4.2	1.3	0.1	0.4	0.1	19.5	1.0	0.7	0.1	6.4	1.0	13.2	0.1
BA1-02-S-0015-04202015	BA1-02	0-15	1.1	0.6	0.4	0.6	2.2	0.4	13.9	5.1	4.6	1.3	0.1	0.4	0.1	18.7	1.0	0.6	0.1	5.9	1.0	10.9	0.1
BA1-02-S-0560-04202015	BA1-02	15-60	1.8	0.7	0.5	2.9	1.3	0.8	18.9	2.3	4.0	1.3	0.1	0.4	0.1	23.1	1.0	0.7	0.1	6.5	1.0	17.6	0.1
BA1-03-S-0015-04202015	BA1-03	0-15	0.9	0.4	0.3	2.0	0.9	0.5	22.8	1.8	3.8	1.2	0.1	0.4	0.1	20.6	1.0	0.6	0.1	6.2	1.0	10.0	0.1
BA1-03-S-1560-04202015	BA1-03	15-60	1.0	0.6	0.4	2.5	1.3	0.7	19.6	2.0	3.8	1.3	0.1	0.4	0.1	18.4	1.0	0.7	0.1	6.1	1.0	14.1	0.1
BA1-04-S-0015-04202015	BA1-04	0-15	1.4	0.6	0.4	2.6	1.8	0.7	23.6	2.0	4.2	1.4	0.1	0.5	0.1	26.4	1.0	0.7	0.1	7.7	1.0	16.6	0.1
BA1-04-S-1560-04202015	BA1-04	15-60	1.1	0.7	0.5	1.8	1.7	0.6	21.4	2.2	4.1	1.5	0.1	0.4	0.1	22.7	1.0	0.8	0.1	6.6	1.0	18.1	0.1
BA1-05-S-0015-04202015	BA1-05	0-15	1.2	0.6	0.4	1.3	1.9	0.5	22.3	2.1	4.1	1.5	0.1	0.4	0.1	23.0	1.0	0.7	0.1	7.1	1.0	13.9	0.1
BA1-05-S-1560-04202015	BA1-05	15-60	1.1	0.7	0.5	2.8	0.6	0.6	23.7	2.1	4.3	1.5	0.1	0.4	0.1	24.2	1.0	0.8	0.1	6.9	1.0	14.3	0.1
BA1-06-S-0015-04202015	BA1-06	0-15	1.4	0.5	0.4	3.0	0.6	0.8	23.5	2.1	4.2	1.5	0.1	0.4	0.1	22.6	1.0	0.7	0.1	7.0	1.0	15.1	0.1
BA1-06-S-1560-04202015	BA1-06	15-60	1.1	0.7	0.5	1.9	1.9	0.6	22.0	2.3	4.3	1.7	0.1	0.5	0.1	23.6	1.0	0.7	0.1	7.1	1.0	14.5	0.1
BA1-07-S-0015-04202015	BA1-07	0-15	1.4	0.6	0.4	0.9	1.4	0.4	22.2	2.1	4.1	1.8	0.1	0.4	0.1	22.0	1.0	0.6	0.1	6.6	1.0	13.8	0.1
BA1-07-S-1560-04202015	BA1-07	15-60	1.4	0.6	0.5	1.5	2.3	0.6	19.3	2.0	3.8	1.7	0.1	0.4	0.1	22.6	1.0	0.8	0.1	6.9	1.0	14.0	0.1
BA1-08-S-0015-04202015	BA1-08	0-15	1.2	0.7	0.5	2.9	0.9	1.2	24.9	2.0	4.3	1.5	0.1	0.5	0.1	21.8	1.0	0.7	0.1	6.5	1.0	14.6	0.1
BA1-08-S-1560-04202015	BA1-08	15-60	0.8	0.6	0.4	1.9	0.8	0.6	20.9	2.6	4.2	1.2	0.1	0.4	0.1	18.6	1.0	0.6	0.1	6.0	1.0	15.2	0.1
BA1-09-S-0015-04202015	BA1-09	0-15	1.3	0.4	0.4	2.1	1.0	0.6	17.4	1.8	3.4	1.5	0.1	0.5	0.1	3.8	1.0	0.7	0.1	<1	1.0	12.2	0.1
BA1-09-S-1560-04202015	BA1-09	15-60	1.5	0.5	0.4	1.6	1.5	0.6	20.7	2.2	4.1	1.5	0.1	0.4	0.1	21.9	1.0	0.7	0.1	7.0	1.0	15.3	0.1
BA1-10-S-0015-04202015	BA1-10	0-15	1.0	0.6	0.4	1.5	1.2	0.5	20.5	1.9	3.8	1.3	0.1	0.4	0.1	20.1	1.0	0.7	0.1	6.3	1.0	12.5	0.1
BA1-10-S-1560-04202015	BA1-10	15-60	1.2	0.6	0.4	2.8	0.6	0.6	16.7	3.2	4.1	1.3	0.2	0.5	0.1	22.8	1.0	0.8	0.1	6.5	1.0	13.8	0.1
BA1-11-S-0015-04202015	BA1-11	0-15	1.1	0.6	0.4	2.1	1.3	0.7	15.5	5.8	5.5	1.3	0.1	0.4	0.1	21.1	1.0	0.6	0.1	6.4	1.0	11.2	0.1

Laboratory Analysis Results for Background Area 2 Soil Samples

Sample ID	Location	Depth (cm)	Ra-226 (pCi/g)			Ac-228 (pCi/g)			K-40 (pCi/g)			Uranium (mg/kg)		Molybdenum (mg/kg)		Vanadium (mg/kg)		Selenium (mg/kg)		Arsenic (mg/kg)		Moisture (%)	
			Final Result	MDC	Precision (±)	Final Result	MDC	Precision (±)	Final Result	MDC	Precision (±)	Final Result	PQL	Final Result	PQL	Final Result	PQL	Final Result	PQL	Final Result	PQL	Final Result	PQL
BA2-01-S-0015-04212015	BA2-01	0-15	1	0.4	0.3	1.6	1.1	0.7	12.8	3.3	3.5	0.9	0.05	0.3	0.10	13.4	1	0.4	0.1	3.3	1	4.2	0.1
BA2-01-S-1560-04212015	BA2-01	15-60	0.7	0.6	0.4	1	1.6	0.4	17.1	1.7	3.3	0.9	0.06	0.3	0.10	12.9	1	0.3	0.1	3.3	1	6.1	0.1
BA2-02-S-0015-04212015	BA2-02	0-15	0.9	0.6	0.4	2.2	1.1	0.6	16.7	2.1	3.3	1.1	0.06	0.4	0.10	14.9	1	0.4	0.1	3.4	1	5.5	0.1
BA2-02-S-1560-04212015	BA2-02	15-60	1.2	0.3	0.2	2.2	0.3	0.3	16.5	1.1	2.3	1.1	0.06	0.4	0.10	16.4	1	0.4	0.1	3.9	1	8.2	0.1
BA2-03-S-0015-04212015	BA2-03	0-15	1	0.5	0.4	1.8	0.5	0.4	14.2	1.7	3	1	0.05	0.3	0.10	14.3	1	0.4	0.1	3.1	1	3.8	0.1
BA2-03-S-1560-04212015	BA2-03	15-60	0.9	0.6	0.4	0	1.7	0.3	17.3	2.8	3.8	1.1	0.06	0.3	0.10	16.3	1	0.4	0.1	3.7	1	7.6	0.1
BA2-04-S-0015-04212015	BA2-04	0-15	0.7	0.5	0.4	1.3	1	0.4	18.6	1.7	3.4	0.9	0.06	0.3	0.10	14.3	1	0.3	0.1	2.7	1	5.8	0.1
BA2-04-S-1560-04212015	BA2-04	15-60	0.7	0.6	0.4	0	0.5	0.3	15.3	1.8	3.2	0.8	0.06	0.2	0.10	14.5	1	0.3	0.1	2.9	1	8.2	0.1
BA2-05-S-0015-04212015	BA2-05	0-15	0.8	0.6	0.4	1.3	1.1	0.6	10.7	3.8	3.9	1.1	0.06	0.3	0.10	14.6	1	0.3	0.1	3.3	1	4.9	0.1
BA2-05-S-1560-04212015	BA2-05	15-60	0.8	0.6	0.4	1.5	1.4	0.5	13.1	4.2	4.2	0.9	0.06	0.3	0.10	14.4	1	0.4	0.1	3.2	1	6.7	0.1
BA2-06-S-0015-04212015	BA2-06	0-15	1.2	0.6	0.4	1.5	1.2	0.5	17.5	1.7	3.3	0.9	0.05	0.3	0.10	15.3	1	0.4	0.1	3.1	1	4.1	0.1
BA2-06-S-1560-04212015	BA2-06	15-60	1.1	0.5	0.5	2.5	0.8	0.7	19.6	1.7	3.5	0.9	0.06	0.7	0.10	17.7	1	0.4	0.1	3.8	1	6.6	0.1
BA2-07-S-0015-04212015	BA2-07	0-15	0.8	0.6	0.4	1.4	1.3	0.6	17.2	1.6	3.2	1.1	0.05	0.4	0.10	15.3	1	0.4	0.1	3.3	1	4.1	0.1
BA2-07-S-1560-04212015	BA2-07	15-60	0.9	0.6	0.4	1.7	0.5	0.4	16.8	1.7	3.2	1.2	0.06	0.4	0.10	17.3	1	0.4	0.1	4.8	1	6.6	0.1
BA2-08-S-0015-04212015	BA2-08	0-15	1.2	0.5	0.4	1.3	1.5	0.5	15	3.5	4	1	0.06	0.4	0.10	15.4	1	0.3	0.1	3.3	1	5	0.1
BA2-08-S-1560-04212015	BA2-08	15-60	1	0.5	0.4	2.4	0.5	0.8	17.4	1.7	3.3	1.1	0.06	0.4	0.10	17.9	1	0.8	0.1	4.4	1	7.2	0.1
BA2-09-S-0015-04212015	BA2-09	0-15	1.1	0.4	0.3	1.4	0.5	0.4	15.9	1.7	3.2	1.1	0.06	0.3	0.10	16.8	1	0.3	0.1	4	1	4.6	0.1
BA2-09-S-1560-04212015	BA2-09	15-60	1	0.5	0.4	1.4	0.5	0.4	15.3	1.6	3	0.9	0.06	0.3	0.10	14.4	1	0.4	0.1	3.6	1	6.9	0.1
BA2-10-S-0015-04212015	BA2-10	0-15	0.8	0.5	0.4	0	0.5	583	12.2	4.2	4.3	0.5	0.05	0.2	0.10	9.7	1	0.3	0.1	2.3	1	3.1	0.1
BA2-10-S-1560-04212015	BA2-10	15-60	0.6	0.3	0.2	1.2	0.5	0.3	14.4	1.1	2.2	0.5	0.06	0.2	0.10	10.7	1	0.3	0.1	2.2	1	5.3	0.1
BA2-11-S-0015-04212015	BA2-11	0-15	0.8	0.4	0.3	0.9	1	0.3	14.4	1.6	2.9	0.6	0.05	0.2	0.10	10.1	1	0.3	0.1	2.2	1	3	0.1

Attachment A2: Indoor Radon Monitoring Data Reports

AccuStar Professional Radon Laboratory Services Since 1984

Radon in Air

NELAC NY 11769
NRPP 101193 AL
NRSB ARL0017

EPA Method #402-R-92-004
Charcoal Canister
NRPP Device Code 1017, 1159
NRSB Device Code 10302,10320

Laboratory Report for:

ERG Environmental Restoration Group
8809 Washington Street Northeast Suite 150
Albuquerque NM 87113

Property Tested:

MAC I West Building
Not Indicated 564507 565508

Log Number	Device Number	Area Tested	Result (pCi/L)
2018630	564507	First Floor	1.1
2018631	564508	First Floor Duplicate	1.1
		Average:	**1.1** pCi/L

Radon test results are below the EPA action level of 4 pCi/L. No further action is required at this time. The EPA suggests that you may want to test again in the future to ensure that radon levels remain below the action level. If the property tested uses water from a private well, you may wish to consider testing for radon in water.

Comment: Confidential: Release results to client only. ERG Enviromental Restoration Group was emailed a copy of this report.

Distributed by: ERG Environmental Restoration Group

Test Began:	12/05/2016	10:30 am	Date Received:	12/12/2016	Date Analyzed:	12/12/2016
Test Ended:	12/07/2016	10:30 am	Date Logged:	12/12/2016	Date Reported:	12/12/2016

Test Exposure Duration: 48.0 Hours

Report Reviewed By: _____ Report Approved By: _____
Carolyn D. Koke, President, AccuStar Labs

Disclaimer:
The uncertainty of this radon measurement is ~+/- 10 %. Factors contributing to uncertainty include statistical variations, daily and seasonal variations in radon concentrations, sample collection techniques and operation of the dwelling. Interference with test conditions may influence the test results.

This report may only be transferred to a third party in its entirety. Analytical results relate to the samples AS RECEIVED BY THE LABORATORY. Results shown on this report represent levels of radon gas measured between the dates shown in the room or area of the site identified above as "Property Tested". Incorrect information will affect results. The results may not be construed as either predictive or supportive of measurements conducted in any area of this structure at any other time. AccuStar Labs, its employees and agents are not responsible for the consequences of any action taken or not taken based upon the results reported or any verbal or written interpretation of the results.

Rev 1512 11 Awl Street Medway MA 02053 888-480-8812 FAX 508-533-8831 Page 1 of 1

AccuStar Professional Radon Laboratory Services Since 1994

Radon in Air

NELAC NY 11769
NRPP 101193 AL
NRSB ARL0017

EPA Method #402-R-92-004
Charcoal Canister
NRPP Device Code 1017, 1159
NRSB Device Code 10302,10320

Laboratory Report for:

ERG Environmental Restoration Group
8809 Washington Street Northeast Suite 150
Albuquerque NM 87113

Property Tested:

MAC I East Building
Not Indicated 564503 564504

Log Number	Device Number	Area Tested	Result (pCi/L)
2018634	564503	First Floor	0.9
2018635	564504	First Floor Duplicate	0.7
		Average:	**0.8 pCi/L**

Radon test results are below the EPA action level of 4 pCi/L. No further action is required at this time. The EPA suggests that you may want to test again in the future to ensure that radon levels remain below the action level. If the property tested uses water from a private well, you may wish to consider testing for radon in water.

Comment: Confidential: Release results to client only. ERG Enviromental Restoration Group was emailed a copy of this report.

Distributed by: ERG Environmental Restoration Group

Test Began:	12/05/2016	10:30 am	Date Received:	12/12/2016	Date Analyzed:	12/12/2016
Test Ended:	12/07/2016	10:32 am	Date Logged:	12/12/2016	Date Reported:	12/12/2016

Test Exposure Duration: 48.0 Hours

Report Reviewed By: _____ Report Approved By: _____

Carolyn D. Koke, President, AccuStar Labs

Disclaimer:

The uncertainty of this radon measurement is ~+/- 10 %. Factors contributing to uncertainty include statistical variations, daily and seasonal variations in radon concentrations, sample collection techniques and operation of the dwelling. Interference with test conditions may influence the test results.

This report may only be transferred to a third party in its entirety. Analytical results relate to the samples AS RECEIVED BY THE LABORATORY. Results shown on this report represent levels of radon gas measured between the dates shown in the room or area of the site identified above as "Property Tested". Incorrect information will affect results. The results may not be construed as either predictive or supportive of measurements conducted in any area of this structure at any other time. AccuStar Labs, its employees and agents are not responsible for the consequences of any action taken or not taken based upon the results reported or any verbal or written interpretation of the results.

Rev 1512 11 Awl Street Medway MA 02053 888-480-8812 FAX 508-533-8831 Page 1 of 1

Attachment A3: Instrument Calibration Certificates

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 218564

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR288465

- ☑ Mechanical Check
- ☑ F/S Response Check
- ☑ Geotropism
- ☑ Meter Zeroed
- ☑ THR/WIN Operation
- ☑ Reset Check
- ☑ Audio Check
- ☑ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Cable Length: ☐ 39-inch ☑ 72-inch ☐ Other:

Source Distance: ☐ Contact ☑ 6 inches ☐ Other:

Source Geometry ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV

Window:

Barometric Pressure: 24.33 inches Hg

Temperature: 74 °F

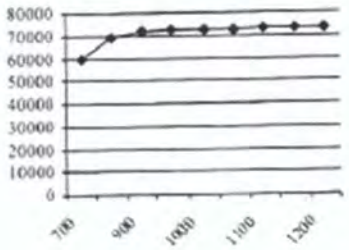
Relative Humidity: 20 %

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398892	400
x 1000	100	100	100		100
x 100	400	400	400	39888	400
x 100	100	100	100		100
x 10	400	400	400	3986	400
x 10	100	100	100		100
x 1	400	400	400	398	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	59599	
800	69486	
900	71679	
950	72244	
1000	72475	9432
1050	72877	
1100	73119	
1150	73031	
1200	73241	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

Fluke multimeter serial number: ☐ 8749012

☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

☐ Other Source:

Calibrated By:

Calibration Date: 4-16-15 Calibration Due 4-16-16

Reviewed By:

Date: 4/16/15

ERG Form ITC.101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A-1997

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 282973

Detector: Manufacturer: Ludlum Model Number: ~~44~~-10 Serial Number: PR118986

- ☑ Mechanical Check
- ☑ F/S Response Check
- ☑ Geotropism
- ☑ Meter Zeroed
- ☑ THR/WIN Operation
- ☑ Reset Check
- ☑ Audio Check
- ☑ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V

Cable Length: ☐ 39-inch ☑ 72-inch ☐ Other:

Source Distance: ☐ Contact ☑ 6 inches ☐ Other:

Source Geometry ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV

Window:

Barometric Pressure: 24.69 inches Hg

Temperature: 77 °F

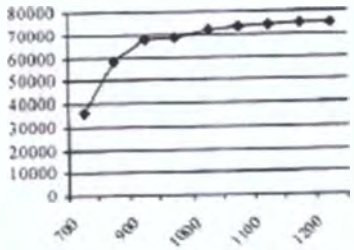
Relative Humidity: 20 %

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	399626	400
x 1000	100	100	100		100
x 100	400	400	400	39985	400
x 100	100	100	100		100
x 10	400	400	400	3998	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	36064	
800	58303	
900	67676	
950	68787	
1000	71543	
1050	73189	
1100	73675	11545
1150	74374	
1200	74783	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932

☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

Fluke multimeter serial number: ☐ 8749012

☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

☐ Other Source:

Calibrated By:

Calibration Date: 10-22-14 Calibration Due 10-22-15

Reviewed By:

Date: 10/23/14

ERG Form ITC. 101.A 10/23/14

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 86306

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR090262

☑ Mechanical Check ☑ THR/WIN Operation
☑ F/S Response Check ☑ Reset Check
☑ Geotropism ☑ Audio Check
☑ Meter Zeroed ☑ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
Cable Length: ☐ 39-inch ☑ 72-inch ☐ Other:

Source Distance: ☐ Contact ☑ 6 inches ☐ Other:
Source Geometry ☑ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

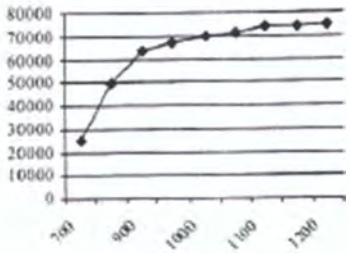
Barometric Pressure: 24.69 inches Hg
Temperature: 76 °F
Relative Humidity: 20 %

Instrument found within tolerance: ☑ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	399609	400
x 1000	100	100	100		100
x 100	400	400	400	39962	400
x 100	100	100	100		100
x 10	400	400	400	3995	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
1050	70926	
1100	73928	
1150	73946	11361
1200	74343	
700	25330	
800	49292	
900	63873	
950	67039	
1000	69580	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ☑ 201932
☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03
☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

Fluke multimeter serial number: ☐ 8749012
☑ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Other Source:

Calibrated By:
Reviewed By:

Calibration Date: 10-22-14 Calibration Due 10-22-15
Date: 10/23/14
10/23/14

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A-1997

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 282961

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR150786

- ✔ Mechanical Check
- ✔ F/S Response Check
- ✔ Geotropism
- ✔ Meter Zeroed
- ✔ THR/WIN Operation
- ✔ Reset Check
- ✔ Audio Check
- ✔ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ✔ 500 V ✔ 1000 V ✔ 1500 V

Cable Length: ☐ 39-inch ☐ 72-inch ✔ Other: Curly

Source Distance: ☐ Contact ✔ 6 inches ☐ Other:

Source Geometry: ✔ Side ☐ Below ☐ Other:

Threshold: 10 mV

Window:

Barometric Pressure: 24.89 inches Hg

Temperature: 70 °F

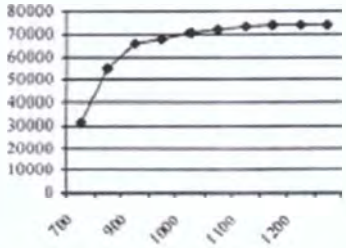
Relative Humidity: 20 %

Instrument found within tolerance: ✔ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398910	400
x 1000	100	100	100		100
x 100	400	400	400	39893	400
x 100	100	100	100		100
x 10	400	400	400	3988	400
x 10	100	100	100		100
x 1	400	400	400	397	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	31039	
800	54820	
900	65946	
950	67927	
1000	70337	
1050	71980	
1100	73095	9770
1150	73716	
1200	73648	
1250	74225	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV =1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ✔ 201932

☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

Fluke multimeter serial number: ☐ 87490128

✔ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

☐ Other Source:

Calibrated By:

Reviewed By:

Calibration Date: 25 Nov 16 Calibration Due: 25 Nov 17

Date: 11/28/16

ERG Form ITC.101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A-1997

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer: Ludlum Model Number: 2221r Serial Number: 138368

Detector: Manufacturer: Ludlum Model Number: 44-10 Serial Number: PR154615

- ✔ Mechanical Check
- ✔ F/S Response Check
- ✔ Geotropism
- ✔ Meter Zeroed
- ✔ THR/WIN Operation
- ✔ Reset Check
- ✔ Audio Check
- ✔ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ✔ 500 V ✔ 1000 V ✔ 1500 V

Cable Length: ☐ 39-inch ✔ 72-inch ☐ Other:

Source Distance: ☐ Contact ✔ 6 inches ☐ Other:

Source Geometry: ✔ Side ☐ Below ☐ Other:

Threshold: 10 mV

Window:

Barometric Pressure: 24.78 inches Hg

Temperature: 74 °F

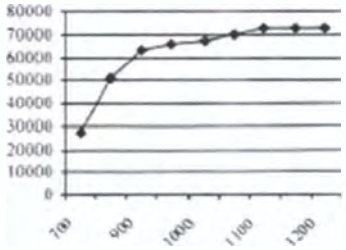
Relative Humidity: 20 %

Instrument found within tolerance: ✔ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	398436	400
x 1000	100	100	100		100
x 100	400	400	400	39845	400
x 100	100	100	100		100
x 10	400	400	400	3984	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	26998	
800	51037	
900	63340	
950	65550	
1000	67410	
1050	70113	
1100	72217	
1150	72561	9216
1200	72337	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ✔ 201932

Fluke multimeter serial number: ☐ 87490128

☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

✔ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

☐ Other Source:

Calibrated By: Calibration Date: 7-10-16 Calibration Due: 7-10-17

Reviewed By: Date: 7/10/16

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	218563	
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR150851	

✔ Mechanical Check ✔ THR/WIN Operation
✔ Γ/S Response Check ✔ Reset Check
✔ Geotropism ✔ Audio Check
✔ Meter Zeroed ✔ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ✔ 500 V ✔ 1000 V ✔ 1500 V
Cable Length: 39-inch ✔ 72-inch Other:

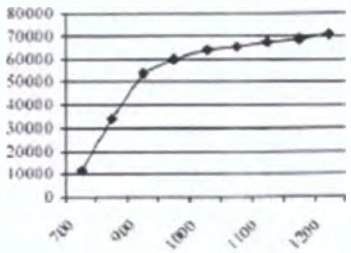
Barometric Pressure: 24.51 inches Hg
Source Distance: Contact ✔ 6 inches Other: Threshold: 10 mV Temperature: 74 °F
Source Geometry: ✔ Side Below Other: Window: Relative Humidity: 20 %

Instrument found within tolerance: ✔ Yes No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	399802	400
x 1000	100	100	100		100
x 100	400	400	400	39987	400
x 100	100	100	100		100
x 10	400	400	400	3998	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	11246	
800	33904	
900	53843	
950	59637	
1000	63641	
1050	65147	
1100	66831	
1150	68228	9797
1200	70822	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: 97743 ✔ 201932 Fluke multimeter serial number: 87490128
Alpha Source: Th-230 sn: 4098-03@12,800dpm/6,520 cpm (1/4/12) ✔ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
Beta Source: Tc-99 sn: 4099-03@17,700dpm/11,100cpm(1/4/12) Other Source:

Calibrated By: Calibration Date: 5-1-17 Calibration Due: 5-1-18
Reviewed By: Date: 5/1/17

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

Reuter-Stokes

Calibration Certificate

Reuter-Stokes certifies that the Environmental Radiation Monitor, identified below, has been calibrated for output using the shadow shield technique*, and calibrated with radiation sources traceable to the National Institute of Standards and Technology.

Sensor Type: 100 R/Hr

Serial Number: 07J00KM1

Calibration Date: 7/9/2014

Sensitivity: 10.05 mV/µR/h

Authorized Signature

*Calibration Procedure: RS-SOP 238.1

Reuter-Stokes

Calibration Data

Sensor Type:	100 R/1Ir	Source (CS-137):	BB-400
Serial Number:	07J00KM1	Date of Certification:	12/1/1994
Calibration Date:	7/9/2014	Exposure Rate at 1 meter:	4.226 mR/h

Customer Name: ENVIRONMENTAL RESTORATION GROUP

Sensitivity (Ra-226): 10.05 mV/µR/h

Distance		Exposure Rate	P+S+A	S+A	P	k(CS-137)
Feet	cm	µR/h	V	V	V	mV/µR/h
12	366	197.193	2.553	0.547	2.006	10.18
14	427	144.278	1.949	0.483	1.465	10.16
16	488	110.006	1.550	0.435	1.116	10.14
18	549	86.558	1.277	0.399	0.878	10.14

k(CS-137) = 10.16 mv/µR/h

k(Ra-226) = 0.9892 k(CS-137)

k(Ra-226) = 10.05 mv/µR/h

$\bar{k}$ = 10.16 mv/µR/h

σ = .015 mv/µR/h

$V = \frac{\sigma}{k}$ = 0.145%

By: [signature]

Date: 7-10-14

Reuter-Stokes

RSS-131 FIRMWARE PARAMETERS

S/N 07J00KM1

RAC	2.176E-08
ZLN	0.000E+00
ZMN	3.520E-01
ZHN	2.000E-03
ZLD	0.000E+00
ZMD	-2.414E-04
ZHD	-6.174E-07
RLN	4.619E+11
RMN	2.231E+09
RHN	1.001E+07
RLV	-1.524E+08
RMV	2.094E+04
RHV	-1.548E+02

By: _____
Level 2 Nuclear / Electrical Inspector

Date: 7-10-14

Reviewed By: _____
Product Engineer

Attachment A4: Function Check Forms and Field Logbook

DAILY TASK(S)

1. SAFETY TAILGATES PRE-SURVEY
2. FUNCTION CHECKS
3. DUST MEASUREMENTS POST-SURVEY
4. MEASUREMENTS
5. FRISK OUT ✓

4/20/15

10:00 ARRIVE @ SMITH LA

10:45

SET #2

2221 s/n : 282973 CAL DUE 10/22/15

44-10 s/n PR118986 w/ 6' CURLY CABLE
BKG CAL JIG
Cs-137 s/n 332-94 4.81 μG 4/14/89

	γ	BKG
#1	53838	7417
2	52802	7558
3	52789	7499
4	53408	7424
5	54900	7501
6	52418	7374
7	51842	7362
8	53824	7604
9	53056	7450
10	53197	7336

HV: 1100
THR: 98

FUNCTION CHECK ✓
BACKGROUND LOCATION @ SECOND PARKING LANE, END OF WHITE LINE AT THE NAAZBAAH VETERANS CENTER PARKING LOT. PICTURE TAKEN

Scale: 1 square =

13:45 SURVEYED BA1 ✓
NOW SOIL SAMPLING
✓ READINGS W/ SET #1

BA1-B1-S-0015-04202015
0 16,143 cpm
30 cm 23,589 cpm
60 cm 25,005

BA1-02-S-0015-04202015
0 cm 15,968
30 cm 22,565
60 cm 25,883

BA1-03-S-0015-04202015
0 cm 15,523
30 cm 21,692
60 cm 24,439

BA1-04-S-0015-04202015
0 cm 16637
30 cm 23,327
60 cm 25,677

BA1-05-S-0015-04202015
0 cm 16186
30 cm 24,407
60 cm 27859

BA1-06-S-0015-04202015
0 cm 17,001
30 cm 25,705
60 cm 28365

BA1-07-S-0015-04202015
0 cm 16242
30 cm 23377
60 cm 27128

BA1-08-S-0015-04202015
0 cm 16063
30 cm 22543
60 cm 25,344

★ REBAR @ ~ 20-25 cm COLLECTED APPROXIMATELY @ HOLE NEXT TO IT.

Scale: 1 square =

4/21

06:30 MEET @ BREAKFAST
FOR TAILGATE SAFETY MEET.

07:55 MORNING FUNCTION CHECK

	Y	BKG	HV	BAT	STR
SET #1	53483	7154	1003	6.1	105
#2	55507	7548	1104	6.2	99
#3	53305	7265	1157	6.1	102

MODEL 12 SN 274087 — α: TH-230 SOURCE S/N: 9132-10
43-5 PR204397 USE ORIG CAL SRG. 4/16/16

α SOURCE ≈ 1000 cpm
BKG 0 c/m

BAT ✓

08:30 AT BA2 AND STARTING SOIL SAMPLING AND DOWN HOLE LOGGING W/ 2221 44-10 SET #1. PER HAND AUGER AND WORKPLAN.

Scale: 1 square = ______

BA2-01-S-0015-04212015
0 cm 13,566
30 cm 20095
60 cm 21039

BA2-02-S-0015-04212015
0 cm 13,887
30 cm 21211
60 cm 21782

BA2-03-S-0015-04212015
0 cm 13900
30 cm 21216
60 cm 22431

BA2-04-S-0015-04212015
0 cm 13137
30 cm 18855
60 cm — *

* HIT REFUSAL LAST 4".
SAMPLE 0015-0060 NEXT TO FIRST HOLE.
REFUSAL @ SECOND HOLE SAME DEPTH.

Scale: 1 square = ______ Rite in the Rain

BA2-05-S-0015-04212015
0 cm 13977
30 cm 20721
60 cm 21643

BA2-06-S-0015-04212015
0 cm 14182
30 cm 21420
60 cm 21929

BA2-07-S-0015-04212015
0 cm 14012
30 cm 20923
60 cm 22289

BA2-08-S-0015-04212015
0 cm 13486
30 cm 21140
60 cm 22144

BA2-09-S-0015-04212015
0 cm 13609
30 cm 20803
60 cm 21358

Scale: 1 square = ______

BA2-10-S-0015-04212015
0 cm 12286
30 cm 17104
~~60 cm~~ 45 cm 17334

* BA2-11-S-0015-04212015
FIELD DUPLICATE TAKEN @/WITH TOP 15 cm AT BA2-10.

10:40 DONE W/ SOIL SAMPLING @ BA2.

→ HIT REFUSAL @ 45 cm. SANDSTONE IN AREA. VISIBLE ON SURFACE IN MANY AREAS.

11:10 BEGIN SURVEY @ BJ2

12:00 BREAK. ~1/3 DONE W/ TRANSECTS AT BJ2.
CHANDARA & DARLENE JENKINS JUST ARRIVED. MARK RIPPORDA CALLED AND ON WAY.

Scale: 1 square = ______ Rite in the Rain

15:00 FINISHED @ BJ2
WENT TO UPPER VENT RAISE AND SURVEYED SHOT IN UTILITY RAISED & SHAFT, PLUS MYSTERY HOLE. NO PIPE BUT HOLE ~ 6" DIA AND DEEPER THAN FEW FEET.

17:25 FINISHED @ MAC 2 & HEADING TO FUNCTION CHECK.

AFTER BJ2 SCANNED OUT OVERTONES FEET & ALL PASSED

17:45

SET #	γ	BKG	HV	BAT	TIME
1	51907	6684	1005	6.1	110
2	52945	7367	1101	6.0	98
3	53359	7315	1154	6.0	102

12/43-5 SOURCE 1000 cpm
BKG 0 cpm
BAT ✓

18:00 LEAVING SMITH LAKE. PROCESSING DATA ON DRIVE

PROCESSED DATA SENT TO RANDY AS .CSV & DISCUSS.

12

Scale: 1 square =

4/12

08:00 FUNCTION CHECK

SET #	γ	BKG	HV	BAT	TIME
1	52154	6905	1105	6.1	106
2	53344	8039	1106	6.0	98
3	52012	7606	1160	6.0	103

12/43-5 @ 1000 cpm BAT ✓
BKG 0 cpm

8:45 STARTING TO BGND SURVEY @ MAC 2

DISCUSSED SPACING & ACCESS W/ RANDY. SURVEY RADIALS OUT FROM SURVEYED AREAS. DO NOT SURVEY EAST OF FENCE — UNSURE OF ACCESS.

@ OTHER SITES (BJ1 & MAC1) SWITCH TO 18M TRANSECTS & THEN RADIAL OUT TO BACKGROUND @ WHATEVER SPACING NECESSARY.

~11:30 RANDY & MARK A(CP) SPLIT SITE.

13:00 FINISHED @ MAC 2 FOR DAY MOVED OVER TO BJ2 FOR REST OF DAY.

HOOKED UP W/ CHANDARA & DARLENE (MNDNR). SET UP THEIR GPS - 2221 FOR THEM. DISCUSSED TRAINING THEM ON SYSTEM(S).

JUAN III LEFT FOR DAY.

17:50 FINISHED FOR DAY @ BJ2. WENT TO CAL.

18:10 SMITH LAKE CHAPTER PARKING LOT GATE LOCKED. GONE TO PULLOFF NEAR ENTRY ROAD.

SET #	γ	BKG	HV	BAT	TIME
3	55996	9756	1152	5.8	102
2	56276	9615	1094	5.8	98

19:30 PROCESS DATA & WORK ON PAPERWORK.

13

Scale: 1 square =

4/23

7:45 SMOKE w/ RANDY READING SPACING. REFERENCE E-MAIL. W/ MARK RIPPERDA.

8:00 FUNCTION CHECK

SET #	Y	BKG	IN	BAT	THR
1	53870	7154	1008	6.1	108
2	53702	7716	1107	5.9	99
3	53418	7558	1159	5.9	103

12/43-5 @ 1000 BKG 0 BAT ✓

11:00 SMOKE w/ MIKE & RANDY ABOUT ACCESS @ MAC 1. ADVISED TO LEAVE PROPERTY. MOSTLY DONE ANYWAY. LEFT AND GATE LOCKED @ GATE.

12:20 SURVEYED MAC 1 HAUL ROAD FROM MAIN CAMP. OUT TO CHEVRON SITE - HAUL ROAD IS OFF PROPERTY. HEADING TO BJ1. TOOK ~ 1 hr. DUST MEASUREMENT. MAX = 0.100 µg/m³ AND TYPICALLY WAS 0.000 µg/m³.

16:00 FINISHED WALKING HAUL RD. @ BJ1. WALKED THE BJ1 TRANSECTS, AIR RAISED, AND DOWN DAMAGE WHERE ACCESSIBLE. HEADING TO FUNCTION CHECK LOCATION. DUST @ BJ1 MAX 0.325 µg/m³ w/ TYPICAL READING @ 0.000

16:15

SET #	Y	BKG	IN	BAT	THR
2	54458	7415	1101	5.7	98
3	53030	7327	1154	5.7	102

12/43-5 SOURCE: 1000 cpm BKG 0 cpm BAT ✓

SCANNED FEET OUT BEFORE LEAVING AND NO CONTAMINATION ON ANYONE.

16:25 LEAVING SITE & PROCESSING DATA ON WAY BACK TO ORANGE.

Scale: 1 square = _____

4/24/15

7:45 FUNCTION CHECK @ NAAZBAAH

SET #	Y	BKG	BAT	IN	THR
1	54678	7143	6.1	1006	107
2	55527	7493	5.8	1106	98
3	53987	7335	5.8	1160	102

12/43-5 SOURCE: 1000 BKG: 0 BAT: ✓

JUAN III NOT HERE TODAY. WORKING IN ABQ TO GET MAC 1 SIGNATURES.

11:00 SPOKE w/ RANDY & JUAN.

11:45 30 MINUTE BREAK FOR LUNCH. AT LUNCH DURING &

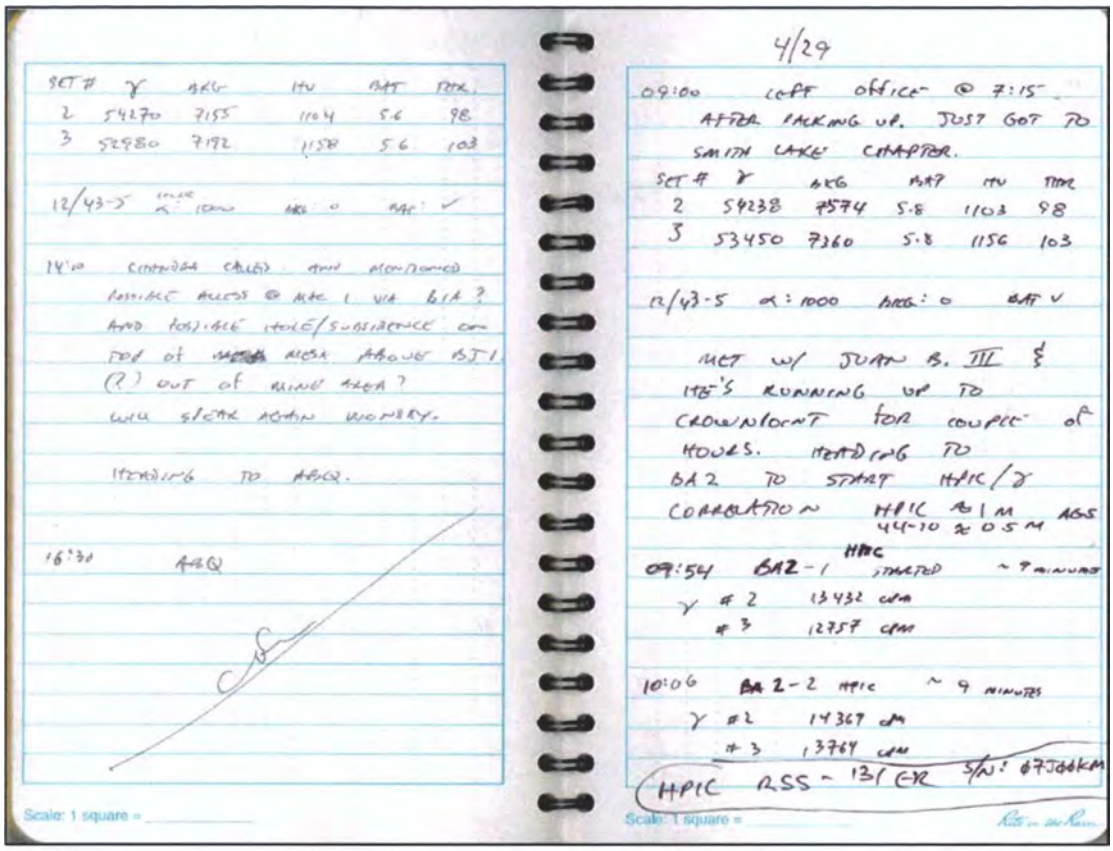
14:00 DONE @ BJ1. AGAIN TAKEN READINGS & PUT ANOTHER ROUND ON HAUL RD. WEATHER/SNOW LIGHT MOVING IN. LEAVING SITE.

10:00 SENT INFO TO RANDY AND MIKE.

LOADED CALIBRATED SURVEY FILES FOR BJ1 TOMORROW.

(10)

Scale: 1 square = _____



SET # γ AKG HV BAT TIME
2 54270 7155 1104 5.6 98
3 52980 7192 1158 5.6 103

12/43-5 α: 1000 AKG: 0 BAT ✓

14:10 CHANDRA CALLED AND ACKNOWLEDGED POSSIBLE ACCESS @ MAC 1 VIA BIA? AND POSSIBLE ISOLATE/SUBSISTENCE CAMP OF MEN AREA ABOVE BJ1 (?) OUT OF MINE AREA? WILL SPEAK AGAIN MONDAY.

HEADING TO AREA.

16:30 AREA

Scale: 1 square = _____

4/29

09:00 LEFT OFFICE @ 7:15 AFTER PACKING UP. JUST GOT TO SMITH LAKE CHAPTER.

SET # γ AKG BAT HV TIME
2 54238 7574 5.8 1103 98
3 53450 7360 5.8 1156 103

12/43-5 α: 1000 AKG: 0 BAT ✓

MET W/ JUAN B. III & HE'S RUNNING UP TO CROWNPOINT FOR COUPLE of HOURS. HEADING TO BA2 TO START HPIC/γ CORRELATION HPIC AS 1 M AGS 44-10 & 0.5 M

09:54 BA2-1 HPIC STARTED ~ 9 MINUTES
γ #2 13432 cpm
#3 12757 cpm

10:06 BA2-2 HPIC ~ 9 MINUTES
γ #2 14367 cpm
#3 13769 cpm

HPIC ASS - 131 ER S/N: 67J66KM

Scale: 1 square = _____

10:28 BJ2-1 HPIC ~ 10 MINUTES
γ #2 10401 cpm
#3 10240 cpm
★ MAKING COMPARISON HPIC MEASUREMENTS SET ~ 10' APART.

10:45 BJ2-2 HPIC ~ 10 MINUTES
#2 ~~23852~~ cpm 22746
#3 ~~21420~~ cpm 22617
★ ~ COMPARISON ~ 5-10' APART.

10:59 BJ2-3 HPIC
#2 29894 cpm ★ BJ2-4 HPIC w/ NEW GP
#3 29754

11:11 BJ2-4 HPIC
#2 37711 ★ BJ2-3 MAC w/NEW GP
#3 38005

RAN HPICS AT OPPOSITE LOCATIONS ON SAME TRIPODS FOR COMPARISON SAKE.

Scale: 1 square = _____

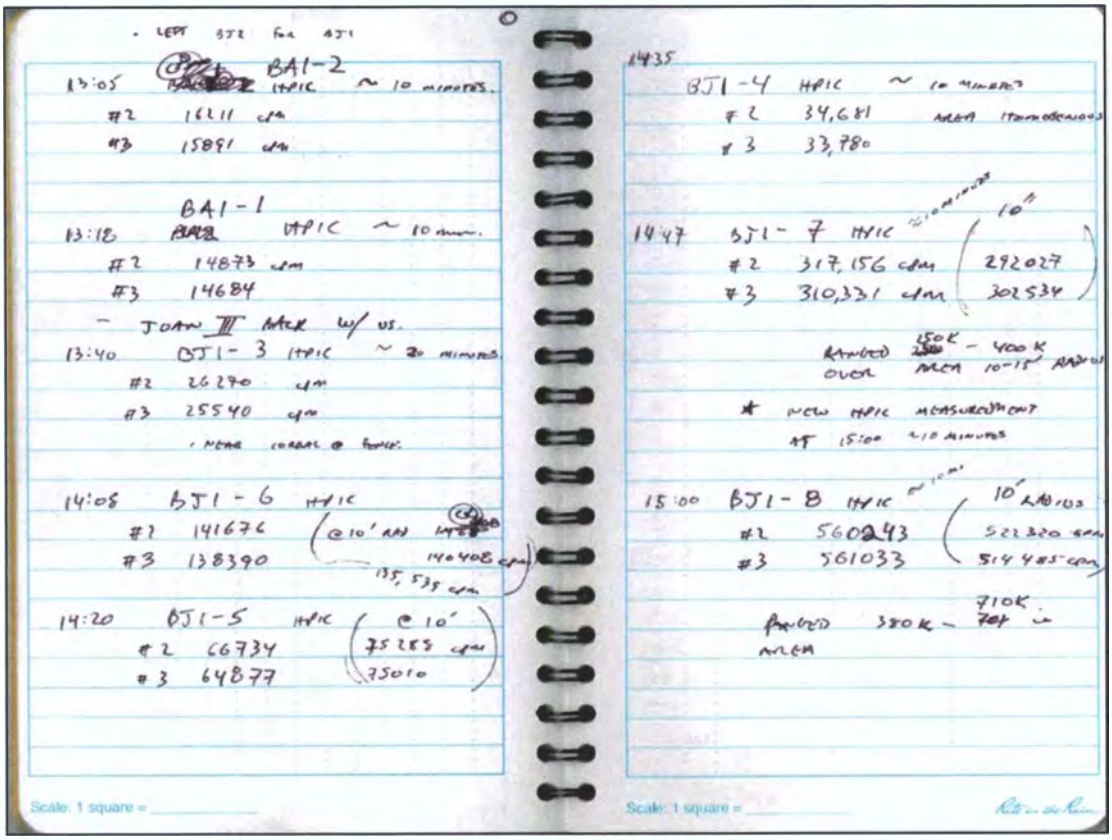
11:27 BJ2-5 HPIC (10' RADIUS 71917 71944)
#2 73809
#3 ~~73076~~ cpm 71974
★ NEW HPIC
DELETE 2-3 DATA ← LAST MIN HPIC
NOT REAL HOMOGENOUS IN THIS AREA. 80K FOUND < 3M AWAY ★ 1

12:08 BJ2-6 HPIC (10' RADIUS 3 MIN NEW HPIC LOCATION 141976 143866)
#2 129546 cpm ★ NEW HPIC @ 11:27
#3 126673 cpm
WITHIN 3 M DIAMETER READINGS W/ AKG 75K TO 130K
DID NOT RAN HPIC off WHEN DONE REMOVE LAST 2-3 MINUTES of DATA.

11:43 BJ2-7 ★ NEW HPIC @ 11:54
#2 237148 cpm (10' RADIUS → 291,232)
#3 224074 cpm (@ 10' RADIUS 263,830 cpm)

11:54 BJ2-8 10' cpm
#2 458182 (366214) ★ NEW HPIC TIME @ 11:58
#3 452607 (359134)
242 READINGS PLUS/MINUS 300K - 400K W/IN 10'

Scale: 1 square = _____



· LEFT BJ2 for BJ1

13:05 BA1-2 HPIC ~ 10 MINUTES.
#2 16211 cpm
#3 15891 cpm

BA1-1
13:18 HPIC ~ 10 min.
#2 14873 cpm
#3 14684
- JOAN III BACK W/ US.

13:40 BJ1-3 HPIC ~ 20 MINUTES.
#2 26270 cpm
#3 25540 cpm
· MEAN CORRAL @ FENCE.

14:08 BJ1-6 HPIC
#2 141676 (@10' AH 140408 cpm)
#3 138390 135,535 cpm

14:20 BJ1-5 HPIC (@10'
#2 66734 75285 cpm
#3 64877 73010)

Scale: 1 square =

1435
BJ1-4 HPIC ~ 10 MINUTES
#2 34,681 AREA ITERMEDIATIONS
#3 33,780

1447 BJ1-7 HPIC ~10 MINUTES (10')
#2 317,156 cpm 292027
#3 310,331 cpm 302534

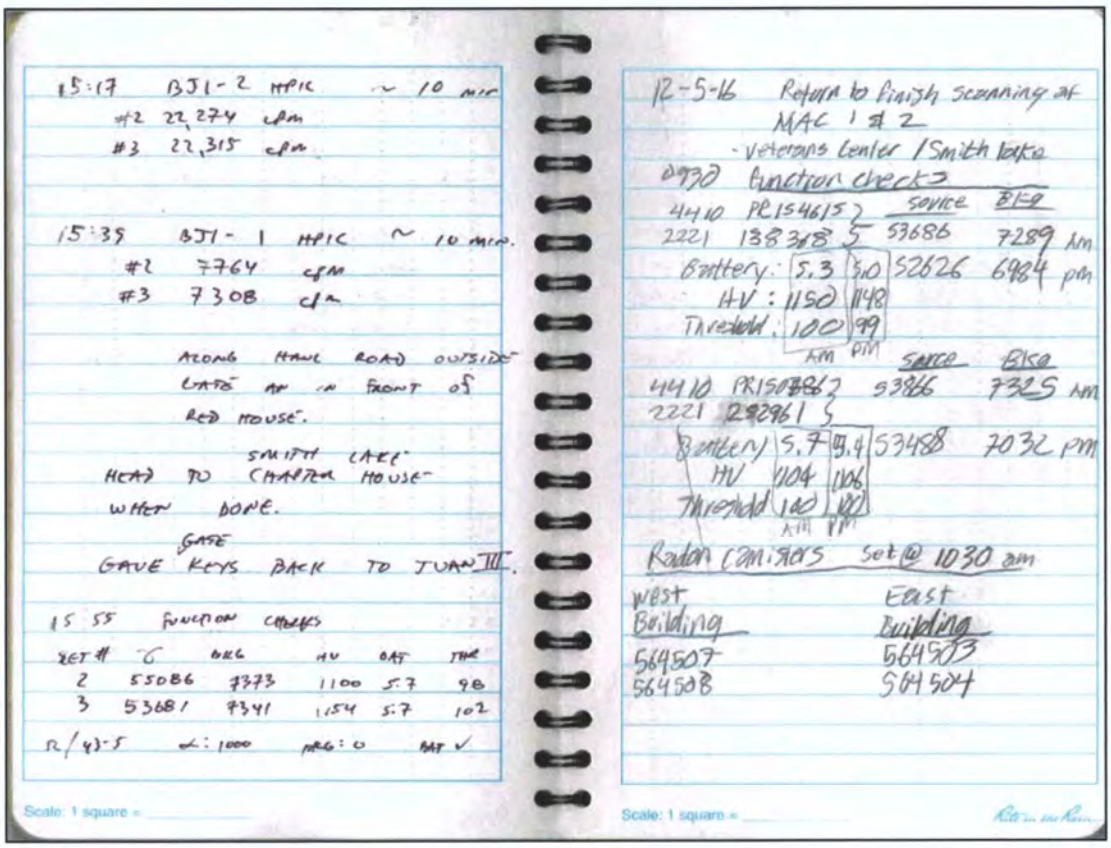
RANGED 150K - 400K OVER AREA 10-15 RADIUS

★ NEW HPIC MEASUREMENT AT 15:00 ~10 MINUTES

15:00 BJ1-8 HPIC ~10 MINUTES (10' AB 103
#2 560243 522320 cpm
#3 561033 514485 cpm

RANGED 380K - 710K 704 in AREA

Scale: 1 square =



15:17 BJ1-2 HPIC ~ 10 MIN
#2 22,274 cpm
#3 22,315 cpm

15:39 BJ1-1 HPIC ~ 10 MIN.
#2 7764 cpm
#3 7308 cpm

ALONG HAUL ROAD OUTSIDE GATE AT IN FRONT OF RED HOUSE.
SMITH LAKE.
HEAD TO CHAPIN HOUSE WHEN DONE.
GAVE GATE KEYS BACK TO JUAN III.

15 55 FUNCTION CHECKS

SET #	C	DRG	HV	BAT	TMP
2	55086	7373	1100	5.7	98
3	53681	7341	1154	5.7	102

R/43-5 ∠: 1000 PRG: 0 BAT ✓

Scale: 1 square =

12-5-16 Return to finish scanning at MAC 1 & 2
· Veterans Center / Smith Lake
0930 Function checks

			Source	BKG	
4410	PR154615				
2221	138348	5	53686	7289	AM
Battery:	5.3	5.0	52626	6984	PM
HV:	1150	1148			
Threshold:	100	99			
	AM	PM			

			Source	BKG	
4410	PR150886				
2221	129261	5	53886	7325	AM
Battery	5.7	5.4	53488	7032	PM
HV	1104	1106			
Threshold	100	100			
	AM	PM			

Radon canisters set @ 1030 am

West Building	East Building
564507	564503
564508	564504

Scale: 1 square =

CHARR NOTES:

08:15 MET JUAN III BEGAY
@ SMITH LAKE CHAPTER HOUSE.

FUNCTION CHECKED INSTRUMENTS
& THEY CAME IN SPOT ON
w/ PREVIOUS 2221/44-10 SETS
@ ~ 53K w/SOURCE & 7 KCPM
BKG.

10:20
@ MAC 1 SET UP
BACK PACKS & OPENED INTO
2 BUILDINGS.

SUNNY BUT
COLD TODAY 40 - 45°F
LIGHT SNOW ON GROUND —
SNOW COVERAGE VERY LIMITED
MAYBE 20% IN SHADY AREAS
& < 5% IN SUNNY.

~ 13:45 FOUND ELEVATED
READINGS @ MAC 1
HEAD TO MAC 2.

Scale: 1 square = ______

~ 14:00 STARTED @ MAC 2
w/ γ SURVEY.
MATT WALKER & CHUCK
FARR.

AREA LARGER THAN
PRE GENERATED TRANSECTS.
~

16:30 STOPPED SURVEYING.
HEADING FOR GAS.

RANDY MET / TALKED w/
CLARK SPROAT (BARRICK) WHILE
WE SURVEYED.

17:00 FUNCTION CHECK
SPOT ON.

19:45 SENT RANDY
GIS FILES FOR DAY.

(12+) [signature]

Scale: 1 square = ______

Rite in the Rain

12/7/16

10:00 MEET JUAN III @ SMITH LAKE
CHAPTER HOUSE.

(138368) (PR159685)
#4 2221/44-10 SOURCE 53260 CPM
BAT: 5.2 BKG 7314 CPM
HV: 1148
THR: 100 NET 45946

10:30 PICKUP Rn CANS
564507 } WEST
564508 } BLDG

10:32 # 564503 } EAST
564504 } BLDG.

FINISHED γ SURVEY ~ 11:00
THEN HEAD TO DROP KEYS off with
ANTHONY (CHAPT. PRESIDENT) w/ JUAN III
11:40 FUNCTION CHECK #4 SET @ SMITH LAKE.
BAT: 5.1 SOURCE: 52586
HV: 1148 BKG: 7383
THR: 102 45203
11:50 HEADING BACK TO ABQ.

Scale: 1 square = ______

5-3-17 — Final scan at MAC 2
— Walk with EPA N. of BJ 2
Function check
Veterans Center / Smith lake
0930

44-10	PR150851		Source	Bkg	
2221	278563		49937	6838	a.m.
Battery	5.6 V	5.4	49502	7249	p.m.
HV	1149	1154			
Threshold	98	104			
	a.m.	p.m.			

Scale: 1 square = ______

Rite in the Rain

#1

ERG

Single-Channel Function Check Log

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	218564
Cal. Due Date:	4/16/16

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR 288465
Cal. Due Date:	4/16/16

Comments:
ERG J16 @ THE NAAZBAAH
VETERANS CENTER PARKING
LOT

Source: Cs-137 Activity: 4.81 uCi Source Date: 6/16/94 Distance to Source: 4.5"
Serial No.: 332-94 Emission Rate: N/A cpm/emissions

Date	Time	Battery	High Voltage	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4/20/15	11:00	6.2	1000	52825	6928	45897	cf	THR: 105
4/20/15	17:10	6.1	1003	52114	6594	45520	cf	THR: 104
4/21/15	7:55	6.1	1003	53483	7154	46329	cf	THR: 103
4/21/15	17:45	6.0	1005	51901	6684	45217	cf	THR: 110
4/22/15	8:00	6.1	1005	52154	6505	45249	cf	THR: 106
4/22/15	—	NOT USED THIS DAY						
4/23/15	8:00	6.1	1008	53870	7194	46676	cf	THR: 108
4/23/15	—	NOT USED TODAY						
4/24/15	7:45	6.1	1006	54678	7143	47535	cf	THR: 107
4/24/15	—	NOT USED TODAY.						

#2

ERG

Single-Channel Function Check Log

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	282973
Cal. Due Date:	10/22/15

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR 118986
Cal. Due Date:	10/22/15

Comments:
ERG J16 @ THE NAAZBAAH
VETERANS CENTER PARKING
LOT

Source: Cs-137 Activity: 4.81 uCi Source Date: 6/16/94 Distance to Source: 4.5"
Serial No.: 332-94 Emission Rate: N/A cpm/emissions

Date	Time	Battery	High Voltage	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4/20/15	11:00	6.2	1100	53197	7336	45861	cf	THR: 98
4/20/15	17:10	6.1	1101	55192	7379	47813	cf	THR: 98
4/21/15	7:55	6.2	1104	55507	7548	47959	cf	THR: 99
4/21/15	17:45	6.0	1101	52945	7367	45578	cf	THR: 98
4/22/15	8:00	6.0	1106	53944	8035	45305	cf	THR: 95
4/22/15	18:10	5.8	1099	56276	9615	46661	cf	THR: 98 * AT ROAD CLOSURE.
4/23/15	08:00	5.8	1107	53702	7716	45986	cf	THR: 99
4/23/15	16:15	5.7	1101	54458	7415	47043		THR: 98
4/24/15	7:45	5.8	1106	55527	7493	48034	cf	THR: * 55527 7493
4/24/15	10:00	5.6	1104	54270	7155	47115	cf	THR: 98

#3

ERG

Single-Channel Function Check Log

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	86306
Cal. Due Date:	10/22/15

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR090262
Cal. Due Date:	10/22/15

Comments:
ERG JIG @ NAAZ BAAH
VETERANS CENTER PARKING
LOT

Source: Cs-137 Activity: 4.81 uCi Source Date: 6/16/94 Distance to Source: 4.5"

Serial No: 332-94 Emission Rate: N/A cpm/emissions

Date	Time	Battery	High Voltage	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
4/20/15	11:00	6.2	1150	52475	6824	45651	cf	THR: 102
4/20/15	17:10	6.1	1155	52717	7494	45223	cf	THR: 102
4/21/15	7:55	6.2	1157	53305	7265	46040	cf	THR: 102
4/21/15	17:45	6.0	1154	53359	7315	46044	cf	THR: 102
4/22/15	8:00	6.0	1160	52012	7606	44406	cf	THR: 103
4/22/15	15:10	5.8	1152	55996	9756	46240	cf	THR: 102
4/23/15	8:00	5.9	1159	53418	7558	45860	cf	THR: 103
4/23/15	16:15	5.7	1154	53030	7327	45703	cf	THR: 102
4/24/15	7:45	5.8	1160	53787	7335	46652	cf	THR: 102
4/24/15	16:00	5.6	1158	52980	7192	45788	cf	THR: 103

ERG

Single-Channel Function Check Log

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	282961
Cal. Due Date:	~~7/19/17~~ 11/25/17 (cf)

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR150786
Cal. Due Date:	~~7/19/17~~ 11/25/17 (cf)

Comments:
@ BJ/MAC F/C AREA @
NAAZBAH VETERANS
CENTER @ SMITH LAKE
CHAPTER

Source: Cs-137 Activity: 4.81 uCi Source Date: 6/16/94 Distance to Source: ~ 4.5"

Serial No: 332-94 Emission Rate: N/A cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
12/5/16	09:30	5.7	1104	100	53866	7325	46541	cf	
12/5/16	16:50	5.4	1106	100	53488	7032	46458	cf	

Single-Channel Function Check Log

ERG

Environmental Restoration Group Inc.
6009 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 296-4224

METER	
Manufacturer	LUDLUM
Model	~~44-10~~ 2221
Serial No.	138368
Cal. Due Date	7/19/16

DETECTOR	
Manufacturer	LUDLUM
Model	44-10
Serial No.	PR154615
Cal. Due Date	7/19/16

Comments:
@ BJ/MAC FUNCTION
CHECK LOCATION @
VETERANS CENTER
NAZBHA.

Source: Cs-137 Activity: 4.81 uCi Source Date: 6/16/94 Distance to Source: ~ 4.5"

Serial No.: 332-94 Emission Rate: N/A ~~cpm/emissions~~

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
12/5/16	09:30	5.3	1150	100	53686	7285	46397	JF	
12/5/16	16:50	5.0	1148	99	52626	6984	45642	JF	
12/7/16	10:00	5.2	1148	100	53260	7314	45946	JF	
12/7/16	11:40	5.1	1148	102	52586	7383	45203	JF	

Single-Channel Function Check Log

ERG

Environmental Restoration Group Inc.
6009 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 296-4224

METER	
Manufacturer	Ludlum
Model	~~44-10~~ 2221
Serial No.	218563
Cal. Due Date	5-1-18

DETECTOR	
Manufacturer	Ludlum
Model	44-10
Serial No.	PR150851
Cal. Due Date	5-1-18

Comments:

Source: Cs137 Activity: 4.81 uCi Source Date: 6/16/94 Distance to Source: 4.5'

Serial No.: 332-94 Emission Rate: N/A cpm/emissions

Date	Time	Battery	High Voltage	Threshhold	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
5/3/17	9:30am	5.6	1149	98	48937	6838	42099	MW	
5/3/17	2:55pm	5.4	1154	104	48502	7249	41253	MW	

Attachment A5: Data Validation Check Sheets

ATTACHMENT 1

Data Validation Worksheets
Validation for Remedial Verifications and Risk Assessments

Soil Data Validation

Site: Black Jack and Mac Mines Project: Phase 1 Investigation

Lab Job No.: C1504078 6 Sample ID's: BA1-01 thru -11 BA2-01 thru -11

Sample Date: 4/20/15 + 4/21/15

Laboratory: Energy Laboratories; Casper, WY

Validation Date: 9-1-15 Type: Level IV

Method: E 200.8 Selenium only

Criteria	OK	FYI	Action	Comments
Holding Times	✓			
Chain-of Custody	✓			
Detection Limits	✓			
Calibration Blanks	✓			
Initial Calibration	✓			
Continuing Calibration	✓			
Blanks	✓			
Lab Control Sample	✓			
Lab Duplicate	✓			
Matrix Spike	✓			
Other Pertinent Criteria:				
Criteria	**OK**	**FYI**	**Action**	**Comments**

Additional Comments: _____

Signature: _____ Date: 9-22-15

ERG
Environmental Restoration Group Inc

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ATTACHMENT 1

Data Validation Worksheets
Validation for Remedial Verifications and Risk Assessments

Soil Data Validation

Site: Black Jack and Mac Mines Project: Phase 1 Investigation

Lab Job No.: C15040786 Sample ID's: BA1-01 thru -10, BA2-01 thru -11

Sample Date: 4/20/15 + 4/21/15

Laboratory: Energy Laboratories; Casper, WY

Validation Date: 9-1-15 Type: Level IV

Method: SW 6020B - As, Mo, U

Criteria	OK	FYI	Action	Comments
Holding Times	✓			
Chain-of Custody	✓			
Detection Limits	✓			
Calibration Blanks	✓			
Initial Calibration	✓			
Continuing Calibration	✓			
Blanks	✓			
Lab Control Sample	✓			
Lab Duplicate	✓			
Matrix Spike	✓			
Other Pertinent Criteria:				
Criteria	**OK**	**FYI**	**Action**	**Comments**

Additional Comments: _____

Signature: _____ Date: 9-22-15

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Environmental Restoration Group Inc

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ATTACHMENT 1

Data Validation Worksheets
Validation for Remedial Verifications and Risk Assessments

Soil Data Validation

Site: Black Jack and Mac Mines Project: Phase 1 Investigation

Lab Job No.: C15040786 Sample ID's: BA1-01 thru -11, BA2-01 thru -11

Sample Date: 4/20/15 + 4/21/15

Laboratory: Energy Laboratories; Casper, WY

Validation Date: 9-17-15 Type: Level IV

Method: E901.1

Criteria	OK	FYI	Action	Comments
Holding Times	✓			
Chain-of Custody	✓			
Detection Limits	✓			
Calibration Blanks	✓			
Initial Calibration	✓			
Continuing Calibration	✓			
Blanks	✓			
Lab Control Sample	✓			
Lab Duplicate	✓			
Matrix Spike	✓			

Other Pertinent Criteria:

Criteria	OK	FYI	Action	Comments

Additional Comments: High precision for Th-228 (583 pCi/g) on sample ID BA2-10-S-0015-04212015.

Signature: [signature] Date: 9-22-15

ERG
Environmental Restoration Group Inc

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Attachment A6: Gamma Count Rate Mapping Example

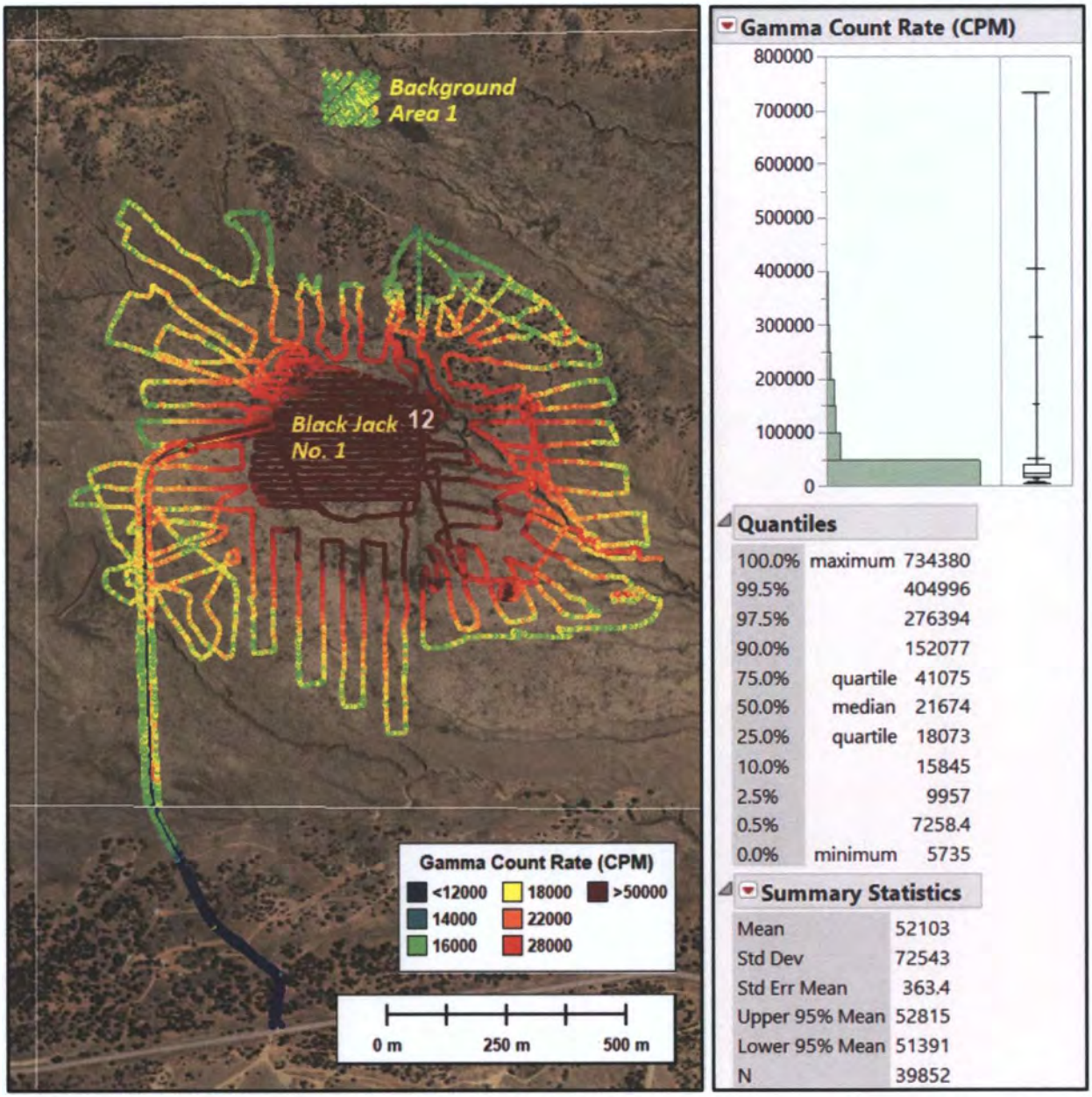

Figure A6: Gamma Count Rates at Black Jack 1 and BA1 (left) and summary statistics for Black Jack 1 (right).

APPENDIX B

Attachment B1: Level IV Data Reports for Background Soil Samples

(Provided on CD, Hardcopies Available on Request)

UNSCANNABLE MEDIA

To use the unscannable media document # 2387209
contact the Region 9 Regional Records Center – Superfund Division

Removal Site Evaluation and Interim Removal Action

Black Jack and Mac Mines

McKinley County, New Mexico

Phase 1 Summary Report

Part 2: Geomorphic Characterization and Assessment

Revision 1

Prepared for:

Homestake Mining Company of California

460 West 50 North, Suite 500

Salt Lake City, Utah 84101

Prepared by

Alan Kuhn Associates LLC

with support from

EL Engineering Services LLC

August 22, 2017

CONTENTS

1 BACKGROUND

This report documents the work conducted by Alan Kuhn Associates LLC (AKA) in support of Environmental Restoration Group (ERG) for the Scope of Work for Interim Removal Action AOC, Phase 1 – Transect Gamma Scan, Geomorphologic Survey and Background Study, for the Black Jack No.1 and No.2 and the Mac No.1 and No. 2 mine sites required to be completed by Homestake Mining Company of California ("Respondent") pursuant to the Administrative Settlement Agreement and Order on Consent ("AOC"), CERCLA Docket No. 2014-06, entered into voluntarily with the United States Environmental Protection Agency ("EPA"). Specifically, this report addresses the Removal Site Evaluation Phase 1 Geomorphologic Survey, which the Scope of Work describes as follows:

> "Respondent shall conduct a geomorphologic survey to characterize the existing terrain features and geomorphological stability of the Sites to evaluate active and potential erosion processes as well as existing and potential pathways for erosion of mine-related material to support closure options analysis in the future."

In the course of performing the geomorphological survey, AKA also assisted ERG in the location and identification of natural and mine-related hazards on each mine site. The inventory and assessment of mine features and hazards are included in Attachment A to this report, and photographs of selected features referenced in this report and in Attachment A are contained in Attachment B. Several mine features were identified as high priority for immediate mitigation of potential physical hazards, including the main mine shaft at Black Jack 2 (previous fence had deteriorated), and two open holes at Mac 1. Temporary fencing to restrict access to each of these mine hazards was completed on June 1, 2017.

2 GEOMORPHIC CHARACTERIZATION AND ASSESSMENT APPROACHES

Geomorphic characterization and assessment of the mine sites has involved two approaches, one focused on watershed characteristics using the methods of David Rosgen and the other on landform characterisitcs using the methods of the U.S. Forest Service. Combined, these two methods address the land features and processes needed to assess the geomorphic characteristics of the mine sites.

Data collection for these geomorphologic studies was conducted at intermittent intervals between April 2014 and May 2017. These studies included review of geologic and topographic maps, aerial photos, and satellite imagery as well as field measurements and site feature identification.

2.1 WATERSHED CHARACTERIZATION AND ASSESSMENT

A simplified watershed characterization and assessment was performed generally in accordance with the WARSSS (Watershed Assessment of River Stability and Sediment Supply) procedures developed by Rosgen (2007). WARSSS is a three-level technical framework of methods for assessing suspended and bedload sediment in rivers and streams. The WARSSS is directed primarily at stability of landforms, especially watercourses, as they might affect site reclamation rather than sediment transport. Therefore, only relevant elements of WARSSS have been utilized. If necessary, a more detailed WARSSS

assessment will be performed in later phases of the project. The watersheds of the four mine sites are shown on Figures BLJK1-1, BLJK2-1, MAC1-1 and MAC 2-1. The results of the WARSSS are documented in Table 1.

2.1.1 Reconnaissance Level Assessment

The initial WARSSS level is Reconnaissance Level Assessment (RLA). RLA was performed in September-October 2014 and April 2015 and was used to determine which areas with mine features or uranium-related contamination are exposed to potential disturbance or erosion by surface water runoff. The RLA steps are:

1. Identify obvious sediment sources generated by mining activities
2. Identify channel stability impacts from mining (such as erosion or sedimentation of mine wastes) and, conversely, exposure of mine features and wastes to natural changes in channel stability
3. Exclude non-impacted watersheds/areas/reaches from further assessment; and
4. Locate impacted or potentially impacted areas for the next higher level of assessment.

2.1.2 Rapid Resource Inventory for Sediment and Stability Consequence (RRISSC)

The Rapid Resource Inventory for Sediment and Stability Consequence (RRISSC) is the second or intermediate assessment level. The three objectives of this assessment level are to 1) exclude low-risk areas from further consideration; 2) provide management and/or mitigation recommendations for moderate-risk rating sites with monitoring; and 3) identify high-risk sites, sub-watersheds and/or river reaches that require more detailed assessment. Such high-risk sites advance to the Prediction Level Assessment, or PLA. In this site characterization phase of the Black Jack Mac project, only objectives 1 and 3 are relevant and have been addressed.

PLA requires extensive field data and a level of analysis that exceeds the scope of site characterization phase. If necessary, the relevant elements of PLA will be undertaken in the later phase of the Black Jack Mac project. The results of the RLA and RRISSC assessments are documented in Table 2.

The effects of water and wind are treated together because one makes sediment available for the other to move. The effects of wind on each of the mine sites are evident in accumulations of sand and silt on the leeward side of some structures, brush and clumps of grass. However, dunes and deflation basins are not present on the sites. Wind direction is predominantly from the southwest but varies both seasonally and diurnally and is also affected by topography. Prevailing wind direction can be inferred from regional climate data and distributions of radiological contamination at each site. Soil-size ore and mine waste can be eroded, transported and deposited by wind, water, or both; both mechanisms operate and combine at all four sites to re-distribute those materials from their original locations on the mine sites. Average wind velocity in the Black Jack Mac area is 29 miles per hour at 80m above ground (NREL 2010), so wind has the capacity to move sand and silt size particles.

2.2 LANDFORM CHARACTERIZATION AND ASSESSMENT

Landform characterization and assessment is based on the U.S. Forest Service methodology (Haskins et al, 1998) and the output of the WARSSS. The objective is to assess the stability, both erosional and structural, of landforms on the mine sites and of landforms close enough to the mine sites to impact their long-term stability and land use.

The U.S. Forest Service methodology and nomenclature of Haskins et al, 1998 are documented on Table 3. This method has four components:

- Geomorphic Process
- Landform
- Morphometry
- Geomorphic Generation

2.2.1 Geomorphic Processes

The geomorphic processes that shaped the mine sites are tectonism, mass wasting, and fluvial and eolian erosion and deposition. Tectonism caused the uplift of the Zuni Mountains to the south, which caused the tilting of the Chaco Slope where the mines are located. Mass wasting has caused landslides and rockfalls in the general area, although these features are not present on the Black Jack and Mac mine sites. The present dominant process is fluvial erosion and deposition with contribution from and interaction with eolian erosion and deposition.

2.2.2 Landforms

The primary landforms are controlled by the underlying geologic strata and structures. The mine sites are underlain by sedimentary rock of Cretaceous age consisting of shale and sandstone units of the Mancos and Dakota formations. Two relic geologic structures, the Mariano Lake anticline and the Smith Lake syncline with axes running east-west and approximately one-half mile apart, control the terrain and drainage and thus the geomorphology of the mine sites.

The high ground is formed by mesas and cuestas capped by erosion-resistant sandstone. Low ground consists of dipslopes of sandstone or valleys with shallow alluvial soil over bedrock. Except for the north vent at Black Jack 2, the mine sites are located on low ground. Runoff as sheet flow and stream flow from high ground crosses all four mine sites, but watercourses are ephemeral, flowing only after large storms. Wind causes some erosion and deposition of sediment, but the dominant active processes affecting landforms are fluvial, either as sheet flow down slopes or stream flow, which is the more dynamic process in erosion.

2.2.3 Morphometry

At this level of site characterization, morphometry (landform measurement) consisted of selective surveying of channel depth and width at locations close to or immediately downstream of mine features that could be impacted by channel erosion. At a larger scale, measurements were taken from

topographic maps and from aerial and satellite imagery. More details measurements were made of the mine features that were man-made landforms such as waste rock piles and ore pads. Morphometry generally followed the WARSSS methodology of Rosgen and, therefore, is documented in Table 1.

2.2.4 Geomorphic Generation

Geomorphic generation is a part of the landform classification that allows for the recognition of more than one geomorphic process type or landform at any given location due to process overprinting. Three categories are generally recognized – active, dormant or relict – but only relic and active classifications apply to the mine sites. Geologic processes like folding and faulting are considered to be relic because there is no evidence of them being active in the mines area in Holocene time. Active applies to wind- and water-driven processes.

3 MINE SITE GEOMORPHIC CHARACTERIZATION AND ASSESSMENT

All four mine sites are located on the Chaco Slope of the San Juan Basin and have similar geomorphic features:

- Ephemeral, single thread watercourses
- Low to moderate channel sinuosity
- Slope grades on the mine sites less than 7%
- Sedimentary terrain with bedrock dipping ENE at 4 degrees or less, the result of the anticline-syncline folds

All the mine sites are tectonically stable with only relic features. Within the watersheds of Black Jack 1 and Black Jack 2, mass wasting is occurring in the upper reaches, well upslope of the mine sites. There are no landforms within any of the four mine sites that are subject to mass wasting or to substantial impact from eolian processes. Therefore, only fluvial processes (erosion or deposition) of overland and stream flow have impacted landforms within the mine sites.

None of the mine sites has permanent water impoundments or riparian habitat. Although there is some visible evidence of past crop cultivation at Mac 1, the historic land use is apparently grazing at all mine sites. Nothing in the natural geomorphology would limit grazing or other historic land use in the future.

3.1 MINE SITE GEOMORPHIC CHARACTERISTICS

For the purposes of this geomorphic characterization, except for Black Jack 1 the watershed of each mine is limited to the terrain upslope from the mine surface that contributes to runoff or erosion across the mine surface. Black Jack 1 watershed includes areas downstream of the mine site because arroyos there are advancing up gradient to the waste pile area.

All of the watersheds have only ephemeral watercourses that are influent when they convey runoff. Black Jack 2 has a relatively large watershed that extends far beyond the limits of the mine site; the other three mine sites have limited watersheds.

The geomorphic classifications of valleys and watersheds of the four mine sites, following the Rosgen WARSSS system (NRCS, 2007) are listed in Table 1.

3.1.1 Black Jack 1

Black Jack 1 is located on the north flank of the Mariano Lake Anticline, part of the Chaco Slope of the San Juan Basin. Black Jack 1 surficial soils are Holocene and Pleistocene colluvial and alluvial fan sediments (sand, silt, and gravel), derived from the Gallup Sandstone mesa to the west. Surficial soils overlie Mancos Formation consisting mostly of shale with sandstone and limestone interbeds, exposed in the low ridge north of the mine. Bedrock dips NNE, 2-3 degrees or 4-5%.

Black Jack 1 watershed (Figure BLJK1-1) is limited to 218.1 acres by several closely spaced drainages from the east side of Hosta Butte mesa, leaving only one narrow watershed above the mine site. This watershed extends approximately 5800 feet from the highest point in the watershed, at 8100 feet elevation, southeast to the confluence of the main and tributary arroyos crossing the site at 7390 feet elevation, with 4200 feet of that length up-gradient of the mine site. The westernmost 1300-1400 feet of the watershed is a very steep (30-50% grade) Type I valley with Rosgen Type A1a+ steam channels, below which both surface grades and watercourse grades flatten to as low as 2% away from the mesa in a Type III valley with predominantly Rosgen Type A1, B1, and G1 stream channels across the mine site. Hydrologic base level is controlled by Smith Lake 2.3 miles southeast of the mine site.

The watershed has one main arroyo (entrenched watercourse) that begins on the mesa slope and runs east, then southeast from the north side to the east side of the mine site. Two tributary arroyos (north arroyo and south arroyo) extend westward from the main arroyo near the downstream end of the watershed, each dividing into two branches, north branch and south branch (Figure BLJK1-2). The main arroyo and the tributaries are entrenched through 2-8 feet of alluvium into Mancos Formation shale.

The north arroyo is larger and more active than the south arroyo. Both branches of the north arroyo are entrenched, with steep sides and narrow channel beds, and are naturally actively headcutting. (Photo BJ1-8). The south branch of the north arroyo is headcutting toward the waste rock pile (Figure BLJK 1-2).

However, ground has been modified along the north branch of the north arroyo near the remnants of the mine surface facilities (Figure BLJK1-3, Photo BJ1-10) between the northeast edge of the waste pile and the main arroyo, apparently during mine operations, by filling in approximately 300 feet of the north branch, effectively damming the upstream portion of the branch and leaving a nick point (step) armored with metal, tires and other mine debris at the fence along the east-west half section line of Section 12 (Photo BJ1-9). The south branch is actively headcutting westward toward the south toe of the waste rock pile. The nick point on the south branch is 65 feet east of the north-south fence and approximately 150 feet from the toe of the waste pile (Photo BJ1-8).

The south arroyo is smaller and less entrenched than the north arroyo. The north branch of the south arroyo and the south branch of the north arroyo are advancing west-northwest along parallel paths approximately 100 feet apart. However, the latter has a steeper gradient and can be expected to capture more of the runoff from the former over time.

3.1.2 Black Jack 2

Black Jack 2 is located on the west arm of a structurally controlled valley over the south limb and axis of the Smith Lake Syncline. The surface has a thin cover (less than 10 feet) of eolian sand and alluvial sand, silt, and gravel as valley fill on the eroded surface of the Twowells Tongue of the Dakota sandstone or the Whitewater Arroyo Tongue of the Mancos Formation (Green and Jackson, 1975; Robertson, 1990). The mesa to the northwest, where the vent shaft is located, is capped by the Twowells Tongue of the Dakota sandstone overlying the Whitewater Arroyo Tongue of the Mancos Formation. Bedrock units dip NNE at approximately 2 degrees, and ground surface generally slopes NE at 2-2.5%. Base level is controlled by the earthen dam in Section 7, approximately one mile north.

The Black Jack 2 watershed, illustrated on Figure BLJK2-1, is relatively large, 4616 acres, extending from the top (southern) edge of the mesas north of highway I-40 approximately 4.3 miles NNE to the Black Jack 2 site, descending from 8351 feet to 7435 feet elevation at an average slope of 4%. The watershed has two distinct valley types, Type I in the mesas (upper 4 miles of the watershed) and Type III in the valley where the mine site is located.

Most of the watershed consists of the slopes of north-tilted mesas (cuestas) that are drained by three deeply incised and degrading canyon tributaries (Type I valleys with Rosgen Type A1 streams) that separate these cuestas and merge to the north to form the primary watercourse at 1.2 miles and 1.6 miles from the mine site. The primary watercourse is a Type IV valley with a Rosgen Type G4c/G5c stream that descends at an average grade of 2.8% through the canyon to the stock pond at Wolf Canyon Road, where the canyon ends 0.3 miles upstream (south) of the mine site. At that point the slope gradient flattens to 1.5-2.0%, the channel definition becomes less distinct, and aggradation (sediment deposition) is dominant.

The stock pond is formed by a cross-valley berm. It has no constructed spillway, but the overflow is evidently from the northwest corner along a chute, eroded to rock, that ends at the road, where overflow spills over the road. North of the road the watercourse is in a Type III valley and Rosgen Type C6/F6 natural channel for 0.25 miles, at which point it has been diverted to a more northeasterly course from the natural northwesterly course that passes the old mine hoist house 0.33 miles from Wolf Canyon Road. From that point north, the original channel is difficult to discern and appears to become braided and mostly filled with eolian or alluvial sediment before ending in the alluvial fill basin 0.75 miles north of Wolf Canyon Road. The diversion channel extends 0.25 miles around the east side of the mine site and rejoins the original stream course approximately 0.2 miles upstream of the alluvial basin.

A broad and shallow swale occupies approximately 113 acres that includes the west half of the mine site (Figure BLJK2-2). It drains the mesa slope west of the primary watercourse canyon and a smaller canyon within that mesa. There is no discernible watercourse in the valley beyond the mouth of the canyon,

and the runoff from the canyon appears to disperse across the broad swale that follows the toe of the mesa west of the mine site.

The earthen dam is Section 7 has created a hydrologic base level for runoff from both Black Jack 2 and Mac 2 mine sites, causing development of a flood plain playa (the alluvial fill basin) in the Type VIII valley upstream of the dam. By trapping sediment from a large watershed, the playa has expanded over parts of section 7, 17, and 18.

3.1.3 Mac 1

The watershed is small with a total area of 173.7 acres, extending 1.1 miles SSW from the mine and only 1000-1600 feet wide with a nearly uniform grade of 2.9% and also extending NNE from the mine site at a steeper grade of 5.8% for 0.27 miles and less than 1000 feet wide. Base level is controlled by Mariano Lake, approximately 5 miles west.

The mine site is located between the SSW and NNE slopes in a topographic saddle aligned along the synclinal axis at elevation of approximately 7450, with higher ground up to elevation 7514 to the NNE and elevation 7605 to the SSW (Figure MC1-1). Surface water runs down these slopes toward the mine, then either WNW along a Type IV shallow valley with Rosgen C6c/E6 watercourse to a north-draining canyon 2000 feet west of the mine site or ESE through a steep draw with Type VI valley and Type G1/G4 watercourse that heads on the east side of the mine site and discharges to another north-draining canyon east of the mine. Man-made diversion ditches were excavated north and west of the mine surface facilities, apparently by the mine operator, to intercept runoff from the north slope and direct it to natural arroyos west of the mine site. These diversion ditches are not included in this geomorphic assessment because they are not natural watercourses and can be easily removed without impacting the watershed.

The Mac 1 mine (Figure MC1-2) is located along the axis of the Smith Lake syncline, which controls the topography of the site and causes the rock units exposed at mine ground surface to be essentially horizontal. The Twowells Tongue of the Dakota sandstone is exposed where the thin overlying alluvium is missing or has been removed. The site has been extensively cleared, leaving only sparse tree cover around the edges.

3.1.4 Mac 2

The Mac 2 watershed of 30.2 acres (Figure MC2-1) extends south to and slightly beyond Wolf Canyon Road and north to the fence at the north boundary of the mine. The high point is elevation 7605 at the southeast corner of the watershed, and the low point is elevation 7417 in the watercourse at the north fence. Runoff from the upper portion of the watershed is sheet flow for up to 600 feet before reaching a watercourse. Several small Type C1b/E5b watercourses begin in the upper part of the Type VI valley watershed and gradually converge northward and then merge at the north edge of the mine site.

The Mac 2 mine claim area and facilities (Figure MC2-2) occupy 6.85 acres located on the south limb of the Smith Lake Syncline. Surface soils are a thin overlay of Holocene and Pleistocene colluvium consisting of silt, sand and gravel resting on Whitewater Arroyo Tongue of the Mancos (shale with

laminated sandstone and siltstone) grading upward into the Twowells Tongue of the Dakota sandstone. Channel depth, and therefore entrenchment, is limited to the depth of soil, generally less than two feet, that overlies erosion-resistant sandstone. Bedrock dips NNE at approximately 4 degrees or 7% grade. Ground surface is slightly flatter at 3.5-4% grade. Base level is controlled by the earthen dam in Section 7, approximately one mile north, which has caused the channel gradients to flatten downstream of the Mac 2 site, creating more aggrading conditions.

3.2 MINE SITE GEOMORPHIC ASSESSMENTS

3.2.1 Black Jack 1

Black Jack 1 mine site is illustrated in figures BLJK1-1, BLJK1-2 and BLJK1-3. The only geomorphic process of importance with respect to reclamation and future land use is fluvial erosion. The south branch of the north arroyo and the north branch of the south arroyo are actively headcutting westward toward the waste rock pile (Photo BJ1-8). The waste rock pile is releasing sediment currently with sheet and rill flow, but the rate of erosion will increase as the nick point (step in the channel thalweg) advances closer to the pile. No data are available to support a calculation of erosion rates in either arroyo branch.

The arroyo banks are steep and even undercut in many locations, but lateral migration is not likely to pose a risk to the mine surface footprint because the watershed is small, and the sinuosity is only moderate, especially in the arroyo channels downgradient from the mine. This assessment is supported by the watercourse management score of very low to low for the Streambank Erosion Potential (Table 4). Other watercourse management scores (for Sensitivity to Disturbance, Recovery Potential, Sediment Supply, Vegetation Controlling Influence) are all favorable or neutral for maintaining or improving stream channel stability. However, as noted on the table, headcutting of the north branch of the south arroyo and the south branch of the north arroyo as well as the stability of the nick point on the north branch of the north arroyo are flagged for action in Table 4.

3.2.2 Black Jack 2

Black Jack 2 mine site is illustrated in BLJK2-1 and BLJK2-2. The mine site is flat and virtually devoid of landforms that extend above the general ground surface. However, the watershed above this mine site is relatively large with deep canyons, and runoff is concentrated in the main canyon (primary watercourse) that discharges to the stock tank at Wolf Canyon Road and then across the mine site. Although the watercourse gradients are not high for terrain with steep canyon walls, the short time of concentration of runoff from the canyon walls to a channel with constrained width makes flash flooding likely in the watershed down to Wolf Canyon Road. Once the road is overtopped, a flash flood would quickly fill the shallower, flatter channel through the mine site and would probably inundate the mine site and overflow to the swale along the toe of the mesa. The watercourse management scores (Table 4) emphasize the vulnerability of Black Jack 2 to flash flood impacts, with high Sensitivity to Disturbance, Sediment Supply, and Streambank Erosion Potential.

3.2.3 Mac 1

Mac 1 mine site is illustrated in figures MC1-1 and MC1-2. The mine site is located on a topographic saddle with upslope gradients limited by the synclinal limbs that afford substantial protection against both mass wasting and fluvial process hazards. Shallow sandstone provides protection from advancement of the east side draw, which receives a minor amount of the runoff from the watershed; most of that runoff flows westward off of the mine site. The watercourse management scores for the east draw rapidly deteriorate east of the mine site, but on the mine site the sandstone bedrock supports the desirable end of the score range listed on Table 4.

The valley to the west from the mine site drains the majority of runoff from the watershed. Except for some man-made diversion ditches, the runoff path to the west follows the valley axis without entrenchment until it is beyond the mine site boundary. The soil is erodible but is protected by a low surface gradient and good vegetative cover. Thus, the west valley has good watercourse management scores.

3.2.4 Mac 2

Mac 2 mine site is illustrated in figures MC2-1 and MC2-2. The site contains no mass wasting landforms. Eolian erosion and deposition occurs on a small scale, resulting in minor deposition of windblown sediment on the leeward side of shrubs. The limited watershed area and shallow soils above bedrock on the uniform cuesta dipslope create conditions for brief, rapid runoff after intense storms with consequent high potential for surface disturbance (in the form of lateral migration of watercourses) but with relatively low net soil erosion. Mine waste piles form the only features that rise above the dipslope and, therefore, are particularly vulnerable to erosion from lateral migration of the shallow, slightly entrenched watercourses. The pinnate dendritic to subparallel channel pattern makes channel merging and splitting relatively easy, so present locations of watercourses offer no assurance that waste piles are safe from stream erosion processes in the future. The watercourse management scores (Table 4) are mixed - shallow soil and lack of entrenchment make Mac 2 watercourses very sensitive to disturbance and prone to streambank erosion, but good vegetative cover and low-moderate sediment generation provide good recovery potential.

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TABLES

Table 1: Watershed Assessment of River Stability and Sediment Supply (WARSSS) Classifications

Site	Watershed		Valley Type	Rosgen Stream Type	Channel Pattern (sinuosity)	Channel Width/ Depth Ratio	Entrenchment Ratio (valley width/bank width)	Comments
	Length, mi.	Ave. Gradient						
Black Jack 1 (overall)	0.8	0.098	III		sinuous			entire watershed
Main arroyo	1.08	0.5 to 0.02						top of mesa to junction with south arroyo
mesa slope	0.2	0.5	I	A1a+	1.1	0.5	1	
above nick point to mesa	0.66	0.02	III	B6	>1.2	>12	1.4 -2.2	
below nick point	0.53	0.025	III	G1	>1.2	<12	<1.4	
North arroyo main stem	0.06	0.03	III	G1	~1.2	~1	~1	from nick point east from fence
North branch	0.09	0.04 to 0.025	III	A1	<1.2	<12	<1.4	blocked by makeshift dam at nick point at fence
above nick point	0.18	0.037	III	B1	<1.2	>12	~1.4	north branch of north arroyo partly backfilled
South branch	0.15	0.063	III	A1	<1.2	<12	<1.4	advancing toward south edge of waste pile
South arroyo main stem	0.1	0.044	III	A1	<1.2	<12	~1.4	toe of mesa to nick point at sec. 12 east fence
North branch	0.3	0.033	III	B1	<1.2	>12	1.4 -2.2	advancing toward south edge of waste pile
South branch	0.06	0.044	III	B1a	<1.2	>12	~1.4	
Black Jack 2	4.3	0.038						entire watershed
Primary watercourse	4	0.028	I		<1.2			entire watercourse
top to mile 1.15	1.15	0.038	I	A1	<1.2	<12	~1	steep canyon walls with narrow bottom
mile 1.15 to mile 2.3	1.16	0.039	I	A1	<1.2	<12	~1	steep canyon walls with narrow bottom
mile 2.3 to mile 3.73	1.43	0.015	IV	G4c/G5c	1.0 to 1.1	<12	>1.4 to <1.4	steps separated by non-entrenched sections
Wolf Canyon Rd to mine	0.37	0.015	III	C6/F6	<1.2	>12	> 1.4	original channel
Swale at toe of mesa	1.05	0.019	III	na	na	> 40	na	no discernible channel, slopes to valley basin
Mac 1								no entrenched watercourses on the mine site
South slope	1.1	0.027						no watercourses
North slope	0.27	0.045						no watercourses
West valley	0.31	0.007	IV	C6c/E6	<1.2	>12	> 1.4	no natural watercourse west from center of mine site to fence line; north slope man-made diversions
East side draw	0.33	0.037	VI	G1/G4	<1.2	>12	> 1.4	channel starts east of mine boundary (fence line), where gradient and entrenchment increase to east
Mac 2	0.4	0.037	VI	C1b/ E5b	1.35	<12	>2.2	several small watercourses slightly entrenched, merge into one channel at north fence line

Table 2: Simplified Watershed Assessment Per WARSSS

Reconnaissance Level Assessment (RLA)		Black Jack 1	Black Jack 2	Mac 1	Mac 2
RLA1	Sediment sources generated by mining activities	Waste pile, ore pad, deteriorated concrete	Remnant ore and waste rock, shaft muck piles near north vent shaft, drill cuttings	Remnant ore and waste rock, drill cuttings	Waste pile, ore pad, deteriorated concrete, trash piles
RLA2	Channel stability impacts from mining	Debris dam and partial backfilling of north branch of north arroyo	0.25 diversion channel, sedimentation in channel downstream of mine site	Redirection of flow and sediment released from north slope diversion ditches	Some possible lateral constraint of easternmost watercourse adjacent to the large waste rock pile.
RLA3	Exposure of mine features, wastes to natural changes in channel stability	Waste pile and ore pad in path of natural headcutting of arroyos	Entire mine site vulnerable to inundation if Wolf Canyon stock tank is breached.	Potential but minimal risk of headcutting of east draw into waste rock pile area.	Waste piles and shaft vulnerable to erosion due to lateral migration of channels.
RLA4	Non-impacted watersheds, areas, reaches excluded from further assessment	Watercourses west of mine.	Primary watercourse upstream of stock tank at Wolf Canyon Road, swale at toe of mesa west of mine.	South slope south of waste pile/ ore pad areas, north slope above diversion ditches.	Watercourses upstream from southernmost trash pile and concrete foundation.
Rapid Resource Inventory for Sediment and Stability Consequence (RRISSC) *		**Black Jack 1**	**Black Jack 2**	**Mac 1**	**Mac 2**
RRISSC 1	Low-risk areas excluded from further consideration	Areas west of access road, north of main arroyo, and south of north branch of south arroyo	Primary watercourse upstream of stock tank at Wolf Canyon Road, swale at toe of mesa west of mine.	RLA4 list	Watercourses upstream from southernmost trash pile and concrete foundation.
RRISSC 3	High-risk sites, sub-watersheds and/or river reaches requiring more detailed assessment.	RLA5 list plus waste pile, ore pad	Ore pad and waste pile areas, primary watercourse north of Wolf Canyon Road,	none	RLA 5 list, shaft.

*RRISSC 2 was not evaluated in this phase.

Table 3: Landform Classification

Site	Process		Landform	Geomorphic Generation	Comments
	Primary	Subprocess			
Black Jack 1	Tectonic	Folding	Anticline - north limb	Relic	Tectonically stable
	Mass Wasting	Fall	Talus on mesa slope	Active	Not impacting mine site
	Eolian	Deposition	Sand sheet	Active	Thin, discontinuous across site
	Fluvial	Fluvial Slope	Mesa- eroding slope	Active	West of mine site
	Fluvial	Fluvial Slope	Alluvial fan	Active	Thins to ESE across the mine site
	Fluvial	Fluvial Slope	Erosion fan remnant	Active	Arroyos entrenching through alluvium into underlying shale
	Fluvial	Stream	Channel, thalweg	Active	Shallow arroyos in alluvium to nick points (steps), entrenchment into bedrock
Black Jack 2	Tectonic	Folding	Syncline - south limb	Relic	Tectonically stable
	Mass Wasting	Fall	Talus on mesa slope	Active	Not impacting mine site
	Mass Wasting	Slide	Rotational slide	Active	In canyons south of Wolf Canyon Road
	Eolian	Deposition	Sand sheet	Active	Thin, discontinuous across mine site
	Fluvial	Fluvial Slope	Eroding slope	Active	West of mine site; near north vent shaft
	Fluvial	Fluvial Slope	Cuestas - dipslopes	Active	Top of watershed to Wolf Canyon Road, south of mine site
	Fluvial	Stream	Floodplain, channel, thalweg	Active	Shallow arroyos and diversions in alluvium downstream of Wolf Canyon Road
	Fluvial	Stream	Channel, thalweg	Active	Canyons south of Wolf Canyon Road
Mac 1	Tectonic	Folding	Syncline axis	Relic	Tectonically stable
	Eolian	Deposition	Sand sheet	Active	Thin, discontinuous across mine site
	Fluvial	Fluvial Slope	Surface eroding slope	Active	Minor rilling associated with dipslope runoff, especially north slope
	Fluvial	Stream	Channel, thalweg	Active	Active westward headcutting of east arroyo, limited by Dakota Sandstone
Mac 2	Tectonic	Folding	Syncline - south limb	Relic	Tectonically stable
	Eolian	Deposition	Sand sheet	Active	Thin, discontinuous, concentrated on leeward side of vegetation.
	Fluvial	Fluvial Slope	Cuestas - dipslope	Active	Near downslope end of bedrock-control slope, which limits entrenchment
	Fluvial	Fluvial Slope	Surface eroding slope	Active	Minor rilling between watercourses associated with dipslope runoff
	Fluvial	Stream	Channel, thalweg	Active	Pinnate dendritic to subparallel channels

Landform Classification per U.S. Forest Service Methods (Haskins et al, 1998)

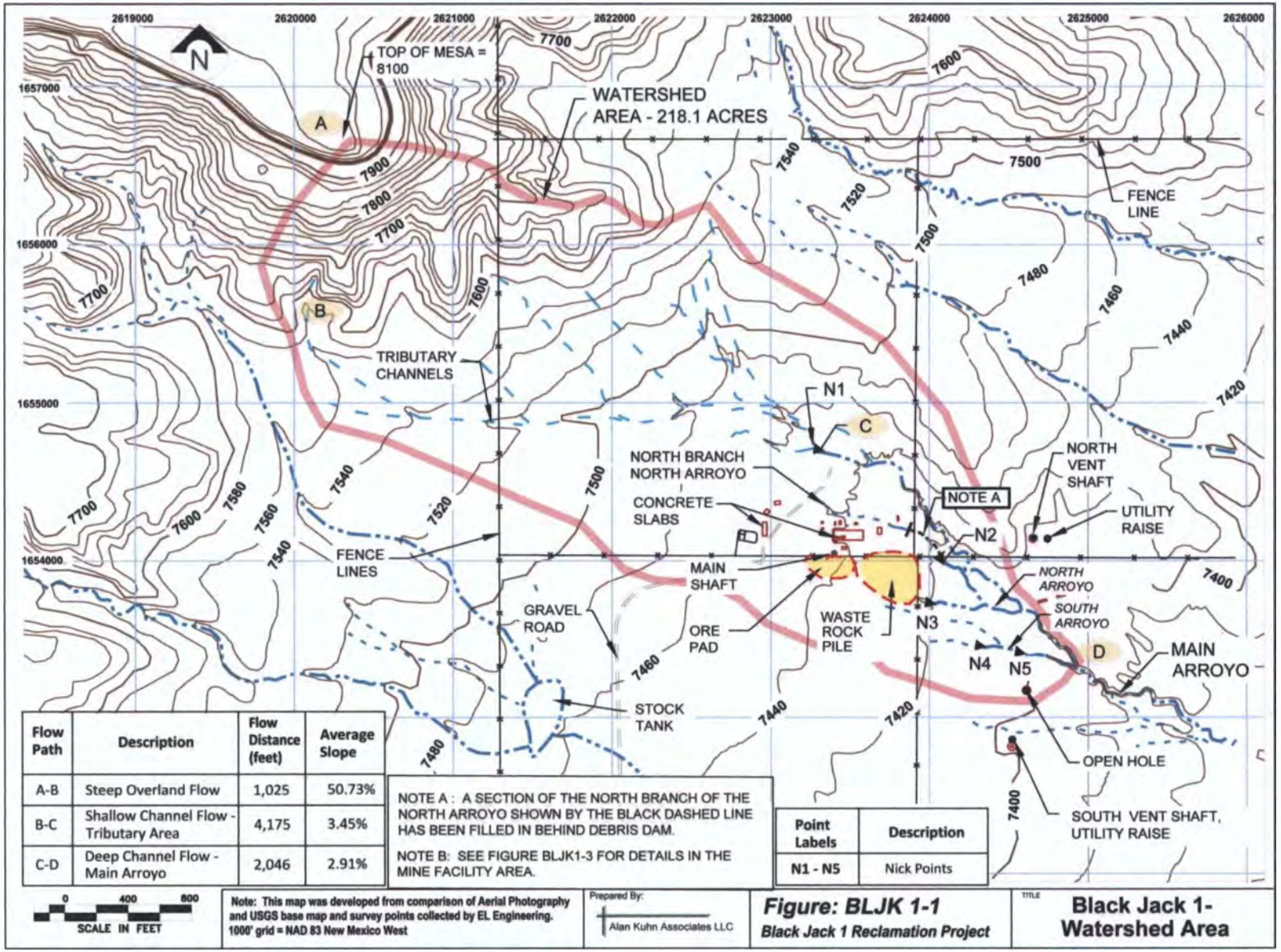
See WARSSS classifications for morphometrics.

Table 4: Watercourse Management

Site	Rosgen Stream Type	Sensitivity to Disturbance	Recovery Potential	Sediment Supply	Streambank Erosion Potential	Vegetation Controlling Influence	Comments
Black Jack 1 (overall)							
Main Arroyo							
mesa slope	A1a+	very low	excellent	very low	very low	negligible	no action required
toe of mesa to nick point	B6	moderate	excellent	moderate	low	moderate	no action required
below nick point	G1	low	good	low	low	low	no action required
North arroyo main stem	G1	low	good	low	low	low	no action required
north branch	A1	very low	excellent	very low	very low	negligible	no action required
above nick point	B1	very low	excellent	very low	very low	negligible	nick point is man-made, may be unstable
south branch	A1	very low	excellent	very low	very low	negligible	active headcutting
South arroyo main stem	A1	very low	excellent	very low	very low	negligible	no action required
north branch	B1	very low	excellent	very low	very low	negligible	active headcutting
south branch	B1a	very low	excellent	very low	very low	negligible	no action required
Black Jack 2							
Primary watercourse							
top to mile 1.15	A1	very low	excellent	very low	very low	negligible	no action required
mile 1.15 to mile 2.3	A1	very low	excellent	very low	very low	negligible	no action required
mile 2.3 to mile 3.73	G4c/ G5c	extreme	very poor	very high	very high	high	mine site flooding possible if stock tank is overtopped
Wolf Canyon Rd to mine	C6/ F6	very high	good to fair	high	high to very high	very high to moderate	radiological materials susceptible to erosion
Mac 1							
West valley	C6c/ E6	very high	good	low to high	moderate to high	very high	man-made diversion ditches on north slope
East side draw	G1/ G4	low to extreme	good to very poor	low to very high	low to very high	low to high	headcutting limited by sandstone.
Mac 2	C1b/ E5b	very high	good to very good	very low to moderate	low to high	moderate to very high	Channel beds vary from soil to rock

Watercourse Management by Rosgen Stream Type per Table 3, Rosgen and Silvey, 1996

FIGURES



Flow Path	Description	Flow Distance (feet)	Average Slope
A-B	Steep Overland Flow	1,025	50.73%
B-C	Shallow Channel Flow - Tributary Area	4,175	3.45%
C-D	Deep Channel Flow - Main Arroyo	2,046	2.91%

NOTE A : A SECTION OF THE NORTH BRANCH OF THE NORTH ARROYO SHOWN BY THE BLACK DASHED LINE HAS BEEN FILLED IN BEHIND DEBRIS DAM.

NOTE B: SEE FIGURE BLJK1-3 FOR DETAILS IN THE MINE FACILITY AREA.

Point Labels	Description
N1 - N5	Nick Points

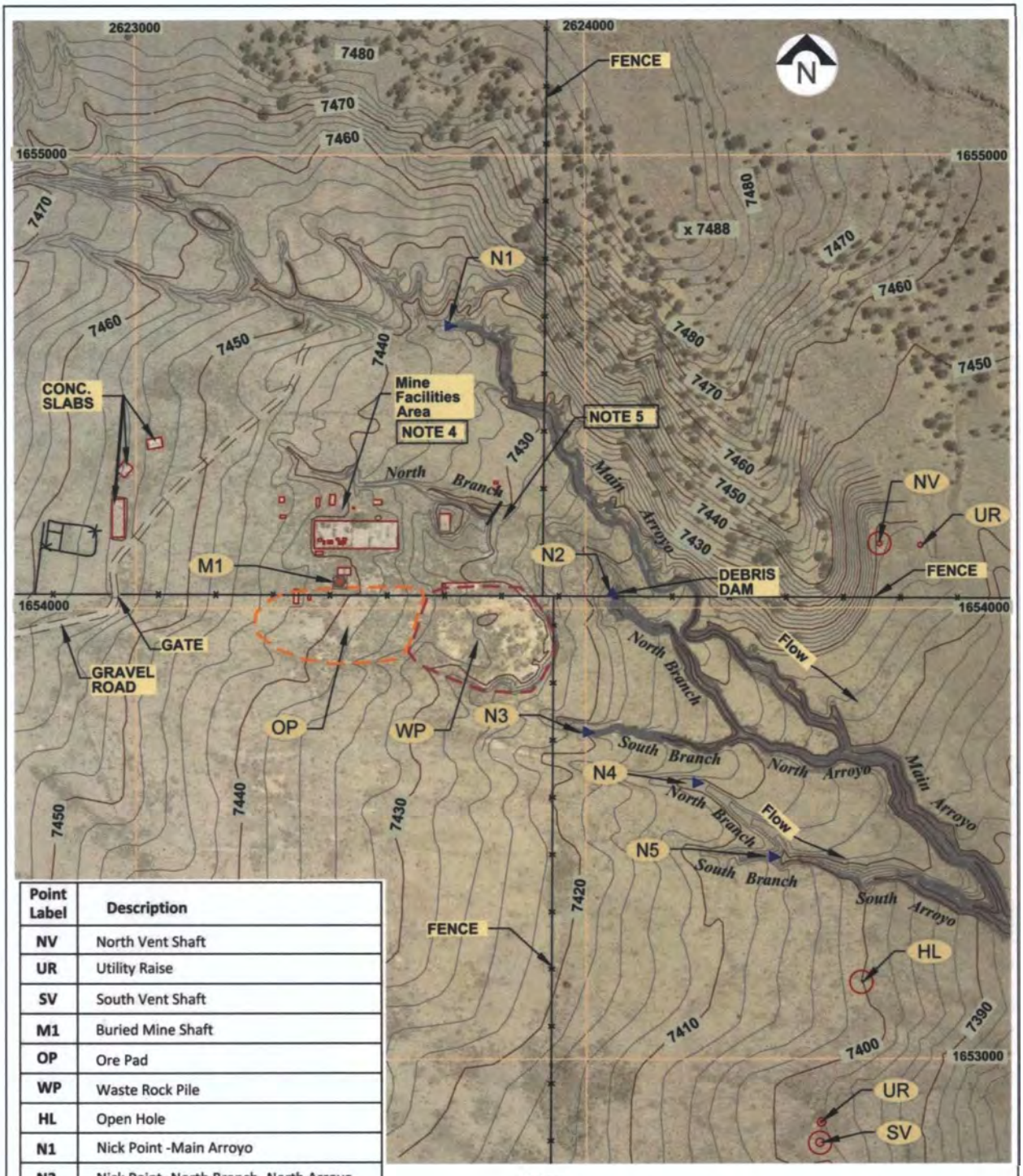
0 400 800
SCALE IN FEET

Note: This map was developed from comparison of Aerial Photography and USGS base map and survey points collected by EL Engineering.
1000' grid = NAD 83 New Mexico West

Prepared By:
Alan Kuhn Associates LLC

Figure: BLJK 1-1
Black Jack 1 Reclamation Project

TITLE
Black Jack 1- Watershed Area



Point Label	Description
NV	North Vent Shaft
UR	Utility Raise
SV	South Vent Shaft
M1	Buried Mine Shaft
OP	Ore Pad
WP	Waste Rock Pile
HL	Open Hole
N1	Nick Point -Main Arroyo
N2	Nick Point -North Branch -North Arroyo
N3	Nick Point -South Branch- North Arroyo
N4	Nick Point -North Branch-South Arroyo
N5	Nick Point -South Branch - South Arroyo

Notes:

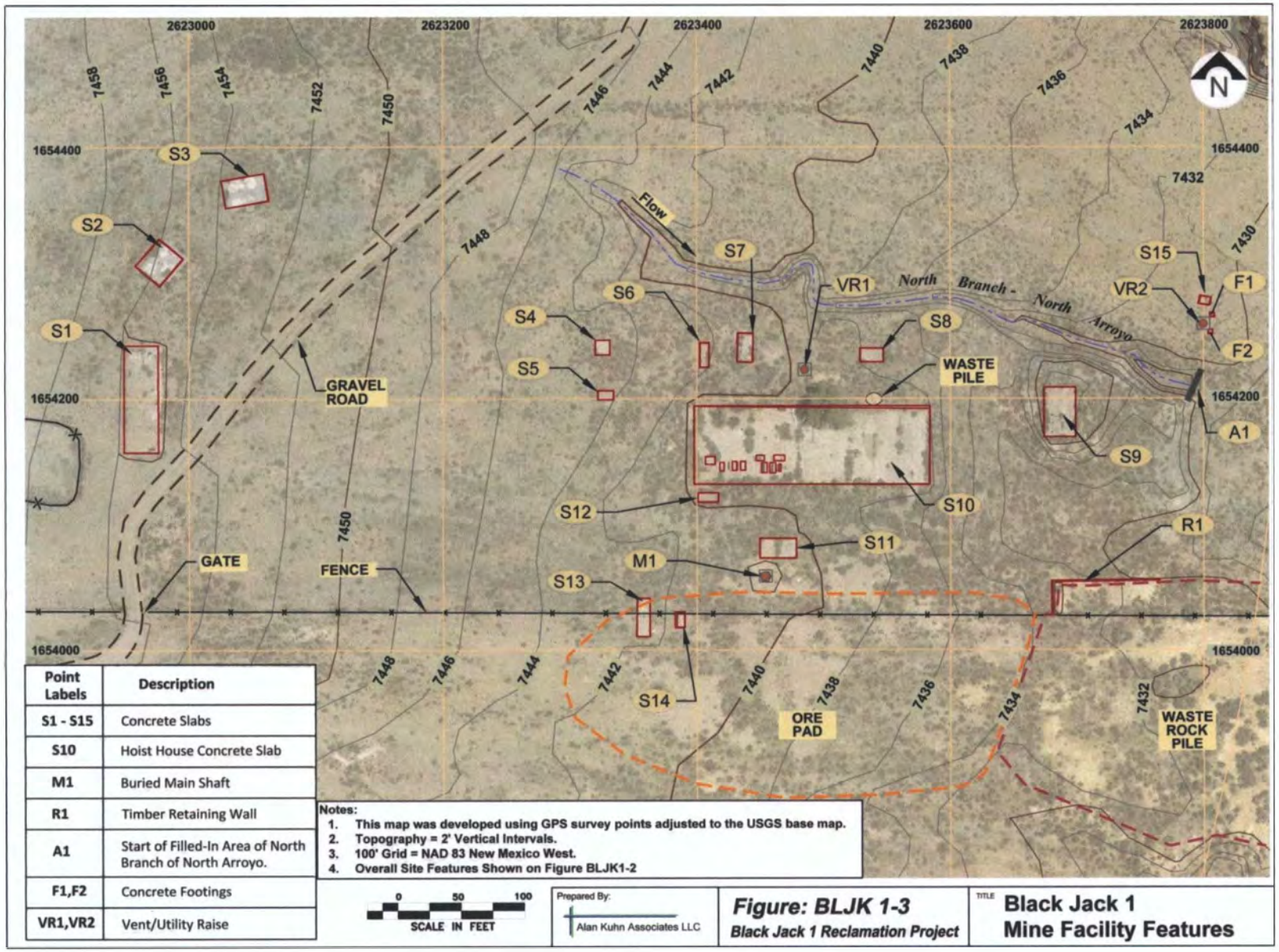
1. This map was developed using GPS survey points adjusted to the USGS base map.
2. Topography = 2' Vertical Intervals.
3. 1000' Grid and Coordinates = NAD 83 New Mexico West.
4. See Figure BLJK1-3 for Mine Facility Features.
5. Filled-In Section of North Branch of North Arroyo Behind Debris Dam.

0 150 300
SCALE IN FEET

Prepared By:
Alan Kuhn Associates LLC

Figure: BLJK 1-2
Black Jack 1 Reclamation Project

TITLE
Black Jack 1 Site Features



Point Labels	Description
S1 - S15	Concrete Slabs
S10	Hoist House Concrete Slab
M1	Buried Main Shaft
R1	Timber Retaining Wall
A1	Start of Filled-In Area of North Branch of North Arroyo.
F1,F2	Concrete Footings
VR1,VR2	Vent/Utility Raise

Notes:

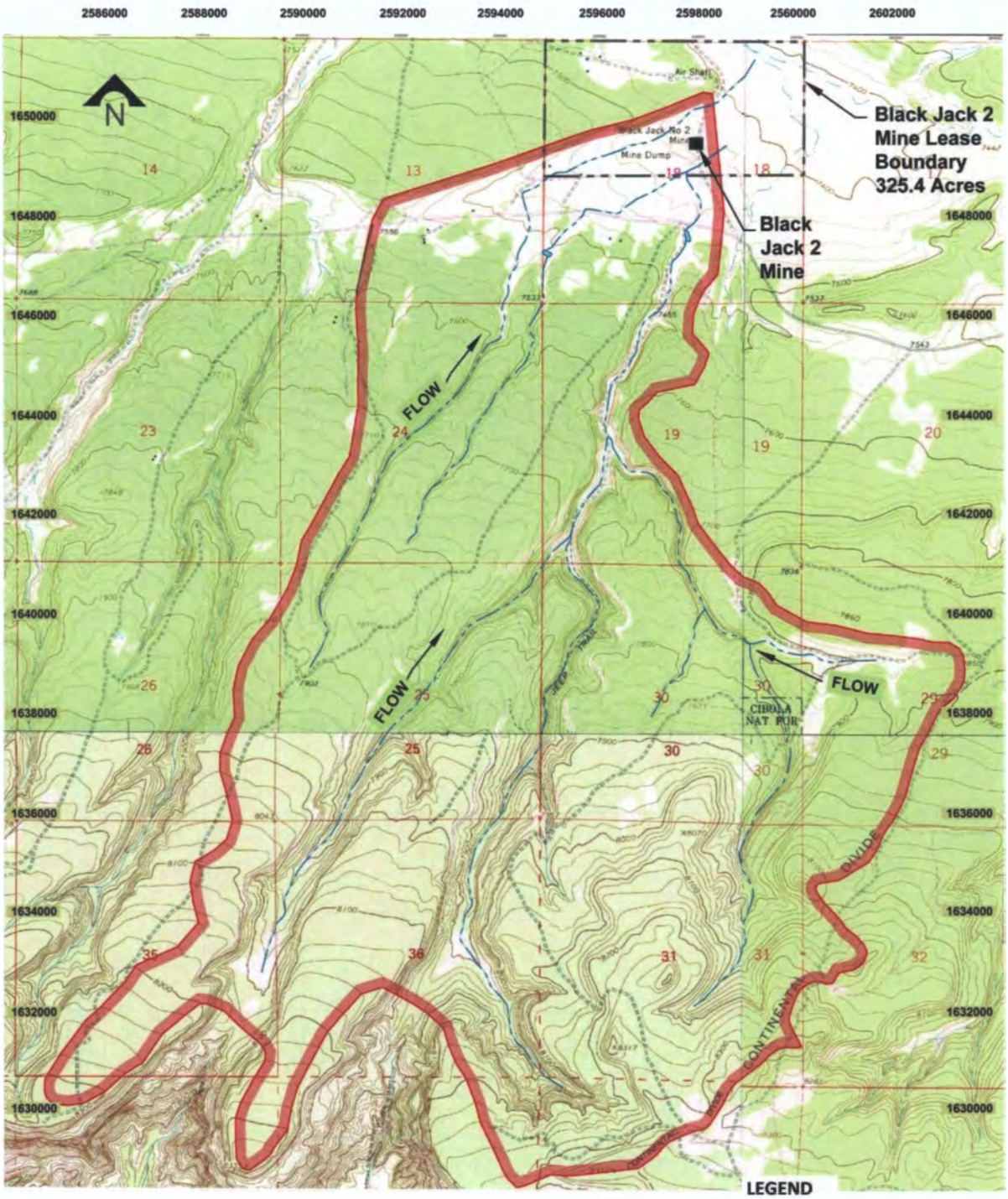
1. This map was developed using GPS survey points adjusted to the USGS base map.
2. Topography = 2' Vertical Intervals.
3. 100' Grid = NAD 83 New Mexico West.
4. Overall Site Features Shown on Figure BLJK1-2

0 50 100
SCALE IN FEET

Prepared By:
Alan Kuhn Associates LLC

Figure: BLJK 1-3
Black Jack 1 Reclamation Project

TITLE
Black Jack 1
Mine Facility Features

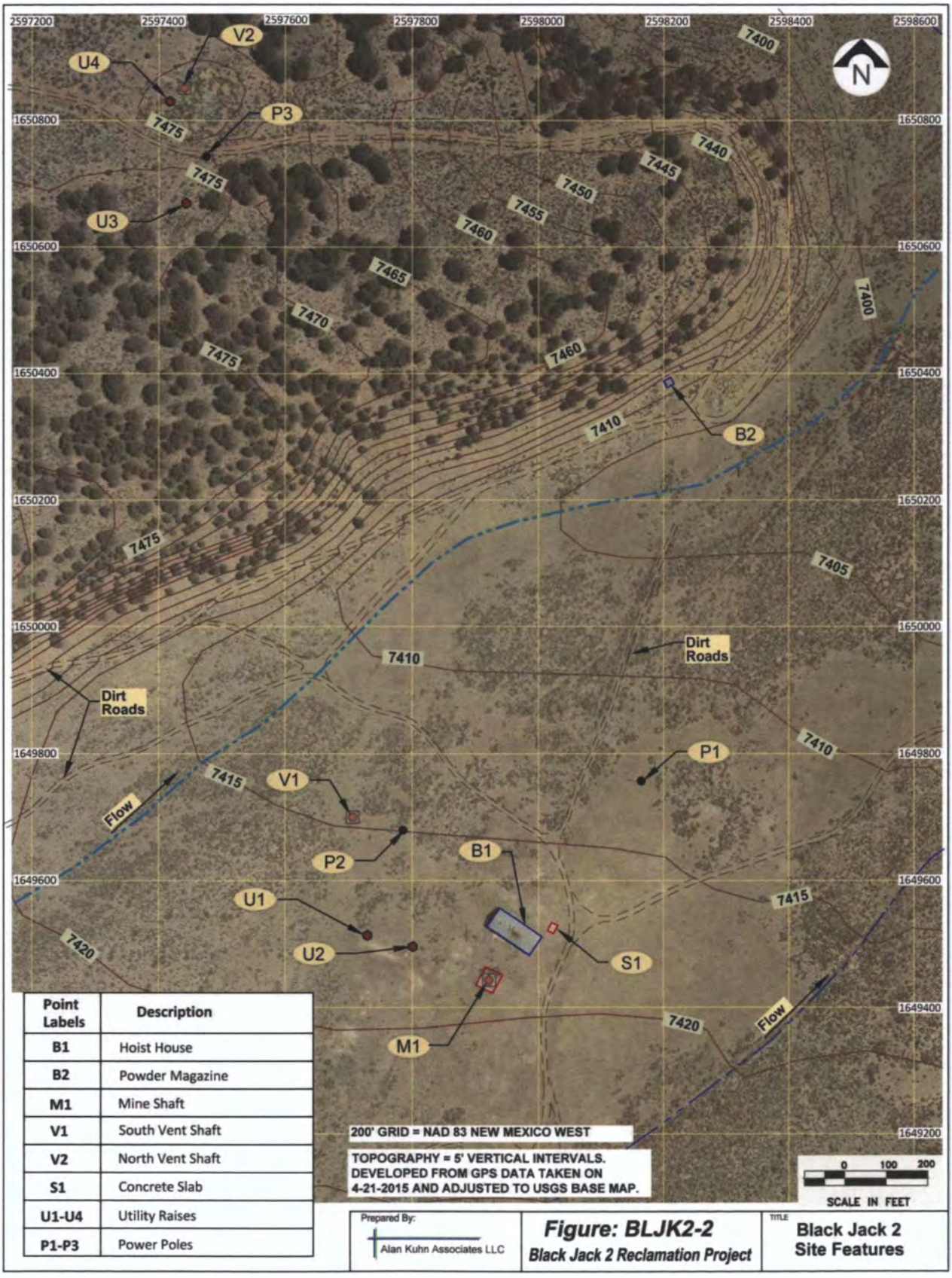


Note: This map was developed from USGS base map.
2000' grid = NAD 83 New Mexico West

Prepared By:
Alan Kuhn Associates LLC

Figure: BLJK2-1
Black Jack 2 Reclamation Project

TITLE
BLACK JACK 2
WATERSHED AREA

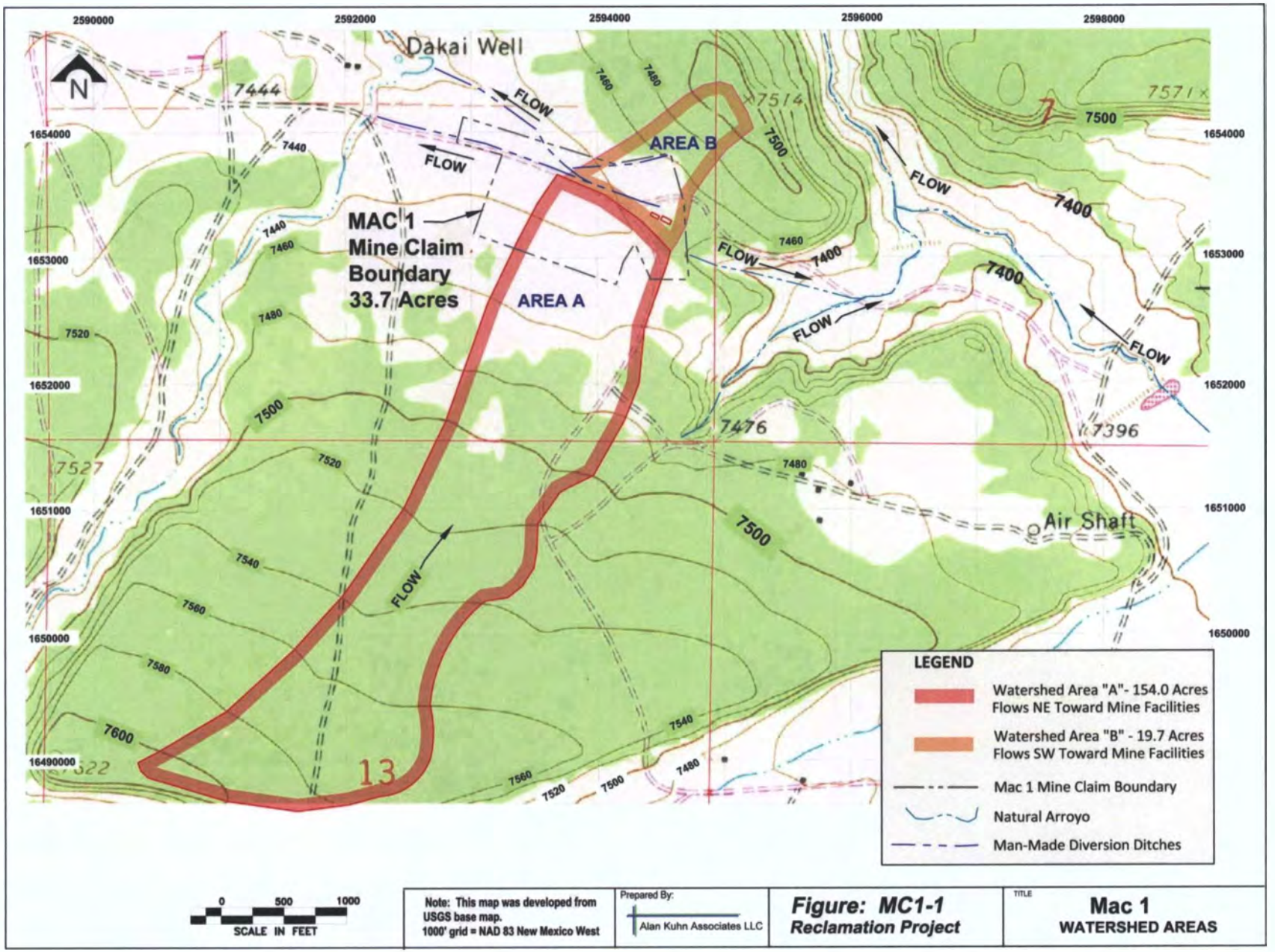


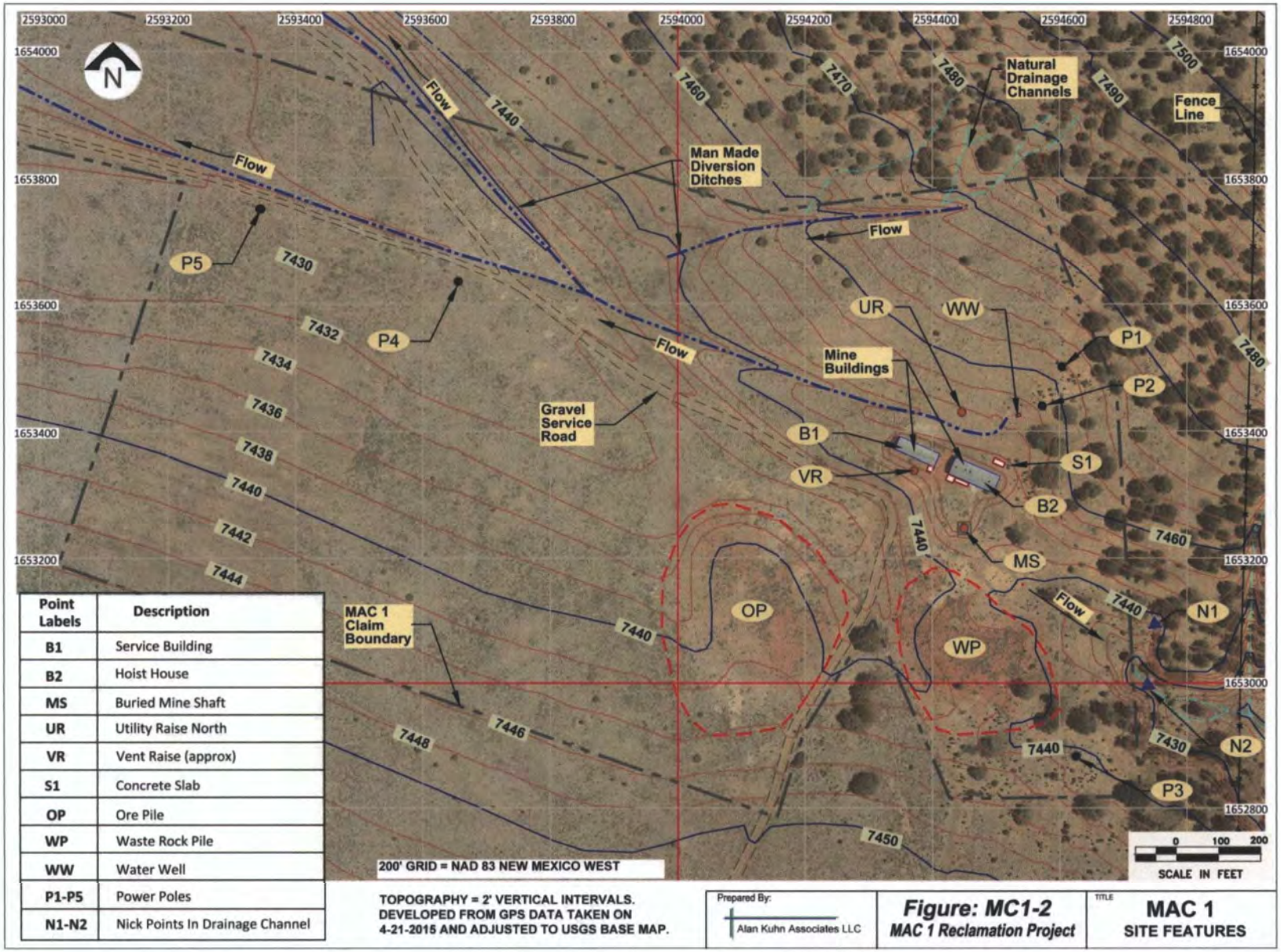
Point Labels	Description
B1	Hoist House
B2	Powder Magazine
M1	Mine Shaft
V1	South Vent Shaft
V2	North Vent Shaft
S1	Concrete Slab
U1-U4	Utility Raises
P1-P3	Power Poles

Prepared By: Alan Kuhn Associates LLC

Figure: BLJK2-2
Black Jack 2 Reclamation Project

TITLE
Black Jack 2 Site Features


2590000
2592000
2594000
2596000
2598000
Dakai Well
N
7444
FLOW
AREA B
MAC 1
Mine Claim
Boundary
33.7 Acres
AREA A
7514
7571
7500
7400
7460
7480
7520
7476
7396
7527
7540
7560
7580
7600
7522
13
Air Shaft
1654000
1653000
1652000
1651000
1650000
16490000
LEGEND
Watershed Area "A"- 154.0 Acres
Flows NE Toward Mine Facilities
Watershed Area "B" - 19.7 Acres
Flows SW Toward Mine Facilities
Mac 1 Mine Claim Boundary
Natural Arroyo
Man-Made Diversion Ditches
0 500 1000
SCALE IN FEET
Note: This map was developed from USGS base map.
1000' grid = NAD 83 New Mexico West
Prepared By:
Alan Kuhn Associates LLC
Figure: MC1-1
Reclamation Project
TITLE
Mac 1
WATERSHED AREAS



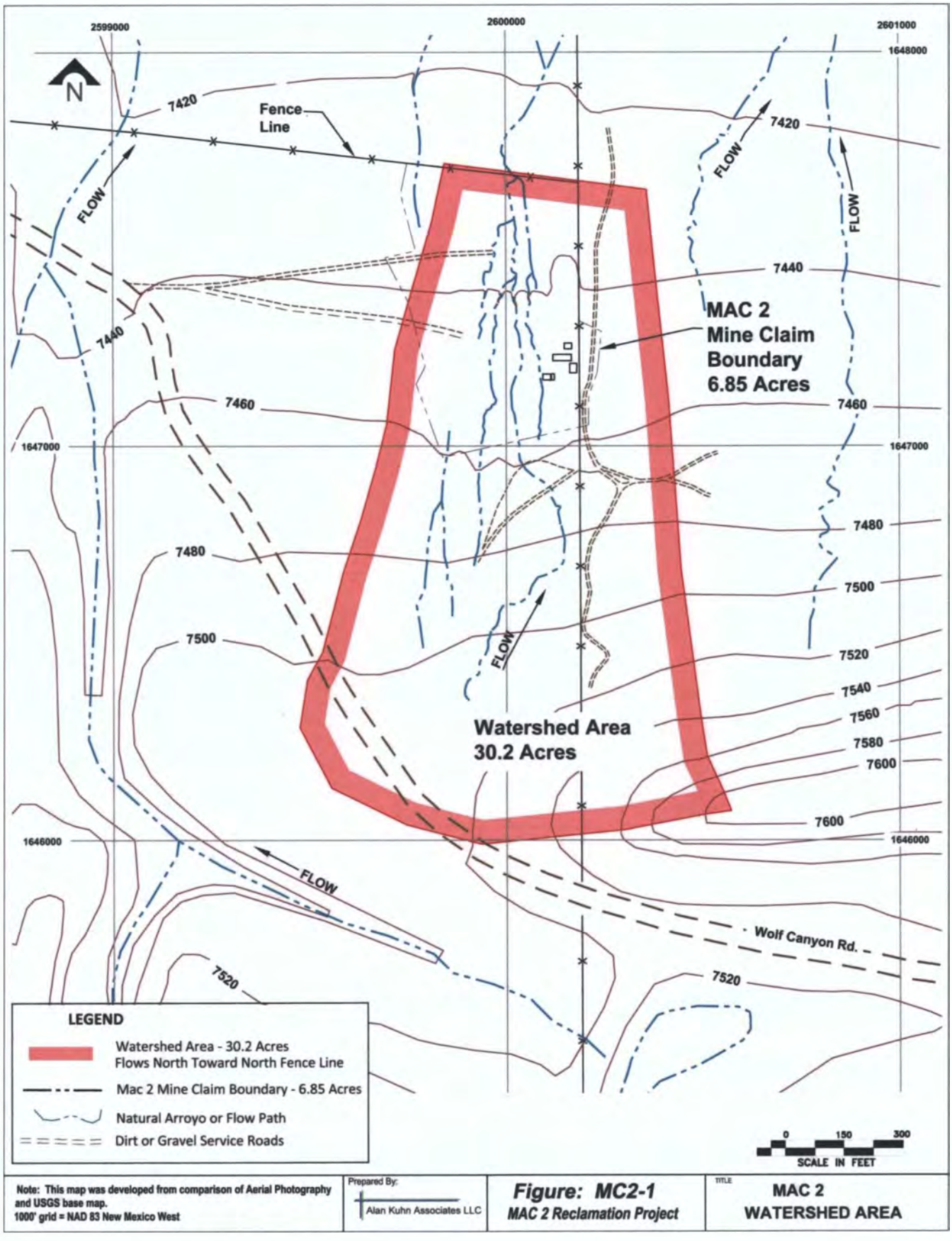
Point Labels	Description
B1	Service Building
B2	Hoist House
MS	Buried Mine Shaft
UR	Utility Raise North
VR	Vent Raise (approx)
S1	Concrete Slab
OP	Ore Pile
WP	Waste Rock Pile
WW	Water Well
P1-P5	Power Poles
N1-N2	Nick Points In Drainage Channel

TOPOGRAPHY = 2' VERTICAL INTERVALS.
DEVELOPED FROM GPS DATA TAKEN ON
4-21-2015 AND ADJUSTED TO USGS BASE MAP.

Prepared By: Alan Kuhn Associates LLC

Figure: MC1-2
MAC 1 Reclamation Project

TITLE
MAC 1
SITE FEATURES

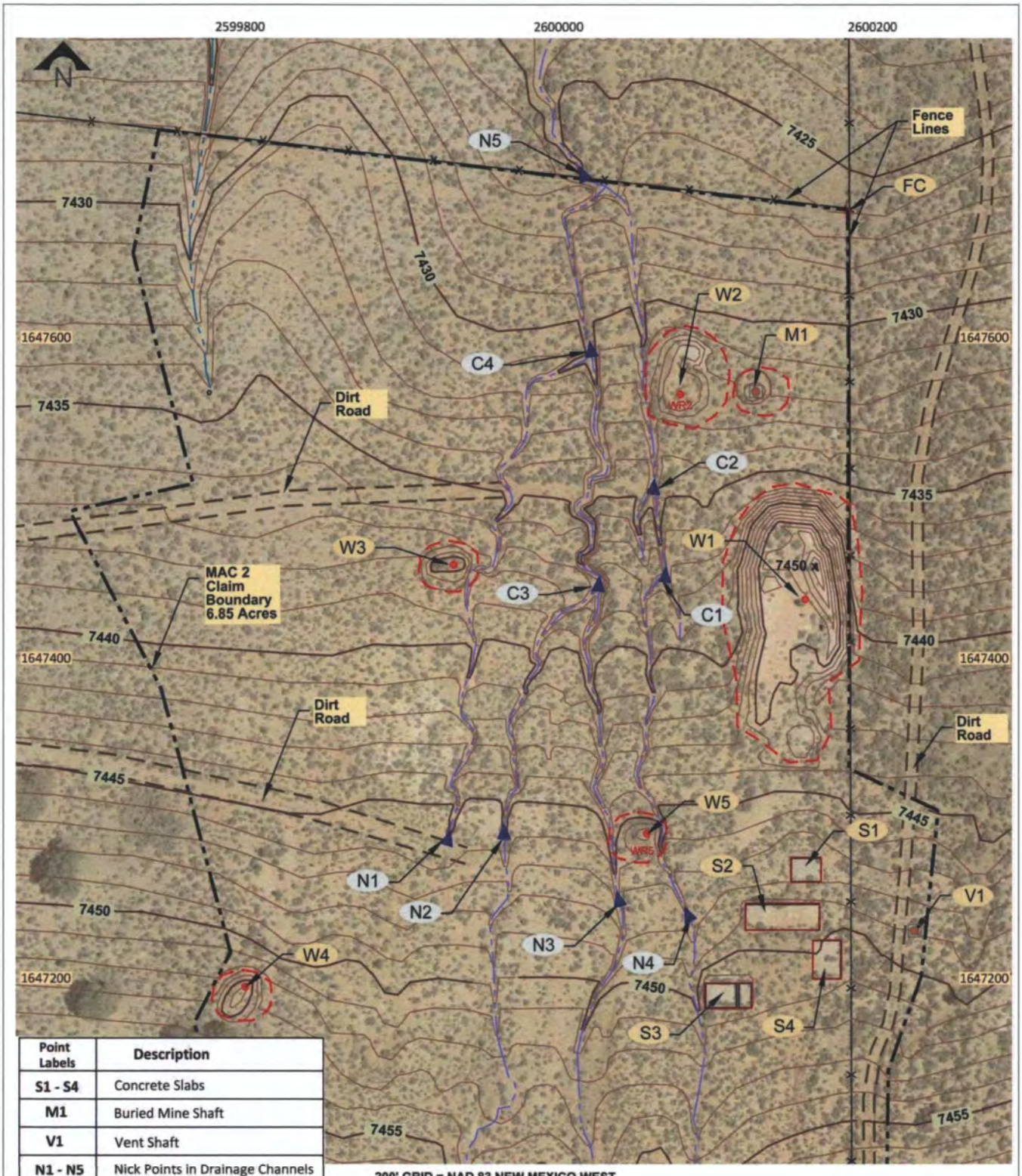


Note: This map was developed from comparison of Aerial Photography and USGS base map.
1000' grid = NAD 83 New Mexico West

Prepared By: Alan Kuhn Associates LLC

Figure: MC2-1
MAC 2 Reclamation Project

TITLE
MAC 2 WATERSHED AREA



Point Labels	Description
S1 - S4	Concrete Slabs
M1	Buried Mine Shaft
V1	Vent Shaft
N1 - N5	Nick Points in Drainage Channels
C1 - C4	Points of Convergence in Drainage Channels
W1	Waste Rock Pile
W2 - W5	Mine Waste Piles
FC	Fence Corner

200' GRID = NAD 83 NEW MEXICO WEST

TOPOGRAPHY = 1' VERTICAL INTERVALS.
DEVELOPED FROM GPS DATA TAKEN ON
4-21-2015 AND ADJUSTED TO USGS BASE MAP.

0 20 40 60 80
SCALE IN FEET

Prepared By:
Alan Kuhn Associates LLC

Figure: MC2-2
MAC 2 Reclamation Project

TITLE
MAC 2
SITE FEATURES

ATTACHMENT A

INVENTORY AND NON-RADIOLOGICAL HAZARD ASSESSMENT OF MINE SITE FEATURES

Black Jack and Mac Mines

Mine	Point Code	Feature	Location Coordinates NAD 83 NM West		Type of Hazard	Hazard Description	Photo in Attachment B
			Northing	Easting			
Black Jack 1	WP	Waste rock pile	1653924	2623802	Safety	steep slopes - trip and fall risk; step or fall on metal debris	BJ1-1
	WP	Waste rock pile	1653924	2623802	Environmental	blowing dust, fluvial erosion	BJ1-1
	OP	Ore pad area	1653960	2623475	Environmental	blowing dust, fluvial erosion	
	M1	Main shaft	1654060	2623453	Environmental	soil erosion and transport	BJ1-2
	NV	North vent shaft	1654142	2624652	Safety	incomplete backfill - fall risk	BJ1-3, -4
	F1	Concrete foundations	1654253	2623804	Safety and Environmental	trip, fall risk; loss of habitat	BJ1-5
	F2	Concrete foundations	1654266	2623805			BJ1-5
	VR1	Utility/vent raises	1654222	2623484	Environmental	contaminant pathway to ground water	
	VR2	Utility/vent raises	1654260	2623798			BJ1-6
	SV	South vent shaft	1652815	2624519	Safety	forced entry through cap plate - fall risk	BJ1-7
	SV	South vent shaft	1652815	2624519	Environmental	contaminant pathway to ground water	BJ1-7
	HL	Open hole near south vent shaft	1653171	2624614	Environmental	contaminant pathway to ground water	
	N1	Nick Point Main Arroyo	1654623	2623712	Safety and Environmental	fall risk and fluvial erosion	
	N2	Nick Point North Branch North Arroyo	1654039	2624072			
	N3	Nick Point South Branch North Arroyo	1653748	2624017			BJ1-8
	N4	Nick Point South Branch South Arroyo	1653473	2624297			
	N5	Nick Point South Arroyo	1653399	2624686			
	near N2	Debris dam on north branch north arroyo	1654015	2624060	Safety	unstable, fall and laceration risk	BJ1-9
	near N2	Debris dam on north branch north arroyo	1654015	2624060	Environmental	vermin habitat, alteration of surface water flow	BJ1-9
	A1	North branch north arroyo backfill	1654208	2623817	Environmental	backfill blocking arroyo - surface water impedance	BJ1-10
Black Jack 2	B1	NW Corner Hoist House	1649559	2597938	Safety	superstructure deteriorated - risk of collapse	BJ2-1
	M1	Mine Shaft	1649435	2597919	Safety	incomplete backfill - fall risk	BJ2-2 -3,-4,-5
	near U1 and U2	Waste pile and ore pad area	*1649400*	*2597800*	Environmental	blowing dust, fluvial erosion	BJ2-6
	V1	South Vent Shaft	1649704	2597703	Environmental	contaminant pathway to ground water	BJ2-7
	V1	South Vent Shaft	1649704	2597703	Safety	open hole - fall risk for child, small animals	BJ2-7
	U1	Utility Raise	1649498	2597800	Environmental	contaminant pathway to ground water	BJ2-8, -9
	U2	Utility Raise	1649508	2597733			
	U3	Utility Raise	1650678	2597442			
	U4	Utility Raise	1650835	2597411			
	S1	Concrete Slab (NW Corner)	1649533	2598019	Environmental	minor loss of habitat	
	V2	North Vent Shaft	1650853	2597441	Environmental	contaminant pathway to ground water	
	near V2 and U4	North vent shaft muck pile	*1650835*	*2597441*	Environmental	soil erosion and transport	
	B2	Powder Magazine	1650390	2598204	Safety	superstructure deteriorated - risk of collapse	

ATTACHMENT A **(continued)**

Mine	Point Code	Feature	Location Coordinates NAD 83 NM West		Type of Hazard	Hazard Description	Photo in Attachment B
			Northing	Easting			
	B2	Hoist House, Change House (NW Corner)	1653360	2594437	Safety	condition unknown; some deformation visible	Mac1-1
	MS	Main Mine Shaft (Center of Shaft)	1653248	2594448	Safety	incomplete backfill - fall risk	Mac1-2,-3,-4
	north of MS	Mine shaft tunnel (collapsed)	*1653300*	2594448	Safety	incomplete backfill - fall risk	Mac1-5
	S1	Concrete Slab (NW Corner)	1653357	2594498	Environmental	minor loss of habitat	Mac1-6
	WP	Center of Waste Rock Pile	1653057	2594452	Environmental	blowing dust, fluvial erosion	
	OP	Center of Ore Pile	1653115	2594122	Environmental	blowing dust, fluvial erosion	Mac1-7
	WW	Water Well	1653425	2594535	Environmental	contaminant pathway to ground water	Mac1-8
	VR1	Utlity Raise	1653429	2594536	Environmental,	contaminant pathway to ground water	Mac1-9,-10
	VR2	Vent Raise (approx)	1653338	2594372	Safety	open hole - fall risk for child, small animals	Mac1-9,-10
	N1	Start of Arroyo	1633104	2594751	Environmental	fluvial erosion	
	N2	Arroyo Dropoff	1653048	2594712	Environmental	fluvial erosion	
	none	Diversion ditches	N and NW of B1 and B2		Environmental	soil erosion and transport	
Mac 2	W1	Waste Rock Pile	1647424	2600154	Safety	steep slopes - trip and fall risk	Mac2-1
	W1	Waste Rock Pile	1647424	2600154	Environmental	fluvial erosion, blowing dust	Mac2-1
	W2	Mine Waste Pile	1647551	2600083	Environmental	fluvial erosion, blowing dust	Mac2-3
	W2	Mine Waste Pile	1647551	2600083	Safety	steep slopes - trip and fall risk	Mac2-3
	W3	Mine Waste Pile- trash	1647445	2599933	Safety	unstable scrap metal; fall and laceration risk	Mac2-2
	W4	Mine Waste Pile	1647181	2599801	Environmental	fluvial erosion, blowing dust	Mac 2-4
	W4	Mine Waste Pile	1647181	2599801	Safety	steep slopes - trip and fall risk	Mac 2-4
	W5	Mine Waste Pile	1647276	2600055	Environmental	fluvial erosion, blowing dust	
	S1	Concrete Slab (NW Corner)	1647261	2600146	Environmental	minor loss of habitat	
	S2	Concrete Slab (NW Corner)	1647232	2600178			Mac2-5
	S3	Concrete Slab (NW Corner)	1647183	2600092			
	S4	Concrete Slab (NW Corner)	1647209	2600160			
	M1	Main Mine Shaft (Center of Shaft)	1647552	2600124	Environmental	backfill settled, depression for water infiltration	
	V1	Vent Shaft	1647216	2600226	Environmental	contaminant pathway to ground water	Mac2-6
	V1	Vent Shaft	1647216	2600226	Safety	open hole - fall risk for child, small animals	Mac2-6
	N1	Start of West Channel	1639406	2616803	Environmental	fluvial erosion	
	N2	Start of West branch Center channel	1639410	2616840	Environmental	fluvial erosion	
	N3	Start of East branch Center channel	1639367	2616911	Environmental	fluvial erosion	
	N4	Start of East Channel	1639358	2616957	Environmental	fluvial erosion	
	N5	Channel Leaving the Site	1639822	2616889	Environmental	fluvial erosion	
	none	Roads	NA	NA	Environmental	soil erosion and transport	

NOTE: Coordinates were determined using hand-held GPS instrument, with commensurate accuracies.

Italic numbers are estimated values

ATTACHMENT B

PHOTOGRAPHICS OF BLACK JACK AND MAC MINE SITES

BLACK JACK 1

BJ1-1 Waste rock pile, looking north

BJ1-2 Main shaft backfill (mound in foreground) looking WNW

BJ1-3 North vent shaft

BJ1-4 Close-up view of north vent shaft

BJ1-5 Concrete foundations near main shaft

BJ1-6 Utility raise near south vent shaft

BJ1-7 South vent shaft

BJ1-8 Arroyo nick point (step)

BJ1-9 Mine debris dam blocking north branch of north arroyo

BJ1-10 Partial backfill in north branch of north arroyo

BLACK JACK 2

BJ2-1 Mine building

BJ2-2 Mine shaft

BJ2-3 Fencing around mine shaft improved in 2017, looking northwest

BJ2-4 Fencing around mine shaft improved in 2017, looking northeast

BJ2-5 Close-up of mine shaft collar

BJ2-6 Ore pad and waste pile area

BJ2-7 Open south vent pipe west of main shaft

BJ2-8 Well casing or utility pipe, with backfill

BJ2-9 Utility raise near north vent shaft

MAC 1

Mac1-1 Mine office building (left) and hoist/ change house (right)

Mac1-2 Mine shaft collar

Mac1-3 Mine shaft collar with fencing installed in 2017

Mac1-4 Close-up of mine shaft collar with fencing installed in 2017

Mac1-5 Collapsed shaft tunnel (foreground, with timbers)

Mac1-6 Concrete slab north of hoist house

Mac1-7 Ore pad area, view to SW

Mac1-8 Well and 10m tower (on its side), north of hoist house

Mac 1-9 Uncovered vent raise south of office building with fencing installed in 2017

Mac 1-10 Uncovered vent raise south of office building, looking east

MAC 2

Mac2-1 Large waste rock pile south of shaft

Mac2-2 Trash and waste pile west of large waste rock pile

Mac2-3 Small waste pile NW of large pile

Mac2-4 Small waste pile SW of large pile

Mac2-5 Concrete slabs south of larger waste rock pile

Mac2-6 Open vent raise southeast of large waste rock pile