Site Characterization Report
Pinos Altos Mining District
Grant County, New Mexico

CERCLIS Number: NMN000606749
Contract Number: W9126G-06-D-0025
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Pinos Altos, Grant County, New Mexico
Contract No. W9126G-06-D-0025
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List of Abbreviations and Acronyms

µg/kg	Micrograms per Kilogram
ABA	Acid Base Accounting
ARD	Acid Rock Drainage
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
E & E	Ecology and Environment, Inc.
ERT	Emergency Response Team
FOSC	Federal On-Scene Coordinator
GPS	Global Positioning System
HASP	Health and Safety Plan
IAG	Interagency Agreement
ISE	Imminent and Substantial Endangerment
LOD	Limits of Detection
mg/kg	Milligrams per Kilogram
MPA	Maximum Potential Acidity
MS	Mineral Survey
NMED	New Mexico Environment Department
N.M.P.M.	New Mexico Prime Meridian
NNP	Net Neutralization Potential
No.	Number
NP	Neutralization Potential
OSWER	Office of Solid Waste and Emergency Response
PAMD	Pinos Altos Mining District
ppm	Parts per Million
QA	Quality Assurance

QC	Quality Control
QCP	Quality Control Plan
R	Range
RPB	Response and Prevention Branch
SAP	Sampling and Analysis Plan
SARA	Superfund Amendment and Reauthorization Act
Sec.	Section
SOP	Standard Operating Procedure
T	Township
TOWP	Task Order Work Plan
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
XRF	X-Ray Fluorescence
yd^3	Cubic Yard

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Introduction

Ecology and Environment, Inc. (E & E) was tasked by the United States Army Corps of Engineers (USACE), Fort Worth District, to perform site characterization activities related to the Pacific Ridge area of the Pinos Altos Mining District (PAMD) located in Grant County, New Mexico. The work was performed under USACE Contract Number (No.) W9126G-06-D-0025, Task Order No. 0005 (Appendix A). Project funding was under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendment and Reauthorization Act (SARA) through a United States Environmental Protection Agency (USEPA) and USACE Interagency Agreement (IAG).

The Pacific Ridge area of the PAMD (Site) was referred to the USEPA by the New Mexico Environment Department (NMED) based on concern over elevated concentrations of heavy metals related to historic mining and ore benefaction activities in the district. Data from the study will be used by the USEPA Region 6 Response and Prevention Branch (RPB) to determine whether environmental hazards are present at the site that pose "imminent and substantial endangerment (ISE) to human health or the environment" and, as appropriate, evaluate the potential for a removal action at the site and identify alternatives to mitigate environmental hazards that meet ISE criteria.

The PAMD project was divided into three tasks: Planning, Field Investigation, and Final Deliverable Preparation. The characterization activities were performed in general accordance with the Task Order Work Plan (TOWP) developed as part of the planning phase of the project (Appendix B). A Sampling and Analysis Plan (SAP), Quality Control Plan (QCP), and site specific Health and Safety Plan (HASP) are included as part of the TOWP. E & E personnel involved in the project included Julian Myers; Joe M. Cornelius, Ph.D.; David Beeson, P.G.; Stephen Elliott, David Ellis; Collin Johnson; and Jason Zoller. E-Lab Analytical, Inc.,

Houston, Texas, and Energy Laboratories, Inc., College Station, Texas, provided analytical services for the project.

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Background

The PAMD is situated in the Pinos Altos Mountains, a small north-south trending mountain range located approximately 6 miles north-northeast of Silver City, Grant County, New Mexico (Figure 1). The sulfide ores of the district are conducive to acid rock drainage (ARD) and increased metals mobility. Potential mining-related contaminants include lead, cadmium, arsenic, zinc, and mercury. The principal ore deposits in the district are veins in intrusive rocks, replacement bodies in limestone, and placer. Replacement bodies are restricted to the west side of the range. Gold was the principal producer for the district, but silver, copper, and zinc also were exploited.

The Pacific Ridge area occupies portions of Sections (Sec.) 1 and 12 of Township 17 South (T17S), Range 14 West (R14W) and Sec. 6 and 7, T17S, R13W New Mexico Principal Meridian (N.M.P.M.). The approximate geographic center for the area resides at Latitude 32°51'30" North and Longitude 108°14'00" West.

Gold deposits were discovered in the PAMD around 1860 and were productive until the early part of the twentieth century. Early mining efforts were hindered by frequent Indian attacks. Initial mineral exploitation centered around vein and placer deposits on the east side of the range. A concentrating and smelter facility (the Silver City Reduction Works) was constructed in Silver City, principally, to treat the ores from the PAMD. In the late 1890's, the Hearst estate of San Francisco, California, established the Pinos Altos Gold Mining Company and purchased the Silver City Reduction Works. By 1906, a narrow gage railroad had been constructed to connect the mines with the smelter at Silver City. During 1908 and 1909, mining in the district received a setback from the failure of the Comanche Mining Smelting Company and the closure of the Silver City smelter. The Savannah Copper Company obtained the Comanche assets and reopened the smelter at Silver City. By the 1930's, mining on the east side of the range was essentially reduced to intermittent production from small operations. During the 1940's, zinc was the most important metal mined in the PAMD, principally from the Empire Zinc Cleveland mine on the west side of the range.

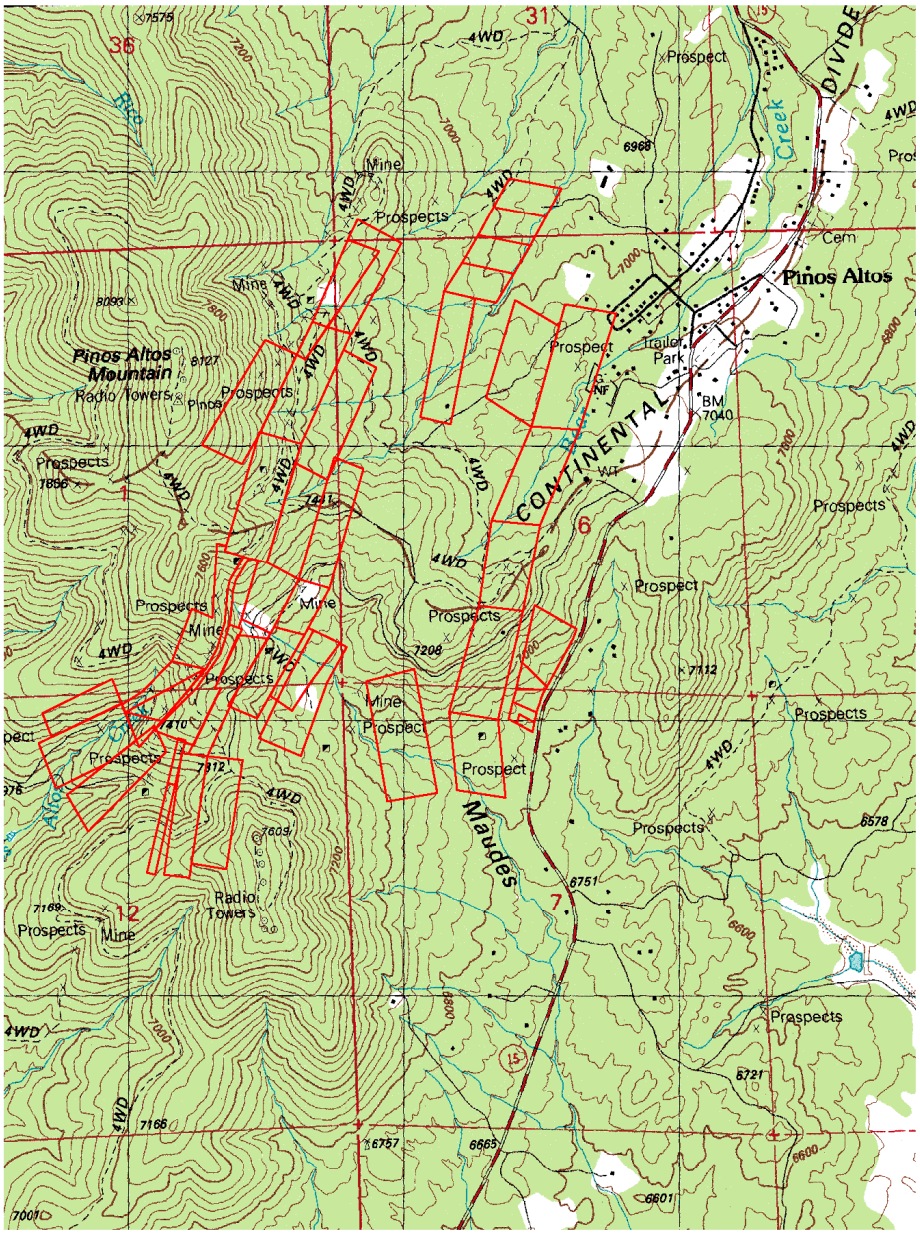

Figure 1. Site Location Map
Pinos Altos Mining District
Pinos Altos, Grant County, New Mexico

Mining activities in the Pacific Ridge area exploited vein and placer gold deposits. Thirty-six patented and nine non-patented claims were identified in the Pacific Ridge area of the PAMD (Figure 2). Individual claims are located and identified by claim name and/or their mineral survey (MS) number. The patented mining claims occupy approximately 420 acres. No current mining activities in the Pacific Ridge area were identified outside of individuals panning for gold.

Reconnaissance of the Pacific Ridge portion of the PAMD was conducted under USACE Contract No. W912BV-06-G-1001, Task Order 0004. E & E toured the area with NMED personnel on April 12, 2007. The Pacific Ridge area of the PAMD is accessible via Radio Tower Road, which is of off New Mexico Highway 15.

Based on watershed (Figure 3), the Pacific Ridge area of the PAMD may be divided into northern, eastern, and western portions. The northern portion drains into Bear Creek. Bear Creek flows to the San Francisco River, a part of the Upper Gila-Mangas Watershed. The eastern portion drains south-southeast, entering Maudes canyon arroyo, a part of the Mimbres River drainage basin. The west side of the Pacific Ridge area drains south-southwest, forming the headwaters for Pinos Altos Creek. Pinos Altos Creek flows through Silver City prior to joining the San Vicente Arroyo.

Claims of particular interest on the west side include the Pacific (MS 64), Pacific Fraction (MS 1567), Pacific Fraction No. 2 (MS 1566), Colorado (MS 1567), Tampico (MS 505), and Passaic (MS 64). Large waste rock piles, slag material, mill tailings, and remnant mill structures occur on these claims. Waste rock piles were also observed on the Aztec (MS 706) and Ohio (MS 811) claims.

Claims of interest on the east side include the Globe Democrat (MS 787), Montana (MS 711), Manhattan No. 2 (MS 712), Valley Key (MS 713), Aztec (MS 706), Golden Era (MS 709), Mina Grande (MS 797), and Bullion (MS 795) claims. A significant volume of waste rock and mill tailings were noted on these claims. The waste rock/tailings were yellow-orange in color with a sulfuric acid smell characteristic of ARD.

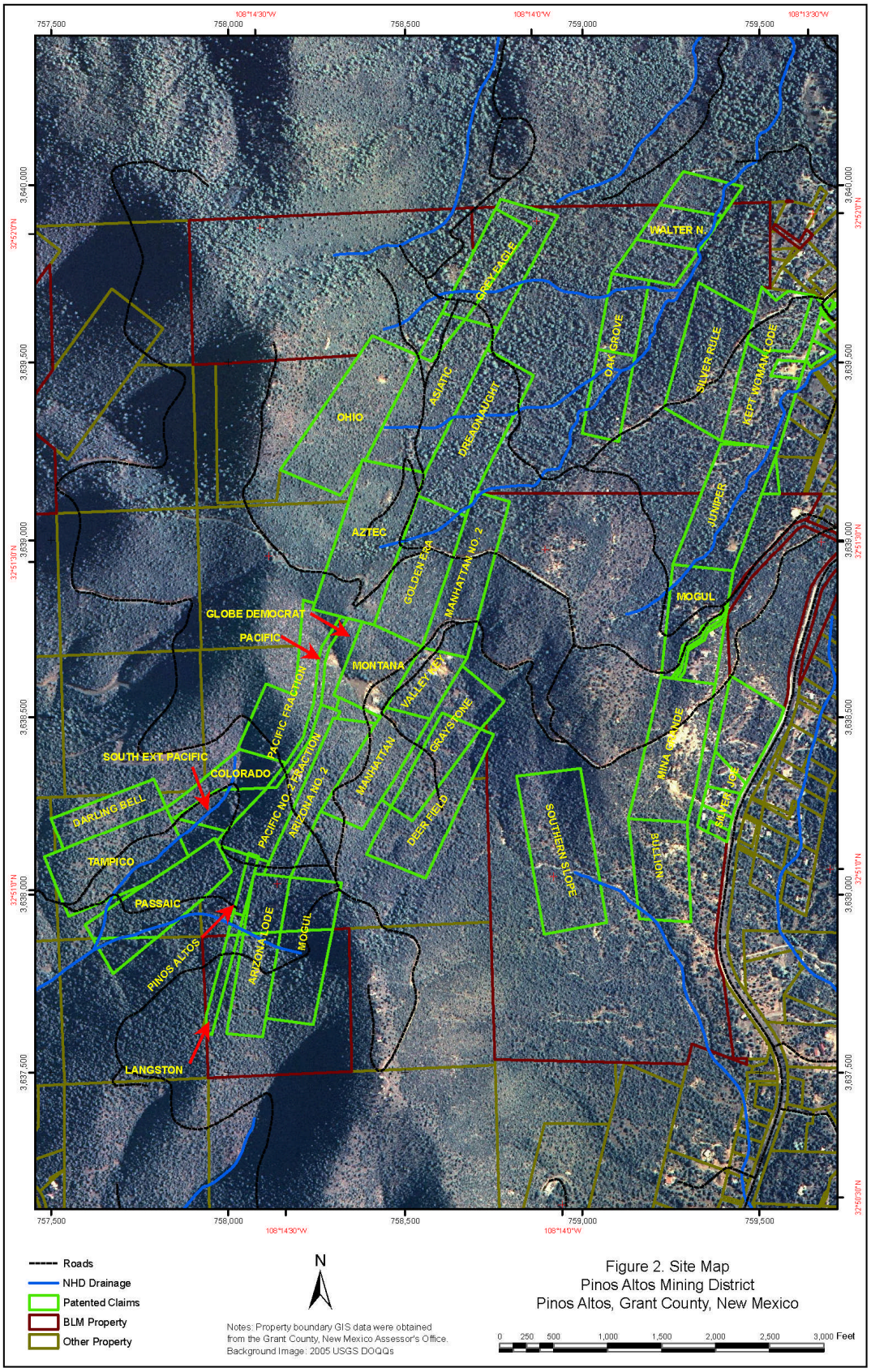

Figure 2. Site Map
Pinos Altos Mining District
Pinos Altos, Grant County, New Mexico

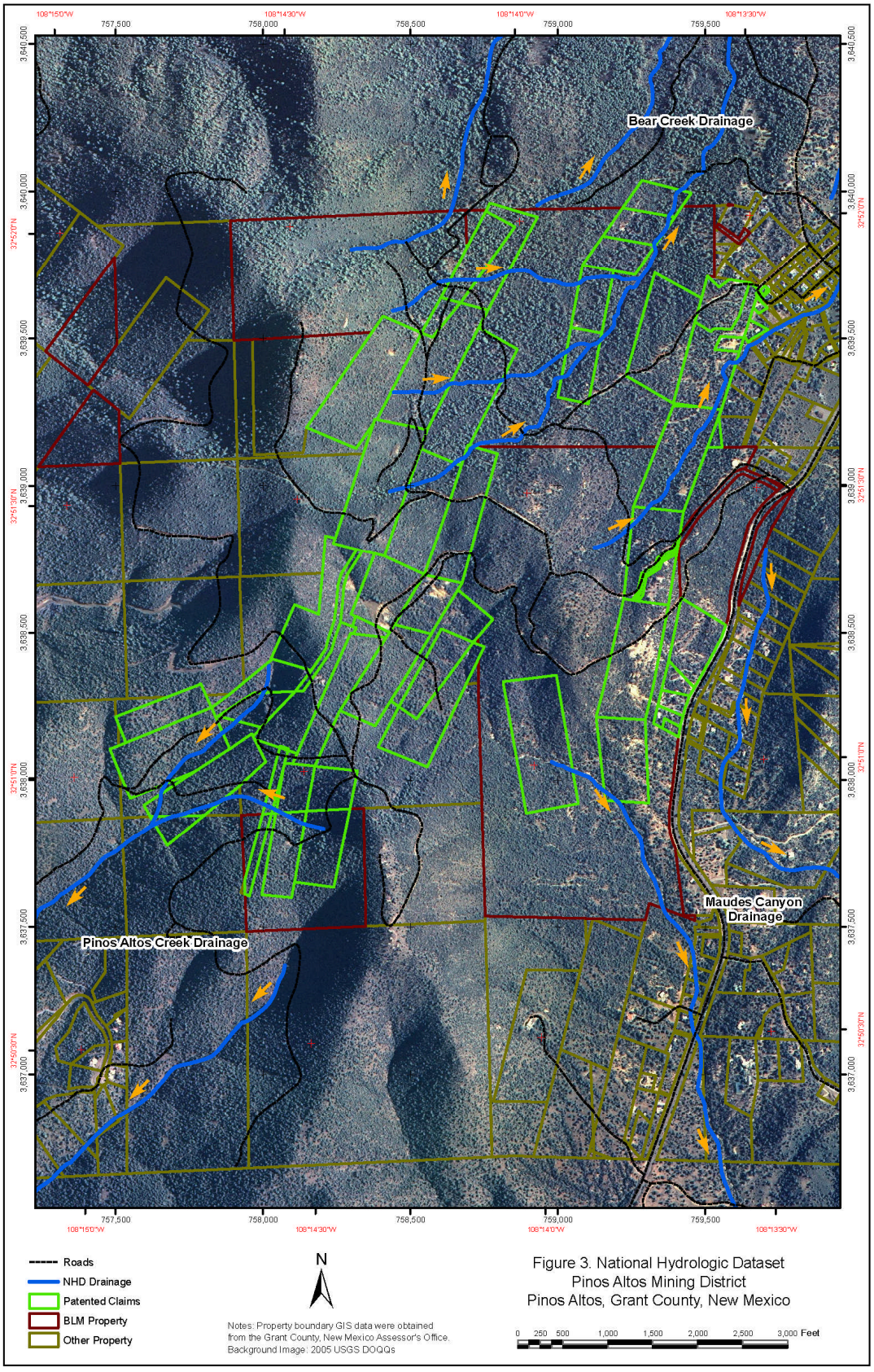

Figure 3. National Hydrologic Dataset
Pinos Altos Mining District
Pinos Altos, Grant County, New Mexico

Claims of the northern portion of the Pacific Ridge area are within or adjacent to the town of Pinos Altos. The waste rock and tailings on the Kept Woman (MS 810) claim occur adjacent to Bear Creek and residential properties. This site was previously investigated as the Bear Creek Tailings Site (CERCLIS No. NMD986676906). The Mammoth Mill Site (CERCLIS No. NM0001097716) also occurs adjacent to Bear Creek.

Of concern is the current and future residential development in the Pinos Altos/Silver City area. The local NMED office is frequently contacted by realtors interested in developing the mine claims. Residential development occurs south of and down gradient from the Pacific Ridge area. Residential development is greater on the east side of Pacific Ridge. Occupied residences occur on the Silver Bell (MS 1777), Grey Eagle (MS 708), Dreadnaught (MS 1923), and Kept Woman claims. Residential construction is in progress on the Mogul (MS 796) claim. According to NMED, road improvements west of the Kept Woman claim are related to future residential development.

In addition to residential development, Radio Tower Road allows public access to many of the claims. Evidence of recreational use was noted on the Montana, Manhattan No. 2, Valley Key, Bullion, and Mina Grande claims.

Based on the previous study results, literature review, and site reconnaissance, the USEPA Federal On-Scene Coordinator (FOSC) deemed that additional assessment activities were required to evaluate potential threats related to the PAMD.

3 Field Investigation

Characterization of the Pacific Ridge of the PAMD included the following actions:

1. Obtain access to properties to perform soil sampling to determine the extent of contamination;
2. Conduct soil sampling for X-ray fluorescence (XRF) total metals analyses;
3. Submit selected soil samples to a conventional laboratory for XRF confirmation analysis;
3. Characterize extent and estimate volume of contaminated soil related to the Pacific Ridge of the PAMD using survey methods in conjunction with soil sampling and analytical results.

A project specific SAP (Appendix B) was prepared and describes the sampling and analytical strategies and procedures for characterization of the PAMD. All proposed sampling and analytical methods follow USACE and USEPA standard operating procedure (SOP) guidance documents (e.g., USACE EM_200-1-3, USEPA Emergency Response Team [ERT] SOPs, USEPA Office of Solid Waste and Emergency Responses [OSWER] guidance documents, USEPA SW846 analytical methods, etc.). Specific methods and procedures are discussed in the SAP.

3.1 Property Ownership, Historical Information, and Access Agreements

The PAMD investigation included both private and public lands. Private lands within the project area are mainly patented mining claims. Residential properties are located within and adjacent to the project boundaries. The United States Bureau of Land Management (BLM) manages the public lands in the project area.

Property ownership is available in Appendix C and summarized in Table C-1 and Figure C-1. Ownership information obtained from the Grant County Tax Assessors Office was used to contact and obtain signed access agreements prior to sampling.

Properties where access was denied or the property owner(s) were unable to be contacted were not included in the PAMD sampling activities. Access to BLM land was coordinated through Mr. David Jevons, Hazardous Materials Coordinator, with the Las Cruces Field Office. Access agreements obtained for the project are available in Appendix C.

Historical and property title information was used to assist in determining sample location points and property boundaries, and will be available to USEPA for potential enforcement activities. Available chain-of-title information for the patented mining claims within the study area is in Appendix D. The property histories presented in Appendix D are based on the information that could be obtained during the project and are subject to further verification and research. Also included in Appendix D is a time line for the Hearst estate related to the PAMD and Silver City Reduction Works and available mineral survey plat maps for the mining claims.

3.2. Field Activities

Field investigation included the following activities:

- Document site conditions through logbook entries and photographic documentation;
- Perform surface and subsurface soil sampling and XRF analytical activities to define the extent of contamination related to historic mining operations;
- Screen selected soil samples for mercury and pH;
- Confirm XRF results through conventional laboratory analysis for priority pollutant metals;
- Conduct a Global Positioning System (GPS) survey to document sample locations and structures related to the project;
- Estimate the volume of contaminated materials identified; and
- Evaluate composite waste samples for total metals, toxicity, acid generation potential, and phytostabilization potential to characterize the waste and provide preliminary information regarding potential disposal and treatment options.

The PAMD field investigation was performed from October 7 through 18, 2007. Logbook and photographic documentation for

the field mobilization is available from Appendix E. Additional detail concerning field assessment activities and objectives is available in the SAP (Appendix B).

3.3 Data Quality and Usability

During site investigation activities for the PAMD project, efforts were made to ensure that the quality of all data generated through XRF spectrometric and conventional laboratory analyses met appropriate established criteria for usability of diverse entities. Some of these efforts included, but were not limited to, the following:

- Adhering to stipulations in the USEPA and USACE pre-approved SAP for sample collection, analysis, and analytical data validation;
- Analysis of XRF confirmation samples by a USACE-certified laboratory to ensure high quality standards, adequate data reporting, and adherence to detailed USEPA SW-846 analytical methods;
- Validating generated data through conventional analytical laboratory analysis using the USEPA Contract Laboratory Program *National Functional Guidelines* for inorganic data reviews. During data validation procedures, certain data qualifiers were appended to various analytes in accordance with guideline stipulations. These data qualifiers serve as warnings or cautionary alerts for the data because they result from one or more data validation requirement outliers or deficiencies; and
- Performing XRF sample analysis in general accordance with SW-846 Method 6200 using an Innov-X Systems-A field portable XRF unit. All quality assurance/quality control (QA/QC) procedures were performed according to the method, including the analysis of a known calibration verification check sample (National Institute of Standards and Technology standard reference material 2711 – Montana soil). In addition, each sample was analyzed three times, and the average analyte concentration was used to represent the concentration for each sample location. This procedure increased the likelihood of obtaining data for a representative sample, decreased the chances of a "hit" or "miss," and tended to mitigate the potential for variability in the sample matrix. The PAMD XRF Survey Report is available in Appendix F.

During the field investigation, 217 surface and subsurface soil samples were collected and subjected to XRF analysis. Soil lead (Pb), copper (Cu), and zinc (Zn) concentrations obtained from the XRF analysis are summarized in Appendix F, Table F-1. Conventional laboratory analyses for priority pollutant metals and pH were performed on 22 of the samples (10.2%) to confirm the XRF results. XRF confirmation sample results are summarized in Appendix F, Table F-2. Qualifiers were used to further clarify the integrity of the data and to subsequently provide additional guidance to the data user. The Data Quality Assurance Review for the samples is included in Appendix F, Attachment F-2.

Comparison between the XRF and analytical confirmation sample results is presented in Appendix F, Table F-3. The correlation coefficient (R^2) for the data were 0.7328 (73.28 %) for Pb, 0.8278 (82.78%) for Cu, and 0.6895 (68.95%) for Zn. The screening level data usability criteria (R^2= 0.70) is met for Pb and Cu but not Zn for the total sample populations. The lower R^2 values are believed to reflect the lower number of confirmation samples (22) magnifying the correlations at high and/or low analyte concentrations. For example, the R^2 value for Pb increases to 0.875 (87.5%) when two samples with concentrations greater than 5,000 milligrams per kilogram (mg/kg) (samples 108 and 298) are removed from the data set and improves to 0.926 (92.6%) when an additional sample (222) with a Pb concentration of 4,203.6 mg/kg is omitted.

The concentration of arsenic (As) and cadmium (Cd) in several of the samples were below the Limits of Detection (LODs) for the XRF unit. The LODs are a function of testing time and sample matrix. Increased testing time improves detection limits as a function of the square root of the testing time. An "ideal" matrix, such as silica sand, will result in better detection limits than a typical soil matrix which contains iron, manganese, and other metallic components. However, evaluation of the As and Cd correlations, excluding samples with concentrations below the LODs (5 of 22 for As and 16 of 22 for Cd), results in an R^2 of 0.937 (93.7 %) for As and 0.880 (88%) for Cd for the PAMD XRF survey.

In addition to the priority pollutant metals analysis, four composite waste samples were analyzed for acid generation potential using acid/base accounting analytical methods, for phytostabilization potential using standard agricultural soil fertility and toxicity testing methods, and for leachability using toxicity characteristic leaching procedure analysis. The laboratory data package for the waste samples is included in Appendix F, Attachment F-2. The data were used to provide preliminary information regarding potential disposal and treatment options for the PAMD site and are discussed in the Waste Characterization section of this report.

4 Investigation Results

4.1 Field Investigation Sample Results

Surface and subsurface soil samples were analyzed for their metals content in order to characterize and define the extent of contamination related to the PAMD site. XRF and conventional laboratory analytical data were evaluated. Data were compared to the 2007 USEPA Region 6 Human Health Medium-Specific Screening Levels for residential and industrial properties (Appendix F, Attachment F-3). Industrial exposure levels are synonymous with United States Forest Service (USFS) and BLM recreational levels. Comparison of data to risk-based media concentrations provides an initial evaluation for the relative environmental concern for a site. USEPA-RPB bases removal actions on site-specific evaluations. Sample identification and locations for the study area are available in Appendix G, Maps G-1 through G-4. Soil pH information was collected at several locations using a pH probe. Soil pH screening results are summarized in Appendix F.

4.1.1 Background Sample Concentrations

Background samples were collected from eleven (11) locations in areas of undisturbed soil outside of the PAMD areas of concern. Background sample results, including XRF confirmation sample 136, are summarized in Appendix F, Table F-4. Background sample concentrations for lead ranged from 13.8 to 90.7 parts per million (ppm), with an average of 46.3 ppm. Copper concentrations ranged from 107.1 to 252.4 ppm, with an average of 164.6 ppm. Zinc background sample concentrations ranged from 72.8 to 734.6 ppm, with an average concentration of 239.7 ppm. With respect to As, seven of the 11 background samples had concentrations below the XRF LODs. Detectable As concentrations ranged from 11.2 to 15.8 ppm, with an average concentration of 14.2 ppm. All of the background samples were below LODs for Cd. Laboratory analysis of sample 136 had an estimated Cd concentration of 0.9 ppm. Other analyte concentrations from sample 136 are summarized in Appendix F, Table F-4 and include 34.7 ppm Pb, 115 ppm Cu, 157 Zn, 4.28

ppm As, and 0.038 ppm mercury. The soil pH for sample 136 was 6.63 standard units. Soil pH screening results ranged from 6.9 units (sample 258) to 5.8 units (sample 234).

4.1.2 Lead Concentrations


Bullion claim

XRF Pb concentrations (see Appendix F, Table F-1) ranged from below the XRF LODs to 26,341 ppm for sample 259, collected from an isolated waste rock pile located northwest of the Pacific Ridge claims. Other samples with Pb concentrations greater than 5,000 ppm (> 0.5%) are associated with waste piles on the Bullion (sample 298) and Globe Democrat (sample 159) claims, and the Hearst Mill (sample 108). Map G-5 (Appendix G) illustrates the XRF soil lead concentrations and distribution for the PAMD investigation.

Laboratory lead data (Appendix F, Table F-2) also documented concentrations above the USEPA 2007 screening levels. Of the 22 XRF confirmation samples analyzed, 17 exceeded the residential action level of 400 ppm, with 14 of the 17 also exceeding the industrial/recreational level of 800 ppm. The maximum obtained lead concentration was 12,800 ppm (1.23%) collected from waste rock from the Bullion claim (sample 298). The laboratory lead concentration distribution is presented on Map G-6 (Appendix G).

4.1.3 Additional Metals Concentrations

XRF and laboratory analysis of the PAMD samples also documented additional soil metal concentrations above the 2007 USEPA Region 6 Screening Levels for residential and industrial properties. In addition to Pb, soil screening levels were exceeded for As, Cd, Cu, and Zn.

Arsenic: One hundred twenty-four (124) XRF soil samples and fourteen (14) confirmation samples exceeded the residential limit for As (22 ppm). In addition, eight (8) of the XRF and two (2) of the laboratory samples exceeded the industrial/recreation limit of 280 ppm. The distribution of XRF and laboratory As results are presented in Appendix G, Maps G-7 and G-8, respectively.

Cadmium: Thirty-four (34) XRF soil samples and six (6) confirmation samples exceeded the residential limits for Cd (39 ppm). None of the sample concentrations exceeded the

industrial/recreation limit of 560 ppm. The distribution of XRF and laboratory Cd concentrations are presented in Appendix G, Maps G-9 and G-10, respectively.

Copper: Seven (7) XRF soil samples and four (4) laboratory confirmation samples exceeded the residential limits for Cu (2,900 ppm). None of the sample concentrations exceeded the Cu industrial/recreation limit of 42,000 ppm. The distributions of XRF Cu concentrations are presented in Appendix G, Map G-11.

Zinc: Two (2) XRF soil samples and no (0) confirmation samples exceeded the residential limits for Zn (23,000 ppm). One of the XRF sample concentrations also exceeded the industrial/recreation limit of 100,000 ppm. The distributions of XRF Zn concentrations are presented in Appendix G, Map G-12.

Mercury: Selected samples were evaluated for mercury using the Lumex Mercury Analyzer (Lumex), a portable mass spectrometer that detects elemental mercury vapor concentrations in air. Mercury screening results are summarized in Appendix F. No significant mercury concentrations were obtained during the screening activities. Confirmation samples had mercury concentrations ranging from 2.3 ppm in sample 186 to 0.013 ppm in sample 281 (Appendix F, Table F-2).

4.2 Extent of Contamination and Waste Volumes

Maps illustrating the concentration and distribution of the identified metals of concern are available in Appendix G. Appendix H contains copies of the investigation results provided to the various property owners, which include maps for individual claims or small groups of claims.

Evaluation of the various contaminant distribution maps indicates that the soil contamination identified during the PAMD study emanates from waste rock and/or tailings generated from mining operations. Based on climate and topography, the probable pathway for contaminant migration is via surface water transport. During field activities, measurements were collected in order to estimate waste volumes.

As previously discussed, the project area can be separated into northern, eastern, and western portions based on watershed

drainage pattern, with the northern portion draining into Bear Creek, the eastern portion draining into Maudes Canyon Arroyo, and western portion draining into Pinos Altos Creek (see Figure 3). Table 1 presents volume estimates for the measured waste piles separated by study area. Volume estimates are in-place volumes based on field measurements and sample results. Based on waste pile characteristics, equations to determine the volume of cubes and/or cones were used to calculate the estimated quantity of material.

Waste rock on Ohio claim

North Project Area (Bear Creek Drainage)

Waste piles with Pb, As and/or Cd concentrations above assessment levels were identified on the Ohio, Asiatic (MS707), Aztec, and Mogul (MS 796) claims and on BLM property east of the Gray Eagle claim and west of the Mogul (MS 796) claims.

The waste rock pile on the Ohio claim (Location 222) exceeds recreation screening levels for Pb and residential levels for As (Appendix F, Table F-1). The location consists of a shaft and waste rock pile (Appendix E, photographs 489-492 and 717-722). The waste pile is yellowish-orange and devoid of vegetation. Field screening of the material produced a pH of 3.8 units (Appendix F, Table F-4). Elevated Pb and As concentrations seen in samples 223, 224, 316, and 317 suggest that waste has been transported down gradient (east) on to the Asiatic claim. The estimated in-place volume for Location 222 is 20,944 cubic yards (yd^3).

The waste rock pile in the southern portion of the Asiatic (Location 314) exceeds screening levels for Pb, As, and Cd (Appendix F, Table F-1). The pile is sparsely vegetated and yellowish-orange in color (Appendix E, photographs 552-554 and 711-713). Waste volume is approximately 7,800 yd^3. An adjacent, smaller, waste rock pile (Location 315) does not contain metal concentrations above assessment levels. This pile is coarser, vegetated, and gray in color (Appendix E, photograph 714).

Two waste rock piles on the Aztec claim (Locations 239 and 240) also exceed screening levels. Location 239, characterized by samples 239 and 241, consists of a shaft with a head frame and large waste rock pile (Appendix E, photographs 555-558 and 563-564). The waste pile is yellowish-orange and devoid of vegetation, has a pH of approximately 3.5 units and exceeds screening levels for Pb and Cd (Appendix F, Tables F-1and F-4). The estimated volume of the 239-241 pile is 17,121 yd^3. The second waste pile (Location 240/242) exceeds residential screening levels for As and

Cd. The yellow-gray waste rock pile lacks vegetation (Appendix E, photographs 559-562 and 565-567), had a pH of 3.8 units and has an estimated volume of 7,700 yd^3.

Table 1. Waste Volume Estimates

Location/Sample No.	Claim Name	Volume (yd^3)
BEAR CREEK DRAINAGE		**68505**
214	Non-Pat. BLM	839
215	Mogul	10957
218	Non-Pat. BLM	62
222	Ohio	20944
229, 230	Non-Pat. BLM	1165
235	Non-Pat. BLM	616
238	Non-Pat. BLM	777
239, 241	Aztec	17121
240, 242	Aztec	7704
246	Non-Pat. BLM	123
307	Non-Pat. BLM	342
314	Asiatic	7854
MAUDES CANYON ARROYO DRAINAGE		**492945**
151, 152, 153	Pacific Fraction No. 2	10908
155,156, 159	Pacific Fraction	41888
157, 158	Aztec	130900
162, 163,164	Globe Democrat	14468
165	Montana	24000
167, 166	Montana	52360
174	Montana	39270
179	Manhattan	1200
186, 187	Valley Key	84000
195	Valley Key	18000
272	Non-Pat. BLM	342
288	Arizona No. 2	2908
295 - 298	Bullion	38522
-	Mina Grande	34178
PINOS ALTOS CREEK DRAINAGE		**265334**
102-103 (Upper Mill)	Pacific Fraction No. 2	1542
106-108 (Lower Mill)	South Extension-Pacific	1047
128	Colorado	52
129, 130, 131	Pacific	122700
135	Pacific Fraction	22089
133, 134, 138 -140	Colorado	52360
142,143	South Extension-Pacific	10603
144	Pacific	8378
145 - 149	Pacific Fraction No. 2	26180
257	Non-Pat. Private	6000
259, 260	Non-Pat. Private	155
284, 285	Non-Pat. Private	4850
286, 287	Non-Pat. Private	2778
291, 294	Pacific	3600

293	Pacific Fraction No. 2	3000
	PAMD TOTAL	**819536**

Well preserved arrastra at Location 307

Location 307 is on BLM property east of the Gray Eagle claim (Appendix G, Map G-1). The site consists of a series of small test pits or collapsed shaft with an associated small waste pile (Appendix E, photographs 701-706). Sample 307 slightly exceeds residential screening levels for Pb and As (Appendix F, Table F-1). Estimated volume is approximately 350 yd^3. Of additional interest at this site is the presence of a well preserved arrastra (Appendix E, photographs 699 and 700).

Location 215 – Waste pile on north tract of Mogul (MS 796)

Location 215 is located on the north tract of the Mogul (MS 796) claim, adjacent to the dirt access road (Appendix G, Map G-2). The site consists of a collapsed shaft and large yellow-orange waste pile (Appendix E, photographs 472-475 and 101002-101004). Field screening of the material produced a pH of 4.2 units (Appendix F, Table F-4). Sample 215 exceeds residential screening levels for Pb and As and has an estimated volume of 10,950 yd^3. Elevated metals in samples 216 and 217, collected in the drainage down gradient of Location 215 (Appendix E, photographs 476- 479), apparently documents surface water transport of the mine waste (Appendix F, Table F-1).

The remaining five locations (218, 214, 229/230, 235, and 238) are located on BLM property west of the Mogul (MS 796) claim (Appendix G, Map G-2). Location 218, southwest of the Mogul (MS 796) claim, consists of a small, approximate 60 yd^3, yellowish-tan, waste pile (Appendix E, photographs 481-484). Metal concentrations for the pile exceed recreational Pb and residential As screening levels (Appendix F, Table F-1). Field screening produced a neutral pH of 6.8 units (Appendix F, Table F-4).

Collapsed shaft and waste rock at Location 214

Location 214 consists of a yellow-orange waste rock pile and collapsed shaft (Appendix E, photographs 469-471 and 101001). The waste pile exceeds recreational Pb screening levels and is adjacent to a commonly used dirt road to the Mogul (MS 796) and other claims. Field screening produced an acidic pH of less than 3.5 units (Appendix F, Table F-4). Waste volume is approximately 850 yd^3.

Location 229, characterized by samples 229 and 230, consists of two collapsed shafts and associated waste rock piles (Appendix E,

photographs 516-523). The waste rock had a slightly acidic pH of 6.0 (Appendix F, Table F-4). Sample results from the waste rock piles exceed residential Pb and As screening levels (Table F-1). Waste volume at the location is approximately 1,160 yd^3.

Location 235 consists of a collapsed shaft and associated waste rock pile (Appendix E, photographs 538-540). Sample results from the waste rock piles exceed recreational Pb and residential As screening levels (Appendix F, Table F-1). Waste volume at the location is approximately 615 yd^3.

Location 238 consists of a partially collapsed shaft and associated waste rock pile (Appendix E, photographs 545-551). Field screening produced a pH of 5.0 units (Appendix F, Table F-4). Sample results from the waste rock pile exceed recreational Pb and residential As and Cd screening levels (Appendix F, Table F-1). Waste volume at the location is approximately 775 yd^3.

Location 246, near the northwest corner of the Silver Rule (MS 291) claim, consists of a small waste pile and two collapsed shafts and/or test pits (Appendix E, photographs 574-578). Field screening of the material produced a pH of 4.0 units (Appendix F, Table F-4). Sample 246 exceeds residential screening levels for As (Appendix F, Table F-1). The estimated volume of the pile is approximately 125 yd^3.

Large waste rock piles on the east side of Pacific Ridge

East Project Area (Maudes Canyon Drainage)

Maudes Canyon Arroyo originates on the Pacific (MS 64) claim (see Figures 1, 2, and 3). The drainage receives sediment from the east side of the Pacific Ridge and from the north-south trending line of mining claims in the eastern portion of the study area. A significant volume of waste rock and mill tailings were noted in the east project area, especially on the Montana claim. The waste rock/tailings were typically yellow-orange in color with a sulfuric acid smell characteristic of ARD.

Waste rock associated with the Hearst Shaft (left) and Aztec claim (right)

With respect to the Pacific Ridge or western portion of the Maudes Canyon drainage, mining waste with Pb, Cu, As, and/or Cd concentrations above assessment levels was identified on the Aztec, Pacific, Pacific Fraction No. 2, Globe Democrat, Montana, Arizona No. 2 (MS 1358), Manhattan (MS 710), and Valley Key mining claims (Appendix F, Table F-1; Appendix G, Maps G-5 through G-11).

Location 157, characterized by samples 157 and 158, is located on the southern portion of the Aztec claim, up gradient of the Hearst Shaft, on the Pacific claim. The site consists of a collapsed shaft and very large waste rock pile (Appendix E, photographs 375-379 and 1010021) which extends approximately 300 feet down slope. Sample results from the waste rock pile exceed recreational Pb and residential As screening levels (Appendix F, Table F-1). The waste pile consists of coarser gray rock covering orange, finer grained material and is likely analogous to desert pavement, where wind removes finer grained material leaving coarse particles as a covering to the soil. The estimated volume is 130,900 yd^3.

Detail of waste rock associated with the Hearst Shaft

Location 155, characterized by samples 155 through 159, is located southwest of and down gradient to the Aztec waste rock pile (Appendix G, Map G-4). The site consists of waste rock associated with the Hearst Shaft (Appendix E, Photographs 367-374, 380- 385, and 1010024-1010028), which originated on the on the Pacific claim and extends onto the Globe Democrat claim. Based on field screening results, the material has a pH of 3.6 units (Appendix F, Table F-4). Sample results exceed recreational screening levels for Pb and As (Appendix F, Table F-1). The estimated volume is 42,000 yd^3. The shaft head frame is present and recreational visitors to the shaft were observed on several occasions during the assessment. Material from this claim also extends down gradient via Maudes Canyon Arroyo (samples 160 and 161) to the Pacific Fraction No. 2 and Montana claims.

Radio Tower Road crossing mine waste on Montana claim

Location 162, characterized by samples 162 through 164, consists of waste rock and or possible tailings within Maudes Canyon Arroyo on the Globe Democrat claim (Appendix E, photographs 386-391). Samples exceed recreational Pb, residential As, and/or residential Cd screening levels and the estimated volume is approximately 14,468 yd^3.

A significant volume of mine waste with characteristics typical of ARD is present on the Montana claim within Maudes Canyon Arroyo (Appendix E, photographs 392-403). In addition, the material is bisected by Radio Tower Road, which facilitates access and exposure to the material. Recreational usage by the public is common. Field screening of the material produced pH values ranging from 4.6 to 3.4 standard units (Appendix F, Table F-4) Analyses of samples 165-169, 171-176, 266-269, and 271 document concentrations above screening levels for Pb, As, and/or Cd (Appendix F, Table F-1). The estimated volume of the mine waste present on the Montana claim is in excess of 115,000 yd^3.

Radio Tower Road crossing mine waste on Montana claim

Two additional waste piles are located on the northern portion of the adjacent Valley Key claim (Appendix G, Map G-3; Appendix E, photographs 413, 414, 422, and 423). The first pile consists of a large volume of material which partially fills and forms a bench within a large, well-developed drainage channel originating on the claim. Remnant structures at the site suggest that the material is related to a mill (Appendix E, photograph 405). Analyses of samples 186 and 187 documents Pb and As concentrations above recreational screening levels (Appendix F, Table F-1). A second, smaller waste pile is to the north-northeast (Appendix E, photographs 422-424) and is characterized by samples 195-197. The material has ARD characteristics and exceeds residential screening levels for Pb and As. The estimated volume of the Valley Key piles is approximately 102,000 yd^3 (Table 1). Both piles are acidic with pH values ranging from 3.8 to less than 3.5 units (Appendix F, Table F-4)

A waste rock pile, characterized by sample 288, was documented on the Arizona No. 2 claim up gradient to Maudes Canyon Arroyo (Appendix E, photograph 666; Appendix G, Map G-4). The waste pile is partially vegetated, orange-brown to gray in color, and exceeds recreational screening levels for Pb and residential levels for As (Appendix F, Table F-1). The estimated volume for the waste rock pile is approximately 2,900 yd^3 (Table 3). Samples 289 and 290, collected down gradient from the pile document surface water transport of the material (Appendix F, Table F-1).

Waste rock on the Pacific Fraction No. 2 claim

A large waste rock pile, characterized by samples 151-153, was identified on the steep slope of the southern portion of the Pacific Fraction No. 2 adjacent to the dirt access roads extending from Radio Tower Road (Appendix E, photographs 360-365; Appendix G, Map G-4). The waste pile is yellow to orange to gray in color with a pH of approximately 3.8 units, and exceeds recreational screening levels for Pb in sample 153 and residential screening levels for Pb, As, and Cd in all three samples (Appendix F, Tables F-1 and F-4). There is a collapsed shaft and scattered support timbers at the site. The thin trail that crosses the pile and leads to the Globe Democrat claim appears to be the former narrow gauged railroad track. The estimated volume for the waste rock pile is 14, 500 yd^3 (Table 3). Surface water from Locations 288 and 151 drains east-southeast and join Maudes Canyon Arroyo down gradient of the Manhattan claim.

An additional waste pile, identified as Location 179, occurs within Maudes Canyon Arroyo on the Manhattan claim (Appendix E, photographs 406-408). Analysis of samples 179-181 document that the pile and sediments down gradient from the pile exceed residential screening levels for As and/or Cd. The pile has ARD characteristics and an estimated volume of 1,200 yd^3.

Down gradient of the Manhattan claim, Maudes Canyon Arroyo crosses BLM land and the Graystone (MS 1472), Deer Field (MS1472), Southern Slope (MS 1568) and the southwest corner of the Bullion (MS 795) claims (Figure 2; Appendix G, Map G-3). In this area, the slope has decreased substantially and no extensive mining waste was observed (Appendix E, photographs 410-412). Mine waste related to the Bullion claim is drained by a separate system and will be discussed with the east margin claims. Sample 182, collected from within the drainage on the Graystone claim, exceeds residential screening levels for Pb and As and was the only sample from this area with a Pb concentration above the screening level. In addition to sample 182, samples 183, 185, 191-194, 204, 210, and 212 had concentrations above the residential As screening level (Appendix F, Table F-1; Appendix G, Maps G-5 through G-8). The sediment is slightly acid to neutral with pH values ranging 4.6 to 6.5 units (Appendix F, Table F-4). Adjacent to this drainage, near Location 208, a mine shaft was noted (Appendix E, photographs 648-649). Samples collected outside of Maudes Canyon Arroyo, samples 201 through 209, 211and 213, did not exceed screening levels.

Maudes Canyon Arroyo at Sample Location 208

With respect to the east portion of the Maudes Canyon drainage, mining waste with Pb, Cu, As, and/or Cd concentrations above assessment levels was documented on the Mina Grande and Bullion claims and BLM property (Appendix F, Table F-1; Appendix G, Maps G-5 through G-11). Because of access issues, complete assessment of the Mina Grande claim was unable to be performed and the lower waste pile (Appendix E, photograph 696) was unable to be included in the XRF survey. Limited samples were collected from the Radio Tower Road right-of-way, which cuts across the upper Mina Grande waste pile (Appendix E, photographs 613-615). Analysis of samples 262-265 document that the roadway portion of the pile exceeds recreational screening levels for Pb and residential screening levels for As (Appendix F, Table F-1). The Mina Grande waste piles consist of light yellow to orange material with an estimated volume of 30-35,000 yd^3 for both piles. Both piles drain to the east and southeast. Samples 199, 225, 226, and 277 (Appendix F, Table F-1; Appendix G,

Mina Grande lower waste piles

Drainage down gradient of the Mina Grande waste piles. Note salts.

Maps G-5 and G-11), with Pb and/or As above residential screening levels, document surface water transport of the material onto adjacent residential properties (Appendix E, photographs 427, 493, 496, 498 and 641-642).

The Bullion claim is located south of the Mina Grande claim and is easily accessible from Highway 15. During the field activities, recreational use visitors were observed on the Bullion and adjacent BLM property. Like the Mina Grande waste piles, the material has characteristics of ARD and drains to the east and southeast. Several structures related to the mining operations, including the mine shaft and head works, are still present and pose a significant physical threat, as well as an attractive nuisance (Appendix E, photographs 633-635, 683, 687, 688, 690, 692, and 1010035-1010039). Many of the samples from the Bullion claim exceed recreational screening levels for Pb and/or residential levels for As (Appendix F, Table F-1, samples 274, 295-297, 299, and 300-306; Appendix G, Maps G-5 through G-11). Lead concentrations range from background concentrations outside of disturbed areas (sample 304) to greater than 5,000 ppm in mine waste (sample 298). Arsenic ranged from below instrument (XRF) detection limits to 141 ppm (sample 298). Confirmation laboratory analysis of sample 298 contained Pb and As concentrations of 12,800 and 56 ppm, respectively (Appendix F, Table F-2). Mine waste associated with the Bullion claim is estimated to exceed 38,000 yd^3 (Table 1). Drainage samples 272 and 305 document surface water transport of waste material east, onto adjacent BLM property.

Mining waste on Bullion claim

Drainage from Bullion claim

An additional waste pile, identified as Location 272, is located on BLM land east of the Bullion (Appendix E, photographs 648-649). Sample 272 has an As concentration above residential screening levels (Appendix F, Table F-1). This isolated pile has an estimated volume of approximately 600 yd^3.

West Project Area (Pinos Altos Creek Drainage)

Pinos Altos Creek originates in the Pacific Ridge of the Pinos Altos Mountains, north of the Colorado claim (Figures 1, 2, and 3). To the south, a second drainage channel originates on the Mogul (MS 757) claim and joins Pinos Altos Creek east of the Passaic (MS 498) claim. Large waste rock piles, slag material, and mill tailings with Pb, Cu, Zn, As, and/or Cd concentrations above assessment levels were identified in the west project area (Appendix F, Table F-1; Appendix G, Maps G-5 through G-11).

Waste rock on the Pacific Fraction and Colorado claims.

A small, isolated, waste rock pile, characterized by samples 259 and 260, is located in Lot 14 of Sec. 12, T17S, R14W, northwest of the Pacific Ridge claims (Appendix E, photographs 611-612; Appendix G, Map G-4). The waste rock is situated on a steep slope down gradient from a dirt road. The material exceeds recreational screening levels for Pb and As (Appendix F, Table F-1) with sample 259 having Pb and As concentrations of 26,341 and 835 ppm, respectively. Estimated volume of the pile is 150 yd^3 (Table 3). The location and small volume of the material suggest that it may have been the result of a transportation accident or test pit.

Location 291 is situated on the southern portion of the Pacific claim, up-gradient of Pinos Altos Creek. The location, characterized by samples 291 and 294, consists of waste rock and two collapsed shafts and/or test pits (Appendix E, photographs 669, 673-676, and 1010029-1010034). The waste rock is brown to orange in color and exceeds recreational screening levels for Pb and residential screening levels for As and Cd (Appendix F, Table F-1). Estimated waste volume for the location is 3,600 yd^3.

Two waste rock piles were identified on the adjacent Pacific Fraction No. 2 claim. Waste rock at Location 293 (Appendix E, photographs 671-672) is also brown to orange in color, exceeds residential screening levels for As and Cd (Appendix F, Table F-1), and has an estimated volume of 3,000 yd^3. A second waste rock pile, characterized by sample 292, did not exceed screening levels for any of the metals of concern (Appendix F, Table F-1).

A waste rock pile, characterized by sample 135, was identified in the southern portion of the Pacific Fraction claim, adjacent to one of the dirt access roads extending from Radio Tower Road (Appendix E, photographs 316-318; Appendix G, Map G-4). The waste pile is on a very steep slope, orange-brown to gray in color, and exceeds recreational screening levels for Pb and residential screening levels for Cd (Appendix F, Table F-1). The estimated volume for the waste rock pile is 22, 000 yd^3.

Waste Rock near northeast corner of the Colorado claim

A large waste rock pile, characterized by samples 132 through 134 and 138 through 140 was located near the northeast corner of the Colorado claim (Appendix E, photographs 311-315, 319, 324-331, 337, and 338; Appendix G, Map G-4). The waste pile is on a very steep slope, orange-brown to gray in color with a pH of approximately 4.6 units, and exceeds screening levels for Pb, As, and Cd (Appendix F, Tables F-1 and F-4). The estimated volume

for the waste rock pile is 52,360 yd^3. Sample 141, adjacent to the waste rock (Appendix E, photographs 332-334) did not exceed screening levels.

Location 128 consists of a collapsed shaft/test pit and associated waste rock east of Pinos Altos Creek within the Colorado claim (Appendix E, photographs 304-306). The waste rock, characterized by sample 128, exceeds residential screening levels for Pb and As (Appendix F, Table F-1) and has an estimated volume of approximately 50 yd^3.

Location 129, characterized by samples 129 through 130, is a large waste rock pile on a steep slope (Appendix E, photographs 308, 309, and 1010021). The waste rock is gray and exceeds residential screening levels for Pb and/or As (Appendix F, Table F-1). Estimated volume is in excess of 120,000 yd^3.

Sampling at Location 129

Location 142-143, located near the boundary between the Colorado and South Extension of the Pacific claims (Appendix G, Map G-4), consists of a poorly sorted waste rock pile with abundant coarse material (Appendix E, photographs 335, 336, and 339-342). The material exceeds residential screening levels for Pb and As (Appendix F, Table F-1) and has an estimated volume of 10,600 yd^3.

An additional waste rock pile, characterized by sample 144 occurs on the South Extension of the Pacific claim (Appendix G, Map G-4). The material exceeds recreational screening levels for Pb and recreational levels for As (Appendix F, Table F-1) and has an estimated volume of 10,600 yd^3.

Mill tailings in Pinos Altos Creek

In addition to the afore mentioned waste rock piles, structures and process waste, such as slag and mill tailings related to the Hearst Mill are present on the Pacific No. 2 and South Extension of the Pacific claim (Appendix E, photographs 272-283, 1010017, and 1010018). The upper mill area, characterized by samples 101, 102, 103, and 105, exceeds recreational screening levels for Pb and residential levels for As and/or Cd (Appendix F, Table F-1). The lower mill area contains brick structures and appears to be where mill tailings were released into the Pinos Altos Creek drainage system. Samples of the upper mill area (samples 105-108) tailings exceed recreational and/or residential screening levels for Pb, Cu, Zn, As, and Cd (Appendix F, Table F-1). The large mine shaft located in the Tampico claim, north of the Pinos Altos channel, is

believed to be the Gillette Shaft (Appendix E, photographs 292 and 593; Appendix G, Map G-4). Sample 249, collected adjacent to the shaft, exceeds recreational screening levels for Pb (Appendix F, Table F-1).

Drainage from the Mill Area extends southwest through the Colorado, Tampico, and Passaic claims (Figure 2). The drainage has a steep gradient, well defined banks, and merges with the southern channel at Location 118, south of the Passaic (Appendix E, photographs 285, 289, 291-295, and 594-596). Drainage samples through this area (samples 110, 112, 114, 115, 117, and 118) exceed recreational or residential screening levels for Pb and recreational levels for As and/or Cd (Appendix F, Table F-1). Recognizable mill tailings in the drainage are intermittent and located on the bank/side of the drainage channel (Appendix E, photographs 280, 281, 286-288, and 1010018). Samples collected from the tailings (samples 107 and 111) exceed recreational and/or recreational screening levels for Pb, Cu, Zn, As, and Cd (Appendix F, Table F-1). Samples collected outside of the drainage (samples 109, 113, and 250-252) do not exceed screening levels (Appendix F, Table F-1), except for sample 251 with a Pb concentration of 435 ppm.

The southern drainage channel originates on the Mogul (MS 757) claim, but also receives runoff from the Arizona, Pinos Altos, Langston, Pacific Fraction No. 2, Arizona No. 2, and Passaic claims and non-patented land (Figures 1, 2, and3). Because of access issues, no samples were collected from the Mogul (MS 757), Arizona, Pinos Altos and Langston claims (MS 957).

A large waste rock pile, characterized by samples 145 through 149, was located near the southern margin of the Pacific Fraction No. 2 claim (Appendix E, photographs 346-355; Appendix G, Map G-4). The partially vegetated waste pile is on a steep slope, gray to orange-brown in color, and exceeds screening levels for Pb, As, and Cd (Appendix F, Table F-1). The estimated volume for the waste rock pile is 26,180 yd^3.

Location 285 on the Pacific Fraction No. 2 claim

Two additional waste rock piles, identified as Locations 285 and 286, occur on the steep slope south of the Pacific Fraction No. 2 claim and up-gradient to the south drainage channel (Appendix G, Map G-4). Location 285 (Appendix E, photographs 659-661, 101005, and 101006) is characterized by samples 284 and 285, which exceed recreational screening levels for Pb and residential levels for As and Cd (Appendix F, Table F-1). The waste is gray

to orange-brown in color, and has an estimated volume of 4,850 yd^3. Location 286 (Appendix E, photographs 662 and 663) consists of waste gray to orange-brown waste rock with an estimated volume of 2,778 yd^3. Characterized by samples 286 and 287, the material exceeds recreational screening levels for Pb and residential levels for Cu and As (Appendix F, Table F-1).

A concrete foundation, rock wall and a crucible cup dump area, thought to be related to Hearst Mill ore assay operations, is located in the northwestern portion of the Passaic claim (Attachment E, photographs 591, 592 and 10100014-1010016; Appendix G, Map G-4). Sample 248, collected from the assay cup dump exceeds recreational Pb and residential As screening levels (Appendix F, Table F-1).

Mining structures and waste rock at Location 255

Mining operation structures and a large waste rock pile, characterized by samples 255-257 were located on non-patented land west of the Pinos Altos/Langston claims (Appendix E, photographs 600-609, 664, 665, and 1010008; Appendix G, Map G-4). The gray waste pile is situated on a steep slope and exceeds recreational screening levels for Pb and/or residential screening levels for As and Cd (Appendix F, Table F-1). The estimated volume for the waste rock pile is 6,000 yd^3.

No recognizable mill tailings were observed in the south drainage channel. Drainage samples from Locations 153 and 154 slightly exceed residential screening levels for As only in sample 254 (Appendix F, Table F-3).

Initial samples (119 and 120) collected down-gradient from the merger of the south channel with Pinos Altos Creek exceeded residential Pb, As, and Cd screening levels (Appendix F, Table F-3). Later samples (120-124) either do not exceed screening levels or only slightly exceed residential As levels. Confirmation laboratory analysis results for sample 124 (most down gradient sample) do not exceed residential screening levels.

4.3 Waste Characterization

As part of the PAMD site characterization project, composite waste samples were collected and analyzed to characterize the material and to assist in the evaluation of potential threat abatement options. Additional information is available from the PAMD Waste Characterization Report included in Appendix F.

Composite waste samples from four locations were collected and analyzed to characterize the material and to assist in the evaluation of potential threat abatement options. The locations were characterized with respect to their acid generation potential. Composite samples were obtained from waste piles related to the Mogul (MS 796), Bullion, Montana, and Valley Key patented mining claims. Acid Based Accounting (ABA) laboratory techniques compare the amount of acid-producing material to the amount of alkaline-producing material in a sample in order to predict potential water quality impacts. Commonly determined ABA parameters include acid generation potential or maximum potential acidity (MPA), acid neutralization potential or neutralization potential (NP), acid-base potential or net neutralization potential (NNP), and the NP/MPA ratio. Because of site-specific influences, no universal ABA criteria have been established. In general, NNP values greater than 20 tons of calcium carbonate per kiloton ($tCaCO_3/kt$) or a NP/MPA ratio greater than 3 to 1 indicate a low acid generation potential. Materials with NNP values between 20 and -20 tCaCO3/Kt or a NP/MPA ratio between 1:1 and 3:1 have an uncertain potential. NNP values below -20 $tCaCO_3/kt$ or a NP/MPA ratio less than 1:1 indicate a high acid generation potential. The PAMD ABA results are summarized in Table 2.

Table 2. Summary of PAMD ABA Results

	Sample Location	ABA-01 Mogul	ABA-02 Bullion	ABA-03 Montana	ABA-04 Valley Key
Net Neutralization Potential (NNP)	tCaCo3/kt	-1	-3	1	-4
Acid Base Accounting (ABA)	tCaCo3/kt	-2	-5	0	-7
Neutralization Potential (NP)	tCaCo3/kt	0.9	0	3.8	0
Exchangable Acidity (EA)	tCaCo3/kt	1	2	1.3	2.8
Potential Acidity (PA)	tCaCo3/kt	1.6	2.8	2.8	3.8
Sulfur, total	%	0.47	1.34	1.48	3.73
Sulfur, sulfate	%	0.31	0.72	0.85	2.29
Sulfur, pyritic	%	0.05	0.09	0.09	0.12
Sulfur, organic	%	0.11	0.53	0.54	1.32
pH	Standard Units	3.8	3.4	4.5	2.9

Evaluation of the data indicates that the material has potential for acid generation because all four samples had NNP values between -20 and 20 $tCaCO_3/kt$. These results are due largely to the very low NP of the material. However, samples containing less than

0.3% sulfide sulfur are generally considered to be incapable of sustaining acid generation. PAMD samples had less than 0.3% pyretic sulfur. Soil pH values, ranging from 2.9 to 4.5 units, indicate that acid generation is occurring.

Consideration of all of the ABA data suggested that the acid generation potential for the material is low. Geochemical treatment previously conducted by USEPA-RPB used calcium carbonate applied at a rate of 1.25 times the current and future acidity of the material. The Valley Key waste material is the worst-case example for the PAMD project. This material has a pH of 2.9 units and an acid potential of -3.8 $tCaCO_3$/kt. Because pyretic sulfur content is characteristically below amounts required to sustain acid generation, geochemical treatment to address future acid generation of the material may not be required. Instead, a cap, either physical or vegetative, could be installed to control the infiltration and interaction of water with the material in order to reduce acid generation potential. The option would conserve on-site repository volume. However, the current acid soil pH would limit vegetative cap as an option.

5

Summary and Discussion

The PAMD assessment identified in excess of 800,000 yd^3 of soil (Table 1) with heavy metal concentrations above the 2007 USEPA Region 6 Human Health Medium-Specific Screening Levels. Contamination is primarily related to Pb, As, and Cd, but exceedances also occur for Cu and Zn (Appendix F, Table F-1). The concentration and distribution of the contaminants indicates that the contamination emanates from waste rock and mill tailings generated from historic mining operations, and that a primary pathway for contaminant migration is via surface water transport via Bear Creek, Maudes Canyon Arroyo, and Pinos Altos Creek (Appendix G, Maps G5-G12).

Because of the volume of material to address, operable units would need to be established at a claim or small group of claims level and prioritized. Due to their accessibility, waste related to the Mogul (MS 796), Bullion, and Montana/Valley Key claims appear to have a greater potential to impact the public.

A potential threat abatement option is the use of geochemical treatment in conjunction with phytostabilization (vegetative cap). Rather than complete removal of the mining waste, site-specific conditions at each operable unit would dictate scenarios that would implement a combination of in-place stabilization and excavation, relocation, and placement of the material into the on-site repository or off-site disposal, as appropriate. Waste characterization (Table 2) indicates the material could be treated to address current and future acidity, reduce metal mobility, and allow for establishment of a vegetative cap. This remedy was successfully implemented at the Mammoth Mill Site (CERCLIS No. NM0001097716) located in the north portion of the PAMD, adjacent to Bear Creek.

Because of the historic significance the PAMD, removal activities related should comply with the requirements of Section 106 of the Historic Preservation Act.

A

USACE Contract No. W9126G-06-D-0025, Task Order No. 0005

B

Task Order Work Plan

C

Access

D

Property History

E

Field Documentation

F

Sample Results and Data Usability

G

Contaminant Distribution Maps

H

Property Owner Results

Digital Files