Arsenic Investigation

Black Mountain Open Space Park
San Diego, California

City of San Diego

202 C Street, 5th Floor MSD 5D | San Diego, California 92101

May 3, 2018 | Project No. 108246003

Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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1 INTRODUCTION

Ninyo & Moore was retained by the City of San Diego (City) and subsequently by their consultant, Helix Environmental Planning, Inc., (Helix) to assist with the initial phase of the Black Mountain Open Space Park (park) Project (Project) located in the Rancho Peñasquitos community area of San Diego. A portion of the Park contains the historic Black Mountain Arsenic Mine, located on the northeast slope of a narrow canyon on the north side of Black Mountain. Based on the years the mine operated, during the 1920s, the State of California, Department of Conservation (DOC) has classified the mine site as a legacy abandoned mine, since it ceased operations before state and federal laws required reclamation of mined land.

The initial scope of work for this Project was to evaluate and delineate locations of elevated arsenic concentrations in soils along the Miners Ridge Loop Trail based on the presence of elevated arsenic concentrations in soils and rocks (Johnston, 2016, USD, 2015-2017) (Appendix A). The Project was subsequently expanded to evaluate arsenic concentrations in soils along other designated, open Park trails maintained by City staff and used by the public. Human health and ecological risk assessments (HHRA and ERA, respectively) were performed to evaluate whether the arsenic detected in soils along Park trails would be a risk to human health and/or ecological receptors at the Park. In addition, soils at the mine workings and ore processing areas and related features (herein referred to as mine workings and ore processing areas) were sampled to begin assessing those areas. It is important to note that the presence of elevated arsenic concentrations and other metals in soils (and rocks) is a result of naturally occurring processes.

Recommended remedial actions were developed related to the physical closures of the abandoned mine workings and ore processing areas and to remediate portions of Park trails with elevated arsenic concentrations. The recommended remediation was developed to be protective to City staff and the public, based on the results of the HHRA and ERA, and in collaboration with state Department of Conservation, Division of Mine Reclamation (DOC) staff because of their expertise in physical mine closures. The remedial actions also took into consideration the City's goals for the Park and the designation of the former mine site as a cultural and historical resource (ASM Affiliates, 2007) (Appendix A).

The second phase of the Project will generally consist of evaluating the recommended physical mine closure options related to the abandoned mine workings and ore processing areas and implementing physical closures of these features. This phase of the Project is also anticipated to evaluate physical restrictions and/or remediation of soils, rocks and/or ore concentrate associated with portions of this area.

The third phase of the Project will consist of evaluating the potential impacts to groundwater in the canyon containing the mine workings and ore processing areas.

The Park is owned by, and the responsibility of, the City of San Diego, operating under the authority of the City Manager. City staff park rangers of The Open Space Parks Division of the Park and Recreation Department perform tasks such as conducting interpretive programs, foot patrol, trail brushing, removing non-native plant material with hand tools, installing or repairing signage, visitor assistance, using hand tools for trail maintenance work, and open cab tractor or Sweco tractor work in certain areas for certain projects (e.g., trail maintenance, removing trash), patrolling in a closed cab vehicle, and mowing non-native vegetation (City, 2017).

Background information (Johnston, 2016, USD, 2015-2017), indicates that soils/rocks at the former mine workings and ore processing areas and at certain areas along the Miners Ridge Loop Trail contain elevated arsenic concentrations, and therefore, may have the potential to adversely impact the health of City staff that routinely maintain trails at the park and the public that use the trails primarily for hiking and biking. Preliminary work (Johnston 2016) found arsenic concentrations as high as 480,000 parts per million (ppm) in some rocks and almost 20,000 ppm in some soils.

Based on background information, in 1923, mining operations began on the north slope of Black Mountain, reportedly to mine arsenopyrite and some gold, process the ore, and send it to a refinery. Background documents describe the ore as being associated with northwest trending, discontinuous parallel “dikes of quartzite” 10 to 15 feet wide that cut the surrounding “diorite” (actually more accurately described as Santiago Peak Volcanic rocks). As is common when reviewing historical descriptions of former mine sites, while the trend of the structures and apparent small quantities of ore are consistent with field observations, some of the rock type descriptions appear to differ from what was actually observed at the mine site. Mine workings are mostly located below the Park trails in an unnamed northeast trending canyon/tributary. At the time of this Project, the mine workings where ore was extracted consisted of two short adits (horizontal openings), a short inclined shaft (vertical opening), and various relatively small excavation pits. The ore processing area is also mostly located in the same northeast trending canyon/tributary and consists of remnants of ore crushing and roasting equipment as well as a dust chamber on the northwest slope of the canyon and cyanide vats.

Background information indicates two separate ore processing operations at the site (ASM, 2007). Historical documents and field observations of the abandoned mine workings (consisting of relatively short adits and a short inclined shaft and the presence of only minor pits or excavations, and absence of significant mine tailings, etc.) suggest operations were relatively short lived. Typical of mines in those days, the site was abandoned with no remediation, since mine reclamation plans or remediation were not required. A more complete description of the mine workings and ore processing areas is provided in Appendix A and later in this report.

The mine site area was previously described by ASM (2007), as extending for approximately 620 feet in a northeasterly direction along a canyon and generally consists of two main areas. At the southwest end, near the canyon bottom are an adit and tailings piles where the ore was mined and extracted, and approximately 220 feet to the northeast, the mill site where the ore was processed and the location of a narrow excavated terrace that measures approximately 120 feet by 40 feet. Two road cuts lead from the adits and tailings to the mill site. Descriptions of the mine are also included in the January 1925, Chapter XXI of the State Mineralogist covering Mining in California; 1966 Country Report 3 – The Geology and Mineral Resources of San Diego County, California, by Harold Weber; and the 1966 California Division of Mines and Geology, Minerals of California, Bulletin 189.

ASM (2007) identified and described former mine workings in the canyon area consisting of a main adit and a second adit to the north, vertical pit, pit and debris, core processing area, dust flue, concrete reservoir and cyanide vats generally located along the canyon area. Additional relatively minor mine workings, pits, cuts, etc., have been identified and mapped by USD staff (USD, 2016). The above described mine workings in the canyon area, as well as other minor mine workings identified by USD (2015 to 2017) are within the boundaries of the Park, which is used as a public space primarily for hiking and mountain biking. The main trails in the Park, Miners Ridge Loop, Black Mountain, Nighthawk, and Little Black Mountain Loop, are generally located topographically higher and to the south and east of the majority of mine workings in the canyon/tributary area. Although the mine workings are located off the main Park trails, they are accessible and generally known to the public who leave evidence of their visits through graffiti, trash (bb pellets, beer cans), plus books and candles left in workings and at/in ore processing areas.

This Project is a collaborative effort between the City, USD, and Ninyo & Moore. USD has conducted significant work related to arsenic concentrations in soils and rocks at the park and Ninyo & Moore appreciates their providing knowledge, insight, and previous information that greatly benefit this project.

2 PROJECT OBJECTIVES

The primary objectives of the Project included the following:

- Further evaluate the locations of elevated concentrations of arsenic in soils along designated/open Park trails and at the abandoned mine site (mine workings and ore processing areas). Previous x-ray fluorescence (XRF) data of rocks and soils and analytical testing of samples indicated that, as expected, elevated arsenic concentrations are present in rocks and soils at the mine workings and ore processing areas. However, the XRF and analytical data also indicated the presence of elevated arsenic at some locations along the Miners Ridge Loop Trail.

- Delineate the locations along the designated/open Park trails where elevated levels of arsenic may be present. Based on this information evaluate potential health risk and hazards posed by arsenic in soils at the Park to City staff and the public, based on XRF data, soil sampling and analytical testing, and results of the HHRA.

- Evaluate whether City staff working on trails, and the public, are being exposed to elevated concentrations of arsenic along designated/open Park trails and/or at the abandoned mine workings and ore processing areas.

- Evaluate the potential health risks to human health and ecological receptors related to elevated arsenic concentrations by conducting a human health risk assessment (HHRA) and Ecological Risk Assessment (ERA) on the designated/open Park trails using soil analytical data, air monitoring dust data collected as part of this Project and information on Park usage by the public and City staff workers.

- Based on findings, prepare a site investigation report that includes mitigation measures/ options to the City to address potential exposure from elevated arsenic to City staff and the public using the Park trails. Identify locations of elevated arsenic concentrations along designated Park Trails and provides mitigation measures to reduce/minimize exposure in these areas.

- Document the types of physical hazards that are present at the mine workings and ore processing areas and in conjunction with the DOC, provide specific recommendations for the protection of public safety (e.g., prevent persons from entering and/or falling into old workings).

- Identify and preliminarily evaluate the environmental hazards (e.g., evaluate arsenic concentrations) at the mine workings and ore processing areas to begin to develop appropriate remedial actions to be implemented in a subsequent phase of this project.

- Assist the City by obtaining information from the DOC related to possible requirements and/or recommendations for the mine site area including workings and ore processing areas and inquire about possible assistance and/or funding related to protecting the public from potential physical and potential environmental hazards. Also assist the City with submittals to the DOC related to possible assistance and/or funding for conducting the planned preliminary assessment/site investigation (PA/SI) and for physically implementing controls to protect the public from accessing the abandoned mine workings and ore processing areas.

3 SITE LOCATION AND DESCRIPTION

The Black Mountain Open Space Park consists of approximately 2,350 acres of land consisting of hills, ridges and canyons consisting of coastal sage, remnant grasslands, chaparral and riparian habitat located in the Rancho Peñasquitos area of northern San Diego. The Park is located west of Interstate 15 and Carmel Mountain Road/Peñasquitos Drive, and traverses Carmel Valley Road. Access to Park trails is from Hilltop Community Park at the south and the Black Mountain Community near the center of the Park (Figures 1 and 2). The Park is surrounded by dense suburban population with new homes and residential communities currently under construction to the east and northeast. The Park includes approximately 20 miles of designated, maintained trails and is a popular destination for local hikers and bicyclists.

Within the Park are the remains of the Black Mountain Arsenic Mine, at an elevation of approximately 1,000 feet mean sea level (MSL). The mine workings and ore processing features are located in a relatively narrow, unnamed canyon/tributary on the north side of Black Mountain in the northeast portion of the park. The description of the Black Mountain Mine is based on field work and research by Ninyo & Moore and USD related to this investigation, previous and current field work and research conducted by USD, information contained in government publications and the report by ASM Affiliates (2007). The most significant mine features are identified on Figures 3 and 4, and photographs are included in Appendix B.

The mining and ore processing area generally consists of an approximately 850 foot long area extending in a northeasterly direction, generally paralleling the axis of an unnamed and relatively narrow canyon/tributary. The main mining area appears to have been at the southwestern portion of the canyon and consists of two relatively short adits, on the northwest and southeast sides, informally referred to by USD as the Koala and Hobbit Hole mines, respectively. Tailing piles from both these adits partially fills the canyon between the two adits and extends northeasterly along the canyon bottom for about 80 feet. Approximately 400 feet to the south and above the canyon floor on the southeast side of the canyon is an inclined shaft, informally referred to as the Ranga Adit. Between the Koala and Hobbit Hole Mines and Ranga Mine is a shallow vertical pit located on the southeast side of the canyon, informally referred to as the Glory Hole. There are several other locations of smaller scaled mine features consisting of shallow pits or excavations or cuts and include what are informally referred to as pit mines, potholes, and/or excavations.

Approximately 220 feet northeast of the Koala and Hobbit Hole mines are the remains of the ore processing area, located on a relatively narrow excavated terrace. Two poorly defined road cuts lead from the adits and tailings to the abandoned ore processing (mill) site. The canyon bottom drops relatively steeply from the mine workings (Koala and Hobbit Hole Mine adits) to the ore processing area which is approximately 40 feet above the axis of the canyon. The ore processing area consists of the remnants of wooden structures/buildings, remains of an ore-roasting furnace, concrete footings and foundations, concrete (cyanide) vats, and a poured concrete dust chamber.

Ore processing features located outside the terrace include a concrete dust chamber on the slope above the ore processing area, trending approximately N45°W. The dust chamber measures approximately 7 x 7 feet across and approximately 180 feet in length. Cyanide vats (the northeast vat consists of two vats separated by a concrete divider) are located just above the axis of the canyon, approximately 160 feet northeast of the ore processing area. A poorly defined access road runs from the ore processing area past the cyanide vats and continues to climb the slope in a northwesterly direction and is covered with thick chaparral brush. The road can be followed for about a 0.25 mile to the top of a ridge, northwest of the mine workings area, at which point the brush becomes so thick it can no longer be detected.

The Park is surrounded by single family residential structures, a community park, multiple schools, freeways, and multi-family residential structures. From many of the newer areas of construction (northeast and east of the canyon) the mine workings and ore processing area are visible.

The Black Mountain Mine was identified by ASM Affiliates (2007), as a previously recorded cultural resource designated CA-SDI-11040H. ASM Affiliates stated that ASM affiliates stated that as a result of their study, the Black Mountain Mine Rural Historic District was recommended eligible for the National Register of Historic Resources. A National Register of Historic Places Registration Form was prepared for submission to the Office of Historic Preservation. The Black Mountain Mine Rural Historic District was also recommended eligible for the California Register of Historic Resources and the City of San Diego Historical Site Board Register.

4 MINING HISTORY AND OPERATIONS

Information pertaining to the mining history at the Black Mountain Arsenic Mine was obtained from various sources. Relevant information is summarized as follows:

Chapter of Report XXI of the State Mineralogist covering Mining in California and the Activities of the State Mining Bureau (California State Mining Bureau, 1925)

In the 1925 Chapter of Report of the State Mineralogist, it is indicated that the Black Mountain Mine is located in Section 5, Township 14 South, Range 2 West and nine miles southwest of Escondido on the north slope of Black Mountain at an elevation of approximately 1,000 feet [MSL]. At the time of the report, the mining property was described as consisting of four claims known as the Black Mountain Group, totaling 80 acres. The ore was reported as consisting of arsenopyrite in two parallel “dikes of quartzite” that cut the diorite with a general northwest strike and dip to the northeast. The “dikes” were reported as 10 to 15 feet wide. The arsenopyrite associated with pyrite was reported as occurring in the form of lenses and also as finely disseminated throughout fractures and seam in the “quartzite.” Mine development at the time reportedly consisted of a tunnel 30 feet in length, two shafts approximately 40 feet deep, and a number of open cuts made along the outcrops of the “quartzite dikes.” The mining equipment at the time consisted of a pneumatic compressor and air drills, the mill included a Blake crusher, 20-ton ball mill and an ore concentrator.

California Division of Mines and Geology (CDMG) (currently Department of Conservation) Geology and Mineral Resources of San Diego County, California County Report 3, (Weber, 1963)

In the San Diego County CDMG report, the Black Mountain Group [mine] was listed under Mineral Resources - Arsenic and was reported as the only deposit containing arsenopyrite and minor proportions of gold that has received attention as a possible source of arsenic. The mine site was reported at the same location as the 1925 report. The CDMG report stated that efforts to recover arsenic and gold from this deposit were confined mostly to the 1920’s. The publication states that according to records made available by the owner, the Mace Company conducted smelting tests on samples of the arsenical ore to produce gold bearing matter and recover arsenic trioxide as a fume. It was reported that no plant for such a process was developed. A small concentration plant was erected early in 1924 even though no ore reserves had been developed and that this was impractical because of an insufficient water supply and was shut down and dismantled in July of that year. Subsequent to this, but before 1930, a rotary roaster (estimated from remaining brickwork to have been 15 feet long and 5 feet in diameter) was installed, a reinforced “concrete stack” 180 feet long was constructed directly on the hillside and connected to the roaster by a metal pipe. A small crushing plant provided crushed material for the roaster. It was stated that presumably arsenic was to be recovered from condensed fumes in the “stack.” Reportedly, three cyanide leaching tanks to treat the roasted ore for gold recovery were reported to be installed and never used. Reportedly, only a ton or two of ore was roasted. The only recorded shipment from the property consisted of 700 pounds of material containing 31.4% arsenic, plus a small amount of gold and silver which was sent to a chemical plant at Martinez California in 1924. Several unsuccessful efforts to develop the deposit were made since 1930; however, none recently. The “concrete stack crushing plant structure and brickwork” for the roaster were all that remained in mid-1955.

Regarding the ore, it was reported that the arsenopyrite is distributed sparsely as small masses as large as 3 centimeters long by 0.5 cm thick along fractures and seams in “fine grained quartzite” which is a member of the Black Mountain volcanic rocks of probable Jurassic age. Lenses of arsenopyrite have been reported but no dimensions were given. Pyrite and chalcopyrite are present in minor amounts with the arsenopyrite concentrations and the sulfides are auriferous (gold-bearing). The arsenopyrite concentrations are distrusted discontinuously for a distance of at least 200 feet. It was stated that the deposit has been explored “inextensively” by adits, shafts and shallow pits and trenches. Two adits were driven about 30 feet apart on opposite sides of a small canyon. The longest extends S10°E for 25 feet then S28°E for 50 feet. The other to the north extends N25°E for about 30 feet. Two shafts now caved but reported to be 40 feet deep were sunk at the portal of each of the adits described above, there is no record of ore encountered in the shafts and arsenopyrite bearing material was found only in the first 25 feet of the longest adit. A shallow pit 100 feet higher and 200 feet south of the main adits exposed a zone containing arsenopyrite. A sample from that pit reportedly assayed 7.48% arsenic and 0.34 ounce per ton of gold.

ASM Affiliates Inc. Black Mountain Open Space Park Cultural and Historic Resource Evaluation (ASM, 2007)

The following detailed information about arsenic mining in general and arsenic mining at the Park was obtained from the ASM Affiliates cultural and historical resources report.

At the height of the short-lived white arsenic boom in 1923, several investors began operations in San Diego County on the north slope of Black Mountain to mine arsenopyrite, process the ore, and send it to a refiner to produce white arsenic.

On October 4, 1923, articles of incorporation were filed for the Black Mountain Arsenic Mining Company which controlled four claims known as the Black Mountain Group, covering 80 acres along a relatively narrow canyon on Black Mountain’s north slope.

Background information indicates that work began at Black Mountain in 1924. That year the Mace Company (Mace) of Denver, Colorado conducted smelting tests on samples of the arsenical ore to produce a gold-bearing matte and recover arsenic trioxide as a fume. A small concentrating plant was erected early in the year, even though no ore reserves had been developed. Seven hundred pounds of material containing 31.4% arsenic, plus a small amount of gold and silver, were sent to a Chemical Engineering Company plant in Martinez, California. Operations at Black Mountain were discontinued due to the lack of a reliable water supply, and the concentration plant had been dismantled by July of that year. Mace reportedly was apparently one of the many smelting and mining companies looking for arsenopyrite deposits that could profitably produce white arsenic as a primary product during the short-lived arsenic boom of 1923-1924. Following closure of the Mace operation, development of the mine continued. By the end of 1925, a 30 foot long tunnel and two 40 foot deep shafts had been opened, as well as a number of cuts along the outcrops of the “quartzite dikes.” The ore was said to contain 5% arsenic with from $2 to $5 of gold per ton. Mine equipment consisted of a pneumatic compressor and air drills, a Blake Jaw Crusher, 20-ton ball mill, and an ore concentrator. The plant was driven by a four cylinder, 70-horsepower, tractor gasoline engine.

The concentrates produced from the ore reportedly contained 40% arsenic with “gold values.” With the collapse of the arsenic market and the dismantling of the primary arsenic refineries, including the Martinez operation in 1925, the Black Mountain Arsenic Mining Company appears to have changed strategies and in 1926-1927 installed equipment to process the ore onsite. This included a 15-foot long rotary roaster, connected by a brick flue and steel pipe to a concrete dust chamber, and three concrete cyanide vats. A gyratory crusher was also installed that would have replaced the original Blake Jaw Crusher reported to have been in use in 1925. This would allow the ore to be roasted on-site, the resulting arsenic containing soot collected in the dust chamber, and the roasted concentrates then treated in cyanide to recover any gold. Despite these improvements, it was reported that little other work was done at the mine. During the summers of 1926 and 1927 one of the two kids working at the mine stated that it appeared that in 1927, the operation ran out of fuel oil for firing the roaster and substituted diesel fuel which caused too much heat and the bearings melted on the roaster drum, shutting the entire operation down. Reportedly, some unsuccessful attempts were made to reopen the mine and revive the operations; however, by 1939, all the equipment had been removed for salvage and the site was idle.

The ore processing at the Black Mountain Arsenic Mine evolved through two distinct phases. During the first phase, from late 1924 through 1925, the purpose was to produce a concentrated residue from the ore that could be shipped to a refinery. ASM reported that based on descriptions and evidence on the ground, the ore was mined at the “quartzite outcrops” in the canyon bottom and then conveyed via ore carts on a narrow gauge railroad to the mill built on an excavated terrace some 250 feet down the canyon from the arsenopyrite source. Here the ore was fed into a Blake Rock Crusher and then processed with water in a Harding Ball Mill until it was reduced into a fine slime. From the ball mill the material would have been passed to a concentrator and the resulting ore concentrate shipped to a refining plant.

During the second phase, from 1926 to 1927, the ore was reportedly similarly conveyed to the dumping station in ore carts, roasted and the resulting soot was collected in the concrete dust flue constructed on the hillside above the terrace. The ore was conveyed to the dumping station in ore carts as before, then it appears to have been processed in a gyratory crusher from which it was conveyed to the roaster where it was heated to produce soot (i.e., flue-dust), which passed through the dust-collector. Following roasting, the ore was treated with cyanide to extract gold. The soot in the dust collector would be collected and presumably sold as crude arsenic.

Geochemical Investigation of Anomalous Arsenic Enrichment in the Santiago Peak Volcanics of Southern California, Elizabeth Johnston, University of San Diego, September 2016

This thesis investigates arsenic distribution in igneous rocks at Black Mountain Open Space Park. As described in the Johnson thesis (2016), the extent of arsenic enrichment in the Santiago Peak Volcanic rocks at Black Mountain was initially evaluated by field-portable X-ray fluorescence (FP-XRF). The initial investigation of soils and rocks throughout the park by XRF indicated arsenic concentrations up to 400,000 ppm. It was stated that such concentrations are nearly 100,000 times greater than average for the upper-crust (4.8 ppm, Rudnick and Gao 2003) and, therefore indicate the need to investigate arsenic enrichment throughout the park and the potential for arsenic to be mobilized offsite. The thesis investigated arsenic distribution among rocks cropping out at the Park. Multiple lithologies were sampled so that the extent of heterogeneity would be represented in the sample population. Seventy-nine rock samples were obtained from outcrops at the Park, primarily from around a 1 km^2 area surrounding the abandoned mines and included “in-situ” and “waste rock” samples and the remaining samples were collected from the artisanal strip mine to the north of the park. The following sections summarize the arsenic results presented in the thesis.

Arsenic Enrichment

The total arsenic concentration of powdered bulk rock and sub-samples (n = 168) ranged from non-detectable (<2 ppm) to nearly 300,000 ppm (mean = 7,476 ± 2,694 ppm arsenic). Arsenic was most enriched in samples collected from abandoned arsenic "mines" (n = 27, mean = 36,745 ± 13,801 ppm arsenic), and samples and sub-samples of waste rocks were also highly enriched in arsenic (n = 12, mean = 3,051 ± 2,259 ppm arsenic). Subsamples of weathering rinds and veins typically contained greater arsenic concentrations (n = 44, mean = 9,475 ± 4,941 ppm arsenic) than subsamples of fresh rock (n = 44, mean = 538 ± 245 ppm arsenic).

Trace Metal Enrichment

Based on bulk geochemistry data, the Santiago Peak Volcanic rocks were classified as rhyolites and dacites. Total arsenic concentrations in the Black Mountain Santiago Peak Volcanic rocks (20 samples) ranged from 5.2 to 3,155 ppm. In addition to arsenic, all samples contained copper, lead, and zinc. Antimony was detected in only a few (two) samples. Rhyolites were typically more enriched in arsenic (of the 10 samples, the average arsenic concentration was 586 ± 10 ppm) than dacites (n = 10, mean = 14 ± 9 ppm arsenic). Rhyolites also contained greater concentrations of lead (mean = 28 ± 4 ppm arsenic), while dacites were more enriched in zinc (mean = 114 ± 13 ppm). Rhyolites and dacites had similar average copper concentrations (~30 ppm). The Black Mountain Santiago Peak Volcanic lavas show iron enrichment consistent with the tholeiitic magma series.

Arsenopyrite Weathering and Mobilization

In the Black Mountain Santiago Peak Volcanic rocks, arsenic content was highest in a powder containing arsenopyrite (297,156 ppm arsenic), while a powder containing natropharmacosiderite, arsenosiderite, and yukonite contained 167,070 ppm arsenic. Powders containing goethite and no other known arsenic host minerals (other than hematite) contained arsenic concentrations ranging from 85 ppm arsenic to 43,147 ppm arsenic (n = 17, mean = 4,402 ± 2,516 ppm arsenic). Therefore, there is evidence for several stages of alteration and arsenic remobilization, and that arsenic content is lower in later-stage minerals.

Arsenic enrichment in the Black Mountain Santiago Peak Volcanic rocks (n = 168) ranged from non-detect (<2 ppm arsenic) to nearly 300,000 ppm arsenic (mean = 7,476 ± 2,694 ppm arsenic). This wide range in arsenic content indicates that it is present in several primary and secondary host mineral phases, including those identified as arsenopyrite, scorodite, jarosite, iron oxides, and gypsum, among other host minerals. This work also demonstrates that arsenic content is likely highest in primary host minerals and decreases with each phase of primary mineral weathering. However, arsenic content, even in late-stage secondary host minerals, is anomalous (>1,000 ppm arsenic). Greater arsenic was detected in weathering rinds and veins (mean = 9,475 ± 4,941 ppm) than the fresh components (mean = 538 ± 245) of the same rock (n = 44, Fig 3.6), further indicating that arsenic is mobilized during modern water-rock interactions. These findings suggest the potential for arsenic to be mobilized off-site during storm events, or via groundwater flow (assuming the ore deposit extends below the water table), and indicates a need for future research investigating arsenic transport from host rocks.

Preliminary Recommendations, Arsenic Concentrations and Assessment of Risk, Black Mountain Open Space Park, San Diego, California, Ninyo & Moore, November 30, 2016

On November 23, 2016, a reconnaissance of the Miners Ridge Loop Trail was conducted with City, USD, Helix Environmental Planning, Inc., (Helix), and Ninyo & Moore staff for the purposes of developing a scope of work to assist the City with supplemental data collection regarding arsenic concentrations at the abandoned mine workings, ore processing area and in soils along trails, for the purpose of evaluating the potential health risks. Background information (Johnston, 2016, USD, 2015-2017) indicated that soils/rocks at the former mine site workings and at certain areas along Park trails contain elevated arsenic concentrations, and therefore have the potential to adversely impact the health of City employees that routinely access the site and persons that use the trails primarily for biking and hiking.

Following the site reconnaissance, a brief letter was prepared (Ninyo & Moore, 2016) recommending a medical surveillance program be initiated for City staff working at the park that establishes a method of assessing the employee’s health prior to exposure to potentially elevated arsenic concentrations (and possibly other metals), determines their suitability for work assignments that may require personal protection clothing and equipment, and monitors for evidence of changes in medical conditions that could be work related. It was also recommended that access to the mine site area be blocked (e.g., place rocks at the unmaintained access trails to the mine workings from the Miners Loop Trail). It was also stated that it was likely that additional restricted access to the mine workings and ore processing areas will be recommended based on the rapidly urbanizing region of the area, its location in an open space park and use as a recreation area to protect the public and to promote public safety related to this unsecured Legacy Abandoned Mine.

City of San Diego, Media Release, City Closes Trail to Conduct Tests in Black Mountain Ranch Open Space Park, January 6, 2017

On January 6, 2017, the City of San Diego issued a media release and posted signs indicating the temporary closure of the Miners Ridge Loop Trail. The release stated that the City in collaboration with their research consultants, had detected higher than normal arsenic readings at the abandoned arsenic mine in Black Mountain Open Space Park and that there is no conclusive evidence that there has been or is an imminent threat to the health of the public, plants, or wildlife in and around the mine or along nearby trails as a result of this discovery. The notice stated that trails in close proximity to the mine are closed to allow researchers to conduct further testing, sampling and monitoring of the mine and trails in the area. Public access to the mine and surrounding area is prohibited. This included a portion of the Miners Ridge Loop Trail. Research and thorough testing was indicated as expecting to take several months. Members of the public were advised to follow all signage and Ranger instructions in Black Mountain Ranch Open Space Park. The notification provided a brief history of the mine, indicated access to Black Mountain Peak was still available to the public along western portions of the park and that public updates will be provided as relevant information becomes available and an updated map indicating the locations of trail closures is available to the Public at the park and on the website.

5 PHYSICAL SETTING

The following sections summarize topography, geologic, and hydrogeologic conditions at the site and vicinity, based on the referenced documents and information obtained while conducting this investigation.

5.1 Topography

The topography at Black Mountain Open Space Park that was part of this investigation ranges from approximately 550 to 1,566 feet (Black Mountain) MSL.

5.2 Site Geology

According to a review of the California Geological Survey Geologic map of the San Diego 30' by 60' Quadrangle, the site is underlain by metamorphosed volcanic and sedimentary rocks, undivided. The unit is described as low-grade (green schist facies) metasedimentary rocks (conglomerate, sandstone, and siltstone) interlayered and mixed with metavolcanic rocks consisting of flows, tuffs, and volcaniclastic breccia (Kennedy and Tan, 2008).

Volcanic outcrops in Black Mountain generally consist of lava flows, welded tuff, and volcaniclastic (epiclastic) rocks collectively belonging to the Cretaceous-age Santiago Peak Volcanics. Subaerial eruptive features include vesicles, flow banding, pumice fragments, and accretionary lapilli. The arsenic at the Black Mountain Mine and vicinity is considered to be naturally occurring within the volcanic rocks. Johnston (2016) concluded that arsenic enrichment in the Black Mountain Santiago Peak Volcanic rocks is related to plate tectonics, more specifically, geologic subduction zone processes. The presence of naturally occurring arsenic in these rocks is related to an ancient volcanic arc system. Recent work suggests that, within these ancient volcanic arc systems, arsenic enrichment is associated with volcanic rocks that crystallized from relatively evolved partial melts underlying the volcanic front (e.g., rhyolite). According to Johnston (2016), total arsenic concentrations in samples of the Black Mountain Santiago Peak Volcanics (rock samples) ranged from 5.2 to 3,155 ppm and all the samples additionally contained copper, lead and zinc. Rhyolites were typically more enriched in arsenic than other rock types, with a mean concentration of 586 +/- 10 ppm.

During this investigation, based on observations at the mine workings and areas, arsenopyrite ore as observed in the Koala Mine adit consisted of irregular and discontinuous pods of arsenopyrite and other ore minerals occurring within rhyolite and/or rhyodacite volcanic rocks. Work by Johnston and others at USD (Johnston, 2016 and USD, 2015-2017) has indicated mineralization in the Black Mountain Open Space Park area appears to be related to a northwesterly trending fracture system.

An intermittent stream is located in the unnamed canyon/tributary that is the location of the historic mine workings and ore processing area. Historic records indicate that in the past, an arsenic-rich spring was located northeast further down the unnamed canyon of the arsenic mine and ore processing area (Figures 3 and 4). The park encompasses most of Black Mountain, the highest peak (~1,510 feet MSL) in the community, and surface water within the Park drains into channels that eventually empty into the San Dieguito River. Rainfall in the area can be limited (Johnston, 2016).

According to the Regional Water Quality Control Board (RWQCB) Water Quality Control Plan for the San Diego Basin, the northern portion of the park is situated within the La Jolla Hydrologic Sub-Area (HAS) of the Solana Beach Hydrologic Area (HA), and the San Dieguito Hydrologic Unit (HU). The southeastern portion of the park is situated within the Poway HSA of the Poway HA and the southwest portion is situated within the Miramar Reservoir HSA of the Miramar Reservoir HA. Both the Poway and Miramar Reservoir HAs are situated within the Peñasquitos HU. The Solana Beach and Miramar Reservoir HAs have municipal, agricultural, and industrial existing beneficial uses and the Poway HA has existing beneficial use for municipal and agricultural and potential beneficial use for industrial supply (RWQCB, 2007).

As indicated by Johnston (2016), there are no domestic wells within a one mile radius of the study area (aka park). As reported, historic records reported that in wetter times an arsenic rich spring existed (ASM Affiliates, 2007 and Figure 4). Johnston (2016) stated that previous work in an area of Argentina suggests that the dissolution of rhyolitic glass is the principle source for arsenic in shallow groundwater and the study indicated that volcanic host rocks that formed via ancient volcanic arc processes may produce groundwater elevated in arsenic in arsenic (>5 milligrams/liter). Based on this it was stated that groundwater flowing through the Black Mountain Santiago Peak volcanic “arsenic-rhyolite” is likely to be extremely elevated in dissolved arsenic and thus, may pose a significant health threat if consumed.

6 FIELD INVESTIGATION

The field investigation evolved as the Project proceeded based on results of earlier work and therefore was conducted in several phases as summarized in this section. As part of this investigation, previous studies conducted by USD researchers related to arsenic enrichment of the Santiago Peak Volcanic rocks at Black Mountain were reviewed and discussed. Prior work by USD documented arsenic concentrations in soils and rocks (XRF readings) ranging from below the method detection limit to 400,000 ppm (Johnston, 2016 and USD 2015-2017). Many of these rock and soil samples were not on Park trails (off trail) and in the canyon area in and around the mine workings and ore processing areas. However, several areas of “elevated” arsenic concentrations based on XRF data were identified along portions of the Miners Ridge Loop Trail (Johnston, 2016 and USD 2015-2017).

Although XRF readings along the Miners Ridge Loop Trail identified two locations on the trail with "elevated" arsenic concentrations, the previous USD studies were preliminary and did not include sampling and analytical testing of soils along the trail. Also, the earlier studies did not specifically evaluate at what concentration arsenic is considered to be "elevated" based on conducting human health and ecological risk assessments. The previous studies focused on evaluating arsenic concentrations related to specific geologic/tectonic settings and rock types and evaluated both soils and rocks. This investigation evaluated arsenic concentrations in surface and near surface soils since these soils (as opposed to rock) would potentially be more of a risk to human health and the environment since they could easily be released by air, wind, water etc.

Due to the discovery of multiple areas of elevated arsenic concentrations on the Miners Ridge Loop Trail and because preliminary findings indicated that the elevated arsenic concentrations in soils appear to be related to a specific rock type (rhyolitic volcanic rocks) and possibly related to a geologic structure (e.g., northwest trending fracture system), both which appears to correlate with higher arsenic concentrations in soils (Figures 3 and 4), and because other Park trails could contain elevated arsenic concentrations, it was decided that the project should be expanded to include other designated Park trails.

From April to October 2017, the designated/open Park trails indicated on Figure 3 were screened using an XRF and soil samples were collected for analytical testing (Figure 4). This assessment included screening the trails at regular intervals using XRF (either field portable or benchtop) and collecting soil samples at regular intervals for analytical testing at a California Certified Analytical Laboratory. XRF screening was performed in accordance with SW-846 Test Method 6200: Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. Soil samples were analyzed for total arsenic concentration by EPA method 6010B and select samples were additionally analyzed for other metals by EPA method 6010B/7471A.

It is important to note that prior to this project, USD previously conducted extensive XRF surveys, conducted some sampling and analytical testing, and obtained significant data from Park trails, canyons, and at the mine workings and ore processing areas during preliminary geologic mapping of the area. This previous XRF data was used to further identify/verify potential areas of concern (e.g., locations of potential elevated arsenic concentrations) which were subsequently reevaluated by conducting additional XRF surveys and analytical testing as described in this report section.

6.1 Site Health and Safety Plan

Ninyo & Moore and USD staff conducted field work in accordance with the pre-existing USD site-specific health and safety plan (SHSP) [Appendix C] that identified and provided site safety information for potential chemical and physical hazards that may be encountered. The SHSP was prepared in general accordance with Federal Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Standard (29 Code of Federal Regulations 1910.120) and Title 8 California Code of Regulations, Section 5192.

6.2 X-ray Fluorescence (XRF) Screening and Soil Sampling

The following sections describe the XRF field screening and soil sampling conducted along designated/open Park trails and at the mine workings and ore processing and related areas. XRF screening results are summarized on Figure 3 and soil sample arsenic concentrations are summarized on Tables 1 and 2 and Figure 4, respectively. XRF readings are included in Appendix D.

Park trail samples and mine workings and ore processing samples were collected from soil and not rock since the primary exposure risk was considered to be inhalation of arsenic containing soils or arsenic dust. Arsenic bound in solid and often siliceous volcanic rocks such as observed at the mine workings (e.g., Koala adit) were not considered to be as significant a human health and/or environmental risk as soils, with respect to inhalation. (Dermal contact and ingestion were considered to be lesser exposure routes.)

6.2.1 Miners Ridge Loop Trail

On April 13 and 14, 2017, a portable XRF was used to obtain arsenic readings along the Miners Ridge Loop Trail that comprised the location of the initial investigation. Readings were collected at approximately 100 foot intervals and at closer-spaced intervals, approximately every 25 feet or less, to better define and confirm the locations of the two previously identified areas of elevated arsenic concentrations (Johnston, 2016 and USD, 2015-2017). Concurrently, soil samples BMT-1 to BMT-79 were collected approximately every 200 feet intervals at the same locations as the XRF readings for analytical testing (Table 1 and Appendices D and E).

6.2.2 Mine Workings and Ore Processing Areas

From April 10 to 14, 2017, a portable XRF was used to obtain arsenic readings at the mine workings and ore processing features and related areas. Concurrently and at the same locations as the XRF readings, 23 soil samples, named with reference to the mine or ore processing feature or area were collected and consecutively numbered as samples 1 through 23. Samples of mine workings and ore processing areas were collected from most of the significant features including: the Ranga, Hobbit Hole and Koala adits/inclined shaft and tailings, glory hole, tailings and soil in the area of the dust flume, ore roaster area, cyanide vat area, unnamed tributary (drainage channel), and locations of some of the smaller mine workings (pit mine, and pothole 23) (Table 2 and Appendix B).

6.2.3 Other Park Trails

In general, at areas where the XRF readings were at or above 80 mg/kg for arsenic, soil samples for laboratory analytical analyses were collected and additional XRF readings were obtained at closer distances to generally delineate the length of elevated readings along the trails.

From June 20 to October 6, 2017, XRF readings were obtained from other designated/open Park trails at intervals of approximately 100 feet for general arsenic screening. For this phase of the Project, locations of “elevated” arsenic XRF readings, typically assumed to be greater than 80 mg/kg (based on prior preliminary Park trail XRF readings collected by USD and from the earlier evaluated Miners Ridge Loop Trail) were designated for soil sampling and laboratory analytical testing. Therefore, soil samples were not collected concurrently at each XRF location due to the extensive amount of samples that would be required for testing.

Based on the elevated XRF readings obtained on a portion of the Nighthawk Trail, on June 20, 2017, subsequent soil samples BMT-80 to BMT-85 were collected for laboratory analytical testing (Figure 4). At the same location, on August 23, 2017, three additional soil samples BMT-86 to BMT-89 were collected to delineate the northern extent of elevated arsenic in soils, based on an elevated arsenic concentration in soil sample BMT-85. The additional samples delineated the northern extent of the elevated arsenic in soil in this area.

Based on the elevated XRF readings obtained on a portion of the Little Black Loop Trail, on September 8, 2017, subsequent soil samples BMT-89 to BMT-94 were collected for analytical testing. Based on the analytical results, on October 6, 2017, additional soil samples BMT-95 to BMT-105 were collected and analyzed to delineate the lateral extent of arsenic impacted soils on the trails (Figure 4).

After a preliminary analysis of arsenic XRF and analytical data, it was decided that the Project could benefit from additional arsenic analysis of soil samples along the other designated/open Park trails, as opposed to only analyzing samples associated with defining the areas of elevated XRF arsenic readings. While this was not necessary, it was conducted to improve the results of the investigation and to increase the data pool used to conduct the HHRA. In addition, when elevated areas were discovered, additional XRF readings were obtained and soil samples collected to better define the lateral extent. Based on this decision, 20% of the XRF locations, corresponding to approximately one soil sample for every five XRF readings along the designated/open Park trails, were analyzed for arsenic, designated as BMT-106 to BMT-153.

6.3 XRF Screening Methodology

At each XRF location, the equipment was held against the soil and the trigger was depressed to open the shutter, and one reading was made using the soil mode. Results of each assay were recorded in the memory of the XRF spectrum analyzer and downloaded via the software provided by the manufacturer. In addition, the results of each assay were read and recorded on the XRF Data Sheet field data sheet. XRF testing was performed in accordance with SW-846 Test Method 6200: Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment.

It is important to note that arsenic concentrations by XRF field screening are different than those performed by an analytical testing laboratory which performs arsenic analysis by using acid digestion followed by an accepted analytical method such as EPA test method 6010B. XRF measures the bulk concentration of arsenic in the solid sample while acid extractions (EPA 6010B) are limited to the arsenic that can be removed from a sample using any of a number of standardized extraction procedures.

6.4 Soil Sampling Methodology

Soil samples were collected by coring the laboratory supplied glass jars directly into the soil mass to be sampled or collecting the sample into a zip-lock baggie. If the soil at the sample location was hard or compacted and not readily sampled by coring the jar, it was first broken up by using a hammer covered with a plastic bag. At each location, a new, unused plastic bag was placed over the hammer if it was required to break up the sample or if the sample was broken into numerous pieces, only those samples not in contact with the hammer were collected into the jar or baggie.

6.5 Analytical Testing

Soil samples were submitted to Orange Coast Analytical Inc., a California Certified Analytical Laboratory, under standard chain-of-custody protocols and analyzed for arsenic by EPA test method 6010B. Select samples, those containing the highest arsenic concentrations were additionally analyzed for other metals by the same method and mercury by EPA test method 7471A. In addition, select samples, also those typically with the highest total arsenic concentrations, were additionally analyzed for soluble metal concentrations by the Synthetic Precipitation Leaching Procedure (SPLP) using EPA test method SW-846, Method 1312).

7 SURFACE WIPE SAMPLING AND ANALYTICAL TESTING – ORE PROCESSING FEATURES

Wipe samples were collected from select surfaces of ore processing features that based on site reconnaissance and field observations were considered to be those that were most commonly accessed by the public. The purpose of the sampling and testing was to evaluate arsenic and/or cyanide concentrations on specific ore processing features for developing appropriate remedial action. Background information indicated that it was likely that the cyanide vats associated with the second phase of mine operations at Black Mountain may not have been used or if they were used, only for a very limited time (ASM Affiliates, 2007). Based on this, samples were collected from the vats to evaluate whether cyanide was present to preliminarily develop an appropriate remedial action for these mining features.

On April 10, 2017, 10 surface wipe samples were collected, named with reference to the ore processing feature and consecutively numbered as samples 1 through 10. Six samples were collected from the interior of the dust flume; one sample each was collected from each of the ore roasters (two samples total) and two from accessible cyanide vats (not flooded with water) (Table 4).

7.1 Surface Wipe Sampling Methodology

Surface wipe samples were collected in accordance with procedures for taking wipe samples for metals on surfaces as generally described in NIOSH 9100 “Lead in Surface Wipe Samples” of the NIOSH Manual of Analytical Methods. Each sample was obtained using a laboratory-supplied, pre-moistened (and as applicable, solvent soaked) disposable cloth which was then placed into individual resealable “zip” type baggies or glass vials and resealable “zip” type baggies. The surface sample area consisted of an approximately 1 x 1 foot square, totaling about 144 inch^2.

At each location, the sample method consisted of conducting three wipes over the entire surface area being sampled using firm pressure and “S-shaped” strokes. The first wipe consisted of using the whole cloth and sampling in a up/down (north-south) direction, folding the exposed surface inward and then using half of the sampling pad and the same “S-shaped” strokes at approximately right angles to the first wipe (left-right (east-west), followed by folding the exposed surface inward and using a quarter of the pad to repeat the sampling in an up/down (north south) direction. The wipe was then placed into the resealable baggie or into a vial, followed by a resealable baggie. The sample baggie and vial were immediately labeled and a chain of custody form completed.

7.2 Analytical Testing

The eight samples collected from the dust flume and concrete roaster were analyzed for arsenic by EPA test method 6010B and the two samples collected from the cyanide vats were analyzed for cyanide by EPA test method /SM4500-CN E.

8 QUALITY ASSURANCE/QUALITY CONTROL

Field quality assurance and quality control samples consisting of duplicate soil samples were not collected due to the heterogeneities of soils that were sampled and analyzed. Duplicate surface wipe samples could not be collected at the location previously sampled.

9 DUST MONITORING

On August 23 and 29, 2017, dust monitoring was conducted on designated/open Park trails. The purpose of the dust monitoring was to obtain site specific information about the amount of dust generated on park tails during walking/hiking and biking. Populations using the Park trails generally fall into three categories:

- Hikers
- Hikers with leashed dogs
- Mountain bikers

For purposes of obtaining information about the amount of dust generated by the public using the trails for hiking or biking, site-specific dust monitoring data was collected by Ninyo & Moore staff using a sidepak portable aerosol TSI AM510 personnel dust monitor that was strapped onto a day pack at a height and location generally corresponding to the breathing zone. The monitor uses light scattering technology to determine mass concentration of dust in real-time. An aerosol sample is drawn into the sensing chamber in a continuous stream. The monitor was calibrated each day against a gravimetric reference in accordance with the manufactures specifications. The frequency of readings was set at every 30 seconds to obtain a representative sample of ambient dust concentrations resulting from recreational activities at the site.

Dust data was downloaded directly from the side pack aerosol monitor into the Track Pro Program. The data collected from the monitors was then imported into reports showing the breakdown of dust readings measured every 30 seconds in milligrams per meters cubed (mg/m^3). The reports were named with the initials of Ninyo & Moore staff wearing the apparatus, the test run number if multiple tests were performed on the same day, and date of data collection (Appendix F).

The following table summarizes the time and locations where dust data were collected.

Table 5 - Summary of Dust Monitoring Conducted on Park Trails

Date and Report	Person(s) Conducting Dust Monitoring	Time and Weather Conditions	Comments
08.23.17 BAB foot (1)	Ninyo & Moore staff hiker	~7:54 to 9:15 am overcast with drizzle, often heavy drizzle, slight breeze	Hiked Miners Ridge Loop Trail, with and/or in the general area of the Ninyo & Moore bicyclist/hiker, trail closed, not well maintained due to closure
08.23.17 BMC foot/bike	Ninyo & Moore staff bicyclist/hiker	~7:54 to 9:15 am overcast with drizzle, often heavy drizzle, slight breeze	Rode/hiked Miners Ridge Loop Trail, beginning bicyclist, with and/or in the general area of the Ninyo & Moore hiker, trail closed, not well maintained due to closure
08.23.17 BAB foot (2)	Ninyo & Moore staff hiker	~9:40 to 10:40 am overcast with drizzle, often heavy drizzle, slight breeze	Hiked Miners Ridge Loop Trail
08.23.17 BMC foot	Ninyo & Moore staff hiker	~9:40 to 10:28 am overcast with drizzle, often heavy drizzle, slight breeze	Hiked Miners Ridge Loop Trail
08.23.17 BAB foot (3)	Ninyo & Moore staff hiker	~10:59 to 11:26 am overcast with drizzle, often heavy drizzle, slight breeze	Hiked Miners Ridge Loop Trail
08.29.17 BAB foot	Ninyo & Moore staff hiker	~8:05 to 10:15 am Clear, hot, slight breeze	Hiked Nighthawk and Black Mountain trails, accessed from Hilltop Park
08.29.17 BMC foot	Ninyo & Moore staff hiker	~8:05 to 10:17 am Clear, hot, slight breeze	Hiked Nighthawk, Little Black Loop, Miners Ridge Loop and Sundevil Trails, accessed from Hilltop Park
08.29.17 GSW bike	Ninyo & Moore staff mountain biker	~8:03 to 10:07 am Clear, hot, slight breeze	Mountain biking various trails including Black Mountain Summit, Nighthawk and Little Black Loop, Roadrunner Loop Trails, accessed from Hilltop Park

10 BLACK MOUNTAIN TRAILS USAGE BY CITY STAFF, HIKERS AND BICYCLISTS

10.1 Estimated Trail Usage by Hikers and Bicyclists

While conducting dust monitoring and XRF screening, respectively, Ninyo & Moore and/or USD staff performed informal interviews of persons encountered on the trails to obtain information about how many days/week they use the Park trails and an estimate of how long they spend at the Park during each visit. Information was obtained during the mornings of Wednesday August 23 and Tuesday August 29, 2017, on the weekend of September 8 to 10, 2017, from approximately 8 am to 1 pm and on the morning of October 6, 2017 from approximately 8 to 10 am. This is summarized on Table 6.

Table 6 - Summary of Estimated Time Hikers and Bicyclists Use Park Trails

Date/Time Interviewed	Person(s) Interviewed	Location/Trail	Estimated Days/Week and Hours/Visit
08.23.17	hiker	Miners Loop Trail head	~3 days/week, ~1.5 hours/visit
08.23.17	hiker	Nighthawk Trail Head	~5 days/week, ~1.5 to 2 hours/visit
08.23.17	hiker	Nighthawk Trail	~1 day/week, ~ 2 hours/visit
08.23.17	hiker	Nighthawk Trail	~3 to 4 days/week, ~1.5 hours/visit
08.23.17	mountain biker	Nighthawk Trail	~1 day/week, ~1.5 to 2 hours/visit
08.23.17	mountain biker	Parking lot at Hilltop Park	~2 to 3 days/week, ~2 hours/visit
08.29.17	hiker + dog	Trail head near Hilltop Park parking lot	~2 to 3 days/week, ~1 to 1.5 hours/visit
08.29.17	hiker + dog	Hilltop Community Park Trail	~5 days/week, ~1 to 3 hours/visit
08.29.17	hiker		~7days/week, ~1.5 hours/visit
08.29.17	hiker	Top of Black Mountain	~5 days/week, ~ 40 mins/visit
08.29.17	hiker	Top of Black Mountain	~7 days/week, ~1.5 hours/visit
08.29.17	hiker + dog	Black Mountain Trail	~2 days/week, ~1.5 hours/visit
08.29.17	hiker + dog	Black Mountain Trail	~rarely, ~1 hour/visit
08.29.17	hiker (repeat from Aug 23?)	Black Mountain Trail	4 to 5 days/week, ~1.5 to 2 hours/visit
08.29.17	2 hikers	Little Black Loop	~4 to 5 days/week, ~ 1.5 hour/visit
08.29.17	hiker	Nighthawk Trail	~3 days/week, ~ 2 hours/visit
09.08-10.17	hiker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	hiker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	hiker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	hiker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	hiker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	hiker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	hiker	various	~2 days/week, ~ 2 hours/visit
09.08-10.17	hiker	various	~2 days/week, ~ 2 hours/visit
09.08-10.17	runner	Service road to top of Black Mountain	~5 days/week, ~ .75 hour/visit

Table 6 - Summary of Estimated Time Hikers and Bicyclists Use Park Trails

Date/Time Interviewed	Person(s) Interviewed	Location/Trail	Estimated Days/Week and Hours/Visit
09.08-10.17	runner	Service road to top of Black Mountain	~5 days/week, ~ .75 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	~5 days/week, ~ 1 hour/visit
09.08-10.17	biker	various	new to area, first day on trails
10-06-17	two hikers	various	1st time at park, 1.5 hours/visit
10-06-17	group of mountain bikers	various	1st time at park, plan on 1 visit/month, ~1.5 hrs/visit
10-06-17	hikers with dog	various	~1 day/week,~1.5 hours/visit
10-06-17	hiker	various	~4 days/week, ~1.5 hours/visit

Based solely on field observations, it appears that trails accessed from and in the area of Hilltop Park (e.g., Blackhawk Trail and the trail to the top of Black Mountain) are used more frequently than those located further north and accessed at the Black Mountain parking lot (e.g., Miners Ridge Loop Trail) (however, the Miners Ridge Loop Trail was closed during this investigation). As a subsequent phase of this Project, USD staff will be performing an additional and larger area dust monitoring study after the Park trail Areas of Concern (AOCs) are remediated.

10.2 Estimated Time City Staff is at Black Mountain Open Space Park

Based on information provided by the City, on average it was conservatively estimated that City staff/park rangers are at Black Mountain Open Space Park approximately four hours per week. The activities conducted by City staff generally include conducting interpretive programs, foot patrol, trail brushing, removing non-native plant material with hand tools, installing or repairing signage, visitor assistance, using hand tools for trail maintenance work, and open cab tractor or Sweco tractor work in certain areas for certain projects (e.g., trail maintenance, removing trash), patrolling in a closed cab vehicle, and mowing non-native vegetation. As indicated by the City, the estimated weekly average City staff is working at the park is punctuated by periods of higher use related to spring brushing projects and winter trail construction work. For these periods, which are estimated to last approximately 16 weeks per year, the estimated time City park rangers spend at the Black Mountain Open Space Park is 16 hours/week.

11 BIOACCESSIBILITY OF ARSENIC

The bioaccessibility of arsenic along the Miners Ridge Loop Trail, along additional Park trails, and at the mine workings and ore processing areas (latter not accessible by Park trails) were evaluated by USD staff. For the purposes of this report, the term "bioavailability" refers to the assumption that arsenic can be mobilized from soil and is available for biologic uptake by humans. The term "bioaccessibility" describes data from experiments that use soil from the site mixed with simulated bodily fluid to determine if arsenic is mobilized. The latter is therefore a more comprehensive measure of biologic uptake.

In the absence of site specific specialized experiments, the US EPA recommends conservatively estimating the bioaccessibility of arsenic (termed relative bioavailability or RBA) by calculating the RBA at 60% of the total arsenic concentration in soil based on analytical testing. The HHRA for this investigation (Section 13) conservatively used the RBA of 60% which is a value typically accepted by regulatory agencies overseeing environmental contamination projects. The RBA at 60% is a value based on average soil concentrations in the United States and their effect on swine and therefore not a site-specific value.

Site investigations typically involve soil sampling and analytical testing for constituents of potential concern (COPC) and comparing the analytical results to applicable regulatory guidelines, environmental screening levels, hazardous waste criteria, and/or site-specific cleanup levels to evaluate whether contamination is present and to what extent. The purpose of the bioaccessibility testing was to expand on the arsenic site investigation and characterization by conducting site-specific testing to improve the understanding of the risk to human health related to arsenic concentrations in soils and at the mine workings and ore processing areas.

Bioaccessible arsenic is arsenic that is in a form easily absorbed by cells in the human body thereby increasing the likelihood of arsenic toxicity from the ingestion of arsenic-rich soil. The bioaccessibility experiments conducted were designed to mimic conditions in the human body if arsenic bearing soil or dust was accidentally (or purposefully) ingested. For the bioaccessibility study, the purpose was to develop site-specific bioaccessibility data since the geochemistry of arsenic can sometimes make it very mobile (and hence easily incorporated into the human body) or relatively immobile. This data would then be compared to the conservative US EPA RBA of 60% value typically used for conducting HHRAs.

To determine the bioaccessibility of arsenic in samples collected at this site, researchers at the USD prepared a solution of synthetic gastric fluid, mixed the fine fraction of sampled soil (split samples of those analyzed for arsenic and placed through a 1mm sieve) with this gastric fluid heated to body temperature, and gently agitated the mixture for two hours. This process was designed to simulate conditions in the stomach during digestion. Upon completion of this process, gastric fluid was separated from the soil and analyzed for arsenic by a California Certified Analytical Laboratory using EPA Method 6010B.

The results of these site-specific bioaccessibility studies (termed USD-BA herein) were then used to justify standard calculations indicating cancer and non-cancer risk to humans that may come in contact with these soils at the park. The standard calculations are those that were used in the HHRA section of this report.

This bioaccessibility approach is consistent with the recommended methodology for evaluating site-specific arsenic bioavailability in California soils. Historically, regulatory agencies have required in vivo (processes taking place in a living organism, such as swine) animal studies in order to make site-specific adjustments to RBA. The 2016 Human Health Risk Assessment Note #6 authored by the DTSC discusses a bioaccessibility experiment that effectively predicts RBA when compared to in vivo animal studies. At the time of writing the proposal for this work, and then completing the experiments, the exact protocol for these experiments was not publicly available, pending peer review and publication. At the time of writing this report, however, the publication and resulting protocol is now publicly available (Whitacre et al, 2017). The experimental protocol that was used also involved digesting soils in a synthetic gastric fluid, and is therefore similar to the protocol used for this study. This bioaccessibility study therefore provides the City of San Diego with very current scientific and health risk assessment data to develop appropriate remedial actions for the park.

The samples tested were homogenized splits of the soil samples that were analyzed for total arsenic of the fine fraction concentrations by XRF (Appendix G, Tables 1 and 2). The fine fraction soil concentrations were compared to the amount leached into the digested sample (USD-BA) to determine the bioavailability percentage (Appendix G, Tables 1 and 2). The methodologies used to conduct the bioavailability testing and descriptive statistics are detailed in the USD report provided in Appendix G. The results of the site specific bioaccessibility testing for the Miners Ridge Loop Trail, additional Park trails, mine workings and ore processing areas in the canyon are summarized on Tables 1 and 2 of Appendix G, respectively.

11.1 Miners Ridge Loop Trail and Additional Park Trails

The fine fraction portion of the soil samples collected on the Miners Ridge Loop Trail and additional park trails indicates that arsenic concentrations are variable. Arsenic concentrations in the fine fraction soils range from 5 to 2,330 mg/kg (Appendix G, Table 1).

11.1.1 EPA Default Relative Bioavailability of Arsenic (RBA) in Fine Fraction Soils

As previously indicated, the EPA recommends a conservative default RBA value of 60% of the arsenic concentration. This value is used when there is no site-specific bioaccessible experimental data available. Taking 60% of the total arsenic in the fine fraction from soil samples along the Park trails, the default RBA values range from 3 to 1,398 mg/kg (Appendix G, Table 1). As a comparison, the EPA default value and the site-specific bioaccessible data are both presented on Table 1 of Appendix G.

11.1.2 Site-Specific Arsenic Bioaccessibility (USD-BA) in Fine Fraction Soils

The gastric fluid experiments performed by USD on the fine fraction soils from the trails indicate that significantly less arsenic is actually bioavailable/bioaccessible than the default RBA values reported above. Per the USD-BA study, bioaccessible arsenic in samples from Park trails range from 0 to 25 mg/kg and are generally around 1 mg/kg (mean bioaccessible arsenic is 1 mg/kg, median is 0.4 mg/kg). In other words, the default value of 60% is extremely conservative as the actual percentage ranges from 0 to 9% [95% UCL of 3%] (Appendix G, Table 1).

11.2 Mine Workings and Ore Processing Areas

The mine workings and ore processing areas are not accessible by Park trails and are generally located in the unnamed northwest-southeast trending canyon located below and to the south the Miners Ridge Loop Trail (Figure 4). The site specific bioaccessible arsenic data for the mine workings and ore processing area are summarized in Table 2 of Appendix G.

Soil samples collected in and around the former mining workings and ore processing areas located in the canyon indicate that arsenic concentrations are both variable and in some locations, extremely enriched. Arsenic concentrations in the fine fraction soils range from 10 to 21,500 mg/kg. Based on research by USD staff and others, it is uncommon to measure concentrations of arsenic in soils at concentrations in the tens of thousands. This enrichment is possibly the result of both the natural enrichment of arsenic in rocks and their former disturbance due to historic mining.

11.2.1 EPA Default Relative Bioavailability of Arsenic (RBA) in Fine Fraction Soils

Default RBA for fine fraction soil samples collected at the mine workings and ore processing and related areas in the canyon, range from 6 to 12,900 mg/kg arsenic (Appendix G, Table 2). Both mean RBA (3,035 mg/kg) and median RBA (908 mg/kg) indicate that these soils could potentially release very high concentrations of bioavailable arsenic.

11.2.2 Site Specific Arsenic Bioaccessibility (USD-BA) in Fine Fraction Soils

Site-specific bioaccessible arsenic at the mine workings and ore processing areas and related areas in the canyon range from not detected to 866 mg/kg (Appendix G, Table 2). Unlike the soils along the Park trails, gastric fluid experiments on these fine fraction soils from the mine workings and ore processing and related areas in the canyon indicate the arsenic at the latter locations has the potential to be significantly more readily mobilized (up to 43%) [Appendix G, Table 2] and thereby likely presents a greater risk to human and ecological health.

11.3 Summary of Findings - Bioaccessibility Study

Arsenic bioaccessibility data for the Miners Ridge Loop Trail and additional designated/open Park trails indicates that the soils likely pose significantly less risk (up to 9% USD-BA) when compared to the conservative EPA default RBA default value of 60% that was used for this investigation.

Data for the mine workings and ore processing and related areas in the canyon, although exhibiting variable concentrations of bioaccessible arsenic, suggest that areas at the former ore processing, such as near the concrete roaster, rock crushing area, and dust flue, generally show higher concentrations of bioaccessible arsenic (up to 43%) likely due to the fact that processed ore is present. However, other areas without noticeable processed ore vary significantly, and are up to 25% (Appendix G, Table 2).

It is important to note that although the site specific bioaccessible concentrations for the mine workings/ore processing and related areas (not detected to 43%) are substantially less than the 60% EPA default RBA, the total arsenic concentrations are much higher at the mine workings and ore processing and related areas than on the Park trails (Appendix G, Tables 1 and 2). The recommended default RBA value of 60% was used for the designated/open Park trails primarily because this is a regulatory agency based value that represents a conservative approach to evaluating potential risk and because the designated/open Park trails are accessible to the public. Future work includes the completion of an ERA for the mine working and ore processing and related features (canyon) area. Based on the findings to date, it is likely that some locations in the canyon area will not pass an ERA using the 60% EPA default RBA value.

12 STATISTICAL ANALYSIS OF SOIL ARSENIC ANALYTICAL DATA

A statistical analysis of soil arsenic data was conducted to assess the “upper limit” soil arsenic concentration known to be at the hiking trails. The statistical analysis was also conducted to define the distribution of the data, the average concentration, standard deviation and the 95% upper confidence limit (95UCL) of the mean.

As stated in Section 6.2.3, at areas where the XRF readings were at or above 80 mg/kg, soil samples were collected and additional XRF readings were obtained at a higher sampling density than anywhere else on the trails. Due to the biased sampling approach, the arsenic trail data (both analytical and XRF) are biased towards high arsenic concentrations (Appendix H). Since biased data is likely to produce biased statistical parameters that are not truly representative of site conditions, an unbiased data subset was selected from soil trail data (Appendix I, Table 1). The data subset selected is believed to provide an unbiased and realistic representation of the prevailing soil arsenic concentrations at the trails. The unbiased dataset selected is made of all the soil arsenic analytical data collected at regular intervals at the trails and away from the identified soil arsenic “hot spots.” Given the random sampling nature of these samples, the data was considered to be appropriate to establish the upper limit soil arsenic concentration known to be at the hiking trails. The soil arsenic data used in the statistical analysis is presented in Appendix I, Table 1.

The statistical analysis of soil arsenic data was conducted using the USEPA developed software ProUCL (Version 5.1; Singh and Maichle, 2015). ProUCL was chosen because it was specifically developed to evaluate environmental data and it calculates multiple types of confidence limits. The results of the statistical analysis are presented in Appendix I, Table 1. ProUCL printouts showing the 95UCLs for arsenic at the trails are presented in Appendix I. The 95UCL estimated using the unbiased soil arsenic data was estimated to be 38.81 mg/kg (Appendix I, Table 1).

12.1 Correlation Between Arsenic Analytical Data and XRF Data

Justification of using the in situ XRF data as a screening tool was established using the EPA's ProUCL (Singh and Maichle, 2015) statistical software and comparing the analytical trail results with the XRF results from the same sample. For the relationship, only XRF readings with detected values were included (Table 3). Using classical linear regression analyses, the line that best describes the XRF/arsenic analytical results is described by:

$Y = 1.043 + (0.57 * X)$

where:

X = the XRF reading, in parts per million (ppm)
Y = expected arsenic soil concentration in mg/kg

The results of the ProUCL statistical calculation indicate the r-squared value for the relationship is 0.84. Given this relatively good r-squared value, the equation presented above can be used to predict an approximation of arsenic analytical concentrations using XRF readings. For example, the above linear regression equation can be used to estimate an XRF value that corresponds with the estimated risk-based cleanup level (210 mg/kg). Solving for Y in the equation, the corresponding XRF value is 366.6 ppm. Meaning an XRF concentration of less than 366.6 ppm would typically yield an analytical result less than the risk-based cleanup level of 210 mg/kg 84% of the time. Please note that the XRF results were only used to screen when to send samples for analytical testing at a certified laboratory. XRF results were not used in any of the HHRA calculations.

13 HUMAN HEALTH RISK ASSESSMENT – PARK TRAILS

The purpose of the HHRA was to determine if arsenic at the concentrations detected in soils along designated/open Park trails represent a threat to human health. A secondary objective was to set Risk-Based Cleanup Level (RBCL) for arsenic at the site. The RBCL represents the maximum soil arsenic concentration that is deemed to pose no significant health risk to park users and workers.

The HHRA evaluated human exposure to arsenic in soil by utilizing standard equations and methods developed by the USEPA and the California Department of Toxic Substances Control (DTSC) for similar exposure conditions. The risk assessment included the use of critical toxicity factors (e.g., reference doses [RfDs] for non-carcinogens and slope factors for carcinogens) in estimating potential health risks. In accordance with DTSC risk assessment guidance, it was assumed arsenic in soil at designated/open Park trails has a bioavailability of 60%

(DTSC, 2017, Appendix H). This value is a conservative and health protective assumption since the results of the site specific bioaccessibility studies conducted for the Miners Ridge Loop Trail (Section 11) indicate that arsenic in soil, is bound to the soil and is significantly less available to persons using Park trails or working at the park (up to 9% as opposed to the 60% default value (see Section 11 for additional information).

Results of the HHRA (Appendix H) indicate that estimated cancer risks associated with exposure to arsenic in soil could exceed levels considered acceptable to California health and environmental protection agencies. In light of these results, a “virtual remediation” was conducted by gradually removing from the assessment maximum detected soil arsenic concentrations. The “virtual remediation” was conducted until the estimated soil arsenic exposure point concentration was reduced to a level that was estimated to result in risks at or below one-in-a-million (1E-06). According to the HHRA, potential health risk and hazards posed by arsenic in soil at the designated/open park trails can be reduced to acceptable levels by removing or covering (capping) soils containing arsenic at concentrations exceeding 210 mg/kg.

14 ECOLOGICAL RISK ASSESSMENT – PARK TRAILS

An Ecological Risk Assessment (ERA) is a qualitative and/or quantitative appraisal of the potential effects an impacted site might have on plants and animals other than people. The objective of the ERA was to evaluate the potential threat posed by naturally occurring arsenic in soil to ecological receptors. The major components of the ERA are summarized below.

Source Terms Since arsenic is present in soils at the park, arsenic in soil represents a potential exposure source for ecological receptors that might live at, work, or visit the Park.

Selection of Measurement Endpoints The success of an ERA depends on a well-defined endpoint. An assessment endpoint is a formal expression of the environmental values to be protected. For the park, the assessment endpoints should be among the organisms that are the most sensitive to arsenic. For this evaluation, food-chain modeling was conducted to estimate the potential uptake and absorption of arsenic into local mammals and local birds.

Exposure Assessment Two aspects of exposure assessment were evaluated for this portion of the ERA. First, modeling of arsenic transport from the source must demonstrate that it approaches the organisms of interest. Second, once it is demonstrated that the species of interest can be exposed to elevated arsenic in soils, an assessment of the bioavailability of arsenic to that species was made. There are two factors associated with this part of the assessment: the organism must have a mechanism to capture arsenic from soil, and the arsenic detected at the site must be in a bioavailable form.

Effects Assessment Modeling results for the uptake of arsenic from the soils and foods were compared to dose/response relationships that are available for surrogate test organisms. The types of analysis that were performed included comparison of the soil, sediment, and tissue concentrations that are projected to occur. We know birds tend to acquire their food intake from large territories. Therefore, territorial distribution of arsenic in soils was taken into consideration for this ERA.

14.1 Risk Characterization

A risk characterization was performed for the Park trails using the analytical results of the 82 soil samples analyzed from the open/designated Park trails. The samples from the mine workings and ore processing and related areas (canyon) represent both naturally occurring arsenic enriched rocks and soils, some of which was mined; and anthropogenic processes of arsenic enrichment related to ore processing (Appendix I, Table 2). The canyon area is currently under investigation and an ERA will be conducted in the future using existing mine workings and ore processing analytical data (Appendix I, Table 2) and additional data currently being obtained in the canyon area.

Risk were characterized for two purposes: to assess potential risks associated with the levels of arsenic detected in soil, and as a basis for modeling to determine the concentration of arsenic that can remain in soils without producing adverse effects on the assessment endpoints.

According to the results of the ERA (Appendix I), food foraging and soil ingestion for ecological receptors that may live or visit the designated/open Park trails are expected to be low or insignificant. Ecological receptors are expected to have low intakes of site-related arsenic. Therefore, the overall health hazard posed by arsenic in soil is considered to be low to insignificant for ecological receptors. In other words, results of the risk evaluation indicate that exposures to arsenic in soil at concentrations with a 95UCL of 38.81 mg/kg do not pose a significant health threat to ecological receptors. In the event that modifications are made to the park and those modifications attracted wildlife, the potential threat posed by the modifications should be properly evaluated in an updated ERA.

An ERA is planned to be conducted at the mine workings and ore processing areas after additional data is obtained related to this area. More specifically, for the mine workings and ore processing areas, each area or location needs to be identified and the lateral extent of elevated arsenic concentrations needs to be defined. Once the locations or areas and corresponding lateral extent(s) are defined, an ERA for each can be conducted. An ERA for each individual area needs to be conducted because the magnitude and severity of risks will be proportional to the area covered by each defined location and the concentrations and distribution of arsenic.

14.2 Potential Health Risk to Canines

Informal park visitor surveys conducted by Ninyo & Moore in August 2017 indicated that some hikers are accompanied by dogs. Since pets could be exposed to soil and dust when walking with their owners, the HHRA evaluated whether arsenic detected along Park trails could be at high enough concentrations to pose a health threat to pet dogs. The risk evaluation for pet dogs was conducted following guidance established by the USEPA for the evaluation of risks to animals other than humans. Specifically, the evaluation was conducted by comparing arsenic concentrations to which dogs could be exposed while at designated/open Park trails to arsenic concentrations deemed to pose no significant risk to wild dogs or canids (dog, wolf, fox). This is a very conservative comparison since it’s known domestic dogs will only be at the Park for a few hours and will not be eating or consuming local animals as prey.

The 95% UCL soil arsenic concentration for the designated/open Park trails is 38.81 mg/kg (Appendix I, Table 1), which is lower than the USEPA soil arsenic screening level of 46.0 mg/kg. Based on this, it can be concluded that arsenic in soil along the designated/open Park trails does not pose a health threat to domestic dogs.

15 TOTAL ARSENIC CONCENTRATIONS IN SOIL SAMPLES AND COMPARISON TO THE ARSENIC HHRA LEVEL

This section discusses the total arsenic concentrations based on sampling and analytical testing of 153 soil samples from Park trails, BMT-1 to BMT-153 (Table 1 and Figures 3 and 4) and 23 soil samples collected from the most significant mine workings and ore processing and related areas (Tables 1 and 2, Figures 3 and 4). The laboratory analytical reports and chain-of-custody documentation are included in Appendix J.

15.1 Black Mountain Open Space Park Trails

The total arsenic concentrations from the 79 soil samples (BMT-1 through BMT-79) along the currently closed Miners Ridge Loop Trail related to the initial phase of this investigation range from 2.0 to 6,400 mg/kg. The total arsenic concentrations in soil samples from the designated Park trails evaluated during this investigation (BMT-1 to BMT-153), including the Miners Ridge Loop Trail, range from < 2.0 to 6,400 mg/kg. Based on the soil sample analytical results and using the conservative HHRA value of 210 mg/kg, three AOCs along the Park trails are the locations of soils containing arsenic concentrations greater than 210 mg/kg. The SPLP arsenic concentrations in samples analyzed (those typically containing the highest total arsenic concentrations) range from <0.020 to 2.6 milligrams per liter (mg/L).

At each of the three AOCs, (AOCs 1 through 3), the length of trail corresponding to soils with elevated (>210 mg/kg) arsenic concentrations, was conservatively assumed to extend along the trail to the adjacent samples on either side with arsenic at a concentration <210 mg/kg (Figure 4). Therefore, it is possible that the elevated arsenic concentrations in soils does not extend as far as conservatively estimated along the trail (e.g., to the adjacent sample containing arsenic at a concentration <210 mg/kg).

At some locations the adjacent sample is relatively close by, and at other locations it may be closer to 100 feet away. Other factors that were considered when defining the length of each AOC, particularly AOC-1 (Miners Ridge Loop Trail), were rock type, understanding of the northwesterly trending fracture zone, and extensive previous XRF readings and investigation conducted on the Miners Ridge Loop Trail by USD prior to this investigation.

Prior to finalizing this report, the AOC were presented to City staff. Based on the length of trail to be remediated at AOC-3, approximately 190 feet, and previous soil sample spacing, it was decided that the AOC should be additionally evaluated. The evaluation included collecting and analyzing for arsenic, four additional soil samples (BMT-92 A-D) to the east of BMT-92 and west of BMT-93. Similar to AOC-1, when conducting the additional sampling, spacing of the additional samples was a factor; however, authoritative protocol was used based on consideration of rock type and understanding of the fracture zone in the Park. Analytical results of three of the soil samples, BMT-92A - C range from 160 to 200 mg/kg, less than the 210 mg/kg remedial action level based on the HHRA. One soil sample, BMT-92D, located closest to BMT-93 contains arsenic at a concentration of 300 mg/kg, exceeding the remedial action level. Based on the additional sampling and analytical results, the length of AOC-3 was reduced (Figure 3 and Table 1). The following table summarizes the locations of the three AOCs, the soil samples representing each AOC and range of arsenic concentration(s) in the soil samples analyzed, arsenic concentrations in soil samples adjacent to each AOC, and the estimated length of each AOC.

Table 7 - Black Mountain Trail Areas and Soil Samples Exceeding the HHRA Level for Arsenic

Area of Concern (AOC) Proposed for Remedial Action	Soil Sample (>210 mg/kg)	Arsenic Concentrations along the Trail and Length	Comments
AOC - 1	BMT-65	6,400 mg/kg ~ 20 feet	Miners Ridge Loop Trail, the length of the AOC along the trail is estimated to extend from approximately 3 feet east (beyond) BMT-64 (200 mg/kg As) westerly to approximately 3 feet west (beyond) BMT-66. The AOC corresponds to a relatively narrow fractured bedrock zone. The length of the AOC was based on analytical results; however, also took into consideration rock type, understanding of the fracture zone, and extensive previous XRF readings and data collected on the Miners Ridge Loop Trail by USD prior to this investigation.
AOC - 2	BMT-81 to BMT-85	220 to 3,000 mg/kg ~185 feet	Nighthawk Trail, the length of the AOC along the trail is estimated to extend from approximately BMT-80 (66 mg/kg arsenic) at the south to approximately BMT-86 (130 mg/kg arsenic) at the north.
AOC - 3	BMT-92D and BMT-93	300 and 360 mg/kg ~100 feet	Little Black Loop Trail, the AOC along the trail is estimated to extend from BMT-92C (200 mg/kg arsenic) on the west to BMT-100 (70 mg/kg arsenic) on the northeast. The initial length of the AOC was shortened based on additional sampling and analytical testing (samples BMT-92 A through D).

15.2 Mine Workings and Ore Processing Areas

The mine workings and ore processing areas are not accessible by designated or open Park trails and the most significant workings and ore processing areas and related features are located in the unnamed northeast trending canyon below and to the east-northeast of the nearest trail (Miners Ridge Loop Trail). The total arsenic concentrations in the 23 soil samples collected from the most significant mine workings and ore processing areas and related features ranged from 5.6 to 92,000 mg/kg (Table 2 and Figure 4). The highest concentration from the ore processing area appears to be concentrated ore slurry that may have been dumped onto the ground surface (Processed Slurry SEM12-20). Further down slope and down canyon and outlying the mine workings and ore processing areas, respectively; it appears that this material has migrated down slope as represented by sample Downslope M12-21 and continued down canyon as represented by sample Drainage varve-16, containing arsenic concentrations of 13,000 and 3,100 mg/kg, respectively. The SPLP arsenic concentrations range from 0.16 to 12 mg/L (Table 2).

As previously mentioned, soil samples were not collected of the ore that apparently was mined as observed in the Koala Adit, and rock samples were not collected and analyzed because this investigation focused on evaluating the potential risk of arsenic risk to human health and the environment; therefore, arsenic containing soils or dust were considered to be the source of exposure as opposed to rocks. Based on this, at each of the areas of the mine workings, samples were collected of soils in and around the mine tailings (waste piles) and not of the waste rock which in some cases likely contains higher arsenic concentrations.

15.3 Wipe Samples of Ore Processing Features – Analytical Results

Analytical results of the 11 surface wipe samples are summarized on Table 4. Arsenic in the wipe sample from the small concrete roaster (Concrete roaster wipe-01) is 48 mg/kg and from the larger concrete roaster (Roaster M12-wipe-10) is 110 mg/kg. The five wipe samples from the dust flume contained arsenic at concentrations ranging from 10 to 980 mg/kg. Cyanide was not detected in the two wipe samples from the cyanide vats (Cyanide vat 1 wipe-09) and Cyanide Vat 4 wipe-11) and as previously indicated, these vats may not have been used during mining (ASM Affiliates, 2007).

16 SUMMARY OF FINDINGS

The following summarizes the results of this investigation:

- The arsenic in soils and rocks at the Black Mountain Mine and vicinity is considered to be naturally occurring. Johnston (2016) concluded that arsenic enrichment in the Black Mountain Santiago Peak Volcanic rocks is related to plate tectonics, more specifically, geologic subduction zone processes. The presence of naturally occurring arsenic in the Cretaceous-age, Santiago Peak Volcanic rocks is thought to be related to an ancient volcanic arc system. Recent work suggests that, within these ancient volcanic arc systems, arsenic enrichment is associated with volcanic rocks that crystallized from relatively evolved partial melts underlying the volcanic front (e.g. rhyolite). According to Johnston (2016), total arsenic concentrations in samples of the Black Mountain Santiago Peak Volcanics ranged from 5.2 to 3,155 ppm and all samples contained copper, lead and zinc. Rhyolites were typically more enriched in arsenic than other rock types, with a mean concentration of 586 ppm. The initial investigation of soils and rocks throughout the park by XRF and limited analytical testing indicated arsenic concentrations up to 400,000 ppm.

- Further geologic mapping (Johnston, 2016 and USD, 2015-2017), indicated naturally occurring arsenic-rich rocks and soils were likely exposed along some sections of the nearby Miners Ridge Loop Trail. USD notified the City of these findings and based on this, the trail was closed for the purpose of conducting an arsenic investigation initially along this trail, which was later expanded to include other designated/open Park trails.

- On January 6, 2017, the City of San Diego issued a media release and posted signs indicating the temporary closure of the Miners Ridge Loop Trail. The release stated that the City in collaboration with their research consultants, has detected higher than normal arsenic readings at the abandoned arsenic mine in Black Mountain Open Space Park and that there is no conclusive evidence that there has been or is an imminent threat to the health of the public, plants, or wildlife in and around the mine or along nearby trails as a result of this discovery. The notice also stated that trails in close proximity to the mine are closed to allow researchers to conduct further testing, sampling and monitoring of the mine and trails in the area. Public access to the mine and surrounding area was prohibited.

- Based on field reconnaissance at the mine workings and area, arsenopyrite ore as observed in the Koala Mine adit consists of irregular and discontinuous pods of arsenopyrite and other ore minerals occurring within rhyolite and/or rhyodacite volcanic rocks. Work by Johnston and others at USD (Johnston, 2016 and USD, 2015-2017), and information obtained from this investigation, suggests that arsenic mineralization and/or elevated arsenic concentrations in soils and rocks in addition to being related to rhyolitic/rhyodacite rocks and soils derived from these rocks, also appears to be related to a northwesterly trending fracture system.

- The mine workings and ore processing areas are not accessible by designated/open Park trails and the most significant workings and ore processing areas and related features are located in the unnamed northeast trending canyon topographically lower and to the east-northeast of the nearest trail (Miners Ridge Loop Trail).

- This investigation consisted of extensive XRF screening, and collecting and analyzing 157 soil samples from the designated/open Park trails. Although soil samples were not collected at every XRF reading, based on using the EPA ProUCL statistical software (Singh and Maichle, 2015), a relatively good relationship exists between XRF readings and total arsenic concentration in soils. XRF results were not used in the HHRA.

- Trail samples and mine workings and ore processing samples were collected from soil and not rock since the primary exposure risk was via inhalation, accidental ingestion, and dermal contact exposure routes. Arsenic bound in solid and often siliceous volcanic rocks such as observed at the mine workings (e.g., Koala adit) were not considered to be as significant a human health and/or environmental risk as soils. The total arsenic concentrations in soil samples from the designated/open Park trails evaluated during this investigation (BMT-1 to BMT-153) range from < 2.0 to 6,400 mg/kg.

- Analytical results of the 23 soil samples collected and analyzed from most of the significant mine workings and ore processing related features exhibit wide variability and range from 5.6 to 92,000 mg/kg. The samples from the mine workings and ore processing areas (canyon) represent both naturally occurring arsenic enriched rocks and soils, some of which was mined; and anthropogenic processes of arsenic enrichment related to ore processing. The mine workings and ore processing areas (canyon) are currently under additional investigation.

- It was assumed arsenic at the park has a bioavailability of 60%. This recommended default RBA value was used for the designated/open Park trails primarily because it is a regulatory agency based value that represents a conservative approach to evaluating potential risk and because the designated/open Park trails are accessible to the public. Based on the results of the HHRA, along the designated/open Park trails, soil arsenic concentrations in excess of 210 mg/kg could pose a potential health hazard to people using and/or working on the trails.

- Arsenic in soil along the designated/open Park trails does not pose a health threat to domestic canines/dogs. The 95UCL soil arsenic concentration for the designated/open Park trails is 38.81 mg/kg, which is lower than the USEPA soil arsenic screening level of 46.0 mg/kg.

- Site-specific arsenic bioaccessibility data for the Miners Ridge Loop Trail indicates that the soils likely pose significantly less risk, up to 9%, when compared to the conservative EPA default RBA value of 60% that was used for the HHRA. The results of the site specific bioaccessibility studies indicate that arsenic is bound to the soil and significantly less available to persons using Park trails or working at the park. Data for the mine workings and ore processing and related areas (canyon), although exhibiting variable concentrations of bioaccessible arsenic range up to 43%. Although the site specific bioaccessible concentrations for the mine workings and ore processing and related areas (up to 43%) are substantially less than the 60% EPA default RBA value used for the Park trails portion of this investigation, the total arsenic concentrations are much higher at the mine workings and ore processing and related areas than on the trails.

- An ERA was performed using the analytical results of the 82 soil samples collected (excluding subsequent soil samples BMT-92 A through D specifically collected to additionally delineate AOC-3) and analyzed from the open/designated Park trails. Based on the results of the ERA, food foraging and soil ingestion for ecological receptors that may live or visit the site are expected to be low or insignificant. Ecological receptors are expected to have low intakes of site-related arsenic. Therefore, the overall health hazard posed by arsenic in soil is considered to be low to insignificant for ecological receptors (e.g., results of the risk evaluation indicate that exposures to arsenic in soil at concentrations with a 95UCL of 38.81 mg/kg do not pose a significant health threat to ecological receptors). Based on the results of the ERA, remedial action is not deemed necessary on the designated/open Park trails as long as the future land use remains open space.

- An ERA is planned to be conducted at the mine workings and ore processing areas after additional data is obtained related to this area. More specifically, for the mine workings and ore processing areas, each area or location needs to be identified and the lateral extent of elevated arsenic concentrations needs to be defined. Once the locations or areas and corresponding lateral extent(s) are defined, an ERA for each can be conducted. An ERA for each individual area needs to be conducted because the magnitude and severity of risks will be proportional to the area covered by each defined location and the concentrations and distribution of arsenic. Based on the findings to date, it is likely that some locations in the mine workings and ore processing areas (canyon) will not pass an ERA using the 60% EPA default RBA value.

- Based on the soil sample analytical results of the designated/open Park trails, < 2.0 to 6,400 mg/kg, and using the conservative HHRA value, three AOCs along the park trails are the locations of soils containing arsenic concentrations equal to or greater than 210 mg/kg. At AOC-3, the length of the area along the trail was reduced by additional soil sampling and analytical testing.

- It is important to realize that the Santiago Peak Volcanic rocks and soils are heterogeneous. Previous and current studies indicate that arsenic enrichment is naturally occurring and related to specific rock types (rhyodacite and rhyolite) within the formation and a northwesterly trending fracture system. This investigation evaluated soils naturally enriched in arsenic (with the exception of some of the ore processing areas where arsenic enrichment is additionally related to anthropogenic processes). This investigation was limited to collecting and analyzing a certain number of samples along the designated/open Park trails and at the mine workings and ore processing and related area (canyon). Based on the geology of the park, elevated arsenic concentrations likely exist at locations off trail. Also, due to the heterogeneities of the soils, it is possible that additional areas of elevated arsenic may exist along trails; however, based on the population and close spacing of the samples collected along the trails, these areas, if present, are likely limited in length. In addition, for this investigation, additional XRF readings and soil sampling was conducted related to the northwesterly trend of the elevated arsenic concentrations as they cross designated/open Park trails and specific samples were collected and analyzed in these areas as part of this arsenic investigation.

17 RECOMMENDED REMEDIAL ACTION FOR PARK TRAILS

The following is recommended at this time for the designated/open Park trails:

- Based on results of the HHRA, it is recommended that the three AOCs along designated/open Park trails containing soils with total arsenic concentrations in excess of 210 mg/kg be remediated. Based on conversations with the City, the three areas are planned to be covered to reduce the potential impact to human health. The planned cover will be designed by the City and may consist of placing a geofabric along the length of the affected trail, overlain by gravel/crushed rock, and possibly overlain by wood and/or some or a combination of the above. The objective is to reduce/minimize generation of dust, and therefore, human physical contact or exposure in these areas.

- City staff has been restricted from working on Park trails until this phase of the Black Mountain Open Space Park arsenic investigation was completed. City staff working at the Park should participate in the City’s medical surveillance program. All City staff, rangers, docents, and contractors that will be conducting work at the Park should complete an arsenic awareness training course. The course would cover basic arsenic exposure concerns and be specific to the elevated areas of arsenic known to exist in the Park.

- Remedial action activities as well as certain subsequent activities conducted by City staff working at the park should be in accordance with the Site-specific Health and Safety Plan (SHSP) (Ninyo & Moore, 2018). The planned remedial action will disturb the elevated arsenic containing soils in the three AOCs; therefore, the SHSP will need to be implemented by City staff park rangers when conducting such activities. In addition, the SHSP will need to be implemented if subsequent Park trail maintenance activities conducted by City staff park rangers at the three AOCs involves disturbing the underlying elevated arsenic containing soils that were previously remediated (e.g., implemented for trail repair work if the underlying soils are exposed).

- Other routine activities that are conducted by City staff park rangers such as conducting interpretive programs, foot patrol, trail brushing, removing non-native plant material with hand tools, installing or repairing signage, visitor assistance, using hand tools for trail maintenance work, and open cab tractor or Sweco tractor work in certain areas for certain projects (e.g., trail maintenance, removing trash), patrolling in a closed cab vehicle, and mowing non-native vegetation (City of San Diego, 2017) will not require implementation of this SHSP if the work does not involve disturbing the remediated soils in the three AOCs. Intrusive work at the mine workings and/or ore processing areas is not covered in the existing SHSP and would require an update to the plan.

18 RECOMMENDED PHYSICAL CLOSURES FOR MINE WORKINGS AND ORE PROCESSING AREAS AND FEATURES

As part of the first phase of this Project, an assessment was conducted of physical features of the abandoned mine workings and ore processing features that may be potentially hazardous to the public, and to identify recommended remedial actions. The Abandoned Mined Lands Program (AMLP) of the California DOC performs abandoned mine inventories on public lands throughout the state. The AMLP prepares reports summarizing the results of inventories at specific locations and provides recommendations for closure of hazardous mine features found on public lands. Ninyo & Moore on behalf of the City requested assistance from the DOC related to conducting an inventory, assessing, and providing recommendations for closure of specific hazardous mine features related to the Black Mountain Mine.

18.1 Mine Feature Inventory Methodology

DOC staff conducted an inventory using AMLP standard protocol and data collection methodology, which included office research and preparation, field data collection, and subsequent data entry. Historical information was gathered about the site to gain further knowledge of the extent of mine workings as well as any potential for chemical contamination. Along with historical research, an examination of the most recent aerial photography of the site area was conducted to locate additional potential features not mapped on topographic maps.

In April 2017, AMLP staff Craig Turner, City, Ninyo & Moore and USD staff conducted a reconnaissance of the mine area to assess the physical features of the abandoned mine. The inventory consisted of documenting the location and the physical and qualitative characteristics of the individual mine features. Because of their extensive familiarity with the mine site, USD staff directed the site reconnaissance which consisted of walking to each of mine workings and ore processing features. They additionally described the features such as the lengths of adits because of their previously having conducted research related to the mine site. At each mine feature, data was collected with a GPS and ESRI Collector Application on an Apple IOS device. All location datum was projected in NAD 1983 Teale Albers. Data that was collected included mine feature type, approximate dimensions, condition, access rank (a scale from 1 to 3, for easy to difficult access to the mine site), hazard rank (a scale from 0 to 3, for no hazard to high hazard for the feature), bat rank (a scale from A to D, bats or bat sign present to no bat habitat), aspect (one of eight compass directions), color and volume of waste rock, and any odor observed. A written description of the feature was prepared based on field observations and information from USD and Ninyo & Moore and included information about the surface area around the feature, subsurface conditions observed from the surface, any hazards, existing remediation (as applicable), and cultural or biological resources. Photographs were taken to document each feature, with typically multiple photographs taken for each feature to show the inside of an adit or inclined shaft, the approach or ‘run in’ to an adit, the details of a structure, and the relationship of multiple features to each other. The known and currently remaining mining-related features were inventoried.

Data entry was conducted in the office where data was downloaded from Apple IOS units to create a geo-database using ESRI ArcGIS software. Features were assigned a Feature Identification Number (Feature ID #) and the feature data was entered into a Microsoft Access database and data from the Geo-database was imported into the same database to create individual records for the mine site and each mine feature. Once entered in the AMLP database, analysis of data could be made to provide further information to partner agencies and facilitate reports to aid in future remediation projects.

Various site conditions influence the recommendation for what type of closure is appropriate for potentially hazardous adits, shafts and excavation pits. These conditions include the presence of biological resources (e.g. bats, animals), cultural resources (historical resources/designation), competency of the bedrock observed in the opening of the mine feature, presence/absence of standing water in wet/dry years, unauthorized public visitation levels, and the risk of vandalism. During the Black Mountain Mine inventory, underground features (adits) were not entered by AMLP staff, which limited information gathering for variables such as bedrock competency. However, it is not anticipated that this limitation will affect the recommended remedial action because these features were previously entered by USD and Ninyo & Moore staff whom provided additional information to the DOC about the length and general condition of the two workings and because in general the mine workings are small. External observations of visible conditions were made during the inventory and used to make closure recommendations.

18.2 Inventory of Abandoned Mine Features

During the abandoned mine inventory for the Black Mountain Mine site visit, 14 mine related features were inventoried, and of those, 14 features were identified as potentially hazardous with a hazard rank of 2 or higher and access rank of 2 or higher. *Note: Two additional features were located by non DOC field staff, and the information sent to DOC (Pothole-23 aka Pit Mine 4, and a small ore roaster). They are included in the DOC report (Appendix K).

The mine features discussed in the DOC report were only those for which AMLP provided a hazard rank of 2 and above and an access rank of 2 and above. Each of these mine features is identified by a GPS filename, feature type, feature dimensions, closure recommendation, and GPS latitude and longitude coordinates. Feature dimensions are expressed as X (width), Y (height) and Z (depth). Depth is a key determinant of the hazard rank, as well as orientation of the mine feature (e.g., horizontal [adit] versus vertical [shaft]). Because underground features were not entered, some features may have two recommendations that will require further investigation (e.g. internal stability, rock competency) to determine which is the most appropriate. In the DOC report each feature has associated photographs with labels describing the documented portion of the feature. The types of physical closures/remediation considered for the features assessed at the mine site, were provided by the DOC and are as follows:

Bat Gate This involves installation inside an adit, of a stout, angle-iron gate with bat-compatible bar spacing, and would provide a solid, difficult-to-breach closure. The installation might be challenging or not possible, depending on whether the surrounding portal material is stable and competent enough for the gate to be bolted into it. The costs are also higher versus other remediation approaches.

Culvert Gate This involves installation of a culvert inside an adit with stout angle-iron bat gate set inside the culvert. The culvert would provide some stabilization to the portal area. As the culverts are typically round, one or two could be put in place depending on the size of the portal. This approach would be less expensive than a full bat gate, but would reduce the size of the portal; this can restrict wildlife access (e.g. bat flyway) and alter airflow and temperature regimes inside the mine. A culvert gate would modify the historical portal area to a greater extent than a bat gate.

Cupola This involves installation of an angle iron structure built over a shaft collar. This can include a stabilizing culvert being used vertically, with a cupola/grate on the top. This provides an imposing physical barrier to the shaft feature, making it more difficult to vandalize. A cupola allows bat and other wildlife access, and also preserves the historical aspect of the feature.

Cable Net This involves installation of cable netting material to appropriate specs over the opening of an adit or shaft to provide a warning and a barrier to entry, which also maintains the adit or shaft in a mostly unmodified state. However, it can be bypassed if cut or installed incorrectly and might actually encourage visitation by making the feature more visible.

Fence Installation of fencing (e.g. smooth wire, barbed wire, chain-link) around a feature can provide a warning and a barrier to entry. Warning signage could provide additional information about the dangers of underground mine workings. This is a relatively inexpensive and typically easily-installed option, which maintains the adit or shaft in an unmodified state. However, it can be easily bypassed and might actually encourage visitation by making the feature more visible.

PUF (Polyurethane Foam): The adit or shaft could be closed with expanding polyurethane foam (PUF), including an appropriate cover (e.g. soil, concrete) over the foam, to seal the opening from entry. This would provide a permanent closure. However, this would have some impact on the cultural resource, and possibly on biological resources, if they are present. *Note: Foam is technically not considered a permanent closure type, as it could be cut out or burnt out if needed or through vandalism.

Backfill The adit [and the relatively small excavation pits] could be closed by backfilling or collapsing of the portal area. This would provide a permanent closure. However, this would also impact the cultural and biological resources, and would require heavy equipment activity to and on site.

Information to consider when evaluating the best remedial alternative for the physical mine closures at Black Mountain include, but are not limited to the following:

- Historical Designation/Cultural Resources because of the historical designation of the site and previously identification of cultural resources, mine workings and more specifically ore processing features are likely to remain at the site as opposed to being removed.
- The City's desire to be protective to human health and the environment.
- Results of a biological survey.
- The location of the mine in a City-owned park at a location currently being surrounded by increasingly dense urban growth. There are no park trails to the mine workings and ore processing areas; however, unmarked paths provide access to most mine features.
- The desire to be able to access two of the mine features, specifically the two adits near the base of the canyon (Hobbit Hole and Koala) for subsequent research projects by USD. This would likely require some type of locking gate to restrict access to the general public, but allow access to authorized personnel.
- Opinions/technical input by experienced and qualified subcontractors that perform physical mine closures. It is assumed that such anticipated subcontractors will conduct a site reconnaissance of the mine features and based on this and consideration of the location of the feature/accessibility, bedrock competency, etc. will be able to provide input into the decision.

As indicated in their report, with information from the DOC assessment of physical safety hazards, the City can then perform any required surveys (e.g. biological, cultural) and develop any necessary environmental documentation to implement remediation of hazardous openings. The DOC indicated that they can also assist with specifications and example cost estimates for the various types of closures that were recommended (Appendix K).

Based on the DOC site reconnaissance and information summarized in their report, Table 8 was prepared summarizing the mine features and recommend physical closures. It is important to note that remediation of the mine features by physical closures does not remediate the environmental conditions in this area (e.g., presence of naturally occurring elevated arsenic concentrations in rocks and soils and related to the ore processing (mine tailing, ore concentrate, etc.) and down canyon.

19 RECOMMENDED REMEDIAL ACTION FOR MINE WORKINGS AND ORE PROCESSING AREAS AND FEATURES

Based on the available analytical data and bioaccessibility study, in addition to the physical closure of the mine workings and ore processing features, this area containing naturally occurring elevated arsenic concentrations as well as elevated arsenic concentrations related to ore processing, should be restricted from public access, removed or covered to prevent contact with humans. Additional phases of this Project are currently underway to more completely understand the extent of arsenic enrichment at the mine workings and ore processing areas, including down canyon from this area; the influence of stormwater; the impact to groundwater, if any; and to identify and delineate areas to complete an ERA. The results of the ERA will be used to determine potential remedial actions. However, based on the available data to date, it is likely that some locations in the canyon area will not pass an ERA using the 60% EPA default RBA value and some form of remedial action will be required.

As temporary measures, signage indicating the presence of a carcinogen at elevated concentrations should be placed at known access points to the mine workings and ore processing areas (canyon). The area of the processed ore should be enclosed with fencing and signage to further restrict it from the public due to the elevated arsenic concentrations in this area.

20 LIMITATIONS

The environmental services described in this report have been conducted in general accordance with current regulatory guidelines and the standard-of-care exercised by environmental consultants performing similar work in the project area. No warranty, expressed or implied, is made regarding the professional opinions presented in this report. Variations in site conditions may exist and conditions not observed or described in this report may be encountered during subsequent activities. Please also note that this study did not include an evaluation of geotechnical conditions or potential geologic hazards.

Ninyo & Moore's opinions and recommendations regarding environmental conditions, as presented in this report, are based on limited subsurface assessment and chemical analysis. Further assessment of potential adverse environmental impacts from past on-site and/or nearby use of hazardous materials may be accomplished by a more comprehensive assessment. The samples collected and used for testing, and the observations made, are believed to be representative of the area(s) evaluated; however, conditions can vary significantly between sampling locations. Variations in soil and/or groundwater conditions will exist beyond the points explored in this evaluation.

The environmental interpretations and opinions contained in this report are based on the results of laboratory tests and analyses intended to detect the presence and concentration of specific chemical or physical constituents in samples collected from the subject site. The testing and analyses have been conducted by an independent laboratory which is certified by the State of California to conduct such tests. Ninyo & Moore has no involvement in, or control over, such testing and analysis.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the client requires any additional information, or has questions regarding content, interpretations presented, or completeness of this document. Readers should contact the City of San Diego if they have questions regarding this document.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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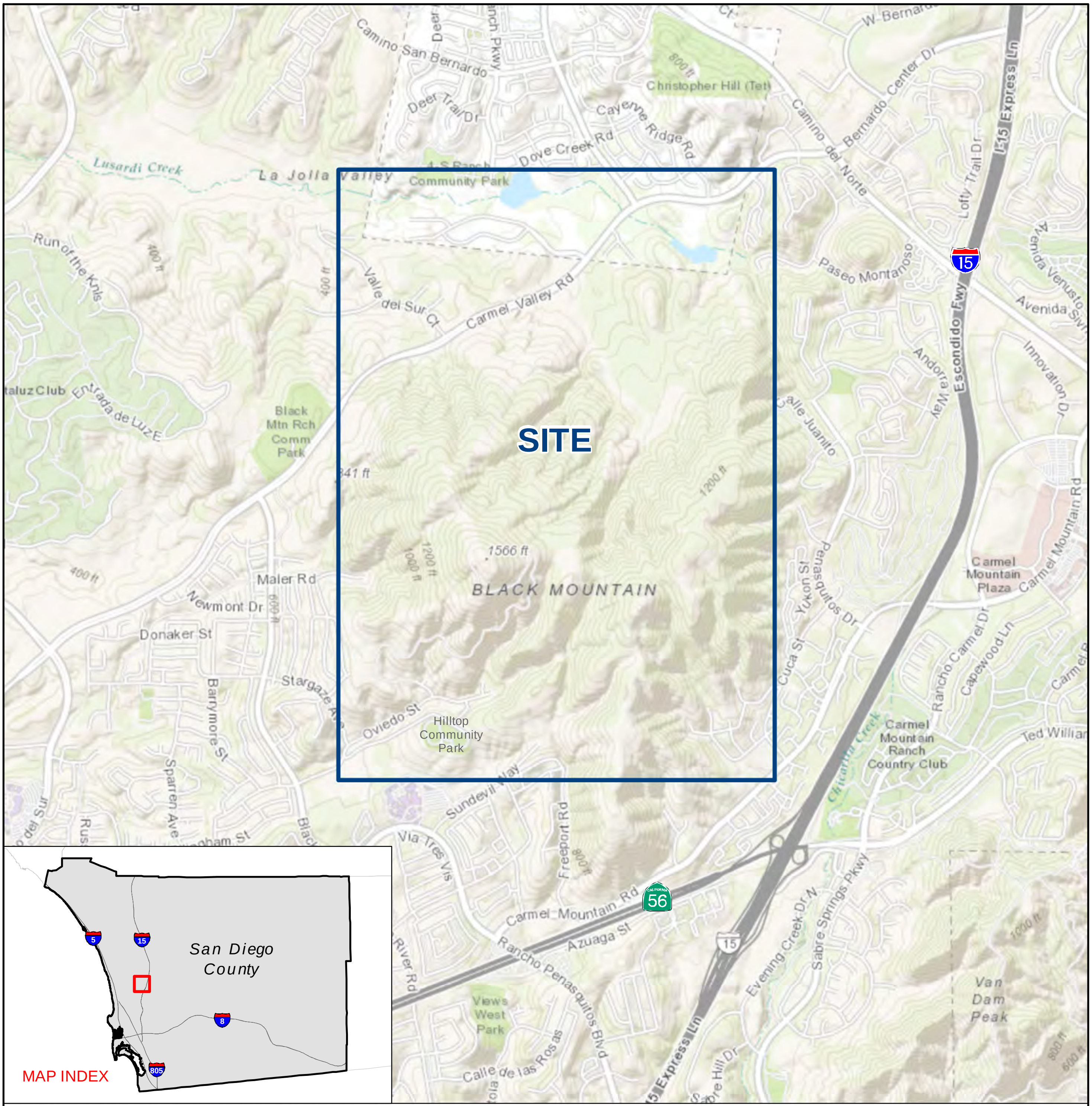
FIGURES



LEGEND

▬ AREA OF ARSENIC INVESTIGATION

N

FEET

0 3,000 6,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: ESRI WORLD TOPO, 2017

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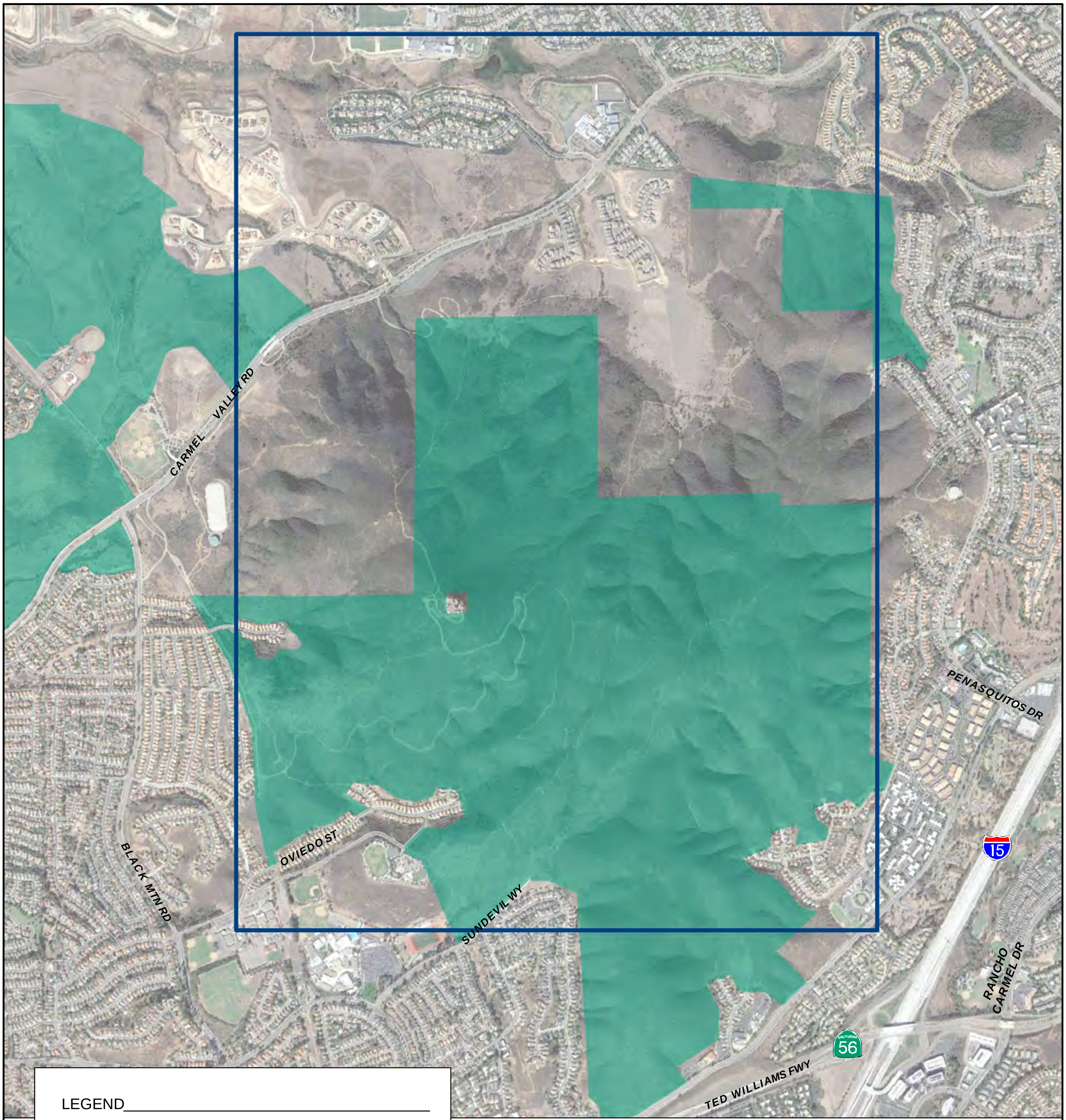
FIGURE 1

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

SITE LOCATION

BLACK MOUNTAIN OPEN SPACE PARK INVESTIGATION
SAN DIEGO, CALIFORNIA

108246003 | 5/18



LEGEND

— AREA OF ARSENIC INVESTIGATION

🟩 BLACK MOUNTAIN OPEN SPACE PARK

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCES: OPEN SPACE - SANDAG, 2017; GOOGLE EARTH, 2017

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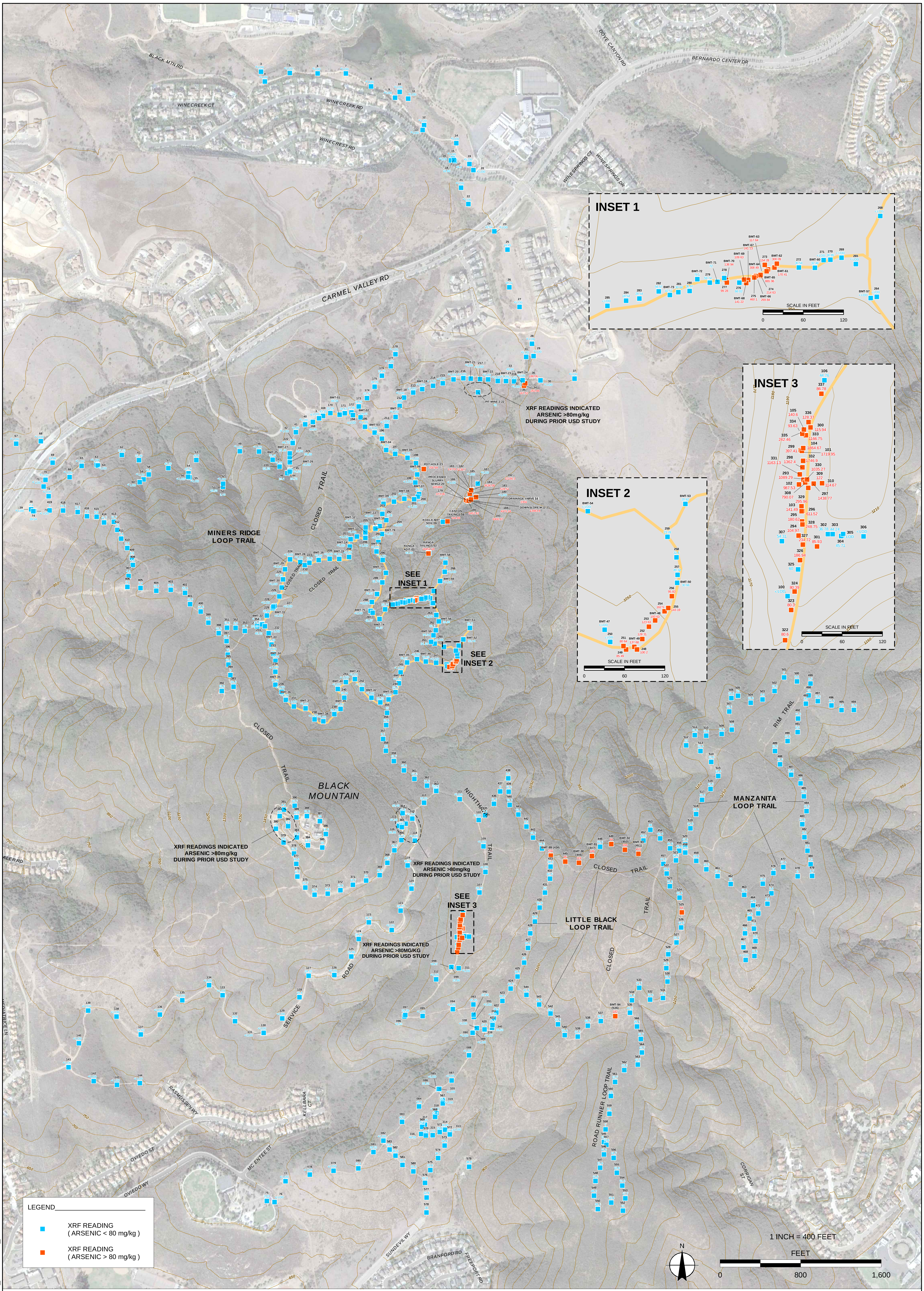
FIGURE 2

SITE AND VICINITY

BLACK MOUNTAIN OPEN SPACE PARK INVESTIGATION
SAN DIEGO, CALIFORNIA
108246003 | 5/18

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



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NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: GOOGLE EARTH, 2017; TOPOGRAPHIC CONTOURS - SANDAG/SANGIS, 2017

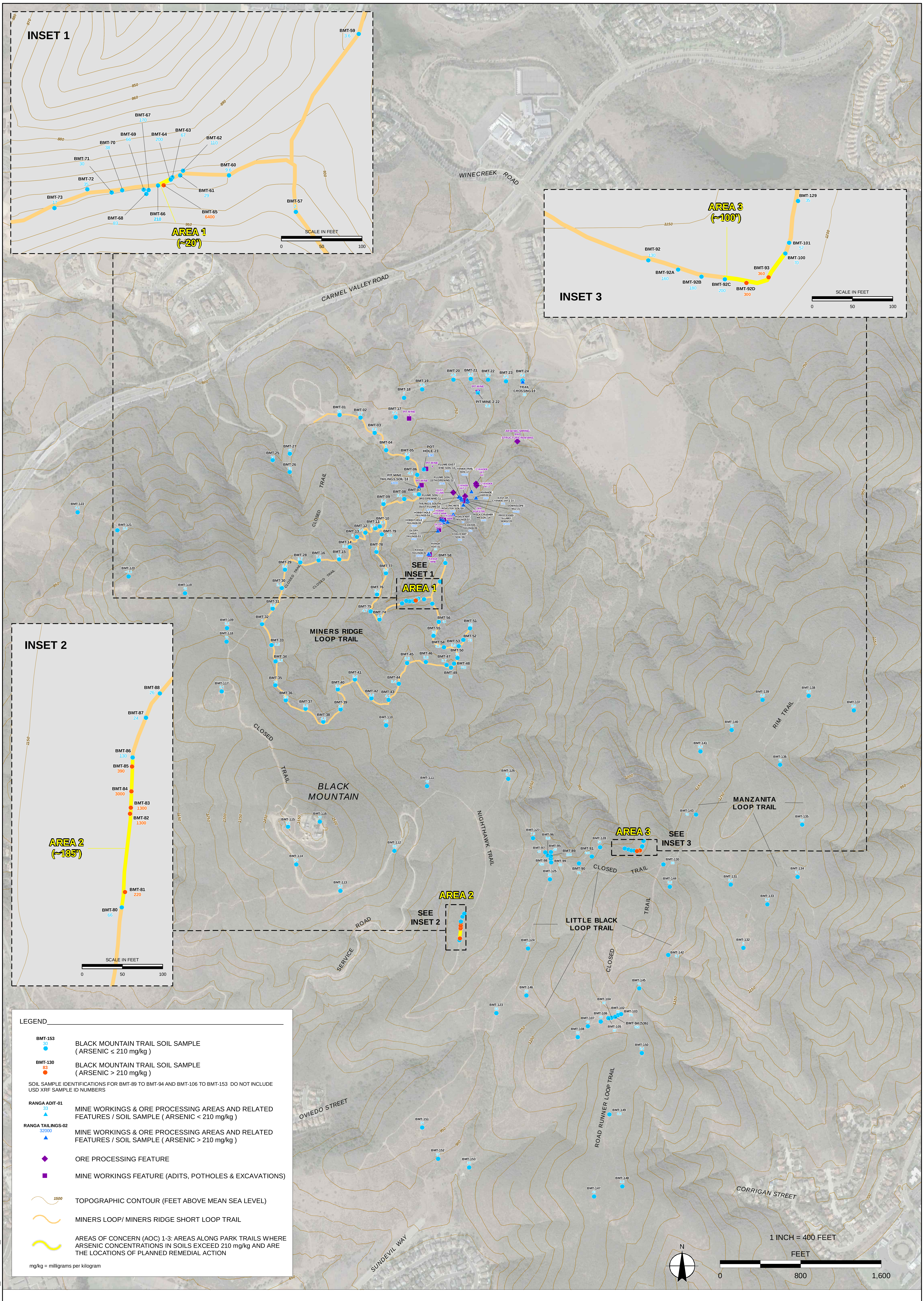
FIGURE 3

XRF SCREENING AND READINGS

BLACK MOUNTAIN OPEN SPACE PARK ARSENIC EVALUATION
SAN DIEGO, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

108246003 | 5/18



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NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: GOOGLE EARTH, 2017; TOPOGRAPHIC CONTOURS - SANDAG/SANGIS, 2017

FIGURE 4

SOIL SAMPLE TOTAL ARSENIC CONCENTRATIONS

BLACK MOUNTAIN OPEN SPACE PARK INVESTIGATION
SAN DIEGO, CALIFORNIA

108246003 | 5/18

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

TABLES

Table 1 - Summary of Black Mountain Park Trail Samples - Metal Concentrations

Sample Identification	Sample Date	Area of Arsenic >80 mg/kg (length in feet)	EPA Test Methods 6010B/7471																				
			Antimony (mg/kg)	Arsenic (mg/kg)	Arsenic (SPLP) (mg/L)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Cadmium (SPLP) (mg/L)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Lead (SPLP) (mg/L)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zinc (SPLP) (mg/L)
BMT-01	04/13/17		--	52	0.036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-02			--	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-03			--	9.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-04			--	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-05			--	5.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-06			--	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-07			--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-08			--	5.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-09			--	3.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-10			--	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-11			--	2.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-12			--	4.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-13			--	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-14			--	3.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-15			--	2.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-16			--	7.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-17			--	5.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-18			--	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-19			--	4.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-20			--	4.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-21			--	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-22			--	3.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-23			--	5.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-24			--	4.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-25	04/14/17		--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-26			--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-27			--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-28			--	3.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-29			--	3.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-30			--	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-31			--	3.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-32			--	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-33			--	9.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-34			--	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-35			--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-36			--	2.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-37			--	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-38			--	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-39			--	5.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-40			--	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-41			--	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-42			--	4.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-43			--	4.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-44			--	9.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-45			--	8.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-46			--	8.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-47			--	6.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-48			<1.0	110	0.073	77	0.50	2.9	--	4.7	5.2	12	6.1	--	<0.10	<1.0	1.9	<1.0	<0.50	<2.0	37	29	--
BMT-49			<1.0	87	0.053	130	0.51	2.4	--	9.9	9.0	13	9.9	--	<0.10	<1.0	4.1	<1.0	<0.50	<2.0	63	42	--
BMT-50			--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-51			--	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-52			--	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-53			--	3.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-54			--	5.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-55			--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-56			--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-57			--	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-58			--	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-59			--	3.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-60			--	9.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 1 - Summary of Black Mountain Park Trail Samples - Metal Concentrations

Sample Identification	Sample Date	Area of Arsenic >80 mg/kg (length in feet)	EPA Test Methods 6010B/7471																				
			Antimony (mg/kg)	Arsenic (mg/kg)	Arsenic (SPLP) (mg/L)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Cadmium (SPLP) (mg/L)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Lead (SPLP) (mg/L)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zinc (SPLP) (mg/L)
BMT-61	4/14/2017 (Continued)		<1.0	29	--	100	<0.50	1.2	--	13	15	9.1	7.5	--	<0.10	<1.0	4.2	1.3	<0.50	<2.0	92	35	--
BMT-62			<1.0	110	0.029	98	0.52	3.2	--	13	15	11	9.4	--	<0.10	<1.0	3.6	1.6	<0.50	<2.0	91	41	--
BMT-63			--	67	0.075	--	--	--	--	--	--	--	8.2	--	--	--	--	--	--	--	--	--	--
BMT-64			<1.0	200	0.39	110	0.59	5.2	--	12	17	12	10	--	<0.10	<1.0	3.2	1.9	<0.50	<2.0	120	57	--
BMT-65		Area 1	6.8	6,400	2.6	120	1.7	130	0.060	4.2	7.5	120	190	<0.080	<0.10	1.7	0.55	2.3	<0.50	<2.0	260	250	0.11
BMT-66			<1.0	210	0.31	120	0.52	5.4	--	13	19	13	10	--	<0.10	<1.0	2.2	<1.0	<0.50	<2.0	120	61	--
BMT-67			<1.0	170	0.11	110	0.57	4.6	--	14	20	11	10	--	<0.10	<1.0	3.5	1.1	<0.50	<2.0	110	45	--
BMT-68			<1.0	83	0.11	110	0.57	2.5	--	15	16	11	9.0	--	<0.10	<1.0	3.8	2.0	<0.50	<2.0	110	39	--
BMT-69			<1.0	66	<0.020	110	0.57	2.1	--	16	18	12	7.7	--	<0.10	<1.0	4.0	<1.0	<0.50	<2.0	110	41	--
BMT-70			<1.0	38	0.031	100	<0.50	1.4	--	12	16	11	7.3	--	<0.10	<1.0	2.8	2.1	<0.50	<2.0	92	38	--
BMT-71			--	30	0.033	--	--	--	--	--	--	--	7.4	--	--	--	--	--	--	--	--	--	--
BMT-72			--	35	<0.020	--	--	--	--	--	--	--	9.4	--	--	--	--	--	--	--	--	--	--
BMT-73			--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-74			--	4.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-75			--	4.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-76			--	5.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-77			--	3.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-78			--	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-79			--	2.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-80	06/20/17		--	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-81		Area 2	--	220	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-82			--	1,300	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-83			--	1,300	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-84			<1.0	3,000	--	410	<0.50	54	--	9.3	7.6	39	17	--	<0.10	<1.0	2.8	<1.0	<0.50	<2.0	65	46	--
BMT-85			<1.0	390	--	180	<0.50	8.6	--	13	9.3	13	18	--	<0.10	<1.0	4.5	<1.0	<0.50	<2.0	72	43	--
BMT-86	08/23/17		--	130	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-87			--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-88			--	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-89 (434)	09/08/17		--	200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-90 (446)			--	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-91 (447)			--	130	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-92 (450)			--	130	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-92A	04/04/18			160																			
BMT-92B				180																			
BMT-92C				200																			
BMT-92D		Area 3		300																			
BMT-93 (451)	09/08/17		--	360	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-94 (536)			--	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-95	10/06/17		--	45	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-96			--	9.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-97			--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-98			--	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-99			--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-100			--	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-101			--	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-102			--	89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-103			--	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-104			--	87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-105			--	87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 1 - Summary of Black Mountain Park Trail Samples - Metal Concentrations

Sample Identification	Sample Date	Area of Arsenic >80 mg/kg (length in feet)	EPA Test Methods 6010B/7471																				
			Antimony (mg/kg)	Arsenic (mg/kg)	Arsenic (SPLP) (mg/L)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Cadmium (SPLP) (mg/L)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Lead (SPLP) (mg/L)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zinc (SPLP) (mg/L)
BMT-106 (537)	09/08/17		--	48	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-107 (538)			--	49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-108 (539)			--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-109 (351)			--	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-110 (356)			--	4.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-111 (362)			--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-112 (367)			--	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-113 (372)			--	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-114 (377)			--	5.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-115 (382)			--	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-116 (387)			--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-117 (392)			--	6.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-118 (397)			--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-119 (402)			--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-120 (407)			--	<2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-121 (412)			--	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-122 (417)			--	4.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-123 (422)			--	33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-124 (427)			--	47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-125 (432)			--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-126 (438)			--	9.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-127 (443)			--	7.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-128 (448)			--	51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-129 (452)			--	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT- 130 (457)			--	83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-131 (462)			--	9.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-132 (467)			--	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-133 (473)			--	3.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-134 (478)			--	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-135 (483)			--	8.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-136 (488)			--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-137 (494)			--	6.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-138 (498)			--	9.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-139 (503)			--	6.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-140 (508)			--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-141 (513)			--	6.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-142 (528)			--	5.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-143 (518)			--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-144 (523)			--	9.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-145 (533)			--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-146 (544)			--	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-147 (549)			--	43	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-148 (554)			--	9.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-149 (559)			--	6.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-150 (564)			--	8.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-151 (569)			--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-152 (574)			--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMT-153 (579)			--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 1 - Summary of Black Mountain Park Trail Samples - Metal Concentrations

Sample Identification	Sample Date	Area of Arsenic >80 mg/kg (length in feet)	EPA Test Methods 6010B/7471																				
			Antimony (mg/kg)	Arsenic (mg/kg)	Arsenic (SPLP) (mg/L)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Cadmium (SPLP) (mg/L)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Lead (SPLP) (mg/L)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zinc (SPLP) (mg/L)
EPA RSL – Residential (mg/kg)			**31**	**0.68**	NA	**15,000**	**160**	**71**	NA	NL	**23**	**3,100**	**400**	NA	**11**	**390**	**1,500**	**390**	**390**	**0.78**	**390**	**23,000**	NA
EPA RSL – Industrial (mg/kg)			**470**	**3**	NA	**220,000**	**2,300**	**980**	NA	NL	**350**	**47,000**	**800**	NA	**46**	**5,800**	**22,000**	**5,800**	**5,800**	**12**	**5,800**	**350,000**	NA
DTSC HERO Residential (mg/kg)			NL	**0.11**	NA	NL	**1,600**	**2,100**	NA	**36,000**[1]	NL	NL	**80**	NA	**1**[1]	NL	**15,000**	NL	**390**[1]	NA	**390**[1]	NL	NA
DTSC HERO Industrial (mg/kg)			NL	**0.36**	NA	NL	**6,900**	**9,300**	NA	**170,000**[1]	NL	NL	**320**	NA	**4.5**[1]	NL	**64,000**	NL	**1,500**[1]	NA	**1,000**[1]	NL	NA
DTSC Background Concentration - Determination of a Southern California Regional Background Arsenic Concentration in Soil, G. Chernoff, W. Bosan and D. Oudiz, March, 2008			NA	**12**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hazardous Waste Criteria																							
TTLC (mg/kg)			**500**	**500**	NA	**10,000**	**75**	**100**	NA	**2,500**	**8,000**	**2,500**	**1,000**	NL	**20**	**3,500**	**2,000**	**100**	**500**	**700**	**2,400**	**5,000**	NA
STLC (mg/L)			**15**	**5**	NA	**100**	**0.75**	**1**	NA	**5**	**80**	**25**	**5**	NA	**0.20**	**350**	**20**	**1**	**5**	**7**	**24**	**250**	NA

Notes:

BMT- 153 (579) - Designated/Open Park Trail Soil Sample
EPA – United States Environmental Protection Agency
RSL - EPA Regional Screening Levels, Region 9, November 2017
DTSC - California Department of Toxic Substances Control
HERO - DTSC Human and Ecological Risk Office
[1] HERO - Human Health Risk Assessment, Note Number: 3, DTSC Recommended Screening Levels, January, 2018
DTSC Background Concentration - Determination of a Southern California Regional Background Arsenic Concentration in Soil, G. Chernoff, W. Bosan and D. Oudiz, March, 2008
TTLC - Total Threshold Limit Concentration - maximum allowable concentration for California Hazardous Waste (California Code of Regulations [CCR] Title 22, Section 66261.24), October 2017
STLC - Soluble Threshold Limit Concentration - maximum soluble concentration for California Hazardous Waste (California Code of Regulations [CCR] Title 22, Section 66261.24), October 2017
SPLP - Synthetic Precipitation Leaching Procedure
mg/kg – milligrams per kilogram
mg/L - milligrams per liter
-- not analyzed
NA – not applicable
NL – not listed
< less than detection limit
6,400 – bold indicates analyte detected at or above the method detection limit
🟥 analytical result exceeds the Human Health Risk Assessment level for arsenic of **210 mg/kg**

Table 2 - Summary of Mine Workings and Ore Processing Area Samples - Metal Concentrations

Sample Identification	Sample Date	EPA Test Methods 6010B/7471																					
		Antimony (mg/kg)	Antimony (SPLP) (mg/L)	Arsenic (mg/kg)	Arsenic (SPLP) (mg/L)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Cadmium (SPLP) (mg/L)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Lead (SPLP) (mg/L)	Mercury (mg/kg)	Mercury (SPLP) (mg/L)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
Ranga adit-01	04/10/17	--	--	33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ranga tailings-02		15	--	32,000	0.98	420	<2.5	750	0.021	<2.5	11	96	40	--	0.23	--	<5.0	<2.5	<5.0	<2.5	<10	180	160
Glory hole tailings-03		--	--	4,400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hobbit hole tailings-04		--	--	5,500	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hobbit hole tailings-05		2.3	--	7,300	1.7	91	<0.50	160	0.037	10	13	65	23	--	1.3	--	<1.0	1.6	3.2	<0.50	<2.0	65	46
Koala adit soil-06		<1.0	--	690	--	42	<0.50	16	--	2.1	3.5	20	10	--	0.14	--	<1.0	1.3	1.4	<0.50	<2.0	19	28
Koala adit tailings-07		<1.0	--	83	--	65	<0.50	2.5	--	11	13	11	12	--	<0.10	--	<1.0	2.8	2.3	<0.50	<2.0	79	45
Canyon tailings-08		--	--	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Concrete roaster soil-09		--	--	1,800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tailings south dust flume-10		4.0	--	14,000	1.9	190	<0.50	300	0.039	4.9	9.4	48	19	--	1.9	--	<1.0	1.3	1.8	<0.50	<2.0	58	64
Flume soil 3rd opening-11		<1.0	--	3,200	1.8	85	<0.50	74	0.038	16	6.4	26	74	<0.080	0.27	--	<1.0	19	1.6	<0.50	<2.0	28	150
Flume soil 15th opening-12		<1.0	--	2,300	1.0	85	<0.50	53	0.022	19	6.3	25	68	<0.080	0.31	--	<1.0	16	2.5	<0.50	<2.0	26	120
Flume east end soil-13		--	--	190	--	--	--	--		--	--	--	--		--	--	--	--	--	--	--	--	--
Rock Crusher M4 soil-14		2.5	--	7,400	12	47	<0.50	170	0.25	2.0	2.7	14	120	0.12	0.54	--	<1.0	<0.50	<1.0	<0.50	<2.0	15	23
East of cyanide vat 1-15		--	--	770	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Drainage varve-16		1.4	--	3,100	0.59	110	<0.50	70	0.013	6.0	2.6	10	7.4	--	0.43	--	<1.0	1.3	1.5	<0.50	<2.0	18	21
Cyanide Trail soil-17		630	<0.20	10,000	5.7	110	<0.50	230	0.12	6.3	7.7	62	2,500	<0.080	0.70	--	<1.0	2.7	<1.0	<0.50	<2.0	37	48
Pit mine tailings soil-18		--	--	1,800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trail crossing-19		<1.0	--	22	--	33	<0.50	0.77	--	2.1	2.2	4.5	5.8	--	<0.10	--	<1.0	1.2	1.4	<0.50	<2.0	15	15
Processed Slurry SEM12-20	04/12/17	64	--	92,000	6.5	51	<0.50	2,600	0.13	170	14	66	480	0.32	210	<0.010	5.0	51	1.7	5.3	<2.0	20	76
Downslope M12-21		4.7	--	13,000	7.2	57	<0.50	290	0.15	21	3.9	23	58	<0.080	5.0	--	<1.0	5.0	<1.0	<0.50	<2.0	19	34
Pit Mine 2-22	04/13/17	--	--	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pothole-23	04/14/17	5.3	--	190	0.16	66	<0.50	5.1	--	9.6	7.7	37	710	0.49	0.33	--	3.2	1.2	<1.0	<0.50	<2.0	63	55
EPA RSL – Residential (mg/kg)		31	NA	0.68	NA	15,000	160	71	NA	NL	23	3,100	400	NA	11	NA	390	1,500	390	390	0.78	390	23,000
EPA RSL – Industrial (mg/kg)		470	NA	3	NA	220,000	2,300	980	NA	NL	350	47,000	800	NA	46	NA	5,800	22,000	5,800	5,800	12	5,800	350,000
DTSC HERO Residential (mg/kg)		NL	NA	0.11	NA	NL	1,600	2,100	NA	36,000 [1]	NL	NL	80	NA	1 [1]	NA	NL	15,000	NL	390 [1]	NA	390 [1]	NL
DTSC HERO Industrial (mg/kg)		NL	NA	0.36	NA	NL	6,900	9,300	NA	170,000 [1]	NL	NL	320	NA	4.5 [1]	NA	NL	64,000	NL	1,500 [1]	NA	1,000 [1]	NL
DTSC Background Concentration - Determination of a Southern California Regional Background Arsenic Concentration in Soil, G. Chernoff, W. Bosan and D. Oudiz, March, 2008		NA	NA	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hazardous Waste Criteria																							
TTLC (mg/kg)		500	NA	500	NA	10,000	75	100	NA	2,500	8,000	2,500	1,000	NA	20	NA	3,500	2,000	100	500	700	2,400	5,000
STLC (mg/L)		15	NA	5	NA	100	0.75	1	NA	5	80	25	5	NA	0.20	NA	350	20	1	5	7	24	250

Notes:

Pothole - 23 - Mine Workings and Ore Processing Soil Sample

EPA – United States Environmental Protection Agency

RSL - EPA Regional Screening Levels, Region 9, November 2017

DTSC - California Department of Toxic Substances Control

HERO - DTSC Human and Ecological Risk Office (HERO)

[1] HERO - Human Health Risk Assessment, Note Number: 3, DTSC Recommended Screening Levels, January, 2018

DTSC Background Concentration - Determination of a Southern California Regional Background Arsenic Concentration in Soil, G. Chernoff, W. Bosan and D. Oudiz, March, 2008

TTLC - Total Threshold Limit Concentration - maximum allowable concentration for California Hazardous Waste (California Code of Regulations [CCR] Title 22, Section 66261.24), October 2017

STLC - Soluble Threshold Limit Concentration - maximum soluble concentration for California Hazardous Waste (California Code of Regulations [CCR] Title 22, Section 66261.24), October 2017

SPLP - Synthetic Precipitation Leaching Procedure

mg/kg – milligrams per kilogram

mg/L - milligrams per liter

-- not analyzed

NA – not applicable

NL – not listed

< less than detection limit

92,000 – bold indicates analyte detected at or above the method detection limit

🟥 analytical result exceeds the Human Health Risk Assessment level for arsenic of **210 mg/kg**

Table 3- Summary and Comparison of Arsenic Analytical Results and XRF Readings

Sample Identification	Sample Date (*XRF Date*)	Arsenic (mg/kg)	XRF Field Reading (ppm)
Mine Workings and Ore Processing Samples			
Ranga adit-01	04/10/17 *(04/10/17)*	33	43.04
Ranga tailings-02		32,000	18,451.18
Glory hole tailings-03		4,400	3,153.14
Hobbit hole tailings-04		5,500	1,222.62
Hobbit hole tailings-05		7,300	2,076.89
Koala adit soil-06		690	< LOD
Koala adit tailings-07		83	244.77
Canyon tailings-08		150	144.89
Concrete roaster soil-09		1,800	1,195.42
Tailings south dust flume-10		14,000	6,260.54
Flume soil 3rd opening-11		3,200	268.98
Flume soil 15th opening-12		2,300	1,891.41
Flume east end soil-13		190	206.41
Rock Crusher M4 soil-14		7,400	8,638.61
East of cyanide vat 1-15		770	822.14
Drainage varve-16	04/10/17 *(04/04/17)*	3,100	2,356
Cyanide Trail soil-17	04/10/17 *(04/10/17)*	10,000	10,398.17
Pit mine tailings soil-18		1,800	1,582.85
Trail crossing-19	04/10/17 *(04/04/17)*	22	<LOD
Processed Slurry SEM12-20	04/12/17 *(04/04/17)*	92,000	105,984
Downslope M12-21		13,000	13,983.80
Pit Mine 2-22	04/13/17 *(04/04/17)*	5.6	16
Pothole-23	04/14/17 *(04/09/17)*	190	200.94
Black Mountain Trail Samples			
BMT-01	04/13/17 *(04/13/17)*	52	66.91
BMT-02		7.7	14.92
BMT-03		9.3	< LOD
BMT-04		6.0	< LOD
BMT-05		5.5	< LOD
BMT-06		4.2	< LOD
BMT-07		13	26.68
BMT-08		5.4	< LOD
BMT-09		3.4	< LOD
BMT-10		3.1	< LOD
BMT-11		2.1	< LOD
BMT-12		4.4	< LOD
BMT-13		5.0	< LOD
BMT-14	04/13/17 *(04/13/17)*	3.3	< LOD
BMT-15		2.7	< LOD
BMT-16		7.2	19.04
BMT-17		5.4	< LOD
BMT-18		7.0	< LOD
BMT-19		4.6	< LOD
BMT-20		4.6	< LOD
BMT-21		5.2	< LOD
BMT-22		3.5	< LOD
BMT-23		5.3	< LOD
BMT-24		4.4	< LOD

Table 3- Summary and Comparison of Arsenic Analytical Results and XRF Readings

Sample Identification	Sample Date (*XRF Date*)	Arsenic (mg/kg)	XRF Field Reading (ppm)
BMT-25	**04/14/17** ***(04/14/17)***	**14**	**32.41**
BMT-26		**12**	< LOD
BMT-27		**17**	**21.66**
BMT-28		**3.7**	< LOD
BMT-29		**3.4**	< LOD
BMT-30		**2.4**	< LOD
BMT-31		**3.3**	< LOD
BMT-32		**7.0**	< LOD
BMT-33		**9.5**	**24.49**
BMT-34		**2.6**	**18.44**
BMT-35		**16**	**31.91**
BMT-36		**2.8**	< LOD
BMT-37		**3.2**	< LOD
BMT-38		**4.2**	< LOD
BMT-39		**5.1**	< LOD
BMT-40		**2.3**	< LOD
BMT-41		**2.4**	< LOD
BMT-42		**4.6**	< LOD
BMT-43		**4.1**	< LOD
BMT-44		**9.4**	< LOD
BMT-45		**8.8**	**19.27**
BMT-46		**8.8**	**19.25**
BMT-47		**6.7**	< LOD
BMT-48		**110**	**193.63**
BMT-49		**87**	**137.68**
BMT-50		**12**	**30.66**
BMT-51		**32**	**53.2**
BMT-52	**04/14/17** ***(04/14/17)***	**73**	**60.18**
BMT-53		**3.9**	**20.82**
BMT-54		**5.3**	< LOD
BMT-55		**20**	**50.34**
BMT-56		**10**	**28.95**
BMT-57		**2.0**	< LOD
BMT-58		**5.0**	< LOD
BMT-59		**3.6**	< LOD
BMT-60		**9.6**	**32.46**
BMT-61		**29**	**170.41**
BMT-62		**110**	**300.09**
BMT-63		**67**	**117.64**
BMT-64		**200**	**308.49**
BMT-65		**6,400**	**865.96**
BMT-66		**210**	**269.84**
BMT-67		**170**	**241.23**
BMT-68		**83**	**141.22**
BMT-69		**66**	**109.63**
BMT-70		**38**	**138.94**
BMT-71		**30**	**72**
BMT-72		**35**	**79.1**
BMT-73		**17**	**42.51**
BMT-74		**4.1**	**30.57**
BMT-75		**4.7**	< LOD
BMT-76		**5.4**	**19.57**
BMT-77		**3.5**	< LOD
BMT-78		**4.0**	< LOD
BMT-79		**2.9**	< LOD

Table 3- Summary and Comparison of Arsenic Analytical Results and XRF Readings

Sample Identification	Sample Date (*XRF Date*)	Arsenic (mg/kg)	XRF Field Reading (ppm)
BMT-80	**06/20/17**	**66**	**193.2**
BMT-81		**220**	**234.7**
BMT-82		**1,300**	**1,035**
BMT-83		**1,300**	**1,163**
BMT-84		**3,000**	**1,747**
BMT-85		**390**	**93.6**
BMT-86	**08/23/17**	**130**	--
BMT-87		**24**	--
BMT-88		**26**	--
BMT-89 (434)	**9/8/2017** ***(09/10/17)***	**200**	**231**
BMT-90 (446)		**78**	**119**
BMT-91 (447)		**130**	**149**
BMT-92 (450)		**130**	**166**
BMT-93 (451)		**360**	**410**
BMT-94 (536)		**150**	**182**
BMT-95	**10/06/17**	**45**	--
BMT-96		**9.6**	--
BMT-97		**15**	--
BMT-98		**150**	--
BMT-99		**20**	--
BMT-100		**70**	--
BMT-101		**57**	--
BMT-102		**89**	--
BMT-103		**70**	--
BMT-104		**87**	--
BMT-105		**87**	--
BMT-106 (537)	**09/08/17** ***(09/10/17)***	**48**	**62.3**
BMT-107 (538)		**49**	**63.7**
BMT-108 (539)		**22**	**31.2**
BMT-109 (351)		**5.6**	**13.6**
BMT-110 (356)		**4.8**	**10.4**
BMT-111 (362)		**15**	**21.2**
BMT-112 (367)		**36**	**42.8**
BMT-113 (372)		**5.2**	**13.8**
BMT-114 (377)		**5.3**	**16.3**
BMT-115 (382)		**5.6**	**12.6**
BMT-116 (387)		**20**	**28**
BMT-117 (392)		**6.1**	**13.2**
BMT-118 (397)		**10**	**28.7**
BMT-119 (402)		**19**	**25.4**
BMT-120 (407)		<2.0	**4.3**
BMT-121 (412)		**2.6**	**7.2**
BMT-122 (417)		**4.1**	**11.2**
BMT-123 (422)		**33**	**36.6**
BMT-124 (427)		**47**	**64.8**
BMT-125 (432)		**30**	**62.5**
BMT-126 (438)		**9.1**	**9.5**
BMT-127 (443)		**7.3**	**15.2**
BMT-128 (448)		**51**	**70.1**
BMT-129 (452)		**35**	**40.6**
BMT- 130 (457)		**83**	**61.2**
BMT-131 (462)		**9.4**	**12**
BMT-132 (467)		**5.0**	**6.2**
BMT-133 (473)		**3.7**	**8.1**
BMT-134 (478)		**3.1**	**6**

Table 3- Summary and Comparison of Arsenic Analytical Results and XRF Readings

Sample Identification	Sample Date (*XRF Date*)	Arsenic (mg/kg)	XRF Field Reading (ppm)
BMT-135 (483)	**09/08/17 *(09/10/17) (cont.)***	**8.9**	**14.8**
BMT-136 (488)		**13**	**12.5**
BMT-137 (494)		**6.9**	**12.4**
BMT-138 (498)		**9.6**	**15**
BMT-139 (503)		**6.5**	**8.9**
BMT-140 (508)		**10**	**9.6**
BMT-141 (513)		**6.6**	**10.4**
BMT-142 (528)		**5.1**	**6.8**
BMT-143 (518)		**19**	**26.8**
BMT-144 (523)		**9.6**	**11.8**
BMT-145 (533)		**18**	**21.1**
BMT-146 (544)		**26**	**41.4**
BMT-147 (549)		**43**	**48.2**
BMT-148 (554)		**9.2**	**13.3**
BMT-149 (559)		**6.8**	**8.8**
BMT-150 (564)		**8.4**	**12.7**
BMT-151 (569)		**21**	**25.8**
BMT-152 (574)		**24**	**36.3**
BMT-153 (579)		**30**	**38.8**

Notes:

XRF– X-ray fluorescence

mg/kg – milligrams per kilogram

ppm- parts per million

-- not analyzed

<LOD less than limit of detection

< less than specified detection limit

6,400 – bold indicates analyte detected at or above the method detection limit

🟥 analytical result exceeds the Human Health Risk Assessment level for arsenic of 210 mg/kg

Table 4 - Summary of Ore Processing Wipe Samples - Total Metal Concentrations

Sample Identification	Sample Date	(ug/wipe)	
		Arsenic (EPA Method 6010B)	Total Cyanide (EPA Method SM4500-CN E)
Concrete roaster wipe-01	04/10/17	**48**	--
Dust flume east end wipe-02		**99**	--
Flume west wall 3rd opening wipe-03		**980**	--
Flume west wall 8th opening wipe-04		**220**	--
Flume ceiling 15th opening wipe-06		**10**	--
Flume west wall 23rd opening wipe-07		**65**	--
Flume west wall 30th opening wipe-08		**250**	--
Cyanide vat 1 wipe-09		**--**	<1
Roaster M12 wipe-10		**110**	--
Cyanide vat 4 wipe-11		**--**	<1

Notes:

EPA – United States Environmental Protection Agency

ug – micrograms

-- not analyzed

980 – bold indicates analyte detected at or above the method detection limit

<1 less than limits of specific detection

Table 8 - Summary of Mine Workings and Ore Processing Features and Recommended Remedial Action

Mine Workings/Ore Processing Feature and Recommended Remedial Action	Description of Feature[1]	Ninyo & Moore Nomenclature Soil and Wipe Samples	ASM Affiliates Nomenclature (2007)	DOC Nomenclature and Feature	Location		DOC Recommended Closure/Remediation
					Latitude	Longitude	
Ranga Mine	Inclined shaft ~ 7 to 8 feet wide at the mouth and ~ 20 feet in length. Located on a steep slope, access through dense vegetation. Wooden mine timbers at the end of the inclined shaft. Located upslope and ~400 feet south of the Koala and Hobbit Hole Mines (adits).	**SOIL SAMPLES** Ranga Adit-01 Ranga Tailings-02	E-10 Pit and Debris	Ranga Mine (72787)	32.98886381917	-117.11239193160	Cable net or fencing and signage.
Glory Hole	Shallow vertical pit approximately 6 x 6 feet width/length and ~ 6 to7 feet deep. Located ~ 150 feet south of the Koala Adit.	**SOIL SAMPLE** Glory Hole Tailings-03	E-9 Vertical Pit	Glory Hole Mine (72786)	32.98951398469	-117.112076599	Fence and sign or backfill. Because the mine feature (excavation pit) is relatively small, backfilling is a good option.
Hobbit Hole Mine	Relatively short adit on the northwest side of the canyon, small portal opening to approximately 4 x 3 feet inside, generally non-eroding walls, and ~25 to 30 feet in length.	**SOIL SAMPLES** Hobbit Hole Tailings-04 Hobbit Hole Tailings-05	E-1 Adit	Hobbit Hole Mine (72785)	32.98982031853	-117.11200441317	Culvert gate (due to loose portal area) to restrict public access to mine and allow authorized personnel access for continued research.
Koala Mine	Relatively short adit on the southeast side of the canyon, opening is approximately 6 x 6 feet and ~ 50 feet in length. Mineralization appears to consist of discontinuous pod-shaped aresenopyrite and other metals/mineralogy occurring in altered volcanic (rhyolite and/or rhyodacite) rocks.	**SOIL SAMPLES** Koala Adit Soil - 06 Koala Tailings-07	E-2 Main Adit	Koala Mine (72784)	32.98980598542	-117.119400981	Locking bat gate to restrict public access to mine and allow authorized personnel to access for continued research.
Concrete Dust Chamber	Dust chamber is constructed of poured concrete, ~ 7x7 feet and 180 feet long. A relatively large opening is at the southeast end (connected the ore roaster with the dust chamber). Corrugated sheet asbestos baffles stretch from the floor to approximately 6 inches short of the ceiling, dividing the interior. Approximately 30 small openings along the base on the northwest side allowed access for cleaning. Purpose was to collect the flue dust (soot) generated by roasting the ore. The flue dust carried fine particles of arsenic and other metals and the chamber allowed the gases to pass through very slowing giving the dust a chance to settle. Associated with the second phase of ore processing.	**SOIL SAMPLES** Tailings South Dust Flume -10 Flume Soil 3rd Opening-11 Flume Soil 15th Opening-12 **WIPE SAMPLES** Dust East End Wipe -02 Flume West Wall 3rd Opening-03 Flume West Wall 8th Opening-04 Flume Ceiling 15th Opening-06 Flume West Wall 23rd Opening-07 Flume West Wall 30th Opening-08	M-15 Dust Flue	Dust Flue (72777)	32.990448152303	-117.11148393202	Cover all entrances. The small openings along the base of the feature, at the northwest side can be closed using existing concrete doors and as necessary, colored poly urethane foam (PUF) which can in turn be covered with shotcrete or concrete. The large opening and small openings missing concrete doors can be covered with colored PUF, which in turn can be covered with shotcrete or concrete. Bar grates also can be used, but is not recommended because preliminary testing indicated elevated arsenic concentrations and this remedial action will require additional assessment for potentially hazardous materials, particularly arsenic and asbestos.
Ore crushing and Processing Area (representing both phases of mining including Phase 1 - Ore Concentration and Phase 2 - Ore Roasting and Cyanidation	Ore processing area (collapsed wooden ore bin, former gasoline engine footings, rock crusher, ball mill, rotary roaster, steel pipe).	**SOIL SAMPLES** Processed Slurry SEM12-20 Downslope M12-21 **WIPE SAMPLE** Roaster M12 wipe-10	Numerous ore processing features were identified (M-2, M-3, M-4, M-6, M-7, M-8, M-9, M-10, M-11, M-12, E-8, etc.)	Ore Roaster Area (72781)	32.990354151462	-117.11122409015	Fence and sign the entire ore processing area (crusher, roaster, piping, concrete foundations, wood, etc.). Possibly cap the surface area with soil/rock and/or revegetate. Assess structures for stability and stabilize if needed for safety and cultural preservation.

Table 8 - Summary of Mine Workings and Ore Processing Features and Recommended Remedial Action

Mine Workings/Ore Processing Feature and Recommended Remedial Action	Description of Feature[1]	Ninyo & Moore Nomenclature Soil and Wipe Samples	ASM Affiliates Nomenclature (2007)	DOC Nomenclature and Feature	Location		DOC Recommended Closure/Remediation
					Latitude	Longitude	
Small Concrete Roaster	Small, concrete roaster	**SOIL SAMPLE** Concrete roaster soil-09 **WIPE SAMPLE** Concrete roaster wipe-01		Concrete Roaster (72792)	32.989991	-117.11166	Possibly move this small ore roaster to the location of the ore processing area so it will be within the fenced and signed and/or capped/vegetated remediation area.
Cyanide Vat 1	Poured concrete reservoirs, ~8 feet deep, Vats 1 and 2 ~10x10 feet and connected Vats 3 and 4 ~10x20 feet. After ore was roasted, it was intended to be removed from the furnace and conveyed to the cyanide vats for leaching (to separate gold from ore). Associated with the second phase of ore processing, possibly cyanide vats were not used/operational	**WIPE SAMPLES** Cyanide vat 1 wipe-09 Cyanide vat 4 wipe-11	C-1, C-2 and C-3 Cyanide Vats	Cyanide Vat 1 (72778)	32.99045031857	32.9898059854	Cover or cable net. Assess for possible removal.
Cyanide Vat 2				Cyanide Vat 2 (72780)	32.99074665171	-117.110885598	
Cyanide Vats 3 and 4				Cyanide Vat 3 (72779)	32.99079648750	-117.110893766	
Pit Mine	Shallow excavation/pit in thick low vegetation, ~6 x 15 feet and ~5 feet + in depth.	Pit Mine Tailings Soil-18	Pit Mine	Pit Mine (72775)	32.99074898481	-117.1126574431	Fence and sign or backfill. Because the mine feature (excavation pit) is relatively small, backfilling is a good option.
Pit Mine 2	Flooded excavation/pit, trending ~ east-west, ~15 x 40 x 10 feet deep, partially filled with water and aquatic plants. Wooden deck on the western side appears to provide access to swimming area.	Pit Mine 2-22	Pit Mine 2/Excavation 2	Pit Mine 2 (72790)	32.9932939845928	-117.110840933215	Remove wooden deck, fence and sign. Good wildlife habitat, if fencing is used, consider smooth wire fencing and large mammal access in fence design
Pit Mine 3	Excavation/pit cut into the hillside, approximately 15 x 50 x 10 feet. Seasonally flooded with water.	no sample	Pit Mine 3/Excavation 3	Pit Mine 3 (72773)	32.9925709847	-117.113645984	Fence and sign or backfill. Good wildlife habitat, if fencing is used, consider smooth wire fencing and large mammal access in fence design.
Pit Mine 4 / Pothole-23	Excavation/pit approximately 10 x 15 feet and 3 to 6 feet deep.	Pothole-23	Pit Mine 4/Pothole-23	Pit Mine 4 (aka Pothole 23) (72791)	32.991181	-117.11259	Fence and sign or backfill. Because the mine feature (excavation pit) is relatively small, backfilling is a good option.

APPENDIX A

Background Information

Fall 1-1-2016

Geochemical Investigation of Anomalous Arsenic Enrichment in the Santiago Peak Volcanics of Southern California

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UNIVERSITY OF SAN DIEGO

San Diego

Geochemical Investigation of Anomalous Arsenic Enrichment in the Santiago Peak Volcanics of Southern California

A thesis submitted in partial satisfaction of the

requirements for the degree of

Master of Science in Marine Science

by

Elizabeth C. Johnston

Thesis Committee

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2016

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I would like to thank Amineh AlBashairesh for her help in the lab, and Mariah Banks, Joseph Chiappe, Ayah Karadesh, and Colin Phillips assistance in the field. Special thanks to my favorite field assistant, Stephen Campbell, who I could always count on for a last-minute trip to Black Mountain. Finally, I would like to thank my committee members for sharing their love of rocks, and for their continuous encouragement and support.

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CHAPTER 1: Introduction

1.1 Background

Black Mountain Open Space Park is located in the Rancho Peñasquitos neighborhood of northern San Diego, and is owned and managed by the City of San Diego. Though artisanal arsenic (As) mining occurred on-site during the 1920's (Stewart 1963), the park remains a popular destination for local hikers and bikers, and is surrounded by a relatively dense suburban population. Our initial investigation of soils and rocks throughout the park by field portable X-ray fluorescence (FP-XRF, Haffert and Craw 2009) revealed As concentrations up to 400,000 ppm. Such concentrations are nearly 100,000 times greater than average for the upper-crust (4.8 ppm, Rudnick and Gao 2003) and, thus, indicate the need to investigate As enrichment throughout the park and the potential for As to be mobilized off-site. This thesis investigates As distribution among rocks cropping out at Black Mountain Open Space Park.

1.2 Arsenic in the natural environment: literature review

Arsenic (As) occurs naturally as the 20th most abundant trace element in the Earth's crust and is widely distributed in the environment. Arsenic exists in organic and inorganic forms and in several valence states (e.g. -3, 0, +3, +5) that reflect the redox conditions of its geochemical environment. Toxicologists are primarily concerned with As^{3+} and As^{5+}, since both are toxic and present in natural waters (Duker et al. 2005).

Of the various sources of As in the environment, ingestion of As-enriched groundwater poses the greatest threat to human health. However, inhalation of airborne As is an additional exposure pathway, along with consuming food grown in As-rich soil (Smedley and Kinniburgh 2001). Long-term exposure can cause chronic As poisoning, impairment of cognitive development, neurotoxicity, diabetes, cardiovascular disease, and bladder, lung, and kidney cancer, as demonstrated in India and Bangladesh, where an estimated 36 to 75 million people in the Bengal Delta were at risk from drinking As-contaminated groundwater at the end of the 20th century (Mukherjee and Bhattacharya 2001, Nordstrom 2002). Such findings have prompted further investigation of the factors controlling As distribution in the natural environment.

1.2.1 Geogenic arsenic enrichment

In the natural environment, As can be anthropogenic or geogenic. Geogenic As is a product of natural geological processes and is, therefore, not a result of human activities. Geogenic As is present in both terrestrial and marine environments, and its concentration varies greatly as a result of mobilization by natural and/or anthropogenic processes (Smedley and Kinniburgh 2001). The average As concentration in the upper continental crust is 4.8 mg/kg (Rudnick and Gao 2003), and average enrichment differs among rock types. In igneous rocks, the average As concentration is approximately 1.5 mg/kg. In metamorphic rocks, As is typically less than 5 mg/kg (Smedley and Kinniburgh 2001), while As in sedimentary rocks ranges from 5 to 10 mg/kg (Webster 1999). Weathering, erosion, and sedimentation, in addition to As contribution from source magmas, lavas, and metamorphic fluids, are important natural processes in controlling As enrichment in the upper crust (Henke 2009). Therefore, As enrichment in individual rock units may deviate significantly from the averages presented above.

1.2.2 Arsenic host minerals

In As-rich rocks, As most commonly forms sulfide minerals, as well as associations with oxides and, less commonly, phosphates (Drahota and Filippi 2009, Majzlan et al. 2014). Arsenic-bearing sulfide minerals are especially common in hydrothermal deposits, causing As to be associated with metal ore minerals and their alteration products (Henke 2009). With exposure to the atmosphere and surface or groundwater, these primary minerals undergo alteration reactions to form secondary minerals, like As oxides or more complicated phases with As, oxygen, and metals (e.g. Fe, Mn, Ni, Drahota and Filippi 2009).

Modern water-rock interactions often cause As to be leached from primary and/or secondary host minerals, making As one of the most problematic trace metals in the environment (Smedley and Kinniburgh 2001). Human activities can greatly influence the stability of As host minerals by altering redox conditions. For example, mining As-bearing ore deposits exposes greater surface area of As-enriched minerals to air and aerated water, leading to increased As leaching and, thus, greater mobilization off-site (Henke 2009). Consequently, concentrations of natural As in drinking water above standards (10 μg/L) are not uncommon. Countries/regions with groundwater elevated in As include: Bangladesh (<1 to 2,500 μg/L), West Bengal, India (<10 to 3,200 μg/L), Thailand (1 to >5,000 μg/L), Argentina (<1 to 9,900 μg/L), Chile (100 to

1,000 μg/L), and the southwestern Unites States (0.38 – 1000 μg/L) (Smedley and Kinniburgh 2001, Nordstrom 2002).

1.2.3 Provenance of arsenic

Recent documentation of the acute and chronic effects of exposure to As in drinking water has emphasized the importance of better-understanding the sources, pathways, and controls on high As in various environmental systems (Smedley and Kinniburgh 2001). Source materials currently considered to be significant contributors of As in global drinking water supplies include: organic-rich black shales, Holocene alluvial sediments with slow flushing rates, mineralized and mined areas (most often gold deposits), volcanogenic sources, and thermal springs (Nordstrom 2002, Mukherjee et al. 2014). However, because aquifers in sediments and sedimentary rocks typically yield more water for drinking supplies (Smedley and Kinniburgh 2001), attention to other source materials, like volcanic host rocks, remains in deficit.

1.2.4 Arsenic in volcanic arcs

Mukherjee et al. (2014) suggest that the global distribution of geogenic As in groundwater is largely controlled by As mobilization in subduction zone fluids, since As enrichment tends to occur in orogenic belts, like the Himalayan, Andean, Western Cordilleran, and Appalachian mountain chains (Mukherjee et al. 2014). Their hypothesis is largely based on the work of Hattori and Guillot (2003), who provide a mechanism for As enrichment in such environments.

Specifically, Hattori and Guillot (2003) propose that the dehydration of subduction zone serpentinites accounts for the observed enrichment of soluble elements in volcanic arc magmas, which are later exhumed to form As-rich volcanic rocks that are eventually incorporated into mountain chains. During subduction, hydrous minerals in subducting slabs and overlying sediments release water and soluble elements (e.g. As, Pb, Sb) because of increased pressure and temperature. After release, such elements and water migrate upward, hydrating the mantle peridotite and forming a serpentinite layer along the plate boundary. The dissolved elements become concentrated as water is consumed by dehydration and eventually become fixed in the serpentinites. Because serpentinites act as a sink for water, serpentinite layers prevent the mantle wedge from partially melting. Thus, the serpentinite layer will continue to subduct with the plate until depths exceed ~100km. Temperatures of about 650°C completely dehydrate the serpentinite to ecologite, releasing hydrothermal fluid and fluid-soluble elements, which hydrate and enrich the overlying mantle wedge and cause partial melting. When the angle of subduction is steep, fluids released from serpentinite dehydration may be focused on a relatively narrow zone more directly beneath the volcanic front, resulting in greater enrichments of fluid soluble elements (Noll et al. 1996). Partial melts eventually rise via buoyancy and hydrostatic pressure and are exhumed by volcanic arcs (Hattori and Guillot 2003). Due to its high solubility, Hattori and Guillot (2003) suggest that As is among the first elements released from the serpentinites and incorporated into the partial melt during serpentinite dehydration. (Breuer and Pichler 2013, Henke 2009, Ballantyne and Moore 1988). Consequently, As is often concentrated in rocks associated with ancient volcanic fronts (Hattori and Guillot 2003). However, Mukherjee et al. (2014) recommends targeted field studies to enhance understanding of this As cycling in these volcanic settings.

1.2.5 The Santiago Peak Volcanics

The Santiago Peak Volcanics (SPV) of Southern California and Northern Baja California, Mexico are remnants and a subaerial volcanic arc, located in the southern portion of the Western Cordilleran orogenic belt. Though its petrogenesis has been disputed (Fife et al. 1996), Herzig and Kimbrough (2014) suggest that the SPV evolved along the western coast of North America during the Cretaceous and, thus, belong to the magmatic plumbing system of the western zone of the Peninsular Ranges Batholith (PRB). In the 1920's, the SPV outcropping at Black Mountain Open Space Park was mined for white As. Mining efforts were small-scale and short-lived, with just 700 pounds of material containing 31.4% As shipped from the property (Stewart 1963).

1.3 Aims of this study

Our findings of anomalous As enrichment (>1,000 ppm) in volcanic rocks exposed at Black Mountain Open Space Park provide an excellent opportunity to investigate As cycling in volcanic arcs, while examining the extent of As enrichment throughout the park and the potential for As to be mobilized from primary and/or secondary host minerals. Thus, this thesis poses the following research questions:

1. What is the geology of rocks cropping out at Black Mountain Open Space Park, and over what spatial scale does rock type vary?
2. What is the distribution of As among SPV rock types, and how can we use this knowledge to propose a model for As cycling in the ancient volcanic arc system?
3. What are the primary and secondary As host minerals in Black Mountain SPV, and how does knowledge of host minerals inform future research investigating As mobility?

1.4 Thesis structure

Research Questions 1 and 2 are presented in Chapter 2, while Chapter 3 addresses Research Question 3. Chapter 2 is written as a manuscript for publication, while Chapter 3 intends to inform future research at Black Mountain Open Space Park. Supplementary data, figures, and analyses are collated in the appendices of this thesis.

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CHAPTER 2: Arsenic enrichment in the Santiago Peak Volcanics of Southern California: implications for geogenic arsenic distribution in ancient and modern volcanic arc systems

2.1 Abstract

Arsenic (As) is enriched in the Santiago Peak Volcanics (SPV) that crop out at Black Mountain Open Space Park in San Diego, CA. Thus, the Black Mountain SPV present an excellent opportunity to investigate As enrichment in ancient volcanic arc systems as a result of deep earth subduction zone processes. Through targeted field study of this unit, we aim to (1) confirm the volcanic arc provenance of rocks cropping out at Black Mountain, (2) investigate As enrichment in relation to volcanic arc processes, and (3) propose a model for As occurrence in the SPV. Our findings indicate Black Mountain SPV evolved from the same magma system as Northern Santa Ana Mountain SPV during the Cretaceous, and that As content varied between the two dominant SPV rock types, with rhyolites containing more As (n = 10, mean = 586 ± 10 ppm As) than dacites (n = 10, mean = 14 ± 9 ppm As). Our proposed model for As enrichment in SPV suggests that As is among the first elements released during serpentinite dehydration (along with Pb), while less soluble elements (e.g. Cu) are released during later stages of subduction. Once As and Pb are released from serpentinites and incorporated into partial melts, we hypothesize that such elements behave like typical incompatible elements and remain dissolved in melts until they are eventually exhumed in rhyolitic lavas. Since As may dissolve out of volcanic host rocks in groundwater aquifers, this enhanced understanding of As distribution among ancient volcanic arc rocks may aid in identifying alternative drinking water sources in regions with known groundwater As enrichment.

2.2 Introduction

Modern volcanic arc systems provide conditions where fluid soluble elements like arsenic (As) can be enriched in subduction zone magmas (Ballantyne and Moore 1988, Hattori and Guillot 2003, Breuer and Pichler 2013). Thus, ancient volcanic arcs are plausible host provinces of As-enriched volcanic rocks (Mukherjee et al. 2014). However, this type of geologic province is not frequently targeted in studies of groundwater As exposure, since aquifers of sediments and sedimentary rocks typically yield more water for drinking supplies (Smedley and Kinniburgh 2002). Recent studies (e.g. O'Shea et al. 2015, Ryan et al. 2015) draw awareness to metamorphic aquifers as potential As hosts, but attention to volcanic rocks remains in deficit.

Mukherjee et al. (2014) hypothesize that geogenic As in groundwater may ultimately be sourced to deep earth processes. A key component of their proposed global As system is As mobilization by subduction zone magmas (Ballantyne and Moore 1988, Breuer and Pichler 2013, Mukherjee et al. 2014). During this process, subducted slabs and overlying sediments release water and soluble elements (e.g. As, Pb, Sb), which hydrate and enrich overlying serpentinites (Hattori and Guillot 2003). With further downward movement of the subducting slab the serpentinite layer transports these fluid-soluble elements to depth. Eventually dehydration of serpentinites occurs, releasing the slab-transported soluble elements and water, leading to partial melting of the mantle wedge and enrichment of such elements in volcanic arc fronts (Hattori and Guillot 2003). However, as recommended by Mukherjee et al. (2014), targeted field studies are required to enhance understanding of As cycling in these volcanic arc settings.

The Santiago Peak Volcanics (SPV) of Southern California (CA), USA and Northern Baja CA, Mexico are remnants of a subaerial volcanic arc that evolved along the west coast of North America during the Cretaceous. In studies by Herzig and Kimbrough (2014) of SPV outcropping in the Northern Santa Ana mountains, parental magmas were likely derived from a shallow, hydrous source magma followed by up to 10% assimilation of continental crust. Rocks range in composition from basalt to rhyolite and likely underwent syn-volcanic greenschist facies metamorphism (Herzig and Kimbrough 2014).

Historical records indicate that the portion of the SPV cropping out 100 km south of the Northern Santa Ana SPV, at Black Mountain Open Space Park (San Diego, CA) was once mined for As (Stewart 1963), providing a unique opportunity to present an integrated view of the interactions between observed As anomalies and volcanic arc processes through targeted field study. The goals of this work are threefold: (1) confirm the volcanic arc provenance of rocks cropping out at Black Mountain, (2) investigate As enrichment in relation to volcanic arc processes, and (3) propose a model for As occurrence in the SPV. Such analysis may enhance understanding of As transport by subduction zone magmas and provide insight into the preferential concentration of As in volcanic arc rocks, which may aid in identifying areas that are susceptible to groundwater elevated in As (Mukherjee et al. 2014).

2.3 Study area

We examined SPV exposed at the surface of Black Mountain Open Space Park. The 950-hectare park is located in the Rancho Peñasquitos Community of northern San Diego (population density = ~1,500 people/mi^2). The park encompasses most of Black Mountain, the highest peak (460 m) in the community, and surface water within the park drains into channels that eventually empty into the San Dieguito River. However, rainfall can be limited (<30 cm/yr) in this semi-arid region of the Southwestern coast of the USA (Fig 2.1b). Field mapping produced a 1:30,000 geologic map (Fig 2.1a) for Black Mountain. Portions of the park surrounding abandoned mines were mapped with greater resolution and indicate that the lithology of Black Mountain SPV varies over a spatial scale of tens of meters.

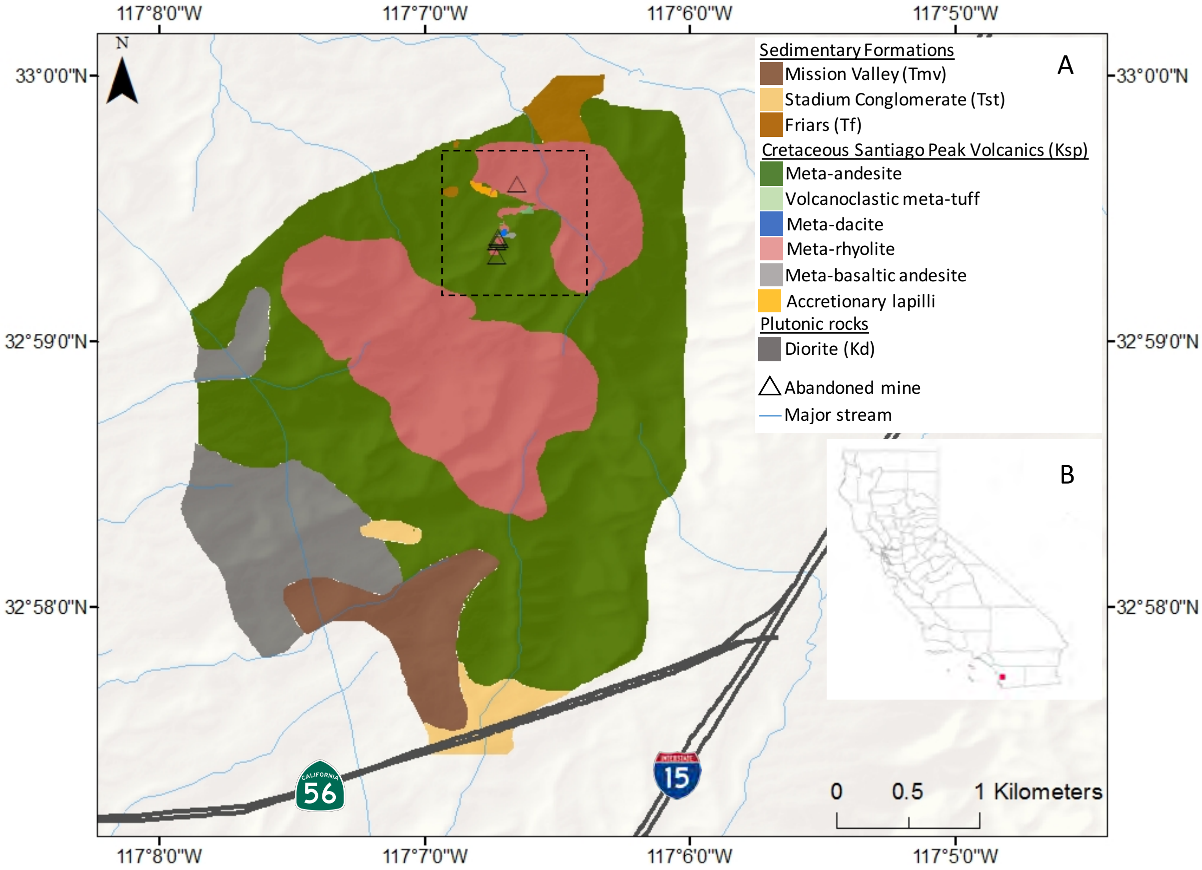

Fig 2.1: a) 1:30,000 geologic map of Black Mountain Open Space Park. Dotted line shows study area, b) Location of study area in San Diego County, California, USA.

2.4 Methods

2.4.1 Sample collection

Following geological mapping and preliminary elemental analysis by field portable X-ray fluorescence (XRF, Haffert and Craw 2009), we collected 20 rock samples from in-situ outcrops at Black Mountain Open Space Park. Sampling was primarily focused around a 1 km^2 area surrounding abandoned mines (Fig 2.1). Though outcrops were limited and sometimes inaccessible, we sampled multiple lithologies so that the extent of heterogeneity is represented in the sample population.

2.4.2 Sample preparation

Bulk rock samples (n = 20) were pulverized into a fine powder using a Bico Pulverizer fitted with ceramic plates at the University of San Diego (USD). Though samples had undergone various extents of weathering, we targeted fresh portions of coherent samples by removing weathering rinds using a diamond-tipped Dremel tool. Powdered rocks were sieved to <53 microns before fusion. A representative subset of samples (n = 10) were cut into thin section for analysis by petrographic microscope. All equipment was routinely cleaned with acetone and compressed air to avoid cross contamination between samples.

2.4.3 Lithology

We analyzed thin sections following Perkins and Henke (2004) using a standard polarizing petrographic microscope at USD.

2.4.4 Bulk rock geochemistry

We examined major element composition using an XRF (Rigaku ZSX Primus II) at the College of Wooster following methods of Pollock et al. (2014). The resulting major element concentrations were used to characterize rock type by total alkali versus silica (TAS, Le Bas et al. 1985) and Jensen Cation (Le Maitre et al. 1989) plots, since samples could have undergone metasomatic loss of alkalis during greenschist facies alteration (Rollinson 1993).

2.4.5 Trace metals

Bulk rock samples were analyzed for trace metals by an Innov-X-5000 X-ray Fluorescence (XRF) at USD. Before each analysis, the XRF passed calibration by reference to a factory provided calibration disc. The Certified Reference Material (CRM) NIST 2710a Montana I Soil was analyzed for data quality assurance before, after, and during analysis of rock powders. Accuracy was assessed by calculating relative percent difference (RPD) from the certified concentration. Duplicates were assessed by calculating relative standard deviation (RSD), and only elements with RSD at or below 5% precision are included in this report (Table 1).

Table 2.1: QA/QC for Innov-X-5000

Sample ID	As (ppm)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Sb (ppm)
NIST 2710a (1)	1,520	3,210	4,136	5,271	50
NIST 2710a (2)	1,517	3,228	4,151	5,276	49
NIST 2710a (3)	1,544	3,244	4,170	5,283	53
NIST 2710a (4)	1,559	3,283	4,192	5,325	50
NIST 2710a (5)	1,558	3,255	4,207	5,310	51
NIST 2710a (6)	1,563	3,340	4,260	5,389	50
NIST 2710a certified value	**1,540**	**3,420**	**4,180**	**5,520**	**52.5**
% RSD*	**1%**	**1%**	**1%**	**1%**	**3%**
% RPD**	**0%**	**-5%**	**0%**	**-4%**	**-4%**

*: Precision measured by %RSD = 100 * (standard deviation/average)

**: Accuracy measured by %RPD = 100 * [(ave. reported value for CRM - CRM certified value)/ CRM certified value)]

2.5 Results

2.5.1 Lithology

Volcanic outcrops in the study area consist of crystallized lava flows (Fig 2.2a), welded tuff (Fig 2.2b), and volcaniclastic (epiclastic) rocks (Fig 2.2c). Subaerial eruptive features include vesicles, flow banding (Fig 2.2a), pumice fragments (Fig 2.2c), and accretionary lapilli (Fig 2.2d). We did not observe features indicative of subaqueous volcanic eruption. All coherent samples were porphyritic, containing relatively fresh crystals of quartz (Qtz, Fig 2.2e), plagioclase (Plag, Fig 2.2b), and pyrite (Py, Fig 2.2b), with plagioclase being the most abundant phenocryst type. However, many phases were pseudomorphs composed of greenschist minerals chlorite (Cl), epidote (Ep), and zoisite (Zo) (Fig 2.2f, Fig 2.2g). We also observed sericite (Ser) in some rhyolitic samples (n = 3, Fig 2.2i).

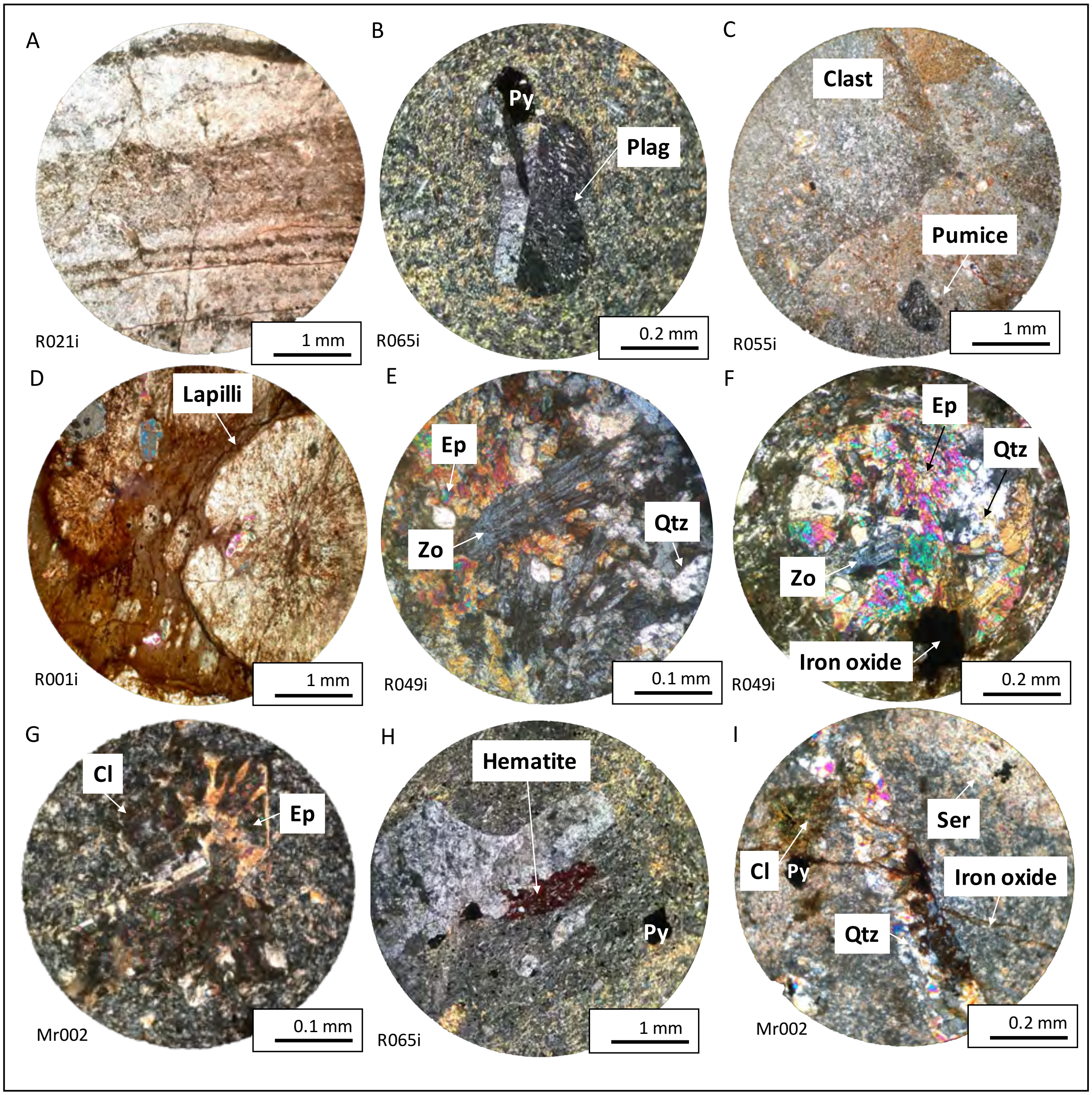

Fig 2.2: Photomicrographs taken in cross-polarizing light showing: a) Minimally altered rhyolite (R021i) exhibiting flow banding, b) Altered dacitic welded tuff (R065i) containing relatively fresh phenocrysts of plagioclase (Plag) and pyrite (Py), c) Altered volcaniclastic dacite (R055i), d) Accretionary lapilli, e) Moderately altered dacite (R049i) containing quartz (Qtz) phenocryst, with zoisite (Zo) and epidote (Ep) bordering phenocryst, f) Altered phenocryst containing quartz (Qtz), epidote (Ep), zoisite (Zo), and minor iron oxide in a moderately altered dacite (R049i), g) Twinned plagioclase phenocrysts in an altered rhyolite (Mr002) that have been almost completely replaced by chlorite (Cl) and epidote (Ep), h) Moderately altered dacitic welded tuff (R065i) containing hematite and pyrite (Py), and i) Highly altered rhyolite (Mr002) containing sericite (Ser), chlorite (Cl), and pyrite (Py).

2.5.2 Bulk geochemistry

Jensen Cation (Fig 2.3a, Le Maitre et al. 1989) and TAS (Fig 2.3b, Le Bas et al. 1985) plots of bulk rock samples identify sub-alkaline rhyolites, dacites, and minor andesites as the most abundant rock types in Black Mountain SPV, with lithology varying over a spatial scale of tens of meters (Fig. 2.1). We will hereafter use the Jensen Cation Plot (Fig 2.3a, Le Maitre et al. 1989) to classify Black Mountain SPV, thus our samples consist of volcanic rhyolites (n = 10) and dacites (n = 10).

Rhyolites typically contained greater SiO_2 (mean = 74.09 ± 2.13[1] wt%), Na_2O (mean = 4.81 ± 0.27 wt%), and K_2O (mean = 2.35 ± 0.25 wt%), while dacites were enriched in Al_2O_3 (mean = 16.84 ± 0.52 wt%), Fe_2O_3 (mean = 9.07 ± 0.35 wt%), CaO (mean = 5.56 ± 1.03 wt%), MgO (mean = 1.7 ± 0.20 wt%), and MnO (mean = 0.15 ± 0.01 wt%) (Table 2). We observed overall trends of decreasing Al_2O_3 ($R^2 = 0.86$), Fe_2O_3 ($R^2 = 0.87$), MgO ($R^2 = 0.53$), CaO ($R^2 = 0.66$), and TiO_2 ($R^2 = 0.82$) relative to SiO_2, while K_2O ($R^2 = 0.34$) and Na_2O ($R^2 = 0.24$) are positively correlated with SiO_2 (Fig 2.4). Black Mountain SPV lavas show Fe enrichment consistent with the tholeiitic magma series (Fig 2.5, Rollinson 1993).

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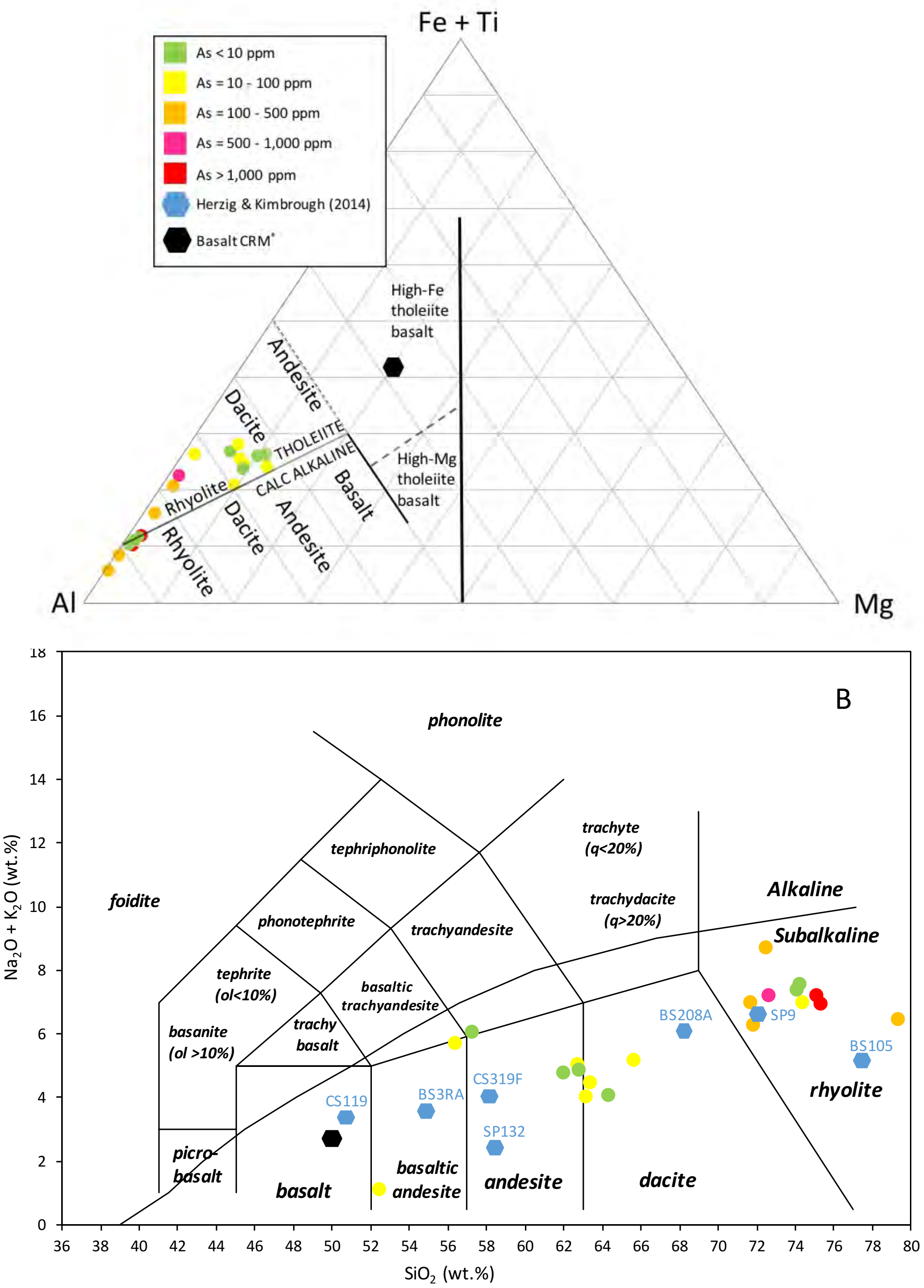
[1] Standard error = $\frac{\text{Standard deviation }(\sigma)}{\sqrt{\text{Sample size (n)}}}$



* : Certified Reference Material (CRM). Basalt, Hawaii Volcanic observatory, BHVO-2 (Wilson, S.A. 1998).

Fig 2.3: a) Jensen Cation (Le Maitre et al. 1989) and b) TAS (Le Bas et al. 1985) plotting of cations measured in rock samples presented in Table 2. Samples are differentiated by As concentration. For comparison, blue hexagons show geochemistry of SPV in the northern Santa Ana Mountains (Herzig and Kimbrough 2014). CRM provided for reference.

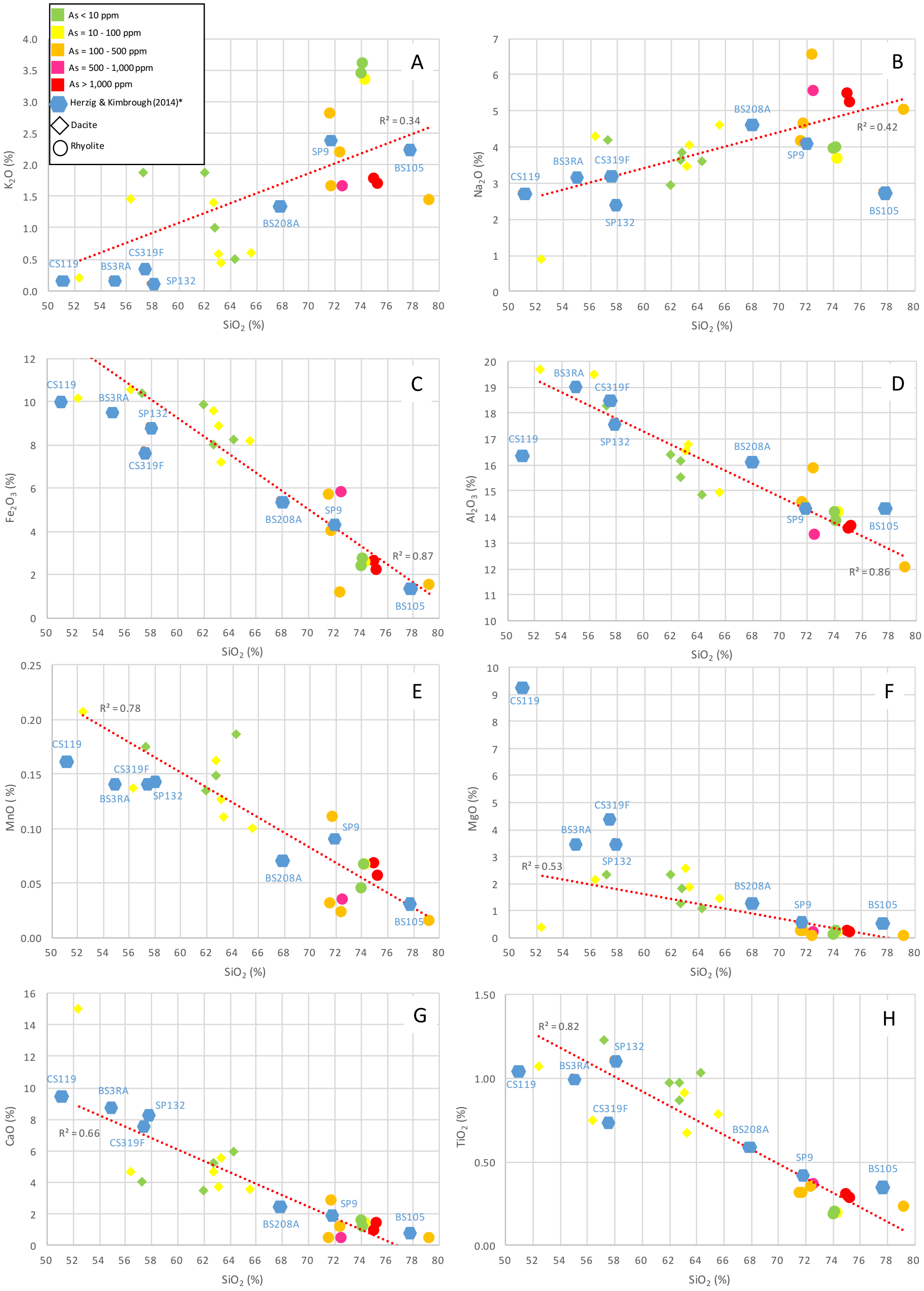
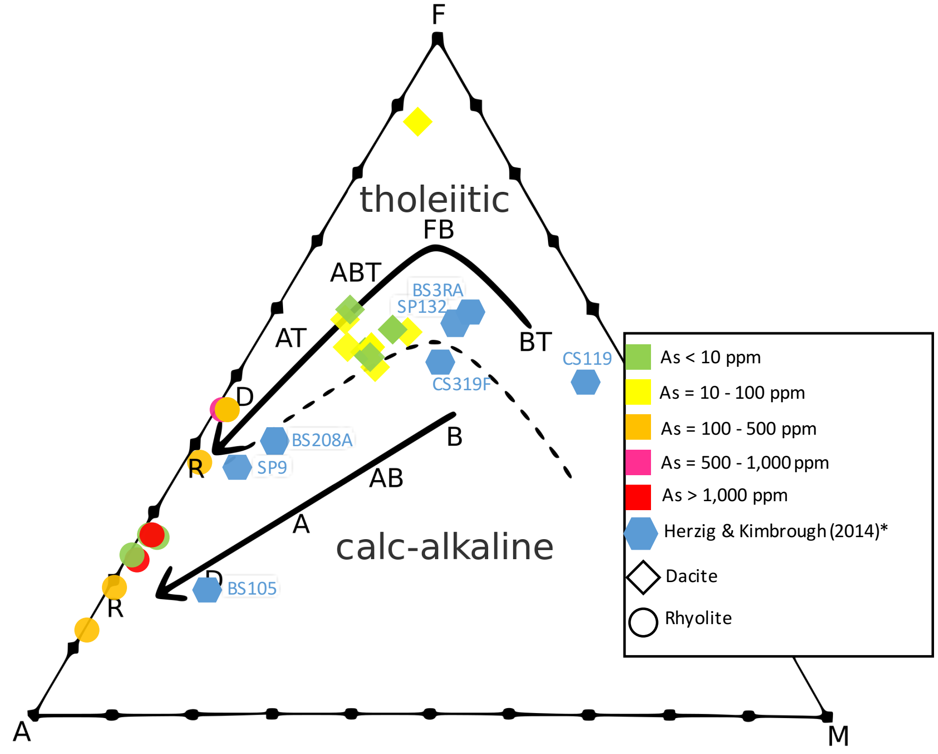


Fig 2.4: Bivariate plots showing concentration of SiO_2 relative to a) K_2O, b) Na_2O, c) Fe_2O_3 $_{tot}$, d) Al_2O_3, e) MnO, f) MgO, g) CaO, and f) TiO_2. Colors indicate relative As enrichment.



* Northern Santa Ana Mountain SPV whole rock geochemical data from Herzig & Kimbrough (2014), Table 5.

Fig 2.5: AFM (A – alkalis (Na_2O + K_2O), F – total iron (Fe_2O_3), M – MgO) Diagram for lavas of the Santiago Peak Volcanics. BT = tholeiitic basalt, FB = ferro-basalt, ABT = tholeiitic basaltic andesite, AT = tholeiitic andesite, D = dacite, R = rhyolite, B = basalt, AB = basaltic andesite. Colors indicate relative As enrichment.

Table 2.2: Major element composition of bulk rock samples (n = 20).

Sample ID	Rock Type	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	$Fe_2O_{3\,tot}$	BaO	Total
		mass%	mass%	mass%	mass%	mass%	mass%	mass%	mass%	mass%	mass%	mass%	mass%
Mr001	Rhyolite	5.01	0.06	12.00	79.28	0.00	1.43	0.40	0.23	0.01	1.49	0.09	100
Mr002	Rhyolite	5.23	0.17	13.63	75.32	0.03	1.69	1.36	0.28	0.06	2.16	0.08	100
R004i	Rhyolite	4.15	0.24	14.52	71.66	0.03	2.81	0.44	0.31	0.03	5.67	0.14	100
R020i	Rhyolite	5.45	0.21	13.53	75.07	0.03	1.76	0.89	0.30	0.07	2.60	0.09	100
R021i	Rhyolite	3.65	0.17	14.15	74.36	0.06	3.33	1.41	0.19	0.07	2.56	0.07	100
R024wp	Rhyolite	5.54	0.20	13.30	72.62	0.03	1.65	0.40	0.36	0.03	5.77	0.09	100
R037i	Rhyolite	6.53	0.06	15.86	72.48	0.04	2.18	1.14	0.35	0.02	1.14	0.19	100
R044i	Rhyolite	4.62	0.21	14.41	71.83	0.01	1.65	2.79	0.31	0.11	3.98	0.07	100
R046i	Rhyolite	3.95	0.21	13.83	74.22	0.03	3.59	1.15	0.20	0.07	2.70	0.07	100
R060i	Rhyolite	3.94	0.11	14.17	74.10	0.01	3.43	1.58	0.18	0.04	2.37	0.07	100
Average	**Rhyolite**	**4.81**	**0.16**	**13.94**	**74.09**	**0.03**	**2.35**	**1.16**	**0.27**	**0.05**	**3.04**	**0.10**	**100**
Standard error	**Rhyolite**	**± 2.7**	**± 0.02**	**± 0.30**	**± 0.67**	**± 0.00**	**± 0.26**	**± 0.22**	**± 0.02**	**± 0.01**	**± 0.48**	**± 0.01**	
R038i	Dacite	0.90	0.35	19.66	52.43	0.07	0.19	14.98	1.06	0.21	10.14	0.01	100
R039i	Dacite	4.03	1.83	16.74	63.34	0.14	0.43	5.54	0.67	0.11	7.15	0.03	100
R049i	Dacite	3.58	1.06	14.82	64.32	0.38	0.49	5.93	1.03	0.19	8.19	0.02	100
R051i	Dacite	3.44	2.55	16.54	63.15	0.14	0.57	3.69	0.91	0.13	8.87	0.03	100
R053i	Dacite	3.64	1.25	15.52	62.74	0.20	1.39	4.63	0.87	0.16	9.56	0.05	100
R054i	Dacite	4.19	2.30	18.26	57.29	0.25	1.86	4.03	1.23	0.18	10.36	0.07	100
R055i	Dacite	2.92	2.31	16.35	62.02	0.13	1.87	3.44	0.97	0.13	9.82	0.05	100
R058i	Dacite	4.59	1.44	14.95	65.60	0.26	0.60	3.52	0.78	0.10	8.14	0.02	100
R065i	Dacite	4.27	2.12	19.45	56.40	0.18	1.44	4.66	0.74	0.14	10.54	0.06	100
R066i	Dacite	3.84	1.79	16.12	62.79	0.19	1.00	5.16	0.97	0.15	7.97	0.04	100
Average	**Dacite**	**3.54**	**1.7**	**16.84**	**61.01**	**0.19**	**0.98**	**5.56**	**0.92**	**0.15**	**9.07**	**0.04**	**100**
Standard error	**Dacite**	**± 0.31**	**± 0.20**	**± 0.52**	**± 1.26**	**± 0.03**	**± 0.19**	**± 1.03**	**± 0.05**	**± 0.01**	**± 0.35**	**± 0.01**	
BHVO-2[+]	Basalt CRM	2.20	7.11	13.55	49.99	0.26	0.51	11.29	2.70	0.17	12.20	0.01	100
Average in upper-crust*		*3.27*	*2.43*	*15.40*	*66.62*	*0.15*	*3.27*	*3.59*	*0.64*	*0.10*	*5.04*	*0.07*	

[+] : Certified Reference Material (CRM). Basalt, Hawaii Volcanic observatory, BHVO-2 (Wilson, S.A. 1998).

*: Rudnick and Gao (2003)

2.5.3 Trace metal enrichment

Total As in Black Mountain SPV (n = 20) ranged from 5.2 ppm to 3,155 ppm. In addition to As, all samples contained copper (Cu), lead (Pb), and zinc (Zn). We detected antimony (Sb) in only a few (n = 2) samples. Rhyolites were typically more enriched in As (n = 10, mean = 586 ± 10 ppm As) than dacites (n = 10, mean = 14 ± 9 ppm As). Rhyolites also contained greater concentrations of Pb (mean = 28 ± 4 ppm As), while dacites were more enriched in Zn (mean = 114 ± 13 ppm). Rhyolites and dacites had similar average Cu concentrations (~30 ppm) (Table 3).

Table 2.3: Summary of trace element enrichment in Black Mountain SPV. Mean +/- standard error.

	As (ppm)	**Cu (ppm)**	**Pb (ppm)**	**Sb (ppm)**	**Zn (ppm)**
Bulk rhyolites (n = 10)	586 +/- 10	30 +/- 6	28 +/- 4	4 +/- 3	46 +/- 8
Bulk dacites (n = 10)	14 +/- 9	30 +/- 3	12 +/- 2	ND	114 +/- 13
Average in upper-crust*	*4.8*	*28*	*17*	*0.4*	*47*

*: Rudnick and Gao (2003)

2.6 Discussion

2.6.1 Volcanic arc provenance of rocks outcropping at Black Mountain

Given the geochemical similarities between Black Mountain SPV and Northern Santa Ana Mountain SPV (Herzig and Kimbrough 2014), we suspect that the two units evolved within the same volcanic arc system during the Cretaceous. Our hypothesis is supported by several lines of evidence. First, we observed welded tuffs, volcaniclastic (epiclastic) rocks, and accretionary lapilli in Black Mountain SPV, which suggest that several distinct stages of subaerial volcanic eruption occurred (Abbott et al. 1993, Herzig and Kimbrough 2014).

Second, we found that lavas were often porphyritic and ranged in composition from dacite to rhyolite (Fig 2.3), with rhyolites containing more SiO_2, Na_2O, and K_2O than dacites (Fig. 2.4). Like Herzig and Kimbrough (2014), we also observed overall trends of decreasing Al_2O_3, Fe_2O_3, MgO, CaO, and TiO_2 relative to SiO_2 (Fig 2.4). Such trends are qualitatively consistent with low-pressure fractional crystallization of hydrous mafic magmas (Rollinson 1993) and, thus, suggest that rhyolites crystallized from more evolved melts than dacites.

Finally, all samples analyzed in thin section contain evidence of varying extents of syn-volcanic alteration (Fig 2.1). Though greenschist facies minerals (e.g. chlorite, epidote, zoisite) often replaced primary igneous phases (e.g. plagioclase) in highly altered samples, we found no evidence of penetrative cleavage indicative of a regional metamorphic event (Fig 2.1). Therefore, our findings corroborate the hypothesis that greenschist facies alteration of SPV occurred contemporaneously with arc volcanism (Herzig and Kimbrough 2014).

2.6.2 Arsenic enrichment in relation to volcanic arc processes

We found that As content varied between the two dominant SPV rock types, with rhyolites typically containing more As (n = 10, mean = 586 ± 10 ppm As) than dacites (n = 10, mean = 14 ± 9 ppm As) (Table 2.2). This finding is particularly interesting because typically igneous rocks report low (close to crustal average; Table 2.3) concentrations of As. For example, Smedley and Kinniburgh (2001) report an average of 1.5 ppm As for igneous rocks. The mean arsenic in these SPV rhyolites is thus about 120 times greater than the averages reported for the upper crust, and nearly 400 times the average for igneous rocks as reported by Smedley and Kinniburgh (2001). Even dacites are enriched above crustal averages, further indicating that volcanic arcs are plausible host provinces of As-enriched volcanic rocks.

2.6.2.1 Partial melt evolution

The enrichment of As in rhyolites may explain the weak to moderate positive correlation we observed between As and SiO_2 ($R^2 = 0.32$) and/or Na_2O ($R^2 = 0.43$), as well as the negative correlation between As and Fe_2O_3 ($R^2 = 0.30$), Al_2O_3 ($R^2 = 0.24$), MnO ($R^2 = 0.33$), MgO ($R^2 = 0.33$), CaO ($R^2 = 0.17$), and/or TiO_2 ($R^2 = 0.28$) (Fig 2.6), given that rhyolites are typically enriched in SiO_2 and Na_2O, but depleted Fe_2O_3, Al_2O_3, MnO, MgO, CaO, and TiO_2 (Fig 2.4).

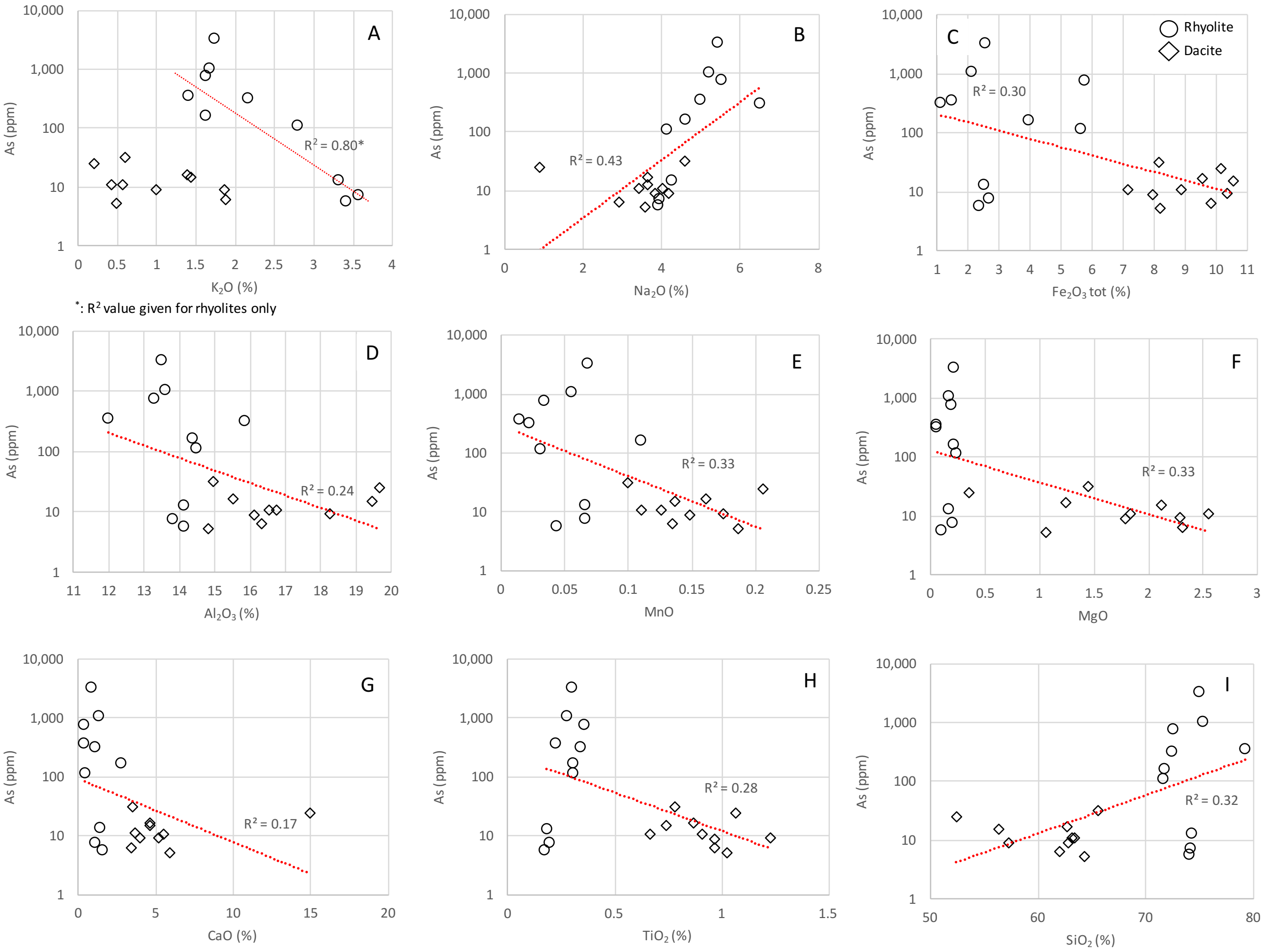
These trends (Fig 2.6) also demonstrate that As is negatively correlated with elements (Fe, Al, Mn, Mg, Ca, and Ti) that are incorporated into minerals during the early stages of fractional crystallization, while As is positively correlated with elements (Si and Na) that incorporate into later-stage minerals. These findings suggest that As enrichment may be controlled, in part, by the fractional crystallization of partial melts, with rocks that crystallized from relatively evolved partial melts like these SPV rhyolites, containing greater As. The AFM diagram (Fig. 2.5), which gives As content in relation to tholeiitic differentiation trends, further supports this hypothesis. The diagram demonstrates that As enrichment in Black Mountain SPV increases as Mg and Fe content of magmas decrease. Thus, felsic rocks that crystallized from more evolved melts typically contain greater As.

Our interpretation is supported by the findings of Johnson et al. 2013 who analyzed rhyolites in the Taupo Volcanic Zone (TVZ) of New Zealand. This work suggests that, throughout the processes of fractional crystallization and extensive degassing, metals (e.g. As) do not partition into an exsolved vapor and instead partition into crystallizing minerals or remain dissolved in the melt until they are eventually exhumed in rhyolites (Johnson et al. 2013).

It is important to note that we observed a strong negative correlation between As and K_2O ($R^2 = 0.80$, Fig 2.6a) in rhyolites, though greater K_2O is typically associated with more evolved melts. The replacement of K-feldspar, albite, and/or sericite by Mg-Fe chlorite (Eq 1, Fig 2.2g) and/or pyrite (Fig 2.2b) during syn-volcanic hydrothermal alteration (Large et al. 2001) may explain this trend, since such reactions suggest that K_2O is re-mobilized by hydrothermal fluids and, thus, may not be associated with the fractional crystallization of source melts.

Eq. 2.1: $2KAl_3Si_3O_{10}(OH)_2$ (sericite) + $3H_4SiO_4 + 9Fe^{2+} + 6Mg^{2+} + 18H_2O \rightarrow$ $3Mg_2Fe_3Al_2Si_3O_{10}(OH)_8$ (chlorite) + $2K^+ + 28H^+$

Further, O’Shea et al. (2015) observed As enrichment in greenschist facies rocks containing chlorite and pyrite. In their study, arsenic was detected in pyrites when the index mineral chlorite was present, suggesting that pyrites, and potentially silicates like chlorites, are likely hosts of As in rocks subjected to greenschist facies metamorphism, like the SPV rhyolites.



*: R^2 value given for rhyolites only

Fig 2.6: Bivariate plots comparing As content (ppm) to concentration of major ions (wt. %), a) K_2O, b) Na_2O, c) Fe_2O_3 $_{tot}$, d) Al_2O_3, e) MnO, f) MgO, g) CaO, f) TiO_2, and g) SiO_2

2.6.2.2 Arsenic mobility in subduction zone fluids

Our findings of As enrichment in an ancient volcanic arc suggest that As in Black Mountain SPV may ultimately be sourced to deep earth subduction zone processes. Though neighboring intrusive igneous plutons of the western Peninsular Ranges Batholith (PRB) likely evolved from the same magma system as the SPV during the Late Cretaceous (Herzig and Kimbrough 2014), we are not aware of comparable degrees and/or extents of As enrichment elsewhere in the SPV or western PRB cropping out in Southern CA or Northern Baja CA, Mexico. Therefore, within the ancient subduction zone, As appears to be most enriched in rocks associated with ancient volcanic arc fronts (Noll et al. 1996).

Hattori and Guillot (2003) suggest that fluid-mobile elements, like As, Sb, and Pb, are enriched in volcanic arc fronts, because they are highly soluble in relatively low temperature aqueous fluids, allowing them to be easily volatilized from subduction zone serpentinites during dehydration and partial melting (Hattori and Guillot 2003). Other trace metals, like Cu, are less soluble and, thus, mobilized at higher temperatures (Hack et al. 2006). Therefore, these less soluble metals may not be as enriched as highly soluble metals in volcanic fronts overlying ancient subduction zones.

We observed higher concentrations of highly soluble metals, As and Pb, in rhyolites, but Cu was equally enriched in both rhyolites and dacites (Table 3). Zinc was much more enriched in dacites than rhyolites (Table 3), potentially resulting from its compatibility in ferromagnesian minerals (Stanton 1994, Johnson et al. 2013), like hornblende and biotite.

The high solubility of As and Pb initially caused these metals to be among the first released from subduction zone serpentinites during dehydration, leading to their initial enrichment in partial melts underlying volcanic arc fronts. Because of their incompatibility in these melts (Hattori and Guillot 2005), As and Pb remained dissolved as melts evolved from mafic to felsic and, thus, were eventually exhumed in rhyolitic lavas. Since Cu is not as soluble as As and Pb (Hattori and Guillot 2003, Hack et al. 2006), Cu may have been released from serpentinites during later stages of subduction. The equivalent Cu content in dacites and rhyolites suggests that Cu enrichment was associated with a syn-volcanic hydrothermal intrusion that occurred during later-stage subduction (Nadeau et al. 2013).

2.6.3 Model for arsenic occurrence in Black Mountain SPV

Based on our results and incorporating the findings of others, we propose the following model to explain As enrichment in Black Mountain SPV (Fig 2.7):

1. During the Cretaceous, the oceanic Farallon Plate began to subduct beneath the continental North American Plate (Herzig and Kimbrough 2014), transporting oceanic sediment to depth.

2. At temperatures of around 650°C, serpentinite dehydration releases water and soluble elements, which migrate upwards and hydrate and enrich the overlying mantle wedge in As and Pb, in that order. Eventually, As and Pb are incorporated into the partial melt (Hattori and Guillot 2003).

3. Due to their high solubility and relative incompatibility (Hattori and Guillot 2003), As and Pb remain dissolved in the partial melt as it evolves from mafic to felsic and, thus, are eventually exhumed in rhyolitic magmas.

4. Because it is less soluble (Hack et al. 2006), Cu is released during later stages of serpentinite dehydration and, thus, likely has a different source melt than As and Pb.

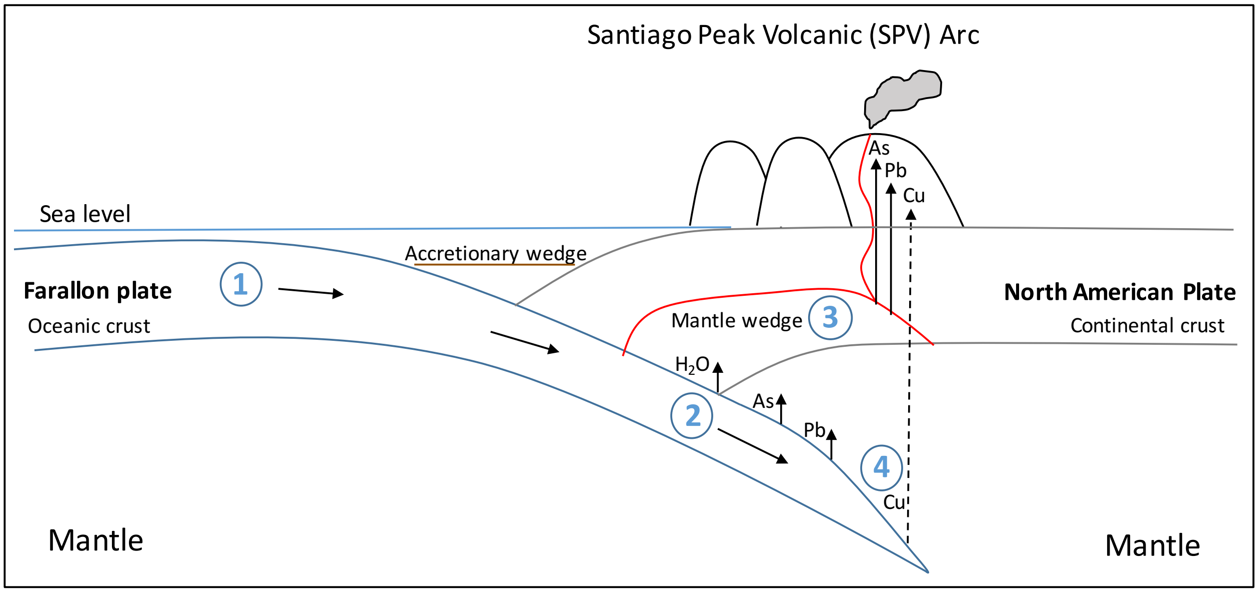


Figure 2.7: Model explaining the provenance of As in Black Mountain SPV

2.6.4 Potential for groundwater arsenic enrichment in Black Mountain SPV

There are no domestic wells within a one mile radius of the study area, though groundwater is eligible for municipal use (CA EPA). Historic records report that, in wetter times, an As-rich spring existed (City of San Diego Cultural Report). Further, previous work in the Chaco-Pampean Plain of Argentina suggests that the dissolution of rhyolitic glass is the principle source for As in shallow groundwaters there (Raychowdury et al. 2014; Bunduschuh et al. 2004). Raychowdhury et al. (2014) proposed that volcanic host rocks that formed via ancient volcanic arc processes may produce groundwater elevated in As (> 5 mg/L). Therefore, any groundwater flowing through the Black Mountain SPV arsenic-rhyolite is likely to be extremely elevated in dissolved arsenic and, thus, may pose a significant health threat if consumed.

2.7 Summary

- Black Mountain SPV evolved from the same magma system as Northern Santa Ana Mountain SPV (Herzig and Kimbrough 2014) during the Cretaceous.

- Arsenic enrichment in Black Mountain SPV is ultimately sourced to deep earth subduction zone processes as proposed globally by Mukherjee et al. (2014).

- Our proposed model for As enrichment in SPV (Fig 2.7) suggests that As is among the first elements released during serpentinite dehydration (along with Pb), while less soluble elements (e.g. Cu) are released during later stages of subduction.

- Once As and Pb are released from serpentinites and incorporated into partial melts (Hattori and Guillot 2003), we hypothesize that such elements behave like typical incompatible elements and remain dissolved in melts until they are eventually exhumed in rhyolitic lavas.

2.8 Conclusion

Our findings of As in an ancient volcanic arc system support the hypothesis that groundwater As may ultimately be sourced to deep earth processes (Mukherjee et al. 2014). Therefore, As tends to be enriched in volcanic arc rocks and, thus, other modern or ancient volcanic arc systems (e.g. Cascade Volcanic Arc, Aleutian Arc, Andean Volcanic Belt) may be prone to groundwater As enrichment (Mukherjee et al. 2014). Our work suggests that, within these ancient volcanic arc systems, As enrichment is associated with volcanic rocks that crystallized from relatively evolved partial melts underlying the volcanic front (e.g. rhyolite). Given that As may dissolve out of volcanic host rocks in groundwater aquifers (Bundschuh et al. 2004, Raychowdhury et al. 2014), this enhanced understanding of As distribution among ancient volcanic arc rocks may aid in identifying alternative drinking water sources in regions with known groundwater As enrichment.

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CHAPTER 3: Arsenic Mineral Associations in the Black Mountain SPV Ore Deposit

3.1 Introduction

Minerals that host arsenic provide insight into arsenic (As) geochemical cycling, since As is present in over 560 chemically diverse minerals that form under a wide range of geochemical conditions (Majzlan et al. 2014). While As is not recognized as a significant component of major rock forming minerals (e.g. silicates and carbonates), it can easily take the place of sulfur in the abundant primary mineral, pyrite (FeS_2) (Smedley and Kinniburgh 2001, Drahota and Filippi 2009, Majzlan et al. 2014). When such primary As minerals are exposed to air and/or aerated water, alteration reactions form secondary minerals enriched in As, like scorodite ($FeAsO_4 \cdot 2H_20$). Thus, As may be mobilized from both primary and secondary minerals during modern water-rock interactions, since it is soluble over a wide pH range and in both oxidizing and reducing conditions (Smedley and Kinniburgh 2001).

By examining primary and secondary As host minerals and their associated As concentrations, we aim to enhance our understanding of As geochemical cycling in Black Mountain SPV, especially during modern water-rock interactions. Such knowledge will inform future research on As transport from Black Mountain SPV, and provide insight into the potential for As to mobilize from host rocks into surrounding communities.

3.2 Study area

Black Mountain Open Space Park is located the Rancho Peñasquitos community of northern San Diego in Southern California (CA), USA (Fig 3.1a). The park contains >15 km of hiking and biking trails climbing to ~500 m and is composed of chaparral, chaparral-coastal sage scrub, and coastal sage scrub vegetation. Surface water within the park drains into channels that eventually empty into the San Dieguito River. However, rainfall is limited (<30 cm/yr) in this semi-arid region of the Southwestern USA.

Field mapping for this study produced a preliminary, 1: 30,000 geologic map (Fig 2.1b) for a portion of the Black Mountain SPV, where As may be enriched along a ~N15°W – N20°W striking fracture zone, since extrapolation of this fracture zone along strike beyond the study area led to the discovery of an artisanal strip mine approximately two miles north of the park (Fig 3.1b). Though portions of Black Mountain Open Space Park were mined for As in the 1920s (Stewart 1963), no previous work has attempted to characterize As host minerals in Black Mountain SPV. Because there are no reports of As enrichment elsewhere in the SPV, we will hereafter call As-enriched SPV cropping out at Black Mountain Open Space Park the Black Mountain SPV ore deposit.

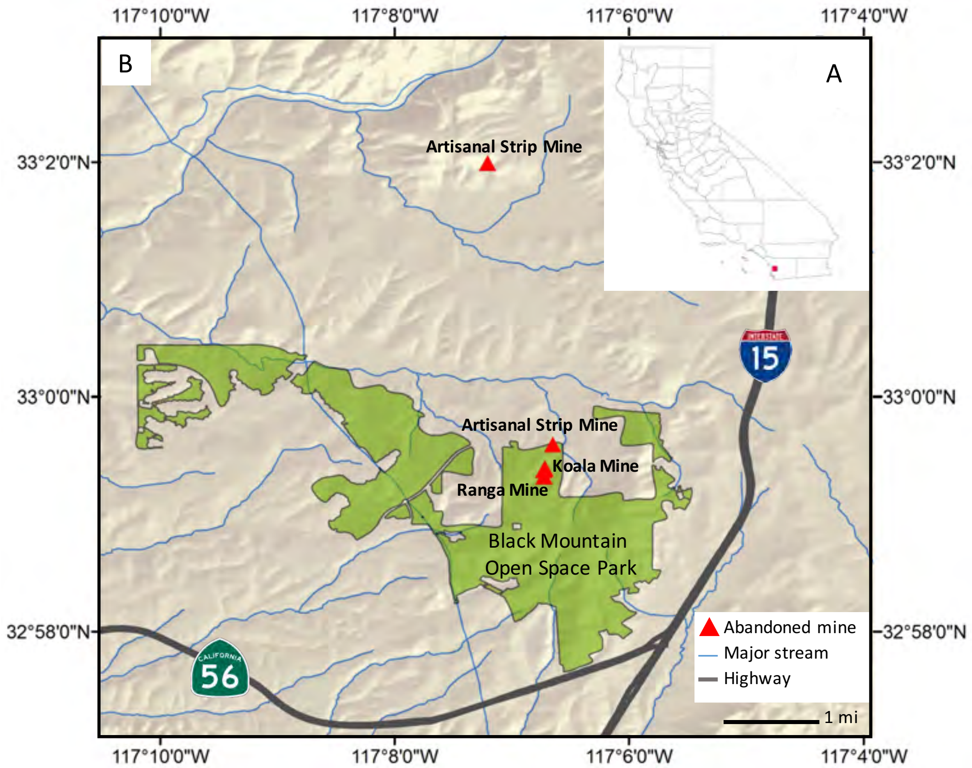

Fig 3.1: A) Location of study area within State of California, USA. B) Location of Black Mountain Open Space Park, San Diego, CA. The park boundary is highlighted in green, and red triangles give locations of abandoned As mines.

3.3 Methods

3.3.1 Sample collection

Extent of As enrichment in Black Mountain SPV was initially evaluated by field-portable X-ray fluorescence (FP-XRF, Haffert & Craw 2009) (Fig 3.2), allowing us to collect in-situ and waste-rock samples (n = 67) with a wide range of As concentrations. The majority of samples (n = 59) were collected from the northern portion of Black Mountain Open Space Park surrounding abandoned As mines, and the remaining samples (n = 8) were collected from the artisanal strip mine to the north of the park (Fig 3.1b).

3.3.2 Bulk rock preparation

Bulk rock samples (n = 67) were pulverized into a fine powder using a Bico Pulverizer fitted with ceramic plates at the University of San Diego (USD). All equipment was routinely cleaned with acetone and compressed air to avoid cross contamination between samples.

3.3.3 Sub-sample preparation

Because many samples were highly heterogeneous, sometimes showing weathering rinds, metamorphic alteration assemblages, veins, and volcaniclastics on very small (mm) spatial scales, we used a diamond-tipped Dremel tool to target subareas of whole rock samples. The term “sub-sample” is hereafter used to define Dremel-targeted samples.

3.3.4 Arsenic concentration

Powdered rocks and sub-samples (n = 168) were analyzed for trace metals by an Innov-X-5000 X-ray Fluorescence (XRF) at USD. The quality assurance/quality control (QA/QC) procedures for samples with <1,000 ppm As are presented in Chapter 2 of this thesis under section 2.3.5. Because we detected anomalous As concentrations (>1,000 ppm) in 22% of samples and sub-samples (n = 37) of Black Mountain SPV, we conducted additional QA/QC procedures to evaluate the accuracy of such anomalous concentrations. Three representative ultra-enriched samples were selected for analysis by EPA 6000/7000 series methods, and resulting As concentrations were compared to As content reported by the XRF. Compared to the EPA 6000/7000 series methods, the Innov-X-5000 XRF either reported anomalous As content accurately (<5% difference) or under-reported As by up to 24% (Table 3.1). While there are several possible reasons for this discrepancy in accuracy (e.g., analytical differences, sample heterogeneity) the purpose of analyzing these samples externally was to confirm the order of magnitude concentration of As being detected at Black Mountain since the As concentrations here are so anomalously enriched.

3.3.5 Mineralogical analysis

Powdered bulk rocks and sub-samples (n = 168) were analyzed by PANalytical X’Pert PRO X-ray diffraction (XRD) at San Diego State University (SDSU). The XRD used a copper Kα X-ray source and operated at 45 kV and 40 mA. Mineral identification and pattern manipulation were conducted using X'Pert Data Software Suite and the Joint Committee on Powder Diffraction Standards (JCPDS) reference database. Identified minerals were assigned a score from 0 – 100 by HighScore PANalytical Software, where 100 is a perfect match with X-ray spectra from the JCPDS reference database.

Table 3.1: QA/QC for samples with anomalous As concentrations

Sample ID	As (ppm) USD[1]	As (ppm) EPA[2]	% Difference[3]
R022i	131,687	158,000	-17%
Mr002	167,070	165,000	1%
Mk004	297,156	390,000	-24%

[1]: Arsenic concentration measured by Innov-X-5000 XRF at the University of San Diego (USD)

[2]: Arsenic content measured by EPA 6000/7000 series methods at EnviroMatrix Analytical, Inc.

[3]: % difference = 100* ((As EPA – As USD)/As USD)

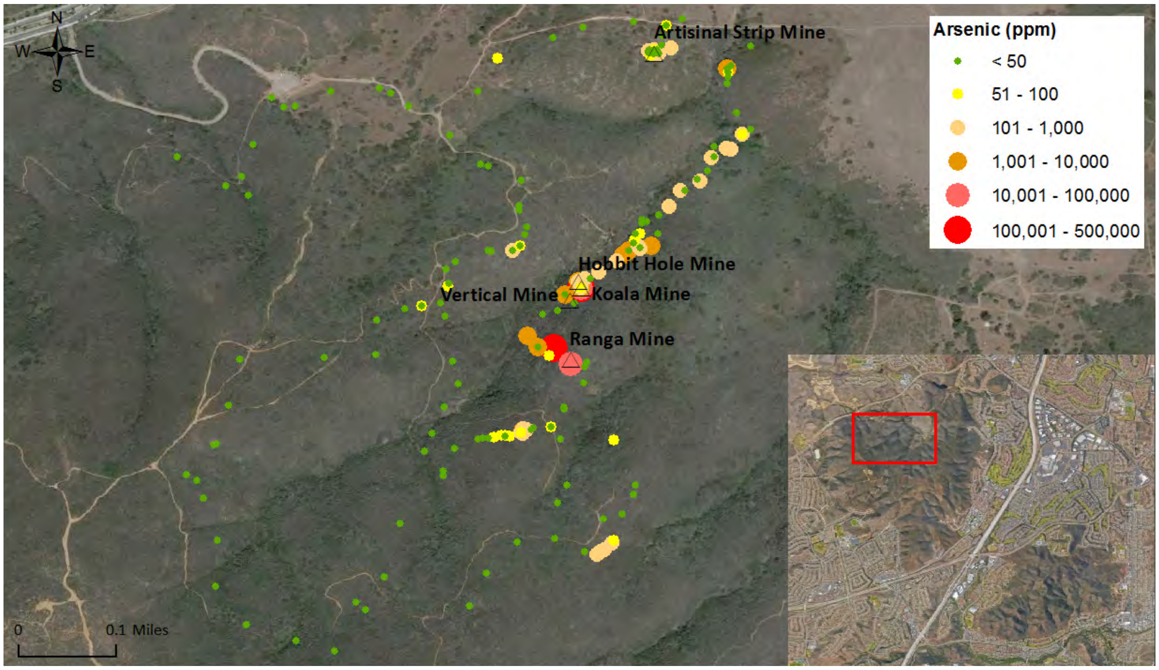

Fig 3.2: Distribution of As in rocks and soil in a portion of Black Mountain Open Space Park. Preliminary As concentrations measured by FP-XRF (after Haffert & Craw 2009)

3.4 Results

3.4.1 Arsenic enrichment

The total As concentration of powdered bulk rock and sub-samples (n = 168) ranged from non-detectable (<2 ppm) to nearly 300,000 ppm (mean = 7,476 ± 2,694[2] ppm As). We found that As was most enriched in samples collected from abandoned As mines (n = 27, mean = 36,745 ± 13,801 ppm As), and samples and sub-samples of waste rocks were also highly enriched in As (n = 12, mean = 3,051 ± 2,259 ppm As). Subsamples of weathering rinds and veins typically contained greater As concentrations (n = 44, mean = 9,475 ± 4,941 ppm As) than subsamples of fresh rock (n = 44, mean = 538 ± 245 ppm As) (Table 3.2).

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[2] Standard error = $\frac{\text{Standard deviation } (\sigma)}{\sqrt{\text{Sample size (n)}}}$

Table 3.2: Trace metal concentrations in Black Mountain SPV. Average +/- standard error. Geochemical techniques presented in Chapter 2 allowed lithologic confirmation of rocks described here as ‘bulk rhyolites’ and ‘bulk dacites’, which permitted them to be confidently presented separately from other sub-samples analyzed as part of this chapter.

	As (ppm)	**Cu (ppm)**	**Pb (ppm)**	**Sb (ppm)**	**Zn (ppm)**
All samples & sub-samples (n = 168)	7,476 +/- 2,694	105 +/- 17	79 +/- 12	58 +/- 4	139 +/- 16
Bulk rhyolites (n = 10)	586 +/- 10	30 +/- 6	28 +/- 4	4 +/- 3	46 +/- 8
Bulk dacites (n = 10)	14 +/- 9	30 +/- 3	12 +/- 2	ND	114 +/- 13
Mine samples & sub-samples (n = 27)	36,745 +/- 13,801	335 +/- 76	95 +/- 22	66 +/- 12	121 +/- 29
Waste rock samples & sub-samples (n =12)	3,051 +/- 2,259	56 +/- 19	125 +/- 44	48 +/- 15	191 +/- 57
Fresh sub-samples (n = 44)	538 +/- 245	57 +/- 9	38 +/- 5	75 +/- 7	128 +/- 22
Weathered sub-samples (n = 44)	9,475 +/- 4,941	112 +/- 22	110 +/- 25	68 +/- 8	140 +/- 15
Average in upper-crust*	*4.8*	*28*	*17*	*0.4*	*47*

*: Rudnick and Gao (2003)

3.4.2 Arsenic mineral associations

3.4.2.1 Field observations

We observed evidence for several phases of primary and secondary As host minerals in Black Mountain SPV. First, field observation of areas where FP - XRF detected anomalous As (>1,000 ppm) revealed that As-rich outcrops characteristically exhibited bright colors of purple-red, maroon, orange, yellow, and grey veins varying in thickness from cm to massive, meter-sized areas of alteration. These outcrops had typically been disturbed into meter-scale pits and cave-like mines.

3.4.2.2 Mineral Identification by Powder X-ray diffraction

Targeted Dremel sampling (Fig 3.3d) and XRF analysis of each distinctively colored vein or crystal mass revealed As concentrations ranging from 923 ppm to 297,156 ppm. We then identified potential As host minerals using XRD. We found evidence of arsenopyrite (FeAsS, Fig 3.4a) in a powder containing 297,156 ppm As (Fig 3.3a). We identified natrojarosite (Fig 3.4b) in a powder containing 49,660 ppm As (Fig 3.3b), and pyrite (FeS_2) and scorodite ($FeAsO_4 \cdot 2H_20$) (Fig 3.4c) were detected in a powder containing 110,100 ppm As (Fig 3.3c). In a powder with 167,070 ppm As, we identified natropharmacosiderite [$(Na,K)Fe_4^{3+}(AsO_4)_3(OH)_4 \bullet 6\text{-}7H_2O$], arsenosiderite ($Ca_2Fe^{3+}O_2(AsO_4)_3 \bullet 3H_2O$), and yukonite ($Ca_7Fe^{3+}(AsO_4)_{10}(OH)_{20} \bullet 15H_2O$) (Fig 3.4d). We detected schauertite ($Ca_3Ge(SO_4)_2(OH)_6 \cdot 3H_2O$) in a powder containing 8,507 ppm As. Finally, we identified gypsum ($CaSO_4 \cdot 2H_2O$) (Fig 3.4f) in a powder containing 923 ppm As (Fig 3.3f). The XRD detected goethite in 17 powders. Analysis by XRF indicates that such powders contain 4,402 ± 2,516 ppm As (Table 3.3).

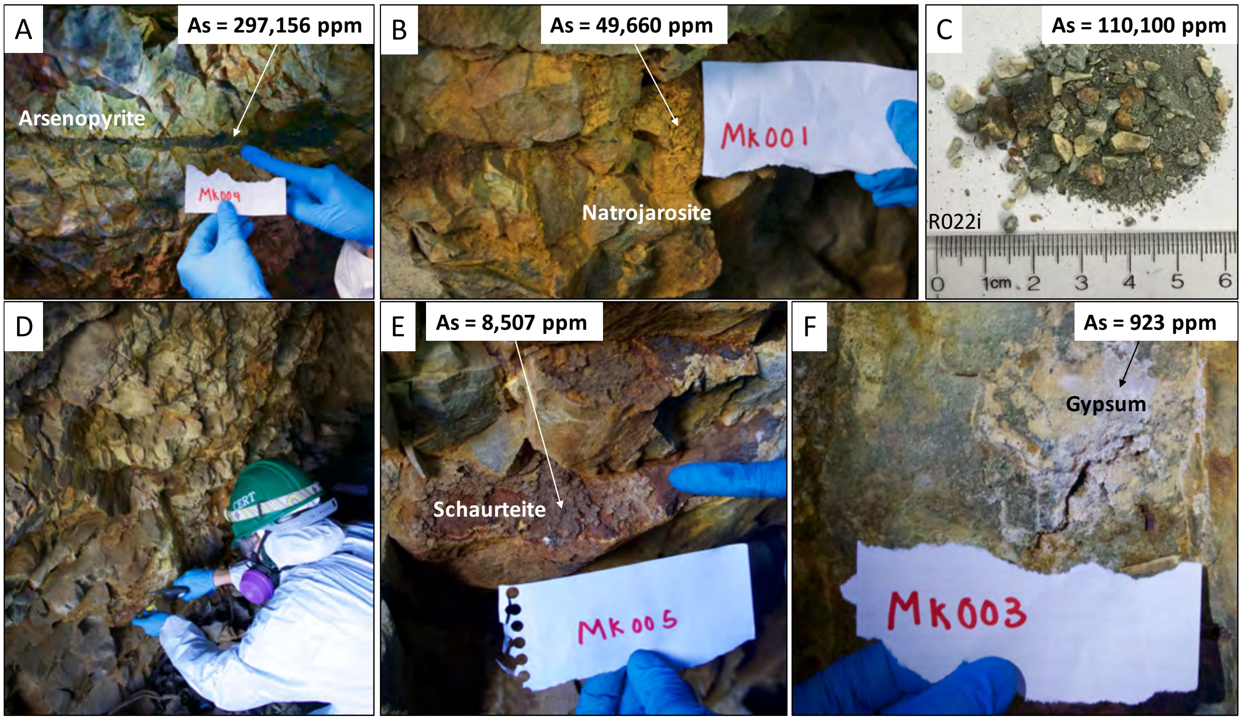

Fig 3.3: Photographs showing: a) Field observations of an arsenopyrite vein, b) Field observations of natrojarosite, c) Sample of scorodite and pyrite in laboratory, d) Method for Dremel-targeted sampling, e) Field observations of schauertite, and f) Field observations of gypsum.

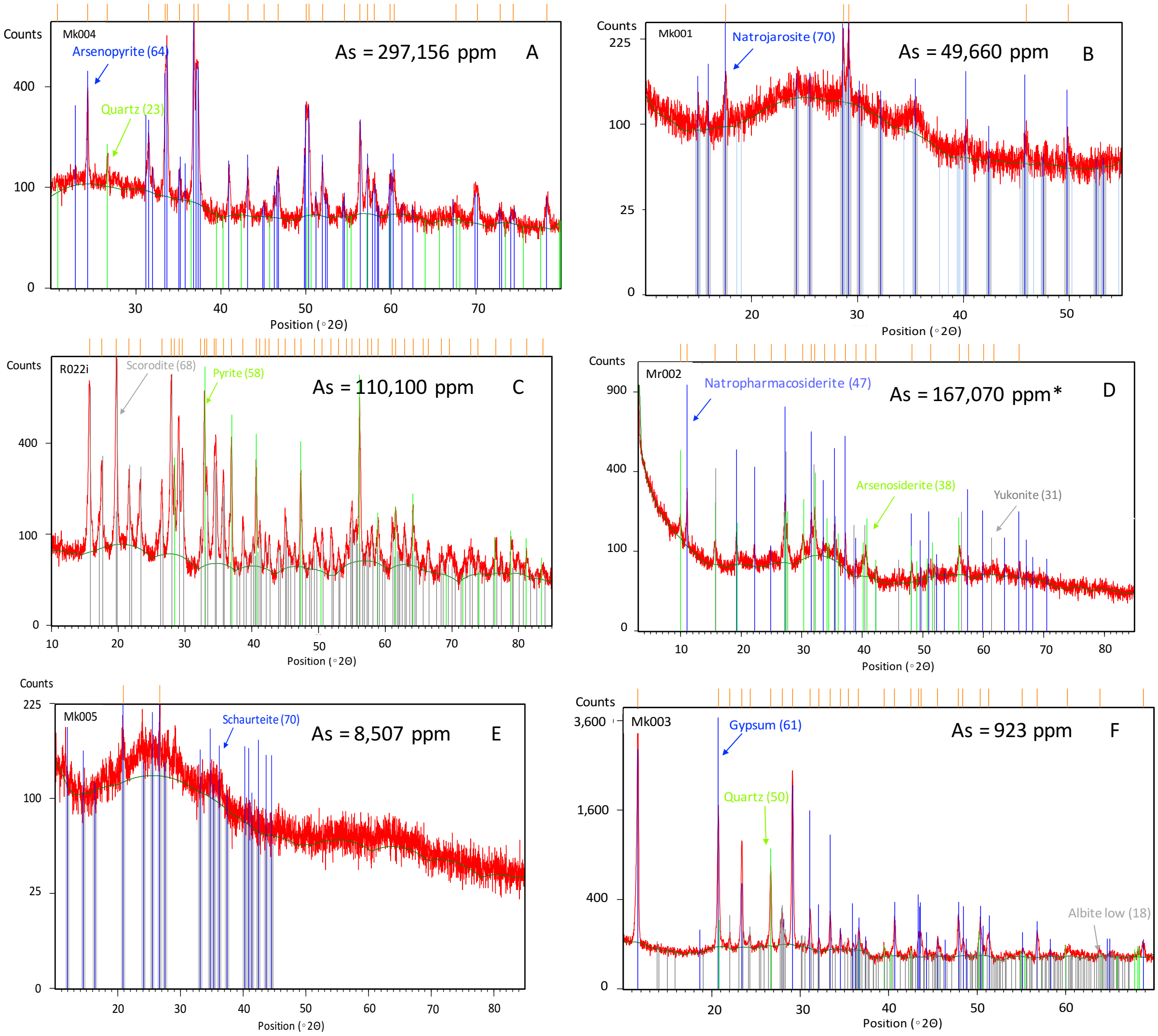

Fig 3.4: XRD spectra for samples: a) Mk004, b) Mk001, c) R022i, d) Mr002, e) Mk005, and f) Mk003. Values to right of identified mineral names represents a score assigned by X'Pert Data Software Suite. The score ranges from 0 – 100, with 100 being a perfect match with X-ray spectra from JCPDS Reference Database.

Table 3.3: Trace metal content of powered bulk rock samples and subsamples containing goethite

Sample ID	As (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Minerals detected by XRD	Score*
R002wp_w	**663**	367	<LOD	156	Quartz	61
					Goethite	43
R003wp	**267**	123	17	62	Quartz	66
					Albite low	47
					Magnetite	36
					Goethite	22
R003wp_w	**958**	484	565	304	Quartz	70
					Goethite	30
R004i_w	**598**	510	644	100	Quartz	52
					Goethite	45
R005wp_w	**1523**	320	<LOD	163	Quartz	64
					Goethite	45
R008f	**2787**	66	50	197	Quartz	48
					Goethite	36
					Rutile	29
					Hematite	20
R008f_w	**6658**	<LOD	<LOD	377	Quartz	62
					Hematite	40
					Goethite	15
R010f	**806**	42	508	37	Hematite	67
					Quartz	43
					Goethite	34
R010f_w	**659**	<LOD	629	26	Hematite	76
					Quartz	38
					Goethite	21
R015f	**<LOD**	62	1007	276	**Goethite**	77
R015f_w	**85**	35	<LOD	135	**Goethite**	69
R017f_w2	**575**	84	<LOD	146	Quartz	69
					Hematite	30
					Goethite	25
R017f_w3	**327**	120	348	126	**Goethite**	50
					Baumite	30
R018f_w	**113**	84	40	120	**Goethite**	69
					Hematite	53
					Quartz	41
R018f_w2	**185**	98	203	163	Quartz	71
					Goethite	49
					Hematite	44
R024wp_w	**5274**	199	304	124	Hematite	61
					Quartz	50
					Albite low	28
					Goethite	22
R043wp_w	**43147**	163	437	168	Quartz	65
					Kusachiite	21
					Goethite	20
R044i_w	**10205**	323	<LOD	336	**Goethite**	38
					Quartz	27
					Albite, Ca-rich, ordered	16
Average	**4,402 ± 2,516**	**193 ± 38**	**396 ± 72**	**168 ± 24**		
Min	85	35	17	26		
Max	43,147	510	1,007	377		

*Values represent a score from 0 – 100, with 100 being a perfect match with X-ray spectra from JCPDS Reference Database

3.5 Discussion

3.5.1 Arsenic enrichment in Black Mountain SPV Ore Deposit

Unlike other trace metals detected by XRF (e.g. Pb, Cu, Sb, Zn), we found that As was consistently anomalously enriched (>1000 ppm) in the Black Mountain SPV ore deposit (Table 3.2). We detected As concentrations up to almost 300,000 ppm in samples and subsamples (n = 168) of Black Mountain SPV. Approximately 93% of samples (n = 168) exceed the average As concentration for the upper crust (4.8 ppm As, Rudnick and Gao 2003), and 94% exceed the average As concentration for igneous rocks (1.5 ppm As, Smedley and Kinniburgh 2001). Within the Black Mountain SPV ore deposit, As was often present in weathering rinds, veins, and/or along fractures.

3.5.2 Arsenic in fresh versus weathered rock

Subsampling of rocks with coherent weathering rinds and/or veins (n = 44) allowed us to compare As content in the weathered components to the As content of the fresh component of the same rock. We found that for 95.5% of such samples, the weathered portion contained more As (Fig 3.5). Further, subsamples of weathering rinds and veins typically contained greater As concentrations on average (n = 44, mean = 9,475 ± 4,941 ppm As) than subsamples of fresh rock (n = 44, mean = 538 ± 245 ppm As) (Table 3.2). This finding indicates that As in Black Mountain SPV is re-dispersed into secondary host minerals during modern water-rock interactions.

3.5.3 Arsenic host minerals

We observed evidence for several phases of primary and secondary As host minerals, including primary minerals arsenopyrite (FeAsS) and pyrite (FeS_2), which can incorporate up to 46% and 10% As (Kolker and Nordstrom 2001), respectively. Primary minerals in Black

Mountain SPV were likely altered to form several phases of secondary host minerals. In in-situ Black Mountain SPV disturbed by mining, we observed evidence for As in known secondary host minerals, like scorodite ($FeAsO_4 \cdot H_20$), natropharmacosiderite [$(Na,K)Fe_4^{3+}(AsO_4)_3(OH)_4 \cdot 6\text{-}7H_2O$], arseniosiderite ($Ca_2Fe^{3+}O_2(AsO_4)_3 \cdot 3H_2O$), and yukonite ($Ca_7Fe^{3+}(AsO_4)_{10}(OH)_{20} \cdot 15H_2O$).

3.5.4 Arsenopyrite weathering

Though scorodite is one common weathering product of arsenopyrite (Eq. 3.1, Foster et al. 1998, Savage et al. 2000, Asta et al. 2009), arsenopyrite may also weather to hydrous ferric oxides (HFO) (Eq 3.2, Majzlan et al. 2014). Subsequently, HFOs age, remobilize, and crystallize to eventually form minerals of the pharmacosiderite supergroup (Eq 3.3, Haffert et al. 2010), like natropharmacosiderite and arseniosiderite. Yukonite is relatively rare, but is often found in association with minerals of the pharmacosiderite supergroup (Majzlan et al. 2014). Minerals of this group eventually weather to become goethite (Eq 3.4, Eq 3.5, Majzlan et al. 2014). Thus, As-rich goethite is a likely end-product of the Black Mountain SPVAs mineral weathering system.

Eq 3.1: $FeAsS + 3H_2O + 3.5O_2 \rightarrow FeAsO_4{\cdot}2H_2O + SO_4^{2-} + 2H^+$

Arsenopyrite Scorodite

Eq 3.2: $FeAsS + 3H_2O + 3.5O_2 \rightarrow FeOOH + H_2AsO_4^- + SO_4^{2-} + 3H^+$

Arsenopyrite HFO

Eq 3.3: $4FeOOH + 3H_2AsO_4^- + 0.5Ba^{2+} + H_2O + 2H^+ \rightarrow Ba_{0.5}Fe_4(OH)_4(AsO_4)_3{\cdot}5H_2O$

HFO Bariopharmacosiderite

Eq 3.4: $4Ba_{0.5}Fe_4(AsO_4)_3(OH)_5{\cdot}5H_2O + 9Ca^{2+} \rightarrow 3Ca_3Fe_4(OH)_6(AsO_4)4{\cdot}3H_2O + 4Fe(OH)_3^0 + 2Ba^{2+} + 14H^+$

Bariopharmacosiderite Arseniosiderite

Eq 3.5: $Ca_3Fe_4(OH)_6(AsO_4)_4{\cdot}3H_2O + 2H^+ \rightarrow 4FeOOH(s) + 3Ca^{2+} + 4H_2AsO_4^- + H_2O$

Arseniosiderite Goethite

In Black Mountain SPV, we found that As content was highest in a powder containing arsenopyrite (297,156 ppm As), while a powder containing natropharmacosiderite, arsenosiderite, and yukonite contained 167,070 ppm As. Powders containing goethite and no other known As host minerals (other than hematite) contained As concentrations ranging from 85 ppm As to 43,147 ppm As ($n = 17$, mean = $4{,}402 \pm 2{,}516$ ppm As). Thus, we found evidence for several stages of alteration and As remobilization, and that As content is lower in later-stage minerals (Fig 3.6).

3.5.5 Sulfate replacement by arsenate

We detected 49,660 ppm As in a powder containing natrojarosite. (Natro)jarosite $[(Na)Fe_3(SO_4)_2(OH)_6]$ is an important constituent of mine wastes derived from arsenian pyrite. Previous studies (e.g. Savage et al. 2000, Asta et al. 2009) have demonstrated that arsenate (AsO_4) may replace sulfate (SO_4) within the crystalline matrix of jarosite. Other studies (e.g Foster et al. 1998, Myneni et al. 1997) demonstrate that AsO_4 can also take the place of SO_4 in other common secondary minerals, such as gypsum ($CaSO_4 \cdot 2H_2O$). Our findings of 923 ppm As in a powder containing gypsum support this hypothesis. We also detected 8,507 ppm As in a powder containing the rare mineral schauertite ($Ca_3Ge(SO_4)_2(OH)_6 \cdot 3H_2O$), further supporting our hypothesis of SO_4 replacement by AsO_4.

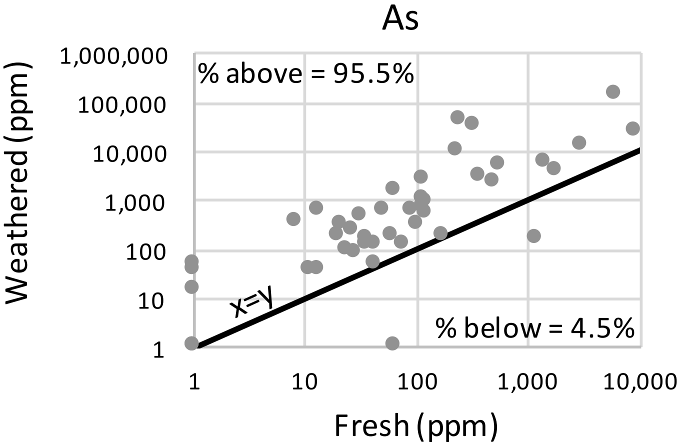

Fig 3.5: Arsenic in fresh versus weathered SPV subsamples.

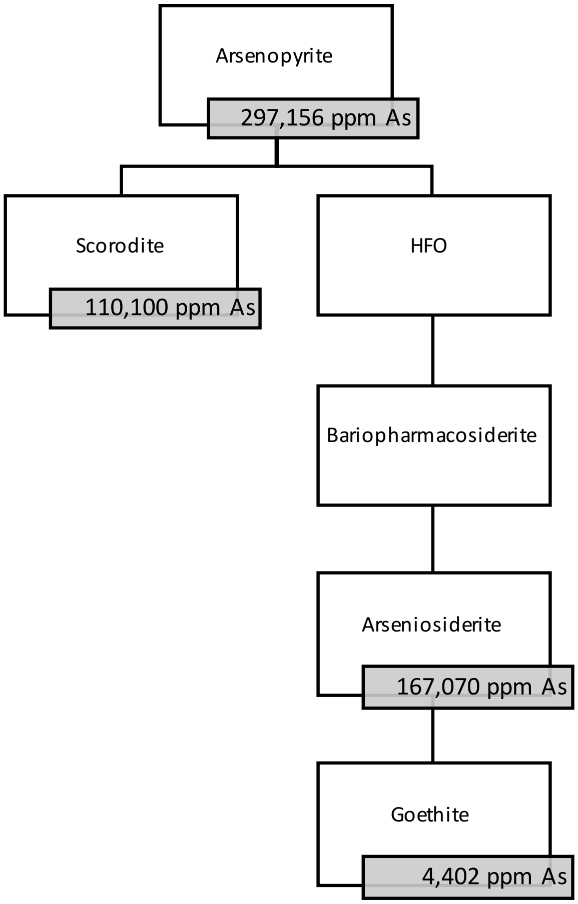

Fig 3.6: Schematic showing arsenopyrite weathering and associated As content of primary and secondary mineral phases.

3.6 Summary and conclusion

We discovered As enrichment in Black Mountain SPV (n = 168) ranging from non-detect (<2 ppm As) to nearly 300,000 ppm As (mean = 7,476 ± 2,694 ppm As). This wide range in As content indicates that As is present in several primary and secondary host mineral phases, including those we've identified as arsenopyrite, scorodite, jarosite, iron oxides, and gypsum, among other host minerals presented in this paper. Our work also demonstrates that As content is likely highest in primary host minerals and decreases with each phase of primary mineral weathering (Fig 3.7). However, As content, even in late-stage secondary host minerals, is anomalous (>1,000 ppm As). We detected greater As in weathering rinds and veins (mean = 9,475 ± 4,941 ppm) than the fresh components (mean = 538 ± 245) of the same rock (n = 44, Fig 3.6), further indicating that As is mobilized during modern water-rock interactions. Our findings suggest the potential for As to be mobilized off-site during storm events, or via groundwater flow (assuming the ore deposit extends below the water table), and indicates a need for future research investigating As transport from host rocks.

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CHAPTER 4: Summary and Conclusion

4.1 Summary

1. *What is the geology of rocks cropping out at Black Mountain Open Space Park, and over what spatial scale does rock type vary?*
    - The Santiago Peak Volcanics (SPV) outcropping at Black Mountain Open Space Park (i.e. Black Mountain SPV) are remnants of a subaerial volcanic arc that underwent syn-volcanic greenschist facies alteration
    - Given the geochemical similarities between Black Mountain SPV and Northern Santa Ana Mountain SPV (Herzig and Kimbrough 2014), the two units likely evolved within the same volcanic arc system during the Cretaceous
    - We observed welded tuffs, volcaniclastic (epiclastic) rocks, and accretionary lapilli in Black Mountain SPV, suggesting that several distinct stages of subaerial volcanic eruption occurred (Fig 2.2)
    - Lavas ranged in composition from dacite to rhyolite (Fig 2.3)
    - In areas of Black Mountain Open Space Park, rock type varies over the spatial scale of tens of meters (Fig 2.1)
2. *What is the distribution of As among SPV rock types, and how can we use this knowledge to propose a model for As cycling in the ancient volcanic arc system?*
    - We found that As content varied between the two dominant SPV rock types, with rhyolites typically containing more As (n = 10, mean = 586 ± 10 ppm As) than dacites (n = 10, mean = 14 ± 9 ppm As) (Table 2.2)

- Our findings of As enrichment in rhyolites, indicate that such enrichment may be controlled by the fractional crystallization of mafic magmas, with rocks crystallizing from more evolved melts containing greater As
- While highly soluble metals, As and Pb, were more enriched in rhyolites, Cu was equally enriched in both rhyolites and dacites (Table 2.2).
    - The high solubility of As and Pb likely caused these metals to be among the first released from subduction zone serpentinites during dehydration (Hattori and Guillot 2003), leading to their initial enrichment in partial melts underlying volcanic arc fronts
    - Because of their incompatibility in these melts, As and Pb remained dissolved as melts evolved from mafic to felsic and, thus, were eventually exhumed in rhyolitic lavas
    - Since Cu is not as soluble as As and Pb (Hack et al. 2006), Cu may have been released from serpentinites during later stages of subduction
- Based on our results and incorporating the findings of others, we propose a model to explain As enrichment in Black Mountain SPV (Fig 2.7)

3. *What are the primary and secondary As host minerals in Black Mountain SPV, and how does knowledge of host minerals inform future research investigating As mobility?*
    - Primary host minerals likely include: pyrite and arsenopyrite (Fig 3.3, Fig 3.4)
    - Secondary host minerals likely include: scorodite, jarosite, natropharmacosiderite, arseniosiderite, yukonite, iron oxides, and gypsum (Fig 3.3, Fig 3.4)

- We found that As content is highest in primary host minerals and decreases with each phase of primary mineral weathering (Fig 3.6). However, As content, even in late-stage secondary host minerals, is anomalous (>1,000 ppm As)
- We detected greater As in weathering rinds and veins (mean = 9,475 ± 4,941 ppm) than the fresh components (mean = 538 ± 245) of the same rock (n = 44, Fig 3.5), indicating that As is mobilized during modern water-rock interactions
- Our findings of As enrichment in primary and secondary host minerals suggest the potential for As to be mobilized off-site during storm events, or via groundwater interaction, and indicate a need for future research investigating As transport from host rocks

4.2 Conclusion

While the first two questions above contribute to growing knowledge of Black Mountain SPV and provenance of As in volcanic arc systems, the third question attempts to inform future research on As mobility at Black Mountain Open Space Park, given that As host minerals may exert an important and predictable control on As mobility in the natural environment (Smedley and Kinniburgh 2001). Based on the findings of this thesis, I recommend that future research conducted at Black Mountain Open Space Park address the following broad questions:

1. What is the spatial extent of geogenic As enrichment at Black Mountain Open Space Park, and what is the potential for human exposure to such As?
2. Is As being mobilized from host rocks, sediments, and soils during rain events, and does storm water transport As into communities surrounding Black Mountain Open Space Park?
3. How does geogenic As enrichment at Black Mountain Open Space Park affect plant and wildlife?

4.3 Work cited

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Smedley, P.L., D.G. Kinniburgh, 2001. A review of the source, behaviour and distribution of arsenic in natural waters. Appl. Geochem. 17: 517-668.

APPENDIX A: Sample locations

Sample ID	**Latitude**	**Longitude**
R001i	32.99292	-117.11329
R002wp	32.99331	-117.11061
R003wp	32.99331	-117.11061
R004i	32.99329	-117.11086
R005wp	32.99331	-117.11061
R006i	32.99327	-117.11083
R007wp	32.99325	-117.11084
R008f	33.03348	-117.12427
R009f	32.98861	-117.11211
R010f	33.03352	-117.12445
R011i	33.03349	-117.12428
R012f	32.992672	-117.11568
R013f	32.992672	-117.11568
R014f	33.033043	-117.12011
R015f	33.033043	-117.12011
R016f	33.03352	-117.12445
R017f	33.033043	-117.12011
R018f	33.033043	-117.12011
R019f	32.98861	-117.11211
R020i	32.98885	-117.11236
R021i	32.99295	-117.10976
R022i	32.98974	-117.11196
R023i	32.98974	-117.11196
R024wp	32.99024	-117.11132
R025i	32.993056	-117.113056
R026i	32.9925	-117.113056
R027wp	32.981389	-117.113056
R028f	32.973056	-117.120833
R029i	32.976389	-117.121111
R030f	32.976667	-117.120556
R031i	32.976111	-117.117222
R032wp	32.981389	-117.113056
R033f	32.99083333	-117.1119444
R034f	32.99111111	-117.1125
R035wp	32.99138889	-117.1130556
R036i	32.99055556	-117.1113889
R037i	32.98972222	-117.1119444
R038i	32.99000	-117.1111111

Sample ID	**Latitude**	**Longitude**
R039i	32.99	-117.1116667
R040i	32.98972222	-117.1119444
R041i	32.99	-117.1116667
R042i	32.99027778	-117.1113889
R043wp	32.99027778	-117.1113889
R044i	32.99138889	-117.1122222
R045f	32.99027778	-117.1113889
R046i	32.993611	-117.110833
R047f	32.9975	-117.115488
R048i	32.99111111	-117.1152778
R049i	32.99027778	-117.1116667
R050f	32.990421	-117.111697
R051i	32.99055556	-117.1108333
R052f	32.99055556	-117.1111111
R053i	32.99055556	-117.1111111
R054i	32.99055556	-117.1102778
R055i	32.99111111	-117.110556
R056f	32.990921	-117.11032
R057i	32.99111111	-117.11
R058i	32.99166667	-117.11
R059i	32.99166667	-117.11
R060i	32.99222222	-117.1094444
R061i	32.99277778	-117.1097222
R062i	32.99305556	-117.1097222
R063i	32.9888	-117.11278
R064i	32.991667	-117.11
R065i	32.989953	-117.11204
R066i	32.991434	-117.110306
R067i	32.989722	-117.113056
Mk001	32.98974	-117.11196
Mk002	32.98974	-117.11196
Mk003	32.98974	-117.11196
Mk004	32.98974	-117.11196
Mk005	32.98974	-117.11196
Mk006	32.98974	-117.11196
Mr001	32.98868	-117.11211
Mr002	32.98868	-117.11211
Mr003	32.98868	-117.11211
Mr004	32.98868	-117.11211
Mr005	32.98868	-117.11211
Mr006	32.98868	-117.11211

APPENDIX B: Trace metals in rhyolites and dacites (n = 20)

		As (ppm)	Cu (ppm)	Pb (ppm)	S (ppm)	Sb (ppm)	Zn (ppm)
Mr001	Rhyolite	**347**	17	12	483	0	14
Mr002	Rhyolite	**1,024**	53	33	0	0	65
R004i	Rhyolite	**109**	67	57	0	23	23.7
R020i	Rhyolite	**3155**	11	33.4	0	0	72
R021i	Rhyolite	**12.6**	12	19	0	0	43.7
R024wp	Rhyolite	**734**	42	29.5	0	0	32.4
R037i	Rhyolite	**305**	27	26	497	0	14
R044i	Rhyolite	**158**	18	15.1	0	13	57
R046i	Rhyolite	**7.2**	38	27	0	0	84
R060i	Rhyolite	**5.5**	18	28.2	0	0	52
R038i	Dacite	**24.8**	19	27	0	0	31
R039i	Dacite	**10.8**	23	11.8	0	0	89
R049i	Dacite	**5.2**	17	15.2	0	0	125
R051i	Dacite	**11**	37	14	0	0	161
R053i	Dacite	**16.6**	47	0	0	0	178
R054i	Dacite	**9**	22	6	0	0	126
R055i	Dacite	**6.3**	33	13.1	0	0	113
R058i	Dacite	**31.6**	41	10.3	0	0	121
R065i	Dacite	**15**	38	8	0	0	114
R066i	Dacite	**9**	20	14.2	0	0	85

APPENDIX C: Trace metals in all samples and subsamples (n = 168)

Sample ID	**As (ppm)**	Cu (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
R001i_Bulk	**4**	7	16	0	34
R002wp_Bulk*	**50**	27	17	0	14
R002wp_f*	**113**	279	32	80	56
R002wp_w*	**663**	367	0	143	156
R003wp_Bulk*	**267**	123	17	18	62
R003wp_f*	**121**	130	45	81	96
R003wp_w*	**958**	484	565	117	304
R004i_Bulk	**109**	67	57	23	23.7
R004i_f	**50**	71	44	98	41
R004i_w	**598**	510	644	118	100
R005wp_f	**64**	232	72	65	52
R005wp_w	**2,007**	461	523	85	170
R006i_Bulk	**17**	20	12	0	29
R006i_f	**59**	97	91	62	72
R006i_w	**185**	38	0	26	46
R007wp_Bulk*	**5**	12	23	0	49
R007wp_f*	**11**	50	76	35	97
R007wp_w*	**39**	62	48	0	166
R008f_Bulk	**2,787**	66	50	20	197
R008f_w	**6,658**	0	0	79	377
R009f_Bulk	**244**	22	10	0	34
R009f_f	**494**	200	49	46	86
R009f_w	**2,167**	46	26	22	31
R010f_Bulk	**806**	42	508	19	37
R010f_w	**659**	0	629	33	26
R011i_Bulk	**35**	0	0	0	10
R012f_Bulk	**14**	45	66	0	35
R014f_f	**8**	102	37	68	39
R014f_w	**359**	47	213	60	83
R015f_Bulk	**0**	62	1,007	42	276
R015f_f	**28**	18	44	41	110
R015f_w	**85**	35	0	0	135
R016f_Bulk	**24**	28	8	0	41
R016f_f	**114**	53	15	51	52
R016f_w	**550**	26	364	26	43
R016f_w2	**29**	34	6	0	34
R016f_w3	**396**	0	0	88	0

Sample ID	**As (ppm)**	Cu (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
R017f_ Bulk	**53**	19	8	10	12
R017f_f	**88**	0	40	166	64
R017f_w	**296**	50	18	98	68
R017f_w2	**575**	84	0	111	146
R017f_w3	**327**	120	348	27	126
R018f_f	**172**	33	38	41	149
R018f_w	**113**	84	40	0	120
R018f_w2	**185**	98	203	107	163
R019wp_f*	**274**	0	37	177	0
R019wp_w*	**1,321**	0	31	195	31
R019wp_w2*	**5,460**	0	42	212	0
R020i_Bulk	**3155**	11	33.4	0	72
R020i_f	**6,211**	31	42	93	91
R020i_w	**142,291**	0	119	98	81
R021i_Bulk	**12.6**	12	19	0	43.7
R021i_f	**0**	32	48	0	69
R021i_w	**48**	163	57	0	157
R022i_Bulk*	**175,294**	1,075	227	190	0
R022i_2*	**131,687**	937	152	124	0
R022i_pyrite*	**7,518**	678	260	30	36
R023i_Bulk*	**28,795**	891	0	110	0
R023i_2*	**32,822**	1,154	183	85	0
R023i_pyrite*	**19,777**	1,153	261	22	0
R024wp_Bulk*	**734**	42	29.5	0	32.4
R024wp_f*	**562**	50	29	151	39
R024wp_w*	**5,274**	199	304	45	124
R026i_Bulk	**3**	9	10	0	46
R027wp_f*	**116**	0	44	105	132
R027wp_w*	**1,038**	24	291	24	474
R027wp_w2*	**860**	0	0	65	516
R028f_Bulk	**9**	25	9	0	82
R029i_Bulk	**18**	26	18	0	78
R029i_f	**36**	27	0	43	133
R029i_w	**240**	37	122	0	92
R030f_Bulk	**13**	13	23	0	100
R031i_Bulk	**183**	25	8	10	45
R032wp_Bulk*	**21**	15	14	0	28
R032wp_w*	**365**	37	241	24	525
R033f_f	**42**	46	125	87	403

Sample ID	**As (ppm)**	Cu (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
R033f_w	**85**	37	16	0	214
R034f_f	**116**	38	125	67	934
R034f_w	**2,674**	95	0	70	201
R035wp_f*	**76**	96	112	106	170
R035wp_w*	**126**	42	18	0	81
R036i_f	**41**	54	16	44	155
R036i_w	**122**	29	18	0	130
R037i_Bulk	**305**	27	26	0	14
R037i_2	**4,259**	148	502	47	85
R038i_Bulk	**24.8**	19	27	0	31
R038i_f	**35**	101	34	93	117
R038i_w	**116**	10	30	0	84
R039i_Bulk	**10.8**	23	11.8	0	89
R039i_f	**13**	28	0	0	86
R039i_w	**598**	120	109	96	180
R040i_Bulk	**92**	27	0	0	56
R040i_f	**1,214**	53	0	44	203
R040i_w	**161**	45	37	0	97
R041i_f	**20**	17	0	0	97
R041i_w	**193**	34	48	84	107
R042i_f	**21**	15	7	0	97
R042i_w	**315**	63	55	36	216
R043wp_f*	**244**	10	9	0	11
R043wp_w*	**27,473**	163	437	57	168
R044i_Bulk	**158**	18	15.1	13	57
R044i_f*	**224**	64	37	186	105
R044i_w*	**10,205**	323	0	129	336
R045f_f	**31**	61	19	50	184
R045f_w	**452**	45	0	47	275
R046i_Bulk	**7.2**	38	27	0	84
R046i_f	**0**	9	12	0	30
R046i_w	**15**	0	20	184	63
R047f_f	**23**	36	0	104	173
R047f_w	**97**	23	0	36	206
R048i_f	**36**	0	32	143	45
R048i_w	**161**	44	30	81	150
R049i_Bulk	**5.2**	17	15.2	0	125
R049i_porphyry	**0**	0	35	120	29
R049i_matrix	**11**	0	22	55	210

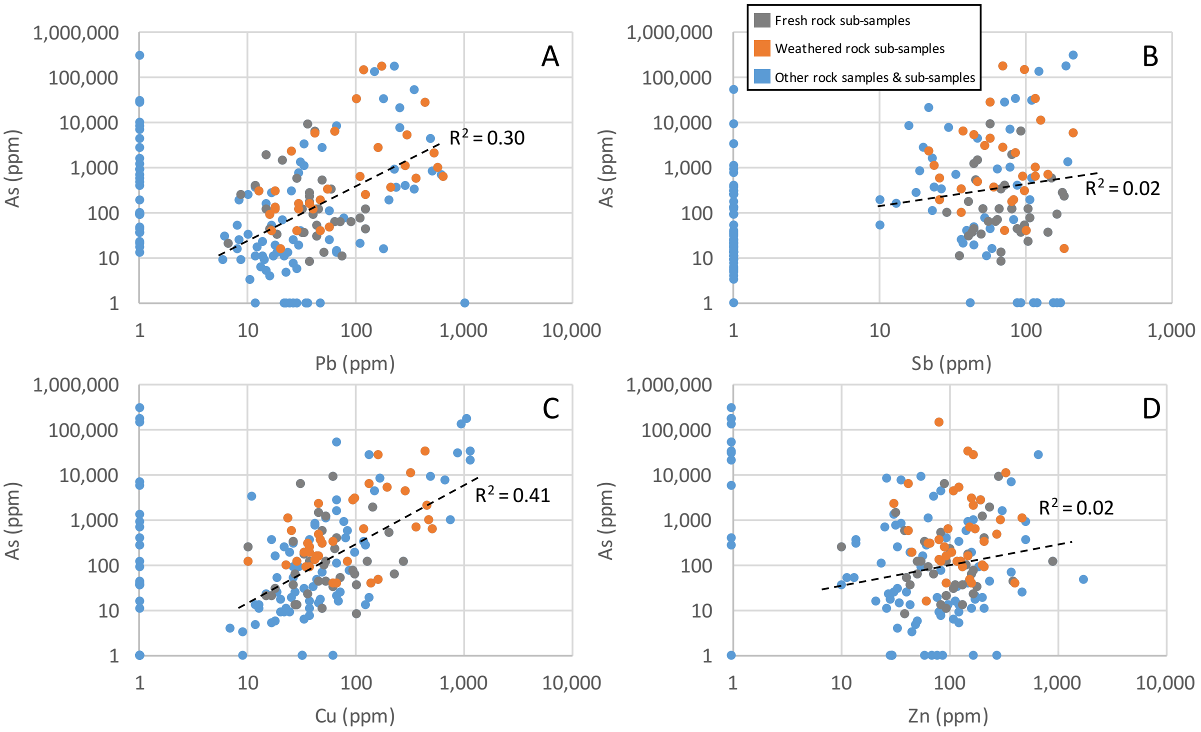
Sample ID	**As (ppm)**	Cu (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
R050f_porphyry	**71**	87	79	52	84
R050f_matrix	**41**	0	0	57	243
R051i_Bulk	**11**	37	14	0	161
R051i_f	**63**	28	65	56	166
R051i_w	**0**	32	25	88	78
R052f_f	**13**	122	66	0	124
R053i_Bulk	**16.6**	47	0	0	178
R053i_f	**19**	133	30	45	205
R054i_Bulk	**9**	22	6	0	126
R055i_Bulk	**6.3**	33	13.1	0	113
R055i_f	**13**	29	52	68	136
R055i_w	**37**	68	17	73	94
R056f_f	**335**	27	59	68	60
R056f_w	**31,235**	440	103	118	149
R057i_f	**0**	0	23	154	89
R057i_w	**0**	0	29	114	30
R058i_Bulk	**31.6**	41	10.3	0	121
R058i_f	**0**	0	27	163	61
R058i_w	**0**	0	22	173	173
R059i_f	**16**	69	185	59	21
R060i_Bulk	**5.5**	18	28.2	0	52
R060i_f	**11**	13	17	0	27
R061i_f	**0**	0	36	94	0
R061i_w	**40**	139	29	101	404
R062i_f	**20**	66	110	37	175
R063i_f	**87**	30	0	0	191
R064i_f	**25**	71	57	36	476
R065i_Bulk	**15**	38	8	0	114
R065i_f	**46**	43	0	45	1,795
R066i_Bulk	**9**	20	14.2	0	85
R066i_f	**37**	0	31	40	149
R067i_f	**69**	50	21	82	375
Mr001_Bulk	**347**	17	12	0	14
Mr001_f*	**1,397**	46	21	47	33
Mr001_w*	**6,048**	132	64	38	43
Mr001_w2*	**7,812**	169	66	16	27
Mr002_Bulk	**1,024**	53	33	0	65
Mr002_f*	**8,944**	61	36	58	289
Mr002_w*	**25,915**	132	0	73	678

Sample ID	**As (ppm)**	Cu (ppm)	Pb (ppm)	Sb (ppm)	Zn (ppm)
Mr002_w2*	**167,070**	0	173	70	0
Mr003_f*	**101**	51	0	29	146
Mr003_w*	**297**	36	13	0	65
Mr004_f*	**370**	68	12	72	215
Mr004_w*	**2,814**	99	159	52	161
Mr005*	**1,479**	67	0	23	309
Mr006_f*	**1,799**	146	15	81	238
Mr006_w*	**4,191**	287	0	57	111
Mk001*	**49,660**	67	351	0	0
Mk002*	**375**	81	291	0	97
Mk003*	**923**	78	0	0	151
Mk004*	**297,156**	0	0	211	0
Mk005*	**8,507**	489	0	0	56
Mk006*	**930**	762	231	78	169

*: sample collected from abandoned mine or waste rock pile

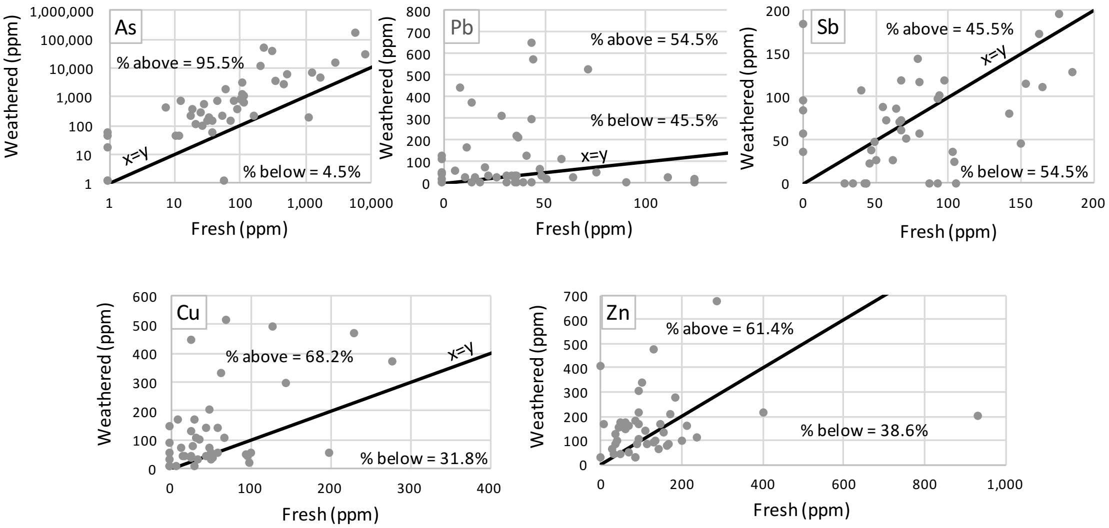
APPENDIX D: Arsenic correlation with lead (Pb), antimony (Sb), copper (Cu), and zinc (Zn)

n = 168



*R^2 value was calculated for points where both metals were detected

APPENDIX E: Trace metal content in fresh versus weathered subsamples of Black Mountain SPV (n = 44)



APPENDIX F: XRD results for all samples and subsamples (n = 168)

Sample ID	**Minerals present (XRD results)**	**Score***
R001i	Quartz	77
	Albite low	32
R002wp	Quartz	63
	Albite	49
	Orthoclase	36
R002wp_f	Quartz	74
	Albite low	35
R002wp_w	Quartz	61
	Goethite	43
R003wp	Quartz	66
	Albite low	47
	Magnetite	36
	Goethite	22
R003wp_f	Quartz	76
	Albite low	36
R003wp_w	Quartz	70
	Goethite	30
	Kusachiite	24
R004i	Quartz	54
	Albite low	42
	Magnetite	26
R004i_f	Quartz	70
	Albite	34
	Biotite	13
R004i_w	Quartz	52
	Goethite	45
R005wp_f	Quartz	72
	Albite low	35
	Biotite	21
R005wp_w	Quartz	64
	Goethite	40
	Albite low	26
R006i	Quartz	52
	Albite, ordered	49
	Roscoelite	29
R006i_f	Quartz	71
	Albite, Ca-rich, ordered	35

Sample ID	**Minerals present (XRD results)**	**Score***
R006i_w	Quartz	66
	Volkonskoite	36
	Metaschoepite	28
R007wp	Quartz	58
	Albite, Ca-rich, ordered	37
	Rectorite	26
R007wp_f	Quartz	76
	Albite low	36
	Biotite	22
R007wp_w	Quartz	70
	Kusachiite	16
	Eastonite	16
R008f	Quartz	48
	Illite	35
	Goethite	36
	Rutile	29
	Muscovite	37
	Hematite	20
R008f_w	Quartz	62
	Hematite	40
	Goethite	15
R009f	Quartz	59
	Albite, ordered	55
	Ankerite	23
	Muscovite (NH4 -rich)	27
	Vermiculite	16
R009f_f	Quartz	71
	Albite, Ca-rich, ordered	39
	Biotite	30
R009f_w	Quartz	66
	Albite, ordered	36
	Kaolinite	42
	Illite	14
	Paranatisite	14
R010f	Hematite	67
	Quartz	43
	Goethite	34
	Goldfieldite	22
	Pseudorutile	26

Sample ID	**Minerals present (XRD results)**	**Score***
R010f_w	Hematite	76
	Quartz	38
	Goethite	21
R011i	Quartz	61
R012f	Quartz	70
	Albite, Ca-rich, ordered	34
	Mica	36
	Calcite	34
	Birnessite	22
	Muscovite	19
R014f_f	Quartz	78
R014f_w	Baumite	46
	Kaolinite	40
	Quartz low	36
R015f	Goethite	77
R015f_f	Quartz	75
	Polylithionite, Fe-rich	39
	Brucite	30
	Albite, Ca-rich, ordered	14
	Gobbinsite	13
R015f_w	Goethite	69
	Spangolite	10
R015f_w_SDSUduplicate	Goethite	41
R016f	Quartz	65
	Muscovite	42
	Gobbinsite	20
	Zemannite	12
R016f_f	Quartz	73
	Muscovite	27
	Zinnwaldite	17
R016f_w	Hematite	73
	Quartz	60
R016f_w2	Quartz	71
	Muscovite	53
	Hematite	40
	Illite	41
R016f_w3	Hematite	63
	Quartz	47
	Giniite, Fe-rich	26

Sample ID	Minerals present (XRD results)	Score*
R017f	Quartz Baumite Maricite Andalusite	52 32 29 23
R017f_f	Quartz Sodalite Mica Birnessite Zinnwaldite Claudetite Kroehnkite	75 38 44 35 20 20 9
R017f_w	Quartz Sodalite Birnessite Braunite Kroehnkite	78 28 23 15 7
R017f_w2	Quartz Hematite Goethite Moissanite Maucherite subcell Baumite	69 30 25 21 25 32
R017f_w3	Goethite Baumite Periclase Muscovite (Ba-rich) Quartz	50 30 23 31 31
R018f_f	Quartz Mica Zinnwaldite Mgriite	80 20 22 14
R018f_w	Goethite Quartz Hematite Goldfieldite Enstatite ferroan	69 41 53 8 14
R018f_w2	Quartz Goethite Hematite	71 49 44

Sample ID	Minerals present (XRD results)	**Score***
R019f_f	Quartz Albite, Ca-rich, ordered Phlogopite	73 34 15
R019f_w	Quartz Fraipontite Anorthite, ordered	60 39 28
R019f_w2	Quartz Heulandite Fraipontite Magnetite Phlogopite	64 31 23 19 15
R020i_f	Quartz Albite low Moissanite Microcline intermediate	68 39 30 13
R020i_w	Quartz Scorodite Bariumpharmacosiderite Albite low	54 47 46 28
R021i_f	Quartz Albite low	75 31
R021i_w	Quartz Albite Eastonite Heterogenite deuterated	71 25 21 21
R022i	Scorodite Pyrite	59 57
R022i_2	Scorodite Pyrite	68 58
R022i_pyrite	Pyrite	67
R023i	Pyrite Melanterite	70 19
R023i_2	Pyrite Montomorillonite Scorodite Rozenite	71 33 40 40
R023i_pyrite	Pyrite	72
R023i_R022i_pyrite	Pyrite	74

Sample ID	Minerals present (XRD results)	**Score***
R024wp	Quartz Albite low Microcline intermediate Enstatite ferroan	57 53 22 26
R024wp_f	Quartz Albite low	69 45
R024wp_w	Hematite Quartz Albite low Goethite	61 50 28 22
R026i	Quartz Albite, Ca-rich, ordered Phlogopite, Fe-rich Muscovite	66 44 21 17
R027wp_f	Quartz Albite low Dolomite, Ferroan Lindackerite	68 39 23 18
R027wp_w	Quartz Westerveldite	44 29
R027wp_w2	Quartz Birnessite (K-exchanged) Cryptohalite Copper arsenate hydrate Iowaite	49 20 21 15 18
R028f	Quartz Albite low Clinochlore, Mn-rich Rutile Dickite	62 34 45 22 17
R029i	Quartz Clinochlore Albite low Muscovite	48 36 32 33
R029i_f	Quartz Clinochlore ferroan Mgriite Albite low Muscovite	66 50 53 26 15

Sample ID	**Minerals present (XRD results)**	**Score***
R029i_w	Quartz	56
	Volkonskoite	47
	Nimite	30
	Epidote	29
R030f	Quartz	69
	Albite, ordered	41
	Vermiculite	27
	Muscovite	25
	Saponite	21
R031i	Palygorskite	49
	Cuprite	47
	Quartz	37
	Pinakiolite	32
R032wp	Quartz	65
	Albite, Ca-rich, ordered	46
	Microcline intermediate	35
R032wp_w_ABA	Sodalite lithian	33
	Pharmacosiderite	29
	Cryptohalite	26
	Westerveldite	23
R033f_f	Quartz	59
	Albite, ordered	37
	Dolomite, ferroan	29
	Clinochlore, Fe- rich	30
	Epidote	26
	Phlogopite	25
R033f_w	Quartz	68
	Birnessite (K-exchanged)	19
	Ankerite	22
	Kusachiite	19
	Brucite	28
	Epidote	24
R034f_f	Quartz	70
	Albite low	37
	Microcline intermediate	16
	Ankerite	21
R034f_w	Quartz	74
	Albite low	32
	Mercury chloride	21

Sample ID	**Minerals present (XRD results)**	**Score***
R035wp_f	Quartz	69
	Albite low	34
	Ankerite	25
	Biotite, Ti- rich	18
R035wp_w	Quartz	77
	Albite low	24
	Ankerite	22
	Jordanite	9
	Mica	18
	Eastonite (mica)	14
R036i_f	Quartz	59
	Albite low	40
	Fraipontite	29
	Ankerite	27
R036i_w	Quartz	67
	Albite low	26
	Ankerite	23
	Birnessite (K-exchanged)	10
R037i	Quartz	35
	Jarosite	49
	Hydrotalcite	25
	Cerianite	32
	Sylvite	24
	Albite, disordered	14
	Gypsum	25
R038i_f	Quartz	67
	Epidote	54
R038i_w	Quartz	66
	Albite low	41
	Bemenite	24
	Spessarite	18
R039i_f	Quartz	66
	Albite, Ca-rich, ordered	38
	Clinochlore, Fe-rich	40
	Biotite	28
R039i_w	Quartz	68
	Albite, Ca-rich, Ordered	39
	Fraipontite	28
	Annite	18

Sample ID	Minerals present (XRD results)	Score*
R040i	Quartz low	74
	Albite low	23
	Giniite	26
R040i_f	Quartz	64
	Anorthite sodian	40
	Dickite	21
	Fraipontite	28
R040i_w	Quartz	72
	Fraipontite	19
	Albite low	26
R041i_f	Albite, Ca-rich, ordered	64
	Quartz	50
	Vermiculite	30
	Dickite	15
R041i_w	Quartz	74
	Albite, Ca-rich, ordered	39
	Brucite	26
	Jordanite	10
	Gobbinsite	7
R042i_f	Quartz low	69
	Albite, Ca-rich, ordered	44
	Gismondine	33
R042i_w	Quartz	76
	Albite, Ca-rich, ordered	34
	Eastonite (mica)	22
R043wp_f	Quartz	62
	Albite low	58
	Microcline intermediate	22
	Zinnwaldite	19
R043wp_w	Quartz	65
	Kusachiite	21
	Goethite	20
	Arsenopyrite	16
	Chalcocite, high	15
	Iron sulfide	11
R044i_f	Quartz	70
	Albite low	35
	Lindackerite	13

Sample ID	**Minerals present (XRD results)**	**Score***
R044i_w	Goethite	38
	Quartz	27
	Albite, Ca-rich, ordered	16
R045f_f	Quartz	65
	Albite, Ca-rich, ordered	43
	Ankerite	27
	Phlogopite, Fe-rich	28
	Fraipontite	24
R045f_w	Quartz	70
	Hematite	36
	Ankerite	30
	Albite, ca-rich, ordered	29
	Fraipontite	17
	Phlogopite, Fe-rich	11
R046i_f	Quartz	65
	Albite low	53
	Microcline, intermediate	31
	Tephorite, Ca-rich	26
	Albite	28
	Siderophyllite lithian	19
R046i_w	Quartz	70
	Albite low	33
	Microcline, intermediate	28
	Biotite	13
R047f_f	Quartz	72
	Fraipontite	41
	Anorthite sodian, intermediate	58
R047f_w	Quartz	60
	Hematite	37
	Kusachiite	16
R048i_f	Quartz	71
	Albite, Ca-rich, ordered	33
R048i_w	Quartz	69
	Albite, Ca-rich, ordered	26
	Montomorillonite	13
R049i_porphyry	Quartz	78
	Mgriite	13

Sample ID	**Minerals present (XRD results)**	**Score***
R049i_matrix	Quartz	67
	Albite low	34
	Ankerite	28
	Biotite	28
	Birnessite (K-exchanged)	21
	Epidote	37
R050f_porphyry	Quartz	72
	Albite, Ca-rich, ordered	28
	Epidote	31
	Muscovite	11
R050f_matrix	Quartz	67
	Albite, Ca-rich, ordered	39
	Birnessite (K-exchanged)	26
	Phlogopite, Fe-rich	36
R051i_f	Quartz	79
	Albite, Ca-rich, ordered	34
	Birnessite (K-exchanged)	12
R051i_w	Quartz	77
	Albite, Ca-rich, ordered	36
	Faujasite (Ce-exchanged)	26
R052f_f	Quartz	70
	Albite low	32
	Phlogopite, Fe-rich	26
	Eastonite (mica)	22
R053i_f	Quartz	73
	Albite, Ca-rich, ordered	33
	Phlogopite, Fe-rich	31
	Birnessite (K-exchanged)	17
R054i_f	Quartz	72
	Phlogopite, Fe-rich	33
	Albite, Ca-rich, ordered	27
R055i_f	Quartz	69
	Biotite	38
	Albite, Ca-rich, ordered	24
	Bearsite	13
R055i_w	Quartz	66
	Birnessite	25
	Albite low	22
	Schoepite	19

Sample ID	**Minerals present (XRD results)**	**Score***
R056f_f	Quartz	69
	Albite low	27
	Dolomite, ferroan	17
	Biotite	12
R056f_w	Quartz	53
	Kusachiite	19
	Colusite	13
	Goethite	10
	Krautite	6
	Asselbornite	12
R057i_f	Quartz	62
	Phlogopite, Fe-rich	15
	Albite, Ca-rich, ordered	16
R057i_w	Quartz	77
	Albite, Ca-rich, ordered	21
	Phlogopite, Fe-rich	19
R058i_f	Quartz	65
	Fraipontite	40
	Kusachiite	20
R058i_w	Quartz	71
	Clinochlore, Fe- rich	55
	Calcite magnesian	20
R059i_f	Quartz	75
	Albite low	24
	Biotite	15
R060i_f	Quartz	68
	Albite, Ca-rich, ordered	47
	Microperthite	34
R061i_f	Quartz	76
	Albite low	30
	Phlogopite, Fe-rich	12
R061i_w	Quartz	39
	Phlogopite	7
R062i_f	Quartz	73
	Albite low	40
	Biotite	21
R063i_f	Quartz	64
	Albite calcian low	50
	Ferropargasite	29

Sample ID	Minerals present (XRD results)	Score*
R064i_f	Moissanite	65
	Quartz	61
	Albite, ordered	44
R065i_f	Quartz	49
	Anorthite, Na-rich, intermediate	35
	Moissanite	20
	Phlogopite, Fe-rich	40
	Birnessite (K-exchanged)	16
R066i_f	Quartz	67
	Albite, Ca-rich, ordered	38
	Dolomite, ferroan	31
	Phlogopite, Fe-rich	26
R067i_f	Quartz	72
	Albite calcian low	31
	Phlogopite, Fe-rich	34
Mr001_f	Quartz	67
	Albite low	34
Mr001_w	Quartz	65
	Albite low	28
	Illite	20
	Carphosiderite	26
	Eastonite (mica)	26
Mr001_recentweathering?	Quartz	70
	Kusachiite	26
	Goethite	19
	Pharmacosiderite	11
	Cristobalite	13
Mr002_hydrothermal?	Sodiumpharmacosiderite	47
	Arseniosiderite	38
	Yukonite	31
Mr002_f	Quartz	63
	Moissanite	42
	Albite, Ca-rich, ordered	35
	Meixnerite	32
	Phlogopite, Fe-rich	24
Mr002_w	Quartz	61
	Vanuralite	25
	Albite low	20
	Jachymovite	20

Sample ID	Minerals present (XRD results)	Score*
Mr003_f	Quartz	67
	Anorthite sodian	38
	Lindackerite	15
	Cordierite (dehydrated, Ar-bearing)	9
Mr003_w	Quartz	64
	Albite calcian low	48
	Faujasite (Ag-exchanged)	26
Mr004_f	Quartz	66
	Albite low	44
	Faujasite (Ag-exchanged)	16
Mr004_w	Quartz	51
	Albite low	30
	Eastonite (mica)	24
Mr005	Quartz	44
	Fraipontite	37
	Jachymovite	19
	Faujasite (Ag-exchanged)	22
Mr006_f	Quartz	64
	Albite low	34
	Birnessite (K-exchanged)	23
	Natrojarosite	32
	Faujasite-Na	16
Mr006_w	Quartz	64
	Natrojarosite	42
	Albite low	31
	Birnessite (K-exchanged)	30
Mk001	Natrojarosite	70
Mk002	Natrojarosite	58
	Plumbojarosite	30
	Tellurium	23
	Iron sulfide	16
	Birnessite (K-exchanged)	15
Mk003	Gypsum	61
	Quartz	50
	Albite low	18
Mk004	Arsenopyrite	64
	Quartz	23
Mk005	Schaurteite	70

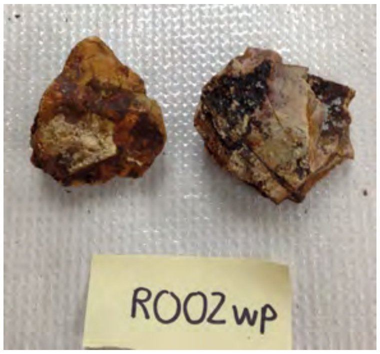
Sample ID	**Minerals present (XRD results)**	**Score***
Mk006	Gypsum	56
	Natroalunite	38
	Quartz	36
	Aluminite	29
	Uranopilite	16

* Identified minerals were assigned a score from 0 – 100 by HighScore PANalytical Software, where 100 is a perfect match with X-ray spectra from the JCPDS reference database.

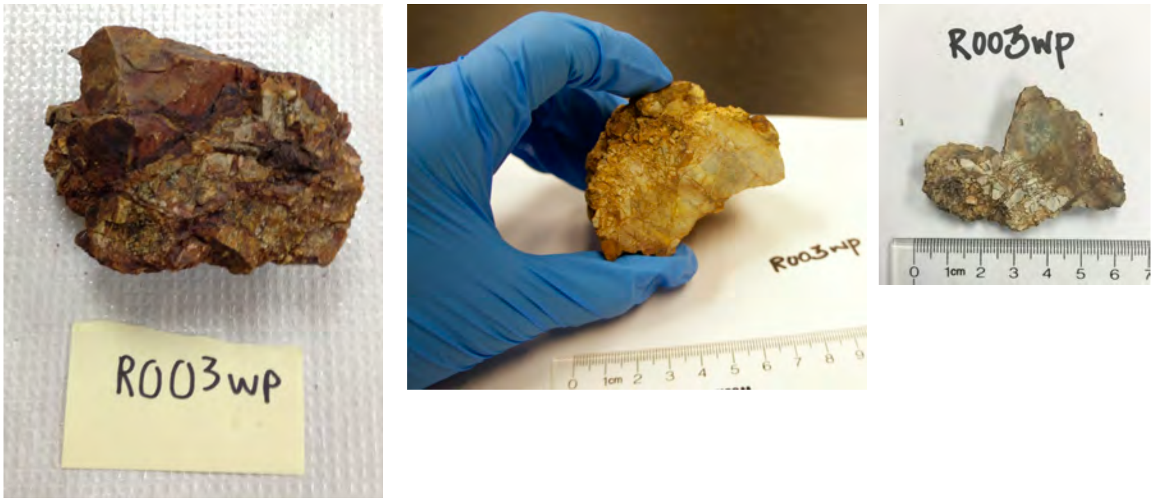
APPENDIX G: Sample photos

R001i

R002wp



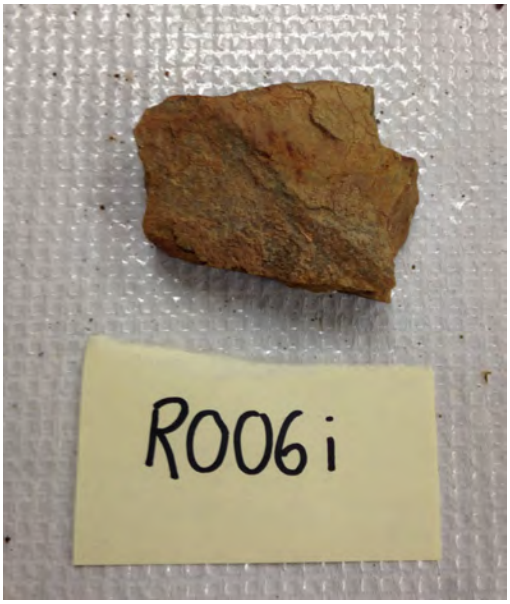
R003wp



R004i

R005wp

R006i



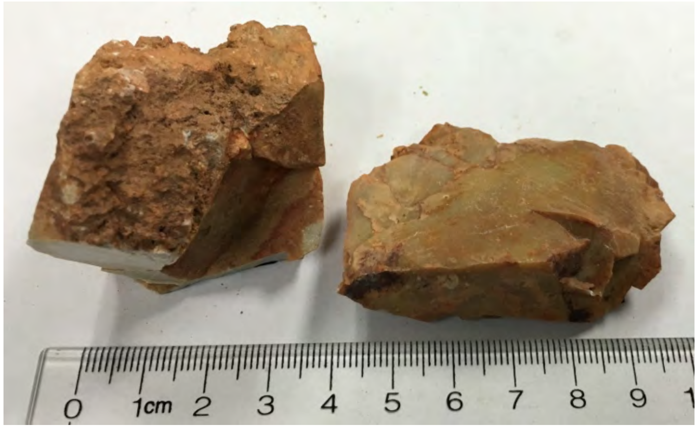
R007wp

R008f

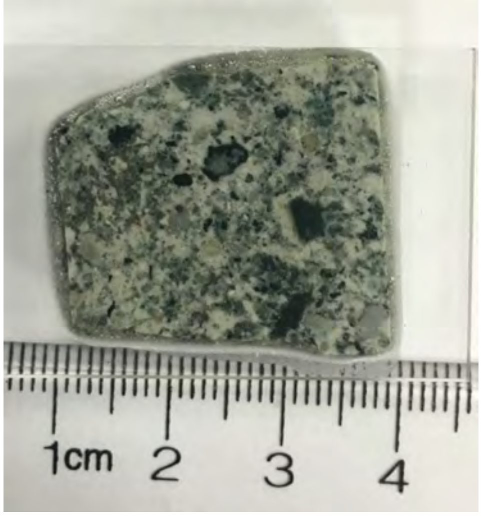
R009f

R010f

R011i

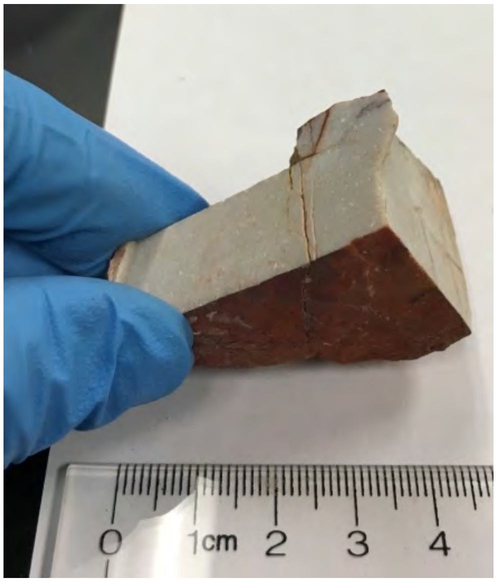


R012f



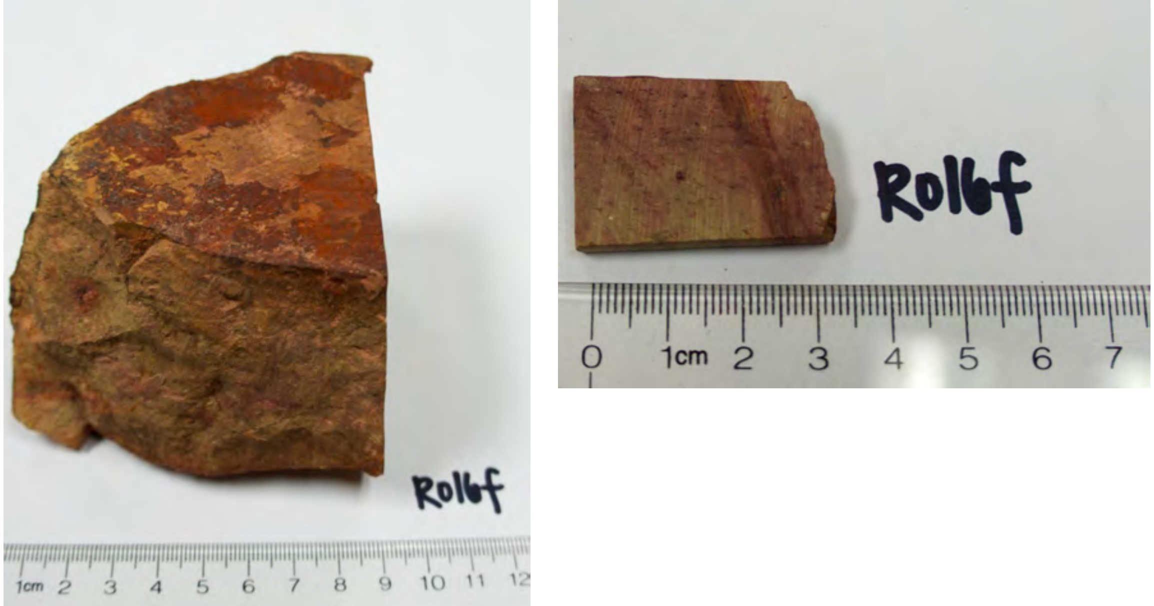
R013f

R014f



R015f

R016f

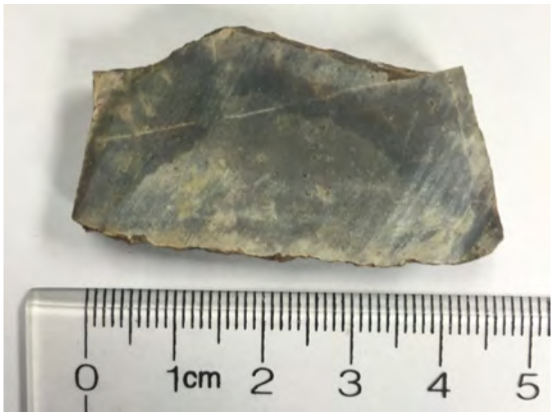


R017f

R018f

R019f

R020i

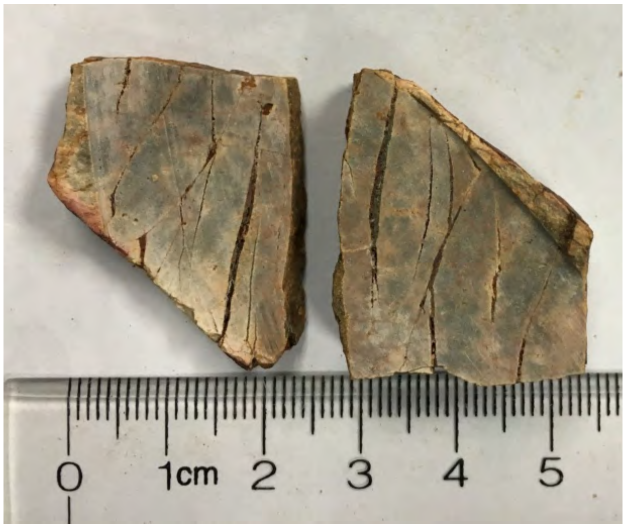


R021i

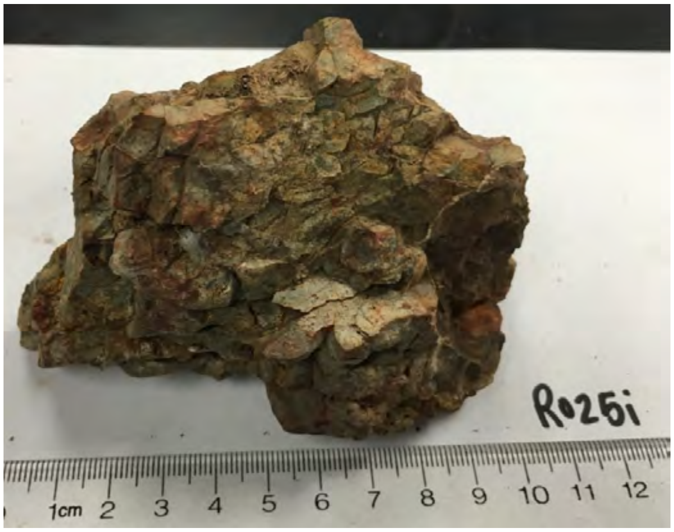
R022i

R023i

R024wp



R025i



R026i

R027wp

R028f

R029i

R030f

R031i

R032wp

R033f

R034f

R035wp

R036i


R036i
Sharpie
Permanent Marker

R037i


R037i
1cm 2 3 4


R037i
0 1cm 2 3 4 5 6 7 8
China

R038i


0
1cm
2
3
4
5
6


DATE:
CONTENTS:
R038i
11/8/15
Sharpie
POINT

R039i


0
1cm
2
3
4
5
6
7
8
9
10

R040i

R041i

R042i

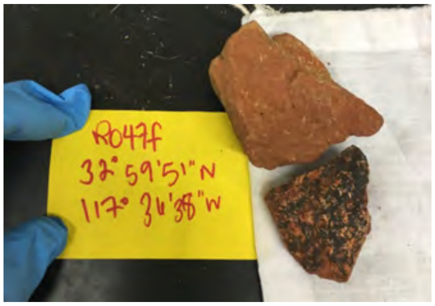
R043wp

R044i

R045f

R046i

R047f



R048i

R049i

R050f

R051i

R052f

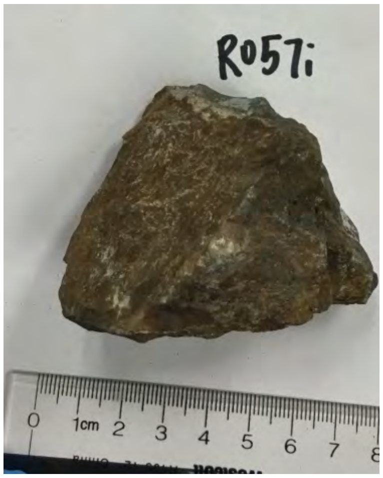
R053i

R054i

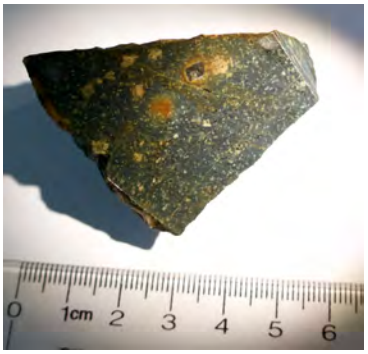
R055i

R056f

R057i



R058i



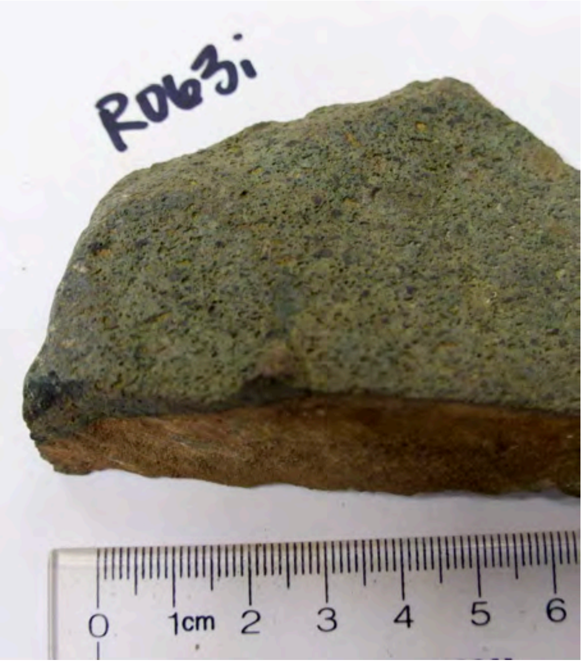
R059i

R060i

R061i

R062i

R063i



R064i

R065i


R065i
1cm 2 3 4 5 6 7 8 9 10 11 12


R065i
0 1cm 2 3 4 5

R066i


R066i
1cm 2 3 4 5 6 7 8


R066i
0 1cm 2 3 4

R067i

Mr001

Mr002


Mr002


Mr002
0 1cm 2 3 4 5 6 7 8 9


Mr002_W
Westcott
0 1cm 2 3 4 5


Mr002
0 1cm 2 3 4

Mr003


Mr003

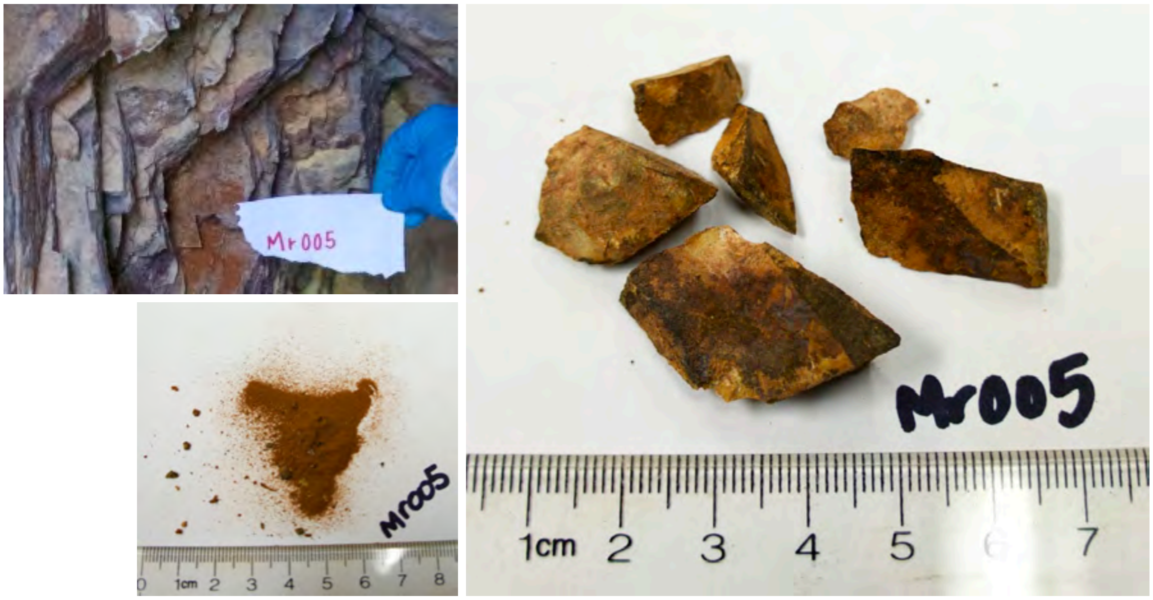

Mr003
1cm 2 3 4 5 6 7 8 9 10 11 12 13


Mr003_W
0 1cm 2 3 4 5

Mr004


Mr 004
Mr004
1cm 2 3 4 5 6 7 8 9 10 11 12 13
Mr004_W
0 1cm 2 3 4 5 6 7 8

Mr005


Mr 005
Mr005
0 1cm 2 3 4 5 6 7 8
Mr005
1cm 2 3 4 5 6 7

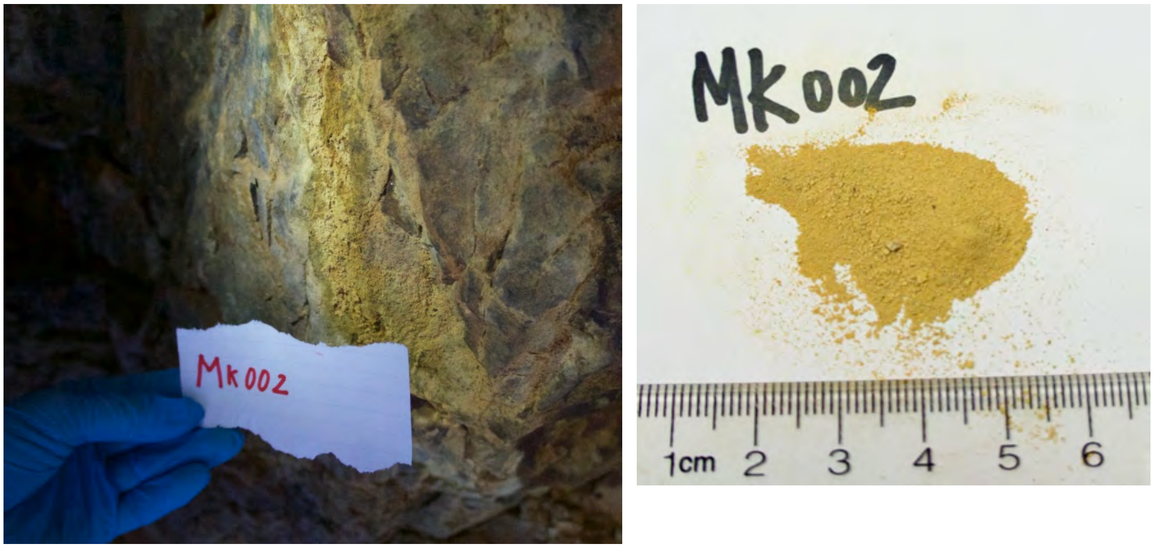
Mr006


Mr 006
Mr006
Mr006_w
1cm 2 3 4 5 6 7 8 9
1cm 2 3 4 5

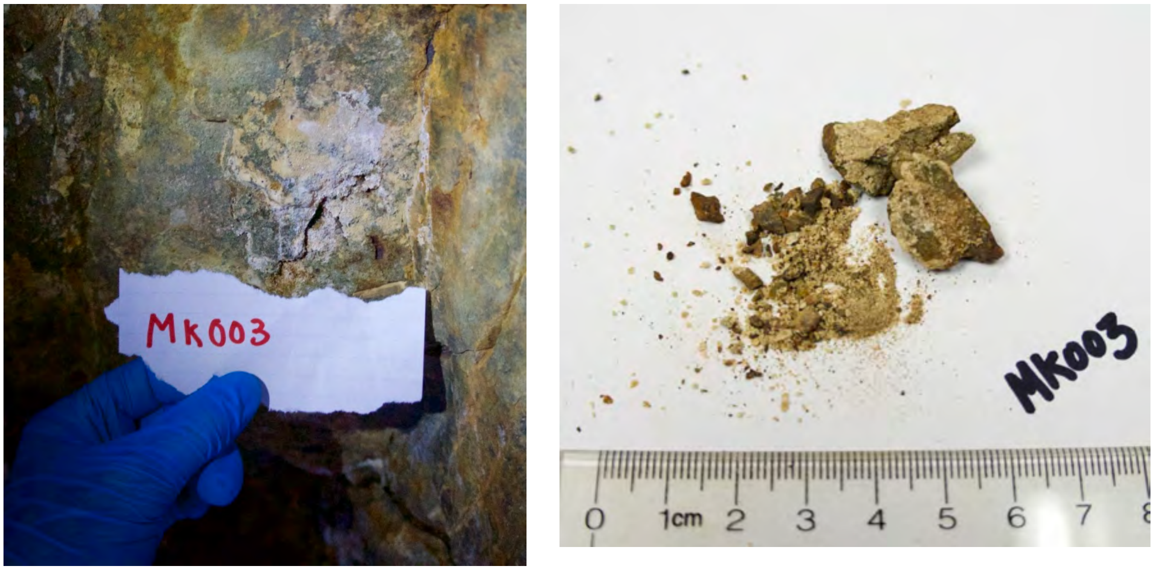
Mk001


Mk001
MK001
MK001
0 1cm 2 3 4 5 6

Mk002

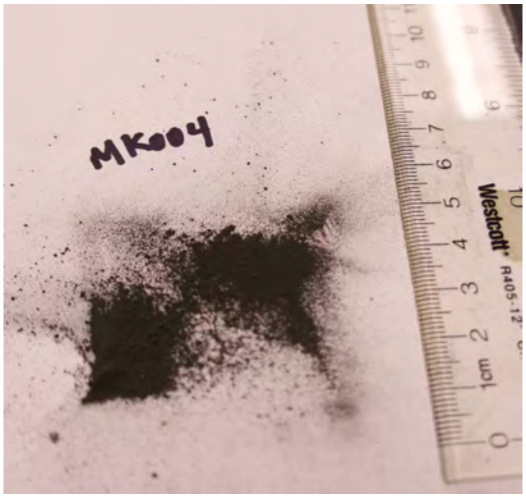


Mk003



Mk004


Mk004

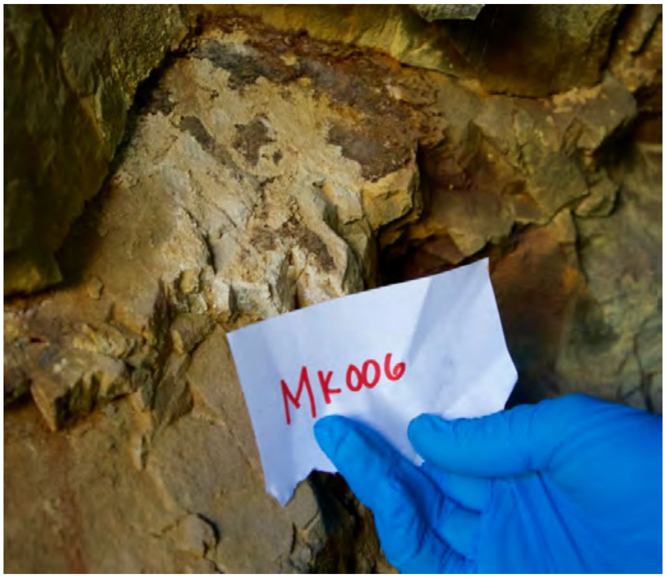

MK004
Westcott
R405-12
1cm
2
3
4
5
6
7
8
9
10

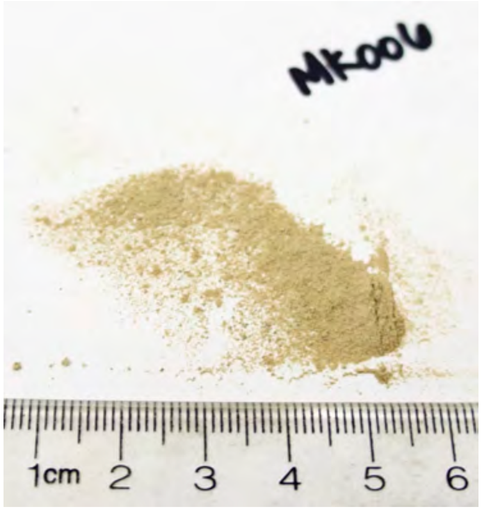
Mk005


MK005


MK005
1cm
2
3
4
5
7
8
9

Mk006





Client Name: University of San Diego	**EMA Log #: 16G0820**
Project Name: Black Mountain Arsenic Verification	

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
R022i >Microns	16G0820-01	Solid	12/15/15 12:00	07/26/16 15:05
Mr002	16G0820-02	Solid	12/15/15 12:00	07/26/16 15:05
Mk004	16G0820-03	Solid	12/15/15 12:00	07/26/16 15:05

Client Name: University of San Diego **EMA Log #: 16G0820**
Project Name: Black Mountain Arsenic Verification

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
R022i >Microns (16G0820-01) Solid Sampled: 12/15/15 12:00 Received: 07/26/16 15:05									
Arsenic	**158000**	100	mg/kg	100	6073002	07/30/16	07/31/16	EPA 6010	HT-04
Mr002 (16G0820-02) Solid Sampled: 12/15/15 12:00 Received: 07/26/16 15:05									
Arsenic	**165000**	100	mg/kg	100	6073002	07/30/16	07/31/16	EPA 6010	HT-04
Mk004 (16G0820-03) Solid Sampled: 12/15/15 12:00 Received: 07/26/16 15:05									
Arsenic	**390000**	100	mg/kg	100	6073002	07/30/16	07/31/16	EPA 6010	HT-04

Client Name: University of San Diego **EMA Log #: 16G0820**
Project Name: Black Mountain Arsenic Verification

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6073002										
Blank (6073002-BLK1)				Prepared: 07/30/16 Analyzed: 07/31/16						
Arsenic	ND	1.00	mg/kg							
LCS (6073002-BS1)				Prepared: 07/30/16 Analyzed: 07/31/16						
Arsenic	103	1.00	mg/kg	100		103	75-125			
LCS Dup (6073002-BSD1)				Prepared: 07/30/16 Analyzed: 07/31/16						
Arsenic	101	1.00	mg/kg	100		101	75-125	2	20	
Duplicate (6073002-DUP1)		**Source: 16G0771-01**		Prepared: 07/30/16 Analyzed: 07/31/16						
Arsenic	5.45	1.00	mg/kg		6.06			11	20	
Matrix Spike (6073002-MS1)		**Source: 16G0771-01**		Prepared: 07/30/16 Analyzed: 07/31/16						
Arsenic	91.6	1.00	mg/kg	92.6	6.06	92	75-125			
Matrix Spike Dup (6073002-MSD1)		**Source: 16G0771-01**		Prepared: 07/30/16 Analyzed: 07/31/16						
Arsenic	94.0	1.00	mg/kg	96.2	6.06	91	75-125	3	20	

Client Name:	University of San Diego	**EMA Log #: 16G0820**
Project Name:	Black Mountain Arsenic Verification	

Notes and Definitions

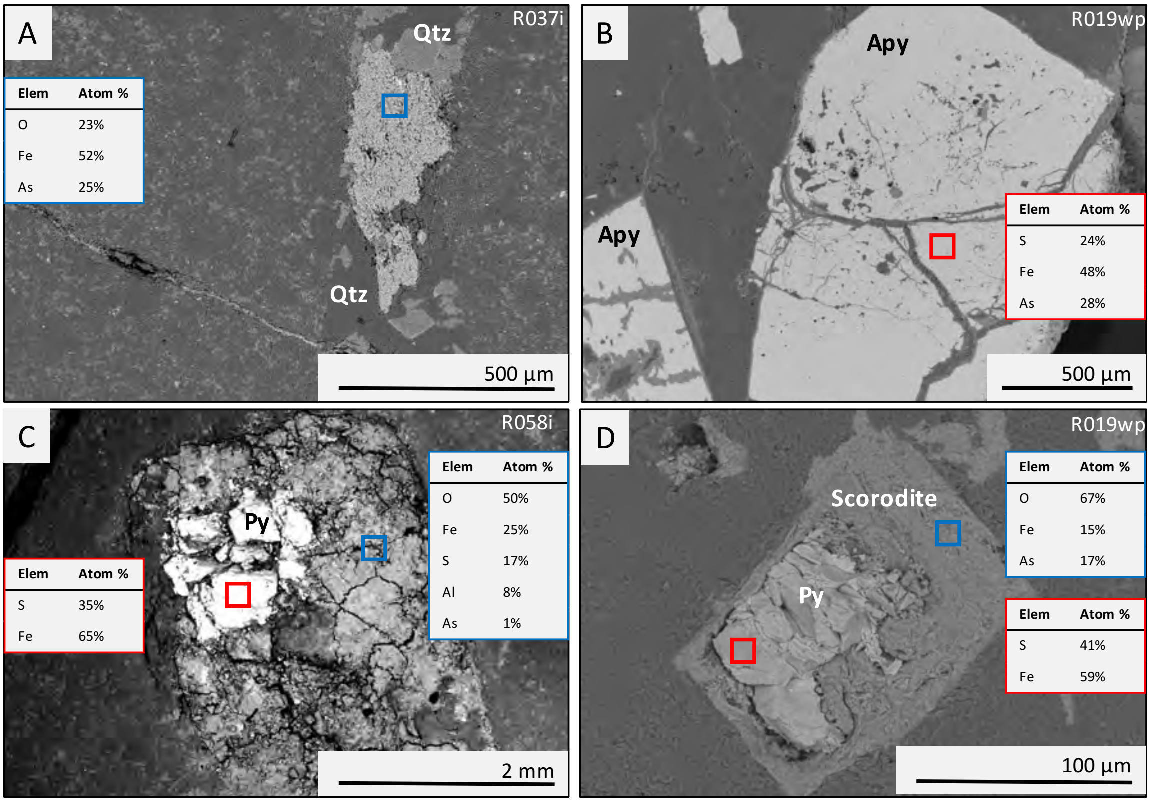
HT-04	This sample was received outside of the EPA recommended holding time for this analysis.
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

APPENDIX I: Scanning Electron Microscope (SEM)

1. *Methods*

A representative subset of whole rock samples (n = 7) were cut into billets for analysis by Scanning Electron Microscope (SEM) at the University of San Diego. Billets were first polished using 600, 800, and 1,200 grit polishing papers and gold coated for 30 seconds with a sputter coater. Energy dispersive spectrometry (EDS) at 15 keV was then used to preform surface imaging using backscattered electron (BSE) techniques, and elemental mapping was conducted using wavelength dispersive spectroscopy (WDS).

2. *Results*



A:

Elem	Atom %
O	23%
Fe	52%
As	25%

B:

Elem	Atom %
S	24%
Fe	48%
As	28%

C:

Elem	Atom %
S	35%
Fe	65%

Elem	Atom %
O	50%
Fe	25%
S	17%
Al	8%
As	1%

D:

Elem	Atom %
O	67%
Fe	15%
As	17%

Elem	Atom %
S	41%
Fe	59%

Fig 1: BSE images of a) scorodite-bearing quartz vein in an altered rhyolite (R037i), b) ~1 mm arsenopyrite crystals in rock disturbed by mining (R019wp), c) highly weathered pyrite in an altered dacite (R058i), d) pyrite with scorodite halo in rock disturbed by mining (R019wp). Blue and red squares represent areas of the sample that were point analyzed by WDS, and resulting atomic percentages are given in tables of corresponding color.

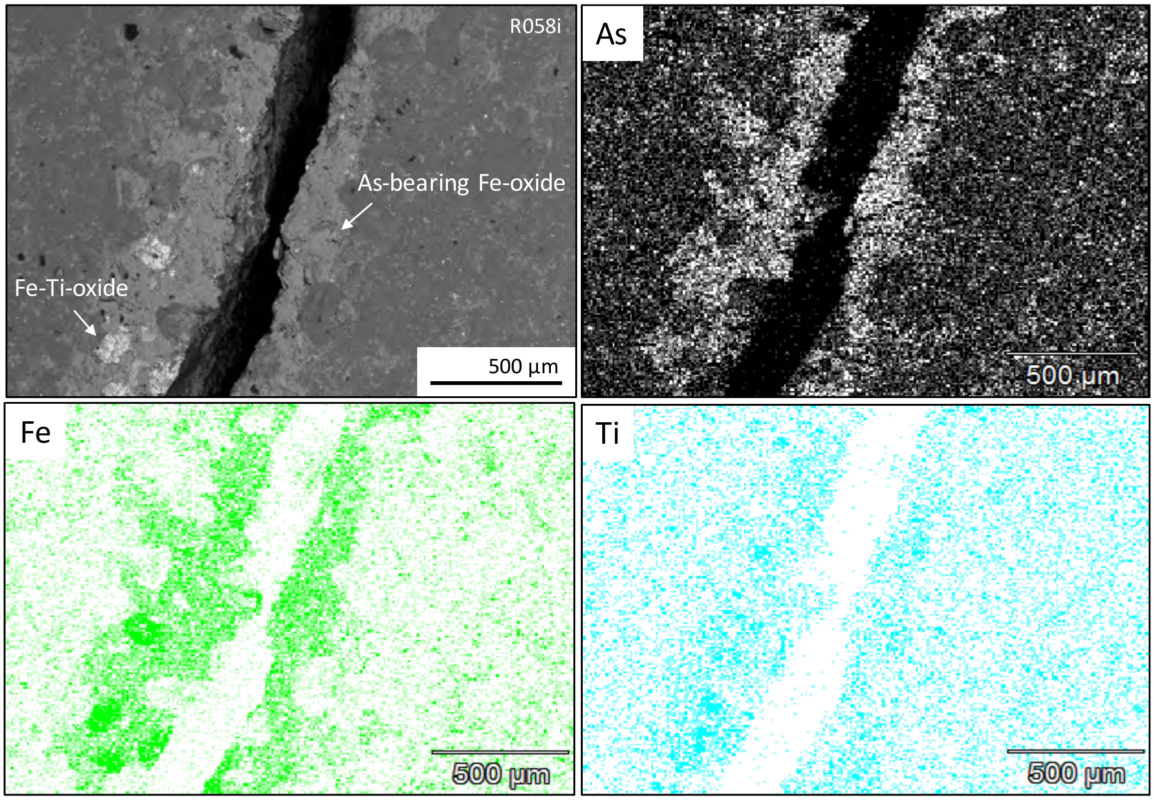


Fig 2: SEM image and elemental mapping indicate presence of As-bearing iron oxides along fractures of an altered dacite (R058i).

BLACK MOUNTAIN OPEN SPACE PARK
CULTURAL AND HISTORIC RESOURCE SURVEY

Prepared for:

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February 2007

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EXECUTIVE SUMMARY

The City of San Diego Department of Park and Recreation is preparing a Management Plan for the Black Mountain Open Space Park in Rancho Bernardo, San Diego. ASM Affiliates, Inc. was hired to complete a cultural resources survey of the 1,314-acre park to identify constraints and opportunities for future park development.

Located within the park are the remains of the Black Mountain Arsenic Mine (CA-SDI-11040H), which was in operation between 1923 and 1927. A major component of this study included detailed recording of the remaining features associated with the mine and archival research to develop a history of the mine and a cultural context for its operation. The mine site includes several adits and tailings where the ore was extracted, and a mill site where the ore was processed. A narrow gauge railway was used to transport the ore from the adits to the mill site. The mill site includes remnants of wooden buildings, remains of an ore-roasting furnace, concrete footings and foundations, concrete vats, and a poured concrete dust chamber 180 ft. in length that extends up the side of the canyon from the mill site. As a result of this study, the Black Mountain Mine Rural Historic District was recommended eligible for the National Register of Historic Resources. A National Register of Historic Places Registration Form has been prepared for submission to the Office of Historic Preservation. The Black Mountain Mine Rural Historic District is also recommended eligible for the California Register of Historic Resources and the City of San Diego Historical Site Board Register.

Prior to field survey, records searches were conducted at South Coastal Information Center and the Museum of Man. Four sites and one isolate were previously recorded within the Black Mountain Open Space Park, including two sparse lithic scatters (SDI-10547 and -10548), a prehistoric lithic quarry site (SDI-13738), the Black Mountain Arsenic Mine (SDI-11040H), and an isolate (P-37-014849). Three of these cultural resources (SDI-10547, -10548, and P-37-014849) were not relocated during the present survey. An additional five cultural resources and an isolate were recorded as a result of the present study. These include two rock cairns (SDI-18275 and -18280), a sparse shell scatter (SDI-18277), an isolated bedrock mortar (SDI-18278), the site of a prehistoric quarry (SDI-18279), and two isolated ceramic sherds (P-37-028093). Should impacts to any of these resources be anticipated as a result of park improvements, they should be formally evaluated for the California Register of Historic Resources and the City of San Diego Historical Site Board Register.

Results of the records search are provided in confidential Appendix A of this report. Department of Parks and Recreation site record forms (DPR 523 series) for each of the resources recorded by this study, including the Black Mountain Mine, are provided in Appendix B.

1. INTRODUCTION

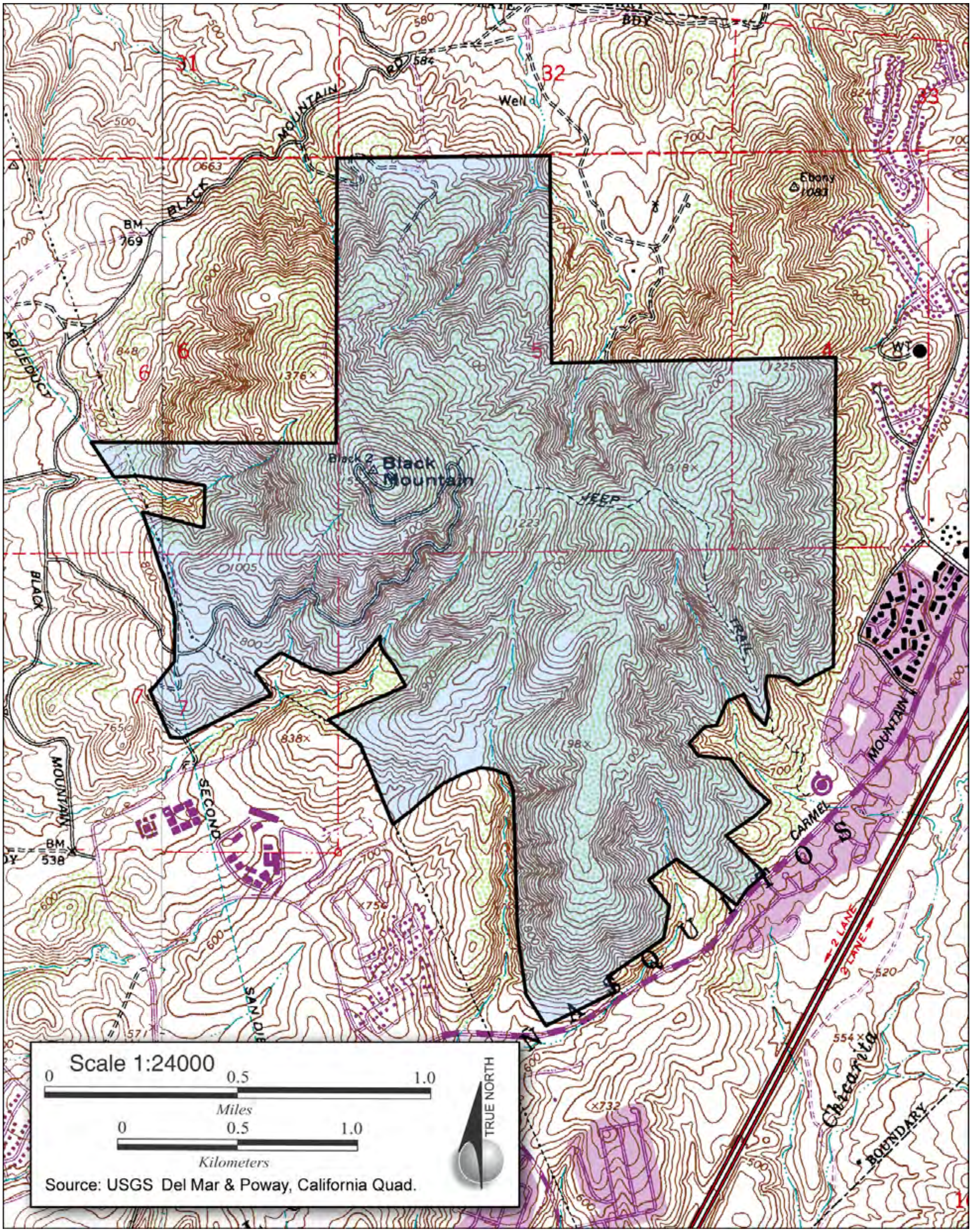
Black Mountain Open Space Park is owned and managed by the City of San Diego, and is comprised of a series of chaparral and coastal sage scrub-covered hills, ridges, and canyons. It is located in the northern portion of the Rancho Penasquitos community, situated between Black Mountain Road to the north and west, Carmel Mountain Road to the south, and Penasquitos Drive to the east (Figures 1, 2, and 3). It is a relatively undisturbed natural area which provides an important wildlife habitat. The park currently encompasses 1,314 acres, with expansion a future possibility. The centerpiece of the park is the 1,554-ft. summit of Black Mountain, which provides 360-degree views of the surrounding area.

The Park originated in 1964 when the City acquired it under the "Recreation and Public Purposes Act of 1926." Easements for San Diego Gas and Electric (SDG&E) and CWA are maintained on-site. Approximately 2 acres at the top of Black Mountain are owned by American Towers, Pacific Bell, and Time Warner. Communication towers and access for the towers are maintained on-site. A 325-acre portion of the 538-acre Montana Mirador parcel, which is located in the southern portion of the plan area, was purchased and dedicated as open space in order to mitigate biological impacts associated with the San Diego CWA ESP. The remaining 213 acres of this parcel were purchased through a Wildlife Conservation Board grant for inclusion in the Park.

Black Mountain Mine, located on the north slope of the mountain at an elevation of approximately 1,000 ft., was mined for arsenopyrite in the 1920s. Many remnants of the mining operation still exist on site. The Rancho Penasquitos Community plan recommends development of an interpretive program and interpretive facilities for the mining operations.

The day-to-day management of the Park is the responsibility of the Park and Recreation Department, operating under the authority of the City Manager. The Open Space Parks Division of the Park and Recreation Department performs tasks such as trash removal, maintenance of all physical structures (such as fences, restrooms, signs, and trails), and brush management. Additionally, this Division provides park rangers, whose primary responsibilities include enforcement of city and state regulations, overseeing small enhancement and restoration efforts, interpretive activities, and coordination of volunteers. The Park and Recreation Department also has a Natural Resource Management Section whose primary purpose is the protection and management of environmental resources within the City's natural parks and open space.

Figure 1. Project vicinity.



Source: USGS Del Mar & Poway, California Quad.

Figure 2. Project location.

Figure 3. View southwest from Black Mountain showing topography, vegetation, and encroaching suburbs.

2. ENVIRONMENTAL AND ARCHAEOLOGICAL CONTEXT

NATURAL SETTING

The following information has been summarized from the draft *Black Mountain Open Space Park Natural Resource Management Plan*, February 2004, prepared by the City of San Diego. The rich natural environment described in the following paragraphs was used by prehistoric people of the region, and provided the setting for the mining activity that came later.

Geology And Soils

The Park is located in the geological area known as the "Poway Quadrant" which consists of rock units called "Santiago Peak Volcanics." The Santiago Peak Volcanics comprise an elongate belt of mildly metamorphosed volcanic, volcaniclastic, and sedimentary rocks that crop out from the southern edge of Los Angeles Basin southward towards Mexico (California Division of Mines 1975). The Santiago Peak Volcanics are extremely erosion-resistant, hard, and form topographic highs. Where fresh, most of the volcanic rocks are dark greenish-gray in color but where weathered are grayish-red to dark reddish-brown. The soil that develops from the volcanic rocks is the color of the weathered rocks and supports growth of dense chaparral. The majority of the soils onsite are classified as San Miguel-Exchequer rocky silt loam with smaller areas supporting San Miguel, Olivenhain, Auld, and Altamont soils. San Miguel soils are derived from meta-volcanic rock that is unique because of their relatively high acidity, clay subsoil layer, and low permeability. Olivenhain, Auld, and Altamont soils are also derived from meta- volcanic parent material and typically have a prominent clay layer (Bowman 1973).

When viewed from a regional scale, Black Mountain is part of a chain of relatively high coastal peaks stretching from northern Baja California to Camp Pendleton. A number of these peaks support sensitive plant species because of unique soils or microclimates (Beauchamp 1986:241). The Park ranges in elevation from 600 ft. above mean sea level at the southern portion of the study area to 1,552 ft. at Black Mountain Peak. The topography is characterized by bands of steep ridges and canyons across the majority of the site. Most of the site is greater than 25 percent slope and much of the remainder is more than 10 percent. The Park is situated on the north slope of Black Mountain and includes Black Mountain Peak and a system of interconnected ridges and ravines, including several U.S. Geological Service blue line streams that eventually drain to Los Peñasquitos, Carmel, and Lusardi creeks. A small portion of the site at the north to northeast boundary consists of more gradually sloping hills and meadows. Surface water within the park drains into channels that lead the water off-site and eventually empty into the San Dieguito River.

Biological Resources

The Park area is comprised of a diverse assemblage of vegetation types and wildlife habitats. Chaparral, chaparral-coastal sage scrub, and coastal sage scrub are the dominant plant communities onsite. Non-native grassland and ruderal habitats are also found within the Park in areas associated with past disturbance. Small patches of native grassland (less than one acre) exist within larger stands of coastal sage scrub. One small patch of freshwater marsh exists in the northern portion of the Park.

Some hillsides include substantial populations of the native purple needle grass (*Nassella pulchra*). These native patches of grassland may provide nesting habitat for the grasshopper sparrow (*Ammodramus savannarum*). Native grasslands have been severely depleted throughout the coastal area and are often overlooked as sub-components of larger stands of non-native grasses.

A total of approximately 308 acres of Diegan coastal sage scrub habitat and approximately 252 acres of coastal sage-chaparral scrub are scattered throughout the Park. A large portion of the coastal sage scrub (100 acres) and coastal sage-chaparral (195 acres) habitat is found on the Montana Mirador section of the Park. Approximately 185 acres of this habitat is California gnatcatcher (*Polioptila californica californica*) core habitat. Dominant species include coastal sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), and lemonadeberry (*Rhus integrifolia*). The coastal sage scrub onsite contains many sensitive plant species including California adolphia (*Adolphia californica*), San Diego viguiera (*Viguiera laciniata*), and San Diego barrel cactus (*Ferocactus viridescens*).

Sensitive wildlife known to use the Diegan coastal sage scrub and chaparral-coastal sage scrub include: the coastal California gnatcatcher, and the orange-throated whiptail (*Cnemidophorus hyperythrus*). The San Diego coast horned lizard (*Phrynosoma coronatum blainvillei*) is also present in small numbers. Many bird species typical of scrub habitats in southern California occur here, such as the California towhee (*Pipilo crissalis*), California quail (*Callipepla californica*), wrentit (*Camaea fasciata*), and California thrasher (*Toxostoma redivivum*). Other animals found in this habitat include the desert cottontail (*Sylvilagus* audubonnii) and western fence lizard (*Sceloporus occidentalis*).

Southern mixed chaparral is the most common habitat type within the Park, totaling approximately 252 acres. Southern mixed chaparral is a plant community dominated by drought-tolerant tall shrubs. This habitat is typically found on north-facing slopes where drier conditions are present. This plant community is dominated by chamise (*Adenostoma fasciculatum*), toyon (*Heteromeles arbutifolia*), ceanothus (*Ceanothus* spp.), mission manzanita (*Xylococcus bicolor*), and sugar bush (*Rhus ovata*). This vegetation type is usually dense with little or no understory cover. As a slightly more common habitat, southern mixed chaparral does not support a large number of sensitive species. However, some of the same species, which inhabit the nearby scrub habitats, may also utilize chaparral habitat.

A small amount of freshwater marsh (0.47 acre) occurs in the northern portion of the Park. Freshwater marsh consists of peripheral stands of vegetation around permanent or late-drying ponds. During the drier portions of the year, the marsh vegetation in these ponds typically dies back to the tuberous root system with only short and sparse young leaves remaining green.

Several of these ponds are highly alkaline during the summer months and a thin layer of salt can often be seen crusting over drying mud in mid and late summer. Dominant plants include cattails (*Typha* spp.) and bulrush (*Scirpus* spp.). Other native plant species likely occurring include marsh fleabane (*Pluchea odorata*), toad rush (*Juncus bufonius*), and several species of sedge (*Cyperus eragrostis*, *C. odoratus*, *C. erythrorhizos*).

Small stands of non-native grassland, totaling approximately 23 acres, 17 acres of which occur within the 325-acre Montana Mirador conservation area, can also be found throughout the Park, usually in areas of disturbance. Eurasian grasses dominate these areas, generally between patches of sage scrub. The dominant non-native grasses include wild oat (*Avena barbata*), bromes (*Bromus madritensis* ssp. *rubens*, *B. hordaceous*, *B. diandrus*), foxtail fescue (*Vulpia myuros*), hare barley (*Hordeum murinum* ssp. *leporinum*), and English ryegrass (*Lolium perenne*).

A variety of wildlife (invertebrates, amphibians, reptiles, birds, and mammals) is found in the Park due to the size and diversity of habitat within the Preserve. A variety of butterfly species, such as Behr's metalmark (*Apodemia mormo virgulti*) and California ringlet (*Coenonympha californica*), are found throughout the Park. Limited habitat exists in the Park for the Hermes copper butterfly (*Lycaena hermes*). Host plant for this species is spiny redberry (*Rhamnus crocea*), which is found within limited areas of the sage scrub in the Park.

A variety of frog and toad species is known to occur in the Park area. One species, the pacific tree frog (*Hyla regilla*), was observed on-site (City of San Diego 1993:42). The bullfrog (*Rana catesbeiana*) is occasionally found throughout the Plan area, usually in lowland aquatic habitats such as streams and ponds. This species is native to Southeast Asia and Australia and was introduced into California around the turn of the century. It is one of the largest anurans in North America, and preys on native frogs and toads.

Lizard species observed on-site include the side-blotched lizard (*Uta stansburiana*) and western fence lizard (City of San Diego 1993). Previous sightings of orange-throated whiptail have been recorded on-site. The San Diego alligator lizard (*Gerrhonotus multicarinatus*), gopher snake (*Pituophis melanoleucus*), San Diego horned lizard and western rattlesnake (*Crotalus viridis*) are additional snake and lizard species expected to occur on-site.

Ample nesting and foraging habitat for many avian species exists on-site, and a wide variety of birds have been observed. Migratory birds species, such as Wilson's warbler (*Wilsonia pusilla*) and olive-sided flycatcher (*Contopus borealis*), are known to visit the Park. Anna's hummingbird (*Calypte anna*), Say's phoebe (*Sayornis saya*), common raven (*Corvus corax clarionensis*), Bewick's wren (*Thyromanes bewickii*), rock wren (*Salpinctes obsoletus*), California thrasher (*Toxostoma redivivum redivium*), lesser goldfinch (*Carduelis psaltria hesperophilus*), yellow-rumped warbler (*Dendroica coronata*), coastal California gnatcatcher (*Polioptila californica californica*), and fox sparrow (*Zonotrichia iliaca*) are among the perching bird species occupying habitat within the Park.

Several rock outcrop formations located throughout the site are embellished with “whitewash,” indicating their use as raptor perches. Birds of prey observed within the Park include red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), northern harrier, Cooper’s hawk (*Accipiter cooperii*), and turkey vulture (*Cathartes aura*). Other species not observed within the Park, but likely to use the area, are golden eagle (*Aquila chrysaetos canadensis*), red-shouldered hawk (*Buteo lineatus elegans*), and sharp-shinned hawk (*Accipiter striatus velox*). Owls and nighthawks are likely to occur within the Park; however, detection of these species is difficult because they are nocturnal. Species likely to utilize the habitat on-site include common barn owl (*Tyto alba*), great horned owl (*Bubo virginiansus*), lesser nighthawk (*Chordeiles acutipennis*), and common poorwill (*Phalaenoptilus nuttallii*).

Direct observation of mammal species is very difficult due to their shy and sometimes nocturnal habits. Evidence such as scat, tracks, burrows, and dens aid in determining presence of various animals. Abundant signs of common species, such as coyote (*Canis latrans*), woodrat (*Neotoma* spp.), mule deer (*Odocoileus hemionus*), and cottontail rabbit (*Sylvilagus auduboni*), have been observed within the Park. Signs of large predators, such as bobcat (*Lynx rufus*) and gray fox (*Urocyon cinereoargentus*), have been observed in portions of the Park (City of San Diego 1993). Habitat within the Park has a high probability of supporting a wide variety of mammals, including rodents such as California ground squirrel (*Spermophilus beecheyi*), striped skunk (*Mephitis mephitus*), and long-tailed weasel (*Mustela frenata*). The old arsenic mine site may potentially be home to a wide variety of bat species. Raccoons (*Procyon lotor*) and related species, such as the ringtail (*Bassariscus astutus*), could also occur within the Park.

CULTURAL HISTORY

Prehistory

Archaeological fieldwork along the southern California coast has yielded a diverse range of human occupation extending from the early Holocene into the Ethnohistoric period (Erlandson and Colten 1991; Jones 1992; Moratto 1984). A variety of different regional chronologies, often with overlapping terminology, have been used in coastal southern California and they vary from region to region (Moratto 1984:Figures 4.5 and 4.17). Today, the prehistory of San Diego County is generally divided into three major temporal periods: Paleoindian, Archaic, and Late Prehistoric. These time periods are characterized by patterns in material culture that are thought to represent distinct regional trends in the economic and social organization of prehistoric groups. In addition, particular scholars referring to specific areas utilize a number of cultural terms synonymously with these temporal labels: San Dieguito for Paleoindian, La Jolla for Archaic, and San Luis Rey for Late Prehistoric (Meighan 1959; Moriarty 1966; Rogers 1939, 1945; True 1966, 1970; Wallace 1978; Warren 1964).

Paleoindian Period

The antiquity of human occupation in the New World has been the subject of considerable debate over the last few decades. The currently accepted model is that humans first entered the western hemisphere between 12,000 and 15,000 B.P. While there is no firm evidence of human occupation in coastal southern California prior to 12,000 B.P., dates as early as 23,000 B.P. and even 48,000 B.P. have been reported (Bada et al. 1974; Carter 1980; Rogers 1974). The amino acid racemization technique used to date these sites has been largely discredited, however, by more recent accelerator radiocarbon dating of early human remains along the California coast (Taylor et al. 1985). Despite intense interest and a long history of research, no widely accepted evidence of human occupation of North America dating prior to 15,000 B.P. has emerged.

As in most of North America, the earliest recognized period of California prehistory is termed Paleoindian. In southern California, this period is usually considered to date from at least 10,000 B.P. until 8500 to 7200 B.P. (Moratto 1984; Warren et al. 1993), and is represented by what is known as the San Dieguito complex (Rogers 1966). Within the local classificatory system, San Dieguito assemblages are composed almost entirely of flaked stone tools, including scrapers, choppers, and large projectile points (Warren 1987; Warren et al. 1993). Until recently, the near absence of milling tools in San Dieguito sites was viewed as the major difference between Paleoindian economies and the lifeways which characterized the later Archaic period.

Based upon rather scant evidence from a small number of sites throughout San Diego County, it has been hypothesized that the people linked to the San Dieguito complex lived within a generalized hunter-gatherer society with band-level organization. This portrayal is essentially an extension to the inland and coastal areas of San Diego County of what has long been considered a continent-wide Paleoindian tradition. This immediate post-Pleistocene adaptation occurred within a climatic period of somewhat cooler and moister conditions than exists presently. The range of possible economic adaptations of San Dieguito bands to this environment are poorly understood at present, but it is typically assumed that these groups followed lifeways similar to other Paleoindian groups in North America.

This interpretation of the San Dieguito complex as the local extension of a post-Clovis big game hunting tradition is based primarily on materials from the Harris Site (Ezell 1983, 1987; Warren 1966, 1967. An unusually high percentage of large bifaces in the Harris assemblage seems indicative of a retooling station, a pattern not found at any other purported San Dieguito sites. Still, there does appear to be some evidence that large biface technology was typical of the earliest occupations of San Diego County, and that this pattern is shared by other complexes in the greater Southwest. What is less clear is how large a role these objects played in the day-to-day subsistence activities of their creators.

Archaic Period

The Archaic period (also referred to as the Early Milling Period) extends back at least 7,200 years, possibly as early as 9000 B.P. (Moratto 1984; Rogers 1966; Warren et al. 1993).

Archaic subsistence is generally considered to have differed from Paleoindian subsistence in two major ways. First, gathering activities were emphasized over hunting, with shellfish and seed collecting of particular importance. Second, milling technology, frequently employing portable ground stone slabs, was developed. The shift from a mostly maritime subsistence focus to a land-based focus is traditionally held to mark the transition from the Paleoindian period to the Archaic period. In reality, the implications of this transition are poorly understood from both an economic and cultural standpoint (see Warren et al. 1993 for an excellent review).

Early Archaic occupations in San Diego County are most apparent along the coast and the major drainage systems that extend inland from the coastal plains (Moratto 1984). Coastal Archaic sites are characterized by cobble tools, basin metates, manos, discoidals (disk-shaped grinding stones), a small number of “Pinto” and “Elko” series dart points, and flexed burials. Together these elements typify what is termed the La Jolla complex in San Diego County, which appears as the early coastal manifestation of a more diversified way of life.

For many years the common model has included something that D. L. True (1958) termed the Pauma complex, an archaeological construct based upon a number of inland Archaic period sites in northern San Diego that appeared to exhibit assemblage attributes different from coastal Archaic sites. Pauma complex sites were typically located on small saddles and hills overlooking stream drainages, and were characterized by artifact scatters of basin and slab metates, manos, some scraper planes, debitage, and occasional ground stone discoidals. Further analysis suggests that the Pauma complex is simply an inland counterpart to the coastal La Jolla complex (Cardenas and Van Wormer 1984; Gallegos 1987; True and Beemer 1982). Given that the distance between the two environments (coastal and inland) is only a few dozen kilometers, and that sites attributed to each complex appear to be contemporaneous, it seems more parsimonious to consider the differences in materials as seasonal manifestations of a mobile residence strategy using both coastal and inland resources. When similar environmental variability exists within Archaic complexes in other regions, such sites are usually considered to represent different aspects of the annual positioning strategies of a single hunter-gatherer culture complex (Bayham and Morris 1986; Sayles 1983; Sayles and Antevs 1941).

In recent years, local archaeologists have questioned the traditional definition of the Paleoindian San Dieguito complex as consisting solely of flaked lithic tools and lacking milling technology. There is speculation that differences between artifact assemblages of “San Dieguito” and “La Jolla” sites may reflect functional differences rather than temporal or cultural variability (Bull 1987; Gallegos 1987; Wade 1986). Gallegos (1987) has proposed that the San Dieguito, La Jolla, and Pauma complexes are manifestations of the same culture, that is, different site types are the result of differences in site locations and resources exploitation (Gallegos 1987:30). This hypothesis, however, has been strongly challenged by Warren and others (1993).

In short, our understanding of the interplay between human land use, social organization, and material culture for the first several millennia of San Diego prehistory is poorly developed, although some progress has been made. Recent data collection has accelerated in the areas of paleoenvironmental analysis, paleoethnobotany, faunal analysis, and lithic technology studies. More importantly, efforts are being made to re-examine the assumptions surrounding existing artifact typologies and climatic reconstructions that form the basis of the standard systematics.

Late Prehistoric Period

In his later overviews of San Diego prehistory, Malcolm Rogers (1945) hypothesized that around 2000 B.P., Yuman-speaking people from the Colorado River region began migrating into southern California. This hypothesis was based primarily on patterns of material culture in archaeological contexts and his reading of ethnolinguistics. This “Yuman invasion” is still commonly cited in the literature, but some later linguistic studies suggest that the movement may have actually been northward from Baja California.

Assemblages derived from Late Prehistoric sites in San Diego County differ in many ways from those in the Archaic tradition. The occurrence of small, pressure-flaked projectile points, the replacement of flexed inhumations with cremations, the introduction of ceramics, and an emphasis on inland plant food collection, processing, and storage (especially acorns) are only a few of the cultural patterns that were well established by the second millennium A.D. The centralized and seasonally permanent residential patterns that had begun to emerge during the Archaic period became well established in most areas. Inland semi-sedentary villages appeared along major watercourses in the foothills and in montane valleys where seasonal exploitation of acorns and piñon nuts were common, resulting in permanent milling stations on bedrock outcrops. Mortars for acorn processing increased in frequency relative to seed-grinding basins.

The Late Prehistoric period is represented in the northern part of San Diego County by the San Luis Rey complex (Meighan 1954; True et al. 1974), and by the Cuyamaca complex in the southern portion of the county (True 1970). The San Luis Rey complex is the archaeological manifestation of the Shoshonean predecessors of the ethnohistoric Luiseño, while the Cuyamaca complex reflects the material culture of the Yuman ancestors of the Kumeyaay (also known as Diegueño).

The San Luis Rey complex is typically divided into two phases: San Luis Rey I and II. San Luis Rey I is a preceramic phase dating from approximately 2000 B.P. to 500 B.P. (True et al. 1974). The material culture of this phase includes small triangular pressure flaked projectile points, manos, portable metates, *Olivella* spp. shell beads, drilled stone ornaments, and mortars and pestles. The San Luis Rey II phase differs only in the addition of ceramics and pictographs. Firm dates for the introduction of ceramics have not been satisfactorily documented, but a date between about A.D. 800 and A.D. 1300 is generally accepted. Evidence compiled by Griset (1986) indicates that the introduction and/or diffusion of ceramic technology throughout San Diego was more complex than previously thought.

According to True and others (1974), the Cuyamaca complex, while similar to the San Luis Rey complex, is differentiated by its greater frequencies of side-notched points, flaked stone tools, ceramics, and milling stone implements, a wider range of ceramic forms, a steatite industry, and cremations placed in urns. Assigning significance to these patterns should be done with caution, however, since it is obvious that seasonal camps in upland areas would reflect a different economic focus and would involve a slightly different set of trade relations than would be expected for populations on the seaboard. Thus a good deal of the variation in artifact form might be therefore attributed to functional differences or point of origin. Gross and others (1989) have suggested that these differences may not serve as indicators of cultural affiliation, and some may be due to different levels of organization. In regards to site structure, we might also expect occupational spans to differ between coastal and inland camps given the shorter summers at higher elevations.

Ethnohistoric Period

In ethnohistoric times, two main cultural groups occupied coastal San Diego County: the Shoshonean-speaking Luiseño and Juaneño in the north and the Kumeyaay or Diegueño in the south. Traditionally, Luiseño territory encompassed an area from roughly Agua Hedionda on the coast, east to Lake Henshaw, north into Riverside County, and west through San Juan Capistrano to the coast (Bean and Shipek 1978; Kroeber 1925; Rivers 1993). The region inhabited by various bands of the Kumeyaay was much larger and probably extended from Agua Hedionda lagoon eastward into the Imperial Valley and southward through much of northern Baja California (Almstedt 1982; Gifford 1931; Hedges 1975; Luomala 1978; Shipek 1982; Spier 1923).

The following short synopsis is derived from various ethnographic and historic documents and publications. More detailed culture histories for the Native American groups of the region are found in Barrows (1900), Bean (1978), Bean and Saubel (1972), Bean and Shipek (1978), Oxendine (1983), Shipek (1977), (1908), and Strong (1929), among others.

The Kumeyaay inhabited a diverse environment including marine, foothill, mountain, and desert resource zones. The Kumeyaay speak a form of the Yuman language (including the dialects Ipai and Tipai) related to the large Hokan superfamily.

There seems to have been considerable variability in the level of social organization and settlement patterns among the Kumeyaay. The Kumeyaay were organized bands containing members of non-localized patrilineal, patrilocal lineages that claimed prescribed territories, but did not own the resources except for some minor plants and eagle aeries (Luomala 1978; Spier 1923). Some of the bands occupied procurement ranges that required considerable residential mobility, such as those in the deserts (Hicks 1963). In the mountains, some of the larger bands occupied a few large residential bases that would be inhabited bi-annually, such as those inhabited in Cuyamaca in the summer and fall, and in Guatay or Descanso during the rest of the year (Almstedt 1982; Rensch 1975). According to Spier (1923), many desert and mountain Kumeyaay spent the spring to autumn in larger residential bases in the upland procurement ranges, and wintered in mixed groups in residential bases along the eastern foothills on the edge of the desert (i.e., Jacumba and Mountain Springs). This variability in settlement mobility and organization reflects the great range of environments within Kumeyaay territory. Most of Kumeyaay mythology was quite similar to the Quechan and Mojave of the Colorado River, as well as other Yuman groups in the Southwest (Gifford 1931; Hicks 1963; Luomala 1978; Spier 1923; Waterman 1910).

Acorns were the most important single food source utilized by the Kumeyaay. Kumeyaay villages were usually located near water, necessary for leaching acorn meal. Other storable resources such as mesquite or agave were equally valuable to bands inhabiting desert areas, at least during certain seasons (Hicks 1963; Shackley 1984). Seeds from grasses, manzanita, sage, sunflowers, lemonade berry, chia, and other plants were also used along with various wild greens and fruits.

Deer, small game, and birds were hunted, and fish and marine foods were eaten. Houses were arranged in the village without apparent patterns. Houses in primary villages were conical structures covered with tule bundles, having excavated floors and central hearths, while houses constructed at mountain bases generally lacked any excavation, probably due to the summer occupation. Other structures included sweathouses, ceremonial enclosures, ramadas, and acorn granaries. The material culture included ceramic cooking vessels, basketry, flaked stone tools, milling implements, arrow shaft straighteners, and bone, shell, and stone ornaments.

Hunting implements consisted of the bow and arrow, curved throwing sticks, nets, and snares. Bone and shell hooks, as well as nets, were used for fishing. Lithic resources of quartz and metavolcanics were commonly available throughout much of the Kumeyaay territory. Other raw materials such as obsidian, chert, chalcedony, and steatite occur in more localized areas. These raw materials were usually acquired through direct procurement or exchange. Projectile point types included the Cottonwood, as well as the Desert Side-notched, both commonly produced. Higher frequencies of ceramics and Desert Side-notched points in artifact assemblages at Kumeyaay sites have been documented (Gross et al. 1989; True 1966, 1970), and this may be one way to differentiate between Kumeyaay and Luiseño territory (True 1966).

Historic Period

Although the earliest historical exploration of the San Diego area can be traced to 1542 with the arrival of the first Europeans, particularly the exploration of San Miguel Bay by Juan Rodriguez Cabrillo, the widely accepted start of the historical period is 1769 with the founding of the joint Mission San Diego de Alcalá and Royal Presidio. The Hispanic period in California's history includes the Spanish Colonial (1769-1820) and Mexican Republic (1820-1846) periods. This era witnessed the transition from a society dominated by religious and military institutions consisting of missions and presidios to a civilian population residing on large ranchos or in pueblos (Chapman 1925).

The first intensive encounter of Spanish explorers and coastal villages of Native Americans was in 1769 with the establishment of Mission San Diego de Alcalá. The Mission of San Juan Capistrano was subsequently established in 1776, followed by San Luis Rey de Franciscan in 1798. The missions "recruited" the Native Americans to use as laborers and convert them to Catholicism. Local Native Americans rebelled briefly against Spanish control in 1775. Most of the individuals that participated in the attack were from Tipai settlements south of the San Diego River Valley. The Ipai to the north apparently did not participate in the rebellion, reflecting possible political affiliations at the time of the attack (Carrico 1981:Figure 2).

The effects of missionization, along with the introduction of European diseases greatly reduced the Native American population of southern California. At the time of contact, Luiseño population estimates range from 5,000 to as many as 10,000 individuals. Kumeyaay population levels were probably similar or somewhat higher. Many of the local Kumeyaay were incorporated into the Spanish sphere of influence at a very early date. Inland Luiseño groups were not heavily affected by Spanish influence until 1816, when an outpost of the mission was established 20 miles further inland at Pala (Sparkman 1908). Most villagers, however, continued to maintain many of their aboriginal customs and simply adopted the agricultural and animal husbandry practices learned from Spaniards.

By the early 1820s, California came under Mexico's rule, and in 1834 the missions were secularized. This resulted in political imbalance and Indian uprisings against the Mexican rancheros. Many of the Kumeyaay left the missions and ranchos and returned to their original village settlements (Shipek 1991). When California became a sovereign state in 1850, the Kumeyaay were heavily recruited as laborers and experienced even harsher treatment. Conflicts between Native Americans and encroaching Anglos finally led to the establishment of reservations for some villages, such as Pala and Sequan. Other Mission groups were displaced from their homes, moving to nearby towns or ranches. The reservation system interrupted the social organization and settlement patterns, yet many aspects of the original culture still persist today. Certain rituals and religious practices are maintained, and traditional games, songs, and dances continue, as well as the use of foods such as acorns, yucca and wild game.

The subsequent American period (1846 to present) witnessed the development of San Diego County in various ways. This time period includes the rather rapid dominance over *Californio* culture by Anglo-Victorian (Yankee) culture and the rise of urban centers and rural communities. A Frontier period from 1845 to 1870 saw the region's transformation from a feudal-like society to an aggressive capitalistic economy in which American entrepreneurs gained control of most large ranchos and transformed San Diego into a merchant-dominated market town. Between 1870 and 1930, urban development established the cities of San Diego, National City, and Chula Vista, while a rural society based on family-owned farms organized by rural school district communities also developed. The Army and Navy took an increased interest in the San Diego harbor between 1900 and 1940. The Army established coastal defense fortifications at Fort Rosecrans on Point Loma and the Navy developed major facilities in the bay (Fredricks 1979; Moriarty 1976; Van Wormer and Roth 1985). The 1920s brought a land boom (Robinson 1942) that stimulated development throughout the city and county, particularly in the Point Loma, Pacific Beach, and Mission Beach areas. Development stalled during the depression years of the 1930s, but World War II ushered in a period of growth based on expanding defense industries. Battery Point Loma, in operation from 1941 to 1943, played a pivotal role in the defense of Fort Rosecrans and San Diego Bay at the outbreak of World War II.

3. STUDY METHODS

Study methods for the project included archival research and pedestrian field surveys. The South Coastal Information Center (SCIC) and the San Diego Museum of Man (Museum of Man) conducted records searches for the study area on September 12, 2005 (Appendix A). The study area includes the 1,314-acre Black Mountain Open Space Park and all areas within one mile of the park boundaries. The search included a review of maps showing previously recorded archaeological and historic resources identified in the study area; a review of maps showing previous studies in the region; a search of the GeoFinder database which includes resources that are listed on the National, California, and local registers; and a review of historic maps for the project area.

ASM Associate Archaeologist Ken Moslak and Assistant Archaeologists Michelle Courtney, Adele Philippides, and Michael Garnsey conducted a pedestrian survey of most of the project area on October 11, 12, and 13, 2005. The survey consisted of transecting accessible portions of the property at approximately 15-m intervals. Areas of steep slope and very dense vegetation were subjectively selected for survey if visible bedrock outcrops appeared to be possible candidates for milling usage or rock art. When found, cultural resources were documented on California State Department of Parks and Recreation (DPR 523) forms. Resources were described and photographed. Their locations were plotted onto 7.5-minute USGS quadrangles and coordinate information was collected using Garmin 12 handheld GPS receivers.

Pedestrian survey of the north central portion of the project area, in the vicinity of the Black Mountain Arsenic Mine, was conducted the week of November 7-11, 2005. ASM Senior Architectural Historian Bill Manley directed the survey. Mr. Manley and Project Historian Steve Van Wormer of Walter Enterprises conducted reconnaissance and preliminary documentation of historic mining features. ASM Associate Archaeologist Scott Wolf and Assistant Archaeologist John Elford surveyed the remaining area in the north-central section of the project area.

Following the survey Project Historian Steve Van Wormer conducted additional historical and archival research at the San Diego Historical Society and a variety of other sources to document the history of arsenic mining in region, and the history of the Black Mountain Arsenic Mine in particular. This research assisted in completion of DPR 523 forms (Appendix B) and National Register of Historic Places Registration Forms.

NATIVE AMERICAN CONSULTATION

Pursuant to SB18, Native American consultation was initiated by ASM Affiliates on August 31, 2005. Ms. Catharine Wright of ASM wrote to the California Native American Heritage Commission (CNAHC), requesting a search of maps and files for information relating to traditional cultural properties or Native American heritage sites recorded within the project area. It was also requested that the CNAHC provide a listing of all tribal representatives who may have relevant knowledge of such locations within the project area. The CNAHC responded with a letter noting that no traditional cultural properties were recorded within the project area and provided a listing of Native American tribes or individuals who could be contacted for more information. A letter was subsequently sent to these tribes and/or individuals. Copies of Native American consultation letters are provided in Appendix C.

RECORDS SEARCH RESULTS

Results of the record searches are summarized below in Tables 1, 2, and 3. The complete results of the records search are included in Appendix A. More than 75 cultural resource studies have been conducted within one mile of the project area. Of these, 13 have intersected some portion of the project. Most previous studies were conducted in association with existing or proposed residential developments to the north and west of the park boundaries. A substantial number of studies have also been conducted in association with development of the State Route 56 transportation corridor south of the park and, to a lesser extent, with the Interstate 15 corridor east of the park.

The records search identified a total of 142 sites or cultural resources and 34 isolated occurrences within the study area. Sites identified by the records search are summarized in Table 2. Of this number, only four sites and one isolate are located inside the Park boundaries. These are discussed below and summarized in Table 3. Sites that have been formally documented and given trinomial designations by the SCIC are noted with an SDI- prefix. Sites documented with the Museum of Man are noted with a W- prefix. Many sites have both an SDI- and W- prefix, meaning both the SCIC and Museum of Man maintain records for these sites. Most, but not all, isolated artifacts are noted with an SDI-I- or W-I- prefix. Sites that have been documented but have not been assigned a trinomial are noted with a P-37- prefix.

Table 1. Previous Cultural Resource Studies Inside Black Mountain Open Space Park

Surveyor	Date / NADB Report Number	Portion of Project	Positive / Negative
Caltrans	1990 / 1126765	South	Negative
Carrillo	1980 / 1127338	West	Positive
City of San Diego	1992 / 1122772	West-central	Positive
Cupples	1974 / 1120511	West	Positive
Hector	1988	North	Positive
Kaldenberg	1975 / 1121243	West	Negative
KEA Environmental	2000 / 1123837	West	Positive
McCorkel	1994 / 1123007	Southwest	Positive
Norwood	1978 / 1221295	Northeast	Positive
Cardenas and Winterrowd	1985	Unknown	Positive
Recon	1978 / 1224947	Southwest	Positive
Recon	1979 / 1228010	Southwest	Positive
Wade	1992 / 122552	West	Negative

Table 2. Previously Recorded Resources Within One Mile of Black Mountain Open Space Park

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
W-1560	Artifact scatter	1977	Corum et al.	2,250 ft SE	Indeterminate
W-1561	Artifact scatter	1977	Corum et al.	2,500 ft SE	Indeterminate
W-1563	Lithic scatter	1977	Corum et al.	4,250 ft E	Indeterminate
W-3704	Lithic scatter	1985	Cardenas and Winterrowd	1,250 ft S	Indeterminate
W-4329 A, B	Habitation site and lithic scatter	1990	Ritz et al.	3,000 ft W	Indeterminate
W-4330	Lithic scatter	1990	Ritz and Collett	3,250 ft W	Indeterminate
W-4334	Lithic scatter	1990	Ritz and Collett	5,000 ft W	Indeterminate
W-4629	Bedrock milling	1990	Ritz	5,000 ft NW	Indeterminate
W-4630	Artifact scatter	1990	Ritz and Hanna	750 ft W	Indeterminate
W-4634	Artifact scatter	1990	Hanna	250 ft N	Indeterminate
W-5217A	Rock enclosure	1992	Pigniolo et al.	1,750 ft NW	Indeterminate
W-6515	Temporary habitation	1971	May	5,000 ft W	Indeterminate
W-6664	Lithic scatter	1993	Smith	5,000 ft N	Indeterminate
SDI-4667	Lithic scatter	1989	Gross et al.	2,500 ft NW	Indeterminate
SDI-5095/W-6524	Lithic scatter	1974	May	2,500 ft NW	Indeterminate
SDI-5105/W-1026	Mine and adobe ruins	1974	May	4,500 ft NW	Indeterminate
SDI-5107	Bedrock milling, rock wall, artifact scatter	1990	May, updated by Ritz	4,500 ft NW	Indeterminate
SDI-5110/W-187	Artifact scatter/midden	1980	Rogers, updated by May and Cardenas	3,500 ft NW	Indeterminate
SDI-5178/W-607A	Bedrock milling and lithic scatters	1978	Carrico, updated by Eckhardt	5,000 ft SE	Indeterminate
SDI-5179/W-607B	Bedrock milling with artifacts	1975	Carrico?	4,500 ft SE	Indeterminate
SDI-5180/W-607C	Bedrock milling	1978	Eckhardt	4,500 ft SE	Indeterminate
SDI-5223/W-1342	Bedrock milling with artifacts	1977	Bull	3,000 ft W	Indeterminate
SDI-5381/W-1337	Temporary habitation	1977	Norwood	3,900 ft SW	Indeterminate
SDI-5382/W-1338	Temporary habitation	1977	Norwood	2,800 ft S	Indeterminate
SDI-5383/W-1339	Temporary habitation	1984	Norwood, updated by RBR Associates	2,000 ft SW	6Y1 – determined ineligible
SDI-5384A/W-1341A	Bedrock milling with artifacts	1977	Norwood	400 ft W	Indeterminate
SDI-5386/W-1520	Lithic scatter	1977	Norwood	In project area	Indeterminate
SDI-5387/W-1521	Bedrock milling	1977	Norwood	5,000 ft W	Indeterminate
SDI-5388/W-1522	Bedrock milling	1977	Norwood	250 ft E	Indeterminate
SDI-5389A/W-1524A	Bedrock milling	1977	Norwood	Adjacent to project	Indeterminate
SDI-5389B/ W-1524B	Bedrock milling	1977	Norwood	250 ft W	Indeterminate
SDI-5390/W-1523	Bedrock milling	1999	Jones and Stokes	1,500 ft W	Indeterminate, reported destroyed
SDI-5391A/W-1340A, W-1341A	Temporary habitation	1977	Norwood	500 ft W	Indeterminate
SDI-5391B/W-1340B	Lithic scatter	1977	Norwood	3,700 ft W	Indeterminate
SDI-6068/W-1969	Lithic scatter	1978	Thesken	3,700 ft E	Indeterminate
SDI-6069/W-1970	Bedrock milling with lithic scatter	1978	Thesken	4,400 ft E	Indeterminate

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
SDI-6970/W-1971	Bedrock milling	1978	Thesken	5,300 ft E	Indeterminate
SDI-6080/W-1564	Lithic scatter and possible quarry	1978	Thesken	4,500 ft E	Indeterminate
SDI-6081/W-1562A	Lithic scatter	1978	Thesken	2,500 ft E	Indeterminate
SDI-6082/W-1562b	Lithic scatter	1978	Thesken	3,000 ft E	Indeterminate
SDI-6086/W-462	Bedrock milling with lithic scatter	1978	Thesken	3,000 ft E	Indeterminate
SDI-6087/W-463	Lithic scatter	1978	Thesken	5,200 ft E	Indeterminate
SDI-6668/W-1859	Artifact scatter	1981	Corum and Carrillo	3,700 ft E	Indeterminate
SDI-6669/W-1858, W-230	Temporary habitation	1978	Walker	4,000 ft E	Indeterminate
SDI-6672/W-2929	Lithic scatter	1974	May	Adjacent to project	Indeterminate
SDI-6673/W-2794	Artifact scatter	1980	May, updated by Walker	3,400 ft W	Indeterminate, reported as destroyed by Walker
SDI-6674/W-2793	Artifact scatter	1980	Walker and Cardenas	3,500 ft W	Indeterminate
SDI-6675	Temporary habitation	1974	May	4,600 ft W	Indeterminate
SDI-6677/W-2790	Temporary habitation	1974	May	2,600 ft W	Indeterminate
SDI-6682/W-2791	Bedrock milling	1980	Cardenas	4,800 ft W	Indeterminate
SDI-6837	Artifact scatter	1981	Corum	3,000 ft S	Indeterminate
SDI-6838	Lithic scatter	1981	Corum	3,000 SE	Indeterminate
SDI-6839	Lithic scatter	1977	Corum et al.	4,300 ft E	Indeterminate
SDI-8719/W-2982	Bedrock milling	1981	Corum	2,750 ft E	Indeterminate
SDI-9286/W-2322	Bedrock milling	1982	Bull, Hector	1,100 ft W	Indeterminate
SDI-10549	Lithic scatter	1986	Cardenas	1,500 ft S	Indeterminate
SDI-10822/W-3882	Temporary habitation	1987	Smith	3,100 ft W	Indeterminate
SDI-11039/W-4004	Artifact scatter, possible rock feature	1988	Smith	Adjacent to project	Indeterminate
SDI-11473	Lithic scatter	1989	Robbins Wade	2,800 ft W	Indeterminate
SDI-11510/W-3380	Bedrock with artifacts and midden	1995	Smith	4,000 ft NE	Indeterminate
SDI-11738	Bedrock milling	1990	Ritz and Collett	4,200 ft W	Indeterminate
SDI-11742	Habitation site	1990	Ritz and Collett	3,900 ft W	Indeterminate
SDI-11743	Lithic scatter	1990	Ritz and Collett	2,700 ft W	Indeterminate
SDI-11747	Lithic scatter	1990	Ritz and Collett	4,900 ft NW	Indeterminate
SDI-11978/W-4626	Artifact scatter with midden	1990	Ritz and Hanna	2,000 ft NW	Indeterminate
SDI-11979/W-4627	Artifact scatter	1990	Ritz and Hanna	2,000 ft NW	Indeterminate
SDI-11980/W-4628	Artifact scatter	1990	Ritz	3,100 ft NW	Indeterminate
SDI-11981	Artifact scatter	1990	Ritz and Hanna	500 ft W	Indeterminate
SDI-11985	Artifact scatter	1990	Hanna	Adjacent to project	Indeterminate
SDI-12744/W-6881A	Temporary habitation and quarry	1995	Smith	4,500 ft NW	Indeterminate
SDI-12748/W-6668	Temporary habitation and quarry	1992	Smith	3,000 ft NW	Indeterminate
SDI-12749/W-6937B	Artifact scatter	1992	Smith	3,600ft NW	Indeterminate
SDI-12750/W-6881B	Quarry	1992	Smith	4,800 ft NW	Indeterminate
SDI-12751/W-6958	Artifact scatter	1992	Smith	2,300 ft N	Indeterminate
SDI-12752/W-6965	Artifact scatter	1992	Smith	5,200 ft NE	Indeterminate
SDI-12753/W-6967	Artifact scatter	1992	Smith	2,600 ft NE	Indeterminate
SDI-12754/W-6969	Artifact scatter	1992	Smith	4,500 ft NE	Indeterminate

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
SDI-12755/W-6994B	Artifact scatter	1992	Smith	3,300 ft NE	Indeterminate
SDI-12756/W-6997A	Habitation site	1992	Smith	3,500 ft NW	Indeterminate
SDI-12758H/W-6998B	Water conveyance system	1992	Smith	2,800 ft N	Indeterminate
SDI-12931/H/W-2790	Prehistoric habitation with historic trash scatter	1992	Pigniolo et al.	3,000 ft W	Indeterminate
SDI-12932/H	Historic rock feature	1992	Pigniolo et al.	1,700 ft NW	Indeterminate
SDI-12933/H	Prehistoric and historic artifact scatter	1992	Pigniolo et al.	1,700 ft NW	Indeterminate
SDI-12975H/W-3880	Historic dam	1992	Smith	5,000 ft NE	Indeterminate
SDI-12976H/W-6992	Historic dam	1995	Smith	3,400 ft N	Indeterminate
SDI-12977H/W-6997B	Bridge	1992	Smith	3,600 ft NW	Indeterminate
SDI-13213H/W-6966	Historic reservoir	1993	Smith	5,000 ft NE	Indeterminate
SDI-13214H/W-7018	Well/cistern	1995	Smith	3,700 ft N	Indeterminate
SDI-13215H/W-6968	Well/cistern	1993	Smith	3,000 ft N	Indeterminate
SDI-13216H/W-6998C	Well/cistern	1995	Smith	2,700 ft N	Indeterminate
SDI-13250/W-7013	Bedrock milling with artifacts	1993	Smith	3,500 ft NW	Indeterminate
SDI-13251/W-6959	Artifact scatter	1993	Smith	2,900 ft NW	Indeterminate
SDI-13252/W-7012	Artifact scatter	1993	Smith	3,250 ft NW	Indeterminate
SDI-13253/W-6937A	Artifact scatter	1993	Smith	3,700 ft NW	Indeterminate
SDI-13254/W-6997C	Temporary habitation	1995	Smith	3,500 ft NW	Indeterminate
SDI-13255/W-7014	Temporary habitation	1995	Smith	3,350 ft NW	Indeterminate
SDI-13256/W-6991	Artifact scatter	1995	Smith	2,800 ft NW	Indeterminate
SDI-13257/W-7016	Lithic scatter	1995	Smith	2,9000 ft N	Indeterminate
SDI-13258/W-7015A	Artifact scatter	1995	Smith	2,650 ft NW	Indeterminate
SDI-13259/W-7017	Artifact scatter	1995	Smith	3,000 ft N	Indeterminate
SDI-13260/W-6998A	Temporary habitation	1992	Smith	3,000 ft N	Indeterminate
SDI-13261/W-6990	Bedrock milling	1995	Smith	4,500 ft NW	Indeterminate
SDI-13262/W-6960	Temporary habitation	1995	Smith	2,250 ft N	Indeterminate
SDI-13263/W-6961	Artifact scatter	1995	Smith	2,500 ft N	Indeterminate
SDI-13264/W-6962	Artifact scatter	1995	Smith	2,000 ft N	Indeterminate
SDI-13265/W-6964	Artifact scatter	1995	Smith	2,100 ft N	Indeterminate
SDI-13266/W-6963	Artifact scatter	1995	Smith	2,500 ft NE	Indeterminate
SDI-13267	Artifact scatter	1995	Smith	>4,000 ft N	Indeterminate
SDI-13268/W-6994C	Artifact scatter	1995	Smith	3,500 ft N	Indeterminate
SDI-13269/W-6995	Artifact scatter	1995	Smith	2,700 ft N	Indeterminate
SDI-13271/W-6971	Lithic scatter	1993	Smith	4,500 ft NE	Indeterminate
SDI-13270/W-6970	Artifact scatter	1993	Smith	4,000 ft NE	Indeterminate
SDI-13273/W-6994A	Artifact scatter	1995	Smith	3,600 ft N	Indeterminate
SDI-13274/W-6869	Lithic scatter	1995	Smith	4,700 ft N	Indeterminate
SDI-13275/W-6871	Lithic scatter	1995	Smith	4,800 ft NE	Indeterminate
SDI-13278/W-6872	Artifact scatter	1993	Smith	4,600 ft NE	Indeterminate
SDI-13279	Lithic scatter	1993	Smith	4,700 ft NE	Indeterminate
SDI-13280/W-7026	Lithic scatter	1993	Smith	4,900 ft NE	Indeterminate
SDI-13281/W-7020	Artifact scatter	1993	Smith	1,750 ft N	Indeterminate
SDI-13282/W-6696	Bedrock milling and artifact scatter	1993	Smith	3,750 ft N	Indeterminate
SDI-13285/W-6996	Bedrock milling and artifact scatter	1993	Smith	3,700 ft N	Indeterminate
SDI-13283/W-6989	Artifact scatter	1993	Smith	4,000 ft N	Indeterminate
SDI-13284/W-7019	Artifact scatter	1995	Smith	4,250 ft N	Indeterminate
SDI-13285/W-7015B	Artifact scatter	1995	Smith	2,650 ft N	Indeterminate
SDI-13286/W-6999	Artifact scatter	1995	Smith	3,500 ft N	Indeterminate
SDI-13287/W-7000	Artifact scatter	1995	Smith	5,000 ft NE	Indeterminate
SDI-13288/W-7021A	Artifact scatter	1995	Smith	4,550 ft N	Indeterminate
SDI-13289/W-7010	Artifact scatter	1995	Smith	4,900 ft NW	Indeterminate

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
SDI-13290/W-6881C	Artifact scatter	1995	Smith	4,700 ft NW	Indeterminate
SDI-13291	Artifact scatter	1995	Smith	>4,000 ft N	Indeterminate
SDI-13292/W-7021B	Artifact scatter	1993	Smith	>4,500 ft N	Indeterminate
SDI-13298/W-7022	Artifact scatter	1993	Smith	>4,500 ft N	Indeterminate
SDI-13300	Artifact scatter	1995	Smith	>4,000 ft N	Indeterminate
SDI-13299/W-7023	Artifact scatter	1995	Smith	>4,500 ft N	Indeterminate
SDI-13300/W-7024	Artifact scatter	1995	Smith	>4,500 ft N	Indeterminate
SDI-13301/W-7025	Temporary habitation	1985	Smith	>4,500 ft N	Indeterminate
SDI-16400	Lithic scatter	2002	Smith	4,000 ft NE	Indeterminate
W-1341B	Isolated core tool	1977	Norwood	500 ft W	N/A
W-3705	One isolated flake	1985	Cardenas and Winterrowd	1,250 ft S	N/A
W-3744	One isolated hand stone	1985	Peter and Mitchell	3,250 ft W	N/A
W-4620	Two isolated flakes	1990	Ritz	1,000 ft NW	N/A
W-4621	One isolated flake	1990	Ritz	1,750 ft NW	N/A
W-4622	One flake and two core fragments	1990	Hanna	1,000 ft E	N/A
W-4624	Two isolated flakes	1990	Hanna	3,250 ft NE	N/A
W-5217B	Isolated core	1992	Pigniolo et al.	1,750 ft NW	N/A
W-6352	Isolated core	1994	James and Pigniolo	2,000 ft W	N/A
W-6663	Isolated flake and isolated scraper	1995	Smith	5,000 ft N	N/A
W-6866	Isolated mano	1995	Smith	4,000 ft N	N/A
W-6870	Isolated scraper	1995	Smith	3,750 ft NE	N/A
SDI-5094	Two isolated flakes	1980	Walker	2,000 ft NW	N/A
SDI-5384B/W-1341B	Isolate core tool	1977	Norwood	400 ft W	N/A
P-37-013867/W-I-19	Isolated core	1994	Pigniolo	4,200 ft W	N/A
P-37-014194	Isolated mano	1995	Smith	2,900 ft NW	N/A
P-37-014195	Isolated mano	1995	Smith	3,600 ft NE	N/A
P-37-014196	Isolated mano	1995	Smith	3,800 ft N	N/A
P-37-014197	Isolated flake	1995	Smith	4,400 ft NE	N/A
P-37-014199	Isolated flake	1995	Smith	5,000 ft N	N/A
P-37-014200	Isolated flake	1995	Smith	5,3000 ft N	N/A
P-37-014755/SDI-I-57	Isolated flake	1984	RBR & Associates	1,500 ft SW	N/A
P-37-014756/SDI-I-58	Isolated scraper	1984	RBR & Associates	3,500 ft SW	N/A
P-37-014757/SDI-I-59	Isolated flake	1984	RBR & Associates	2,900 ft SW	N/A
P-37-014850/SDI-I-152	Isolated flake	1986	RBR & Associates	1,000 ft SW	N/A
P-37-014199/SDI-I-301	Two isolated flakes	1990	Ritz	>4,500 ft N	N/A
P-37-015000/SDI-I-302	Isolated flake	1990	Ritz	1,800 ft W	N/A
P-37-015001/SDI-I-303	One flake and two core fragments	1990	Ritz	1,000 ft E	N/A
P-37-015003/SDI-I-305	Two isolated flakes	1990	Hanna	2,500 ft E	N/A
P-37-15218	Isolated core	1995	Pigniolo et al.	4,400 ft W	N/A
P-37-016575	Isolated historic glass fragment	1999	Wahoff	2,200 ft N	N/A
P-37-016576	Isolated historic glass fragment	1999	Wahoff	2,300 ft W	N/A
P-37-016577	Isolated historic glass fragment	1998	Wahoff	3,000 ft W	N/A

Table 3. Previously Recorded Resources Within Black Mountain Open Space Park

Site Number	Site Type	Year of Latest Record	Recorder	Current Survey Results	National Register Status / Notes
SDI-10547/W-3702A	Lithic scatter	1985	Cardenas and Winterrowd	Not relocated	Indeterminate
SDI-10548/W-3703	Lithic scatter	1985	Cardenas and Winterrowd	Not relocated	Indeterminate
SDI-11040H/W-4003	Historic mine	1988	Hector et al.	Relocated	Eligible
SDI-13738	Quarry	1994	Apple and Lilburn	Relocated	Not evaluated
P-37-014849/W-3702B	Isolated debitage	1985	Cardenas and Winterrowd	Not relocated	N/A

A search of the GeoFinder resource database included a review of the National Register of Historic Places, California Register of Historic Resources, California State Landmarks, California Points of Historic Interest, and other historic property lists. GeoFinder identified one documented historic structure, The Old Peñasquitos Creek Bridge, within the study area. The ca. 1949 bridge is located along Interstate 15 and has been designated as historic bridge number 57C-475 (57-106R).

A review of historic maps provided by SCIC and dating between 1901 and 1953 did not show any buildings, mines, or other features of note within the project area.

Previously Recorded Resources Within Black Mountain Open Space Park

Resources identified by previous surveys with the Black Mountain Park are briefly described below and summarized in Table 3.

SDI-10547

This site consists of one core, one flake, and a piece of lithic shatter recorded within a 12-x-6 m area next to an existing trail. All were of the same metavolcanic rock that forms the bedrock in the area. None of the items were relocated during the current survey.

SDI-10548

This site was recorded as two milky quartz flakes, one metavolcanic flake, and two possible battered cobbles or hammerstones. Items were found within an 18-x-6 m area on an existing jeep trail. The recorders stated that the site had no integrity and despite good ground visibility none of the items could be relocated during the current survey.

SDI-11040H

This site is the remains of an historic arsenic mine located in a small canyon on the north side of Black Mountain. Recorded mine features include roads, remains of an ore roasting furnace, collapsed wooden structures, concrete tanks, chimney, and foundations. Only a rudimentary recording was done at the time. The current survey relocated the mine and found additional features. The mine was researched and recorded in detail and an application for listing on the National Register of Historic Places was submitted. The mine and its eligibility for listing are discussed in detail below.

SDI-13738

This site is a prehistoric lithic quarry consisting of 14 battered metavolcanic bedrock outcrops and sparse flakes within a 60-x-30 m area. The site was relocated during the current survey. While prehistoric quarrying is evident, much of the battering and shattered bedrock flakes may result from other sources. A steep vehicle trail passes through the edge of the site and vehicles may have damaged some to the bedrock exposures. Some of the material also appears represent thermal spalling, the result of fires or repeated diurnal heating and cooling of the rock surface.

P-37-014849

This isolated occurrence consists of two pieces of lithic shatter of the same metavolcanic stone that forms the bedrock in the area. They were not relocated.

4. ARCHAEOLOGICAL RESOURCES

FIELD SURVEY RESULTS

Five previously unrecorded cultural resources and one isolated occurrence was recorded during pedestrian surveys within the park boundaries. One additional site (SDI-18276) was recorded and tentatively field plotted as occurring inside park boundaries. When this site was later plotted more accurately using GPS coordinates collected in the field it was found to be several meters outside of the park boundary. Full documentation for these resources is provided in confidential Appendix B.

SDI-18275

This site is a survey monument that consists of a rock cairn with a steel post or pipe segment in the center. The monument is located in dense chaparral on a west-facing slope 1 mile east-northeast of Black Mountain. A path has recently been cleared to the monument and it has recently been remarked with newer posts, stakes, flagging, and paint. The monument may be a USGS 1/4-section marker although the pipe is damaged by being beaten directly into the ground and may not have held a brass cap. Plotting on USGS quadrangles places the monument near the midpoint of the east boundary of Section 5. The monument also appears to mark a boundary point of the Black Mountain Open Space Park. The age is uncertain although the degree of lichen growth and accumulated plant material suggest that it is greater than 45 years old.

SDI-18276

The site consists of one milling slick measuring 32 x 23 cm located on an 8-x-4.5 m irregular granite outcrop. The condition is good, without exfoliation or substantial weathering of the milled surface. The slick however shows minimal use-wear with less than 1 mm of rock worn away on high spots. It was likely produced by a single transitory episode of grinding. No other artifacts or ecofacts were observed. Five pieces of marine shell located 50 m to the northeast were recorded as a separate site (SDI-18277). Subsequent to field survey, this site was found to be located outside the Black Mountain Open Space Park.

SDI-18277

The site consists of a very sparse shell scatter located on a south-facing slope 100 m southeast of a low saddle. Only five pieces of marine shell, three California oyster and two *Chione* sp., were observed over a 17-x-10 m area, The site is in poor condition in that an unpaved road has been bulldozed through it. The north side of the road had recently burned at the time of the field survey and ground surface visibility was excellent. The south side of the road was vegetated by dense grasses that might conceal additional shell.

SDI-18278

This site consists of an isolated bedrock mortar located on a terrace or bench at the southwestern base of Black Mountain. The cup-shaped mortar is 12 cm in diameter x 5 cm deep on one 2.8-x-1.7 m outcrop of metavolcanic stone. The mortar appears to have been intentionally hidden by a small boulder placed on top of it in recent times. One rounded quartzite cobble from nearby marine terrace formations was located next to the feature. It is an excellent size and shape for use as a pestle but no use-wear or modifications were detected. No other associated artifacts were noted.

SDI-18279

This site is a prehistoric quarry located on a southeast-facing slope. The hillside was covered in extremely dense vegetation that limited ground visibility to the point that many attributes of this site, such as the exact size, limits of the boundaries, and artifact assemblage characteristics, could not be determined. The site appears to be approximately 100 x 50 m and includes a variety of flake types, stages, and sizes. Flakes of porphyritic metavolcanic toolstone are noted in isolated pockets where the ground surface is visible and where flakes and natural toolstone appear to be collecting as these materials are moved downslope by erosional processes. Outcrops of metavolcanic bedrock were noted throughout the area and appear to be the source of the flaked stone. One reddish colored hand stone or mano was noted within one of the collected pockets of material.

SDI-18280

This site consists of a single rock cairn feature located on a ridge top overlooking the mine canyon. The cairn is made up of approximately 60 to 80 large rocks and cobbles, stacked about 1 m high. The cobbles visible in the cairn are all light green fine-grained metavolcanic rock. The cobbles appear to be from the immediate vicinity, because they consist of material taken from the local bedrock outcrops. The cairn is stacked on a partially exposed bedrock boulder of the same light green material. The cobbles are mostly sharp angular rocks with some patina discolorations on exposed surfaces. Dense overgrown scrub vegetation currently covers the site area, leading to very poor ground visibility. No other features or artifacts were noted in association with this cairn. Although rock cairns were often used in marking historic mining claims, there are no associated artifacts or other features to help clarify the cairn’s origin.

P-37-028093

This isolated occurrence consists of two individual ceramic fragments noted on the ground surface of an unnamed trail. The two sherds are consistent with the Tizon Brownware ceramic type. Both are body sherds that refit and so originated from a single vessel. One possible metavolcanic flake was also found adjacent to these ceramic sherds.

SUMMARY

Five previously unrecorded cultural resources and one isolated occurrence were recorded during pedestrian surveys within the park boundaries. These include two rock cairns (SDI-18275 and -18280); one sparse shell scatter (SDI-18277); one isolated bedrock mortar (SDI-18278); one prehistoric quarry (SDI-18279); and two isolated sherds of prehistoric ceramics (P-37-028093). Previously recorded resources within the park boundaries include two lithic scatters (SDI-10547 and -10548), a prehistoric quarry site (SDI-13738), an isolated fragment of debitage (P-37-014849), and the Black Mountain Mine (SDI-11040H). Three of these resources, the two lithic scatters and the isolate, were not relocated during the current field survey. These resources may have been mismapped originally, or may have been destroyed. Updated DPR forms for the other resources are provided in Appendix B.

The historic Black Mountain Mine (SDI-11040H) was documented in considerable detail during the survey and research was conducted to provide a historical context for the mine and a history of its operation. Results of this study are provided in the next chapter.

5. BLACK MOUNTAIN MINE

HISTORICAL CONTEXT

Arsenic Production in the United States 1900 - 1940

Ordinary commercial or white arsenic (also known as arsenious oxide, arsenious acid or anhydrid) is produced largely as a by-product recovered from the soot (known as flue dust) that results from the smelting of copper, lead and other minerals. Arsenic occurs as a constituent of 30 or more minerals. The principal sources are arsenopyrite, arsenic sulfides, nickel, and cobalt arsenic, and several sulfur sinides. Arsenopyrite is probably more plentiful than all other arsenic minerals. It is found in schist and gneiss and in some places forms deposits in them, which have been worked for their arsenic content. These minerals are rarely mined for arsenic alone. The market price has seldom justified its recovery other than as a by-product of smelters established to process other ores (Zaman 1985:28-6, Heikes 1922:51-52).

During the early twentieth century, arsenic was used in a variety of products including paint pigments, calico printing, dying, pyrotechnics, preserving hides, as an antiseptic, making soaps, hardening metals, and the manufacture of plate glass. The principal use was in the production of insecticides, weed killers, and cattle and sheep dips. A “considerable tonnage” of white arsenic was used to make weed killers needed by the railroads in the United States to keep their roadbeds clear (*Engineering and Mining Journal Press* 5-20-1922).

Prior to 1901, no white arsenic was produced in the United States. Major places of manufacture included Cornwall, England, Freidberg, Germany, and Altenberg, Silesia in central Europe. White arsenic, also known as arsenious acid or anhydrid, was obtained as a secondary product in the roasting of arsenical ores of tin, cobalt, nickel, and argentiferous native arsenic for the extraction of silver. The largest supply came from the roasting of arsenical pyrites or “mispickle” and condensing the flue dust in long flues or chambers. The flues in Cornwall measured 600 ft. in length, and 6 ft. high. At Altenberg, in Silesia the soot (volatile matters) was passed through two or three chambers, which were emptied every one or two months. During the operation workmen donned leather clothing with their mouths and nostrils protected by wet cloths (Greenwood 1875:221-224; Struthers 1904:279).

Production of white arsenic began in the United States in 1901 when a plant was opened to recover the material as a by-product of smelting by the Puget Sound Reduction Works, at Everet Washington. The first year the company produced 300 tons. Output more than quadrupled the following year with 1,353 tons (Struthers 1904:279). By 1905, arsenic was also being recovered in Virginia and Montana. Production that year amounted to 1,507,386 pounds of white arsenic, valued at $35,210, as compared with 72,413 pounds valued at $2,185 in 1904 (Schnatterbeck 1906:1087).

Over the next two decades white arsenic production in the United States continued to rise. In 1915, 5,498 short tons of were produced, valued at $302,116. This was an increase of nearly 18 percent over the production of 4,670 tons in 1914 and an increase of 75 percent over the largest previous production year, 1912, when 3,141 tons, valued at $190,757, were produced. One report noted, "As usual the arsenic was all saved as a by-product in the smelting of copper, gold, and silver ores" (Hess 1917:845-846). Over the next two years, production continued to increase steadily resulting in 5,580 tons in 1917, 5,737 tons in 1918, followed by a slight decrease to 5,470 tons in 1919 (Mineral Industry 1919:35-36).

In 1919, government research demonstrated that calcium arsenate, an insecticide produced from white arsenic, was extremely effective against boll weevil infestations in cotton producing sections of the United States (Heikes and Loughlin 1925). When properly applied, from five to seven pounds of calcium arsenate were required to an acre. The number of applications required varied from three to five with an interval of from four to seven days between applications. The gain secured by using the insecticide was as high as 1,000 pounds of seed cotton per acre, and on fairly fertile soil, subject to a serious degree of weevil injury, average gains of from 300 to 500 pounds of seed cotton per acre were considered to be possible (*Engineering and Mining Journal Press* 5-20-1922).

The white arsenic market remained erratic until 1923. In 1920, manufacturers laid in supplies of refined white arsenic in anticipation of an increased demand. However, cotton prices that year fell from an anticipated 45 cents a pound to 12 cents a pound, and many cotton growers were unable to purchase calcium arsenate. One manufacture distributed the insecticide at a price below cost, which discouraged others from marketing it. By the end of the year the supply became exhausted and the demand was again acute prompting a rush into the market for white arsenic and greatly increasing the price of the latter (Heikes and Loughlin 1925).

The following year consumption of calcium arsenate peaked at about 32,000,000 pounds (*Engineering and Mining Journal Press* 4-17-1926). The supply was virtually exhausted and in some instances 40 cents per pound was paid for it. This dramatic price increase prompted the direct treatment of arsenopyrite ore to produce white arsenic as a primary product. Successful plants were established by the Toulon Arsenic Co. near Lovelock, Nevada, the Jardine Mining Co. at Jardine, Montana, the Salt Lake Insecticide Co. at Rowley, Utah, the Keystone Arsenic Co. at Keystone, South Dakota, the National Chemical Co. at Pittsburgh, Pennsylvania, and the Arsenic Products and Refining Company at Martinez, California. The Chipman Engineering Co., owners of an arsenic mine in Colorado, controlled the plant at Martinez, which had in stock considerable custom ore received from Nevada, California, and its mine in Colorado. The sales of white arsenic were 14,271 tons, which sold for $2,808,801, or an average price of 9.84 cents a pound (Heikes 1924:49-51; Heikes and Loughlin 1927a:164-165). Nearly two-thirds of the white arsenic produced in the United States in 1924 came from plants where the ore was directly treated for its arsenic content. The remaining third of the total domestic output was the by-product from the regular ore charges of copper and lead smelting and some arsenic recovered by the manufacture of chemicals (Heikes and Loughlin 1927b:35-39).

The boom, however, was short lived. In 1924 the summer was dry and hot and the depredations of the boll weevil were insignificant. A cold winter followed by another exceptionally dry season over most of the cotton belt almost eliminated the weevil as a factor in cotton production for 1924. The resulting decreased demand, combined with the rapid expansion of production of white arsenic, flooded the market. The price of white arsenic fell 50 percent, from 13.5 cents per pound in January to 6.75 cents per pound in December. The smelting companies had huge stocks of barreled oxide on hand in the United States and Mexico (*Engineering and Mining Journal Press* 4-17-1926; Heikes 1925:63).

For the next two years arsenic sold for less than the price of production and the new plants established for the sole purpose of producing white arsenic as a primary product shut down. White arsenic once again became a commodity produced solely as a by-product of smelters, a condition that continued through the 1930s and is still the case in the early twenty-first century. The price has never been able to justify the production of arsenic as a primary product from arsenopyrite ore in the United States (*Engineering and Mining Journal Press* 4-17-1926, 6-16-1926; Ambruster 1926:63-65, 1927:54-55; Anonymous 1933:35, 1936:38; Gerry and Meyer 1934:11; Heikes 1929:19, 1933:25; Tyler 1929:34, 1930:36, 1931:38, 1932:40).

History of the Black Mountain Mine

At the height of the short-lived white arsenic boom in 1923 several investors began operations in San Diego County on the north slope of Black Mountain to mine arsenopyrite, process the ore, and send it to a refiner to produce white arsenic. Arsenopyrite is distributed rather sparsely on Black Mountain in a fine-grained quartzite, which is a member of the Black Mountain volcanic rocks of probable Jurassic age (Weber et al. 1963:49).

On October 4, 1923, articles of incorporation were filed for the Black Mountain Arsenic Mining Company. The principal place of business was Los Angeles. The five directors included Wilfred Buckland (president) of Hollywood, California, L. K. Vermille (secretary), J. N. Hendrickson, Eugene Overton, and George W. Prince, Jr., all of Los Angeles (Articles of Incorporation 1923). Company offices were located at 1300 Stock Exchange Building in Los Angeles. They controlled four claims known as the Black Mountain Group, which covered 80 acres along a narrow canyon on Black Mountain's north slope. The manager in charge of actual operations on the ground was Frank Hopkins of Escondido (Lawrence 1998; San Diego Chamber of Mines 1927; State Mineralogists 1925:329).

The story of how these six men became involved in an ill-fated effort that never could have succeeded, to mine arsenopyrite on Black Mountain and produce white arsenic as a primary product, is both curious and strange.

Frank Hopkins was a cowboy and former hard rock miner, who worked part time as a trick roper in rodeos and silent films in the late teens and early 1920s. He often acted as an extra in westerns produced by Cecil B. DeMille. Frank got along so well and had such affection for the famous Hollywood director that he named his youngest son, born in 1916, Cecil DeMille Hopkins (Colbeth 2005; Lawrence 1998).

Wilfred Buckland, the president of the Black Mountain Arsenic Mining Company, was Cecil B. DeMille's lighting and art director. Producer David Belasco, who was known for his innovative lighting techniques, had trained both DeMille and Buckland on Broadway. By hiring Buckland, DeMille gave Hollywood its first art director. In all, Wilfred Buckland is credited with working on 80 films between 1914 and 1927 (Buckland Bio 2006).

Eugene Overton, the secretary of the Black Mountain Arsenic Mining Company, was a successful Los Angeles attorney (Census 1920, 1930). He apparently also dabbled in the livestock business and kept cattle at Doane Valley on Palomar Mountain. He was acquainted with Frank Hopkins and his family, who were known to visit his place on Palomar (James 1957). It is very probable that Hopkins may have overseen Overton's cattle operations at times. The remaining Black Mountain Arsenic Mining Company board members - L. K. Vermille, John N. Hendrickson, and George W. Prince, Jr. - were also successful Los Angeles attorneys (Census 1920, 1930).

The catalyst that brought this group together and focused their attention on development of an arsenic mine on Black Mountain appears to have been Frank Hopkins. Frank had been born on December 3, 1887, in South Dakota (California Death Index 1940-1970). As already mentioned, he was a rancher in the Escondido area, who also worked as a rodeo trick roper and movie cowboy for Cecil B. DeMille. His niece, Elva Colbeth, remembered that around 1920 Frank managed a ranch in the San Dieguito River Valley near Del Mar that DeMille might have owned (Colbeth 2005). The 1920 Federal Census Population Manuscript Returns list Frank as a 32-year-old stock farm manger living in Lusardi Precinct, which would put him in the San Dieguito River and Black Mountain area (Beasley 1898). The household consisted of Frank, age 32, his 29-year-old wife Yolande, his brother Lester, who was 25, and Frank and Yolande's three children: Clayton, age 8, Francis, age 7, and Cecil DeMille, age 4 (Census 1920).

In addition to ranching, Frank Hopkins was a prospector. In San Diego County, he had a placer mining operation on Garnet Creek, northwest of Ramona, and was also involved in tungsten mining (Colbeth 2005; State Mineralogists 1925; San Diego Chamber of Mines 1927). He was remembered as a hard drinking promoter, who kept a jug of bootleg "Grappa" nearby as medicine (Lawrence 1998; Colbeth 2005).

As a rancher familiar with the backcountry and living in the region, Frank Hopkins was undoubtedly aware of the arsenic springs on the north slope of Black Mountain. As a prospector, he was probably aware of any sudden rise in price for mineral resources in the mining markets. It seems very likely that as the price for white arsenic suddenly rose to unprecedented levels in 1922 and 1923, Frank approached his well-to-do Hollywood movie industry and Los Angeles attorney acquaintances and encouraged them to invest in the mining operation on Black Mountain, which resulted in the filing of the articles of incorporation for the Black Mountain Arsenic Mining Company in October 1923.

Work began on Black Mountain in 1924. That year the Mace Company of Denver, Colorado conducted smelting tests on samples of the arsenical ore to produce a gold-bearing matte and recover arsenic trioxide as a fume. A small concentrating plant was erected early in the year, even though no ore reserves had been developed. Seven hundred pounds of material containing 31.4 percent arsenic, plus a small amount of gold and silver, were sent to the Chipman Chemical Engineering Company's plant at the Martinez. Operations at Black Mountain were discontinued due to the lack of a reliable water supply, and the concentration plant had been dismantled by July of that year (State Mineralogist 1925:329; Weber et al. 1963:49). The actual relationship that existed between the Mace Company and the Black Mountain Arsenic Mining Company has not been determined. Mace was apparently one of the many smelting and mining companies looking for arsenopyrite deposits that could profitably produce white arsenic as a primary product during the short-lived arsenic boom of 1923-1924. There was, undoubtedly, some sort of agreement between Mace and the Black Mountain board of directors that allowed the Colorado company to proceed with development work. The details of these transactions have not yet come to light.

Following closure of the Mace Company's operation, Black Mountain Arsenic continued development under the direction of Frank Hopkins. The arsenopyrite ore was found in two discontinuous parallel dikes of quartzite 10 to 15 ft. wide that cut the surrounding diorite bedrock with a general northwest strike and dip to the northeast for a distance of about 200 ft. By the end of 1925, a 30-ft. long tunnel and two 40-ft. deep shafts had been opened, as well as a number of cuts along the outcrops of the quartzite dikes. The ore was said to contain 5 percent arsenic with from \$2 to \$5 of gold per ton. Mine equipment consisted of a 7 1/2 x 6 inch Chicago pneumatic compressor and air drills, a 7-x-9 inch Blake Jaw Crusher, 20-ton Herman ball mill, and a Universal Overstrom Concentrator. The plant was driven by a four-cylinder, 70-horsepower, Holt tractor gasoline engine. The concentrates produced from the ore were said to carry 40 percent arsenic with gold values. Two men were employed in the development work (State Mineralogist 1925:329).

It was evidently the goal of the operations at this time to produce a concentrate of arsenic and gold which could be shipped to the Chipman Chemical Engineering Company's plant at Martinez, California, or another of the several refineries established for the primary production of white arsenic during 1923-1924. With the collapse of the arsenic market and the dismantling of the primary arsenic refineries, including the Martinez operation in 1925, the Black Mountain Arsenic Mining Company appears to have changed strategies and in 1926-1927 installed equipment to process the ore on-site. This included a 15-ft. long Gates Rotary Roaster, connected by a brick flue and steel pipe to a 7-ft. wide x 180-ft. long poured concrete dust chamber, and three concrete cyanide vats. A Gates Gyratory Crusher was also installed that would have replaced the original Blake Jaw Crusher reported to have been in use in 1925 (Lawrence 1998, Weber et al. 1963:49). Now the ore could be roasted on-site, the resulting arsenic containing soot collected in the dust chamber, and the roasted concentrates then treated in cyanide to recover any remaining gold.

In spite of these improvements little other work was ever done at the mine. Frank Hopkins employed 16-year-old David W. (Bill) Lawrence and his 10-year-old son Cecil DeMille Hopkins to work the mines during the summers of 1926 and 1927 (Census 1920, 1930; Lawrence 1998). Lawrence recalled:

> I worked drilling and blasting the "pit" in 1926 - 27 (summers) removing overburden with Cecil Hopkins. He was a couple of years younger and the son of Frank Hopkins, mining engineer on the mine project. . . . Everything was carried by hand from the cabin up a trail on the left side of canyon. (The) cabin sat at the mouth of the canyon and arsenic creek. (The) Main water supply was a spring at the head of the creek. (The) Lower springs contained too much arsenic. . . . Old Frank was a hard rock miner from Colorado and taught Cec and I to handle dynamite, sharpen drill bits, handle a jackhammer, & to cook miners style. HA !! And a 5 gal jug of Grappa for Old Frank as medicine [Lawrence 1998].

Only a ton or two of ore was ever roasted (Weber et al. 1963:49). Lawrence stated, "In 1927, while I was working, they ran out of fuel oil for firing the roaster and substituted diesel fuel instead. This caused too much heat and the babbett bearings melted on the roaster drum. This shut the entire operation down. To my knowledge the operation never restarted. F. Hopkins was quite a promoter and was often having financial problems. I believe finances played a role in shutting down and not reopening."

Some unsuccessful attempts were made to reopen the mine. Frank Hopkins, and perhaps others, evidently continued to try and revive the operations. In 1930 his occupation was listed as "arsenic miner" on the Federal Census Population Manuscript Returns (Census 1930). However, given the depressed price for white arsenic during the late 1920s and through the 1930s, a financially successful operation could never have been established at Black Mountain. By 1939, all the equipment had been removed for salvage and the site was idle (State Mineralogist 1939:12).

The history of the Black Mountain Arsenic Mine typifies many of the problems inherent in western mining during the late nineteenth and early twentieth century. From the perspective of the early twenty-first century, the actions of the backers and other participants in the Black Mountain Mine seem highly unreasonable. There seems no logical motivation for a successful movie director such as Wilfred Buckland or his well-to-do Los Angeles attorney associates to invest in as dubious a venture as an arsenic mine, and continue to develop it in the face of falling prices for white arsenic during the late 1920s.

The actions taken by the Black Mountain investors were not unprecedented for the period, however. Many people of means, and others without sound financial resources, invested in unproductive mining properties during the nineteenth and early twentieth centuries, in the hopes of finding the next big strike that would produce extraordinary wealth.

Beginning with the California Gold Rush of 1849, mining had produced great wealth in the American West during the nineteenth and early twentieth centuries. The Gold Rush was followed by fabulous strikes at the Comstock Lode in Nevada in the 1860s, and opening of additional wealthy mines in Nevada, Arizona, Colorado, Montana, and virtually every other state throughout the west through the remaining decades of the century. The last big strike was at Gold Fields and Tonapah, Nevada during the first decade of the twentieth century. Indeed, it seemed that a major strike occurred at least every 5 to 10 years throughout the last half of the nineteenth century that created tremendous riches for those who were fortunate enough to be the earliest investors.

The wealthy and truly productive strikes stand in stark contrast to the literally thousands of unsuccessful or small one and two man operations that made up most of the mines in the west during this period. Encouraged by the really big discoveries that occurred so regularly, thousands of prospectors combed the west and were able to find innumerable wealthy investors willing to spend money on small scale or worthless mining properties in the hope of striking it rich. Many fell victim to blatant fraud. In the Great Diamond Hoax of 1872, a Kentucky grifter, Philip Arnold, convinced some of California's biggest bankers and businessmen, a former U.S. representative, leading lawyers on both coasts, and the founder of Tiffany and Company to invest in a falsified gem mine on the sagebrush-covered mesas of Wyoming. By the time the scam had played itself out Arnold and his partner had gotten away with more than half a million dollars; the equivalent to more than eight million in twenty-first century currency (Wilson 2004).

Many ventures were not entirely fraudulent but based on claims that could never have produced a profit in relationship to the amount of money invested in development. Some, like Black Mountain, were worthless given the small value of the ore. Others had moderate potential but became burdened when investors erected expensive mills and other infrastructure that was more expensive than the wealth the ores contained (Van Wormer and Newland 1996). Western mining engineers identified three major causes for failure: too much expenditure on speculation, insufficient ore reduction and processing systems, and too much expensive machinery on unproven property (Peterson 1977:100). Clearly, the Black Mountain investors were guilty of the first and second named actions - over speculation and over investment in expensive equipment on a completely unproven property.

Technology

The processing plant at the Black Mountain Arsenic Mine evolved through two distinct phases. During the first phase, from late 1924 through 1925, the purpose was to produce a concentrated residue from the ore that could be shipped to a refinery. Based on descriptions and evidence on the ground, the ore was mined at the quartzite outcrops in the canyon bottom and then conveyed via ore carts on a narrow gauge railroad to the mill built on an excavated terrace some 250 ft. down the canyon from the arsenopyrite source. Here the ore was fed into a Blake Rock Crusher and then processed with water in a Harding Ball Mill until it was reduced into a fine slime. From the ball mill the material would have been passed to a concentrator. The resulting concentrate was then shipped to a refining plant as already stated (State Mineralogist 1925:329).

During the second phase, from 1926 to 1927, the purpose was to roast the ore and collect the resulting soot in the long concrete dust-collecting flue built on the hillside above the terrace. The ore was conveyed to the dumping station in ore carts as before. At this point it appears to have been processed in a gyratory crusher from which it was conveyed to the roaster where it was heated to produce soot (i.e., flue-dust), which passed through the dust-collector. Following roasting, the ore would then be treated with cyanide to extract any remaining gold. The soot in the dust collector would eventually be collected and presumably sold as crude arsenic (Lawrence 1998).

DESCRIPTION OF MINE CANYON RESOURCES

Detailed documentation of the Black Mountain Mine features, including photographs, is provided in Appendix B of this report.

The Black Mountain Arsenic Mine site is located on the northwest slope of a narrow canyon on the north side of Black Mountain at approximately 1,000 ft. above mean sea level (Figures 4 and 5). The site extends for approximately 620 ft. in a northeasterly direction along the canyon edge. It consists of two main areas. At the southwest end, near the canyon bottom, are the adits and tailing piles where the ore was extracted. Approximately 220 ft. to the northeast, the mill site where the ore was processed is located on a narrow excavated terrace that measures approximately 120 x 40 ft. Two road cuts lead from the adits and tailings to the mill site.

Additional features associated with the milling process are located outside the terrace. A large concrete flue dust chamber that measures 7 x 7 ft. across x 180 ft. in length is located on the slope above the mill site, and two concrete cyanide vats are situated along the canyon edge, approximately 160 ft. northeast of the mill site terrace. An access road runs from the mill site past the cyanide vats and continues to climb the slope in a northwesterly direction. It is covered with thick chaparral brush, as is the entire hillside. The road can be followed for about a half mile to the top of a ridge northwest of the mine site. At that point the brush becomes so thick it can no longer be detected.

The canyon bottom drops rapidly between the area of the adits and the mill site so that the mill site terrace is actually on the bank approximately 40 ft. above the streambed that forms the canyon. The bank between the terrace and the stream is covered with artifacts, consisting of scrap metal, pieces of equipment, and metal and glass containers deposited there during construction, use and dismantling of the mill.

Archaeological and Landscape Features

The archeological features on the ground represent the machinery and equipment used to extract and process the arsenopyrite ore during the two distinct phases of the Black Mountain Mining operation. To better understand the remains and their relationship to the technological processes involved at the site, they can be grouped into feature systems. A feature system is a group of archaeologically visible features and objects that are related to a specific human activity (Hardesty 1988:9).

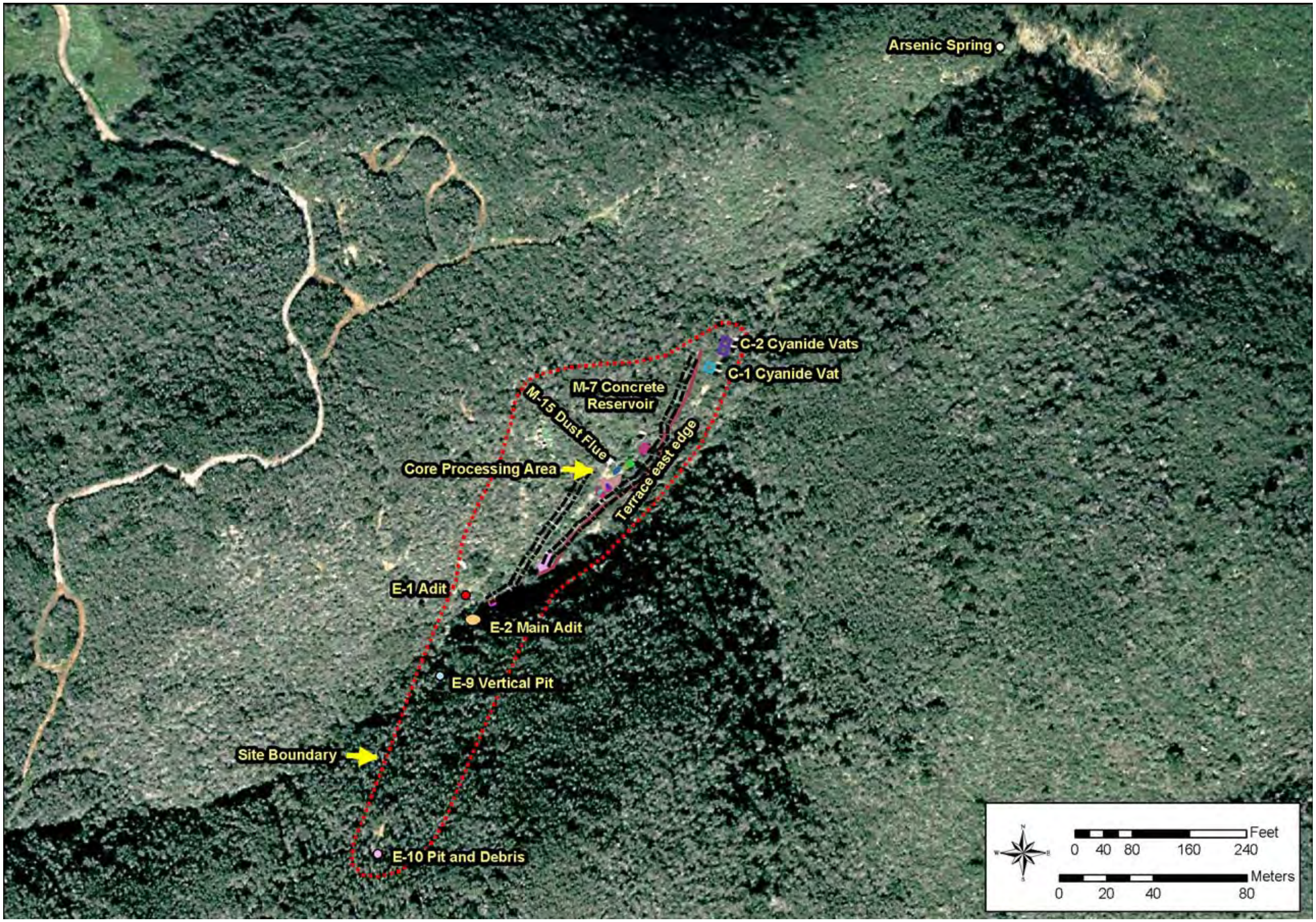


Figure 4. Aerial map view of Mine Canyon and the Black Mountain Mine.

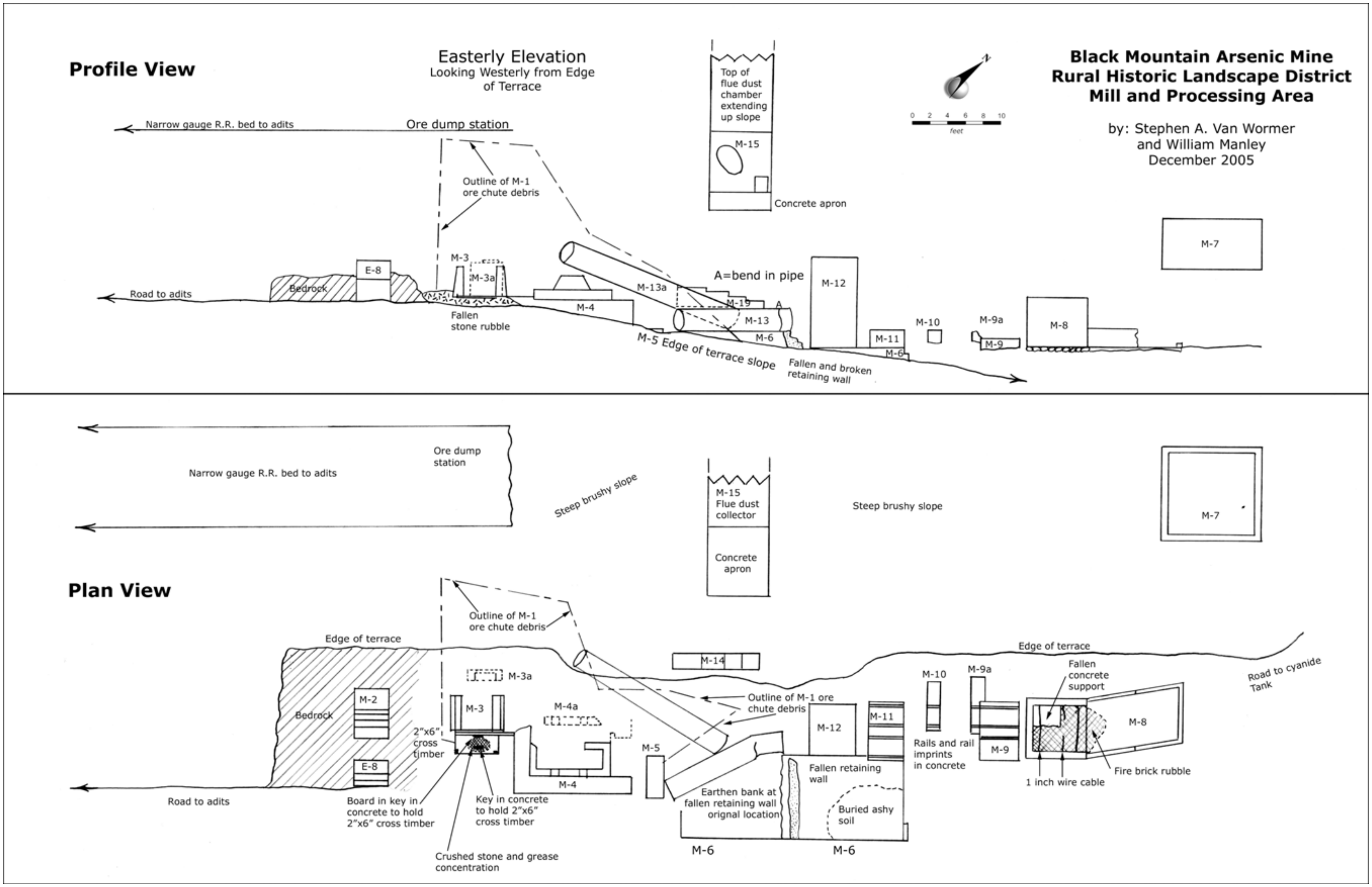


Figure 5. Plan and profile views of the Black Mountain Mine core processing areas.

At the Black Mountain Arsenic Mine site there are two major feature systems consisting of *extractive features* used in removing the ore from the ground and conveying it to the mill site, and *processing features* used in processing the ore to extract the minerals. Using this method, features are analyzed, and described according to the functions they served rather than their geographical proximity to each other. At Black Mountain, for example, the air compressor used to power the rock drills was part of the extractive feature system even though its foundations are several hundred feet away from the shaft and tunnel remains where the jackhammers were used. In addition, a feature cluster or individual features may represent two or more distinct feature systems. This is the case at the mill site at Black Mountain where remains of both the concentration phase and roasting phase of ore processing are located on the same small terrace. The Holt gasoline engine footings (Feature M-2) and reservoir (Feature M-1) were used for both the Phase 1 concentration process and Phase 2 roasting - cyanide process.

Ore Extraction Feature System

The ore extraction feature system consists of all features related to the extraction of ore from the ground and its conveyance to the mill site. It includes adits (Features E-1 and E-2), tailings (Feature E-3), the remains of an ore cart loading platform (Feature E-4), a narrow gauge rail bed for conveying the ore filled carts to the dumping station above the mill site (Feature E-5), a lower road bed (Feature E-6) that leads from the mill site to the storage bunker (Feature E-7), and the footings of the pneumatic compressor located on the mill site terrace that powered the rock drills (Feature E-8).

Adits and Tailings

All that remains of the excavation work at the Black Mountain mine are two small adits located on either side of the narrow canyon at the southwest end of the mine site. The full extent of the excavation is not known, but it was never large. As noted above, by 1925, a 30-ft. long tunnel and two 40-ft. deep shafts had been opened (State Mineralogist 1925:329). Further excavation occurred in a “pit” during the summers of 1926 and 1927 (Lawrence 1998).

Feature E-1 is located on the north side of the canyon and consists of an adit opening some 10-12 ft. in diameter. It appears to have been larger at one time and has been partially filled in. The interior cannot be seen and it does not appear safe to enter. Given the fact that this adit was obviously larger at one time and has had considerable in-filling, it may be the location of the 30-ft. long tunnel and two 40-ft. deep shafts described in 1925. Feature E-2, immediately across from Feature E-1 on the north side of the canyon, is a large adit approximately 15 ft. in diameter that extends about 30 ft. into the hillside. There is neither fill nor fallen debris associated with this small tunnel and it is obvious that no additional shafts were ever associated with it; this leads to the assumption that this is not the excavation described in 1925 and is probably the “pit” excavated by Bill Lawrence and Cecil DeMille Hopkins during the summers of 1926–1927[1]. Feature E-3 is a tailings pile filling the canyon between the two adits and extending easterly along the canyon bottom for about 40 ft.

Two further excavations are located outside the main mine area, on the southern slopes of the drainage to the south. Feature E-9 is a shallow vertical pit located approximately 150 ft. south of Feature E-2, the main shaft. This feature is approximately 6 x 6 ft. wide and 6-7 ft. in depth. Feature E-10 is located upslope and approximately 400 ft. south of the main shaft. This feature consists of a narrow shaft measuring approximately 7-8 ft. wide at the mouth and 20 ft. in depth. It is located on a steep slope and access to this feature is through thick brush. Adjacent to the mouth of the shaft are the remains of a wooden hoist that was used to haul ore out of the shaft. This consists of a H-shaped wooden headwall and ramp leading from the mouth of the shaft. Metal tracks nailed onto the parallel wooden shafts indicate that an ore cart or similar device was pulled up the ramp to the top of the slope. The remains of a wooden trough, where the ore was dumped prior to transportation, are located on the other side of the headwall. It is not known when these pits were excavated. They are at some distance from the main adits and are not connected to the processing area by the narrow gauge railway. It is possible that they were exploratory excavations, and that the rock was transported by mule to the central processing area.

Conveyance System

Feature E-4 is a small concrete platform located at the eastern edge of the tailings pile. Rocks from the tailings have partially covered the feature, which consist of two small parallel footings about 24 inches apart that measure approximately 12 inches wide x 3 ft. in length. They span the narrow stream in the canyon bottom. This appears to be the remains of a platform where ore carts could have been loaded. According to Bill Lawrence, ore was conveyed from this point to the dump station above the mill site in carts that ran on a narrow gauge railway located on the roadbed designated Feature E-5. This approximately 12-ft. wide cut in the hillside runs from Feature E-4 in a northeasterly direction for approximately 240 ft., terminating at a point above the mill site.

Another roadbed, Feature E-6, parallels Feature E-5 and is located approximately 20 ft. lower on the hillside at the level of the mill site. It extends southwesterly from the mill site terrace for approximately 160 ft. Feature E-7, a small concrete storage bunker measuring approximately 24 x 36 inches x 3 ft. in height, is located near the southwest end of the Feature E-6 roadbed near the area of the adits. Steel hinges indicate a heavy steel door once covered the front of this bunker. This storage bunker may have stored explosives used in mining excavations. Feature E-8, located at the juncture of the northeast end of the Feature E-6 roadbed and the extreme southwest edge of the milling area terrace, is a concrete footing that measures approximately 3 x 4 ft. It is stepped on the southeast end to extend down the bank about 5 ft. Footings stepped in this manner were often used to mount air compressors. The

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[1] Exact measurements were not taken for the adits at the time of the current survey as it was not thought safe to enter them. Mike Kelly of the San Diego Conservation Resources Network, who has previously entered the adits, states that Feature E-2 is longer than 30 feet deep and that there is evidence that excavation for a second side tunnel or shaft had been started at the rear of the shaft (Kelly 2006).

Chicago pneumatic compressor reported to be at the site in 1925 may have been mounted at this location (State Mineralogist 1925:329). Steel pipe airlines could easily have been laid from this point to the excavation area along the E-6 roadbed in order to power the Cochise rock drills used at the mine for excavation (Lawrence 1998). The pneumatic drill had originally been developed in the 1860s and was a common tool in mining operations by this time (Baily 1996:17).

Ore Processing Feature Systems

Ore processing features include the remnants of wooden structures, concrete footings and other remains located at the terraced mill site, and also includes concrete cyanide vats located approximately 160 ft. to the northeast of the mill site. As previously explained, there are remains of two distinct phases of mill processing at the site, ore concentration, and ore roasting combined with cyanide treatment.

Phase 1 – Concentration

A collapsed wooden ore bin (Feature M-1), and concrete footings for a gasoline engine, rock crusher, ball mill, and concentrator (Features M-2, M-3, M-4, M-5, and M-6) correspond to the first phase of ore processing, in use from 1924 to 1925 (Figure 6).

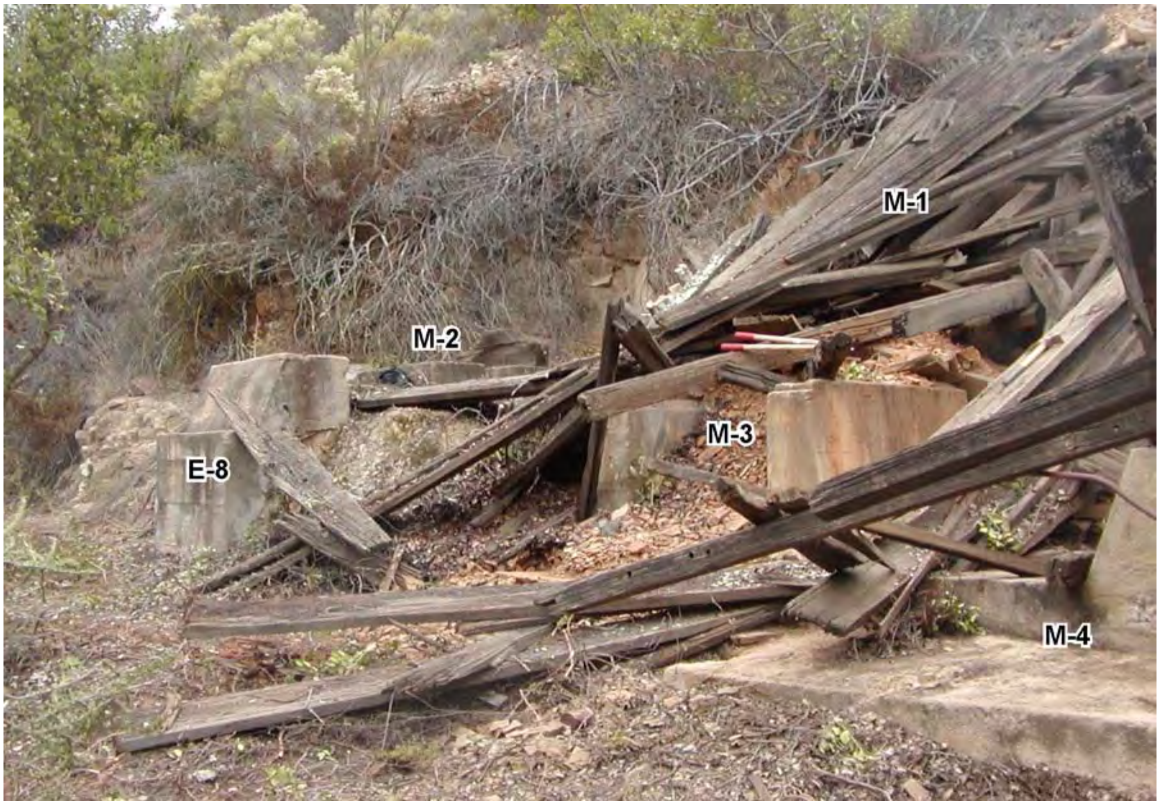

Figure 6. Core processing area showing the collapsed ore bin (M-1), and concrete footings for machinery used in ore processing.

From the dump station at the northeast end of roadbed Feature E-5, the ore was dumped from the ore carts into a wooden hopper or bin with a metal chute at the bottom. This is now represented by Feature M-1, consisting of a roughly L-shaped mound of collapsed lumber and wooden debris measuring approximately 20 x 40 ft. that covers much of the hillside below the dump station as well as many of the concrete footings on the mill site terrace. The concrete footings are remains of the mounts for the various pieces of equipment used in the milling process.

Feature M-2 is a concrete footing located at the southwestern edge of the mill site terrace adjacent to Feature E-8 where the air compressor was probably located. The footings measure approximately 4 x 6 ft. and most likely held the Holt 75 tractor engine used to run the mining equipment. This four-cylinder, in-line, 75-horsepower gasoline engine was originally developed by the Holt Manufacturing Company of Stockton, California, around 1910 for their "Caterpillar" crawler tractors (Barlow 2003:119; Leffingwell 1999:39-41, 293-301). In addition to powering the milling equipment the engine also ran the air compressor, making it part of both the Ore Extraction and Ore Processing feature systems.

Immediately under the ore bin debris are the footings for the Blake Rock Crusher and Harding Ball Mill, represented by Features M-3, M-3a, M-4, and M-4a. Because so much of these footings are covered by lumber, as well as gravel that has washed down from the steep slope above the terrace, their complete dimensions and configuration could not be determined. In shape and relative size, they conform to footings commonly used for rock crushers and ball mills, especially in the use of parallel narrow pyramidal-shaped mounts.

From the ore chute the arsenopyrite would have been fed into the rock breaker for primary crushing. Iron bars known as grizzlys, spaced close enough together to keep pieces too large for the crusher from passing through the chute, were often placed at the top of the ore bin. Primary crushing involved breaking the large lumps of ore down to about a 4-inch diameter size. The Blake Jaw Crusher used at Black Mountain broke the ore by alternately nipping and releasing the material fed between two jaws until it became small enough to fall through the discharge opening. The Blake breaker was originally patented by its inventor Eli Whitney Blake in June 1858. It was the first successful jawbreaker, and its design has held a place as the standard for these types of machines ever since (Richards 1903:13; Zucker and El-Shall 1982:1-4).

From the rock crusher the pieces of ore were fed into a Herman Ball Mill for grinding. The purpose of grinding was to mix the ore with water and reduce it to a fine slime, which was then processed to remove the valuable minerals. A ball mill consists of a rotating steel cylinder with a renewable wear liner. Grinding is accomplished by tumbling the wet ore with a charge of steel balls. A steel ball found at the base of Feature M-3 confirmed that a ball mill originally stood in this general location.

Once the ore was reduced to slime in the ball mill it was conveyed to a concentrator for final processing. In essence, concentrators transform lower grade ore into a higher grade concentrate by the use of a shaking, vibrating motion that separates the metals from lighter materials known as gangue or pulp. There were several types in use at the time the Black Mountain Mine was developed. The simplest were Vanner concentrators that consisted of table-mounted endless belts that shook and vibrated from side to side. The pulp flowed onto the belt surface, where the shaking motion vertically separated the metals and the gangue; the heavier metals settled to the bottom and the lighter gangue stayed near the top and was washed away (Hardesty 1988:43).

The Wilfley Table, originally patented in 1895, had solid riffled plates rather than endless belts (Hardesty 1988:43; Wiard 1915:359-360). The Overstrom Table used at Black Mountain was similar to a Wilfley Table but diamond (rhomboid) shaped, rather than rectangular. This eliminated the problem of waste accumulation in sharp rectangular corners (Mining Dictionary 1996).

The flat concentration tables were often mounted on low rectangular concrete or wooden footings. Given its place in the processing sequence and the need for an open flat rectangular space to set the concentrator, Footing M- 5 and the adjacent 10-ft. square terrace at Feature M-6 seem likely locations. The actual footings may have been removed when the concentrator was taken out and equipment used for ore roasting during the second processing phase installed.

The concentration process required a plentiful supply of water. Feature M-7, an 11.5-ft. square x 8-ft. deep concrete reservoir probably stored water for the concentration process. This same reservoir may also have been intended to store water for the cyanidation employed during the second phase of ore process used from 1926 to 1927.

Phase 2 - Roasting and Cyanidation

Remains of the second phase of ore processing, in use from 1926 to 1927, include the footings for a rotary roaster (M-8, M-9, M-10, M-11, and M-12), large steel pipe (M-13 and M13a), and a trellis support for the pipe (M-14) that connected the roaster with the flue dust chamber (M-15) built on the hill above the mill site terrace (Figure 7). All of the features associated with the ore roasting process are located on the northeast end of the mill site terrace. Approximately 100 ft. northeast of the mill site are two poured concrete reservoirs that were intended to be used as cyanide vats (Features C-1 and C-2).

Roasting

According to Bill Lawrence, primary crushing for the roasting process was conducted in a small gyratory crusher. Gyratory crushers have greater capacity than jaw crushers. Passing the material between an inverted cone and a rotating head breaks the ore (Zucker and El-Shall 1982:1). Lawrence's notes show the crusher located at the dump station at the northeast end of the Feature E-5 roadbed. This seems probable since the rotary roasting furnace used in the process had to be loaded from the top and did not require that the material be reduced to a fine slime as in concentration, thus eliminating the need for a ball mill. A crusher at this point could have reduced the ore to the required size. The crushed rock could then have been fed directly down the hill via an ore chute into a bin above the roaster. It is curious, however, that no footings or other remains for mounting a gyratory crusher at this location or any support for a conveyance system to feed the ore from the crusher to the roaster could be identified. In spite of this, the testimony of Lawrence, and the physical geography of the location, make the crushing of the ore at the dump station and feeding of it directly into the roaster from that point the most likely scenario.

Figure 7. Core processing area showing the remains of the rotary roaster in the foreground. The dust chamber is in the background.

The rotary roaster or furnace was first developed by Bruckner in 1867 for mines in Colorado (Kustel 1880:75). It consisted of a brick-lined horizontal cylinder of iron boilerplate, which revolved on friction rollers between a firebox and a flue, and stirred the ore charge automatically. The flame passed from the firebox directly into the cylinder, and from there, with all the gasses that evolved during roasting, into the flue and dust chambers. In some instances the cylinder was closed at the ends by truncated cones. The common cylinder size was 18 ft. in length x 8 ft. in diameter, with the largest around 22 ft. long x 8.5 ft. in diameter.

The cylinder was usually lined with red brick and the heads with firebrick. In treating lead ores the body of the hearth was also lined with firebrick. A furnace 18.5 ft. long x 8.5 ft. in diameter weighed 45,000 pounds and required 100 firebricks for the heads, 2,800 firebricks for the firebox, and 4,300 red bricks for the body of the furnace.

The furnace was rotated by a spur wheel gear that encircled the outside of the cylinder and was driven by a geared pinion shaft, with a pulley at its end. In some instances, where more than one furnace was in use, the firebox was mounted on rails and could be moved from one furnace to another. These furnaces were known for producing large amounts of flue dust. Although considered a drawback for many mining operations, this would have been an advantage at Black Mountain, where flue dust was to be the primary product (Hofman 1904:198-203; Kustel 1880:75).

Features M-8, M-9, M-10, M-11, and M-12 represent the rotary roaster at Black Mountain. Feature M-8 is a semirectangular concrete slab and footing that measures approximately 18 x 7 ft. The northeastern two thirds is slanted slightly to the northwest. A large concentration of firebrick rubble at the southwest end of the feature indicated that this is where the firebox for the roaster was located.

Features M-9, M-10, and M-11 are a series of poured concrete footings varying from 12 to 24 inches thick. They held the rails that supported the roaster cylinder. Remnants of the steel rails, as well as imprints where others were formerly located, could be seen in all of these footings. In addition, a segment of the gear that fit around the exterior of the furnace so that it could be rotated was found between Features M-9 and M-10.

Feature M-12 is a firebrick-lined flue that set on the southeast end of the gyratory roaster. It measures 4.5 x 6 ft. x 10.5 ft. in height. It has a poured concrete exterior and is lined with firebrick marked "VPC" for the Vitrified Products Corporation of San Diego (Van Wormer and Hector 1987). This flue is not unlike those shown for Bruckner Furnaces shown in historic advertisements. Based on the layout of the firebox location, footings, and flue, as well as the gear segment found between Features M-9 and M-10, the Gates Rotary Roaster at Black Mountain measured 5 ft. in length x 5 ft. in diameter (Weber et al. 1963:49), and was very similar in design to the Bruckner Furnaces in the illustrations.

The flue was connected to the dust chamber located on the bank above the mill site terrace by two large steel pipe segments identified as Features M-13 and M-13a that measure 3 ft. in diameter and about 20 ft. in length. These appear to have been mounted on a wooden trestle supported by a concrete footing designated Feature M-14. This is a stepped foundation 20 x 30 inches x 10 ft. in length built onto the bank.

Feature M-15 is the flue dust chamber located on the hill approximately 16 ft. above and 13 ft. to the northwest of feature M-11. The dust chamber was constructed of poured concrete. It measures 7 x 7 ft. in cross section and 180 ft. in length and runs in a southeast to northwest direction (Figure 8). An opening for a steel pipe chimney is located at the northwest end. Corrugated sheet asbestos baffles stretching from the floor to approximately 6 inches short of the ceiling, divide the interior. A series of portals along the northwest side of the structure allowed access for cleaning. The dust chamber and other concrete footings on site may have been constructed by Hazard Construction Company[1].

The purpose of the dust chamber was to collect the flue dust (soot) generated by roasting the ore. The flue dust carried fine particles of arsenic and other metals. The dust chamber allowed the gasses to pass through very slowly, and gave the dust a chance to settle (Scranton Correspondence School 1902:67).

Figure 8. The southwest side of Feature M-15, the concrete dust chamber.

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[1] Park Ranger Bill Lawrence Jr. was present when his father was interviewed regarding his involvement in the Black Mountain mine. At that time, he identified Hazard Construction Company as the builder of the flue dust chamber (Lawrence 2006).

The design at Black Mountain followed what was considered to be a “common and simple, and effective dust chamber” that consisted of a “large deep flue, with transverse walls built up from the floor part way to the roof.” The walls or baffles slowed the movement of fumes and smoke through the chamber. The space between the upper edges of these cross walls allowed for the slow, quiet passage of the flue gases. As the fumes slowed, the dust particles dropped, according to their weight, and fell into the compartments between the baffles. Here the air was absolutely dead and they remained undisturbed until removed for further treatment (Peters 1899:475). As mentioned above, the Black Mountain dust chamber has openings along the base of the northeast side for removing the flue dust. The method of removal is not known but may have been similar to that used at the Omaha and Grant Smelting and Refining Company. There the flue dust was raked out into shallow pits where it was moistened before handling (Hofman 1904:378-397). The interior of the dust chamber at Black Mountain is remarkably clean. The sides and surfaces of the baffles are only slightly discolored from smoke, suggesting it was probably not used except for a few test runs and never produced enough flue dust to require cleaning.

Cyanide Vats

After the ore was roasted, operators of the Black Mountain Mining Company intended to remove it from the furnace and convey it to the cyanide vats for leaching (Features C-1, C-2, and C-3). Developed in Scotland in 1887, and first used in New Zealand in 1889, the cyanide process revolutionized gold mining by greatly increasing the efficiency of the milling process. It was first used in the United States in 1891, and by the end of the nineteenth century had been universally adopted (Young 1970: 283-286; Scheidel 1894:67; Hardesty 1988:51-65).

The process was relatively simple. Crushed ore or tailings were mixed with a weak cyanide solution that dissolved and separated gold from the ore. The solution was then run through boxes packed with zinc shavings that precipitated the gold, allowing for its recovery. The solution was then pumped into a reservoir for reuse.

Cyanide leaching allowed collection of virtually every atom of gold contained in tailing waste and low-grade ore (Young 1970:283). It was not only a technological, but also a financial breakthrough. The process required fewer workmen than previous milling methods, which meant lower labor costs. In addition, the procedure reused the same water, thus requiring much less than a ball mill, or concentrator - an important savings for small operations with a limited water supply like Black Mountain (Scheidel 1894). It is estimated that cyanidation doubled the world’s annual production of gold at the end of the nineteenth century (Young 1970:284-286; Scheidel 1894:96).

It is assumed that the solution for the cyanide process at Black Mountain was stored in reservoir Feature M-7: the same concrete tank that appears to have originally been built to hold water for the ball mill and concentrator used in the Phase 1 milling process. From here the solution would have been conveyed through pipes to the cyanide vats represented by Features C-1 and C-2. As already stated, these vats would have been previously filled with ore taken from the rotary furnace after roasting. The vats are located approximately 160 ft. to the northeast of the mill site terrace. They are accessed by a roadcut approximately 15 ft. wide and designated Feature A-1. This road continued to the northwest, and was apparently the main access road used to bring the machinery and supplies used to construct the mill.

Features C-1 and C-2 are poured concrete reservoirs approximately 8 ft. in depth. Feature C-1 measures around 10 x 10 ft., and C-2 about 10 x 20 ft. and is divided into two 10-ft. square sections. After leaching, the cyanide solution would have been drained from these tanks and passed through filters to recover the gold. The liquid would then have been pumped back to the reservoir at Feature M-1 for reuse. Remains of the filtering equipment and pipelines for conveying the solution were not found. Although the equipment may have been removed for salvage after the mine shut down, the lack of footings or a terraced pad for the filtering equipment location is problematical and suggest that, given the fact that very little, if any, ore was ever processed at Black Mountain, the cyanide plant may never have been completed.

6 RESOURCE EVALUATION

Because federal grant funds could be involved in future funding for Black Mountain Open Space Park, resource evaluation was conducted using the criteria for the National Register of Historic Places, and the California Register. Criteria included in the City of San Diego Historical Resources Guidelines (updated August 2004) were also used to prepare this report.

NATIONAL REGISTER OF HISTORIC PLACES

The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title H of this Act a reasonable opportunity to comment with regard to such undertaking [National Historic Preservation Act of 1966, as amended Section 106 (16 U.S.C. 470f)].

Criteria for Evaluation

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and,

(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or;
(b) that are associated with the lives of persons significant in our past; or
(c) that embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
(d) that have yielded, or may be likely to yield, information important in prehistory or history.

Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

(1) A religious property deriving primary significance from architectural or artistic distinction or historical importance; or

(2) A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or

(3) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life; or

(4) A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or

(5) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

(6) A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or

(7) A property achieving significance within the past 50 years if it is of exceptional importance.

CALIFORNIA REGISTER OF HISTORICAL RESOURCES

California Environmental Quality Act (CEQA)

CEQA requires that all private and public activities not specifically exempted be evaluated against the potential for environmental damage, including effects to historical resources. Historical resources are recognized as part of the environment under CEQA. It defines historical resources as “any object, building, structure, site, area, or place which is historically significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California” [Division I, Public Resources Code, Section 5021.1(b)].

Lead agencies have a responsibility to evaluate historical resources against the California Register criteria prior to making a finding as to a proposed project’s impacts to historical resources. Mitigation of adverse impacts is required if the proposed project will cause substantial adverse change. Substantial adverse change includes demolition, destruction, relocation, or alteration such that the significance of an historical resource would be impaired. While demolition and destruction are fairly obvious significant impacts, it is more difficult to assess when change, alteration, or relocation crosses the threshold of substantial adverse change. The CEQA Guidelines provide that a project that demolishes or alters those physical characteristics of an historical resource that convey its historical significance (i.e., its character-defining features) can be considered to materially impair the resource's significance.

The California Register is used in the consideration of historic resources relative to significance for purposes of CEQA. The California Register includes resources listed in, or formally determined eligible for listing in, the National Register of Historic Places, as well as some California State Landmarks and Points of Historical Interest. Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts), or that have been identified in a local historical resources inventory may be eligible for listing in the California Register and are presumed to be significant resources for purposes of CEQA unless a preponderance of evidence indicates otherwise.

Generally, a resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing on the California Register of Historical Resources (Pub. Res. Code SS5024.1, Title 14 CCR, Section 4852) consisting of the following:

(1) It is associated with events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States; or

(2) It is associated with the lives of persons important to local, California, or national history; or

(3) It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master, or possesses high artistic values; or

(4) It has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

CITY OF SAN DIEGO CEQA SIGNIFICANCE

If a resource is not listed in, or determined eligible for listing in, the California Register, not included in a local register, or not deemed significant in a historical resource survey it may nonetheless be historically significant. If a proposed project has the potential to affect a historical resource, the significance of that resource must be determined. The significance of a historical resource is based on the potential for the resource to address important research questions as documented in a site-specific technical report prepared as part of the environmental review process. Research priorities for the prehistoric, ethnohistoric and historic periods of San Diego history are discussed in Appendix A (San Diego History) to the City of San Diego Historical Resources Guidelines (updated August 2004) and should be used in the determination of historical significance. As a baseline, the City of San Diego has established the following criteria to be used in the determination of significance under CEQA.

An archaeological site must consist of at least three associated artifacts/ecofacts (within a 50 square meter area) or a single feature and must be at least 45 years of age. Archaeological sites containing only a surface component are generally considered not significant, unless demonstrated otherwise. Such site types may include isolated finds, bedrock milling stations, sparse lithic artifact scatters, and shellfish processing stations. All other archaeological sites are considered potentially significant. The determination of significance is based on a number of factors specific to a particular site including site size, type and integrity; presence or absence of a subsurface deposit, soil stratigraphy, features, diagnostics, and datable material; artifact and ecofact density; assemblage complexity; cultural affiliation; association with an important person or event; and ethnic importance. The determination of significance for historic buildings, structures, objects and landscapes is based on age, location, context, association with an important person or event, uniqueness, and integrity.

A site will be considered to possess ethnic significance if it is associated with a burial or cemetery; religious social or traditional activities of a discrete ethnic population; an important person or event as defined by a discrete ethnic population; or the mythology of a discrete ethnic population.

Archaeological sites containing only a surface component are generally considered not significant, unless demonstrated otherwise. (Testing is required to document the absence of a subsurface deposit.) Such non-significant sites may include:

- Isolates;
- Sparse Lithic Artifact Scatters;
- Isolated Bedrock Milling Stations; and
- Shellfish Processing Stations.

Sparse Lithic Artifact Scatters are identified and evaluated based on criteria from the Office of Historic Preservation's "California Archaeological Resource Identification and Data Acquisition Program: Sparse Lithic Scatters" (February 1988). Isolated Bedrock Milling Stations are defined as having no associated site within a 50 meter radius and lacking a subsurface component. Shellfish Processing Stations are defined as containing a minimal amount of lithics and no subsurface deposit. Historic buildings, structures, objects and landscapes are generally not significant if they are less than 45 years old. A non-significant building or structure located within an historic district is by definition not significant. Resources found to be non-significant as a result of the survey and assessment, will require no further work beyond documentation of the resources and inclusion in the survey and assessment report.

EVALUATION OF BLACK MOUNTAIN MINE

Application Of National Register Criteria

The National Register assessment of the properties associated with the Black Mountain Mine applies the criteria of 36 CFR 60, as well as National Park Service guidance on evaluating mining properties and rural landscapes. National Register (NR) Bulletin #15 provides guidance and standards for applying the Criteria of Evaluation (Andrus and Shrimpton 2002). NR Bulletin #30 addresses the evaluation and documentation of rural historic landscapes (McClelland et al. 1999). NR Bulletin #42 provides guidelines for identifying and evaluating historic mining properties (Noble and Spude 1997). Together, these resources establish the basis for the finding that the Black Mountain Mine Rural Historic Landscape District qualifies for listing in the National Register of Historic Places under Criteria A and C at the local level of significance.

Rural Historic Landscapes

As noted, NR Bulletins #30 and #42 provide guidance for defining and evaluating properties such as those in the Black Mountain Mine project:

> For purposes of the National Register, a rural historic landscape is defined as a geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features. Rural landscapes commonly reflect the day-to-day occupational activities of people engaged in traditional work such as mining, fishing, and various types of agriculture. Often they have developed in response to both the forces of nature and the need to make a living [McClelland et al. 1999].
>
> Mining landscapes can be characterized and distinguished by historic patterns of land use such as strip-mining, hydraulic mining, or open-pit mining; the spatial organization or layout of the landscape; characteristic natural and cultural landforms such as mine waste rock dumps, mill tailing flows, and canyons; roads and pathways; vegetation patterns related to land use such as secondary growth of plants on mine waste rock dumps; distinctive buildings and structures such as headframes or cyanide mills or coal tipples; clusters of buildings and structures such as those at mines or urban settlements; and small-scale features such as mine claim markers or fences [Noble and Spude 1997].

Applying the Criteria of Eligibility to the Black Mountain Mine Rural Landscape Historic District demonstrates that the district meets Criterion A for its direct association with patterns of rural mining in the region. NR Bulletin #30 offers additional guidance:

> Criterion A recognizes the significant contributions that rural properties have made through diverse events and activities, including exploration, settlement, ethnic traditions, farming, animal husbandry, ranching, irrigation, logging, horticulture, fishing, fish culturing, mining, transportation, and recreation. Village and farm clusters, fields, and other land use areas, roadways, natural features, vegetation, and boundary demarcations may together illustrate important events and activities that led to a community's development [McClelland et al. 1999].

The mining venture at Black Mountain was closely associated with regional patterns of mineral exploitation typical of the late nineteenth and early twentieth centuries. Additionally, it reflects the unique episodic history of arsenic mining. The district also meets Criterion A for its representation of patterns of investment in unproductive mining properties that characterized much of the business climate of Western mining throughout the last half of the nineteenth and early twentieth centuries.

Criterion B, which pertains to an association with significant individuals, does not apply; for example, although Wilfred Buckland invested in the venture, this association is neither direct nor significant enough in his life to qualify.

The district meets Criterion C, because it reflects the unique engineering of arsenic extraction and processing. As a rural mining landscape, the site reflects both the direct influences of the natural setting and the patterns of activity associated with the mining process. Circulation patterns, concentrations of mining features and alterations to the landforms all convey the unique engineering and adaptation of the activity.

The site does not appear to meet Criterion D. As noted in NR Bulletin #42, “Application of Criterion D to mining properties requires the development of a good research design that not only identifies the research questions that are important to mining-related scholarship or science but also the information that is needed to answer the research questions” (Noble and Spude 1997). The Black Mountain Mine site appears to have no potential for contributing to research of this significance.

Integrity

As quoted above, 36 CFR 60.4 and NR Bulletin #15 make it clear that to be eligible a property must retain sufficient integrity to convey its significance. NR Bulletin #42, which addresses mining properties, provides focused guidance on integrity:

> When assessing the integrity of a mining property, it is important to remember that the National Register will accept significant and distinguishable entities whose components may lack individual distinction. As discussed elsewhere in this bulletin, the passage of time, exposure to a harsh environment, abandonment, vandalism, and neglect often combine to cause the deterioration of individual mining property components. For example, buildings may have collapsed, machinery may have been removed, and railroad tracks may have been salvaged. However, the property may still exhibit a labyrinth of paths, roads, shaft openings, trash heaps, and fragments of

> industrial activity like standing headframes and large tailings piles. Although these individual components may appear to lack distinction, the combined impact of these separate components may enable the property to convey the collective image of a historically significant mining operation. In essence, the whole of this property will be greater than the sum of its parts. In such cases, a mining property may be judged to have integrity as a system even though individual components of the system have deteriorated over time.
>
> Because most historic mining properties will be abandoned and in poor repair, special care must be taken when evaluating integrity. The integrity of a mining property cannot be judged in the same fashion as the integrity of a building. In some cases, buildings and objects related to mining will have been relocated and many original construction materials will be gone [Noble and Spude 1997].

Location

The Black Mountain Mine Rural Landscape Historic District retains a high degree of integrity of location. All of the adits, roadcuts, and concrete features are on the same locations where they were constructed. The district retains excellent integrity of location.

Design

Design is defined as the "combination of elements that create the form, plan, space, structure, and style of a property." It results from conscious decisions made during the original conception and planning of the property (Andrus and Shrimpton 2002). In spite of removal of major pieces of equipment, the original function of most of the features at the site can be identified and the original designs of the developers as they relate to the ore processing systems can be understood.

Setting

Setting is defined as the "physical environment of a historic property" (Andrus and Shrimpton 2002). The setting of the district is virtually unchanged from the time when the mine was developed. The narrow canyon and brush-covered slopes of Black Mountain remain unaltered, giving the district excellent integrity of setting.

Materials

Materials are "the physical elements that were combined during a particular period of time in a particular pattern of construction to form a historic property" (Andrus and Shrimpton 2002). The district retains original materials in the form of wood, concrete, steel, and masonry in the footings and structures, and earth and stone in the road cuts, adits, and tailings. Because of this, the district retains substantial integrity of materials.

Workmanship

Workmanship is the “physical evidence of crafts of a particular culture or people” (Andrus and Shrimpton 2002). Good integrity of design and materials, as discussed above, combine to give an excellent integrity of workmanship for the district.

Feeling and Association

Feeling is defined as “a property’s expression of the aesthetic or historic sense of a particular period of time” (Andrus and Shrimpton 2002). It results from the presence of historic features that together convey the property’s historic character. Association is the “direct link between an important historic event and a historic property.” The combination of integrity of location, design, setting, materials, and workmanship discussed above combine to give the district a strong feeling and association for its period of significance.

Reviewing the integrity of the Black Mountain Mine Rural Historic Landscape District with this guidance demonstrates that the resource retains substantial integrity of location, design, setting, materials, workmanship, feeling, and association.

Application Of California Register Criteria

Cultural resources listed, or eligible for listing, in the National Register of Historic Places are also eligible for listing in the California Register of Historic Resources (California Register). As the criteria for eligibility to the California Register mirror those of the National Register, the Black Mountain Mine Rural Historic Landscape District is eligible for the California Register under Criteria 1 and 3 as discussed above at a local level of significance.

City of San Diego CEQA Significance

Cultural resources listed in, or eligible for listing, in the National Register of Historic Places and/or the California Register of Historic Resources are also eligible for listing in the City of San Diego Historical Site Board Register.

ARCHAEOLOGICAL SITES

The archaeological sites and isolates recorded by previous surveys and during field survey for this project have not been evaluated for the National Register, California Register, or City of San Diego Historical Site Board Register.

Preliminary assessment of surface features of these sites suggests that most are unlikely to be eligible for listing at either the National, State or local level. Sparse shell scatters (SDI-18277), sparse lithic and shell scatters, isolated milling features (SDI-18276 and -18278) and isolates (P-37-028093) are not considered eligible under City of San Diego Guidelines for eligibility and would not be eligible for listing in the California or National Registers. Isolated historic features such as the rock cairns (SDI-18275 and -18280) are also unlikely to be eligible for listing at either the National, State or local level.

The two prehistoric quarries (SDI-13738 and -18279) have potential for eligibility and formal evaluation for the National Register, California Register, and City of San Diego Historical Site Board Register should be completed if impacts to any of these resources are anticipated as a result of park improvements, such as trail maintenance, or construction of signage.

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APPENDICES

APPENDIX A

Museum of Man Records Search

and

SCIC Records Search

(To be Provided)

APPENDIX B

Site Records

APPENDIX C

Native American Consultation

References

BLACK MOUNTAIN OPEN SPACE PARK CULTURAL AND HISTORIC RESOURCE SURVEY

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February 2007

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EXECUTIVE SUMMARY

The City of San Diego Department of Park and Recreation is preparing a Management Plan for the Black Mountain Open Space Park in Rancho Bernardo, San Diego. ASM Affiliates, Inc. was hired to complete a cultural resources survey of the 1,314-acre park to identify constraints and opportunities for future park development.

Located within the park are the remains of the Black Mountain Arsenic Mine (CA-SDI-11040H), which was in operation between 1923 and 1927. A major component of this study included detailed recording of the remaining features associated with the mine and archival research to develop a history of the mine and a cultural context for its operation. The mine site includes several adits and tailings where the ore was extracted, and a mill site where the ore was processed. A narrow gauge railway was used to transport the ore from the adits to the mill site. The mill site includes remnants of wooden buildings, remains of an ore-roasting furnace, concrete footings and foundations, concrete vats, and a poured concrete dust chamber 180 ft. in length that extends up the side of the canyon from the mill site. As a result of this study, the Black Mountain Mine Rural Historic District was recommended eligible for the National Register of Historic Resources. A National Register of Historic Places Registration Form has been prepared for submission to the Office of Historic Preservation. The Black Mountain Mine Rural Historic District is also recommended eligible for the California Register of Historic Resources and the City of San Diego Historical Site Board Register.

Prior to field survey, records searches were conducted at South Coastal Information Center and the Museum of Man. Four sites and one isolate were previously recorded within the Black Mountain Open Space Park, including two sparse lithic scatters (SDI-10547 and -10548), a prehistoric lithic quarry site (SDI-13738), the Black Mountain Arsenic Mine (SDI-11040H), and an isolate (P-37-014849). Three of these cultural resources (SDI-10547, -10548, and P-37-014849) were not relocated during the present survey. An additional five cultural resources and an isolate were recorded as a result of the present study. These include two rock cairns (SDI-18275 and -18280), a sparse shell scatter (SDI-18277), an isolated bedrock mortar (SDI-18278), the site of a prehistoric quarry (SDI-18279), and two isolated ceramic sherds (P-37-028093). Should impacts to any of these resources be anticipated as a result of park improvements, they should be formally evaluated for the California Register of Historic Resources and the City of San Diego Historical Site Board Register.

Results of the records search are provided in confidential Appendix A of this report. Department of Parks and Recreation site record forms (DPR 523 series) for each of the resources recorded by this study, including the Black Mountain Mine, are provided in Appendix B.

1. INTRODUCTION

Black Mountain Open Space Park is owned and managed by the City of San Diego, and is comprised of a series of chaparral and coastal sage scrub-covered hills, ridges, and canyons. It is located in the northern portion of the Rancho Penasquitos community, situated between Black Mountain Road to the north and west, Carmel Mountain Road to the south, and Penasquitos Drive to the east (Figures 1, 2, and 3). It is a relatively undisturbed natural area which provides an important wildlife habitat. The park currently encompasses 1,314 acres, with expansion a future possibility. The centerpiece of the park is the 1,554-ft. summit of Black Mountain, which provides 360-degree views of the surrounding area.

The Park originated in 1964 when the City acquired it under the "Recreation and Public Purposes Act of 1926." Easements for San Diego Gas and Electric (SDG&E) and CWA are maintained on-site. Approximately 2 acres at the top of Black Mountain are owned by American Towers, Pacific Bell, and Time Warner. Communication towers and access for the towers are maintained on-site. A 325-acre portion of the 538-acre Montana Mirador parcel, which is located in the southern portion of the plan area, was purchased and dedicated as open space in order to mitigate biological impacts associated with the San Diego CWA ESP. The remaining 213 acres of this parcel were purchased through a Wildlife Conservation Board grant for inclusion in the Park.

Black Mountain Mine, located on the north slope of the mountain at an elevation of approximately 1,000 ft., was mined for arsenopyrite in the 1920s. Many remnants of the mining operation still exist on site. The Rancho Penasquitos Community plan recommends development of an interpretive program and interpretive facilities for the mining operations.

The day-to-day management of the Park is the responsibility of the Park and Recreation Department, operating under the authority of the City Manager. The Open Space Parks Division of the Park and Recreation Department performs tasks such as trash removal, maintenance of all physical structures (such as fences, restrooms, signs, and trails), and brush management. Additionally, this Division provides park rangers, whose primary responsibilities include enforcement of city and state regulations, overseeing small enhancement and restoration efforts, interpretive activities, and coordination of volunteers. The Park and Recreation Department also has a Natural Resource Management Section whose primary purpose is the protection and management of environmental resources within the City's natural parks and open space.

Figure 1. Project vicinity.

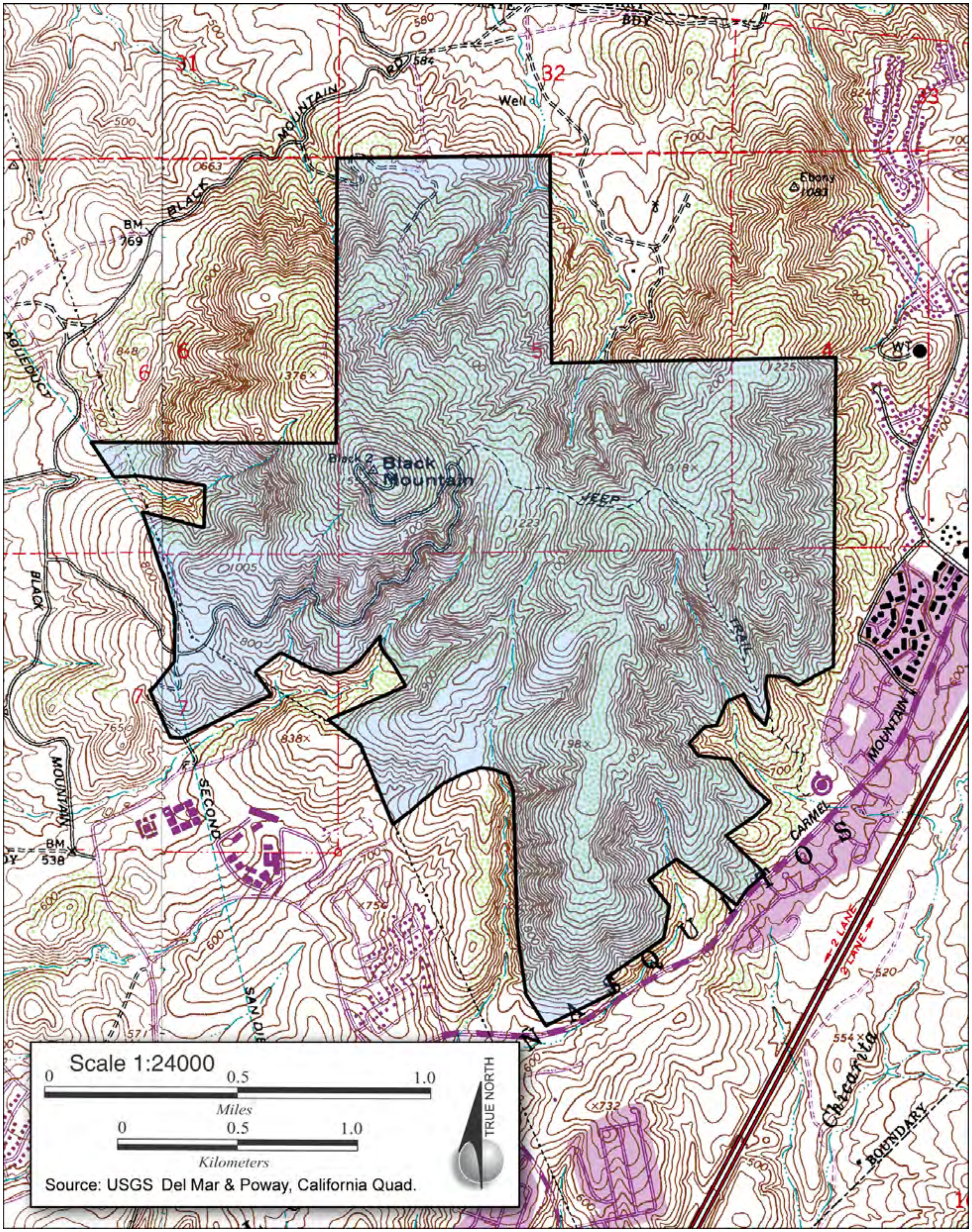

Figure 2. Project location.

Figure 3. View southwest from Black Mountain showing topography, vegetation, and encroaching suburbs.

2. ENVIRONMENTAL AND ARCHAEOLOGICAL CONTEXT

NATURAL SETTING

The following information has been summarized from the draft *Black Mountain Open Space Park Natural Resource Management Plan*, February 2004, prepared by the City of San Diego. The rich natural environment described in the following paragraphs was used by prehistoric people of the region, and provided the setting for the mining activity that came later.

Geology And Soils

The Park is located in the geological area known as the “Poway Quadrant” which consists of rock units called “Santiago Peak Volcanics.” The Santiago Peak Volcanics comprise an elongate belt of mildly metamorphosed volcanic, volcaniclastic, and sedimentary rocks that crop out from the southern edge of Los Angeles Basin southward towards Mexico (California Division of Mines 1975). The Santiago Peak Volcanics are extremely erosion-resistant, hard, and form topographic highs. Where fresh, most of the volcanic rocks are dark greenish-gray in color but where weathered are grayish-red to dark reddish-brown. The soil that develops from the volcanic rocks is the color of the weathered rocks and supports growth of dense chaparral. The majority of the soils onsite are classified as San Miguel-Exchequer rocky silt loam with smaller areas supporting San Miguel, Olivenhain, Auld, and Altamont soils. San Miguel soils are derived from meta-volcanic rock that is unique because of their relatively high acidity, clay subsoil layer, and low permeability. Olivenhain, Auld, and Altamont soils are also derived from meta- volcanic parent material and typically have a prominent clay layer (Bowman 1973).

When viewed from a regional scale, Black Mountain is part of a chain of relatively high coastal peaks stretching from northern Baja California to Camp Pendleton. A number of these peaks support sensitive plant species because of unique soils or microclimates (Beauchamp 1986:241). The Park ranges in elevation from 600 ft. above mean sea level at the southern portion of the study area to 1,552 ft. at Black Mountain Peak. The topography is characterized by bands of steep ridges and canyons across the majority of the site. Most of the site is greater than 25 percent slope and much of the remainder is more than 10 percent. The Park is situated on the north slope of Black Mountain and includes Black Mountain Peak and a system of interconnected ridges and ravines, including several U.S. Geological Service blue line streams that eventually drain to Los Peñasquitos, Carmel, and Lusardi creeks. A small portion of the site at the north to northeast boundary consists of more gradually sloping hills and meadows. Surface water within the park drains into channels that lead the water off-site and eventually empty into the San Dieguito River.

Biological Resources

The Park area is comprised of a diverse assemblage of vegetation types and wildlife habitats. Chaparral, chaparral-coastal sage scrub, and coastal sage scrub are the dominant plant communities onsite. Non-native grassland and ruderal habitats are also found within the Park in areas associated with past disturbance. Small patches of native grassland (less than one acre) exist within larger stands of coastal sage scrub. One small patch of freshwater marsh exists in the northern portion of the Park.

Some hillsides include substantial populations of the native purple needle grass (*Nassella pulchra*). These native patches of grassland may provide nesting habitat for the grasshopper sparrow (*Ammodramus savannarum*). Native grasslands have been severely depleted throughout the coastal area and are often overlooked as sub-components of larger stands of non-native grasses.

A total of approximately 308 acres of Diegan coastal sage scrub habitat and approximately 252 acres of coastal sage-chaparral scrub are scattered throughout the Park. A large portion of the coastal sage scrub (100 acres) and coastal sage-chaparral (195 acres) habitat is found on the Montana Mirador section of the Park. Approximately 185 acres of this habitat is California gnatcatcher (*Polioptila californica californica*) core habitat. Dominant species include coastal sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), and lemonadeberry (*Rhus integrifolia*). The coastal sage scrub onsite contains many sensitive plant species including California adolphia (*Adolphia californica*), San Diego viguiera (*Viguiera laciniata*), and San Diego barrel cactus (*Ferocactus viridescens*).

Sensitive wildlife known to use the Diegan coastal sage scrub and chaparral-coastal sage scrub include: the coastal California gnatcatcher, and the orange-throated whiptail (*Cnemidophorus hyperythrus*). The San Diego coast horned lizard (*Phrynosoma coronatum blainvillei*) is also present in small numbers. Many bird species typical of scrub habitats in southern California occur here, such as the California towhee (*Pipilo crissalis*), California quail (*Callipepla californica*), wrentit (*Camaea fasciata*), and California thrasher (*Toxostoma redivivum*). Other animals found in this habitat include the desert cottontail (*Sylvilagus* audubonnii) and western fence lizard (*Sceloporus occidentalis*).

Southern mixed chaparral is the most common habitat type within the Park, totaling approximately 252 acres. Southern mixed chaparral is a plant community dominated by drought-tolerant tall shrubs. This habitat is typically found on north-facing slopes where drier conditions are present. This plant community is dominated by chamise (*Adenostoma fasciculatum*), toyon (*Heteromeles arbutifolia*), ceanothus (*Ceanothus* spp.), mission manzanita (*Xylococcus bicolor*), and sugar bush (*Rhus ovata*). This vegetation type is usually dense with little or no understory cover. As a slightly more common habitat, southern mixed chaparral does not support a large number of sensitive species. However, some of the same species, which inhabit the nearby scrub habitats, may also utilize chaparral habitat.

A small amount of freshwater marsh (0.47 acre) occurs in the northern portion of the Park. Freshwater marsh consists of peripheral stands of vegetation around permanent or late-drying ponds. During the drier portions of the year, the marsh vegetation in these ponds typically dies back to the tuberous root system with only short and sparse young leaves remaining green.

Several of these ponds are highly alkaline during the summer months and a thin layer of salt can often be seen crusting over drying mud in mid and late summer. Dominant plants include cattails (*Typha* spp.) and bulrush (*Scirpus* spp.). Other native plant species likely occurring include marsh fleabane (*Pluchea odorata*), toad rush (*Juncus bufonius*), and several species of sedge (*Cyperus eragrostis*, *C. odoratus*, *C. erythrorhizos*).

Small stands of non-native grassland, totaling approximately 23 acres, 17 acres of which occur within the 325-acre Montana Mirador conservation area, can also be found throughout the Park, usually in areas of disturbance. Eurasian grasses dominate these areas, generally between patches of sage scrub. The dominant non-native grasses include wild oat (*Avena barbata*), bromes (*Bromus madritensis* ssp. *rubens*, *B. hordaceous*, *B. diandrus*), foxtail fescue (*Vulpia myuros*), hare barley (*Hordeum murinum* ssp. *leporinum*), and English ryegrass (*Lolium perenne*).

A variety of wildlife (invertebrates, amphibians, reptiles, birds, and mammals) is found in the Park due to the size and diversity of habitat within the Preserve. A variety of butterfly species, such as Behr's metalmark (*Apodemia mormo virgulti*) and California ringlet (*Coenonympha californica*), are found throughout the Park. Limited habitat exists in the Park for the Hermes copper butterfly (*Lycaena hermes*). Host plant for this species is spiny redberry (*Rhamnus crocea*), which is found within limited areas of the sage scrub in the Park.

A variety of frog and toad species is known to occur in the Park area. One species, the pacific tree frog (*Hyla regilla*), was observed on-site (City of San Diego 1993:42). The bullfrog (*Rana catesbeiana*) is occasionally found throughout the Plan area, usually in lowland aquatic habitats such as streams and ponds. This species is native to Southeast Asia and Australia and was introduced into California around the turn of the century. It is one of the largest anurans in North America, and preys on native frogs and toads.

Lizard species observed on-site include the side-blotched lizard (*Uta stansburiana*) and western fence lizard (City of San Diego 1993). Previous sightings of orange-throated whiptail have been recorded on-site. The San Diego alligator lizard (*Gerrhonotus multicarinatus*), gopher snake (*Pituophis melanoleucus*), San Diego horned lizard and western rattlesnake (*Crotalus viridis*) are additional snake and lizard species expected to occur on-site.

Ample nesting and foraging habitat for many avian species exists on-site, and a wide variety of birds have been observed. Migratory birds species, such as Wilson's warbler (*Wilsonia pusilla*) and olive-sided flycatcher (*Contopus borealis*), are known to visit the Park. Anna's hummingbird (*Calypte anna*), Say's phoebe (*Sayornis saya*), common raven (*Corvus corax clarionensis*), Bewick's wren (*Thyromanes bewickii*), rock wren (*Salpinctes obsoletus*), California thrasher (*Toxostoma redivivum redivium*), lesser goldfinch (*Carduelis psaltria hesperophilus*), yellow-rumped warbler (*Dendroica coronata*), coastal California gnatcatcher (*Polioptila californica californica*), and fox sparrow (*Zonotrichia iliaca*) are among the perching bird species occupying habitat within the Park.

Several rock outcrop formations located throughout the site are embellished with "whitewash," indicating their use as raptor perches. Birds of prey observed within the Park include red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), northern harrier, Cooper's hawk (*Accipiter cooperii*), and turkey vulture (*Cathartes aura*). Other species not observed within the Park, but likely to use the area, are golden eagle (*Aquila chrysaetos canadensis*), red-shouldered hawk (*Buteo lineatus elegans*), and sharp-shinned hawk (*Accipiter striatus velox*). Owls and nighthawks are likely to occur within the Park; however, detection of these species is difficult because they are nocturnal. Species likely to utilize the habitat on-site include common barn owl (*Tyto alba*), great horned owl (*Bubo virginiansus*), lesser nighthawk (*Chordeiles acutipennis*), and common poorwill (*Phalaenoptilus nuttallii*).

Direct observation of mammal species is very difficult due to their shy and sometimes nocturnal habits. Evidence such as scat, tracks, burrows, and dens aid in determining presence of various animals. Abundant signs of common species, such as coyote (*Canis latrans*), woodrat (*Neotoma* spp.), mule deer (*Odocoileus hemionus*), and cottontail rabbit (*Sylvilagus auduboni*), have been observed within the Park. Signs of large predators, such as bobcat (*Lynx rufus*) and gray fox (*Urocyon cinereoargentus*), have been observed in portions of the Park (City of San Diego 1993). Habitat within the Park has a high probability of supporting a wide variety of mammals, including rodents such as California ground squirrel (*Spermophilus beecheyi*), striped skunk (*Mephitis mephitus*), and long-tailed weasel (*Mustela frenata*). The old arsenic mine site may potentially be home to a wide variety of bat species. Raccoons (*Procyon lotor*) and related species, such as the ringtail (*Bassariscus astutus*), could also occur within the Park.

CULTURAL HISTORY

Prehistory

Archaeological fieldwork along the southern California coast has yielded a diverse range of human occupation extending from the early Holocene into the Ethnohistoric period (Erlandson and Colten 1991; Jones 1992; Moratto 1984). A variety of different regional chronologies, often with overlapping terminology, have been used in coastal southern California and they vary from region to region (Moratto 1984:Figures 4.5 and 4.17). Today, the prehistory of San Diego County is generally divided into three major temporal periods: Paleoindian, Archaic, and Late Prehistoric. These time periods are characterized by patterns in material culture that are thought to represent distinct regional trends in the economic and social organization of prehistoric groups. In addition, particular scholars referring to specific areas utilize a number of cultural terms synonymously with these temporal labels: San Dieguito for Paleoindian, La Jolla for Archaic, and San Luis Rey for Late Prehistoric (Meighan 1959; Moriarty 1966; Rogers 1939, 1945; True 1966, 1970; Wallace 1978; Warren 1964).

Paleoindian Period

The antiquity of human occupation in the New World has been the subject of considerable debate over the last few decades. The currently accepted model is that humans first entered the western hemisphere between 12,000 and 15,000 B.P. While there is no firm evidence of human occupation in coastal southern California prior to 12,000 B.P., dates as early as 23,000 B.P. and even 48,000 B.P. have been reported (Bada et al. 1974; Carter 1980; Rogers 1974). The amino acid racemization technique used to date these sites has been largely discredited, however, by more recent accelerator radiocarbon dating of early human remains along the California coast (Taylor et al. 1985). Despite intense interest and a long history of research, no widely accepted evidence of human occupation of North America dating prior to 15,000 B.P. has emerged.

As in most of North America, the earliest recognized period of California prehistory is termed Paleoindian. In southern California, this period is usually considered to date from at least 10,000 B.P. until 8500 to 7200 B.P. (Moratto 1984; Warren et al. 1993), and is represented by what is known as the San Dieguito complex (Rogers 1966). Within the local classificatory system, San Dieguito assemblages are composed almost entirely of flaked stone tools, including scrapers, choppers, and large projectile points (Warren 1987; Warren et al. 1993). Until recently, the near absence of milling tools in San Dieguito sites was viewed as the major difference between Paleoindian economies and the lifeways which characterized the later Archaic period.

Based upon rather scant evidence from a small number of sites throughout San Diego County, it has been hypothesized that the people linked to the San Dieguito complex lived within a generalized hunter-gatherer society with band-level organization. This portrayal is essentially an extension to the inland and coastal areas of San Diego County of what has long been considered a continent-wide Paleoindian tradition. This immediate post-Pleistocene adaptation occurred within a climatic period of somewhat cooler and moister conditions than exists presently. The range of possible economic adaptations of San Dieguito bands to this environment are poorly understood at present, but it is typically assumed that these groups followed lifeways similar to other Paleoindian groups in North America.

This interpretation of the San Dieguito complex as the local extension of a post-Clovis big game hunting tradition is based primarily on materials from the Harris Site (Ezell 1983, 1987; Warren 1966, 1967. An unusually high percentage of large bifaces in the Harris assemblage seems indicative of a retooling station, a pattern not found at any other purported San Dieguito sites. Still, there does appear to be some evidence that large biface technology was typical of the earliest occupations of San Diego County, and that this pattern is shared by other complexes in the greater Southwest. What is less clear is how large a role these objects played in the day-to-day subsistence activities of their creators.

Archaic Period

The Archaic period (also referred to as the Early Milling Period) extends back at least 7,200 years, possibly as early as 9000 B.P. (Moratto 1984; Rogers 1966; Warren et al. 1993).

Archaic subsistence is generally considered to have differed from Paleoindian subsistence in two major ways. First, gathering activities were emphasized over hunting, with shellfish and seed collecting of particular importance. Second, milling technology, frequently employing portable ground stone slabs, was developed. The shift from a mostly maritime subsistence focus to a land-based focus is traditionally held to mark the transition from the Paleoindian period to the Archaic period. In reality, the implications of this transition are poorly understood from both an economic and cultural standpoint (see Warren et al. 1993 for an excellent review).

Early Archaic occupations in San Diego County are most apparent along the coast and the major drainage systems that extend inland from the coastal plains (Moratto 1984). Coastal Archaic sites are characterized by cobble tools, basin metates, manos, discoidals (disk-shaped grinding stones), a small number of “Pinto” and “Elko” series dart points, and flexed burials. Together these elements typify what is termed the La Jolla complex in San Diego County, which appears as the early coastal manifestation of a more diversified way of life.

For many years the common model has included something that D. L. True (1958) termed the Pauma complex, an archaeological construct based upon a number of inland Archaic period sites in northern San Diego that appeared to exhibit assemblage attributes different from coastal Archaic sites. Pauma complex sites were typically located on small saddles and hills overlooking stream drainages, and were characterized by artifact scatters of basin and slab metates, manos, some scraper planes, debitage, and occasional ground stone discoidals. Further analysis suggests that the Pauma complex is simply an inland counterpart to the coastal La Jolla complex (Cardenas and Van Wormer 1984; Gallegos 1987; True and Beemer 1982). Given that the distance between the two environments (coastal and inland) is only a few dozen kilometers, and that sites attributed to each complex appear to be contemporaneous, it seems more parsimonious to consider the differences in materials as seasonal manifestations of a mobile residence strategy using both coastal and inland resources. When similar environmental variability exists within Archaic complexes in other regions, such sites are usually considered to represent different aspects of the annual positioning strategies of a single hunter-gatherer culture complex (Bayham and Morris 1986; Sayles 1983; Sayles and Antevs 1941).

In recent years, local archaeologists have questioned the traditional definition of the Paleoindian San Dieguito complex as consisting solely of flaked lithic tools and lacking milling technology. There is speculation that differences between artifact assemblages of “San Dieguito” and “La Jolla” sites may reflect functional differences rather than temporal or cultural variability (Bull 1987; Gallegos 1987; Wade 1986). Gallegos (1987) has proposed that the San Dieguito, La Jolla, and Pauma complexes are manifestations of the same culture, that is, different site types are the result of differences in site locations and resources exploitation (Gallegos 1987:30). This hypothesis, however, has been strongly challenged by Warren and others (1993).

In short, our understanding of the interplay between human land use, social organization, and material culture for the first several millennia of San Diego prehistory is poorly developed, although some progress has been made. Recent data collection has accelerated in the areas of paleoenvironmental analysis, paleoethnobotany, faunal analysis, and lithic technology studies. More importantly, efforts are being made to re-examine the assumptions surrounding existing artifact typologies and climatic reconstructions that form the basis of the standard systematics.

Late Prehistoric Period

In his later overviews of San Diego prehistory, Malcolm Rogers (1945) hypothesized that around 2000 B.P., Yuman-speaking people from the Colorado River region began migrating into southern California. This hypothesis was based primarily on patterns of material culture in archaeological contexts and his reading of ethnolinguistics. This “Yuman invasion” is still commonly cited in the literature, but some later linguistic studies suggest that the movement may have actually been northward from Baja California.

Assemblages derived from Late Prehistoric sites in San Diego County differ in many ways from those in the Archaic tradition. The occurrence of small, pressure-flaked projectile points, the replacement of flexed inhumations with cremations, the introduction of ceramics, and an emphasis on inland plant food collection, processing, and storage (especially acorns) are only a few of the cultural patterns that were well established by the second millennium A.D. The centralized and seasonally permanent residential patterns that had begun to emerge during the Archaic period became well established in most areas. Inland semi-sedentary villages appeared along major watercourses in the foothills and in montane valleys where seasonal exploitation of acorns and piñon nuts were common, resulting in permanent milling stations on bedrock outcrops. Mortars for acorn processing increased in frequency relative to seed-grinding basins.

The Late Prehistoric period is represented in the northern part of San Diego County by the San Luis Rey complex (Meighan 1954; True et al. 1974), and by the Cuyamaca complex in the southern portion of the county (True 1970). The San Luis Rey complex is the archaeological manifestation of the Shoshonean predecessors of the ethnohistoric Luiseño, while the Cuyamaca complex reflects the material culture of the Yuman ancestors of the Kumeyaay (also known as Diegueño).

The San Luis Rey complex is typically divided into two phases: San Luis Rey I and II. San Luis Rey I is a preceramic phase dating from approximately 2000 B.P. to 500 B.P. (True et al. 1974). The material culture of this phase includes small triangular pressure flaked projectile points, manos, portable metates, *Olivella* spp. shell beads, drilled stone ornaments, and mortars and pestles. The San Luis Rey II phase differs only in the addition of ceramics and pictographs. Firm dates for the introduction of ceramics have not been satisfactorily documented, but a date between about A.D. 800 and A.D. 1300 is generally accepted. Evidence compiled by Griset (1986) indicates that the introduction and/or diffusion of ceramic technology throughout San Diego was more complex than previously thought.

According to True and others (1974), the Cuyamaca complex, while similar to the San Luis Rey complex, is differentiated by its greater frequencies of side-notched points, flaked stone tools, ceramics, and milling stone implements, a wider range of ceramic forms, a steatite industry, and cremations placed in urns. Assigning significance to these patterns should be done with caution, however, since it is obvious that seasonal camps in upland areas would reflect a different economic focus and would involve a slightly different set of trade relations than would be expected for populations on the seaboard. Thus a good deal of the variation in artifact form might be therefore attributed to functional differences or point of origin. Gross and others (1989) have suggested that these differences may not serve as indicators of cultural affiliation, and some may be due to different levels of organization. In regards to site structure, we might also expect occupational spans to differ between coastal and inland camps given the shorter summers at higher elevations.

Ethnohistoric Period

In ethnohistoric times, two main cultural groups occupied coastal San Diego County: the Shoshonean-speaking Luiseño and Juaneño in the north and the Kumeyaay or Diegueño in the south. Traditionally, Luiseño territory encompassed an area from roughly Agua Hedionda on the coast, east to Lake Henshaw, north into Riverside County, and west through San Juan Capistrano to the coast (Bean and Shipek 1978; Kroeber 1925; Rivers 1993). The region inhabited by various bands of the Kumeyaay was much larger and probably extended from Agua Hedionda lagoon eastward into the Imperial Valley and southward through much of northern Baja California (Almstedt 1982; Gifford 1931; Hedges 1975; Luomala 1978; Shipek 1982; Spier 1923).

The following short synopsis is derived from various ethnographic and historic documents and publications. More detailed culture histories for the Native American groups of the region are found in Barrows (1900), Bean (1978), Bean and Saubel (1972), Bean and Shipek (1978), Oxendine (1983), Shipek (1977), (1908), and Strong (1929), among others.

The Kumeyaay inhabited a diverse environment including marine, foothill, mountain, and desert resource zones. The Kumeyaay speak a form of the Yuman language (including the dialects Ipai and Tipai) related to the large Hokan superfamily.

There seems to have been considerable variability in the level of social organization and settlement patterns among the Kumeyaay. The Kumeyaay were organized bands containing members of non-localized patrilineal, patrilocal lineages that claimed prescribed territories, but did not own the resources except for some minor plants and eagle aeries (Luomala 1978; Spier 1923). Some of the bands occupied procurement ranges that required considerable residential mobility, such as those in the deserts (Hicks 1963). In the mountains, some of the larger bands occupied a few large residential bases that would be inhabited bi-annually, such as those inhabited in Cuyamaca in the summer and fall, and in Guatay or Descanso during the rest of the year (Almstedt 1982; Rensch 1975). According to Spier (1923), many desert and mountain Kumeyaay spent the spring to autumn in larger residential bases in the upland procurement ranges, and wintered in mixed groups in residential bases along the eastern foothills on the edge of the desert (i.e., Jacumba and Mountain Springs). This variability in settlement mobility and organization reflects the great range of environments within Kumeyaay territory. Most of Kumeyaay mythology was quite similar to the Quechan and Mojave of the Colorado River, as well as other Yuman groups in the Southwest (Gifford 1931; Hicks 1963; Luomala 1978; Spier 1923; Waterman 1910).

Acorns were the most important single food source utilized by the Kumeyaay. Kumeyaay villages were usually located near water, necessary for leaching acorn meal. Other storable resources such as mesquite or agave were equally valuable to bands inhabiting desert areas, at least during certain seasons (Hicks 1963; Shackley 1984). Seeds from grasses, manzanita, sage, sunflowers, lemonade berry, chia, and other plants were also used along with various wild greens and fruits.

Deer, small game, and birds were hunted, and fish and marine foods were eaten. Houses were arranged in the village without apparent patterns. Houses in primary villages were conical structures covered with tule bundles, having excavated floors and central hearths, while houses constructed at mountain bases generally lacked any excavation, probably due to the summer occupation. Other structures included sweathouses, ceremonial enclosures, ramadas, and acorn granaries. The material culture included ceramic cooking vessels, basketry, flaked stone tools, milling implements, arrow shaft straighteners, and bone, shell, and stone ornaments.

Hunting implements consisted of the bow and arrow, curved throwing sticks, nets, and snares. Bone and shell hooks, as well as nets, were used for fishing. Lithic resources of quartz and metavolcanics were commonly available throughout much of the Kumeyaay territory. Other raw materials such as obsidian, chert, chalcedony, and steatite occur in more localized areas. These raw materials were usually acquired through direct procurement or exchange. Projectile point types included the Cottonwood, as well as the Desert Side-notched, both commonly produced. Higher frequencies of ceramics and Desert Side-notched points in artifact assemblages at Kumeyaay sites have been documented (Gross et al. 1989; True 1966, 1970), and this may be one way to differentiate between Kumeyaay and Luiseño territory (True 1966).

Historic Period

Although the earliest historical exploration of the San Diego area can be traced to 1542 with the arrival of the first Europeans, particularly the exploration of San Miguel Bay by Juan Rodriguez Cabrillo, the widely accepted start of the historical period is 1769 with the founding of the joint Mission San Diego de Alcalá and Royal Presidio. The Hispanic period in California's history includes the Spanish Colonial (1769-1820) and Mexican Republic (1820-1846) periods. This era witnessed the transition from a society dominated by religious and military institutions consisting of missions and presidios to a civilian population residing on large ranchos or in pueblos (Chapman 1925).

The first intensive encounter of Spanish explorers and coastal villages of Native Americans was in 1769 with the establishment of Mission San Diego de Alcalá. The Mission of San Juan Capistrano was subsequently established in 1776, followed by San Luis Rey de Franciscan in 1798. The missions "recruited" the Native Americans to use as laborers and convert them to Catholicism. Local Native Americans rebelled briefly against Spanish control in 1775. Most of the individuals that participated in the attack were from Tipai settlements south of the San Diego River Valley. The Ipai to the north apparently did not participate in the rebellion, reflecting possible political affiliations at the time of the attack (Carrico 1981:Figure 2).

The effects of missionization, along with the introduction of European diseases greatly reduced the Native American population of southern California. At the time of contact, Luiseño population estimates range from 5,000 to as many as 10,000 individuals. Kumeyaay population levels were probably similar or somewhat higher. Many of the local Kumeyaay were incorporated into the Spanish sphere of influence at a very early date. Inland Luiseño groups were not heavily affected by Spanish influence until 1816, when an outpost of the mission was established 20 miles further inland at Pala (Sparkman 1908). Most villagers, however, continued to maintain many of their aboriginal customs and simply adopted the agricultural and animal husbandry practices learned from Spaniards.

By the early 1820s, California came under Mexico’s rule, and in 1834 the missions were secularized. This resulted in political imbalance and Indian uprisings against the Mexican rancheros. Many of the Kumeyaay left the missions and ranchos and returned to their original village settlements (Shipek 1991). When California became a sovereign state in 1850, the Kumeyaay were heavily recruited as laborers and experienced even harsher treatment. Conflicts between Native Americans and encroaching Anglos finally led to the establishment of reservations for some villages, such as Pala and Sequan. Other Mission groups were displaced from their homes, moving to nearby towns or ranches. The reservation system interrupted the social organization and settlement patterns, yet many aspects of the original culture still persist today. Certain rituals and religious practices are maintained, and traditional games, songs, and dances continue, as well as the use of foods such as acorns, yucca and wild game.

The subsequent American period (1846 to present) witnessed the development of San Diego County in various ways. This time period includes the rather rapid dominance over *Californio* culture by Anglo-Victorian (Yankee) culture and the rise of urban centers and rural communities. A Frontier period from 1845 to 1870 saw the region’s transformation from a feudal-like society to an aggressive capitalistic economy in which American entrepreneurs gained control of most large ranchos and transformed San Diego into a merchant-dominated market town. Between 1870 and 1930, urban development established the cities of San Diego, National City, and Chula Vista, while a rural society based on family-owned farms organized by rural school district communities also developed. The Army and Navy took an increased interest in the San Diego harbor between 1900 and 1940. The Army established coastal defense fortifications at Fort Rosecrans on Point Loma and the Navy developed major facilities in the bay (Fredricks 1979; Moriarty 1976; Van Wormer and Roth 1985). The 1920s brought a land boom (Robinson 1942) that stimulated development throughout the city and county, particularly in the Point Loma, Pacific Beach, and Mission Beach areas. Development stalled during the depression years of the 1930s, but World War II ushered in a period of growth based on expanding defense industries. Battery Point Loma, in operation from 1941 to 1943, played a pivotal role in the defense of Fort Rosecrans and San Diego Bay at the outbreak of World War II.

3. STUDY METHODS

Study methods for the project included archival research and pedestrian field surveys. The South Coastal Information Center (SCIC) and the San Diego Museum of Man (Museum of Man) conducted records searches for the study area on September 12, 2005 (Appendix A). The study area includes the 1,314-acre Black Mountain Open Space Park and all areas within one mile of the park boundaries. The search included a review of maps showing previously recorded archaeological and historic resources identified in the study area; a review of maps showing previous studies in the region; a search of the GeoFinder database which includes resources that are listed on the National, California, and local registers; and a review of historic maps for the project area.

ASM Associate Archaeologist Ken Moslak and Assistant Archaeologists Michelle Courtney, Adele Philippides, and Michael Garnsey conducted a pedestrian survey of most of the project area on October 11, 12, and 13, 2005. The survey consisted of transecting accessible portions of the property at approximately 15-m intervals. Areas of steep slope and very dense vegetation were subjectively selected for survey if visible bedrock outcrops appeared to be possible candidates for milling usage or rock art. When found, cultural resources were documented on California State Department of Parks and Recreation (DPR 523) forms. Resources were described and photographed. Their locations were plotted onto 7.5-minute USGS quadrangles and coordinate information was collected using Garmin 12 handheld GPS receivers.

Pedestrian survey of the north central portion of the project area, in the vicinity of the Black Mountain Arsenic Mine, was conducted the week of November 7-11, 2005. ASM Senior Architectural Historian Bill Manley directed the survey. Mr. Manley and Project Historian Steve Van Wormer of Walter Enterprises conducted reconnaissance and preliminary documentation of historic mining features. ASM Associate Archaeologist Scott Wolf and Assistant Archaeologist John Elford surveyed the remaining area in the north-central section of the project area.

Following the survey Project Historian Steve Van Wormer conducted additional historical and archival research at the San Diego Historical Society and a variety of other sources to document the history of arsenic mining in region, and the history of the Black Mountain Arsenic Mine in particular. This research assisted in completion of DPR 523 forms (Appendix B) and National Register of Historic Places Registration Forms.

NATIVE AMERICAN CONSULTATION

Pursuant to SB18, Native American consultation was initiated by ASM Affiliates on August 31, 2005. Ms. Catharine Wright of ASM wrote to the California Native American Heritage Commission (CNAHC), requesting a search of maps and files for information relating to traditional cultural properties or Native American heritage sites recorded within the project area. It was also requested that the CNAHC provide a listing of all tribal representatives who may have relevant knowledge of such locations within the project area. The CNAHC responded with a letter noting that no traditional cultural properties were recorded within the project area and provided a listing of Native American tribes or individuals who could be contacted for more information. A letter was subsequently sent to these tribes and/or individuals. Copies of Native American consultation letters are provided in Appendix C.

RECORDS SEARCH RESULTS

Results of the record searches are summarized below in Tables 1, 2, and 3. The complete results of the records search are included in Appendix A. More than 75 cultural resource studies have been conducted within one mile of the project area. Of these, 13 have intersected some portion of the project. Most previous studies were conducted in association with existing or proposed residential developments to the north and west of the park boundaries. A substantial number of studies have also been conducted in association with development of the State Route 56 transportation corridor south of the park and, to a lesser extent, with the Interstate 15 corridor east of the park.

The records search identified a total of 142 sites or cultural resources and 34 isolated occurrences within the study area. Sites identified by the records search are summarized in Table 2. Of this number, only four sites and one isolate are located inside the Park boundaries. These are discussed below and summarized in Table 3. Sites that have been formally documented and given trinomial designations by the SCIC are noted with an SDI- prefix. Sites documented with the Museum of Man are noted with a W- prefix. Many sites have both an SDI- and W- prefix, meaning both the SCIC and Museum of Man maintain records for these sites. Most, but not all, isolated artifacts are noted with an SDI-I- or W-I- prefix. Sites that have been documented but have not been assigned a trinomial are noted with a P-37- prefix.

Table 1. Previous Cultural Resource Studies Inside Black Mountain Open Space Park

Surveyor	Date / NADB Report Number	Portion of Project	Positive / Negative
Caltrans	1990 / 1126765	South	Negative
Carrillo	1980 / 1127338	West	Positive
City of San Diego	1992 / 1122772	West-central	Positive
Cupples	1974 / 1120511	West	Positive
Hector	1988	North	Positive
Kaldenberg	1975 / 1121243	West	Negative
KEA Environmental	2000 / 1123837	West	Positive
McCorkel	1994 / 1123007	Southwest	Positive
Norwood	1978 / 1221295	Northeast	Positive
Cardenas and Winterrowd	1985	Unknown	Positive
Recon	1978 / 1224947	Southwest	Positive
Recon	1979 / 1228010	Southwest	Positive
Wade	1992 / 122552	West	Negative

Table 2. Previously Recorded Resources Within One Mile of Black Mountain Open Space Park

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
W-1560	Artifact scatter	1977	Corum et al.	2,250 ft SE	Indeterminate
W-1561	Artifact scatter	1977	Corum et al.	2,500 ft SE	Indeterminate
W-1563	Lithic scatter	1977	Corum et al.	4,250 ft E	Indeterminate
W-3704	Lithic scatter	1985	Cardenas and Winterrowd	1,250 ft S	Indeterminate
W-4329 A, B	Habitation site and lithic scatter	1990	Ritz et al.	3,000 ft W	Indeterminate
W-4330	Lithic scatter	1990	Ritz and Collett	3,250 ft W	Indeterminate
W-4334	Lithic scatter	1990	Ritz and Collett	5,000 ft W	Indeterminate
W-4629	Bedrock milling	1990	Ritz	5,000 ft NW	Indeterminate
W-4630	Artifact scatter	1990	Ritz and Hanna	750 ft W	Indeterminate
W-4634	Artifact scatter	1990	Hanna	250 ft N	Indeterminate
W-5217A	Rock enclosure	1992	Pigniolo et al.	1,750 ft NW	Indeterminate
W-6515	Temporary habitation	1971	May	5,000 ft W	Indeterminate
W-6664	Lithic scatter	1993	Smith	5,000 ft N	Indeterminate
SDI-4667	Lithic scatter	1989	Gross et al.	2,500 ft NW	Indeterminate
SDI-5095/W-6524	Lithic scatter	1974	May	2,500 ft NW	Indeterminate
SDI-5105/W-1026	Mine and adobe ruins	1974	May	4,500 ft NW	Indeterminate
SDI-5107	Bedrock milling, rock wall, artifact scatter	1990	May, updated by Ritz	4,500 ft NW	Indeterminate
SDI-5110/W-187	Artifact scatter/midden	1980	Rogers, updated by May and Cardenas	3,500 ft NW	Indeterminate
SDI-5178/W-607A	Bedrock milling and lithic scatters	1978	Carrico, updated by Eckhardt	5,000 ft SE	Indeterminate
SDI-5179/W-607B	Bedrock milling with artifacts	1975	Carrico?	4,500 ft SE	Indeterminate
SDI-5180/W-607C	Bedrock milling	1978	Eckhardt	4,500 ft SE	Indeterminate
SDI-5223/W-1342	Bedrock milling with artifacts	1977	Bull	3,000 ft W	Indeterminate
SDI-5381/W-1337	Temporary habitation	1977	Norwood	3,900 ft SW	Indeterminate
SDI-5382/W-1338	Temporary habitation	1977	Norwood	2,800 ft S	Indeterminate
SDI-5383/W-1339	Temporary habitation	1984	Norwood, updated by RBR Associates	2,000 ft SW	6Y1 – determined ineligible
SDI-5384A/W-1341A	Bedrock milling with artifacts	1977	Norwood	400 ft W	Indeterminate
SDI-5386/W-1520	Lithic scatter	1977	Norwood	In project area	Indeterminate
SDI-5387/W-1521	Bedrock milling	1977	Norwood	5,000 ft W	Indeterminate
SDI-5388/W-1522	Bedrock milling	1977	Norwood	250 ft E	Indeterminate
SDI-5389A/W-1524A	Bedrock milling	1977	Norwood	Adjacent to project	Indeterminate
SDI-5389B/ W-1524B	Bedrock milling	1977	Norwood	250 ft W	Indeterminate
SDI-5390/W-1523	Bedrock milling	1999	Jones and Stokes	1,500 ft W	Indeterminate, reported destroyed
SDI-5391A/W-1340A, W-1341A	Temporary habitation	1977	Norwood	500 ft W	Indeterminate
SDI-5391B/W-1340B	Lithic scatter	1977	Norwood	3,700 ft W	Indeterminate
SDI-6068/W-1969	Lithic scatter	1978	Thesken	3,700 ft E	Indeterminate
SDI-6069/W-1970	Bedrock milling with lithic scatter	1978	Thesken	4,400 ft E	Indeterminate

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
SDI-6970/W-1971	Bedrock milling	1978	Thesken	5,300 ft E	Indeterminate
SDI-6080/W-1564	Lithic scatter and possible quarry	1978	Thesken	4,500 ft E	Indeterminate
SDI-6081/W-1562A	Lithic scatter	1978	Thesken	2,500 ft E	Indeterminate
SDI-6082/W-1562b	Lithic scatter	1978	Thesken	3,000 ft E	Indeterminate
SDI-6086/W-462	Bedrock milling with lithic scatter	1978	Thesken	3,000 ft E	Indeterminate
SDI-6087/W-463	Lithic scatter	1978	Thesken	5,200 ft E	Indeterminate
SDI-6668/W-1859	Artifact scatter	1981	Corum and Carrillo	3,700 ft E	Indeterminate
SDI-6669/W-1858, W-230	Temporary habitation	1978	Walker	4,000 ft E	Indeterminate
SDI-6672/W-2929	Lithic scatter	1974	May	Adjacent to project	Indeterminate
SDI-6673/W-2794	Artifact scatter	1980	May, updated by Walker	3,400 ft W	Indeterminate, reported as destroyed by Walker
SDI-6674/W-2793	Artifact scatter	1980	Walker and Cardenas	3,500 ft W	Indeterminate
SDI-6675	Temporary habitation	1974	May	4,600 ft W	Indeterminate
SDI-6677/W-2790	Temporary habitation	1974	May	2,600 ft W	Indeterminate
SDI-6682/W-2791	Bedrock milling	1980	Cardenas	4,800 ft W	Indeterminate
SDI-6837	Artifact scatter	1981	Corum	3,000 ft S	Indeterminate
SDI-6838	Lithic scatter	1981	Corum	3,000 SE	Indeterminate
SDI-6839	Lithic scatter	1977	Corum et al.	4,300 ft E	Indeterminate
SDI-8719/W-2982	Bedrock milling	1981	Corum	2,750 ft E	Indeterminate
SDI-9286/W-2322	Bedrock milling	1982	Bull, Hector	1,100 ft W	Indeterminate
SDI-10549	Lithic scatter	1986	Cardenas	1,500 ft S	Indeterminate
SDI-10822/W-3882	Temporary habitation	1987	Smith	3,100 ft W	Indeterminate
SDI-11039/W-4004	Artifact scatter, possible rock feature	1988	Smith	Adjacent to project	Indeterminate
SDI-11473	Lithic scatter	1989	Robbins Wade	2,800 ft W	Indeterminate
SDI-11510/W-3380	Bedrock with artifacts and midden	1995	Smith	4,000 ft NE	Indeterminate
SDI-11738	Bedrock milling	1990	Ritz and Collett	4,200 ft W	Indeterminate
SDI-11742	Habitation site	1990	Ritz and Collett	3,900 ft W	Indeterminate
SDI-11743	Lithic scatter	1990	Ritz and Collett	2,700 ft W	Indeterminate
SDI-11747	Lithic scatter	1990	Ritz and Collett	4,900 ft NW	Indeterminate
SDI-11978/W-4626	Artifact scatter with midden	1990	Ritz and Hanna	2,000 ft NW	Indeterminate
SDI-11979/W-4627	Artifact scatter	1990	Ritz and Hanna	2,000 ft NW	Indeterminate
SDI-11980/W-4628	Artifact scatter	1990	Ritz	3,100 ft NW	Indeterminate
SDI-11981	Artifact scatter	1990	Ritz and Hanna	500 ft W	Indeterminate
SDI-11985	Artifact scatter	1990	Hanna	Adjacent to project	Indeterminate
SDI-12744/W-6881A	Temporary habitation and quarry	1995	Smith	4,500 ft NW	Indeterminate
SDI-12748/W-6668	Temporary habitation and quarry	1992	Smith	3,000 ft NW	Indeterminate
SDI-12749/W-6937B	Artifact scatter	1992	Smith	3,600ft NW	Indeterminate
SDI-12750/W-6881B	Quarry	1992	Smith	4,800 ft NW	Indeterminate
SDI-12751/W-6958	Artifact scatter	1992	Smith	2,300 ft N	Indeterminate
SDI-12752/W-6965	Artifact scatter	1992	Smith	5,200 ft NE	Indeterminate
SDI-12753/W-6967	Artifact scatter	1992	Smith	2,600 ft NE	Indeterminate
SDI-12754/W-6969	Artifact scatter	1992	Smith	4,500 ft NE	Indeterminate

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
SDI-12755/W-6994B	Artifact scatter	1992	Smith	3,300 ft NE	Indeterminate
SDI-12756/W-6997A	Habitation site	1992	Smith	3,500 ft NW	Indeterminate
SDI-12758H/W-6998B	Water conveyance system	1992	Smith	2,800 ft N	Indeterminate
SDI-12931/H/W-2790	Prehistoric habitation with historic trash scatter	1992	Pigniolo et al.	3,000 ft W	Indeterminate
SDI-12932/H	Historic rock feature	1992	Pigniolo et al.	1,700 ft NW	Indeterminate
SDI-12933/H	Prehistoric and historic artifact scatter	1992	Pigniolo et al.	1,700 ft NW	Indeterminate
SDI-12975H/W-3880	Historic dam	1992	Smith	5,000 ft NE	Indeterminate
SDI-12976H/W-6992	Historic dam	1995	Smith	3,400 ft N	Indeterminate
SDI-12977H/W-6997B	Bridge	1992	Smith	3,600 ft NW	Indeterminate
SDI-13213H/W-6966	Historic reservoir	1993	Smith	5,000 ft NE	Indeterminate
SDI-13214H/W-7018	Well/cistern	1995	Smith	3,700 ft N	Indeterminate
SDI-13215H/W-6968	Well/cistern	1993	Smith	3,000 ft N	Indeterminate
SDI-13216H/W-6998C	Well/cistern	1995	Smith	2,700 ft N	Indeterminate
SDI-13250/W-7013	Bedrock milling with artifacts	1993	Smith	3,500 ft NW	Indeterminate
SDI-13251/W-6959	Artifact scatter	1993	Smith	2,900 ft NW	Indeterminate
SDI-13252/W-7012	Artifact scatter	1993	Smith	3,250 ft NW	Indeterminate
SDI-13253/W-6937A	Artifact scatter	1993	Smith	3,700 ft NW	Indeterminate
SDI-13254/W-6997C	Temporary habitation	1995	Smith	3,500 ft NW	Indeterminate
SDI-13255/W-7014	Temporary habitation	1995	Smith	3,350 ft NW	Indeterminate
SDI-13256/W-6991	Artifact scatter	1995	Smith	2,800 ft NW	Indeterminate
SDI-13257/W-7016	Lithic scatter	1995	Smith	2,9000 ft N	Indeterminate
SDI-13258/W-7015A	Artifact scatter	1995	Smith	2,650 ft NW	Indeterminate
SDI-13259/W-7017	Artifact scatter	1995	Smith	3,000 ft N	Indeterminate
SDI-13260/W-6998A	Temporary habitation	1992	Smith	3,000 ft N	Indeterminate
SDI-13261/W-6990	Bedrock milling	1995	Smith	4,500 ft NW	Indeterminate
SDI-13262/W-6960	Temporary habitation	1995	Smith	2,250 ft N	Indeterminate
SDI-13263/W-6961	Artifact scatter	1995	Smith	2,500 ft N	Indeterminate
SDI-13264/W-6962	Artifact scatter	1995	Smith	2,000 ft N	Indeterminate
SDI-13265/W-6964	Artifact scatter	1995	Smith	2,100 ft N	Indeterminate
SDI-13266/W-6963	Artifact scatter	1995	Smith	2,500 ft NE	Indeterminate
SDI-13267	Artifact scatter	1995	Smith	>4,000 ft N	Indeterminate
SDI-13268/W-6994C	Artifact scatter	1995	Smith	3,500 ft N	Indeterminate
SDI-13269/W-6995	Artifact scatter	1995	Smith	2,700 ft N	Indeterminate
SDI-13271/W-6971	Lithic scatter	1993	Smith	4,500 ft NE	Indeterminate
SDI-13270/W-6970	Artifact scatter	1993	Smith	4,000 ft NE	Indeterminate
SDI-13273/W-6994A	Artifact scatter	1995	Smith	3,600 ft N	Indeterminate
SDI-13274/W-6869	Lithic scatter	1995	Smith	4,700 ft N	Indeterminate
SDI-13275/W-6871	Lithic scatter	1995	Smith	4,800 ft NE	Indeterminate
SDI-13278/W-6872	Artifact scatter	1993	Smith	4,600 ft NE	Indeterminate
SDI-13279	Lithic scatter	1993	Smith	4,700 ft NE	Indeterminate
SDI-13280/W-7026	Lithic scatter	1993	Smith	4,900 ft NE	Indeterminate
SDI-13281/W-7020	Artifact scatter	1993	Smith	1,750 ft N	Indeterminate
SDI-13282/W-6696	Bedrock milling and artifact scatter	1993	Smith	3,750 ft N	Indeterminate
SDI-13285/W-6996	Bedrock milling and artifact scatter	1993	Smith	3,700 ft N	Indeterminate
SDI-13283/W-6989	Artifact scatter	1993	Smith	4,000 ft N	Indeterminate
SDI-13284/W-7019	Artifact scatter	1995	Smith	4,250 ft N	Indeterminate
SDI-13285/W-7015B	Artifact scatter	1995	Smith	2,650 ft N	Indeterminate
SDI-13286/W-6999	Artifact scatter	1995	Smith	3,500 ft N	Indeterminate
SDI-13287/W-7000	Artifact scatter	1995	Smith	5,000 ft NE	Indeterminate
SDI-13288/W-7021A	Artifact scatter	1995	Smith	4,550 ft N	Indeterminate
SDI-13289/W-7010	Artifact scatter	1995	Smith	4,900 ft NW	Indeterminate

Site Number	Site Type	Year of Latest Record	Recorder	Distance From Project	National Register Status / Notes
SDI-13290/W-6881C	Artifact scatter	1995	Smith	4,700 ft NW	Indeterminate
SDI-13291	Artifact scatter	1995	Smith	>4,000 ft N	Indeterminate
SDI-13292/W-7021B	Artifact scatter	1993	Smith	>4,500 ft N	Indeterminate
SDI-13298/W-7022	Artifact scatter	1993	Smith	>4,500 ft N	Indeterminate
SDI-13300	Artifact scatter	1995	Smith	>4,000 ft N	Indeterminate
SDI-13299/W-7023	Artifact scatter	1995	Smith	>4,500 ft N	Indeterminate
SDI-13300/W-7024	Artifact scatter	1995	Smith	>4,500 ft N	Indeterminate
SDI-13301/W-7025	Temporary habitation	1985	Smith	>4,500 ft N	Indeterminate
SDI-16400	Lithic scatter	2002	Smith	4,000 ft NE	Indeterminate
W-1341B	Isolated core tool	1977	Norwood	500 ft W	N/A
W-3705	One isolated flake	1985	Cardenas and Winterrowd	1,250 ft S	N/A
W-3744	One isolated hand stone	1985	Peter and Mitchell	3,250 ft W	N/A
W-4620	Two isolated flakes	1990	Ritz	1,000 ft NW	N/A
W-4621	One isolated flake	1990	Ritz	1,750 ft NW	N/A
W-4622	One flake and two core fragments	1990	Hanna	1,000 ft E	N/A
W-4624	Two isolated flakes	1990	Hanna	3,250 ft NE	N/A
W-5217B	Isolated core	1992	Pigniolo et al.	1,750 ft NW	N/A
W-6352	Isolated core	1994	James and Pigniolo	2,000 ft W	N/A
W-6663	Isolated flake and isolated scraper	1995	Smith	5,000 ft N	N/A
W-6866	Isolated mano	1995	Smith	4,000 ft N	N/A
W-6870	Isolated scraper	1995	Smith	3,750 ft NE	N/A
SDI-5094	Two isolated flakes	1980	Walker	2,000 ft NW	N/A
SDI-5384B/W-1341B	Isolate core tool	1977	Norwood	400 ft W	N/A
P-37-013867/W-I-19	Isolated core	1994	Pigniolo	4,200 ft W	N/A
P-37-014194	Isolated mano	1995	Smith	2,900 ft NW	N/A
P-37-014195	Isolated mano	1995	Smith	3,600 ft NE	N/A
P-37-014196	Isolated mano	1995	Smith	3,800 ft N	N/A
P-37-014197	Isolated flake	1995	Smith	4,400 ft NE	N/A
P-37-014199	Isolated flake	1995	Smith	5,000 ft N	N/A
P-37-014200	Isolated flake	1995	Smith	5,3000 ft N	N/A
P-37-014755/SDI-I-57	Isolated flake	1984	RBR & Associates	1,500 ft SW	N/A
P-37-014756/SDI-I-58	Isolated scraper	1984	RBR & Associates	3,500 ft SW	N/A
P-37-014757/SDI-I-59	Isolated flake	1984	RBR & Associates	2,900 ft SW	N/A
P-37-014850/SDI-I-152	Isolated flake	1986	RBR & Associates	1,000 ft SW	N/A
P-37-014199/SDI-I-301	Two isolated flakes	1990	Ritz	>4,500 ft N	N/A
P-37-015000/SDI-I-302	Isolated flake	1990	Ritz	1,800 ft W	N/A
P-37-015001/SDI-I-303	One flake and two core fragments	1990	Ritz	1,000 ft E	N/A
P-37-015003/SDI-I-305	Two isolated flakes	1990	Hanna	2,500 ft E	N/A
P-37-15218	Isolated core	1995	Pigniolo et al.	4,400 ft W	N/A
P-37-016575	Isolated historic glass fragment	1999	Wahoff	2,200 ft N	N/A
P-37-016576	Isolated historic glass fragment	1999	Wahoff	2,300 ft W	N/A
P-37-016577	Isolated historic glass fragment	1998	Wahoff	3,000 ft W	N/A

Table 3. Previously Recorded Resources Within Black Mountain Open Space Park

Site Number	Site Type	Year of Latest Record	Recorder	Current Survey Results	National Register Status / Notes
SDI-10547/W-3702A	Lithic scatter	1985	Cardenas and Winterrowd	Not relocated	Indeterminate
SDI-10548/W-3703	Lithic scatter	1985	Cardenas and Winterrowd	Not relocated	Indeterminate
SDI-11040H/W-4003	Historic mine	1988	Hector et al.	Relocated	Eligible
SDI-13738	Quarry	1994	Apple and Lilburn	Relocated	Not evaluated
P-37-014849/W-3702B	Isolated debitage	1985	Cardenas and Winterrowd	Not relocated	N/A

A search of the GeoFinder resource database included a review of the National Register of Historic Places, California Register of Historic Resources, California State Landmarks, California Points of Historic Interest, and other historic property lists. GeoFinder identified one documented historic structure, The Old Peñasquitos Creek Bridge, within the study area. The ca. 1949 bridge is located along Interstate 15 and has been designated as historic bridge number 57C-475 (57-106R).

A review of historic maps provided by SCIC and dating between 1901 and 1953 did not show any buildings, mines, or other features of note within the project area.

Previously Recorded Resources Within Black Mountain Open Space Park

Resources identified by previous surveys with the Black Mountain Park are briefly described below and summarized in Table 3.

SDI-10547

This site consists of one core, one flake, and a piece of lithic shatter recorded within a 12-x-6 m area next to an existing trail. All were of the same metavolcanic rock that forms the bedrock in the area. None of the items were relocated during the current survey.

SDI-10548

This site was recorded as two milky quartz flakes, one metavolcanic flake, and two possible battered cobbles or hammerstones. Items were found within an 18-x-6 m area on an existing jeep trail. The recorders stated that the site had no integrity and despite good ground visibility none of the items could be relocated during the current survey.

SDI-11040H

This site is the remains of an historic arsenic mine located in a small canyon on the north side of Black Mountain. Recorded mine features include roads, remains of an ore roasting furnace, collapsed wooden structures, concrete tanks, chimney, and foundations. Only a rudimentary recording was done at the time. The current survey relocated the mine and found additional features. The mine was researched and recorded in detail and an application for listing on the National Register of Historic Places was submitted. The mine and its eligibility for listing are discussed in detail below.

SDI-13738

This site is a prehistoric lithic quarry consisting of 14 battered metavolcanic bedrock outcrops and sparse flakes within a 60-x-30 m area. The site was relocated during the current survey. While prehistoric quarrying is evident, much of the battering and shattered bedrock flakes may result from other sources. A steep vehicle trail passes through the edge of the site and vehicles may have damaged some to the bedrock exposures. Some of the material also appears represent thermal spalling, the result of fires or repeated diurnal heating and cooling of the rock surface.

P-37-014849

This isolated occurrence consists of two pieces of lithic shatter of the same metavolcanic stone that forms the bedrock in the area. They were not relocated.

4. ARCHAEOLOGICAL RESOURCES

FIELD SURVEY RESULTS

Five previously unrecorded cultural resources and one isolated occurrence was recorded during pedestrian surveys within the park boundaries. One additional site (SDI-18276) was recorded and tentatively field plotted as occurring inside park boundaries. When this site was later plotted more accurately using GPS coordinates collected in the field it was found to be several meters outside of the park boundary. Full documentation for these resources is provided in confidential Appendix B.

SDI-18275

This site is a survey monument that consists of a rock cairn with a steel post or pipe segment in the center. The monument is located in dense chaparral on a west-facing slope 1 mile east-northeast of Black Mountain. A path has recently been cleared to the monument and it has recently been remarked with newer posts, stakes, flagging, and paint. The monument may be a USGS 1/4-section marker although the pipe is damaged by being beaten directly into the ground and may not have held a brass cap. Plotting on USGS quadrangles places the monument near the midpoint of the east boundary of Section 5. The monument also appears to mark a boundary point of the Black Mountain Open Space Park. The age is uncertain although the degree of lichen growth and accumulated plant material suggest that it is greater than 45 years old.

SDI-18276

The site consists of one milling slick measuring 32 x 23 cm located on an 8-x-4.5 m irregular granite outcrop. The condition is good, without exfoliation or substantial weathering of the milled surface. The slick however shows minimal use-wear with less than 1 mm of rock worn away on high spots. It was likely produced by a single transitory episode of grinding. No other artifacts or ecofacts were observed. Five pieces of marine shell located 50 m to the northeast were recorded as a separate site (SDI-18277). Subsequent to field survey, this site was found to be located outside the Black Mountain Open Space Park.

SDI-18277

The site consists of a very sparse shell scatter located on a south-facing slope 100 m southeast of a low saddle. Only five pieces of marine shell, three California oyster and two *Chione* sp., were observed over a 17-x-10 m area, The site is in poor condition in that an unpaved road has been bulldozed through it. The north side of the road had recently burned at the time of the field survey and ground surface visibility was excellent. The south side of the road was vegetated by dense grasses that might conceal additional shell.

SDI-18278

This site consists of an isolated bedrock mortar located on a terrace or bench at the southwestern base of Black Mountain. The cup-shaped mortar is 12 cm in diameter x 5 cm deep on one 2.8-x-1.7 m outcrop of metavolcanic stone. The mortar appears to have been intentionally hidden by a small boulder placed on top of it in recent times. One rounded quartzite cobble from nearby marine terrace formations was located next to the feature. It is an excellent size and shape for use as a pestle but no use-wear or modifications were detected. No other associated artifacts were noted.

SDI-18279

This site is a prehistoric quarry located on a southeast-facing slope. The hillside was covered in extremely dense vegetation that limited ground visibility to the point that many attributes of this site, such as the exact size, limits of the boundaries, and artifact assemblage characteristics, could not be determined. The site appears to be approximately 100 x 50 m and includes a variety of flake types, stages, and sizes. Flakes of porphyritic metavolcanic toolstone are noted in isolated pockets where the ground surface is visible and where flakes and natural toolstone appear to be collecting as these materials are moved downslope by erosional processes. Outcrops of metavolcanic bedrock were noted throughout the area and appear to be the source of the flaked stone. One reddish colored hand stone or mano was noted within one of the collected pockets of material.

SDI-18280

This site consists of a single rock cairn feature located on a ridge top overlooking the mine canyon. The cairn is made up of approximately 60 to 80 large rocks and cobbles, stacked about 1 m high. The cobbles visible in the cairn are all light green fine-grained metavolcanic rock. The cobbles appear to be from the immediate vicinity, because they consist of material taken from the local bedrock outcrops. The cairn is stacked on a partially exposed bedrock boulder of the same light green material. The cobbles are mostly sharp angular rocks with some patina discolorations on exposed surfaces. Dense overgrown scrub vegetation currently covers the site area, leading to very poor ground visibility. No other features or artifacts were noted in association with this cairn. Although rock cairns were often used in marking historic mining claims, there are no associated artifacts or other features to help clarify the cairn's origin.

P-37-028093

This isolated occurrence consists of two individual ceramic fragments noted on the ground surface of an unnamed trail. The two sherds are consistent with the Tizon Brownware ceramic type. Both are body sherds that refit and so originated from a single vessel. One possible metavolcanic flake was also found adjacent to these ceramic sherds.

SUMMARY

Five previously unrecorded cultural resources and one isolated occurrence were recorded during pedestrian surveys within the park boundaries. These include two rock cairns (SDI-18275 and -18280); one sparse shell scatter (SDI-18277); one isolated bedrock mortar (SDI-18278); one prehistoric quarry (SDI-18279); and two isolated sherds of prehistoric ceramics (P-37-028093). Previously recorded resources within the park boundaries include two lithic scatters (SDI-10547 and -10548), a prehistoric quarry site (SDI-13738), an isolated fragment of debitage (P-37-014849), and the Black Mountain Mine (SDI-11040H). Three of these resources, the two lithic scatters and the isolate, were not relocated during the current field survey. These resources may have been mismapped originally, or may have been destroyed. Updated DPR forms for the other resources are provided in Appendix B.

The historic Black Mountain Mine (SDI-11040H) was documented in considerable detail during the survey and research was conducted to provide a historical context for the mine and a history of its operation. Results of this study are provided in the next chapter.

5. BLACK MOUNTAIN MINE

HISTORICAL CONTEXT

Arsenic Production in the United States 1900 - 1940

Ordinary commercial or white arsenic (also known as arsenious oxide, arsenious acid or anhydrid) is produced largely as a by-product recovered from the soot (known as flue dust) that results from the smelting of copper, lead and other minerals. Arsenic occurs as a constituent of 30 or more minerals. The principal sources are arsenopyrite, arsenic sulfides, nickel, and cobalt arsenic, and several sulfur sinides. Arsenopyrite is probably more plentiful than all other arsenic minerals. It is found in schist and gneiss and in some places forms deposits in them, which have been worked for their arsenic content. These minerals are rarely mined for arsenic alone. The market price has seldom justified its recovery other than as a by-product of smelters established to process other ores (Zaman 1985:28-6, Heikes 1922:51-52).

During the early twentieth century, arsenic was used in a variety of products including paint pigments, calico printing, dying, pyrotechnics, preserving hides, as an antiseptic, making soaps, hardening metals, and the manufacture of plate glass. The principal use was in the production of insecticides, weed killers, and cattle and sheep dips. A "considerable tonnage" of white arsenic was used to make weed killers needed by the railroads in the United States to keep their roadbeds clear (*Engineering and Mining Journal Press* 5-20-1922).

Prior to 1901, no white arsenic was produced in the United States. Major places of manufacture included Cornwall, England, Freidberg, Germany, and Altenberg, Silesia in central Europe. White arsenic, also known as arsenious acid or anhydrid, was obtained as a secondary product in the roasting of arsenical ores of tin, cobalt, nickel, and argentiferous native arsenic for the extraction of silver. The largest supply came from the roasting of arsenical pyrites or "mispickle" and condensing the flue dust in long flues or chambers. The flues in Cornwall measured 600 ft. in length, and 6 ft. high. At Altenberg, in Silesia the soot (volatile matters) was passed through two or three chambers, which were emptied every one or two months. During the operation workmen donned leather clothing with their mouths and nostrils protected by wet cloths (Greenwood 1875:221-224; Struthers 1904:279).

Production of white arsenic began in the United States in 1901 when a plant was opened to recover the material as a by-product of smelting by the Puget Sound Reduction Works, at Everet Washington. The first year the company produced 300 tons. Output more than quadrupled the following year with 1,353 tons (Struthers 1904:279). By 1905, arsenic was also being recovered in Virginia and Montana. Production that year amounted to 1,507,386 pounds of white arsenic, valued at $35,210, as compared with 72,413 pounds valued at $2,185 in 1904 (Schnatterbeck 1906:1087).

Over the next two decades white arsenic production in the United States continued to rise. In 1915, 5,498 short tons of were produced, valued at $302,116. This was an increase of nearly 18 percent over the production of 4,670 tons in 1914 and an increase of 75 percent over the largest previous production year, 1912, when 3,141 tons, valued at $190,757, were produced. One report noted, "As usual the arsenic was all saved as a by-product in the smelting of copper, gold, and silver ores" (Hess 1917:845-846). Over the next two years, production continued to increase steadily resulting in 5,580 tons in 1917, 5,737 tons in 1918, followed by a slight decrease to 5,470 tons in 1919 (Mineral Industry 1919:35-36).

In 1919, government research demonstrated that calcium arsenate, an insecticide produced from white arsenic, was extremely effective against boll weevil infestations in cotton producing sections of the United States (Heikes and Loughlin 1925). When properly applied, from five to seven pounds of calcium arsenate were required to an acre. The number of applications required varied from three to five with an interval of from four to seven days between applications. The gain secured by using the insecticide was as high as 1,000 pounds of seed cotton per acre, and on fairly fertile soil, subject to a serious degree of weevil injury, average gains of from 300 to 500 pounds of seed cotton per acre were considered to be possible (*Engineering and Mining Journal Press* 5-20-1922).

The white arsenic market remained erratic until 1923. In 1920, manufacturers laid in supplies of refined white arsenic in anticipation of an increased demand. However, cotton prices that year fell from an anticipated 45 cents a pound to 12 cents a pound, and many cotton growers were unable to purchase calcium arsenate. One manufacture distributed the insecticide at a price below cost, which discouraged others from marketing it. By the end of the year the supply became exhausted and the demand was again acute prompting a rush into the market for white arsenic and greatly increasing the price of the latter (Heikes and Loughlin 1925).

The following year consumption of calcium arsenate peaked at about 32,000,000 pounds (*Engineering and Mining Journal Press* 4-17-1926). The supply was virtually exhausted and in some instances 40 cents per pound was paid for it. This dramatic price increase prompted the direct treatment of arsenopyrite ore to produce white arsenic as a primary product. Successful plants were established by the Toulon Arsenic Co. near Lovelock, Nevada, the Jardine Mining Co. at Jardine, Montana, the Salt Lake Insecticide Co. at Rowley, Utah, the Keystone Arsenic Co. at Keystone, South Dakota, the National Chemical Co. at Pittsburgh, Pennsylvania, and the Arsenic Products and Refining Company at Martinez, California. The Chipman Engineering Co., owners of an arsenic mine in Colorado, controlled the plant at Martinez, which had in stock considerable custom ore received from Nevada, California, and its mine in Colorado. The sales of white arsenic were 14,271 tons, which sold for $2,808,801, or an average price of 9.84 cents a pound (Heikes 1924:49-51; Heikes and Loughlin 1927a:164-165). Nearly two-thirds of the white arsenic produced in the United States in 1924 came from plants where the ore was directly treated for its arsenic content. The remaining third of the total domestic output was the by-product from the regular ore charges of copper and lead smelting and some arsenic recovered by the manufacture of chemicals (Heikes and Loughlin 1927b:35-39).

The boom, however, was short lived. In 1924 the summer was dry and hot and the depredations of the boll weevil were insignificant. A cold winter followed by another exceptionally dry season over most of the cotton belt almost eliminated the weevil as a factor in cotton production for 1924. The resulting decreased demand, combined with the rapid expansion of production of white arsenic, flooded the market. The price of white arsenic fell 50 percent, from 13.5 cents per pound in January to 6.75 cents per pound in December. The smelting companies had huge stocks of barreled oxide on hand in the United States and Mexico (*Engineering and Mining Journal Press* 4-17-1926; Heikes 1925:63).

For the next two years arsenic sold for less than the price of production and the new plants established for the sole purpose of producing white arsenic as a primary product shut down. White arsenic once again became a commodity produced solely as a by-product of smelters, a condition that continued through the 1930s and is still the case in the early twenty-first century. The price has never been able to justify the production of arsenic as a primary product from arsenopyrite ore in the United States (*Engineering and Mining Journal Press* 4-17-1926, 6-16-1926; Ambruster 1926:63-65, 1927:54-55; Anonymous 1933:35, 1936:38; Gerry and Meyer 1934:11; Heikes 1929:19, 1933:25; Tyler 1929:34, 1930:36, 1931:38, 1932:40).

History of the Black Mountain Mine

At the height of the short-lived white arsenic boom in 1923 several investors began operations in San Diego County on the north slope of Black Mountain to mine arsenopyrite, process the ore, and send it to a refiner to produce white arsenic. Arsenopyrite is distributed rather sparsely on Black Mountain in a fine-grained quartzite, which is a member of the Black Mountain volcanic rocks of probable Jurassic age (Weber et al. 1963:49).

On October 4, 1923, articles of incorporation were filed for the Black Mountain Arsenic Mining Company. The principal place of business was Los Angeles. The five directors included Wilfred Buckland (president) of Hollywood, California, L. K. Vermille (secretary), J. N. Hendrickson, Eugene Overton, and George W. Prince, Jr., all of Los Angeles (Articles of Incorporation 1923). Company offices were located at 1300 Stock Exchange Building in Los Angeles. They controlled four claims known as the Black Mountain Group, which covered 80 acres along a narrow canyon on Black Mountain's north slope. The manager in charge of actual operations on the ground was Frank Hopkins of Escondido (Lawrence 1998; San Diego Chamber of Mines 1927; State Mineralogists 1925:329).

The story of how these six men became involved in an ill-fated effort that never could have succeeded, to mine arsenopyrite on Black Mountain and produce white arsenic as a primary product, is both curious and strange.

Frank Hopkins was a cowboy and former hard rock miner, who worked part time as a trick roper in rodeos and silent films in the late teens and early 1920s. He often acted as an extra in westerns produced by Cecil B. DeMille. Frank got along so well and had such affection for the famous Hollywood director that he named his youngest son, born in 1916, Cecil DeMille Hopkins (Colbeth 2005; Lawrence 1998).

Wilfred Buckland, the president of the Black Mountain Arsenic Mining Company, was Cecil B. DeMille's lighting and art director. Producer David Belasco, who was known for his innovative lighting techniques, had trained both DeMille and Buckland on Broadway. By hiring Buckland, DeMille gave Hollywood its first art director. In all, Wilfred Buckland is credited with working on 80 films between 1914 and 1927 (Buckland Bio 2006).

Eugene Overton, the secretary of the Black Mountain Arsenic Mining Company, was a successful Los Angeles attorney (Census 1920, 1930). He apparently also dabbled in the livestock business and kept cattle at Doane Valley on Palomar Mountain. He was acquainted with Frank Hopkins and his family, who were known to visit his place on Palomar (James 1957). It is very probable that Hopkins may have overseen Overton's cattle operations at times. The remaining Black Mountain Arsenic Mining Company board members - L. K. Vermille, John N. Hendrickson, and George W. Prince, Jr. - were also successful Los Angeles attorneys (Census 1920, 1930).

The catalyst that brought this group together and focused their attention on development of an arsenic mine on Black Mountain appears to have been Frank Hopkins. Frank had been born on December 3, 1887, in South Dakota (California Death Index 1940-1970). As already mentioned, he was a rancher in the Escondido area, who also worked as a rodeo trick roper and movie cowboy for Cecil B. DeMille. His niece, Elva Colbeth, remembered that around 1920 Frank managed a ranch in the San Dieguito River Valley near Del Mar that DeMille might have owned (Colbeth 2005). The 1920 Federal Census Population Manuscript Returns list Frank as a 32-year-old stock farm manger living in Lusardi Precinct, which would put him in the San Dieguito River and Black Mountain area (Beasley 1898). The household consisted of Frank, age 32, his 29-year-old wife Yolande, his brother Lester, who was 25, and Frank and Yolande's three children: Clayton, age 8, Francis, age 7, and Cecil DeMille, age 4 (Census 1920).

In addition to ranching, Frank Hopkins was a prospector. In San Diego County, he had a placer mining operation on Garnet Creek, northwest of Ramona, and was also involved in tungsten mining (Colbeth 2005; State Mineralogists 1925; San Diego Chamber of Mines 1927). He was remembered as a hard drinking promoter, who kept a jug of bootleg "Grappa" nearby as medicine (Lawrence 1998; Colbeth 2005).

As a rancher familiar with the backcountry and living in the region, Frank Hopkins was undoubtedly aware of the arsenic springs on the north slope of Black Mountain. As a prospector, he was probably aware of any sudden rise in price for mineral resources in the mining markets. It seems very likely that as the price for white arsenic suddenly rose to unprecedented levels in 1922 and 1923, Frank approached his well-to-do Hollywood movie industry and Los Angeles attorney acquaintances and encouraged them to invest in the mining operation on Black Mountain, which resulted in the filing of the articles of incorporation for the Black Mountain Arsenic Mining Company in October 1923.

Work began on Black Mountain in 1924. That year the Mace Company of Denver, Colorado conducted smelting tests on samples of the arsenical ore to produce a gold-bearing matte and recover arsenic trioxide as a fume. A small concentrating plant was erected early in the year, even though no ore reserves had been developed. Seven hundred pounds of material containing 31.4 percent arsenic, plus a small amount of gold and silver, were sent to the Chipman Chemical Engineering Company's plant at the Martinez. Operations at Black Mountain were discontinued due to the lack of a reliable water supply, and the concentration plant had been dismantled by July of that year (State Mineralogist 1925:329; Weber et al. 1963:49). The actual relationship that existed between the Mace Company and the Black Mountain Arsenic Mining Company has not been determined. Mace was apparently one of the many smelting and mining companies looking for arsenopyrite deposits that could profitably produce white arsenic as a primary product during the short-lived arsenic boom of 1923-1924. There was, undoubtedly, some sort of agreement between Mace and the Black Mountain board of directors that allowed the Colorado company to proceed with development work. The details of these transactions have not yet come to light.

Following closure of the Mace Company's operation, Black Mountain Arsenic continued development under the direction of Frank Hopkins. The arsenopyrite ore was found in two discontinuous parallel dikes of quartzite 10 to 15 ft. wide that cut the surrounding diorite bedrock with a general northwest strike and dip to the northeast for a distance of about 200 ft. By the end of 1925, a 30-ft. long tunnel and two 40-ft. deep shafts had been opened, as well as a number of cuts along the outcrops of the quartzite dikes. The ore was said to contain 5 percent arsenic with from $2 to $5 of gold per ton. Mine equipment consisted of a 7 1/2 x 6 inch Chicago pneumatic compressor and air drills, a 7-x-9 inch Blake Jaw Crusher, 20-ton Herman ball mill, and a Universal Overstrom Concentrator. The plant was driven by a four-cylinder, 70-horsepower, Holt tractor gasoline engine. The concentrates produced from the ore were said to carry 40 percent arsenic with gold values. Two men were employed in the development work (State Mineralogist 1925:329).

It was evidently the goal of the operations at this time to produce a concentrate of arsenic and gold which could be shipped to the Chipman Chemical Engineering Company's plant at Martinez, California, or another of the several refineries established for the primary production of white arsenic during 1923-1924. With the collapse of the arsenic market and the dismantling of the primary arsenic refineries, including the Martinez operation in 1925, the Black Mountain Arsenic Mining Company appears to have changed strategies and in 1926-1927 installed equipment to process the ore on-site. This included a 15-ft. long Gates Rotary Roaster, connected by a brick flue and steel pipe to a 7-ft. wide x 180-ft. long poured concrete dust chamber, and three concrete cyanide vats. A Gates Gyratory Crusher was also installed that would have replaced the original Blake Jaw Crusher reported to have been in use in 1925 (Lawrence 1998, Weber et al. 1963:49). Now the ore could be roasted on-site, the resulting arsenic containing soot collected in the dust chamber, and the roasted concentrates then treated in cyanide to recover any remaining gold.

In spite of these improvements little other work was ever done at the mine. Frank Hopkins employed 16-year-old David W. (Bill) Lawrence and his 10-year-old son Cecil DeMille Hopkins to work the mines during the summers of 1926 and 1927 (Census 1920, 1930; Lawrence 1998). Lawrence recalled:

> I worked drilling and blasting the "pit" in 1926 - 27 (summers) removing overburden with Cecil Hopkins. He was a couple of years younger and the son of Frank Hopkins, mining engineer on the mine project. . . . Everything was carried by hand from the cabin up a trail on the left side of canyon. (The) cabin sat at the mouth of the canyon and arsenic creek. (The) Main water supply was a spring at the head of the creek. (The) Lower springs contained too much arsenic. . . . Old Frank was a hard rock miner from Colorado and taught Cec and I to handle dynamite, sharpen drill bits, handle a jackhammer, & to cook miners style. HA !! And a 5 gal jug of Grappa for Old Frank as medicine [Lawrence 1998].

Only a ton or two of ore was ever roasted (Weber et al. 1963:49). Lawrence stated, "In 1927, while I was working, they ran out of fuel oil for firing the roaster and substituted diesel fuel instead. This caused too much heat and the babbett bearings melted on the roaster drum. This shut the entire operation down. To my knowledge the operation never restarted. F. Hopkins was quite a promoter and was often having financial problems. I believe finances played a role in shutting down and not reopening."

Some unsuccessful attempts were made to reopen the mine. Frank Hopkins, and perhaps others, evidently continued to try and revive the operations. In 1930 his occupation was listed as "arsenic miner" on the Federal Census Population Manuscript Returns (Census 1930). However, given the depressed price for white arsenic during the late 1920s and through the 1930s, a financially successful operation could never have been established at Black Mountain. By 1939, all the equipment had been removed for salvage and the site was idle (State Mineralogist 1939:12).

The history of the Black Mountain Arsenic Mine typifies many of the problems inherent in western mining during the late nineteenth and early twentieth century. From the perspective of the early twenty-first century, the actions of the backers and other participants in the Black Mountain Mine seem highly unreasonable. There seems no logical motivation for a successful movie director such as Wilfred Buckland or his well-to-do Los Angeles attorney associates to invest in as dubious a venture as an arsenic mine, and continue to develop it in the face of falling prices for white arsenic during the late 1920s.

The actions taken by the Black Mountain investors were not unprecedented for the period, however. Many people of means, and others without sound financial resources, invested in unproductive mining properties during the nineteenth and early twentieth centuries, in the hopes of finding the next big strike that would produce extraordinary wealth.

Beginning with the California Gold Rush of 1849, mining had produced great wealth in the American West during the nineteenth and early twentieth centuries. The Gold Rush was followed by fabulous strikes at the Comstock Lode in Nevada in the 1860s, and opening of additional wealthy mines in Nevada, Arizona, Colorado, Montana, and virtually every other state throughout the west through the remaining decades of the century. The last big strike was at Gold Fields and Tonapah, Nevada during the first decade of the twentieth century. Indeed, it seemed that a major strike occurred at least every 5 to 10 years throughout the last half of the nineteenth century that created tremendous riches for those who were fortunate enough to be the earliest investors.

The wealthy and truly productive strikes stand in stark contrast to the literally thousands of unsuccessful or small one and two man operations that made up most of the mines in the west during this period. Encouraged by the really big discoveries that occurred so regularly, thousands of prospectors combed the west and were able to find innumerable wealthy investors willing to spend money on small scale or worthless mining properties in the hope of striking it rich. Many fell victim to blatant fraud. In the Great Diamond Hoax of 1872, a Kentucky grifter, Philip Arnold, convinced some of California's biggest bankers and businessmen, a former U.S. representative, leading lawyers on both coasts, and the founder of Tiffany and Company to invest in a falsified gem mine on the sagebrush-covered mesas of Wyoming. By the time the scam had played itself out Arnold and his partner had gotten away with more than half a million dollars; the equivalent to more than eight million in twenty-first century currency (Wilson 2004).

Many ventures were not entirely fraudulent but based on claims that could never have produced a profit in relationship to the amount of money invested in development. Some, like Black Mountain, were worthless given the small value of the ore. Others had moderate potential but became burdened when investors erected expensive mills and other infrastructure that was more expensive than the wealth the ores contained (Van Wormer and Newland 1996). Western mining engineers identified three major causes for failure: too much expenditure on speculation, insufficient ore reduction and processing systems, and too much expensive machinery on unproven property (Peterson 1977:100). Clearly, the Black Mountain investors were guilty of the first and second named actions - over speculation and over investment in expensive equipment on a completely unproven property.

Technology

The processing plant at the Black Mountain Arsenic Mine evolved through two distinct phases. During the first phase, from late 1924 through 1925, the purpose was to produce a concentrated residue from the ore that could be shipped to a refinery. Based on descriptions and evidence on the ground, the ore was mined at the quartzite outcrops in the canyon bottom and then conveyed via ore carts on a narrow gauge railroad to the mill built on an excavated terrace some 250 ft. down the canyon from the arsenopyrite source. Here the ore was fed into a Blake Rock Crusher and then processed with water in a Harding Ball Mill until it was reduced into a fine slime. From the ball mill the material would have been passed to a concentrator. The resulting concentrate was then shipped to a refining plant as already stated (State Mineralogist 1925:329).

During the second phase, from 1926 to 1927, the purpose was to roast the ore and collect the resulting soot in the long concrete dust-collecting flue built on the hillside above the terrace. The ore was conveyed to the dumping station in ore carts as before. At this point it appears to have been processed in a gyratory crusher from which it was conveyed to the roaster where it was heated to produce soot (i.e., flue-dust), which passed through the dust-collector. Following roasting, the ore would then be treated with cyanide to extract any remaining gold. The soot in the dust collector would eventually be collected and presumably sold as crude arsenic (Lawrence 1998).

DESCRIPTION OF MINE CANYON RESOURCES

Detailed documentation of the Black Mountain Mine features, including photographs, is provided in Appendix B of this report.

The Black Mountain Arsenic Mine site is located on the northwest slope of a narrow canyon on the north side of Black Mountain at approximately 1,000 ft. above mean sea level (Figures 4 and 5). The site extends for approximately 620 ft. in a northeasterly direction along the canyon edge. It consists of two main areas. At the southwest end, near the canyon bottom, are the adits and tailing piles where the ore was extracted. Approximately 220 ft. to the northeast, the mill site where the ore was processed is located on a narrow excavated terrace that measures approximately 120 x 40 ft. Two road cuts lead from the adits and tailings to the mill site.

Additional features associated with the milling process are located outside the terrace. A large concrete flue dust chamber that measures 7 x 7 ft. across x 180 ft. in length is located on the slope above the mill site, and two concrete cyanide vats are situated along the canyon edge, approximately 160 ft. northeast of the mill site terrace. An access road runs from the mill site past the cyanide vats and continues to climb the slope in a northwesterly direction. It is covered with thick chaparral brush, as is the entire hillside. The road can be followed for about a half mile to the top of a ridge northwest of the mine site. At that point the brush becomes so thick it can no longer be detected.

The canyon bottom drops rapidly between the area of the adits and the mill site so that the mill site terrace is actually on the bank approximately 40 ft. above the streambed that forms the canyon. The bank between the terrace and the stream is covered with artifacts, consisting of scrap metal, pieces of equipment, and metal and glass containers deposited there during construction, use and dismantling of the mill.

Archaeological and Landscape Features

The archeological features on the ground represent the machinery and equipment used to extract and process the arsenopyrite ore during the two distinct phases of the Black Mountain Mining operation. To better understand the remains and their relationship to the technological processes involved at the site, they can be grouped into feature systems. A feature system is a group of archaeologically visible features and objects that are related to a specific human activity (Hardesty 1988:9).

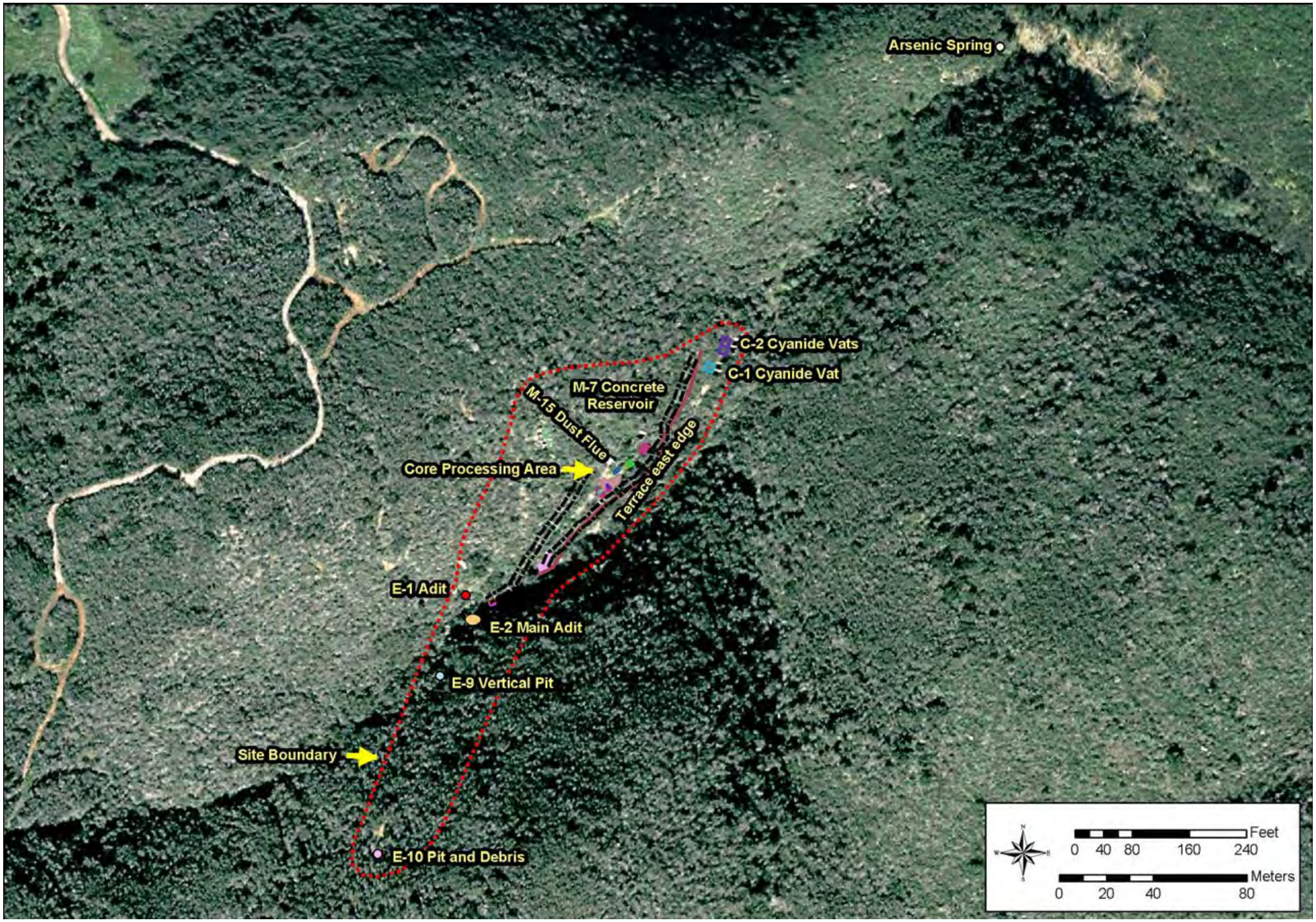

Figure 4. Aerial map view of Mine Canyon and the Black Mountain Mine.

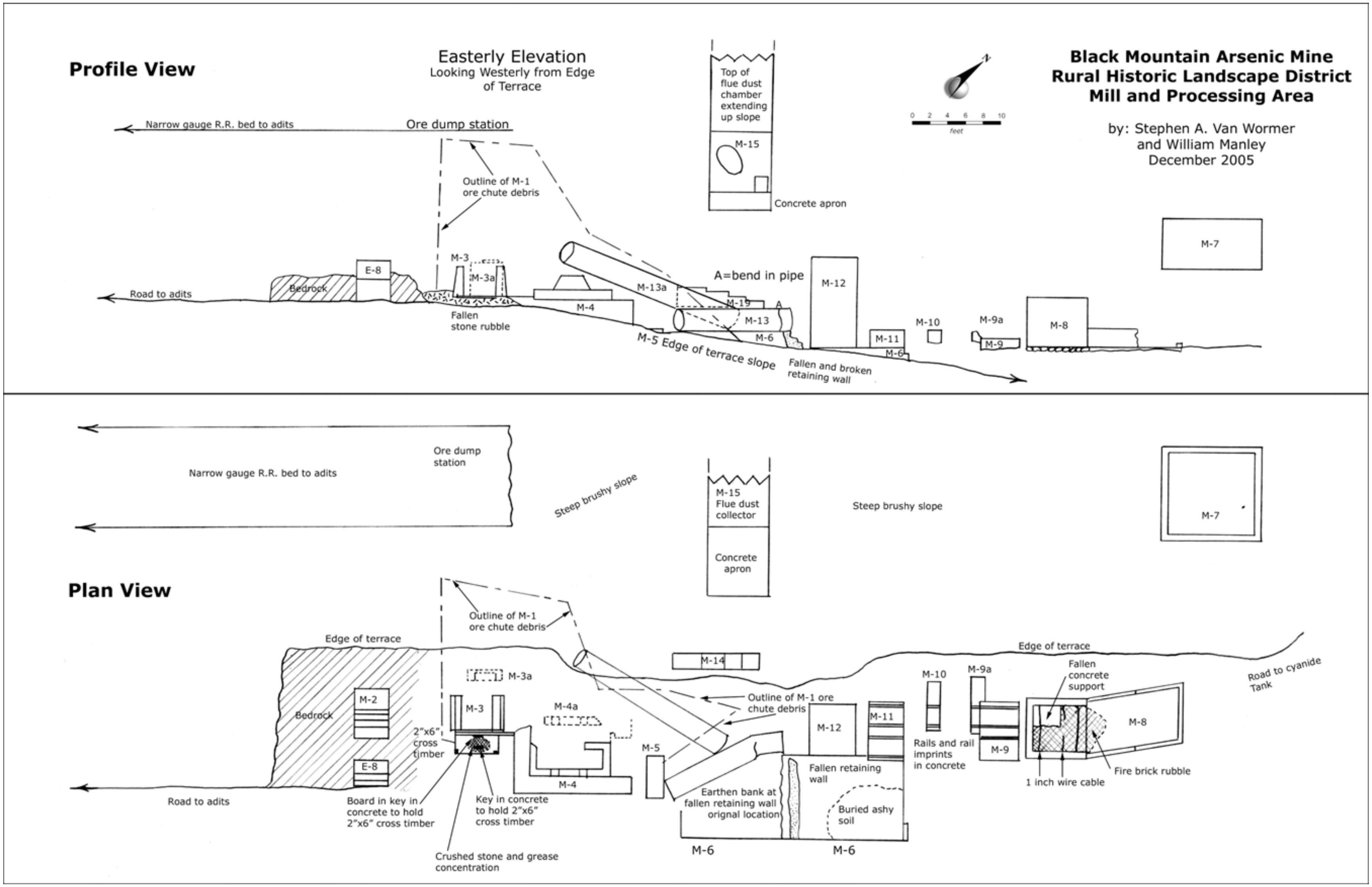

Figure 5. Plan and profile views of the Black Mountain Mine core processing areas.

At the Black Mountain Arsenic Mine site there are two major feature systems consisting of *extractive features* used in removing the ore from the ground and conveying it to the mill site, and *processing features* used in processing the ore to extract the minerals. Using this method, features are analyzed, and described according to the functions they served rather than their geographical proximity to each other. At Black Mountain, for example, the air compressor used to power the rock drills was part of the extractive feature system even though its foundations are several hundred feet away from the shaft and tunnel remains where the jackhammers were used. In addition, a feature cluster or individual features may represent two or more distinct feature systems. This is the case at the mill site at Black Mountain where remains of both the concentration phase and roasting phase of ore processing are located on the same small terrace. The Holt gasoline engine footings (Feature M-2) and reservoir (Feature M-1) were used for both the Phase 1 concentration process and Phase 2 roasting - cyanide process.

Ore Extraction Feature System

The ore extraction feature system consists of all features related to the extraction of ore from the ground and its conveyance to the mill site. It includes adits (Features E-1 and E-2), tailings (Feature E-3), the remains of an ore cart loading platform (Feature E-4), a narrow gauge rail bed for conveying the ore filled carts to the dumping station above the mill site (Feature E-5), a lower road bed (Feature E-6) that leads from the mill site to the storage bunker (Feature E-7), and the footings of the pneumatic compressor located on the mill site terrace that powered the rock drills (Feature E-8).

Adits and Tailings

All that remains of the excavation work at the Black Mountain mine are two small adits located on either side of the narrow canyon at the southwest end of the mine site. The full extent of the excavation is not known, but it was never large. As noted above, by 1925, a 30-ft. long tunnel and two 40-ft. deep shafts had been opened (State Mineralogist 1925:329). Further excavation occurred in a “pit” during the summers of 1926 and 1927 (Lawrence 1998).

Feature E-1 is located on the north side of the canyon and consists of an adit opening some 10-12 ft. in diameter. It appears to have been larger at one time and has been partially filled in. The interior cannot be seen and it does not appear safe to enter. Given the fact that this adit was obviously larger at one time and has had considerable in-filling, it may be the location of the 30-ft. long tunnel and two 40-ft. deep shafts described in 1925. Feature E-2, immediately across from Feature E-1 on the north side of the canyon, is a large adit approximately 15 ft. in diameter that extends about 30 ft. into the hillside. There is neither fill nor fallen debris associated with this small tunnel and it is obvious that no additional shafts were ever associated with it; this leads to the assumption that this is not the excavation described in 1925 and is probably the “pit” excavated by Bill Lawrence and Cecil DeMille Hopkins during the summers of 1926–1927[1]. Feature E-3 is a tailings pile filling the canyon between the two adits and extending easterly along the canyon bottom for about 40 ft.

Two further excavations are located outside the main mine area, on the southern slopes of the drainage to the south. Feature E-9 is a shallow vertical pit located approximately 150 ft. south of Feature E-2, the main shaft. This feature is approximately 6 x 6 ft. wide and 6-7 ft. in depth. Feature E-10 is located upslope and approximately 400 ft. south of the main shaft. This feature consists of a narrow shaft measuring approximately 7-8 ft. wide at the mouth and 20 ft. in depth. It is located on a steep slope and access to this feature is through thick brush. Adjacent to the mouth of the shaft are the remains of a wooden hoist that was used to haul ore out of the shaft. This consists of a H-shaped wooden headwall and ramp leading from the mouth of the shaft. Metal tracks nailed onto the parallel wooden shafts indicate that an ore cart or similar device was pulled up the ramp to the top of the slope. The remains of a wooden trough, where the ore was dumped prior to transportation, are located on the other side of the headwall. It is not known when these pits were excavated. They are at some distance from the main adits and are not connected to the processing area by the narrow gauge railway. It is possible that they were exploratory excavations, and that the rock was transported by mule to the central processing area.

Conveyance System

Feature E-4 is a small concrete platform located at the eastern edge of the tailings pile. Rocks from the tailings have partially covered the feature, which consist of two small parallel footings about 24 inches apart that measure approximately 12 inches wide x 3 ft. in length. They span the narrow stream in the canyon bottom. This appears to be the remains of a platform where ore carts could have been loaded. According to Bill Lawrence, ore was conveyed from this point to the dump station above the mill site in carts that ran on a narrow gauge railway located on the roadbed designated Feature E-5. This approximately 12-ft. wide cut in the hillside runs from Feature E-4 in a northeasterly direction for approximately 240 ft., terminating at a point above the mill site.

Another roadbed, Feature E-6, parallels Feature E-5 and is located approximately 20 ft. lower on the hillside at the level of the mill site. It extends southwesterly from the mill site terrace for approximately 160 ft. Feature E-7, a small concrete storage bunker measuring approximately 24 x 36 inches x 3 ft. in height, is located near the southwest end of the Feature E-6 roadbed near the area of the adits. Steel hinges indicate a heavy steel door once covered the front of this bunker. This storage bunker may have stored explosives used in mining excavations. Feature E-8, located at the juncture of the northeast end of the Feature E-6 roadbed and the extreme southwest edge of the milling area terrace, is a concrete footing that measures approximately 3 x 4 ft. It is stepped on the southeast end to extend down the bank about 5 ft. Footings stepped in this manner were often used to mount air compressors. The

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[1] Exact measurements were not taken for the adits at the time of the current survey as it was not thought safe to enter them. Mike Kelly of the San Diego Conservation Resources Network, who has previously entered the adits, states that Feature E-2 is longer than 30 feet deep and that there is evidence that excavation for a second side tunnel or shaft had been started at the rear of the shaft (Kelly 2006).

Chicago pneumatic compressor reported to be at the site in 1925 may have been mounted at this location (State Mineralogist 1925:329). Steel pipe airlines could easily have been laid from this point to the excavation area along the E-6 roadbed in order to power the Cochise rock drills used at the mine for excavation (Lawrence 1998). The pneumatic drill had originally been developed in the 1860s and was a common tool in mining operations by this time (Baily 1996:17).

Ore Processing Feature Systems

Ore processing features include the remnants of wooden structures, concrete footings and other remains located at the terraced mill site, and also includes concrete cyanide vats located approximately 160 ft. to the northeast of the mill site. As previously explained, there are remains of two distinct phases of mill processing at the site, ore concentration, and ore roasting combined with cyanide treatment.

Phase 1 – Concentration

A collapsed wooden ore bin (Feature M-1), and concrete footings for a gasoline engine, rock crusher, ball mill, and concentrator (Features M-2, M-3, M-4, M-5, and M-6) correspond to the first phase of ore processing, in use from 1924 to 1925 (Figure 6).

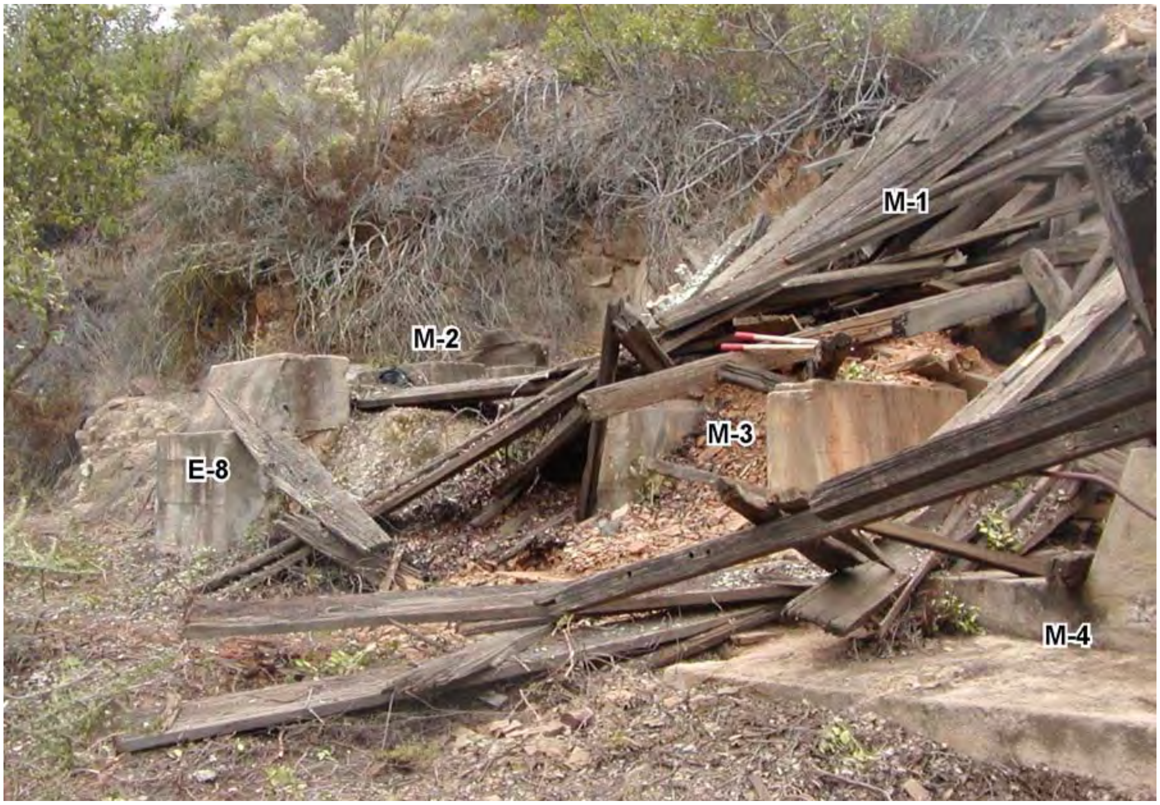

Figure 6. Core processing area showing the collapsed ore bin (M-1), and concrete footings for machinery used in ore processing.

From the dump station at the northeast end of roadbed Feature E-5, the ore was dumped from the ore carts into a wooden hopper or bin with a metal chute at the bottom. This is now represented by Feature M-1, consisting of a roughly L-shaped mound of collapsed lumber and wooden debris measuring approximately 20 x 40 ft. that covers much of the hillside below the dump station as well as many of the concrete footings on the mill site terrace. The concrete footings are remains of the mounts for the various pieces of equipment used in the milling process.

Feature M-2 is a concrete footing located at the southwestern edge of the mill site terrace adjacent to Feature E-8 where the air compressor was probably located. The footings measure approximately 4 x 6 ft. and most likely held the Holt 75 tractor engine used to run the mining equipment. This four-cylinder, in-line, 75-horsepower gasoline engine was originally developed by the Holt Manufacturing Company of Stockton, California, around 1910 for their "Caterpillar" crawler tractors (Barlow 2003:119; Leffingwell 1999:39-41, 293-301). In addition to powering the milling equipment the engine also ran the air compressor, making it part of both the Ore Extraction and Ore Processing feature systems.

Immediately under the ore bin debris are the footings for the Blake Rock Crusher and Harding Ball Mill, represented by Features M-3, M-3a, M-4, and M-4a. Because so much of these footings are covered by lumber, as well as gravel that has washed down from the steep slope above the terrace, their complete dimensions and configuration could not be determined. In shape and relative size, they conform to footings commonly used for rock crushers and ball mills, especially in the use of parallel narrow pyramidal-shaped mounts.

From the ore chute the arsenopyrite would have been fed into the rock breaker for primary crushing. Iron bars known as grizzlys, spaced close enough together to keep pieces too large for the crusher from passing through the chute, were often placed at the top of the ore bin. Primary crushing involved breaking the large lumps of ore down to about a 4-inch diameter size. The Blake Jaw Crusher used at Black Mountain broke the ore by alternately nipping and releasing the material fed between two jaws until it became small enough to fall through the discharge opening. The Blake breaker was originally patented by its inventor Eli Whitney Blake in June 1858. It was the first successful jawbreaker, and its design has held a place as the standard for these types of machines ever since (Richards 1903:13; Zucker and El-Shall 1982:1-4).

From the rock crusher the pieces of ore were fed into a Herman Ball Mill for grinding. The purpose of grinding was to mix the ore with water and reduce it to a fine slime, which was then processed to remove the valuable minerals. A ball mill consists of a rotating steel cylinder with a renewable wear liner. Grinding is accomplished by tumbling the wet ore with a charge of steel balls. A steel ball found at the base of Feature M-3 confirmed that a ball mill originally stood in this general location.

Once the ore was reduced to slime in the ball mill it was conveyed to a concentrator for final processing. In essence, concentrators transform lower grade ore into a higher grade concentrate by the use of a shaking, vibrating motion that separates the metals from lighter materials known as gangue or pulp. There were several types in use at the time the Black Mountain Mine was developed. The simplest were Vanner concentrators that consisted of table-mounted endless belts that shook and vibrated from side to side. The pulp flowed onto the belt surface, where the shaking motion vertically separated the metals and the gangue; the heavier metals settled to the bottom and the lighter gangue stayed near the top and was washed away (Hardesty 1988:43).

The Wilfley Table, originally patented in 1895, had solid riffled plates rather than endless belts (Hardesty 1988:43; Wiard 1915:359-360). The Overstrom Table used at Black Mountain was similar to a Wilfley Table but diamond (rhomboid) shaped, rather than rectangular. This eliminated the problem of waste accumulation in sharp rectangular corners (Mining Dictionary 1996).

The flat concentration tables were often mounted on low rectangular concrete or wooden footings. Given its place in the processing sequence and the need for an open flat rectangular space to set the concentrator, Footing M- 5 and the adjacent 10-ft. square terrace at Feature M-6 seem likely locations. The actual footings may have been removed when the concentrator was taken out and equipment used for ore roasting during the second processing phase installed.

The concentration process required a plentiful supply of water. Feature M-7, an 11.5-ft. square x 8-ft. deep concrete reservoir probably stored water for the concentration process. This same reservoir may also have been intended to store water for the cyanidation employed during the second phase of ore process used from 1926 to 1927.

Phase 2 - Roasting and Cyanidation

Remains of the second phase of ore processing, in use from 1926 to 1927, include the footings for a rotary roaster (M-8, M-9, M-10, M-11, and M-12), large steel pipe (M-13 and M13a), and a trellis support for the pipe (M-14) that connected the roaster with the flue dust chamber (M-15) built on the hill above the mill site terrace (Figure 7). All of the features associated with the ore roasting process are located on the northeast end of the mill site terrace. Approximately 100 ft. northeast of the mill site are two poured concrete reservoirs that were intended to be used as cyanide vats (Features C-1 and C-2).

Roasting

According to Bill Lawrence, primary crushing for the roasting process was conducted in a small gyratory crusher. Gyratory crushers have greater capacity than jaw crushers. Passing the material between an inverted cone and a rotating head breaks the ore (Zucker and El-Shall 1982:1). Lawrence's notes show the crusher located at the dump station at the northeast end of the Feature E-5 roadbed. This seems probable since the rotary roasting furnace used in the process had to be loaded from the top and did not require that the material be reduced to a fine slime as in concentration, thus eliminating the need for a ball mill. A crusher at this point could have reduced the ore to the required size. The crushed rock could then have been fed directly down the hill via an ore chute into a bin above the roaster. It is curious, however, that no footings or other remains for mounting a gyratory crusher at this location or any support for a conveyance system to feed the ore from the crusher to the roaster could be identified. In spite of this, the testimony of Lawrence, and the physical geography of the location, make the crushing of the ore at the dump station and feeding of it directly into the roaster from that point the most likely scenario.

Figure 7. Core processing area showing the remains of the rotary roaster in the foreground. The dust chamber is in the background.

The rotary roaster or furnace was first developed by Bruckner in 1867 for mines in Colorado (Kustel 1880:75). It consisted of a brick-lined horizontal cylinder of iron boilerplate, which revolved on friction rollers between a firebox and a flue, and stirred the ore charge automatically. The flame passed from the firebox directly into the cylinder, and from there, with all the gasses that evolved during roasting, into the flue and dust chambers. In some instances the cylinder was closed at the ends by truncated cones. The common cylinder size was 18 ft. in length x 8 ft. in diameter, with the largest around 22 ft. long x 8.5 ft. in diameter.

The cylinder was usually lined with red brick and the heads with firebrick. In treating lead ores the body of the hearth was also lined with firebrick. A furnace 18.5 ft. long x 8.5 ft. in diameter weighed 45,000 pounds and required 100 firebricks for the heads, 2,800 firebricks for the firebox, and 4,300 red bricks for the body of the furnace.

The furnace was rotated by a spur wheel gear that encircled the outside of the cylinder and was driven by a geared pinion shaft, with a pulley at its end. In some instances, where more than one furnace was in use, the firebox was mounted on rails and could be moved from one furnace to another. These furnaces were known for producing large amounts of flue dust. Although considered a drawback for many mining operations, this would have been an advantage at Black Mountain, where flue dust was to be the primary product (Hofman 1904:198-203; Kustel 1880:75).

Features M-8, M-9, M-10, M-11, and M-12 represent the rotary roaster at Black Mountain. Feature M-8 is a semirectangular concrete slab and footing that measures approximately 18 x 7 ft. The northeastern two thirds is slanted slightly to the northwest. A large concentration of firebrick rubble at the southwest end of the feature indicated that this is where the firebox for the roaster was located.

Features M-9, M-10, and M-11 are a series of poured concrete footings varying from 12 to 24 inches thick. They held the rails that supported the roaster cylinder. Remnants of the steel rails, as well as imprints where others were formerly located, could be seen in all of these footings. In addition, a segment of the gear that fit around the exterior of the furnace so that it could be rotated was found between Features M-9 and M-10.

Feature M-12 is a firebrick-lined flue that set on the southeast end of the gyratory roaster. It measures 4.5 x 6 ft. x 10.5 ft. in height. It has a poured concrete exterior and is lined with firebrick marked "VPC" for the Vitrified Products Corporation of San Diego (Van Wormer and Hector 1987). This flue is not unlike those shown for Bruckner Furnaces shown in historic advertisements. Based on the layout of the firebox location, footings, and flue, as well as the gear segment found between Features M-9 and M-10, the Gates Rotary Roaster at Black Mountain measured 5 ft. in length x 5 ft. in diameter (Weber et al. 1963:49), and was very similar in design to the Bruckner Furnaces in the illustrations.

The flue was connected to the dust chamber located on the bank above the mill site terrace by two large steel pipe segments identified as Features M-13 and M-13a that measure 3 ft. in diameter and about 20 ft. in length. These appear to have been mounted on a wooden trestle supported by a concrete footing designated Feature M-14. This is a stepped foundation 20 x 30 inches x 10 ft. in length built onto the bank.

Feature M-15 is the flue dust chamber located on the hill approximately 16 ft. above and 13 ft. to the northwest of feature M-11. The dust chamber was constructed of poured concrete. It measures 7 x 7 ft. in cross section and 180 ft. in length and runs in a southeast to northwest direction (Figure 8). An opening for a steel pipe chimney is located at the northwest end. Corrugated sheet asbestos baffles stretching from the floor to approximately 6 inches short of the ceiling, divide the interior. A series of portals along the northwest side of the structure allowed access for cleaning. The dust chamber and other concrete footings on site may have been constructed by Hazard Construction Company[1].

The purpose of the dust chamber was to collect the flue dust (soot) generated by roasting the ore. The flue dust carried fine particles of arsenic and other metals. The dust chamber allowed the gasses to pass through very slowly, and gave the dust a chance to settle (Scranton Correspondence School 1902:67).

Figure 8. The southwest side of Feature M-15, the concrete dust chamber.

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[1] Park Ranger Bill Lawrence Jr. was present when his father was interviewed regarding his involvement in the Black Mountain mine. At that time, he identified Hazard Construction Company as the builder of the flue dust chamber (Lawrence 2006).

The design at Black Mountain followed what was considered to be a "common and simple, and effective dust chamber" that consisted of a "large deep flue, with transverse walls built up from the floor part way to the roof." The walls or baffles slowed the movement of fumes and smoke through the chamber. The space between the upper edges of these cross walls allowed for the slow, quiet passage of the flue gases. As the fumes slowed, the dust particles dropped, according to their weight, and fell into the compartments between the baffles. Here the air was absolutely dead and they remained undisturbed until removed for further treatment (Peters 1899:475). As mentioned above, the Black Mountain dust chamber has openings along the base of the northeast side for removing the flue dust. The method of removal is not known but may have been similar to that used at the Omaha and Grant Smelting and Refining Company. There the flue dust was raked out into shallow pits where it was moistened before handling (Hofman 1904:378-397). The interior of the dust chamber at Black Mountain is remarkably clean. The sides and surfaces of the baffles are only slightly discolored from smoke, suggesting it was probably not used except for a few test runs and never produced enough flue dust to require cleaning.

Cyanide Vats

After the ore was roasted, operators of the Black Mountain Mining Company intended to remove it from the furnace and convey it to the cyanide vats for leaching (Features C-1, C-2, and C-3). Developed in Scotland in 1887, and first used in New Zealand in 1889, the cyanide process revolutionized gold mining by greatly increasing the efficiency of the milling process. It was first used in the United States in 1891, and by the end of the nineteenth century had been universally adopted (Young 1970: 283-286; Scheidel 1894:67; Hardesty 1988:51-65).

The process was relatively simple. Crushed ore or tailings were mixed with a weak cyanide solution that dissolved and separated gold from the ore. The solution was then run through boxes packed with zinc shavings that precipitated the gold, allowing for its recovery. The solution was then pumped into a reservoir for reuse.

Cyanide leaching allowed collection of virtually every atom of gold contained in tailing waste and low-grade ore (Young 1970:283). It was not only a technological, but also a financial breakthrough. The process required fewer workmen than previous milling methods, which meant lower labor costs. In addition, the procedure reused the same water, thus requiring much less than a ball mill, or concentrator - an important savings for small operations with a limited water supply like Black Mountain (Scheidel 1894). It is estimated that cyanidation doubled the world's annual production of gold at the end of the nineteenth century (Young 1970:284-286; Scheidel 1894:96).

It is assumed that the solution for the cyanide process at Black Mountain was stored in reservoir Feature M-7: the same concrete tank that appears to have originally been built to hold water for the ball mill and concentrator used in the Phase 1 milling process. From here the solution would have been conveyed through pipes to the cyanide vats represented by Features C-1 and C-2. As already stated, these vats would have been previously filled with ore taken from the rotary furnace after roasting. The vats are located approximately 160 ft. to the northeast of the mill site terrace. They are accessed by a roadcut approximately 15 ft. wide and designated Feature A-1. This road continued to the northwest, and was apparently the main access road used to bring the machinery and supplies used to construct the mill.

Features C-1 and C-2 are poured concrete reservoirs approximately 8 ft. in depth. Feature C-1 measures around 10 x 10 ft., and C-2 about 10 x 20 ft. and is divided into two 10-ft. square sections. After leaching, the cyanide solution would have been drained from these tanks and passed through filters to recover the gold. The liquid would then have been pumped back to the reservoir at Feature M-1 for reuse. Remains of the filtering equipment and pipelines for conveying the solution were not found. Although the equipment may have been removed for salvage after the mine shut down, the lack of footings or a terraced pad for the filtering equipment location is problematical and suggest that, given the fact that very little, if any, ore was ever processed at Black Mountain, the cyanide plant may never have been completed.

6 RESOURCE EVALUATION

Because federal grant funds could be involved in future funding for Black Mountain Open Space Park, resource evaluation was conducted using the criteria for the National Register of Historic Places, and the California Register. Criteria included in the City of San Diego Historical Resources Guidelines (updated August 2004) were also used to prepare this report.

NATIONAL REGISTER OF HISTORIC PLACES

The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title H of this Act a reasonable opportunity to comment with regard to such undertaking [National Historic Preservation Act of 1966, as amended Section 106 (16 U.S.C. 470f)].

Criteria for Evaluation

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and,

> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or;
> (b) that are associated with the lives of persons significant in our past; or
> (c) that embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> (d) that have yielded, or may be likely to yield, information important in prehistory or history.

Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

(1) A religious property deriving primary significance from architectural or artistic distinction or historical importance; or

(2) A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or

(3) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life; or

(4) A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or

(5) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

(6) A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or

(7) A property achieving significance within the past 50 years if it is of exceptional importance.

CALIFORNIA REGISTER OF HISTORICAL RESOURCES

California Environmental Quality Act (CEQA)

CEQA requires that all private and public activities not specifically exempted be evaluated against the potential for environmental damage, including effects to historical resources. Historical resources are recognized as part of the environment under CEQA. It defines historical resources as “any object, building, structure, site, area, or place which is historically significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California” [Division I, Public Resources Code, Section 5021.1(b)].

Lead agencies have a responsibility to evaluate historical resources against the California Register criteria prior to making a finding as to a proposed project’s impacts to historical resources. Mitigation of adverse impacts is required if the proposed project will cause substantial adverse change. Substantial adverse change includes demolition, destruction, relocation, or alteration such that the significance of an historical resource would be impaired. While demolition and destruction are fairly obvious significant impacts, it is more difficult to assess when change, alteration, or relocation crosses the threshold of substantial adverse change. The CEQA Guidelines provide that a project that demolishes or alters those physical characteristics of an historical resource that convey its historical significance (i.e., its character-defining features) can be considered to materially impair the resource's significance.

The California Register is used in the consideration of historic resources relative to significance for purposes of CEQA. The California Register includes resources listed in, or formally determined eligible for listing in, the National Register of Historic Places, as well as some California State Landmarks and Points of Historical Interest. Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts), or that have been identified in a local historical resources inventory may be eligible for listing in the California Register and are presumed to be significant resources for purposes of CEQA unless a preponderance of evidence indicates otherwise.

Generally, a resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing on the California Register of Historical Resources (Pub. Res. Code SS5024.1, Title 14 CCR, Section 4852) consisting of the following:

(1) It is associated with events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States; or

(2) It is associated with the lives of persons important to local, California, or national history; or

(3) It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master, or possesses high artistic values; or

(4) It has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

CITY OF SAN DIEGO CEQA SIGNIFICANCE

If a resource is not listed in, or determined eligible for listing in, the California Register, not included in a local register, or not deemed significant in a historical resource survey it may nonetheless be historically significant. If a proposed project has the potential to affect a historical resource, the significance of that resource must be determined. The significance of a historical resource is based on the potential for the resource to address important research questions as documented in a site-specific technical report prepared as part of the environmental review process. Research priorities for the prehistoric, ethnohistoric and historic periods of San Diego history are discussed in Appendix A (San Diego History) to the City of San Diego Historical Resources Guidelines (updated August 2004) and should be used in the determination of historical significance. As a baseline, the City of San Diego has established the following criteria to be used in the determination of significance under CEQA.

An archaeological site must consist of at least three associated artifacts/ecofacts (within a 50 square meter area) or a single feature and must be at least 45 years of age. Archaeological sites containing only a surface component are generally considered not significant, unless demonstrated otherwise. Such site types may include isolated finds, bedrock milling stations, sparse lithic artifact scatters, and shellfish processing stations. All other archaeological sites are considered potentially significant. The determination of significance is based on a number of factors specific to a particular site including site size, type and integrity; presence or absence of a subsurface deposit, soil stratigraphy, features, diagnostics, and datable material; artifact and ecofact density; assemblage complexity; cultural affiliation; association with an important person or event; and ethnic importance. The determination of significance for historic buildings, structures, objects and landscapes is based on age, location, context, association with an important person or event, uniqueness, and integrity.

A site will be considered to possess ethnic significance if it is associated with a burial or cemetery; religious social or traditional activities of a discrete ethnic population; an important person or event as defined by a discrete ethnic population; or the mythology of a discrete ethnic population.

Archaeological sites containing only a surface component are generally considered not significant, unless demonstrated otherwise. (Testing is required to document the absence of a subsurface deposit.) Such non-significant sites may include:

- Isolates;
- Sparse Lithic Artifact Scatters;
- Isolated Bedrock Milling Stations; and
- Shellfish Processing Stations.

Sparse Lithic Artifact Scatters are identified and evaluated based on criteria from the Office of Historic Preservation's "California Archaeological Resource Identification and Data Acquisition Program: Sparse Lithic Scatters" (February 1988). Isolated Bedrock Milling Stations are defined as having no associated site within a 50 meter radius and lacking a subsurface component. Shellfish Processing Stations are defined as containing a minimal amount of lithics and no subsurface deposit. Historic buildings, structures, objects and landscapes are generally not significant if they are less than 45 years old. A non-significant building or structure located within an historic district is by definition not significant. Resources found to be non-significant as a result of the survey and assessment, will require no further work beyond documentation of the resources and inclusion in the survey and assessment report.

EVALUATION OF BLACK MOUNTAIN MINE

Application Of National Register Criteria

The National Register assessment of the properties associated with the Black Mountain Mine applies the criteria of 36 CFR 60, as well as National Park Service guidance on evaluating mining properties and rural landscapes. National Register (NR) Bulletin #15 provides guidance and standards for applying the Criteria of Evaluation (Andrus and Shrimpton 2002). NR Bulletin #30 addresses the evaluation and documentation of rural historic landscapes (McClelland et al. 1999). NR Bulletin #42 provides guidelines for identifying and evaluating historic mining properties (Noble and Spude 1997). Together, these resources establish the basis for the finding that the Black Mountain Mine Rural Historic Landscape District qualifies for listing in the National Register of Historic Places under Criteria A and C at the local level of significance.

Rural Historic Landscapes

As noted, NR Bulletins #30 and #42 provide guidance for defining and evaluating properties such as those in the Black Mountain Mine project:

> For purposes of the National Register, a rural historic landscape is defined as a geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features. Rural landscapes commonly reflect the day-to-day occupational activities of people engaged in traditional work such as mining, fishing, and various types of agriculture. Often they have developed in response to both the forces of nature and the need to make a living [McClelland et al. 1999].
>
> Mining landscapes can be characterized and distinguished by historic patterns of land use such as strip-mining, hydraulic mining, or open-pit mining; the spatial organization or layout of the landscape; characteristic natural and cultural landforms such as mine waste rock dumps, mill tailing flows, and canyons; roads and pathways; vegetation patterns related to land use such as secondary growth of plants on mine waste rock dumps; distinctive buildings and structures such as headframes or cyanide mills or coal tipples; clusters of buildings and structures such as those at mines or urban settlements; and small-scale features such as mine claim markers or fences [Noble and Spude 1997].

Applying the Criteria of Eligibility to the Black Mountain Mine Rural Landscape Historic District demonstrates that the district meets Criterion A for its direct association with patterns of rural mining in the region. NR Bulletin #30 offers additional guidance:

> Criterion A recognizes the significant contributions that rural properties have made through diverse events and activities, including exploration, settlement, ethnic traditions, farming, animal husbandry, ranching, irrigation, logging, horticulture, fishing, fish culturing, mining, transportation, and recreation. Village and farm clusters, fields, and other land use areas, roadways, natural features, vegetation, and boundary demarcations may together illustrate important events and activities that led to a community's development [McClelland et al. 1999].

The mining venture at Black Mountain was closely associated with regional patterns of mineral exploitation typical of the late nineteenth and early twentieth centuries. Additionally, it reflects the unique episodic history of arsenic mining. The district also meets Criterion A for its representation of patterns of investment in unproductive mining properties that characterized much of the business climate of Western mining throughout the last half of the nineteenth and early twentieth centuries.

Criterion B, which pertains to an association with significant individuals, does not apply; for example, although Wilfred Buckland invested in the venture, this association is neither direct nor significant enough in his life to qualify.

The district meets Criterion C, because it reflects the unique engineering of arsenic extraction and processing. As a rural mining landscape, the site reflects both the direct influences of the natural setting and the patterns of activity associated with the mining process. Circulation patterns, concentrations of mining features and alterations to the landforms all convey the unique engineering and adaptation of the activity.

The site does not appear to meet Criterion D. As noted in NR Bulletin #42, “Application of Criterion D to mining properties requires the development of a good research design that not only identifies the research questions that are important to mining-related scholarship or science but also the information that is needed to answer the research questions” (Noble and Spude 1997). The Black Mountain Mine site appears to have no potential for contributing to research of this significance.

Integrity

As quoted above, 36 CFR 60.4 and NR Bulletin #15 make it clear that to be eligible a property must retain sufficient integrity to convey its significance. NR Bulletin #42, which addresses mining properties, provides focused guidance on integrity:

> When assessing the integrity of a mining property, it is important to remember that the National Register will accept significant and distinguishable entities whose components may lack individual distinction. As discussed elsewhere in this bulletin, the passage of time, exposure to a harsh environment, abandonment, vandalism, and neglect often combine to cause the deterioration of individual mining property components. For example, buildings may have collapsed, machinery may have been removed, and railroad tracks may have been salvaged. However, the property may still exhibit a labyrinth of paths, roads, shaft openings, trash heaps, and fragments of

> industrial activity like standing headframes and large tailings piles. Although these individual components may appear to lack distinction, the combined impact of these separate components may enable the property to convey the collective image of a historically significant mining operation. In essence, the whole of this property will be greater than the sum of its parts. In such cases, a mining property may be judged to have integrity as a system even though individual components of the system have deteriorated over time.
>
> Because most historic mining properties will be abandoned and in poor repair, special care must be taken when evaluating integrity. The integrity of a mining property cannot be judged in the same fashion as the integrity of a building. In some cases, buildings and objects related to mining will have been relocated and many original construction materials will be gone [Noble and Spude 1997].

Location

The Black Mountain Mine Rural Landscape Historic District retains a high degree of integrity of location. All of the adits, roadcuts, and concrete features are on the same locations where they were constructed. The district retains excellent integrity of location.

Design

Design is defined as the “combination of elements that create the form, plan, space, structure, and style of a property.” It results from conscious decisions made during the original conception and planning of the property (Andrus and Shrimpton 2002). In spite of removal of major pieces of equipment, the original function of most of the features at the site can be identified and the original designs of the developers as they relate to the ore processing systems can be understood.

Setting

Setting is defined as the “physical environment of a historic property” (Andrus and Shrimpton 2002). The setting of the district is virtually unchanged from the time when the mine was developed. The narrow canyon and brush-covered slopes of Black Mountain remain unaltered, giving the district excellent integrity of setting.

Materials

Materials are “the physical elements that were combined during a particular period of time in a particular pattern of construction to form a historic property” (Andrus and Shrimpton 2002). The district retains original materials in the form of wood, concrete, steel, and masonry in the footings and structures, and earth and stone in the road cuts, adits, and tailings. Because of this, the district retains substantial integrity of materials.

Workmanship

Workmanship is the "physical evidence of crafts of a particular culture or people" (Andrus and Shrimpton 2002). Good integrity of design and materials, as discussed above, combine to give an excellent integrity of workmanship for the district.

Feeling and Association

Feeling is defined as "a property's expression of the aesthetic or historic sense of a particular period of time" (Andrus and Shrimpton 2002). It results from the presence of historic features that together convey the property's historic character. Association is the "direct link between an important historic event and a historic property." The combination of integrity of location, design, setting, materials, and workmanship discussed above combine to give the district a strong feeling and association for its period of significance.

Reviewing the integrity of the Black Mountain Mine Rural Historic Landscape District with this guidance demonstrates that the resource retains substantial integrity of location, design, setting, materials, workmanship, feeling, and association.

Application Of California Register Criteria

Cultural resources listed, or eligible for listing, in the National Register of Historic Places are also eligible for listing in the California Register of Historic Resources (California Register). As the criteria for eligibility to the California Register mirror those of the National Register, the Black Mountain Mine Rural Historic Landscape District is eligible for the California Register under Criteria 1 and 3 as discussed above at a local level of significance.

City of San Diego CEQA Significance

Cultural resources listed in, or eligible for listing, in the National Register of Historic Places and/or the California Register of Historic Resources are also eligible for listing in the City of San Diego Historical Site Board Register.

ARCHAEOLOGICAL SITES

The archaeological sites and isolates recorded by previous surveys and during field survey for this project have not been evaluated for the National Register, California Register, or City of San Diego Historical Site Board Register.

Preliminary assessment of surface features of these sites suggests that most are unlikely to be eligible for listing at either the National, State or local level. Sparse shell scatters (SDI-18277), sparse lithic and shell scatters, isolated milling features (SDI-18276 and -18278) and isolates (P-37-028093) are not considered eligible under City of San Diego Guidelines for eligibility and would not be eligible for listing in the California or National Registers. Isolated historic features such as the rock cairns (SDI-18275 and -18280) are also unlikely to be eligible for listing at either the National, State or local level.

The two prehistoric quarries (SDI-13738 and -18279) have potential for eligibility and formal evaluation for the National Register, California Register, and City of San Diego Historical Site Board Register should be completed if impacts to any of these resources are anticipated as a result of park improvements, such as trail maintenance, or construction of signage.

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APPENDICES

APPENDIX A

Museum of Man Records Search

and

SCIC Records Search

(To be Provided)

APPENDIX B

Site Records

APPENDIX C

Native American Consultation

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APPENDIX B

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Ranga Adit-01

Ranga Adit-01

Ranga Adit-01

Ranga Tailings-02


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tailings
4/10/17 10:15


Glory Hole-03
tailings
4/10/17 10:15

Glory hole tailings-03

Glory hole tailings-03

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APPENDIX C

Site Health and Safety Plan

UNIVSERSITY OF SAN DIEGO, DEPARTMENT OF ENVIRONMENTAL AND OCEAN SCIENCES

SITE
HEALTH AND SAFETY PLAN
(HASP)

BLACK MOUNTAIN OPEN SPACE PARK, SAN DIEGO, CALIFORNIA

SOILS CONTAMINATED WITH ARSENIC

July 14, 2015

PREPARED BY
BY H. M. PITT LABS, INC.

LAB # 144009

Leland S. Pitt

Certified Industrial Hygienist, #4303
President, H. M. Pitt Labs, Inc.

Program Manager, University of San Diego
Mr. Eric Cathcart

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2434 SOUTHPORT WAY, SUITE L, NATIONAL CITY, CALIFORNIA
PHONE (619) 474-8548 FAX (858)-412-3305

Safety Compliance Agreement Form

PURPOSE: This plan is designed to investigate the spatial distribution of arsenic in rock and soil s across the Black Mountain Open Space Park. This park is currently open to the public for recreational use. There is known large deposits of arsenic in the soils and rocks in Black Mountain. This area was once mined for arsenic. The intent of the soils/ rock testing is to hone in on the exposure possibilities to workers and the public using and working in the park.—with particular emphases on along drainage paths and fracture zones. In addition the intent is to determine the mineral host of arsenic and their influence on arsenic mobility, and finally to determine the extent to which arsenic is mobile in the environment.

Site: BLACK MOUNTAIN OPEN SPACE PARK, SAN DIEGO, CA.

To conduct this study, a field x-ray fluorescence device (FP-XRF) will be used to determine the spatial extent of arsenic enrichment at Black Mountain. Specifically, we will sample every 1 meter surrounding anthropomorphic disturbances (i.e. mine remnants) and every5 meters along drainage paths. FP-XRF data will be used to select rock and soil samples of varying sizes that will be further analyzed in the lab, with arsenic concentrations of less than 500 PPM targeted to ensure safety in lab. Some selected samples of varying particle sizes will be leached in locally collected rainwater for a month. The leachate will then be analyzed for arsenic using inductively coupled plasma optical emission spectroscopy (ICP-OES) to determine the extent to which arsenic is mobile under local environmental conditions. Dry sieving and analyzing some of these samples for arsenic will aid in determining which particle size holds the most arsenic.

A scanning electron microscope or x-ray diffraction (XRD) will be used to determine the mineral hosts of arsenic, and leaching experiments in local rainwater will air in determining their influence on arsenic mobility. Finally, dust exposure via the trail system throughout Black Mountain will be assessed using air sampling pumps. These samples will be analyzed with an XRF or by using standard hygiene lab analyses to determine the extent to which arsenic is enriched in the dust and therefore, the potential public health impact to park patrons.

Data reliability will assessed with rigorous laboratory quality assurance/ quality control checks (e.g. use of certified reference materials), and results will be subjected to appropriate statistical analyses (e.g. special techniques, such as kriging). Spatial analyses in GIS will enhance assessment of public exposure to arsenic. Specifically, the results of this study will be compared to other relevant local parameters (e.g. surrounding residential population, rainfall, wind direction) to estimate potential for arsenic exposure and evaluate which factors had the greatest influence on arsenic mobility.

University of San Diego certifies that this document has been read by the Program Manager and related personnel management in charge of the site operations defined herein. This document was written in compliance with the requirements of OSHA standard 29 CFR 1910.120 and Title 8 CCR 5192 as well as all Federal, State and local regulations and statutes, and submitted for review and approval by the University of San ego, Department of Environmental and Ocean Sciences prior to commencement of any site work or handling of contaminated soils/materials.

I. the undersigned, acknowledge that I have attended the safety meeting and I have read and understand this safety plan, and do agree to assertively adhere to the specifications within. I understand that I may be prohibited from continuing work on the project for failing to comply with this safety plan.

(Names Printed) Signature Company Title
Date

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1)______________________________ _______________ ___________________

2)______________________________ _______________ ___________________

3)______________________________ _______________ ___________________

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Meeting Conducted By:____________________________________

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5)_______________________________ ________________ ____________________

Meeting Conducted By:______________________________________

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(Signature)

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1.0 Site Specific Health and Safety Plan (HASP)

1.1 Scope of the Site Health and Safety Plan (HASP)

This Site Health and Safety Plan (HASP) is intended to meet the requirements of 29 CFR. Part 1910.120., other pertinent sections of CFR Part 1910, CCR Title 8, Section 5192 and U. S. Army Corps of Engineers Safety & Health Requirements EM 385-1-1. This plan also must serve as a guide to deal with handling contaminated soils handled at this site

The following sections of CCR Title 8. Section 5192 and 29 CFR Part 1910 are addressed.

Section 5192	Organizational Structure
Section 5192	Comprehensive Work plan
Section 5192	Health and Safety Plan
Section 1910.95	Noise
Section 1910.106	Flammable and Combustible Liquids
Section 1910.134	Respirators
Section 1910.152	First Aid and Medical Services
Section 1910.1000	Air Contaminants as listed in the Z tables
Section 1910.120	Hazardous Waste Operations

All employees and subcontractors of University of San Diego, Department of Environmental and Ocean Sciences involved in field work remediation at this site will have completed the required 40 hour HAZWOPER initial training course as required by law and/or contract specifications, and will have maintained this qualification through annual refresher training. The Site Safety Manager will have completed additional 8-hours of training as a Hazardous Waste Supervisor in accordance with 29 CFR 1910.120. HAZWOPER training certificates will be posted or available on site. Workers must be trained for handling or being exposed --- potentially --- to stressors other than arsenic in soils. This type of training for other hazards that may be encountered at the Black Mountain site could include: unknown petroleum oils, diesel fuel, gasoline fuel, poly nuclear aromatics (PAH/PNA), other toxic metals, unreported/unidentified underground storage tanks (UST's) and confined space entry hazards associated with mining. These stressors and others are covered in the HAZWOPER training. But the only stressor that this plan will address specifically is the potential for workers to be exposed to arsenic. In addition, all employees that undergo HAZWOPER training shall be involved in a program of medical monitoring, and are certified to wear respiratory protection as specified in 29 CFR1910.134, 29 CFR 1910.120 and Title 8 CCR 5144.

This plan was prepared from the best available information concerning site conditions at the time. The Health and Safety specifications in this plan are based on reasonable knowledge that heavy metals and petroleum hydrocarbons are likely to be encountered on the site. The other stressors -- or possible stressors --- shall only be encountered as contained hazards or potential hazards. Real spills, exposures or remediation of stressors like but not limited to : PCB's, other toxic metals, oxygen deficiencies, LEL's greater than 5 % will be strictly handled by site specific plans or more likely the contracted hazardous response company along with the local fire department. Any change in condition that results in the use of a licensed abatement or hazardous materials response company will be done under the control and guidance of University of San Diego, Department of Environmental and Ocean Sciences and the HM Pitt Labs Site Technician. Unless specified in this site safety plan, the field team does not have the option to modify the levels of personal protection in any way. It is recognized that conditions on the site may change, or that more information may become available during the operation. If during the operation it is determined that the conditions are not as described, or the protection specified in the site safety plan requires modification, work will cease. Work will not resume until authorized by the Program Manager (PM) and Site Health and Safety Officer (SHSO), and the hazards have been corrected.

If conditions encountered at the site differ form that represented by the University project documents, remediation / sampling / work shall be done under the control of University of San Diego, Department of Environmental and Ocean Sciences and other qualified sources.

1.2 Site Descriptions and Contamination Characterization

This HASP is being developed in accordance with the critical scheduling path as established in the plans and specifications for the timely testing of soils that have been contaminated with arsenic.

As stated earlier the extent of the safety concerns involve: 1. General personnel safety problems like noise, heavy equipment, trips, falls and general eye protection etc. 2. Exposure to arsenic.

The exact locations of this soils work are shown on location maps in Appendix A.

HM Pitt Labs Inc.'s CIH and Professional Geologist (PG) will not be on site during the entire contract/ research project. Rather it will be the responsibility of University personnel to comply with requirements in this plan that involve sampling of soils/ rock debris and air samples

This plan will be augmented with specific site descriptions and remediation practices for each specific location if unknown conditions should arise. As stated earlier, if there is a change in conditions, all additional work shall be done under the auspices of University of San Diego, Department of Environmental and Ocean Sciences and the Owner. During the other phases of the work when the CIH and/or PG will not be on site it will be the responsibility of the contractors safety officers and the H. M. Pitt Site technician to directly work under the guidance of the CIH and/or PG. It is the responsibility of the Safety Officer to inform the CIH and the site technician of all aspects of the site safety during the entire course of this sampling project and any remediation work (if required) and the other unknown stressors.

The tasks to be performed as described in the site job are:

- Isolate all sites of soils sampling by using the methods and work practices as described in this general safety and health plan.
- Properly excavate and stockpile soils for analysis
- Monitor and test the air and soils

Please refer to the contract specifications for a precise listing of all improvements required for this contract.

Please refer to Appendix I for tables concerning contaminants. Among the known or suspected contaminants characterized in the site operation are:

Chemical Name:	Inorganic arsenic
Concentration Range:	Refer to analytical provided by earlier XRF work please refer to appendix E
Media in Which Found:	soil / rocks

Estimated Quantities /Volumes to Be Impacted by Site Work.: Please refer to the University's sampling plan.

Safety Data Sheets: Included in the contractor's submittals

Project duration is limited to the project requirements.

Site topography is uneven/ hilly to generally level. Surrounding surface conditions are unimproved grounds with hillsides. The prevailing weather conditions are not expected to be a significant consequence to the work performance due to the generally mild weather conditions typical to this geographical location.

1.3 Description and Sampling Program

The on site monitoring shall be done by H.M. Pitt Labs for initial air samples for air borne arsenic dust from the university sampling. The trained technician shall take at least air samples as indicated in this plan and may have to use other direct reading instrumentation on site to include, but not limited to, Combustible Gas Indicator (CGI), Photo Ionization Detector (PID) and X-Ray Fluorescence (XRF) Analyzer. The sites will be continuously sampled for at least arsenic and may have to test or monitor other metals and hydrocarbons in workers breathing zones, and at the perimeter to the hazard areas.

2.0 Hazard Assessment and Risk Analysis

Industrial hygiene sampling was conducted to determine the nature of the soils contaminants and to evaluate the inherent hazard activities involved with the operation. A risk analysis for all tasks for the site can or may be done using the required risk matrix approach as specified by the Army Corps of Engineers manual and Title 8 CCR

2.1 This HASP is primarily for arsenic. Its' presence is known and confirmed at the job site. Other toxic vapors, gases and aerosols will be monitored as required in this HASP, but it is expected that only arsenic identified from sampling shall be expected in the job site.

2.2 Action Levels of Primary Contaminants

The action levels of contaminants are determined by the Threshold Limit Values (TLV) as well and the P.E.L.'s. Biological Exposure indexes can also be found as published by the American Conference of Governmental Industrial Hygienists for 2015.
It should be noted that the hydrocarbons (including aromatics) are of unknown structure, and therefore, unknown toxicity. In fact many of the compounds that may be encountered may not have a listed PEL, TLV-TWA, or NIOSH REL nor would they have an action level. Federal regulations concerning health standards like arsenic, lead and asbestos, mandate levels of action that are clear and well known. Other reference consensus standards like, but not limited to, NIOSH and ACGIH, may indicate that action be taken at other levels of exposure or contamination. Volatiles like, but not limited to benzo(a)pryene, phenanthrene, acridine, chrysene, anthracene, and pyrene have been given a NIOSH REL of 0.1 mg/M^3. This will be used as the action level for the field. This means that any significant data of 0.1 mg/M3 or greater will require a change of condition and additional hygiene sampling in the field. PID levels of 10.0 mg/M3 will be used as an action level for hydrocarbons. Please be aware that only arsenic is expected in this research project

3.0 Accident Prevention Plan

3.1 Education and Training

The level of training provided will be consistent with the worker's job function and responsibilities. The training program involves both classroom instruction in a wide range of Health and Safety topics and "hands-on" practice. This training program for work around hazardous substances also incorporates on-site experience under the direct supervision of trained, experienced personnel.

-Before their first assignment, every new employee will receive a thorough safety orientation (i.e.. the contents of this plan). Job specific safe work practices and hazards peculiar to the particular work to be undertaken will be covered with all employees and/or subcontractor's personnel (Please see sign acknowledgment at the front of this plan.)

- When employees may be exposed to known or suspected work place hazards, they will be instructed in the recognition of the hazard, the procedures for protecting themselves from injury, and in first aid procedures in case of injury.

-Previous experience will be considered when assigning personnel, and only those qualified by training of experience will be permitted to operate machinery and equipment.

-Safety meetings with all supervisory personnel will be conducted by or at the direction of the SHSO at the start of the project and at least monthly to review accident prevention efforts safety policy, and the procedures pertinent to the work being performed.

-The project supervisor will hold daily "tailgate" safety meetings with their crews to discuss procedures, suggestions, past accidents, and any upcoming changes in work conditions or types that may pose safety or health hazards. The Activity Hazard Analysis and Risk Analysis (Appendix C) for a specific activity may be prepared as an aide in conducting safety meetings. Copies of the Safety Meeting Report, Safety Exposure Report, and Accident investigation Report will be recorded and a copy maintained on the lot, site or field office at all times.

- Any other operations where more specific training is required by law or regulations ---such as the use of respiratory equipment may occur ---- will require additional training according to the applicable regulation.

- All excavation, benching, pot holing, drilling or stockpiling university workers in an exclusion or contamination zones will require the forty hours of HAZWOPER training

3.2 Health and Physical Requirements

Employees must be physically capable of performing their assigned duties.

- No employee will be permitted on the job site whose mental or physical condition may be detrimental to the safety of his or her self or others.

- All drivers of vehicles with a rated capacity of more than 26, 000 pounds or carrying loads requiring placards will be required to pass a biannual physical examination, or as otherwise required by applicable State or Federal regulations.

- All equipment vehicle or machinery operators must be able to read and understand all signs, signals, and operation instructions in use.

- Employees will not be required or allowed to wear a respirator unless they have been examined by a licensed physician and given clearance to work in writing as being able to perform assigned duties while wearing any such device.

- All HAZWOPER trained employers shall undergo the following medical testing:

Blood and urine sampling for arsenic
PFT
Complete physical

4.0 Staff Organization and Responsibilities

4.1 Responsibility and Authority

Personnel responsible for the project safety at the site are the Program Manager (PM). Site Superintendents) Health & Safety Manager or in his absence the Site Health and Safety Officer (SHSO) working under the direction of the CIH and his project site technician. The project CIH from HM Pitt Labs, Inc. and the Professional Geologist from the university will be responsible for complete oversite of this project. This includes the daily review of the daily direct reading logs and determining the necessity for additional protective equipment and/or monitoring. Copies of all documentation will be submitted daily to the university and the representatives from the park.

The site safety plan must be approved by the Program Manager and the Health & Safety Manager. The SHSO is responsible for reviewing and approving all safety plans and attachments, and advising the PM on Health and Safety matters. The SHSO has the authority to audit compliance with the provisions of site safety plans, and to suspend or modify work practices for safety reasons. The PM or SHSO may dismiss from the work site any individual whose conduct on site endangers the Health and Safety of others.

The PM is also responsible for ensuring that the provisions of safety plans are implemented. All field personnel must have met medical examination and training requirements. An adequate supply of specified safety equipment and materials must be made available, and the required safety reports will be submitted.

The SHSO will conduct site specific Hazardous Communications Program with all personnel prior to commencement of work plan activities. Attendance will be mandatory and sign-offs required. Daily "tail gate" safety meetings will be conducted by supervisors and all personnel shall be informed of the day’s activities, and updated as to any special hazards and conditions that may exist.

4.1.1 HASP. Organization

4.1.1.1 Organization Responsibilities

Senior Level Management-

- Provides necessary facilities, equipment, and funding support.
- Provides adequate personnel and time resources to conduct activities safely
- Supports the efforts of off-site and on-site management.
- Supports appropriate disciplinary action when unsafe acts or practices occur.

- **Program Manager –**
- Provides background review of the project, of the work plan, of the HASP, and the field procedures
- Ensures that the Work Plan is completed accurately and on schedule.
- Briefs the site managers, and subcontractors on their specific assignments and responsibilities.
- Uses the SHSO to enforce safety and health requirements.
- Is ultimately responsible for enforcement and monitoring of the Site Health and Safety Plan

Contracts Manager –

- Provides contractual support
- Define and direct all assigned subcontractors
- Maintains records and data for contract and site activities

Health and Safety Manager –

- Implement and oversee Health and Safety Program
- Provide support to off-site and on-site requirements of the SHSO.
- Maintain current regulatory requirements
- Develop and implement new training requirements

- **Site Health and Safety Officer (SHSO) and Competent Persons / On site Hygienist** (**See Appendix E for Personnel**): Leland S. Pitt is the project CIH; Eric Cathcart is the project Professional Geologist
- Participates in the preparation of and implements the Site Health and Safety Plan
- Selects protective clothing and equipment as required by this plan and as recommended by H. M. Pitt's Certified Industrial Hygienist.
- Periodically inspects protective clothing and equipment
- Ensures that protective clothing and equipment are properly stored and maintained.
- Coordinates health and safety program activities with the Health and Safety Manager.
- Confirms that site personnel are suitable for work based on a physician's recommendation
- CIH daily review of direct reading logs and laboratory sample results and determination of the necessity for additional PPE, monitoring and decontamination procedures.

- **Monitor or Technician for on-site hazards and conditions**.
  (H.M. Pitt Labs, Inc.)

- Is knowledgeable of emergency procedures, evacuation routes, and the telephone numbers for the ambulance station and medical facilities, poison control center, fire department, emergency response and the local police.
- Coordinates emergency medical care.
- Pull soils, personal samples, and other bulk materials, wash water, and other samples from sites for laboratory evaluation as required.

  Constantly monitors soils during worker excavation/ sampling operations activity, general construction safety hazards, and air quality per the direction of University of San Diego, Department of Environmental and Ocean Sciences' CIH. This monitoring shall be at least for arsenic

- **Quality Assurance Inspector –**
- Implements and executes the contractor's Quality Control Plans
- Provides off-site and on-site inspections for compliance
- Initiates corrective action and subsequent re-inspection
- Represents University of San Diego, Department of Environmental and Ocean Sciences regarding all quality assurance matters

- **Project Superintendent –**
- Manages field operations
- Executes the work plan and schedule
- Coordinates with the Site Health and Safety Officer in determining protection levels.
- Enforces site control.
- Documents field activities and sampling collection. This activity can be done outside reduction zone.

- **On-site University Personnel**
- Obey safety instructions, rules and regulations.
- Use Personal Protective Equipment (PPE) and safety devices provided or as required.
- Report any unsafe conditions or unsafe work practices to their supervisors.
- Participate actively in "tailgate" or "toolbox" safety meetings.
- Provide suggestions for Improvement of the program operations
- It is up to the individual employees and it is their responsibility to implement all aspects of this Site Health and Safety Plan

- **Emergency Response Team:** San Diego Fire Department
- Provides on-site and off-site emergency response
- Provides on-site personnel decontamination facilities.
- Provides on-site and off-site emergency control measures.

- **Subcontractor(s):**
- Performs specified requirements of the work plan.
- Acknowledges and complies with the HASP
- Acknowledges and complies with Q & A program

- Provides all required reports and compliance with the university's research requirements.

5.0 Personal Protective Equipment (PPE)

The selection of the PPE applies to work activities where complete skin protection is warranted, and the use of NIOSH approved air purifying respirators is suitable to protect against possible low level generation of aerosols, dusts, mists, or organic vapors. The lowest level of respiratory protection that may be used for this job site will be a half face negative pressure respirator that uses a combination carbon filter approved to remove dusts, mists, or organic chemical vapors and HEPA-type particulate removal bulk particles. This shall be worn by University of San Diego, Department of Environmental and Ocean Sciences' employees / students throughout any excavation, stockpiling and sampling suspect soils as required.

HAZWOPER trained employees will be certified by an approved physician as being physically fit to wear respiratory protective devices to perform their assigned field work.

University of San Diego, Department of Environmental and Ocean Sciences' PPE usage is governed and dictated by this plan.

At a minimum the following items of protective clothing will be provided and furnished for on-site personnel

- Approved clothing, including shirts with sleeves and long pants. PPE will be required to be used as required for protection from recognized hazards.

- Safety-toe shoes, boots, or step in foot protectors will be worn by personnel exposed to potential foot injury.

- Hard hats meeting the requirements of ANSI Z89 1-1969 (R) Class A or ANSI 289 2-1972(R) Class B will be worn by all workers and visitors on the work site.

- Approved safety eye and face protection will be worn by personnel exposed to injury from dust, flying particles, splashes, and other hazards.

- Approved gloves will be worn by all employees subject to handling hazardous materials, hot objects or tools, or other equipment which may cause hand injuries.

- Ear plugs or muffs will be worn by personnel exposed no noise levels exceeding 80 decibels (dB). There will be no exposure to impact noise exceeding a 140 dB peak sound pressure level.

- Personnel driving or riding in passenger vehicles will use seat belts.

- All prescription eyeglasses in use on-site will be safety glasses. Prescription lens inserts will be provided for full face respirators. Contact lenses are prohibited.

5.1 Procedures for PPE Selection

The PM and SHSO will determine the level of PPE that will be used at each specific site.

NO CHANGES TO THE SPECIFIED LEVEL OF PROTECTION WILL BE MADE WITHOUT THE APPROVAL OF THE SHSO AND THE PM. IT WILL BE THE RESPONSIBILITY OF THE CIH TO MAKE THE DETERMINATION OF WHEN PERSONAL PROTECTIVE EQUIPMENT NEEDS TO UPGRADED OR DOWNGRADED. THIS DETERMINATION WILL BE BASED ON DAILY LOGS OF FIELD MEASUREMENTS USING EXISTING ACTION LEVELS AND/OR PERMISSIBLE EXPOSURE LEVELS.

While the initial survey data indicates quite clearly that the only contaminates that may be encountered during excavation, stockpiling and sampling is arsenic based on the type of operations that will be performed at the job sites. It must be noted that there is always the potential for other contaminants others than those listed in the project documents to surface during the course of work with excavating, and sampling soils. The following are the levels of required protection.

REQUIRED LEVELS OF PROTECTION

TASK	LEVEL OF PROTECTION
General set up for sampling	Type D
Soils excavation and Stockpiling, Any work in contaminated soils areas	Type D

5.2 Respirator Use Procedures

- Employees will not be required or allowed to wear a respirator unless it has been determined by a licensed physician that they are physically able to perform work while using the required respiratory protective equipment.

- Each respirator shall be individually assigned and not interchanged between workers. Cartridges, canisters and filters will be changed daily.

- No full beards, mustaches or facial hair that interfere with a good face seal are permitted.

5.3 Respirator Maintenance Procedures

- All respirators will be inspected before and after each use. Respirators not routinely in use will be inspected at least monthly.

- Respirators will be routinely (once per day) collected, cleaned and disinfected to insure that employees are properly protected.

- Replacement of parts or other repairs will only be done by experienced persons within the recommendations of the manufacturer.

5.4 Respirator Program Effectiveness

- The SHSO will audit employee personnel files to ensure that an up-to date respirator fit test has been performed before anyone is allowed to perform work at the job site.

- This program will undergo constant review to insure employee protection.

6.0 Medical Surveillance

Introduction

Workers handling hazardous wastes can experience high levels of stress. Their daily tasks may expose them to toxic chemicals and safety hazards. They may develop heat stress while wearing protective equipment or working under temperature extremes or face life-threatening emergencies such as explosions or fires. Therefore, a medical program is essential to assess and monitor workers' health and fitness both prior to employment, and during the course of work: to provide emergency and other treatment as needed: and to keep accurate records for future reference.

The Medical Monitoring Program for University of San Diego, Department of Environmental and Ocean Sciences is in strict compliance with 29 CFR 1910.120, 29 CFR Part 1910.134[bl[l0] (respirator medical evaluation), and specific medical requirements of 29 CFR Part 1910.95 and 29 CFR Parts 1910.1001 through 1910. 1045. 29 CFR 1910.1001 through 1910.1045 are specific standards written for common important chemical stressors / hazards --- like hydrocarbons and metals.

6.1 Medical Monitoring

University of San Diego, Department of Environmental and Ocean Sciences’ project students or any subcontractor personnel will have adequate protection from exposures through administrative and engineering controls, and appropriate personal protective equipment and decontamination procedures as described in this HASP will be in use. This medical surveillance shall be based on the chemical nature of the exposures as determined by the on site safety personnel and analysis.

University of San Diego, Department of Environmental and Ocean Sciences utilizes the services of a board certified occupational-health physician to oversee the medical examinations and surveillance. The name of the examining physician, evidence of examination, and written certification of fitness for work, including ability to work in heat and cold environment and the ability to wear required respiratory protection for personnel working in the operation is provided in Appendix E.

The medical test analysts for University of San Diego, Department of Environmental and Ocean Sciences' employees / students are performed by a laboratory that has demonstrated satisfactory performance in an established inter laboratory testing program. The clinical or diagnostic laboratory where samples are sent meet either the minimum requirements under the Clinical Laboratories Improvement Act of 1967 (42 CFR Part 74 Subpart M Section 263[aj], or (the conditions for coverage under Medicare. These programs are administered by the Health Care Financing Administration (HCFA), US Department of Health and Human Services (DHHS).

The components of this HASP Medical Monitoring Program include the following:

- Surveillance
    - Pre-employment Screening
    - Annual Examinations
    - Periodic Medical Examination
    - Termination Examination

- Treatment
    - Emergency
    - Non-emergency on a case-by-case basis

- Record keeping

- Program Review

Additional clinical tests may be included at the discretion of the occupational physician performing the examination.

Nonscheduled medical examinations will be conducted under the following circumstances:

- After acute exposure to any toxic or hazardous material
- At the discretion of the SHSO and PM when an employee may have been exposed to dangerous levels of toxic or hazardous materials.
- At the discretion of the SHSO and PM at the request of an employee with demonstrated symptoms of exposure to toxic or hazardous material.

7.0 Exposure Monitoring and Air Sampling Program

The purpose of air monitoring during this project is to identity and quantify airborne contaminants in order to determine the level of worker protection needed, and containment controls needed to protect the health and safety of the surrounding community. Initial screening for identification is often qualitative; i.e. the contaminant or the class to which it belongs is demonstrated to be present but the determination of its concentration (quantification) must wait for subsequent testing. Two principal approaches will be implemented for identifying and/or quantifying airborne contaminants.

- The on-site use of direct-reading Instruments - direct reading combustible gas / oxygen meter, and the use on site direct reading colorimetric tubes as required for unknown or unexpected contaminates. In addition the H.M. Pitt Site hygienist may have to constantly monitor the excavation site for unknown or unidentified hydrocarbons with a direct reading PID portable instrument. Continuous means every fifteen minutes.
- Laboratory analysis of air samples obtained by gas sampling bag, filter, sorbent, or wet contaminant collection methods can be done if desired. Air cassettes will be taken in compliance with standard sampling techniques using personal and area pumps in compliance with the project specifications, federal, state and local requirements. It is almost certain that the only metal that we would be monitoring for will be arsenic. Non-volatile mercury samples (mercury compounds) must be digested separately from the other metals in the lab. Metallic mercury may not be sampled on the same air cassette as the other metals. Any air sampling will again be done in compliance with all State, Local and Federal requirements. Any detection of vapors/ gases/ dusts, mists, fumes in the air that may or are in excess of a TLV or action level shall require an immediate job shut down, and I.H. sampling in accordance with the latest NIOSH Hygiene procedure.

As a matter of policy HM Pitt Labs' site technician will be doing daily on site direct monitoring for heavy metals and hydrocarbons.

As an internal safety requirement, University of San Diego, Department of Environmental and Ocean Sciences chooses to use a 5% L.E.L. reading level for additional safety if flammable gases are encountered at the job site. This level will ALWAYS meet or exceed the requirements of 10% L.E.L. by definition as listed in 29 CFR 1910.146 for confined space entry

Confined space entry is not anticipated to be required at this site**.** In the event that confined spaces are encountered, they shall be certified gas free initially by a certified Marine Chemist from H. M. Pitt labs. Any confined space must be inspected for oxygen, L.E.L., CO, H_2S, and unknown hydrocarbons using a PID -- and any other compound found in the confined space during the inspection by the Marine Chemist or the project's CIH. The CIH shall fill out a permit entry form (see submittals), and this form must be posted at all common or usual entrances to the confined space. The CIH shall update (recheck) the confined space at least every 24 hours during entry and hot work if there is a change in condition. Any trenching shall be monitored continuously every fifteen minutes.

Any significant reading on the combustible gas meter either of oxygen deficiency --- less than 19.5 %, or any L.E.L reading of 5 % will cause the University of San Diego, Department of Environmental and Ocean Sciences SHSO to shut down all but emergence rescue work and call the designated CIH. Any hydrogen sulfide detected in significance (even 1 PPM is not tolerable) or carbon monoxide in excess of 25 PPM. Any PID reading at or in excess of 10 mg/M3 will cause a work stoppage. Any report from analysis of the PNA/PAH samples at or in excess of 0.1 mg/M3 will cause work to stop.

Direct reading instruments will be used to rapidly detect flammable or explosive atmospheres, oxygen deficiency, certain other gases and vapors if unexpectedly encountered at the job site. The information provided by direct-reading instruments will be used to institute appropriate protective measures, e.g. personal protective equipment. This then will help to determine the most appropriate equipment for further monitoring, and to develop optimum sampling and analytical protocols.

No calibration is needed for the Drager tubes. It is required that prior to each shift the direct reading combustible gas / oxygen meter shall be calibrated with an appropriate span gas. The PID will be calibrated daily. Calibration data will be submitted on a daily basis to the Port. All results including non-zero readings shall be recorded by the SHSO.

Any combustible gas reading in excess of 5% of the LEL will cause an immediate cessation of all work and evacuation of personnel from all work zones.

Any valid indication of any stressor in excess of an Action level or PEL will trigger an immediate response for the SHSO / competent person to correct the problem exposure. This is certainly true for metals and possibly hydrocarbons which are the primary stressors that are expected at the job site.

The SHSO will review all air monitoring data on a daily basis or within 24 hours of any excursion over any work control limits. The review will include:

- Quantity detected concentration
- Evaluating if the correct data was collected
- Looking for trends
- Integrating any long term sampling
- Correct engineering controls
- Determine the effectiveness of engineering controls.

Dust and vapor control will be developed to minimize fugitive dust and vapor emissions from the work site. Engineering controls such as poly-sheet covering of waste, the use of vapor suppression foam or water suppression for dust will be used during and before each work phase and when required by the site Industrial Hygienist. The use of watering down the earth and covering the subsequent soil will be the only initial procedures that will be routinely required.

7.1 Perimeter Monitoring

HM Pitt Labs site technician may establish perimeter monitoring locations at the site sampling in locations to be determined by the technician. Perimeter sampling will be performed in accordance with the specification.

Background readings will be made using the direct reading instruments (LEL, mg/M3 from PID). Additionally baseline samples will be made for metals other than arsenic that could be found during excavation.

7.1.1 Periodic Monitoring

Site conditions and thus atmospheric chemical conditions may change following the initial characterization of the site. For this reason monitoring will be repeated periodically especially when:

- Work begins on a different portion of the site
- Different contaminants are being handled
- A markedly different type of operation is initiated
- Workers are handling leaking drums or working in areas with obvious liquid contamination.

7.2 Personal Monitoring

Metals monitoring, direct reading of hydrocarbons by PID and the use of the CGI and XRF analyzer-- as well as other data collection for other stressors ---- will be performed as often as necessary, and whenever necessary, to protect field personnel from explosion hazards, asphyxiation or chemical exposure.

It will be the policy of HM Pitt Labs, Inc. to be flexible in these matters. It has already been amply spelled out how and when we shall monitor for a variety of stressors. It must be noted that the entire basis of this “arsenic work plan” is data which reflects airborne hazards at or less than the action levels that have been spelled out. Any readings in excess of these levels will cause a change in this plan which will or may cause drastic changes in monitoring strategy. We do not know what monitoring will be necessary or its frequency if conditions are other than has been described.

Direct reading monitoring is scheduled to be done every shift as specified in the research specifications during excavation, sampling, stockpiling or work in trenches or other confined spaces. Direct reading includes the combustible gas indicator and PID monitoring. Metals—arsenic -- will be monitored for every shift every day during any activity that disturbs soils.

Monitoring will be performed by the on site industrial hygienist trained in the use and care of the monitoring equipment. As stated earlier all confined space entry testing and permitting will be done by the certified CIH. The record of the instrument readings and calibration Information will be kept and recorded in HM Pitt Labs' daily reports.

If there needs to be personal monitoring by the CIH of high risk workers, this will be done will be for those who are closest to the source of contaminant generation. This will be done in strict compliance with the OSHA 1910.120 and OSHA 1910.100 standards – the arsenic standard 29 CFR 1910.1018. At a minimum 25% of the workers doing a specific job will be sampled for eight hour time weighted sampling. All sample results will be compared to OSHA standards. It should be noted that this personnel monitoring will initially be restricted to arsenic, but may be done on other stressors if the on site direct reading instruments show a possibility of air borne contamination, and at all times during any excavation and/or sampling of soils.

If field personnel suspect emissions outside the restricted areas, measurements will be made at the source at both upwind and downwind positions. If the concentrations at these locations exceed the respirator use action levels, measurements must then be made in the breathing zone of the individuals working closest to the contamination source. Decisions regarding respiratory protection will be made using measured dusts/vapor concentrations in the breathing zone.

The expected air temperature at the job site will be in the temperate range and will not be a problem. If it is determined, however, that heat stress monitoring is required, all work will cease and only HM Pitt's CIH will be allowed to monitor heat stress in strict accordance with the ACIGH 2015 TLV booklet.

In general some of the factors that will be considered --- be certainly not limited to --- are listed below:

- Monitoring frequency will increase as the ambient temperature increases or as slow recovery rates are observed.

- Monitoring will be performed by a person with a current First Aid/CPR certification who is trained to recognize the symptoms.

- The heat stress physiological monitoring shall include, but not be limited to, the following:
  a) Heart rate.
  b) Body temperature.
  c) Body water loss.

7.3 Action Levels of Toxic Atmosphere

During abatement work, workers will be exposed to levels of varying metallic dusts - specifically arsenic. **The action level for arsenic will be the half of the NIOSH REL/**

15 minute exposure limit of 2 micrograms per cubic meter of air or 1 microgram per cubic meter or air.

The action level for the PID is 10 mg/M3 for general hydrocarbons.

The PEL and Action level for any hydrocarbons will be deduced following detection and identification of the material or materials.

The action levels of toxics that could trigger a hazard exposure are presented in the project specifications. Toxic vapors, gases and aerosols will be monitored as required in this HASP.

Any readings at or above the action levels will cause all work to cease. It is and will be the policy of the university to implement engineering and administrative changes to bring levels of exposure below the action levels.

It has already been stated that University of San Diego, Department of Environmental and Ocean Sciences' workers must don a half face negative pressure respirator with HEPA filter and activated charcoal filters approved for hydrocarbons/ particulates during sampling, excavation, and stockpiling work.

7.4 Equipment Calibration

All direct reading instruments will be calibrated daily and zero checked twice daily or each time the instrument is moved. The use and calibration of the instrument will be by a qualified trained technician. All readings will be recorded in micrograms per cubic meter, fibers per cc, or possibly ppm or the equivalent, and a record of the instrument readings and calibration information will be kept in the field log book. The direct reading Drager tubes do not need maintenance, and the combustible gas / oxygen meter will be adjusted and maintained prior to the start of the shift as described previously. Sampling pumps for arsenic in air and other stressors must be calibrated against a certified rotometer or a primary standard like a bubble burette.

8.0 Standard Operating Safety Procedures, Engineering Practice Controls

8.1 Site Rules and Prohibitions

- All workers are to maintain in their possession company issued safety equipment such as hard-hats, safety goggles, respirators, etc. which are to be worn as PPE in accordance with this HASP. All employees are to wear at all times work boots, long pants, shirts and hard-hats while at the job-site.

- At no time shall any employee attempt to operate any equipment which is not functioning in a proper or safe manner. Any such equipment problems shall be reported to their supervisor immediately.

- Eating, drinking, gum chewing or smoking not be allowed within the work zone; and only allowed in a designated area by the SHSO.

- Three work zones will be established as further delineated elsewhere in this plan. Work zones will be established by the PM utilizing guidance in the drawing plans. The PM will clearly layout and will identify work zones, hazard zones and non-hazard zones at the job-site and will limit equipment operations and personnel in the zones as required for safety.

- Activities inside the hazard areas will be conducted with a buddy who is able to:
  - a) Provide his or her partner with assistance.
  - b) Observe his or her partner for sign of chemical or heat exposure.
  - c) Periodically check the integrity of his or her partner's protective clothing
  - d) Notify the Superintendent, PM or SHSO or others if emergency help is needed.

8.2 Sanitation

- Drinking water will be provided from known potable supplies.
- All outlets dispensing non-potable water will be conspicuously posted. "WATER UNFIT FOR DRINKING"

- Disposable, single use cups will be provided for drinking water. Used cups will be disposed of properly.

- Adequate toilet faculties will be provided for site personnel consisting of at least one portable chemical toilet at each work-site, unless other facilities are readily available.

8.3 Illumination

Employees will work only during daylight hours or University of San Diego, Department of Environmental and Ocean Sciences will provide lighting of at a minimum of 30 foot-candles during all work performed during darkness. Explosion proof lighting will be used in flammable or explosive atmospheres.

9.0 Site Control Measures

The work site will be clearly marked (i.e. warning and/or barrier tape). Construction zone notices will be posted at locations sufficient to warn any non-worker of potential hazards. No one not directly involved in work or inspection will be allowed into the construction zone. No smoking or eating signs shall also be posted.

The Zones for established work are as follows:

The Exclusion Zone - The restricted access areas, the immediate area up to fifty feet or as delineated by the SHSO

The Contamination Reduction Zone - The area directly adjacent to the exclusion zones and including a radius of fifty feet

The Support Zone - The area starting from the CRZ extending outward to an additional 50 feet radius.

The Support zone will be established on the site and is defined as the area outside the zones of exclusion and reduction zones. The function of the support zone is to provide:

- An entry area for personnel, materials and equipment to the construction zone.

- An exit area for decontamination personnel, materials and equipment from the construction zone.

- Location for support area facilities.

- A storage area for clean safety and work equipment.

- An area for site workers to safely rest or take a break without PPE requirements of the construction zone.

The Exclusion zone is that area of the construction site that hazardous materials are being removed or processed. This is one of the areas where proper HAZWOPER training is required. This zone includes the exclusion areas or zones.

The Reduction zone is that area of potential exposure where decontamination is taking place of either personnel or equipment. This area includes wash down areas for equipment and PPE change sites. This is the other area where HAZWOPER certification training is required.

10.0 Personal Hygiene and Decontamination

Introduction

Decontamination - the process of removing or neutralizing contaminants that have accumulated on personnel and equipment - is critical to Safety and Health at hazardous waste sites. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles and other equipment used on site. It protects all site personnel by minimizing the transfer of harmful materials into clean areas. It helps prevent mixing of incompatible chemical, and it protects the community by preventing uncontrolled transportation of contaminants from the site.

10.1 Prevention of Contamination

University of San Diego, Department of Environmental and Ocean Sciences has established Standard Operating Procedures that minimize contact with waste and the potential for contamination. Those procedures include but are not limited to the following:

- Stress work practices that minimize contact with hazardous substances (e.g. do not walk through areas of obvious contamination; do not directly touch potentially hazardous substances). The use of local HEPA Vacuuming at the site of removal or contamination, with as little entry into confined space as possible

- Use remote sampling handling, and container-opening techniques (e.g.. drum grapplers, pneumatic impact wrenches).

- Protect monitoring and sampling instruments by bagging. By making openings in the bags for sample ports and sensors that must contact site materials.

- Wear disposable outer garments and use disposal equipment where appropriate.

- Cover equipment and tools with a strippable coating which can be removed during decontamination.

- The most important aspect of contamination control will be the use of a charged water fire hose with a spray nozzle to keep dust levels down to a bare minimum.

- Soils shall be stockpiled inside the exclusion zones and covered as appropriate. There is nothing that pertains to University of San Diego, Department of Environmental and Ocean Sciences about possible spills at the job site.

10.2 Decontamination Methods

All personnel, clothing, equipment and samples leaving the contaminated area of a site (generally referred to as the exclusion and reduction zone) must be decontaminated to remove any harmful chemicals or infectious organisms that may have adhered to them. Any time personnel leave the contaminated area they must decontaminate prior to leaving the work area. Decontamination methods include either: 1.) physically remove contaminants. 2.) inactivate contaminants by chemical detoxification or sterilization or 3.) remove contaminants by a combination of both physical and chemicals means.

In general this will be done by washing down equipment, and removing PPE prior to leaving the exclusion and reduction zones. Gloves, respirators, hard hats, boots and goggles will be cleaned with water and detergent when exiting exclusion and reduction zones. Waste generated in this work will be decontaminated on site or correctly packaged for off site transportation and disposal as hazardous waste. Other specific requirements are not envisioned at this time based on the level of contaminates found by earlier evaluation.

In the event that site conditions and monitoring results indicate that there has been a change in conditions relative to contaminant levels by CIH review, the proposed decontamination steps in this plan, at the direction of the CIH, will be upgraded to appropriate levels. This change will be provided to the university and the owner of the park's representative in writing.

10.3 Disposal Methods

All equipment used for decontamination must be decontaminated and/or disposed of properly. Buckets, brushes, clothing, tools and other contaminated equipment will be collected, placed in containers and labeled. Also, all spent solutions and wash water will be collected and disposed of properly. Clothing that is not completely decontaminated, should be placed in plastic bags pending further decontamination and/or disposal. University of San Diego, Department of Environmental and Ocean Sciences will be responsible for excavating and stockpiling the suspected contaminated soils. All hazardous waste shall not be stored on site for more than 90 days. Management of the hazardous wastes must meet the specifications as sited aby the university, the project CIH, and the owner of the black mountain open space park

10.4 Emergency Decontamination

In addition to routine examination procedures, emergency decontamination procedures will be established. In an emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. If immediate medical treatment is required to save a life, decontamination will be delayed until the victim is stabilized. If decontamination can be performed without interfering with essential lifesaving techniques or first-aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life, decontamination must be performed immediately. If an emergency due to a heat-related illness develops, protective clothing will be removed from the victim as soon as possible to reduce the heat stress. During an emergency, provisions will also be made for protecting medical personnel and disposing of contaminated clothing and equipment.

10.5 Equipment

Gloves, respirators, hard hats, boots, and goggles will be cleaned with water and detergent. In all cases, materials known or suspected to be contaminated will not leave the site. Waste materials will be containerized and labeled or stock piled and covered with visqueen material.

10.6 Smoking and Eating

Smoking and open flames are strictly prohibited. Eating is also not allowed inside the construction zone, decontamination zone, or support zone. All smoking and eating shall be done outside of the work area and away from the job site.

11.0 Emergency Equipment and First aid Requirements

Before the start of site work, arrangements will be made with station emergency services, health clinics, hospitals, fire departments, and ambulance services for the emergency treatment of injured personnel. A list of available emergency services, location of telephones, and written directions with maps to the designated hospital will be posted at the job site.

Special training will be provided to all site workers informing them about emergency services and phone numbers. Emergency Communications will be by telephone.

Transportation of injured personnel to medical facilities will be by the most appropriate means available.

At least one employee trained in First Aid/CPR and certified by the American Red Cross or other approved agency will be on site at all times to render first aid treatment when needed.

First aid materials will be readily available at each work site, and will consist of at least one weatherproof 16 unit first aid kit filled with materials recommended by a consulting physician for no more than 25 workers and will be supplied by University of San Diego, Department of Environmental and Ocean Sciences. These will be located within the reduction zone.

In the event of personnel injury, the immediate supervisor will initiate the accident report investigation and will complete the accident report, and furnish it to the Owner as required by the contract.

12.0 Emergency Response Plan and Contingency Procedures for on and off site

University of San Diego, Department of Environmental and Ocean Sciences has developed and Emergency Response and Contingency Plan for on-site and off-site emergencies, as specified In the OSHA 29 CFR 1910. 120(1).

The following standard emergency procedures will be used by on site and off-site personnel. The SHSO will be notified of on-site emergencies and be responsible for ensuring that the appropriate procedures are followed.

12.1 Emergency Procedures

Upon notification of an injury in the work area/job site, the PM and SHSO will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue with the on-site emergency trained person initiating the appropriate first aid and necessary follow-up as required. If the injury increases the risk to other workers or the risk to the community, activities on-site will stop until the added risk is removed or minimized. The paramedics/hospital will be alerted and all personnel moved to a safe distance from the accident area, and or work area/job site or both.

On and Off Site Injuries

12.1.1.1 Electrocution:

In the event of suspected electrocution, the following emergency field procedures are to be implemented:

- Do not touch or move the victim until the source of electricity is removed or disconnected.
- Send for emergency services.
- Check victim for pulse and breathing: begin CPR as necessary and continue until appropriate help arrives. If conscious keep victim seated and treat for shock until help arrives.

12.1.1.2 Head, Neck, or Back Injuries

In the event of suspected head, back, or neck injuries, the following emergency field procedures are to be implemented:

- Do not move or transport the victim except in the case of eminent danger to prevent possible further nerve damage.
- Send for emergency services.
- Immobilize the victim to prevent further injury pending the arrival of emergency services.
- Treat other life threatening conditions as necessary

12.1.1.3 Bleeding.

In the event of extensive or continuous bleeding, the following emergency field procedures are to be implemented:

- Remove the victim from sources of imminent danger.
- Stop or retard bleeding by applying direct pressure to the wound with clean dressings or to pressure points.
- Tourniquets should be used only for massive or continuous bleeding such as in amputated limbs.
- Send for emergency services or transport victim to nearest medical facility.
- Keep the victim as calm as possible and treat for shock.

12.1.1.4 Fractures, Sprains, and Other Injuries:

In the event of suspected fractures, sprains, or other injuries; the following emergency field procedures are to be implemented:

- Immobilize the victim as appropriate for the injury. Remove victim from the work area for observation. Do not allow victim to return to work until nature and extent of injuries are fully known and victim is fully and truly recuperated.
- Send for emergency services or transport victim to nearest medical facility as the situation dictates.
- Administer first aid treatment appropriate for the injury pending arrival of emergency services.

12.1.1.5 Eye Injuries:

In the event of eye trauma, the following emergency field procedures shall be implemented:

- Remove victim from sources of imminent danger and restrain victim from rubbing or pressing the Injury (eye).
- Send for emergency services or transport victim to nearest medical facility as the situation dictates.
- For minor eye injuries protect the eye from further injury by taping or bandaging an object such as a cup over the eye to isolate the eye and any protruding object. Do not remove any protruding object which may have punctured the eye.
- For minor eye irritation due to particles, dust or vapors, flush eyes with water until the offending material is removed.
- Do not allow any person to enter work area without proper eye protection. Do not allow victim with obstructed or impaired vision to return to the work area.

12.1.1.6 Heat Stress:

In the event of suspected heatstroke or heat exhaustion, the following emergency field procedures are to be implemented:

- Remove victim from the work area to a shaded or cool area for observation and have the victim sit or recline and rest.

- Administer liquids as necessary only to conscious persons.

- In case of heatstroke, the victim's temperature must be cooled immediately. Cool the victim by removing clothing and PPE, bathing with water or wet cloths or vigorously fanning.
- Send for emergency services or transport victim to nearest medical facility as the situation dictates.

12.1.2. Fire or Explosion

In case of fire or explosion the following emergency procedures shall be implemented:

- Discontinue all work and remove personnel from the area. Remove injured personnel and administer first aid.
- Secure all equipment, fuel or power sources as possible without jeopardizing personnel safety.

  Send for emergency services as the situation dictates.

  Use only designated fire extinguisher types appropriate for the class of fire.

  Do not jeopardize personnel safety and health to save equipment.

12.1.3 Personal Protective Equipment Failure

If any site worker experiences a failure or alteration of protective equipment that affects their health and safety, that person and his/her buddy shall immediately leave the construction zone. Reentry will not be permitted until the equipment has been repaired or replaced.

12.1.4 Other Equipment Failure

If any other equipment on site fails to operate property, the PM and SHSO will be notified and they will immediately determine the effect of this failure on operations. If the failure affects the safety of personnel or the health and safety of the community, or prevents completion of the work plan tasks; all personnel will leave the work zone until corrective action is completed and re-entry is approved by the FM and SHSO.

In all cases when an on-site emergency results in the evacuation of the construction zone, personnel will not reenter until:

- The conditions resulting in the emergency have been corrected.
- The hazards have been reassessed.
- The HASP has been reviewed.
- Site personnel have been brief on any changes in the HASP

12.2 Procedures for Reporting Incidents

Incidents of any kind will be immediately reported to the Superintendent and to the PM. The SHSO will notify all appropriate contracting personnel and Government agencies. A written incident report will be filed with the university and a copy maintained in the project safety files.

In the event of an emergency associated with the work operators, University of San Diego, Department of Environmental and Ocean Sciences will:

- Take diligent action to remove or otherwise minimize the cause of the emergency.
- Institute whatever measures that might be necessary to prevent any repetition of the conditions or actions leading to or resulting in the emergency.

12.3 Normal and Emergency Communications

A list for emergency communications with environmental, health and emergency services shall be posted at the site. Personnel will be alerted to an emergency by the use of an air horn located within the Exclusion zone. Normal communications between workers at the site will be through cell phones.

A listing of emergency contacts will be posted at conspicuous places on the project site.

A map of evacuation routes or places of safe refuge in case of emergency will be listed in the submittals, and will be posted in the Support zone. An emergency meeting place is designated on a site map as submitted.

12.4 Spill Containment Plan

It has already been stated that due to the nature of the work that University of San Diego, Department of Environmental and Ocean Sciences will be doing at the site, it is not expected that University of San Diego, Department of Environmental and Ocean Sciences will bring materials into the work area that could cause a spill --- other than fuel oil, diesel, or even gasoline.

It is the policy of University of San Diego, Department of Environmental and Ocean Sciences to notify the local Fire Department of any spill outside of minor fuel spills.

Minor diesel/ fuel spills will cause the immediate notification of the on-site University of San Diego, Department of Environmental and Ocean Sciences Safety and competent persons, the H.M. Pitt Labs, Inc. site monitor/ technician, the project CIH, and appropriate regulatory authority.

- Minor spills will be immediately dammed or contained per directions from the above notified persons.
- All spills will be covered when appropriate
- All spills shall be barrier off from other trades and the public with warning tape at a minimum.

- The Project CIH along with the site technician shall form a plan of action to deal / clean up the spill if necessary.

13.0 Record keeping

All required logs reports and other records will be maintained on the project site at all times. The university has developed a format to include confined space entry permit, tool box safety meetings, employee/visitor logs, daily reports, accident reports and spill reports.

APPENDIX A

SITE LOCATION MAPS

APPENDIX B

CERTIFICATES OF TRAINING AND MEDICAL EXAMINATION

APPENDIX C

EQUIPMENT LIST

EQUIPMENT LIST*

Personal Protective Equipment

Approved respirators available

_____ SCBA

_____ SAR

_____ Full Face

_____ Half Face

______ Cartridge Type (specify)

______ Organic vapor

Surgical Gloves

Outer work gloves

_______Type nitrile

Protective Clothing _____
_____
Type Tyvek _____
_____
Poly Tyvek _____
_____
Sarasex _____
_____
Hooded _____
_____
Rain Suit _____
Butyl Apron _____
Safety Glasses _____

Equipment

Hard hat w/face shield _____
Neoprene safety boots _____
Steel-toed boots _____
Boot Covers _____
Hearing Protection _____
Alternates _____

Site Security

_____ Traffic Cones

_____ Banner Tape

_____ Flagging Tape

_____ Warning Signs

_____ Waste Drum Labels

_____ Binoculars

_____ Megaphone

_____ Radio / Mobile

_____ Fencing

_____ Security Guard

____

____

____

____

____

Decontamination

Plastic Sheeting
Large Washtubs
Small Washtubs
Scrub Brushes
Pressurized sprayer
Solvent sprayer
Plastic Trash Can

Instrumentation

OVA _____
HNU, PID _____
OVM _____
Oxygen/Explosimeter _____
Drager System colorimeteric tubes _____
WGBT _____
Magnetometer _____
GPR _____
EM _____
______________________________ _____
______________________________ _____
______________________________ _____
______________________________ _____
______________________________ _____
_____

First Aid Equipment/Supplies _____

First aid kit _____
Oxygen _____
Eye wash _____

Stretcher _____
Fire Extinguisher _____
Thermometer(s) _____
Blood Pressure Monitor _____
Drinking water _____
______________________________ _____
______________________________ _____
______________________________ _____
______________________________ _____

Trash Bags
Water Bottles
Paper Towels
Duct Tape
Masking tape
Zip lock bags
Detergent (Alconox)
Hand soap
TSP
Sodium hypochlorite
Sodium bicarbonate
Solvent Rinse
    Acetone
    Methanol
    Other______________
Tables
Sampler dissembler rack
Chairs
Tools

____
_____
_____
_____

_____
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_____
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____
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____

*This is not meant to be a comprehensive list ---- not all of these things/ instruments are to be at the job site. This list is to be used as a guide to responsible parties.

EQUIPMENT LIST*

Additional Equipment

Camera ______
Film ______
Drum dolly ______
Towels ______
Pick ______
Shovels ______
Step Ladder ______
Bailers ______
Rope ______
Standard field tool kit ______
Field Kit ______
Tarp (for shade) ______
______________________________ ______
______________________________ ______
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* This is not a comprehensive list --- not all of the equipment is to be used
This is meant to be used as a selection aid to responsible persons.

APPENDIX D

LIST OF EMERGENCY NUMBERS AND CONTACTS

APPENDIX E

TOXIC ATMOSPHERES

Analysis	Constituent	PEL	Action Level
Direct Reading	Total Volatile Organic Compounds	none	10 ppm, sustained over one minute
Direct Reading	Benzene	1.0ppm	0.25 ppm
Laboratory Analysis	Mercury	C 0.1mg/m3	0.005 mg/m3
Laboratory Analysis	Total Petroleum Hydrocarbons	none	5/10 ppm
Laboratory Analysis	PAH/PNA	Various – see next page	5 ppm
Laboratory Analysis	Benzene	1.0ppm	0.5 ppm
Laboratory Analysis	1, 2 – Dichlorobenzene	C 50ppm	12.5 ppm
Laboratory Analysis	Ethyl Benzene	100ppm	50 ppm
Laboratory Analysis	Isopropyl	50 ppm	25 ppm
Laboratory Analysis	Naphthalene	10 ppm	5 ppm
Laboratory Analysis	Toluene	200ppm	25 ppm
Laboratory Analysis	1,2,4 – Trimethyl Benzene	None NIOSH 25 ppm	12.5 ppm

***NOTE**: The Abbreviations in the Table Above Can be Found in the Niosh Pocket Guide to Chemical Hazards Handbook.*

Analysis	Constituent	PEL	Action Level
Laboratory Analysis	1, 3, 5 Trimethyl Benzene	None NIOSH 25 ppm	12.5 ppm
Laboratory Analysis	Xylene	1.0ppm	0.25 ppm
Laboratory Analysis	1, 1, 1 Trichloroethane 15	C 350ppm	175 ppm
Laboratory Analysis	1, 1, 2 Trichloroethane	10 ppm	5 ppm
Laboratory Analysis	Methylene Chloride	25 ppm	5 ppm
Laboratory Analysis	Arsenic18	0.10 mg/m3	0.005 mg/m3
Laboratory Analysis	Barium	0.5 mg/m3	0.25 mg/m3
Laboratory Analysis	Beryllium	.002 mg/ m3	0.001 mg/m3
Laboratory Analysis	Cadmium	.005 mg/m3	0.0025 mg/ m3
Laboratory Analysis	Chromium II Chromium III Chromium VI	0.5 mg/m3 0.5 mg/m3 0.001 mg/m3	0.25 mg/m3 0.25 mg/m3 0.0005 mg/m3
Laboratory Analysis	Cobalt	0.1 mg/m3	0.025 mg/m3
Laboratory Analysis	Copper	1.0 mg/ m3	0.5 mg/m3
Laboratory Analysis	Lead	0.05 mg/m3	0.03 mg/m3
Laboratory Analysis	Molybdenum	5.0 mg/m3	2.5 mg/m3
Laboratory Analysis	Nickel	1.0 mg/ m3	0.5 mg/m3
Laboratory Analysis	Silver	0.01 mg/ m3	0.005 mg/3
Laboratory Analysis	Vanadium	C 0.1 mg/m3 NIOSH 0.05 mg/ m3	0.025 mg/m3
Laboratory Analysis	Zinc	5.0 mg/m3	2.5 mg/m3
Laboratory Analysis	Mercury	C 0.1 mg/m3 inorganic 0.01 mg/m3	0.005 mg/m3

Constituent	Health Effects per NIOSH
Total Volatile Organic Compounds	ER: Inh , Abs, Ing, Con SY: Irrit Eyes; head, conf, Excitement, mal; nau, vomit, abdom pain; Irrit bladder; profuse sweat; jaun; hema, Renal shutdown; derm, optical neuritis, corn Damage TO: Eyes, skin, blood, liver, kidneys, CNS
Benzene	ER: Inh, Abs, Ing, Con SY: Irrit eyes, skin, nose, resp sys; dizz; Head, nau, staggered gait; anor, lass; derm; Bone marrow depres; (carc) Leukemia TO: Eyes, skin, resp sys, CNS, kidneys, liver, spleen
Mercury	ER: Inh, Abs, Ing, Con SY: Pares; ataxia, dysarthria; vision, hearing dist; spasticity, jerking limbs; dizz; salv, lac; Nau, vomit, diarr, constip; skin burns; vomit, emotional dist; kidney inj; possible terato effects TO: Eyes, skin, CNS, PNS, kidneys
Total Petroleum Hydrocarbons	ER: Inh , Abs, Ing, Con SY: Irrit Eyes; head, conf, Excitement, mal; nau, vomit, abdom pain; Irrit bladder; profuse sweat; jaun; hema, Renal shutdown; derm, optical neuritis, corn Damage TO: Eyes, skin, blood, liver, kidneys, CNS
PAH/PNA	ER: Inh , Abs, Ing, Con SY: Irrit Eyes; head, conf, Excitement, mal; nau, vomit, abdom pain; Irrit bladder; profuse sweat; jaun; hema, Renal shutdown; derm, optical neuritis, corn Damage TO: Eyes, skin, blood, liver kidneys, CNS
Benzene	ER: Inh, Abs, Ing, Con SY: Irrit eyes, skin, nose, resp sys; dizz; Head, nau, staggered gait; anor, lass; derm; Bone marrow depres; (carc) Leukemia TO: Eyes, skin, resp sys, CNS, kidneys, liver, spleen

1,2 – Dichlorobenzene	ER: Inh, Abs, Ing, Con SY: Irrit eyes, nose; liver, kidney damage; Skin blisters TO: Eyes, skin, resp sys, liver, kidneys
Ethyl Benzene	ER: Inh, Ing, Con SY: Irrit eyes, skin, muc memb; head; derm; Narco, coma TO: Eyes, skin, resp sys, CNS
Naphthalene	ER: Inh , Abs, Ing, Con SY: Irrit Eyes; head, conf, Excitement, mal; nau, vomit, abdom pain; Irrit bladder; profuse sweat; jaun; hema, Renal shutdown; derm, optical neuritis, corn Damage
Toluene	ER: Inh, Abs, Ing, Con SY: Irrit eyes, nose; lass, conf, euph, dizz, Head; dilated pupils, lac; anxi, musc ftg, Insom; pares; derm; liver, kidney damage TO: Eyes, skin, resp sys, CNS, liver, kidneys
1,2,4 – Trimethyl Benzene	ER: Inh, Abs, Ing, Con SY: Irrit eyes, nose; lass, conf, euph, dizz, Head; dilated pupils, lac; anxi, musc ftg, Insom; pares; derm; liver, kidney damage TO: Eyes, skin, resp sys, CNS, liver, kidneys
Xylene	ER: Inh, Abs, Ing, Con SY: Irrit eyes, skin, nose, throat; dizz, excitement, drow Inco, staggering gait; corn vacuolization; anor nau, vomit, Abdom pain; derm TO: Eyes, skin, resp sys, CNS, GI tract, blood, liver, kidneys
1, 1, 1 Trichloroethane	ER: Inh, Ing, Con SY: Irrit eyes, skin; head, lass, CNS depres, poor equi; derm; card arrhy; liver damage TO: Eyes, skin, CNS, CVS, liver
1, 1, 2 Trichloroethane	ER: Inh, Abs, Ing, Con SY: Irrit eyes, nose; CNS depres; liver, kidney damage; Derm; (carc) TO: Eyes, resp sys, CNS, liver, kidneys (in animals; liver cancer)
Methylene Chloride	ER: Inh, Abs, Ing, Con SY: Irrit eyes, skin; head, lass, drow, dizz; numb, tingle limbs; nau; (carc) TO: Eyes, skin, CVS, (in animals; lung; liver, salivary & mammary gland tumors)

Arsenic	ER: Inh, Abs, Con, Ing SY: Ulceration of nasal septum, derm, GI disturbances, peri Nuer, resp irrit, hyperig of skin, (carc) TO: Liver, Kidneys skin, lungs, lymphatic sys (lung & lymphatic cancer) ER: Inh, Abs, Con, Ing SY: in animals: irrit skin, possible derm; resp distress; diarr; Kidney damage; musc tremor, convuls; possible GI tract, Repro effects; possible liver damage TO: Skin; Resp sys, kidneys, CNS, liver, GI tract, repro sys
Barium	ER: Inh, Ing, Con SY: Irrit eyes, skin, upper resp sys; skin burns; gastroenteritis; musc spasm; slow pulse, extrasystoles; hypokalemia TO: Eyes, skin, resp sys, heart, CNS
Beryllium	ER: Inh, Ing, Con SY: Berylliosis (chronic exposure): anor, low-wgt, lass, chest pain, cough, clubbing of fingers, cya, pulm insufficiency; irrit eyes; derm; (carc)
Cadmium	ER: Inh, Ing SY: Pulm edema, dysp, cough, chest tight, subs pain; head; Chills, musc aches; nau, vomit, diarr; anos, emphy, prot, mild anemia; (carc) TO: Resp sys, kidneys, prostate, blood (prostatic & lung Cancer)
Chromium II	ER: Inh, Ing, Con SY: Irrit resp; nasal septum perf; liver, kidney damage; leucyt, Leupen, eosin; eye inj, conj; skin ulcer, sens derm (carc) TO: Eyes, Skin
Chromium III	ER: Inh, Ing, Con SY: Irrit eyes; sens derm TO: Eyes, Skin
Chromium VI	ER: Inh, Ing, Con SY: Irrit eyes; sens derm TO: Eyes, Skin R: Inh, Ing, Con SY: Irrit eyes; sens derm TO: Eyes, skin
Copper	ER: Inh, Ing, Con SY: Irrit eyes, nose, pharynx; nasal septum perf; metallic Taste; derm; in animals; lung, liver, kidney damage; anemia TO: Eyes, skin, resp sys, liver, kidneys (incr risk with)
Cobalt	ER: Inh, Ing, Con SY: Cough, dysp, wheez, decr pulm func; low-wgt; derm; diffuse nodular fib; resp hypersensitivity, asthma TO: Skin, resp sys Wilson's disease

Lead	ER: Inh, Ing, Con SY: Lass, insom; facial pallor; anor, low-wgt, malnut; constip, Abdom pain, colic; anemia; gingival lead line; tremor; para Wrist, ankles, encephalopathy; kidney disease; irrit eyes; Hypotension TO: Eyes, GI tract, CNS, kidneys, blood, gingival tissue
Molybdenum	ER: Inh, Ing, Con SY: In animals: irrit eyes, nose, throat; anor; inco: dysp; anemi TO: Eyes, resp sys, kidneys, blood
Nickel	ER: Inh, Ing, Con SY: Sens Derm, allergic asthma, pneu; (carc) TO: Nasal cavities, lungs, skin (lung and nasal cancer
Silver	ER: Inh, Ing, Con SY: Blue-gray eys, nasal septum, throat, skin; irrit, ulceration skin; GI dist TO: Nasal septum, skin, eyes
Vanadium	ER: Inh, Ing, Con SY: Irrit eyes, skin, throat; green tongue, metallic taste, eczema; cough; fine rales, wheez, bron, dysp TO: Eyes, skin, resp sys
Zinc	ER: Inh, Con SY: Irrit eyes, skin, nose, throat; conj; cough, copious sputum; Dysp, chest pain, pulm edema pneu; pulm fib, cor pulmonale; fever; cyan; tachypnea; skin burns TO: Eyes, skin, resp sys, CVS
Mercury	ER: Inh, Abs, Ing, Con SY: Pares; ataxia, dysarthria; vision, hearing dist; spasticity, jerking limbs; dizz; salv; lac; nau, vomit, diarr, constip, skin burns; emotional dist; kidney inj; possible terato effects

Note: When any of the action levels are reached for any of the materials listed in the above tables, work shall stop and the CIH and the Port of San Diego's representative shall agree on the engineering controls that must be implemented prior to work resuming.

APPENDIX F

PERSONAL PROTECTIVE EQUIPMENT (PPE)

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Levels of Protection as Defined by 29 CFR 1910.120

Level A

To be selected when the greatest level of skin respiratory and eye protection is required. Level A equipment consist of:

- Pressure-demand full-face piece SCBA or pressure-demand. supplied air respirator with escape SCBA
- Fully-encapsulating chemical resistant suit
- Inner and outer chemical-resistant gloves
- Chemical resistant safety boots/shoes

  Two-way radio communication if conditions warrant
- Hard-hat cooling unit coveralls. long cotton underwear. disposable gloves and boot covers

Level B

To be selected when the highest level of respiratory protection is necessary. but a lesser level of skin protection needed Level B equipment consist of:

- Pressure-demand full face piece SCBA or pressure-demand supplied-air respirator with escape SCBA.
- Chemical-resistant clothing (overalls and long-sleeve jacket, hooded one or two-piece chemical splash suit, disposable chemical resistant one-piece-suit.)
- Inner and outer chemical resistant gloves
- Inner and outer chemical resistant safety boots/shoes
- Hard-hat
- Two way radio communication if conditions warrant.
- Coverall disposable boot covers face shields long cotton underwear. (Optional)

Level C

To be selected when the concentrations and types of airborne substances are known and the criteria for using air carrying respirators are met. Level C equipment consist of:

- Full-face piece or half face piece air-purifying canister equipped respirator approved by NIOSH.
- Chemical resistant clothing (overall and long sleeves jacket; hooded one or two piece.
- Chemical splash suit disposable chemical resistant one piece suit, inner and outer chemical resistant gloves.
- Hard-hat

- Two way radio communication if conditions warrant.
- Coverall disposable boot covers face shields long cotton underwear. (Optional)

Level D

To be selected as a work uniform affording minimal protection used for nuisance contamination only. Work functions preclude splashes immersion or the potential for unexpected inhalation of or contact with hazard levels on any chemical. The atmosphere contains no known hazard. A minimum Level D personal protection must be used while at the job site. Level D equipment consist of:

- Coveralls
- Safety boot/shoes
- Boots (outer) Chemical -resistant disposable (optional)
- Safety glasses or chemical splash goggles.
- Hard hat (with optional face mask).
- Gloves escape mask face shield (optional)

APPENDIX D

XRF Readings

GPS Shot	Time	As	As Error
3	3/7/2017 10:28	< LOD	12.23
4	3/7/2017 10:37	< LOD	15.45
5	3/7/2017 10:39	< LOD	12.84
6	3/7/2017 10:41	< LOD	12.79
7	3/7/2017 10:43	< LOD	11
8	3/7/2017 10:47	< LOD	11.87
9	3/7/2017 10:50	< LOD	12.97
10	3/7/2017 10:52	< LOD	10.66
11	3/7/2017 10:56	< LOD	12.53
12	3/7/2017 11:08	< LOD	13.03
13	3/7/2017 11:09	< LOD	9.95
14	3/7/2017 11:12	< LOD	17.91
15	3/7/2017 11:20	< LOD	11.77
16	3/7/2017 11:23	< LOD	9.99
17	3/7/2017 11:26	18.4	10.66
18	3/7/2017 11:27	18.89	9.54
19	3/7/2017 11:29	< LOD	25.07
20	3/7/2017 11:30	< LOD	37.55
21	3/7/2017 11:33	< LOD	30.48
22	3/7/2017 11:36	< LOD	11.75
23	3/7/2017 11:49	< LOD	37.7
24	3/7/2017 11:51	12.61	7.17
25	3/7/2017 11:57	16.45	9.16
26	3/7/2017 12:01	18.21	11.21
27	3/7/2017 12:04	< LOD	16.52
28	3/7/2017 12:08	< LOD	17.81
29	3/7/2017 12:10	< LOD	11.8
30	3/7/2017 12:14	< LOD	18.11
31	3/7/2017 12:15	< LOD	12.81
32	3/7/2017 12:21	< LOD	15.76
33	3/7/2017 12:30	49.64	8.31
34	3/7/2017 12:31	263.86	33.04
35	3/7/2017 12:34	167.52	17.12
36	3/7/2017 12:37	186.06	19.4
37	3/7/2017 13:12	< LOD	19.68
38	3/8/2017 9:56	2.1	0
39	3/8/2017 10:01	< LOD	17.43
40	3/8/2017 10:40	< LOD	18.28
41	3/8/2017 10:42	19.86	11.24
42	3/8/2017 10:46	< LOD	13.5
43	3/8/2017 10:48	34.01	12.35
44	3/8/2017 10:51	24.73	14.75
45	3/8/2017 10:55	14.65	7.14
46	3/8/2017 10:57	23.1	7.89
47	3/8/2017 11:00	11.64	7.32
48	3/8/2017 11:03	< LOD	12.68

49	3/8/2017 11:06	< LOD	24.48
50	3/8/2017 11:19	2.15	0
51	3/8/2017 11:21	18.53	10.13
52	3/8/2017 11:22	< LOD	23.8
53	3/8/2017 11:25	40.8	12.01
54	3/8/2017 11:28	47.71	10.17
55	3/8/2017 11:29	< LOD	21.39
56	3/8/2017 11:31	< LOD	18.61
57	3/8/2017 11:33	40.26	10.84
58	3/8/2017 11:36	19.3	10.46
59	3/8/2017 11:38	< LOD	21.01
60	3/8/2017 11:39	< LOD	16.1
61	3/8/2017 11:42	22.45	10.85
62	3/8/2017 11:45	23.32	11.27
63	3/8/2017 11:47	< LOD	125.54
64	3/8/2017 11:48	< LOD	24.54
65	3/8/2017 11:50	< LOD	15.4
66	3/8/2017 11:53	< LOD	13.42
67	3/8/2017 12:03	< LOD	15.76
68	3/8/2017 12:06	< LOD	14.28
69	3/8/2017 12:10	19.88	10.24
70	3/8/2017 12:12	< LOD	14.1
71	3/8/2017 12:18	< LOD	16.04
72	3/8/2017 12:21	< LOD	17.01
73	3/8/2017 12:23	< LOD	15.02
74	3/8/2017 12:27	39.04	23.9
75	3/9/2017 8:45	2.03	0
76	3/9/2017 8:48	< LOD	14.56
77	3/9/2017 8:50	< LOD	16.1
78	3/9/2017 8:53	< LOD	17.3
79	3/9/2017 8:56	< LOD	15.37
80	3/9/2017 8:59	21.1	12.06
81	3/9/2017 9:02	28.52	13.18
82	3/9/2017 9:05	< LOD	15.08
83	3/9/2017 9:07	40.1	13.53
84	3/9/2017 9:11	15.4	9.83
85	3/9/2017 9:13	< LOD	58.9
86	3/9/2017 9:14	28.52	13.05
87	3/9/2017 9:16	< LOD	20.01
88	3/9/2017 9:20	< LOD	17.38
89	3/9/2017 9:32	< LOD	33.9
90	3/9/2017 9:34	< LOD	18.58
91	3/9/2017 9:37	< LOD	16.16
92	3/9/2017 9:39	27.95	14.82
93	3/9/2017 9:45	45.45	14.17
94	3/9/2017 9:54	< LOD	20.13
95	3/9/2017 10:07	< LOD	16.23

96	3/9/2017 10:11	19.52	10.49
97	3/9/2017 10:13	26.09	11.47
98	3/9/2017 10:17	18.97	11.66
99	3/9/2017 10:21	23.86	11.96
100	3/9/2017 10:25	< LOD	17.39
101	3/9/2017 10:27	1719.95	64.51
102	3/9/2017 10:29	987.53	42.91
103	3/9/2017 10:31	141.49	18.86
104	3/9/2017 10:33	1864.67	59.87
105	3/9/2017 10:35	140.6	16.62
106	3/9/2017 10:38	44.76	13.99
107	3/9/2017 10:41	26.87	12.77
108	3/9/2017 10:43	< LOD	17.8
109	3/9/2017 10:46	< LOD	16.69
110	3/9/2017 10:48	< LOD	54.01
111	3/9/2017 10:50	< LOD	16.26
112	3/9/2017 11:06	29.71	10.65
113	3/9/2017 11:10	29.05	13.11
114	3/9/2017 11:13	< LOD	23.6
115	3/9/2017 11:15	41.39	16.28
116	3/9/2017 11:16	66.98	19.8
117	3/9/2017 11:19	49.19	19.61
118	3/9/2017 11:22	< LOD	27.67
119	3/9/2017 11:25	36.76	15.83
120	3/9/2017 11:27	30.91	13.73
121	3/9/2017 11:30	24.07	14.98
122	3/9/2017 11:31	< LOD	77.42
123	3/9/2017 11:34	31.53	16.62
124	3/9/2017 11:36	24.09	12.03
125	3/9/2017 11:39	29.96	13.86
126	3/9/2017 11:41	< LOD	28.07
127	3/9/2017 11:43	24.32	14.09
128	3/9/2017 11:46	16.4	10.28
129	3/9/2017 11:48	< LOD	17.49
130	3/9/2017 11:50	< LOD	103.14
131	3/9/2017 11:51	< LOD	17.44
132	3/9/2017 11:54	20.8	12.87
133	3/9/2017 11:56	< LOD	14.41
134	3/9/2017 11:58	< LOD	20.37
135	3/9/2017 12:00	< LOD	22.89
136	3/9/2017 12:02	< LOD	23.59
137	3/9/2017 12:04	24.65	13.47
138	3/9/2017 12:06	< LOD	22.46
139	3/9/2017 12:09	< LOD	21.79
140	3/9/2017 12:11	< LOD	16.93
141	3/9/2017 12:14	< LOD	13.53
142	3/9/2017 12:15	< LOD	32.99

143	3/9/2017 12:17	< LOD	22.96
144	3/9/2017 12:22	< LOD	16.5

See 4.10.17 Field Notes for addit

GPS Shot	**Reading No**	**Time**	**As**	**As Error**
	1	4/10/2017 8:45		
	2	4/10/2017 9:41		
	3	4/10/2017 9:42	43.04	16.94
	4	4/10/2017 9:44	20.16	13.02
	5	4/10/2017 9:45	953.21	126.26
	6	4/10/2017 9:47	60.46	15.76
	7	4/10/2017 9:47	73.5	23.76
	8	4/10/2017 9:52	18451.18	366.72
	9	4/10/2017 9:55	12498.57	308.31
	10	4/10/2017 10:02	662.7	73.38
145	11	4/10/2017 10:07	131.64	25.83
146	12	4/10/2017 10:12	48.64	21.89
	13	4/10/2017 10:17	3153.14	117.86
147	14	4/10/2017 10:19	1675.82	106.18
148	15	4/10/2017 10:24	3305.08	152.74
150	16	4/10/2017 10:28	< LOD	29.68
156	17	4/10/2017 10:28	< LOD	31.16
	18	4/10/2017 10:31	155.99	23.99
	19	4/10/2017 10:32	< LOD	124.57
	20	4/10/2017 10:33	< LOD	60.18
	21	4/10/2017 10:34	1222.62	87.87
	22	4/10/2017 10:38	2076.89	88.92
	23	4/10/2017 10:50	652.5	31.81
	24	4/10/2017 10:52	139.61	17.73
	25	4/10/2017 10:53	< LOD	28.57
	26	4/10/2017 10:54	< LOD	21.82
	27	4/10/2017 10:55	128.7	31.02
	28	4/10/2017 10:58	418.63	50.43
	29	4/10/2017 11:00	< LOD	31.09
	30	4/10/2017 11:02	244.77	37.63
	31	4/10/2017 11:06	295515.34	5300.81
152	32	4/10/2017 11:12	122.86	34.16
153	33	4/10/2017 11:13	134.76	33.87
154	34	4/10/2017 11:14	117.42	27.65
	35	4/10/2017 11:15	144.89	33.61
155	36	4/10/2017 11:19	91.27	18.22
156	37	4/10/2017 11:23	101.59	34.56
	38	4/10/2017 11:25	1195.42	96.7
	39	4/10/2017 11:27	341.4	77.86
157	40	4/10/2017 11:41	151.57	55.23
158	41	4/10/2017 11:45	6260.54	236.29
159	42	4/10/2017 11:52	3212.45	198.39
160	43	4/10/2017 11:57	354.76	57.08
	44	4/10/2017 12:04	268.98	39.69

	45	4/10/2017 12:04	1307.08	93.29
	46	4/10/2017 12:13	19694.5	562.56
	47	4/10/2017 12:20	188.08	35.29
	48	4/10/2017 12:26	462.01	86.97
	49	4/10/2017 12:27	1053.45	102.04
	50	4/10/2017 12:28	3380.98	217.85
	51	4/10/2017 12:29	1891.41	85.33
	52	4/10/2017 12:34	503.43	81.09
	53	4/10/2017 12:37	1248.56	245.25
	54	4/10/2017 12:39	310.33	69.63
161	55	4/10/2017 12:51	206.41	44.45
162	56	4/10/2017 13:01	1738.29	117.67
	57	4/10/2017 13:09	1225.11	102.84
163	58	4/10/2017 13:12	253.83	52.67
164	59	4/10/2017 13:15	8638.61	230.44
165	60	4/10/2017 13:25	822.14	61.18
166	61	4/10/2017 13:39	< LOD	44.96
	62	4/10/2017 13:45	< LOD	41.24
168	63	4/10/2017 13:47	10398.17	297.74
	64	4/10/2017 14:09	86.17	33.44
	65	4/10/2017 14:09	1582.85	163.98

tional shot information

GPS Shot	Reading N	Time	As	As Error
	1	4/11/2017 13:55		
	2	4/11/2017 13:58		
	3	4/11/2017 14:05	< LOD	5.53
	4	4/12/2017 8:21	18.05	9.58
	5	4/12/2017 8:22	28.73	11.58
	6	4/12/2017 8:30	44.64	17.95
169	7	4/12/2017 8:31	43.15	12.28
170	8	4/12/2017 8:32	21.24	10.52
171	9	4/12/2017 8:33	34.42	12.75
172	10	4/12/2017 8:34	27.96	9.92
173	11	4/12/2017 8:35	24.63	9.88
174	12	4/12/2017 8:36	23.42	12.59
175	13	4/12/2017 8:37	34.05	15.04
176	14	4/12/2017 8:39	24.46	12.34
177	15	4/12/2017 8:40	< LOD	14.98
178	16	4/12/2017 8:41	< LOD	13.33
	17	4/12/2017 9:03	< LOD	25.15
	18	4/12/2017 9:03	< LOD	35.36
	19	4/12/2017 9:04	< LOD	185.66
	20	4/12/2017 9:12	< LOD	27.76
	21	4/12/2017 9:14	< LOD	35.58
	22	4/12/2017 9:16	< LOD	93.01
	23	4/12/2017 9:17	< LOD	39.72
	24	4/12/2017 9:18	9433.62	625.91
	25	4/12/2017 9:22	48.37	26.6
	26	4/12/2017 9:28	41.49	23.23
	27	4/12/2017 9:30	< LOD	216.16
	28	4/12/2017 9:32	312.09	47.3
	29	4/12/2017 9:32	827.55	91.8
	30	4/12/2017 9:33	3521.9	197.63
	31	4/12/2017 9:33	882.46	106.28
	32	4/12/2017 9:34	11351.46	486.41
	33	4/12/2017 9:40	72.38	8.59
	34	4/12/2017 9:43	120.39	13.24
	35	4/12/2017 9:44	152.31	25.97
179	36	4/12/2017 9:53	373.06	184.2
180	37	4/12/2017 9:54	< LOD	52.94
181	38	4/12/2017 9:55	528.51	46.35
182	39	4/12/2017 9:58	5139.7	264.31
183	40	4/12/2017 9:59	14778.96	382.18
184	41	4/12/2017 10:00	3636.08	183.31
185	42	4/12/2017 10:02	< LOD	50.3
186	43	4/12/2017 10:03	< LOD	52.85
187	44	4/12/2017 10:04	< LOD	53.66

	45	4/12/2017 10:05		
	46	4/12/2017 10:08	< LOD	152281.6
	47	4/12/2017 10:09	< LOD	45.52
188	48	4/12/2017 10:13	4975.34	389.58
	49	4/12/2017 10:22	105983.6	1695.8
	50	4/12/2017 10:25	187885.6	3976.55
	51	4/12/2017 10:29	54338.56	1014.31
190	52	4/12/2017 10:33	5452.42	237.21
191	53	4/12/2017 10:33	13983.83	387.84
192	54	4/12/2017 10:34	12166.29	409.18
193	55	4/12/2017 10:35	6900.87	314.83
	56	4/12/2017 10:46	2444.81	173.89
	57	4/12/2017 10:51	< LOD	58.29
	58	4/12/2017 10:59	485211.6	7901.07
	59	4/12/2017 11:10	853.31	60.42
	60	4/12/2017 11:24	180.93	34.09
	61	4/12/2017 11:30	1813.6	122.28
	62	4/12/2017 11:34	< LOD	2.11
	63	4/12/2017 11:34	691.65	85.42
	64	4/12/2017 11:40	< LOD	0.15
	65	4/12/2017 12:12	215.51	68.04
	66	4/12/2017 12:12	2213.14	191.09
	67	4/12/2017 12:13	266.21	63.51
	68	4/12/2017 12:14	112.45	34.76
	69	4/12/2017 12:14	150.32	42.62
	70	4/12/2017 12:17	< LOD	64.44
	71	4/12/2017 12:17	< LOD	38.4
	72	4/12/2017 12:18	< LOD	38.14
	73	4/12/2017 12:19	< LOD	47.06
	74	4/12/2017 12:21	< LOD	41.88
	75	4/12/2017 12:23	< LOD	32.17
	76	4/12/2017 12:23	< LOD	28.85
	77	4/12/2017 12:24	< LOD	68.18
	78	4/12/2017 12:24	< LOD	32.87
	79	4/12/2017 12:25	< LOD	33.19
	80	4/12/2017 12:27	< LOD	111.97
	81	4/12/2017 12:27	< LOD	38.58
	82	4/12/2017 12:30	< LOD	40.46
	83	4/12/2017 12:31	< LOD	102.63
	84	4/12/2017 12:31	< LOD	41.15
	85	4/12/2017 12:32	< LOD	54.23
	86	4/12/2017 12:45	< LOD	29.97
	87	4/12/2017 12:46	< LOD	71.63
	88	4/12/2017 12:56	< LOD	40.4
	89	4/12/2017 12:58	< LOD	94.59

90	4/12/2017 12:58	< LOD	107.11
91	4/12/2017 13:03	< LOD	157.44
92	4/12/2017 15:55		
93	4/12/2017 15:57		
94	4/12/2017 16:00	< LOD	9.61
95	4/12/2017 16:04	< LOD	24.53
96	4/12/2017 16:05	< LOD	7.25
97	4/13/2017 7:04	< LOD	6.33
98	4/13/2017 7:29	< LOD	123.8
99	4/13/2017 7:35	66.91	11.77
100	4/13/2017 7:41	< LOD	24.17
101	4/13/2017 7:43	14.92	7.97
102	4/13/2017 7:45	< LOD	12.86
103	4/13/2017 7:48	< LOD	13.91
104	4/13/2017 7:51	< LOD	19.16
105	4/13/2017 7:53	< LOD	12.64
106	4/13/2017 7:56	< LOD	27.99
107	4/13/2017 7:58	< LOD	17.55
108	4/13/2017 8:05	< LOD	15.73
109	4/13/2017 8:07	< LOD	23.3
110	4/13/2017 8:10	< LOD	16.8
111	4/13/2017 8:12	26.68	15.87
112	4/13/2017 8:14	< LOD	21.32
113	4/13/2017 8:15	< LOD	20.29
114	4/13/2017 8:17	< LOD	17.98
115	4/13/2017 8:20	< LOD	18.06
116	4/13/2017 8:21	< LOD	17.44
117	4/13/2017 8:25	< LOD	17.82
118	4/13/2017 8:27	< LOD	17.83
119	4/13/2017 8:29	< LOD	18.81
120	4/13/2017 8:30	< LOD	19.26
121	4/13/2017 8:34	< LOD	17.24
122	4/13/2017 8:35	< LOD	17.36
123	4/13/2017 8:38	< LOD	17.68
124	4/13/2017 8:40	< LOD	18.39
125	4/13/2017 8:43	< LOD	18.17
126	4/13/2017 8:45	< LOD	17.63
127	4/13/2017 8:48	< LOD	18.08
128	4/13/2017 8:49	< LOD	18.1
129	4/13/2017 8:52	< LOD	17.83
130	4/13/2017 8:54	19.04	11.01
131	4/13/2017 9:02	< LOD	18.7
132	4/13/2017 9:24	< LOD	18.73
133	4/13/2017 9:26	< LOD	17.72
134	4/13/2017 9:30	< LOD	18.24
135	4/13/2017 9:32	< LOD	17.2

136	4/13/2017 9:34	< LOD	17.99
137	4/13/2017 9:36	< LOD	18.94
138	4/13/2017 9:39	< LOD	18.48
139	4/13/2017 9:40	< LOD	18.49
140	4/13/2017 9:46	< LOD	19.07
141	4/13/2017 9:49	< LOD	17.84
142	4/13/2017 9:52	< LOD	18.76
143	4/13/2017 9:55	< LOD	18.28
144	4/13/2017 9:59	< LOD	18.4
145	4/13/2017 10:06	< LOD	17.38
146	4/13/2017 10:09	< LOD	18.9
147	4/13/2017 10:11	< LOD	0.15
148	4/13/2017 10:18	< LOD	18.39
149	4/13/2017 10:22	< LOD	0.15
150	4/13/2017 10:50		

GPS Shot	As	As Error
1	< LOD	123.8
194	< LOD	24.17
195	< LOD	12.86
196	< LOD	19.16
197	< LOD	27.99
198	< LOD	15.73
199	< LOD	16.8
200	< LOD	21.32
201	< LOD	20.29
202	< LOD	18.06
203	< LOD	17.82
204	< LOD	18.81
205	< LOD	17.24
206	< LOD	17.68
207	< LOD	18.17
208	< LOD	18.08
209	< LOD	17.83
210	< LOD	18.7
211	< LOD	18.73
212	< LOD	18.24
213	< LOD	17.99
214	< LOD	18.48
215	< LOD	18.49
216	< LOD	17.84
217	< LOD	18.28
218	< LOD	17.38
219	< LOD	18.39
220	32.53	11.62
221	39.69	12.38
222	44.72	18.85
223	53.6	15.99
224	< LOD	17.86
225	17.56	11.51
226	< LOD	18.04
227	< LOD	17.9
228	< LOD	18.35
229	20.41	11.58
230	22.39	12.34
231	45.03	16.24
232	< LOD	18.54
233	< LOD	18.11
234	< LOD	18.89
236	< LOD	18.35
237	< LOD	17.07
238	< LOD	18.99
239	26.51	12.05

240	18.84	12.07
241	< LOD	18.16
242	< LOD	18.01
243	20.52	11.65
244	22.4	12.7
245	< LOD	16.81
246	< LOD	18.32
247	< LOD	17.82
248	100.2	29.74
249	85.49	18.86
250	< LOD	18.85
251	80.64	31.65
252	128.31	20.43
253	123.63	20.98
254	162.5	19.13
255	143.19	15.21
256	95.83	15.42
257	49.34	14.16
258	32.6	13.14
259	23.28	11.26
260	< LOD	18.12
261	31.93	13.24
262	32.1	10.39
263	< LOD	16.81
264	< LOD	18.38
265	< LOD	17.74
266	< LOD	18.08
268	< LOD	18.14
269	< LOD	18.36
270	30.85	11.84
271	< LOD	18
272	30.54	12.51
273	154.28	19.94
274	214.63	22.53
275	460.1	43.82
276	66.02	16.41
277	99.28	18.84
278	77.3	14.25
279	59.74	13.04
280	30.97	12.11
281	30.68	13.74
282	56.57	11.93
283	28.54	11.68
284	18.54	11.79
285	< LOD	18.13
286	25.21	13.07
287	16.97	9.52

288	< LOD	18.07
289	18.76	12
290	< LOD	17.59
291	< LOD	17.28
292	17.8	9.75

GPS Shot	Reading No	Time	Type	Duration	Units	As	As Error
	1	4/28/2017 16:37	SHUTTER_CAL	104.6	cps		
	2	4/29/2017 7:11	SHUTTER_CAL	100.56	cps		
	3	4/29/2017 7:17	BULK	11.17	ppm	< LOD	23.77
	4	4/29/2017 8:22	BULK	5.1	ppm	4771.91	222.15
	5	4/29/2017 8:25	BULK	2.86	ppm	246707.75	5013.01
	6	4/29/2017 8:49	BULK	2.22	ppm	8995.27	486.94
	7	4/29/2017 8:51	BULK	5.11	ppm	132305.67	2428.87
	8	4/29/2017 9:07	BULK	1.58	ppm	1400.1	186.15
	9	4/29/2017 9:09	BULK	4.16	ppm	2296.4	153.07
	10	4/29/2017 9:16	BULK	5.41	ppm	700.35	84.1
	11	4/29/2017 9:20	BULK	3.83	ppm	131.55	56.23
	12	4/29/2017 9:26	BULK	4.43	ppm	< LOD	44.49
	13	4/29/2017 9:53	SHUTTER_CAL	100.6	cps	1.75	0
	14	4/29/2017 9:53	BULK	6.03	ppm	59.35	38.44
	15	4/29/2017 9:54	BULK	3.5	ppm	< LOD	55.97
	16	4/29/2017 9:55	BULK	9.83	ppm	< LOD	52.7
	17	4/29/2017 9:56	BULK	3.16	ppm	< LOD	57.62
	18	4/29/2017 9:57	BULK	4.78	ppm	< LOD	54.65
	19	4/29/2017 9:57	BULK	4.15	ppm	< LOD	55.83
	20	4/29/2017 9:58	BULK	2.54	ppm	< LOD	90.73
	21	4/29/2017 10:02	BULK	3.82	ppm	< LOD	43.33
	22	4/29/2017 10:05	BULK	4.1	ppm	< LOD	39.53
	23	4/29/2017 10:08	BULK	3.19	ppm	< LOD	27.04
	24	4/29/2017 10:09	BULK	2.87	ppm	< LOD	66.98
	25	4/29/2017 10:09	BULK	3.51	ppm	< LOD	77.13
	26	4/30/2017 8:37	SHUTTER_CAL	100.77	cps	1.96	0
	27	4/30/2017 8:39	BULK	11.08	ppm	< LOD	26.54
293	28	4/30/2017 8:58	BULK	12.37	ppm	1089.29	76.39
294	29	4/30/2017 9:01	BULK	9.85	ppm	104.97	28.28
295	30	4/30/2017 9:02	BULK	11.75	ppm	180.62	32.58
296	31	4/30/2017 9:03	BULK	11.11	ppm	611.52	56.81
297	32	4/30/2017 9:05	BULK	10.78	ppm	1438.77	92.14
298	33	4/30/2017 9:06	BULK	10.47	ppm	1362.4	85.51
299	34	4/30/2017 9:07	BULK	9.51	ppm	397.41	51.92
300	35	4/30/2017 9:08	BULK	9.54	ppm	115.94	32.95
	36	4/30/2017 9:14	BULK	4.45	ppm	1572.95	146.27
301	37	4/30/2017 9:17	BULK	10.45	ppm	85.93	27.91
302	38	4/30/2017 9:18	BULK	10.52	ppm	36.78	18.81
303	39	4/30/2017 9:19	BULK	7.3	ppm	44.24	21.3
304	40	4/30/2017 9:19	BULK	7.97	ppm	45.71	24.59
305	41	4/30/2017 9:20	BULK	8.59	ppm	< LOD	32.66
306	42	4/30/2017 9:21	BULK	4.77	ppm	< LOD	48.34
307	43	4/30/2017 9:24	BULK	7.3	ppm	54.31	27.55
308	44	4/30/2017 9:30	BULK	10.47	ppm	790.07	61.52

309	45	4/30/2017 9:33	BULK	6.67	ppm	122	33.3
310	46	4/30/2017 9:34	BULK	7.01	ppm	114.67	35.68
311	47	4/30/2017 9:40	BULK	7.59	ppm	< LOD	38.74
312	48	4/30/2017 9:43	BULK	6.97	ppm	< LOD	42.59
313	49	4/30/2017 10:04	BULK	6.36	ppm	< LOD	39.93
314	50	4/30/2017 10:05	BULK	11.7	ppm	26.85	16.16
315	51	4/30/2017 10:06	BULK	9.23	ppm	< LOD	31.05
316	52	4/30/2017 10:08	BULK	12.68	ppm	48.59	23.08
317	53	4/30/2017 10:09	BULK	7.88	ppm	< LOD	32.95
318	54	4/30/2017 10:10	BULK	8.57	ppm	< LOD	33.3
319	55	4/30/2017 10:12	BULK	15.52	ppm	< LOD	31.42
320	56	4/30/2017 10:13	BULK	7.01	ppm	< LOD	42.04
321	does not exist						
322	does not exist						
323	does not exist						
324	does not exist						
325	does not exist						
326	does not exist						
327	does not exist						
328	does not exist						
329	does not exist						
330	does not exist						
331	does not exist						

GPS Shot	Reading No	Time	Type	As	As Error
	1	6/20/2017 6:34	SHUTTER_CAL		
	3	6/20/2017 7:04	SHUTTER_CAL	1.86	0
	4	6/20/2017 7:05	BULK	338.21	45.68
	5	6/20/2017 7:07	BULK	187.78	33.22
	6	6/20/2017 7:08	BULK	116.3	31.32
	7	6/20/2017 7:12	BULK	111.23	33.92
322	8	6/20/2017 7:13	BULK	80.6	32.25
	9	6/20/2017 7:15	BULK	80.3	51.48
323	10	6/20/2017 7:16	BULK	80.39	21.96
324	11	6/20/2017 7:18	BULK	60	20.33
325	12	6/20/2017 7:19	BULK	193.24	31.67
326	13	6/20/2017 7:23	BULK	186.94	35.62
327	14	6/20/2017 7:25	BULK	234.72	34.37
328	15	6/20/2017 7:27	BULK	248.75	35.42
329	16	6/20/2017 7:28	BULK	295.96	39.52
330	17	6/20/2017 7:30	BULK	1035.27	57.78
331	18	6/20/2017 7:32	BULK	1163.13	71.11
332	19	6/20/2017 7:35	BULK	1746.9	95.62
333	20	6/20/2017 7:37	BULK	1166.75	71.7
334	21	6/20/2017 7:39	BULK	93.63	28.46
335	22	6/20/2017 7:41	BULK	242.46	38.75
336	23	6/20/2017 7:43	BULK	128.37	29.67
	24	6/20/2017 7:44	BULK	< LOD	168.74
337	25	6/20/2017 7:45	BULK	86.78	25.55
338	26	6/20/2017 8:09	BULK	< LOD	28.3
339	27	6/20/2017 8:12	BULK	< LOD	29.73
340	28	6/20/2017 8:13	BULK	33.63	19.55
	29	6/20/2017 8:14	BULK	< LOD	72.17
341	30	6/20/2017 8:15	BULK	< LOD	33.89
342	Does not exist				
343	Does not exist				
344	Does not exist				
345	Does not exist				
346	Does not exist				
347	Does not exist				
347	Does not exist				
348	Does not exist				
349	Does not exist				
350	Does not exist				

GPS Shot	As (ppm)	As +/-
351	13.6	1.3
352	9.6	1.3
353	11.7	1.3
354	21.5	1.4
355	15	1.2
356	10.4	1.2
357	8.1	1.3
359	12.7	1.3
360	18.9	1.5
361	17.5	1.5
362	21.2	1.4
363	27.1	1.4
364	11.6	1.4
365	44.5	1.7
366	71.5	1.9
367	42.8	1.6
368	49.7	1.7
369	43.3	1.6
370	51	1.8
371	18.7	1.4
372	13.8	1.3
373	14.8	1.3
374	13.7	1.3
375	15.7	1.4
376	11.7	1.4
377	16.3	1.4
378	12.8	1.5
379	9.5	1.3
380	7.4	1.4
381	6.5	1.2
382	12.6	1.4
383	15.8	1.4
384	12.3	1.3
385	19	1.5
386	14.9	1.4
387	28	1.7
388	10.8	1.3
389	15.9	1.5
390	10.7	1.4
391	4.4	1.4
392	13.2	1.4
393	20.9	1.5
394	9	1.2
395	10.5	1.3
396	11	1.3

397	28.7	1.6
398	16.9	1.3
399	14.8	1.2
400	24.8	1.5
401	16.9	1.4
402	25.4	1.5
403	28.8	1.5
404	15.4	1.3
405	7.4	1.3
406	7.1	1.3
407	4.3	1.2
408	4.6	1.3
409	6.9	1.3
410	6.8	1.3
411	8.4	1.3
412	7.2	1.3
413	11.7	1.3
414	11.7	1.3
415	9.6	1.3
416	7.3	1.3
417	11.2	1.3
418	19.1	1.3
419	5	1.3
420	27.4	1.5
421	36.5	1.6
422	36.6	1.6
423	39.3	1.6
424	43.3	1.7
425	38.5	1.7
426	43	1.9
427	64.8	2
429	39.9	1.7
430	50.9	1.8
431	52	1.9
432	62.5	1.8
433	38.2	1.7
434	231	3
435	7.4	1.4
436	11.4	1.4
437	9	1.3
438	9.5	1.4
439	12.2	1.4
440	13.2	1.3
441	12.4	1.3
442	9.2	1.3
443	15.2	1.4
444	22.5	1.5

445	85	2
446	119	2
447	149	3
448	70.1	2
449	84	2
450	166	3
451	410	4
452	40.6	1.7
453	36	1.7
454	40.4	1.7
455	48.6	1.7
456	40.4	1.6
457	61.2	1.8
458	30.6	1.5
459	26.4	1.6
460	16.5	1.4
461	17.4	1.4
462	12	1.4
463	12.4	1.4
464	11.4	1.3
465	14.9	1.5
466	9.6	1.3
467	6.2	1.2
468	<LOD	3.8
469	11.8	1.4
470	6.2	1.3
471	7.6	1.4
472	5.3	1.2
473	8.1	1.5
477	17.4	1.4
474	5.8	1.3
475	18.2	1.4
476	14	1.3
478	6	1.3
479	8.7	1.3
480	7.3	1.4
481	9.1	1.5
482	8.8	1.4
483	14.8	1.5
484	11.3	1.3
485	10.5	1.5
491	8.6	1.5
500	6.8	1.5
501-1	6	1.5
501-2	13.2	1.4
503	8.9	1.5
543	35.8	1.7

545	11.3	1.3
546	11.9	1.4
547	13.4	1.5
548	14.6	1.5
549	48.2	1.8
550	38.1	1.7
551	16.4	1.5
552	13	1.5
553	17.7	1.6
554	13.3	1.4
555	10.9	1.6
556	14.7	1.5
557	10.8	1.5
558	7	1.3
559	8.8	1.3
560	9.6	1.4
561	13.7	1.3
562	25.5	1.5
563	15.7	1.5
564	12.7	1.4
565	16.7	1.4
566	26.1	1.5
567	25.1	1.5
568	27.1	1.5
569	25.8	1.5
570	33.1	1.5
571	29.8	1.5
572	37.8	1.6
573	34.4	1.5
574	36.3	1.6
575	28.8	1.5
576	22.3	1.4
577	22.9	1.4
579	38.8	1.6
580	20.3	1.4
581	28.7	1.5
582	36.3	1.5
583	23.5	1.3
428	34	1.7
483	14.8	1.5
484	11.3	1.3
486	11	1.4
487	24.3	1.7
488	12.5	1.5
489	10.2	1.4
490	14.8	1.5
492	11.3	1.4

493	5.3	1.2
494	12.4	1.3
495	9.5	1.3
496	11.4	1.4
497	19.6	1.7
498	15	1.6
499	9.5	1.4
504	10.8	1.3
505	73	2
506	24.3	1.6
507	10.1	1.4
508	9.6	1.4
509	10.9	1.4
510	19.8	1.5
511	10.6	1.4
512	23	1.6
513	10.4	1.3
514	13.8	1.4
515	14.4	1.5
516	13.5	1.5
517	16.4	1.4
518	26.8	1.5
519	34.8	1.7
520	17.6	1.5
521	54.5	1.8
522	38.4	1.7
523	11.8	1.8
524	32.4	1.6
525	84	2
526	14.8	1.4
527	23.1	1.5
528	6.8	1.4
529	12.6	1.4
530	10.4	1.4
531	10.6	1.4
532	16.9	1.4
533	21.1	1.5
534	38.5	1.7
535	41.2	1.7
536	182	3
537	62.3	1.8
538	63.7	1.8
539	31.2	1.5
540	20.4	1.5
541	22.1	1.5
542	23.4	1.4
544	41.4	1.7

APPENDIX E

Black Mountain Trails – Soil Sample Photographs

BMT-01

BMT-02

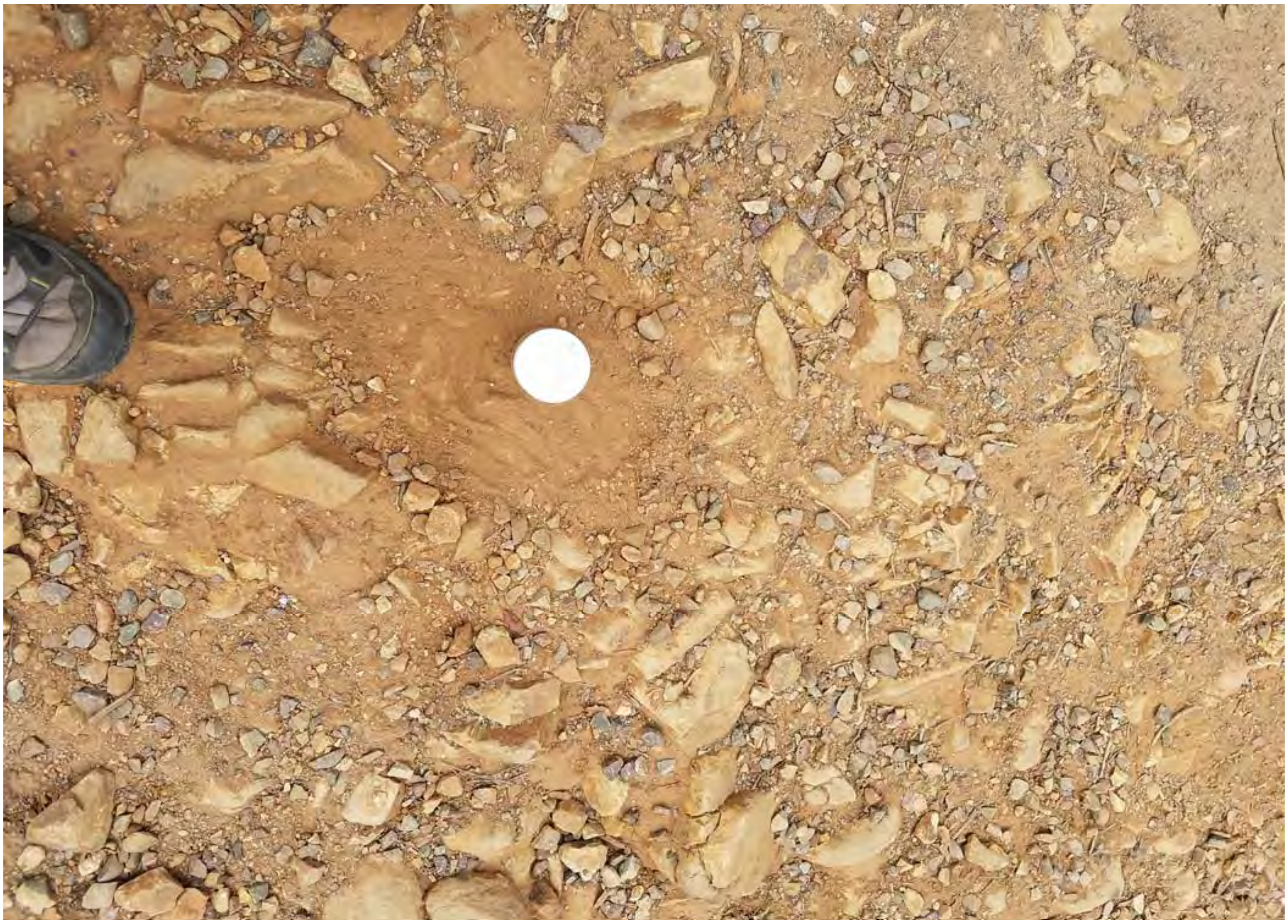
BMT-03

BMT-04

BMT-05


BMT-06
0804
4/13/17

BMT-07



BMT-08

BMT-09


BMT-10 4/13
0825

BMT-11

BMT- 12


BMT-13
0845 4/13

BMT-14

BMT-15

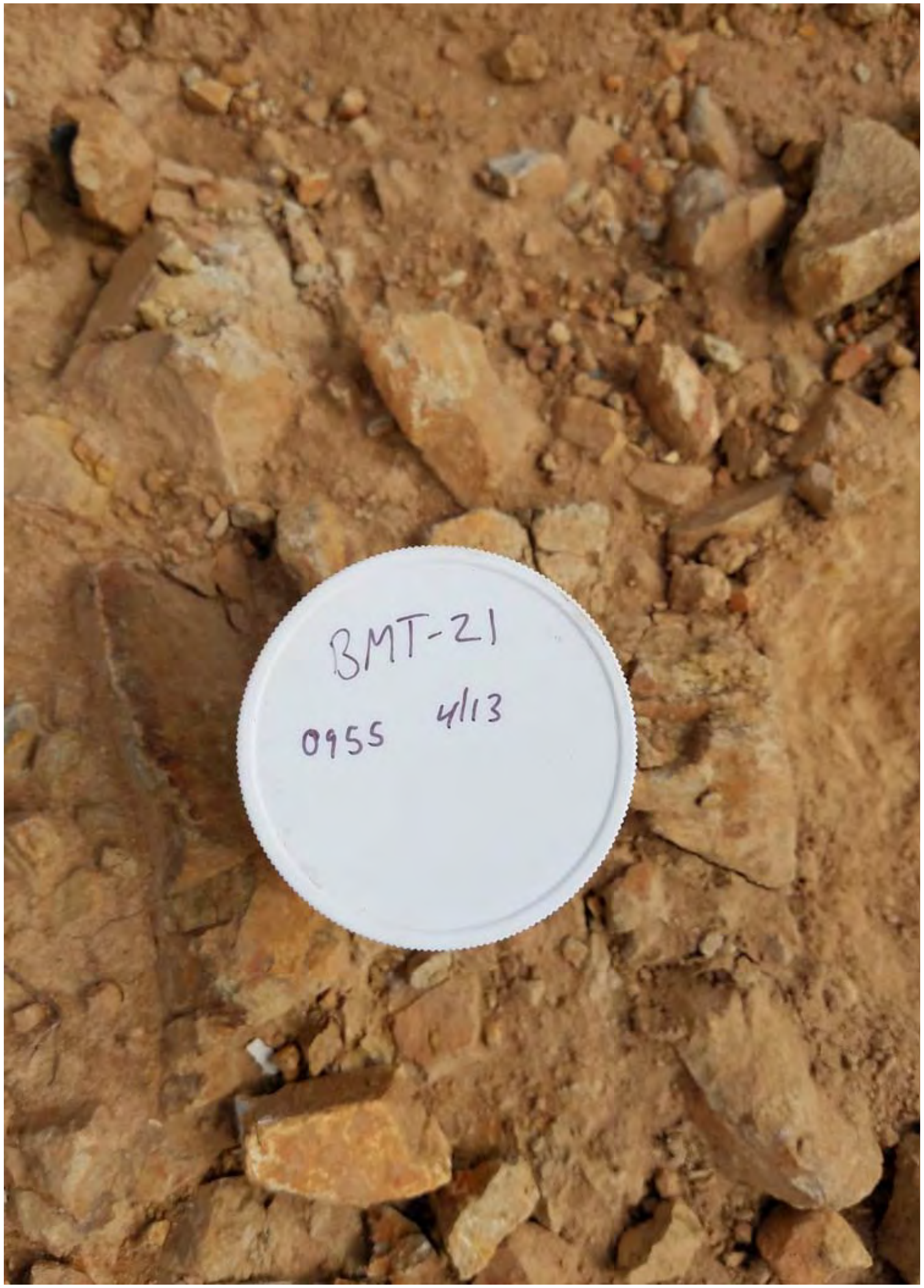

BMT-16
0855
4113

BMT-17

BMT-18

BMT-19

BMT-20


BMT-21
0955 4/13

BMT-22

BMT- 23

BMT-24

BMT-25


BMT-26
0720
4/4/17

BMT-27

BMT-28

BMT-29

BMT-30

BMT-31

BMT-32

BMT-33

BMT-34

BMT-35

BMT-36

BMT-37

BMT-38

BMT-39

BMT-40

BMT-41

BMT-42

BMT-43

BMT-44

BMT-45

BMT-46

BMT-47

BMT-48

BMT-49

BMT-50

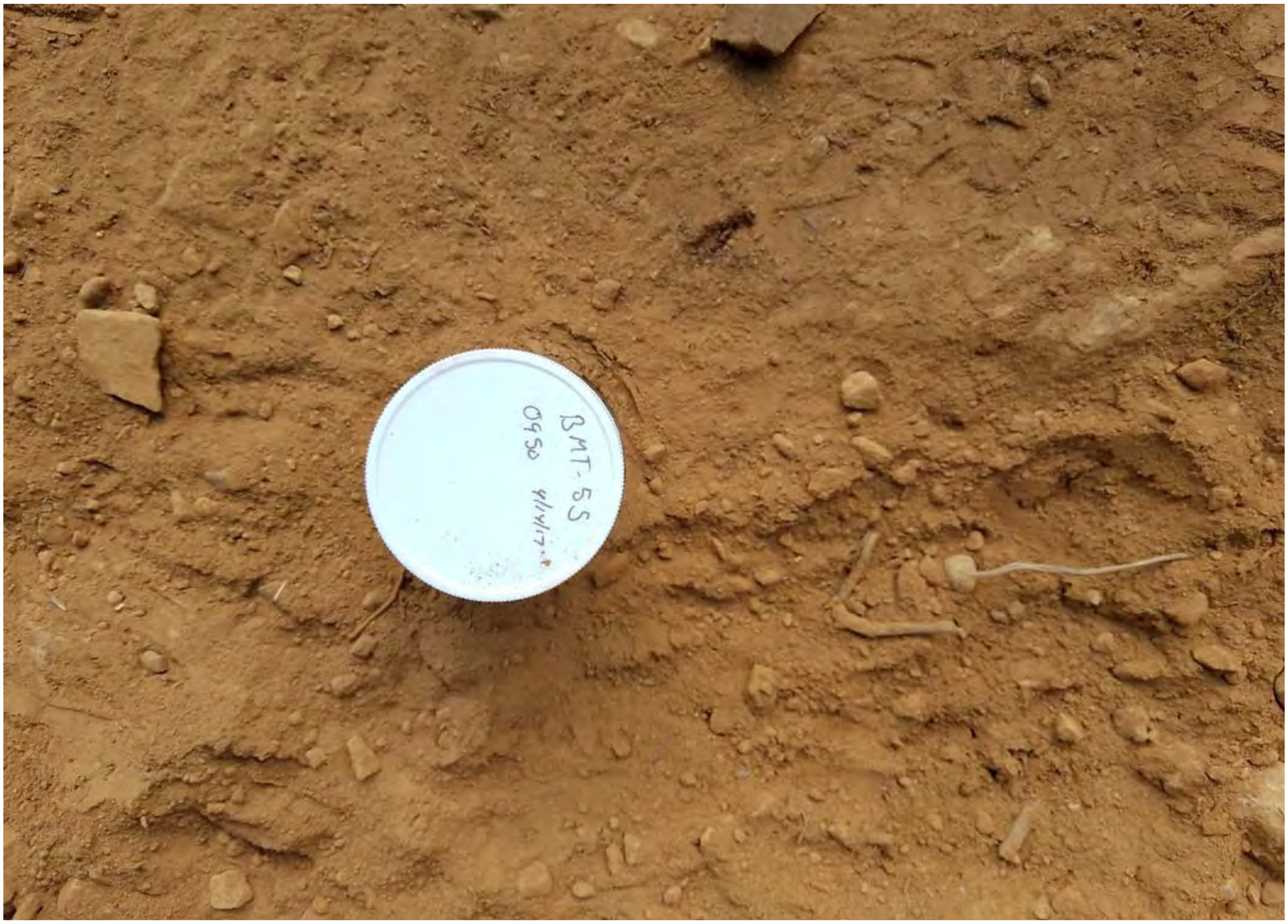
BMT-51

BMT-52

BMT-53


BMT-54
0945
BMT-54

BMT-55



BMT- 56

BMT-57


BMT-58
toto
1005
4/14/17

BMT-59

BMT-60

BMT-61

BMT-62

BMT-63

BMT-64

BMT-65

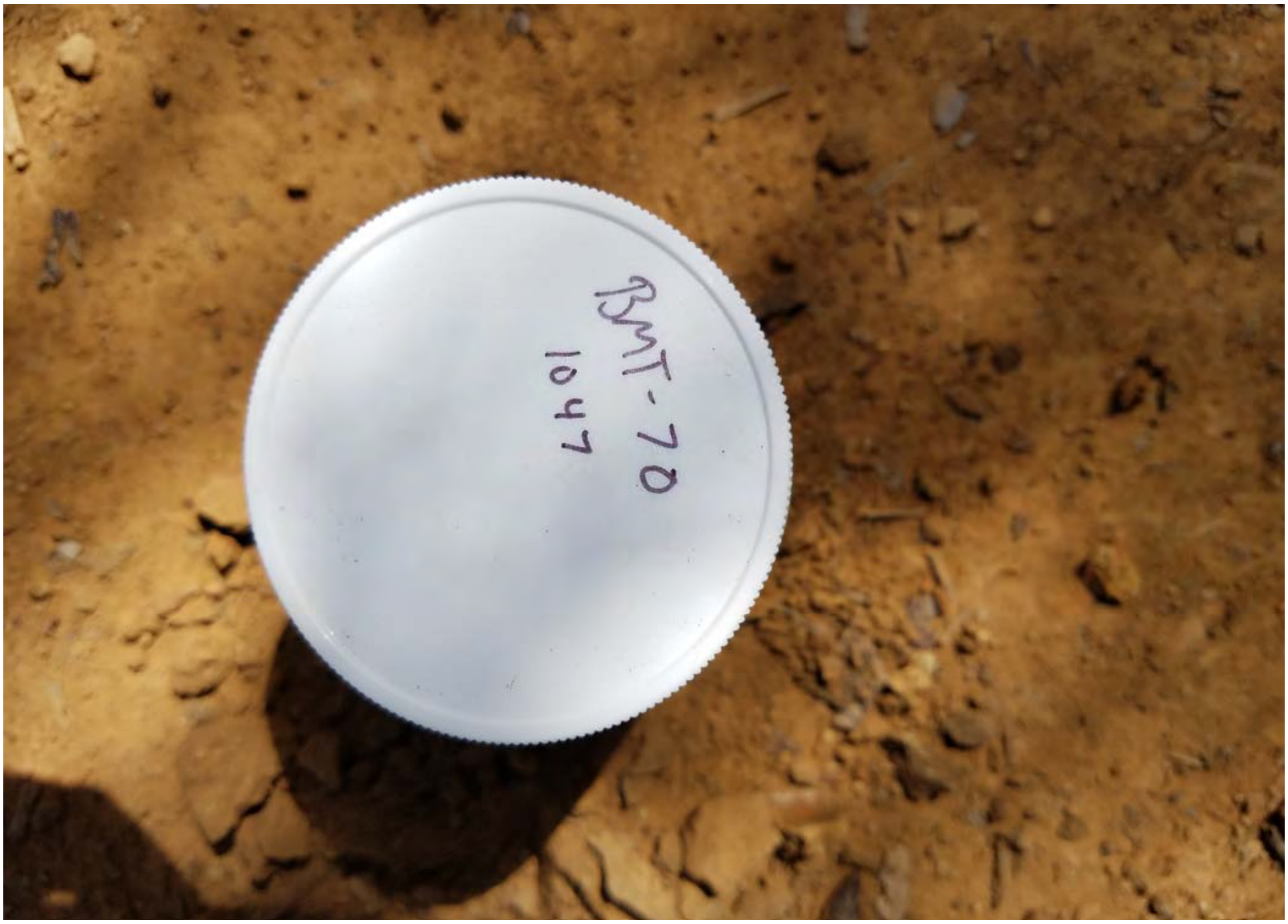
BMT-66

BMT-67

BMT-68

BMT-69

BMT-70

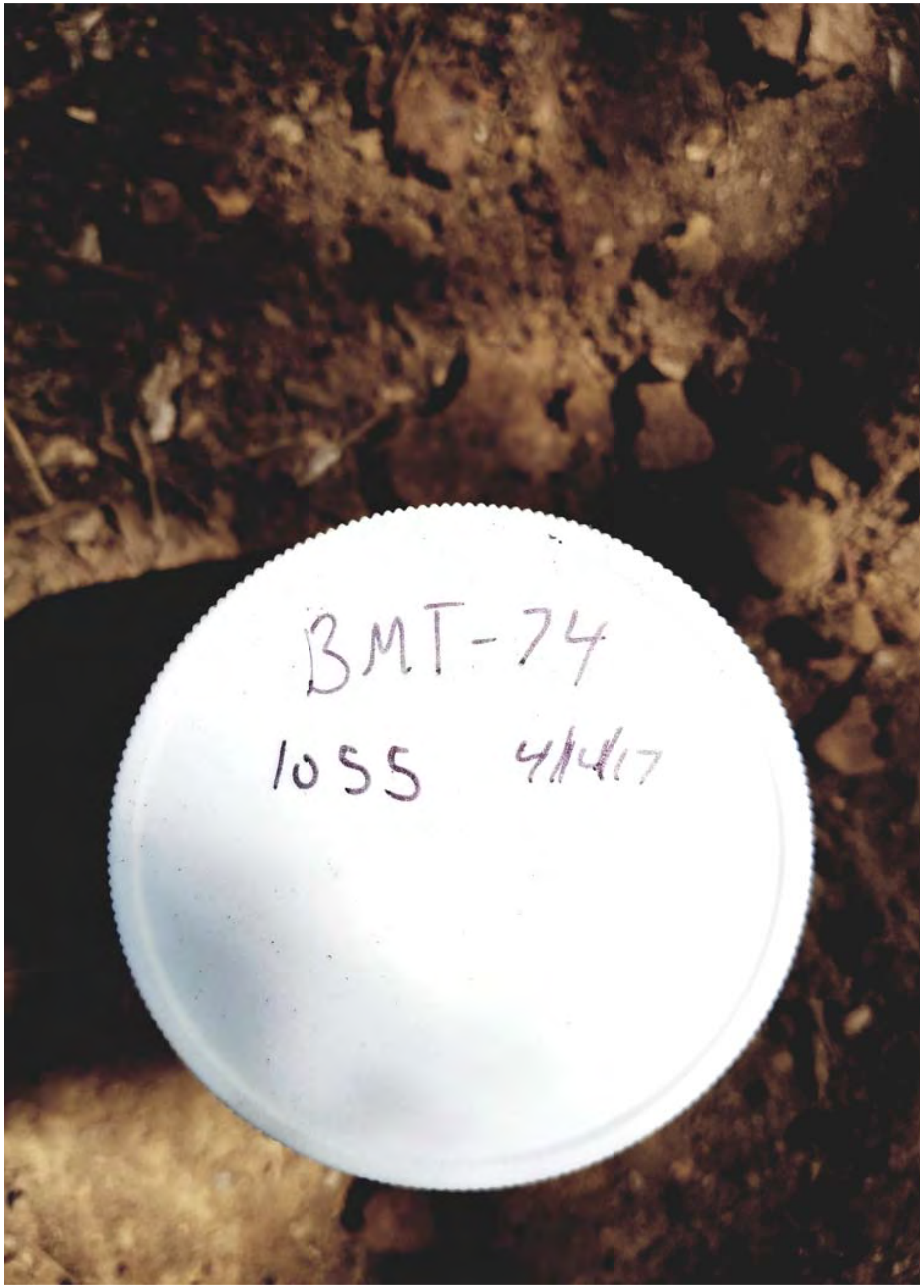


BMT-71

BMT-72

BMT-73

BMT-74



BMT-75

BMT-76

BMT-77


BMT-78
1105 4/14/17


BMT-79
1130hrs
4/14/202

BMT-80

BMT-81

BMT-82

BMT-83

BMT-84

BMT-85


BMT-85
0345
WARNING-WEAR SAFETY GOGGLES

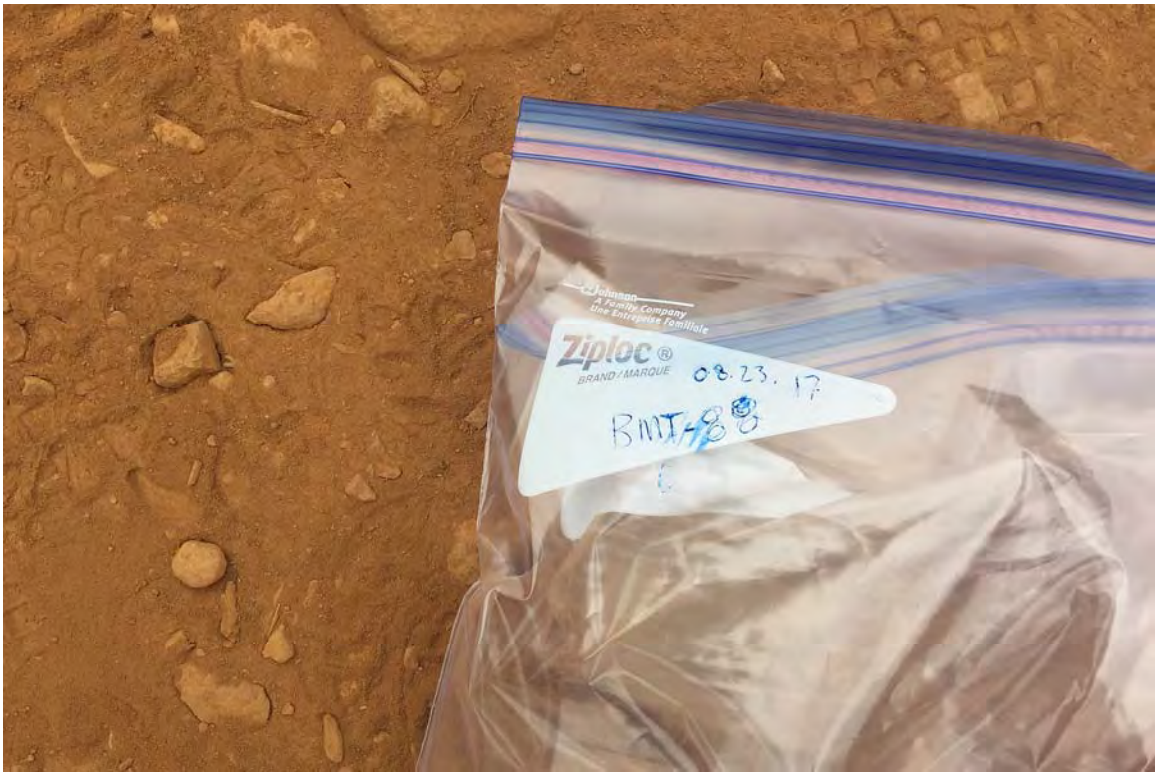

WARNING-WEAR SAFETY GOGGLES

BMT-86

BMT-87

BMT-88

BMT-88



BMT-95

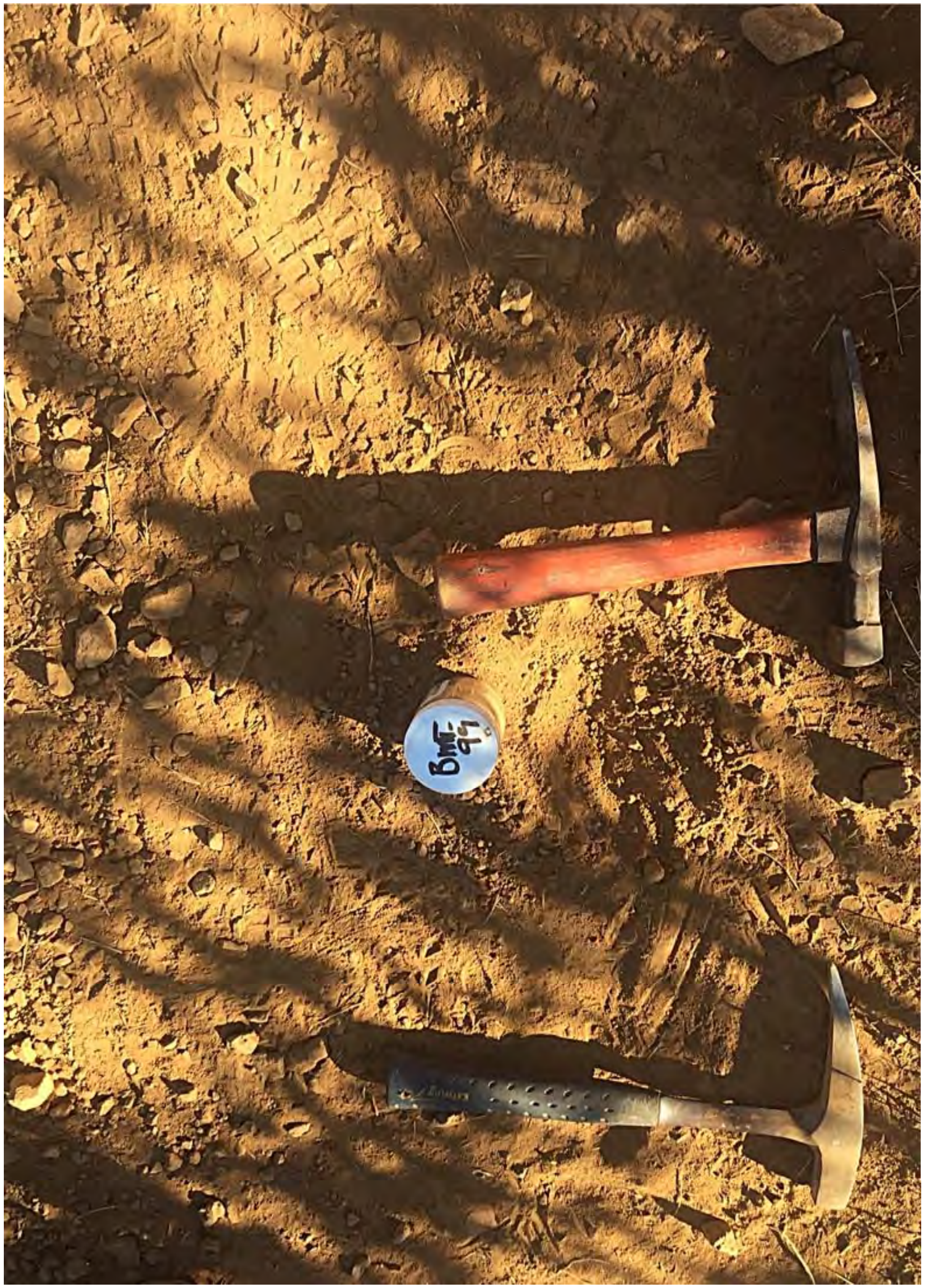
BMT-95

BMT-96


BMT-97


BMT-97

BMT-98


BMT-
99


BMT-
99

BMT-100

BMT-101

BMT-102

BMT-103


BMT-104

BMT-105

APPENDIX F

Dust Monitoring Field Data – August 2017

BAB foot (1) 082317

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11403008	Start Time	07:54:25
		Stop Date	08/23/2017
		Stop Time	09:15:55
		Total Time	0:01:21:30
		Logging Interval	30 seconds

Statistics

	Aerosol
Avg	0.043 mg/m^3
Max	0.317 mg/m^3
Max Date	08/23/2017
Max Time	07:57:25
Min	0.015 mg/m^3
Min Date	08/23/2017
Min Time	08:39:55
TWA (8 hr)	0.007
TWA Start Date	08/23/2017
TWA Start Time	07:54:25
TWA End Time	09:15:55

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	07:54:55	0.037
2	08/23/2017	07:55:25	0.036
3	08/23/2017	07:55:55	0.036
4	08/23/2017	07:56:25	0.035
5	08/23/2017	07:56:55	0.062
6	08/23/2017	07:57:25	0.317
7	08/23/2017	07:57:55	0.035
8	08/23/2017	07:58:25	0.040
9	08/23/2017	07:58:55	0.050
10	08/23/2017	07:59:25	0.041
11	08/23/2017	07:59:55	0.056
12	08/23/2017	08:00:25	0.045
13	08/23/2017	08:00:55	0.047
14	08/23/2017	08:01:25	0.041
15	08/23/2017	08:01:55	0.044
16	08/23/2017	08:02:25	0.208
17	08/23/2017	08:02:55	0.047
18	08/23/2017	08:03:25	0.054
19	08/23/2017	08:03:55	0.035
20	08/23/2017	08:04:25	0.038
21	08/23/2017	08:04:55	0.108

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	08:05:25	0.053
23	08/23/2017	08:05:55	0.045
24	08/23/2017	08:06:25	0.048
25	08/23/2017	08:06:55	0.041
26	08/23/2017	08:07:25	0.065
27	08/23/2017	08:07:55	0.043
28	08/23/2017	08:08:25	0.060
29	08/23/2017	08:08:55	0.043
30	08/23/2017	08:09:25	0.035
31	08/23/2017	08:09:55	0.040
32	08/23/2017	08:10:25	0.044
33	08/23/2017	08:10:55	0.041
34	08/23/2017	08:11:25	0.067
35	08/23/2017	08:11:55	0.053
36	08/23/2017	08:12:25	0.044
37	08/23/2017	08:12:55	0.062
38	08/23/2017	08:13:25	0.053
39	08/23/2017	08:13:55	0.040
40	08/23/2017	08:14:25	0.047
41	08/23/2017	08:14:55	0.039
42	08/23/2017	08:15:25	0.040
43	08/23/2017	08:15:55	0.042
44	08/23/2017	08:16:25	0.035
45	08/23/2017	08:16:55	0.040
46	08/23/2017	08:17:25	0.025
47	08/23/2017	08:17:55	0.036
48	08/23/2017	08:18:25	0.041
49	08/23/2017	08:18:55	0.040
50	08/23/2017	08:19:25	0.049
51	08/23/2017	08:19:55	0.041
52	08/23/2017	08:20:25	0.050
53	08/23/2017	08:20:55	0.041
54	08/23/2017	08:21:25	0.041
55	08/23/2017	08:21:55	0.044
56	08/23/2017	08:22:25	0.039
57	08/23/2017	08:22:55	0.036
58	08/23/2017	08:23:25	0.044
59	08/23/2017	08:23:55	0.042
60	08/23/2017	08:24:25	0.038
61	08/23/2017	08:24:55	0.037
62	08/23/2017	08:25:25	0.035
63	08/23/2017	08:25:55	0.041
64	08/23/2017	08:26:25	0.042
65	08/23/2017	08:26:55	0.037
66	08/23/2017	08:27:25	0.041
67	08/23/2017	08:27:55	0.037

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	08:28:25	0.049
69	08/23/2017	08:28:55	0.043
70	08/23/2017	08:29:25	0.049
71	08/23/2017	08:29:55	0.053
72	08/23/2017	08:30:25	0.044
73	08/23/2017	08:30:55	0.048
74	08/23/2017	08:31:25	0.037
75	08/23/2017	08:31:55	0.036
76	08/23/2017	08:32:25	0.039
77	08/23/2017	08:32:55	0.038
78	08/23/2017	08:33:25	0.031
79	08/23/2017	08:33:55	0.038
80	08/23/2017	08:34:25	0.037
81	08/23/2017	08:34:55	0.059
82	08/23/2017	08:35:25	0.044
83	08/23/2017	08:35:55	0.040
84	08/23/2017	08:36:25	0.041
85	08/23/2017	08:36:55	0.040
86	08/23/2017	08:37:25	0.038
87	08/23/2017	08:37:55	0.019
88	08/23/2017	08:38:25	0.037
89	08/23/2017	08:38:55	0.037
90	08/23/2017	08:39:25	0.045
91	08/23/2017	08:39:55	0.015
92	08/23/2017	08:40:25	0.032
93	08/23/2017	08:40:55	0.038
94	08/23/2017	08:41:25	0.038
95	08/23/2017	08:41:55	0.036
96	08/23/2017	08:42:25	0.052
97	08/23/2017	08:42:55	0.041
98	08/23/2017	08:43:25	0.034
99	08/23/2017	08:43:55	0.032
100	08/23/2017	08:44:25	0.032
101	08/23/2017	08:44:55	0.032
102	08/23/2017	08:45:25	0.044
103	08/23/2017	08:45:55	0.046
104	08/23/2017	08:46:25	0.035
105	08/23/2017	08:46:55	0.039
106	08/23/2017	08:47:25	0.038
107	08/23/2017	08:47:55	0.038
108	08/23/2017	08:48:25	0.033
109	08/23/2017	08:48:55	0.037
110	08/23/2017	08:49:25	0.037
111	08/23/2017	08:49:55	0.036
112	08/23/2017	08:50:25	0.029
113	08/23/2017	08:50:55	0.039

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/23/2017	08:51:25	0.036
115	08/23/2017	08:51:55	0.032
116	08/23/2017	08:52:25	0.029
117	08/23/2017	08:52:55	0.034
118	08/23/2017	08:53:25	0.033
119	08/23/2017	08:53:55	0.036
120	08/23/2017	08:54:25	0.029
121	08/23/2017	08:54:55	0.028
122	08/23/2017	08:55:25	0.042
123	08/23/2017	08:55:55	0.028
124	08/23/2017	08:56:25	0.033
125	08/23/2017	08:56:55	0.042
126	08/23/2017	08:57:25	0.028
127	08/23/2017	08:57:55	0.033
128	08/23/2017	08:58:25	0.033
129	08/23/2017	08:58:55	0.038
130	08/23/2017	08:59:25	0.036
131	08/23/2017	08:59:55	0.032
132	08/23/2017	09:00:25	0.036
133	08/23/2017	09:00:55	0.044
134	08/23/2017	09:01:25	0.039
135	08/23/2017	09:01:55	0.046
136	08/23/2017	09:02:25	0.033
137	08/23/2017	09:02:55	0.036
138	08/23/2017	09:03:25	0.034
139	08/23/2017	09:03:55	0.033
140	08/23/2017	09:04:25	0.039
141	08/23/2017	09:04:55	0.034
142	08/23/2017	09:05:25	0.038
143	08/23/2017	09:05:55	0.043
144	08/23/2017	09:06:25	0.032
145	08/23/2017	09:06:55	0.033
146	08/23/2017	09:07:25	0.032
147	08/23/2017	09:07:55	0.035
148	08/23/2017	09:08:25	0.033
149	08/23/2017	09:08:55	0.035
150	08/23/2017	09:09:25	0.033
151	08/23/2017	09:09:55	0.032
152	08/23/2017	09:10:25	0.033
153	08/23/2017	09:10:55	0.034
154	08/23/2017	09:11:25	0.037
155	08/23/2017	09:11:55	0.038
156	08/23/2017	09:12:25	0.034
157	08/23/2017	09:12:55	0.034
158	08/23/2017	09:13:25	0.041
159	08/23/2017	09:13:55	0.038

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/23/2017	09:14:25	0.035
161	08/23/2017	09:14:55	0.035
162	08/23/2017	09:15:25	0.031
163	08/23/2017	09:15:55	0.038

BAB foot (2) 082317

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11403008	Start Time	09:40:42
		Stop Date	08/23/2017
		Stop Time	10:40:12
		Total Time	0:00:59:30
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.035 mg/m^3
Max	0.196 mg/m^3
Max Date	08/23/2017
Max Time	10:34:12
Min	0.024 mg/m^3
Min Date	08/23/2017
Min Time	10:22:42
TWA (8 hr)	0.004
TWA Start Date	08/23/2017
TWA Start Time	09:40:42
TWA End Time	10:40:12

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	09:41:12	0.031
2	08/23/2017	09:41:42	0.035
3	08/23/2017	09:42:12	0.035
4	08/23/2017	09:42:42	0.031
5	08/23/2017	09:43:12	0.030
6	08/23/2017	09:43:42	0.033
7	08/23/2017	09:44:12	0.036
8	08/23/2017	09:44:42	0.031
9	08/23/2017	09:45:12	0.027
10	08/23/2017	09:45:42	0.028
11	08/23/2017	09:46:12	0.034
12	08/23/2017	09:46:42	0.000
13	08/23/2017	09:47:12	0.027
14	08/23/2017	09:47:42	0.035
15	08/23/2017	09:48:12	0.038
16	08/23/2017	09:48:42	0.040
17	08/23/2017	09:49:12	0.032
18	08/23/2017	09:49:42	0.035
19	08/23/2017	09:50:12	0.035
20	08/23/2017	09:50:42	0.030
21	08/23/2017	09:51:12	0.032

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	09:51:42	0.031
23	08/23/2017	09:52:12	0.000
24	08/23/2017	09:52:42	0.035
25	08/23/2017	09:53:12	0.035
26	08/23/2017	09:53:42	0.034
27	08/23/2017	09:54:12	0.040
28	08/23/2017	09:54:42	0.033
29	08/23/2017	09:55:12	0.029
30	08/23/2017	09:55:42	0.033
31	08/23/2017	09:56:12	0.032
32	08/23/2017	09:56:42	0.032
33	08/23/2017	09:57:12	0.033
34	08/23/2017	09:57:42	0.030
35	08/23/2017	09:58:12	0.042
36	08/23/2017	09:58:42	0.033
37	08/23/2017	09:59:12	0.031
38	08/23/2017	09:59:42	0.031
39	08/23/2017	10:00:12	0.031
40	08/23/2017	10:00:42	0.037
41	08/23/2017	10:01:12	0.039
42	08/23/2017	10:01:42	0.040
43	08/23/2017	10:02:12	0.034
44	08/23/2017	10:02:42	0.038
45	08/23/2017	10:03:12	0.034
46	08/23/2017	10:03:42	0.032
47	08/23/2017	10:04:12	0.033
48	08/23/2017	10:04:42	0.032
49	08/23/2017	10:05:12	0.033
50	08/23/2017	10:05:42	0.043
51	08/23/2017	10:06:12	0.035
52	08/23/2017	10:06:42	0.029
53	08/23/2017	10:07:12	0.035
54	08/23/2017	10:07:42	0.035
55	08/23/2017	10:08:12	0.041
56	08/23/2017	10:08:42	0.035
57	08/23/2017	10:09:12	0.041
58	08/23/2017	10:09:42	0.036
59	08/23/2017	10:10:12	0.035
60	08/23/2017	10:10:42	0.035
61	08/23/2017	10:11:12	0.037
62	08/23/2017	10:11:42	0.034
63	08/23/2017	10:12:12	0.034
64	08/23/2017	10:12:42	0.036
65	08/23/2017	10:13:12	0.031
66	08/23/2017	10:13:42	0.030
67	08/23/2017	10:14:12	0.031

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	10:14:42	0.035
69	08/23/2017	10:15:12	0.030
70	08/23/2017	10:15:42	0.038
71	08/23/2017	10:16:12	0.035
72	08/23/2017	10:16:42	0.034
73	08/23/2017	10:17:12	0.033
74	08/23/2017	10:17:42	0.033
75	08/23/2017	10:18:12	0.032
76	08/23/2017	10:18:42	0.032
77	08/23/2017	10:19:12	0.031
78	08/23/2017	10:19:42	0.034
79	08/23/2017	10:20:12	0.028
80	08/23/2017	10:20:42	0.029
81	08/23/2017	10:21:12	0.027
82	08/23/2017	10:21:42	0.029
83	08/23/2017	10:22:12	0.029
84	08/23/2017	10:22:42	0.024
85	08/23/2017	10:23:12	0.032
86	08/23/2017	10:23:42	0.027
87	08/23/2017	10:24:12	0.028
88	08/23/2017	10:24:42	0.028
89	08/23/2017	10:25:12	0.029
90	08/23/2017	10:25:42	0.031
91	08/23/2017	10:26:12	0.034
92	08/23/2017	10:26:42	0.033
93	08/23/2017	10:27:12	0.035
94	08/23/2017	10:27:42	0.034
95	08/23/2017	10:28:12	0.033
96	08/23/2017	10:28:42	0.028
97	08/23/2017	10:29:12	0.030
98	08/23/2017	10:29:42	0.032
99	08/23/2017	10:30:12	0.041
100	08/23/2017	10:30:42	0.033
101	08/23/2017	10:31:12	0.037
102	08/23/2017	10:31:42	0.031
103	08/23/2017	10:32:12	0.029
104	08/23/2017	10:32:42	0.030
105	08/23/2017	10:33:12	0.033
106	08/23/2017	10:33:42	0.026
107	08/23/2017	10:34:12	0.196
108	08/23/2017	10:34:42	0.054
109	08/23/2017	10:35:12	0.046
110	08/23/2017	10:35:42	0.031
111	08/23/2017	10:36:12	0.034
112	08/23/2017	10:36:42	0.032
113	08/23/2017	10:37:12	0.056

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/23/2017	10:37:42	0.035
115	08/23/2017	10:38:12	0.026
116	08/23/2017	10:38:42	0.069
117	08/23/2017	10:39:12	0.029
118	08/23/2017	10:39:42	0.066
119	08/23/2017	10:40:12	0.033

BAB foot (3) 082317

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11403008	Start Time	10:59:22
		Stop Date	08/23/2017
		Stop Time	11:26:22
		Total Time	0:00:27:00
		Logging Interval	30 seconds

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	10:59:52	0.030
2	08/23/2017	11:00:22	0.025
3	08/23/2017	11:00:52	0.213
4	08/23/2017	11:01:22	0.028
5	08/23/2017	11:01:52	0.022
6	08/23/2017	11:02:22	0.024
7	08/23/2017	11:02:52	0.020
8	08/23/2017	11:03:22	0.030
9	08/23/2017	11:03:52	0.023
10	08/23/2017	11:04:22	0.024
11	08/23/2017	11:04:52	0.025
12	08/23/2017	11:05:22	0.023
13	08/23/2017	11:05:52	0.022
14	08/23/2017	11:06:22	0.026
15	08/23/2017	11:06:52	0.026
16	08/23/2017	11:07:22	0.021
17	08/23/2017	11:07:52	0.026
18	08/23/2017	11:08:22	0.024
19	08/23/2017	11:08:52	0.031
20	08/23/2017	11:09:22	0.023
21	08/23/2017	11:09:52	0.028
22	08/23/2017	11:10:22	0.020
23	08/23/2017	11:10:52	0.024
24	08/23/2017	11:11:22	0.021
25	08/23/2017	11:11:52	0.019
26	08/23/2017	11:12:22	0.021
27	08/23/2017	11:12:52	0.021
28	08/23/2017	11:13:22	0.025
29	08/23/2017	11:13:52	0.023
30	08/23/2017	11:14:22	0.022
31	08/23/2017	11:14:52	0.021
32	08/23/2017	11:15:22	0.023
33	08/23/2017	11:15:52	0.026
34	08/23/2017	11:16:22	0.216
35	08/23/2017	11:16:52	1.734

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
36	08/23/2017	11:17:22	0.023
37	08/23/2017	11:17:52	0.025
38	08/23/2017	11:18:22	0.021
39	08/23/2017	11:18:52	0.029
40	08/23/2017	11:19:22	0.024
41	08/23/2017	11:19:52	0.024
42	08/23/2017	11:20:22	0.023
43	08/23/2017	11:20:52	0.021
44	08/23/2017	11:21:22	0.021
45	08/23/2017	11:21:52	0.024
46	08/23/2017	11:22:22	0.026
47	08/23/2017	11:22:52	0.023
48	08/23/2017	11:23:22	0.029
49	08/23/2017	11:23:52	0.025
50	08/23/2017	11:24:22	0.026
51	08/23/2017	11:24:52	0.031
52	08/23/2017	11:25:22	0.028
53	08/23/2017	11:25:52	0.024
54	08/23/2017	11:26:22	0.026

BMC foot 082317

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11306011	Start Time	07:54:30
		Stop Date	08/23/2017
		Stop Time	09:15:30
		Total Time	0:01:21:00
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.047 mg/m^3
Max	0.312 mg/m^3
Max Date	08/23/2017
Max Time	08:41:00
Min	0.031 mg/m^3
Min Date	08/23/2017
Min Time	08:28:30
TWA (8 hr)	0.008
TWA Start Date	08/23/2017
TWA Start Time	07:54:30
TWA End Time	09:15:30

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	07:55:00	0.048
2	08/23/2017	07:55:30	0.040
3	08/23/2017	07:56:00	0.037
4	08/23/2017	07:56:30	0.039
5	08/23/2017	07:57:00	0.036
6	08/23/2017	07:57:30	0.038
7	08/23/2017	07:58:00	0.036
8	08/23/2017	07:58:30	0.048
9	08/23/2017	07:59:00	0.038
10	08/23/2017	07:59:30	0.041
11	08/23/2017	08:00:00	0.041
12	08/23/2017	08:00:30	0.040
13	08/23/2017	08:01:00	0.037
14	08/23/2017	08:01:30	0.050
15	08/23/2017	08:02:00	0.045
16	08/23/2017	08:02:30	0.034
17	08/23/2017	08:03:00	0.041
18	08/23/2017	08:03:30	0.043
19	08/23/2017	08:04:00	0.050
20	08/23/2017	08:04:30	0.044
21	08/23/2017	08:05:00	0.041

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	08:05:30	0.049
23	08/23/2017	08:06:00	0.065
24	08/23/2017	08:06:30	0.043
25	08/23/2017	08:07:00	0.044
26	08/23/2017	08:07:30	0.045
27	08/23/2017	08:08:00	0.062
28	08/23/2017	08:08:30	0.047
29	08/23/2017	08:09:00	0.045
30	08/23/2017	08:09:30	0.041
31	08/23/2017	08:10:00	0.041
32	08/23/2017	08:10:30	0.044
33	08/23/2017	08:11:00	0.042
34	08/23/2017	08:11:30	0.044
35	08/23/2017	08:12:00	0.045
36	08/23/2017	08:12:30	0.040
37	08/23/2017	08:13:00	0.044
38	08/23/2017	08:13:30	0.043
39	08/23/2017	08:14:00	0.045
40	08/23/2017	08:14:30	0.047
41	08/23/2017	08:15:00	0.036
42	08/23/2017	08:15:30	0.041
43	08/23/2017	08:16:00	0.038
44	08/23/2017	08:16:30	0.048
45	08/23/2017	08:17:00	0.051
46	08/23/2017	08:17:30	0.040
47	08/23/2017	08:18:00	0.041
48	08/23/2017	08:18:30	0.048
49	08/23/2017	08:19:00	0.044
50	08/23/2017	08:19:30	0.050
51	08/23/2017	08:20:00	0.044
52	08/23/2017	08:20:30	0.046
53	08/23/2017	08:21:00	0.046
54	08/23/2017	08:21:30	0.046
55	08/23/2017	08:22:00	0.046
56	08/23/2017	08:22:30	0.052
57	08/23/2017	08:23:00	0.048
58	08/23/2017	08:23:30	0.039
59	08/23/2017	08:24:00	0.050
60	08/23/2017	08:24:30	0.045
61	08/23/2017	08:25:00	0.047
62	08/23/2017	08:25:30	0.045
63	08/23/2017	08:26:00	0.043
64	08/23/2017	08:26:30	0.056
65	08/23/2017	08:27:00	0.043
66	08/23/2017	08:27:30	0.042
67	08/23/2017	08:28:00	0.068

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	08:28:30	0.031
69	08/23/2017	08:29:00	0.041
70	08/23/2017	08:29:30	0.050
71	08/23/2017	08:30:00	0.049
72	08/23/2017	08:30:30	0.048
73	08/23/2017	08:31:00	0.120
74	08/23/2017	08:31:30	0.049
75	08/23/2017	08:32:00	0.046
76	08/23/2017	08:32:30	0.063
77	08/23/2017	08:33:00	0.063
78	08/23/2017	08:33:30	0.041
79	08/23/2017	08:34:00	0.042
80	08/23/2017	08:34:30	0.042
81	08/23/2017	08:35:00	0.054
82	08/23/2017	08:35:30	0.051
83	08/23/2017	08:36:00	0.044
84	08/23/2017	08:36:30	0.095
85	08/23/2017	08:37:00	0.064
86	08/23/2017	08:37:30	0.044
87	08/23/2017	08:38:00	0.042
88	08/23/2017	08:38:30	0.042
89	08/23/2017	08:39:00	0.035
90	08/23/2017	08:39:30	0.039
91	08/23/2017	08:40:00	0.043
92	08/23/2017	08:40:30	0.072
93	08/23/2017	08:41:00	0.312
94	08/23/2017	08:41:30	0.057
95	08/23/2017	08:42:00	0.038
96	08/23/2017	08:42:30	0.038
97	08/23/2017	08:43:00	0.042
98	08/23/2017	08:43:30	0.052
99	08/23/2017	08:44:00	0.036
100	08/23/2017	08:44:30	0.038
101	08/23/2017	08:45:00	0.042
102	08/23/2017	08:45:30	0.047
103	08/23/2017	08:46:00	0.050
104	08/23/2017	08:46:30	0.058
105	08/23/2017	08:47:00	0.043
106	08/23/2017	08:47:30	0.039
107	08/23/2017	08:48:00	0.034
108	08/23/2017	08:48:30	0.033
109	08/23/2017	08:49:00	0.038
110	08/23/2017	08:49:30	0.035
111	08/23/2017	08:50:00	0.032
112	08/23/2017	08:50:30	0.031
113	08/23/2017	08:51:00	0.033

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/23/2017	08:51:30	0.045
115	08/23/2017	08:52:00	0.034
116	08/23/2017	08:52:30	0.033
117	08/23/2017	08:53:00	0.034
118	08/23/2017	08:53:30	0.044
119	08/23/2017	08:54:00	0.044
120	08/23/2017	08:54:30	0.036
121	08/23/2017	08:55:00	0.044
122	08/23/2017	08:55:30	0.048
123	08/23/2017	08:56:00	0.034
124	08/23/2017	08:56:30	0.039
125	08/23/2017	08:57:00	0.037
126	08/23/2017	08:57:30	0.036
127	08/23/2017	08:58:00	0.039
128	08/23/2017	08:58:30	0.038
129	08/23/2017	08:59:00	0.033
130	08/23/2017	08:59:30	0.040
131	08/23/2017	09:00:00	0.034
132	08/23/2017	09:00:30	0.036
133	08/23/2017	09:01:00	0.070
134	08/23/2017	09:01:30	0.064
135	08/23/2017	09:02:00	0.103
136	08/23/2017	09:02:30	0.039
137	08/23/2017	09:03:00	0.058
138	08/23/2017	09:03:30	0.142
139	08/23/2017	09:04:00	0.033
140	08/23/2017	09:04:30	0.042
141	08/23/2017	09:05:00	0.085
142	08/23/2017	09:05:30	0.040
143	08/23/2017	09:06:00	0.033
144	08/23/2017	09:06:30	0.041
145	08/23/2017	09:07:00	0.036
146	08/23/2017	09:07:30	0.037
147	08/23/2017	09:08:00	0.036
148	08/23/2017	09:08:30	0.035
149	08/23/2017	09:09:00	0.036
150	08/23/2017	09:09:30	0.039
151	08/23/2017	09:10:00	0.037
152	08/23/2017	09:10:30	0.056
153	08/23/2017	09:11:00	0.039
154	08/23/2017	09:11:30	0.035
155	08/23/2017	09:12:00	0.039
156	08/23/2017	09:12:30	0.047
157	08/23/2017	09:13:00	0.041
158	08/23/2017	09:13:30	0.039
159	08/23/2017	09:14:00	0.034

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/23/2017	09:14:30	0.036
161	08/23/2017	09:15:00	0.036
162	08/23/2017	09:15:30	0.038

BMC foot/bike 082317

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11306011	Start Time	09:40:31
		Stop Date	08/23/2017
		Stop Time	10:28:31
		Total Time	0:00:48:00
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.041 mg/m^3
Max	0.111 mg/m^3
Max Date	08/23/2017
Max Time	10:09:01
Min	0.028 mg/m^3
Min Date	08/23/2017
Min Time	09:45:01
TWA (8 hr)	0.004
TWA Start Date	08/23/2017
TWA Start Time	09:40:31
TWA End Time	10:28:31

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	09:41:01	0.034
2	08/23/2017	09:41:31	0.031
3	08/23/2017	09:42:01	0.035
4	08/23/2017	09:42:31	0.035
5	08/23/2017	09:43:01	0.038
6	08/23/2017	09:43:31	0.030
7	08/23/2017	09:44:01	0.034
8	08/23/2017	09:44:31	0.029
9	08/23/2017	09:45:01	0.028
10	08/23/2017	09:45:31	0.031
11	08/23/2017	09:46:01	0.080
12	08/23/2017	09:46:31	0.047
13	08/23/2017	09:47:01	0.054
14	08/23/2017	09:47:31	0.042
15	08/23/2017	09:48:01	0.040
16	08/23/2017	09:48:31	0.041
17	08/23/2017	09:49:01	0.042
18	08/23/2017	09:49:31	0.038
19	08/23/2017	09:50:01	0.054
20	08/23/2017	09:50:31	0.043
21	08/23/2017	09:51:01	0.038

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	09:51:31	0.037
23	08/23/2017	09:52:01	0.040
24	08/23/2017	09:52:31	0.042
25	08/23/2017	09:53:01	0.040
26	08/23/2017	09:53:31	0.037
27	08/23/2017	09:54:01	0.039
28	08/23/2017	09:54:31	0.050
29	08/23/2017	09:55:01	0.040
30	08/23/2017	09:55:31	0.044
31	08/23/2017	09:56:01	0.040
32	08/23/2017	09:56:31	0.042
33	08/23/2017	09:57:01	0.042
34	08/23/2017	09:57:31	0.031
35	08/23/2017	09:58:01	0.036
36	08/23/2017	09:58:31	0.040
37	08/23/2017	09:59:01	0.034
38	08/23/2017	09:59:31	0.032
39	08/23/2017	10:00:01	0.042
40	08/23/2017	10:00:31	0.039
41	08/23/2017	10:01:01	0.047
42	08/23/2017	10:01:31	0.043
43	08/23/2017	10:02:01	0.036
44	08/23/2017	10:02:31	0.039
45	08/23/2017	10:03:01	0.035
46	08/23/2017	10:03:31	0.039
47	08/23/2017	10:04:01	0.038
48	08/23/2017	10:04:31	0.044
49	08/23/2017	10:05:01	0.041
50	08/23/2017	10:05:31	0.038
51	08/23/2017	10:06:01	0.037
52	08/23/2017	10:06:31	0.037
53	08/23/2017	10:07:01	0.040
54	08/23/2017	10:07:31	0.043
55	08/23/2017	10:08:01	0.043
56	08/23/2017	10:08:31	0.038
57	08/23/2017	10:09:01	0.111
58	08/23/2017	10:09:31	0.048
59	08/23/2017	10:10:01	0.040
60	08/23/2017	10:10:31	0.038
61	08/23/2017	10:11:01	0.065
62	08/23/2017	10:11:31	0.087
63	08/23/2017	10:12:01	0.038
64	08/23/2017	10:12:31	0.046
65	08/23/2017	10:13:01	0.042
66	08/23/2017	10:13:31	0.075
67	08/23/2017	10:14:01	0.040

Test Data

Data Point	Date	Time	Aerosol mg/m^3
68	08/23/2017	10:14:31	0.041
69	08/23/2017	10:15:01	0.036
70	08/23/2017	10:15:31	0.034
71	08/23/2017	10:16:01	0.034
72	08/23/2017	10:16:31	0.038
73	08/23/2017	10:17:01	0.037
74	08/23/2017	10:17:31	0.039
75	08/23/2017	10:18:01	0.049
76	08/23/2017	10:18:31	0.033
77	08/23/2017	10:19:01	0.035
78	08/23/2017	10:19:31	0.040
79	08/23/2017	10:20:01	0.040
80	08/23/2017	10:20:31	0.038
81	08/23/2017	10:21:01	0.046
82	08/23/2017	10:21:31	0.037
83	08/23/2017	10:22:01	0.047
84	08/23/2017	10:22:31	0.056
85	08/23/2017	10:23:01	0.041
86	08/23/2017	10:23:31	0.031
87	08/23/2017	10:24:01	0.032
88	08/23/2017	10:24:31	0.030
89	08/23/2017	10:25:01	0.033
90	08/23/2017	10:25:31	0.039
91	08/23/2017	10:26:01	0.034
92	08/23/2017	10:26:31	0.034
93	08/23/2017	10:27:01	0.041
94	08/23/2017	10:27:31	0.037
95	08/23/2017	10:28:01	0.046
96	08/23/2017	10:28:31	0.039

BAB foot 082917

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/29/2017
Meter S/N	11403008	Start Time	08:05:18
		Stop Date	08/29/2017
		Stop Time	10:15:48
		Total Time	0:02:10:30
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.046 mg/m^3
Max	1.895 mg/m^3
Max Date	08/29/2017
Max Time	08:06:18
Min	0.012 mg/m^3
Min Date	08/29/2017
Min Time	09:11:48
TWA (8 hr)	0.012
TWA Start Date	08/29/2017
TWA Start Time	08:05:18
TWA End Time	10:15:48

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/29/2017	08:05:48	0.058
2	08/29/2017	08:06:18	1.895
3	08/29/2017	08:06:48	0.209
4	08/29/2017	08:07:18	0.045
5	08/29/2017	08:07:48	0.045
6	08/29/2017	08:08:18	0.046
7	08/29/2017	08:08:48	0.043
8	08/29/2017	08:09:18	0.050
9	08/29/2017	08:09:48	0.042
10	08/29/2017	08:10:18	0.040
11	08/29/2017	08:10:48	0.045
12	08/29/2017	08:11:18	0.048
13	08/29/2017	08:11:48	0.048
14	08/29/2017	08:12:18	0.044
15	08/29/2017	08:12:48	0.042
16	08/29/2017	08:13:18	0.039
17	08/29/2017	08:13:48	0.058
18	08/29/2017	08:14:18	0.057
19	08/29/2017	08:14:48	0.053
20	08/29/2017	08:15:18	0.046
21	08/29/2017	08:15:48	0.047

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/29/2017	08:16:18	0.044
23	08/29/2017	08:16:48	0.043
24	08/29/2017	08:17:18	0.042
25	08/29/2017	08:17:48	0.055
26	08/29/2017	08:18:18	0.056
27	08/29/2017	08:18:48	0.040
28	08/29/2017	08:19:18	0.056
29	08/29/2017	08:19:48	0.045
30	08/29/2017	08:20:18	0.042
31	08/29/2017	08:20:48	0.050
32	08/29/2017	08:21:18	0.045
33	08/29/2017	08:21:48	0.054
34	08/29/2017	08:22:18	0.044
35	08/29/2017	08:22:48	0.043
36	08/29/2017	08:23:18	0.042
37	08/29/2017	08:23:48	0.048
38	08/29/2017	08:24:18	0.045
39	08/29/2017	08:24:48	0.046
40	08/29/2017	08:25:18	0.042
41	08/29/2017	08:25:48	0.041
42	08/29/2017	08:26:18	0.038
43	08/29/2017	08:26:48	0.039
44	08/29/2017	08:27:18	0.038
45	08/29/2017	08:27:48	0.052
46	08/29/2017	08:28:18	0.044
47	08/29/2017	08:28:48	0.041
48	08/29/2017	08:29:18	0.048
49	08/29/2017	08:29:48	0.039
50	08/29/2017	08:30:18	0.044
51	08/29/2017	08:30:48	0.040
52	08/29/2017	08:31:18	0.038
53	08/29/2017	08:31:48	0.044
54	08/29/2017	08:32:18	0.039
55	08/29/2017	08:32:48	0.036
56	08/29/2017	08:33:18	0.038
57	08/29/2017	08:33:48	0.044
58	08/29/2017	08:34:18	0.038
59	08/29/2017	08:34:48	0.042
60	08/29/2017	08:35:18	0.033
61	08/29/2017	08:35:48	0.036
62	08/29/2017	08:36:18	0.037
63	08/29/2017	08:36:48	0.059
64	08/29/2017	08:37:18	0.037
65	08/29/2017	08:37:48	0.041
66	08/29/2017	08:38:18	0.060
67	08/29/2017	08:38:48	0.034

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/29/2017	08:39:18	0.042
69	08/29/2017	08:39:48	0.030
70	08/29/2017	08:40:18	0.037
71	08/29/2017	08:40:48	0.123
72	08/29/2017	08:41:18	0.083
73	08/29/2017	08:41:48	0.032
74	08/29/2017	08:42:18	0.031
75	08/29/2017	08:42:48	0.026
76	08/29/2017	08:43:18	0.026
77	08/29/2017	08:43:48	0.028
78	08/29/2017	08:44:18	0.027
79	08/29/2017	08:44:48	0.033
80	08/29/2017	08:45:18	0.030
81	08/29/2017	08:45:48	0.030
82	08/29/2017	08:46:18	0.029
83	08/29/2017	08:46:48	0.033
84	08/29/2017	08:47:18	0.034
85	08/29/2017	08:47:48	0.030
86	08/29/2017	08:48:18	0.032
87	08/29/2017	08:48:48	0.065
88	08/29/2017	08:49:18	0.026
89	08/29/2017	08:49:48	0.025
90	08/29/2017	08:50:18	0.027
91	08/29/2017	08:50:48	0.023
92	08/29/2017	08:51:18	0.022
93	08/29/2017	08:51:48	0.021
94	08/29/2017	08:52:18	0.021
95	08/29/2017	08:52:48	0.019
96	08/29/2017	08:53:18	0.019
97	08/29/2017	08:53:48	0.019
98	08/29/2017	08:54:18	0.021
99	08/29/2017	08:54:48	0.021
100	08/29/2017	08:55:18	0.017
101	08/29/2017	08:55:48	0.021
102	08/29/2017	08:56:18	0.021
103	08/29/2017	08:56:48	0.023
104	08/29/2017	08:57:18	0.019
105	08/29/2017	08:57:48	0.019
106	08/29/2017	08:58:18	0.061
107	08/29/2017	08:58:48	0.041
108	08/29/2017	08:59:18	0.040
109	08/29/2017	08:59:48	0.022
110	08/29/2017	09:00:18	0.023
111	08/29/2017	09:00:48	0.017
112	08/29/2017	09:01:18	0.025
113	08/29/2017	09:01:48	0.016

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/29/2017	09:02:18	0.017
115	08/29/2017	09:02:48	0.016
116	08/29/2017	09:03:18	0.017
117	08/29/2017	09:03:48	0.017
118	08/29/2017	09:04:18	0.018
119	08/29/2017	09:04:48	0.017
120	08/29/2017	09:05:18	0.017
121	08/29/2017	09:05:48	0.018
122	08/29/2017	09:06:18	0.018
123	08/29/2017	09:06:48	0.017
124	08/29/2017	09:07:18	0.021
125	08/29/2017	09:07:48	0.018
126	08/29/2017	09:08:18	0.018
127	08/29/2017	09:08:48	0.016
128	08/29/2017	09:09:18	0.018
129	08/29/2017	09:09:48	0.018
130	08/29/2017	09:10:18	0.014
131	08/29/2017	09:10:48	0.052
132	08/29/2017	09:11:18	0.015
133	08/29/2017	09:11:48	0.012
134	08/29/2017	09:12:18	0.023
135	08/29/2017	09:12:48	0.086
136	08/29/2017	09:13:18	0.026
137	08/29/2017	09:13:48	0.018
138	08/29/2017	09:14:18	0.016
139	08/29/2017	09:14:48	0.020
140	08/29/2017	09:15:18	0.019
141	08/29/2017	09:15:48	0.015
142	08/29/2017	09:16:18	0.015
143	08/29/2017	09:16:48	0.016
144	08/29/2017	09:17:18	0.014
145	08/29/2017	09:17:48	0.063
146	08/29/2017	09:18:18	0.037
147	08/29/2017	09:18:48	0.022
148	08/29/2017	09:19:18	0.019
149	08/29/2017	09:19:48	0.016
150	08/29/2017	09:20:18	0.018
151	08/29/2017	09:20:48	0.020
152	08/29/2017	09:21:18	0.018
153	08/29/2017	09:21:48	0.018
154	08/29/2017	09:22:18	0.020
155	08/29/2017	09:22:48	0.018
156	08/29/2017	09:23:18	0.027
157	08/29/2017	09:23:48	0.029
158	08/29/2017	09:24:18	0.030
159	08/29/2017	09:24:48	0.022

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/29/2017	09:25:18	0.020
161	08/29/2017	09:25:48	0.020
162	08/29/2017	09:26:18	0.022
163	08/29/2017	09:26:48	0.019
164	08/29/2017	09:27:18	0.017
165	08/29/2017	09:27:48	0.022
166	08/29/2017	09:28:18	0.022
167	08/29/2017	09:28:48	0.019
168	08/29/2017	09:29:18	0.022
169	08/29/2017	09:29:48	0.034
170	08/29/2017	09:30:18	0.028
171	08/29/2017	09:30:48	0.026
172	08/29/2017	09:31:18	0.031
173	08/29/2017	09:31:48	0.028
174	08/29/2017	09:32:18	0.034
175	08/29/2017	09:32:48	0.037
176	08/29/2017	09:33:18	0.030
177	08/29/2017	09:33:48	0.027
178	08/29/2017	09:34:18	0.029
179	08/29/2017	09:34:48	0.033
180	08/29/2017	09:35:18	0.032
181	08/29/2017	09:35:48	0.059
182	08/29/2017	09:36:18	0.033
183	08/29/2017	09:36:48	0.039
184	08/29/2017	09:37:18	0.036
185	08/29/2017	09:37:48	0.040
186	08/29/2017	09:38:18	0.035
187	08/29/2017	09:38:48	0.031
188	08/29/2017	09:39:18	0.033
189	08/29/2017	09:39:48	0.036
190	08/29/2017	09:40:18	0.038
191	08/29/2017	09:40:48	0.039
192	08/29/2017	09:41:18	0.037
193	08/29/2017	09:41:48	0.036
194	08/29/2017	09:42:18	0.038
195	08/29/2017	09:42:48	0.045
196	08/29/2017	09:43:18	0.043
197	08/29/2017	09:43:48	0.045
198	08/29/2017	09:44:18	0.045
199	08/29/2017	09:44:48	0.045
200	08/29/2017	09:45:18	0.040
201	08/29/2017	09:45:48	0.040
202	08/29/2017	09:46:18	0.041
203	08/29/2017	09:46:48	0.295
204	08/29/2017	09:47:18	0.057
205	08/29/2017	09:47:48	0.044

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
206	08/29/2017	09:48:18	0.063
207	08/29/2017	09:48:48	0.038
208	08/29/2017	09:49:18	0.038
209	08/29/2017	09:49:48	0.055
210	08/29/2017	09:50:18	0.045
211	08/29/2017	09:50:48	0.042
212	08/29/2017	09:51:18	0.035
213	08/29/2017	09:51:48	0.042
214	08/29/2017	09:52:18	0.035
215	08/29/2017	09:52:48	0.046
216	08/29/2017	09:53:18	0.035
217	08/29/2017	09:53:48	0.040
218	08/29/2017	09:54:18	0.036
219	08/29/2017	09:54:48	0.036
220	08/29/2017	09:55:18	0.036
221	08/29/2017	09:55:48	0.040
222	08/29/2017	09:56:18	0.038
223	08/29/2017	09:56:48	0.044
224	08/29/2017	09:57:18	0.037
225	08/29/2017	09:57:48	0.333
226	08/29/2017	09:58:18	0.043
227	08/29/2017	09:58:48	0.041
228	08/29/2017	09:59:18	0.044
229	08/29/2017	09:59:48	0.042
230	08/29/2017	10:00:18	0.041
231	08/29/2017	10:00:48	0.041
232	08/29/2017	10:01:18	0.051
233	08/29/2017	10:01:48	0.041
234	08/29/2017	10:02:18	0.040
235	08/29/2017	10:02:48	0.039
236	08/29/2017	10:03:18	0.050
237	08/29/2017	10:03:48	0.040
238	08/29/2017	10:04:18	0.037
239	08/29/2017	10:04:48	0.044
240	08/29/2017	10:05:18	0.044
241	08/29/2017	10:05:48	0.038
242	08/29/2017	10:06:18	0.037
243	08/29/2017	10:06:48	0.042
244	08/29/2017	10:07:18	0.044
245	08/29/2017	10:07:48	0.039
246	08/29/2017	10:08:18	0.042
247	08/29/2017	10:08:48	0.042
248	08/29/2017	10:09:18	0.039
249	08/29/2017	10:09:48	0.046
250	08/29/2017	10:10:18	0.039
251	08/29/2017	10:10:48	0.040

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
252	08/29/2017	10:11:18	0.052
253	08/29/2017	10:11:48	0.037
254	08/29/2017	10:12:18	0.050
255	08/29/2017	10:12:48	0.044
256	08/29/2017	10:13:18	0.041
257	08/29/2017	10:13:48	0.039
258	08/29/2017	10:14:18	0.041
259	08/29/2017	10:14:48	0.037
260	08/29/2017	10:15:18	0.039
261	08/29/2017	10:15:48	0.039

BMC foot 082917

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/29/2017
Meter S/N	11306011	Start Time	08:05:18
		Stop Date	08/29/2017
		Stop Time	10:17:18
		Total Time	0:02:12:00
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.307 mg/m^3
Max	6.295 mg/m^3
Max Date	08/29/2017
Max Time	09:41:18
Min	0.024 mg/m^3
Min Date	08/29/2017
Min Time	08:09:48
TWA (8 hr)	0.085
TWA Start Date	08/29/2017
TWA Start Time	08:05:18
TWA End Time	10:17:18

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/29/2017	08:05:48	0.051
2	08/29/2017	08:06:18	0.050
3	08/29/2017	08:06:48	0.051
4	08/29/2017	08:07:18	0.048
5	08/29/2017	08:07:48	0.050
6	08/29/2017	08:08:18	0.048
7	08/29/2017	08:08:48	0.050
8	08/29/2017	08:09:18	0.048
9	08/29/2017	08:09:48	0.024
10	08/29/2017	08:10:18	0.049
11	08/29/2017	08:10:48	0.062
12	08/29/2017	08:11:18	0.050
13	08/29/2017	08:11:48	0.049
14	08/29/2017	08:12:18	0.049
15	08/29/2017	08:12:48	0.048
16	08/29/2017	08:13:18	0.055
17	08/29/2017	08:13:48	0.053
18	08/29/2017	08:14:18	0.049
19	08/29/2017	08:14:48	0.052
20	08/29/2017	08:15:18	0.050
21	08/29/2017	08:15:48	0.050

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/29/2017	08:16:18	0.055
23	08/29/2017	08:16:48	0.058
24	08/29/2017	08:17:18	0.134
25	08/29/2017	08:17:48	0.057
26	08/29/2017	08:18:18	0.056
27	08/29/2017	08:18:48	0.072
28	08/29/2017	08:19:18	0.072
29	08/29/2017	08:19:48	0.050
30	08/29/2017	08:20:18	0.049
31	08/29/2017	08:20:48	0.050
32	08/29/2017	08:21:18	0.050
33	08/29/2017	08:21:48	0.056
34	08/29/2017	08:22:18	0.050
35	08/29/2017	08:22:48	0.052
36	08/29/2017	08:23:18	0.057
37	08/29/2017	08:23:48	0.048
38	08/29/2017	08:24:18	0.058
39	08/29/2017	08:24:48	0.057
40	08/29/2017	08:25:18	0.053
41	08/29/2017	08:25:48	0.051
42	08/29/2017	08:26:18	0.044
43	08/29/2017	08:26:48	0.067
44	08/29/2017	08:27:18	0.047
45	08/29/2017	08:27:48	0.063
46	08/29/2017	08:28:18	0.058
47	08/29/2017	08:28:48	0.050
48	08/29/2017	08:29:18	0.059
49	08/29/2017	08:29:48	0.050
50	08/29/2017	08:30:18	0.055
51	08/29/2017	08:30:48	0.048
52	08/29/2017	08:31:18	0.047
53	08/29/2017	08:31:48	0.046
54	08/29/2017	08:32:18	0.047
55	08/29/2017	08:32:48	0.048
56	08/29/2017	08:33:18	0.049
57	08/29/2017	08:33:48	0.063
58	08/29/2017	08:34:18	0.044
59	08/29/2017	08:34:48	0.050
60	08/29/2017	08:35:18	0.046
61	08/29/2017	08:35:48	0.043
62	08/29/2017	08:36:18	0.052
63	08/29/2017	08:36:48	0.046
64	08/29/2017	08:37:18	0.046
65	08/29/2017	08:37:48	0.052
66	08/29/2017	08:38:18	0.058
67	08/29/2017	08:38:48	0.051

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/29/2017	08:39:18	0.045
69	08/29/2017	08:39:48	0.046
70	08/29/2017	08:40:18	0.052
71	08/29/2017	08:40:48	0.047
72	08/29/2017	08:41:18	0.053
73	08/29/2017	08:41:48	0.058
74	08/29/2017	08:42:18	0.052
75	08/29/2017	08:42:48	0.046
76	08/29/2017	08:43:18	0.151
77	08/29/2017	08:43:48	0.065
78	08/29/2017	08:44:18	0.045
79	08/29/2017	08:44:48	0.043
80	08/29/2017	08:45:18	0.049
81	08/29/2017	08:45:48	0.047
82	08/29/2017	08:46:18	0.040
83	08/29/2017	08:46:48	0.046
84	08/29/2017	08:47:18	0.053
85	08/29/2017	08:47:48	0.044
86	08/29/2017	08:48:18	0.053
87	08/29/2017	08:48:48	0.053
88	08/29/2017	08:49:18	0.043
89	08/29/2017	08:49:48	0.048
90	08/29/2017	08:50:18	0.118
91	08/29/2017	08:50:48	0.075
92	08/29/2017	08:51:18	0.056
93	08/29/2017	08:51:48	0.094
94	08/29/2017	08:52:18	0.050
95	08/29/2017	08:52:48	0.052
96	08/29/2017	08:53:18	0.046
97	08/29/2017	08:53:48	0.053
98	08/29/2017	08:54:18	0.047
99	08/29/2017	08:54:48	0.229
100	08/29/2017	08:55:18	0.051
101	08/29/2017	08:55:48	0.053
102	08/29/2017	08:56:18	0.094
103	08/29/2017	08:56:48	0.063
104	08/29/2017	08:57:18	0.062
105	08/29/2017	08:57:48	0.051
106	08/29/2017	08:58:18	0.048
107	08/29/2017	08:58:48	0.065
108	08/29/2017	08:59:18	0.129
109	08/29/2017	08:59:48	0.052
110	08/29/2017	09:00:18	0.069
111	08/29/2017	09:00:48	0.047
112	08/29/2017	09:01:18	0.053
113	08/29/2017	09:01:48	0.067

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/29/2017	09:02:18	0.048
115	08/29/2017	09:02:48	0.095
116	08/29/2017	09:03:18	0.346
117	08/29/2017	09:03:48	0.049
118	08/29/2017	09:04:18	0.042
119	08/29/2017	09:04:48	0.045
120	08/29/2017	09:05:18	0.042
121	08/29/2017	09:05:48	0.041
122	08/29/2017	09:06:18	0.040
123	08/29/2017	09:06:48	0.033
124	08/29/2017	09:07:18	0.030
125	08/29/2017	09:07:48	0.034
126	08/29/2017	09:08:18	0.037
127	08/29/2017	09:08:48	0.050
128	08/29/2017	09:09:18	0.048
129	08/29/2017	09:09:48	0.047
130	08/29/2017	09:10:18	0.044
131	08/29/2017	09:10:48	0.044
132	08/29/2017	09:11:18	0.049
133	08/29/2017	09:11:48	0.043
134	08/29/2017	09:12:18	0.047
135	08/29/2017	09:12:48	0.043
136	08/29/2017	09:13:18	0.045
137	08/29/2017	09:13:48	0.061
138	08/29/2017	09:14:18	0.101
139	08/29/2017	09:14:48	0.049
140	08/29/2017	09:15:18	0.044
141	08/29/2017	09:15:48	0.053
142	08/29/2017	09:16:18	0.049
143	08/29/2017	09:16:48	0.053
144	08/29/2017	09:17:18	0.046
145	08/29/2017	09:17:48	0.044
146	08/29/2017	09:18:18	0.049
147	08/29/2017	09:18:48	0.051
148	08/29/2017	09:19:18	0.047
149	08/29/2017	09:19:48	0.132
150	08/29/2017	09:20:18	0.056
151	08/29/2017	09:20:48	0.045
152	08/29/2017	09:21:18	0.235
153	08/29/2017	09:21:48	0.239
154	08/29/2017	09:22:18	0.041
155	08/29/2017	09:22:48	0.049
156	08/29/2017	09:23:18	0.055
157	08/29/2017	09:23:48	0.046
158	08/29/2017	09:24:18	0.057
159	08/29/2017	09:24:48	0.051

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/29/2017	09:25:18	0.049
161	08/29/2017	09:25:48	0.042
162	08/29/2017	09:26:18	0.045
163	08/29/2017	09:26:48	0.047
164	08/29/2017	09:27:18	0.053
165	08/29/2017	09:27:48	0.058
166	08/29/2017	09:28:18	0.050
167	08/29/2017	09:28:48	0.047
168	08/29/2017	09:29:18	0.047
169	08/29/2017	09:29:48	0.047
170	08/29/2017	09:30:18	0.053
171	08/29/2017	09:30:48	0.068
172	08/29/2017	09:31:18	0.054
173	08/29/2017	09:31:48	0.055
174	08/29/2017	09:32:18	0.060
175	08/29/2017	09:32:48	0.062
176	08/29/2017	09:33:18	0.052
177	08/29/2017	09:33:48	0.054
178	08/29/2017	09:34:18	0.054
179	08/29/2017	09:34:48	0.052
180	08/29/2017	09:35:18	0.050
181	08/29/2017	09:35:48	0.052
182	08/29/2017	09:36:18	0.051
183	08/29/2017	09:36:48	0.046
184	08/29/2017	09:37:18	0.045
185	08/29/2017	09:37:48	0.053
186	08/29/2017	09:38:18	0.053
187	08/29/2017	09:38:48	0.054
188	08/29/2017	09:39:18	0.053
189	08/29/2017	09:39:48	0.051
190	08/29/2017	09:40:18	0.145
191	08/29/2017	09:40:48	0.580
192	08/29/2017	09:41:18	6.295
193	08/29/2017	09:41:48	1.705
194	08/29/2017	09:42:18	1.090
195	08/29/2017	09:42:48	4.705
196	08/29/2017	09:43:18	1.186
197	08/29/2017	09:43:48	0.984
198	08/29/2017	09:44:18	0.696
199	08/29/2017	09:44:48	0.544
200	08/29/2017	09:45:18	1.156
201	08/29/2017	09:45:48	1.850
202	08/29/2017	09:46:18	1.544
203	08/29/2017	09:46:48	1.276
204	08/29/2017	09:47:18	1.469
205	08/29/2017	09:47:48	2.350

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
206	08/29/2017	09:48:18	2.674
207	08/29/2017	09:48:48	0.864
208	08/29/2017	09:49:18	0.541
209	08/29/2017	09:49:48	0.454
210	08/29/2017	09:50:18	0.633
211	08/29/2017	09:50:48	0.420
212	08/29/2017	09:51:18	0.331
213	08/29/2017	09:51:48	0.269
214	08/29/2017	09:52:18	0.314
215	08/29/2017	09:52:48	1.524
216	08/29/2017	09:53:18	2.722
217	08/29/2017	09:53:48	0.634
218	08/29/2017	09:54:18	0.347
219	08/29/2017	09:54:48	0.236
220	08/29/2017	09:55:18	0.239
221	08/29/2017	09:55:48	1.993
222	08/29/2017	09:56:18	1.468
223	08/29/2017	09:56:48	2.818
224	08/29/2017	09:57:18	1.135
225	08/29/2017	09:57:48	1.121
226	08/29/2017	09:58:18	0.542
227	08/29/2017	09:58:48	1.074
228	08/29/2017	09:59:18	0.296
229	08/29/2017	09:59:48	0.522
230	08/29/2017	10:00:18	0.574
231	08/29/2017	10:00:48	0.855
232	08/29/2017	10:01:18	0.736
233	08/29/2017	10:01:48	0.398
234	08/29/2017	10:02:18	0.254
235	08/29/2017	10:02:48	0.317
236	08/29/2017	10:03:18	0.218
237	08/29/2017	10:03:48	2.610
238	08/29/2017	10:04:18	0.656
239	08/29/2017	10:04:48	0.356
240	08/29/2017	10:05:18	0.236
241	08/29/2017	10:05:48	1.387
242	08/29/2017	10:06:18	0.647
243	08/29/2017	10:06:48	0.347
244	08/29/2017	10:07:18	0.480
245	08/29/2017	10:07:48	0.400
246	08/29/2017	10:08:18	0.784
247	08/29/2017	10:08:48	0.717
248	08/29/2017	10:09:18	0.423
249	08/29/2017	10:09:48	0.518
250	08/29/2017	10:10:18	0.643
251	08/29/2017	10:10:48	0.686

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
252	08/29/2017	10:11:18	0.248
253	08/29/2017	10:11:48	0.290
254	08/29/2017	10:12:18	0.199
255	08/29/2017	10:12:48	1.118
256	08/29/2017	10:13:18	0.371
257	08/29/2017	10:13:48	0.287
258	08/29/2017	10:14:18	0.270
259	08/29/2017	10:14:48	0.254
260	08/29/2017	10:15:18	0.265
261	08/29/2017	10:15:48	0.343
262	08/29/2017	10:16:18	0.333
263	08/29/2017	10:16:48	0.209
264	08/29/2017	10:17:18	0.964

GSW bike 082917

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/29/2017
Meter S/N	11009042	Start Time	08:03:32
		Stop Date	08/29/2017
		Stop Time	10:07:02
		Total Time	0:02:03:30
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.041 mg/m^3
Max	0.248 mg/m^3
Max Date	08/29/2017
Max Time	09:25:32
Min	0.020 mg/m^3
Min Date	08/29/2017
Min Time	09:40:02
TWA (8 hr)	0.010
TWA Start Date	08/29/2017
TWA Start Time	08:03:32
TWA End Time	10:07:02

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/29/2017	08:04:02	0.059
2	08/29/2017	08:04:32	0.051
3	08/29/2017	08:05:02	0.059
4	08/29/2017	08:05:32	0.056
5	08/29/2017	08:06:02	0.047
6	08/29/2017	08:06:32	0.050
7	08/29/2017	08:07:02	0.044
8	08/29/2017	08:07:32	0.051
9	08/29/2017	08:08:02	0.049
10	08/29/2017	08:08:32	0.045
11	08/29/2017	08:09:02	0.043
12	08/29/2017	08:09:32	0.041
13	08/29/2017	08:10:02	0.062
14	08/29/2017	08:10:32	0.047
15	08/29/2017	08:11:02	0.050
16	08/29/2017	08:11:32	0.040
17	08/29/2017	08:12:02	0.043
18	08/29/2017	08:12:32	0.060
19	08/29/2017	08:13:02	0.066
20	08/29/2017	08:13:32	0.063
21	08/29/2017	08:14:02	0.044

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/29/2017	08:14:32	0.055
23	08/29/2017	08:15:02	0.043
24	08/29/2017	08:15:32	0.055
25	08/29/2017	08:16:02	0.071
26	08/29/2017	08:16:32	0.043
27	08/29/2017	08:17:02	0.060
28	08/29/2017	08:17:32	0.060
29	08/29/2017	08:18:02	0.042
30	08/29/2017	08:18:32	0.044
31	08/29/2017	08:19:02	0.049
32	08/29/2017	08:19:32	0.041
33	08/29/2017	08:20:02	0.041
34	08/29/2017	08:20:32	0.056
35	08/29/2017	08:21:02	0.042
36	08/29/2017	08:21:32	0.049
37	08/29/2017	08:22:02	0.047
38	08/29/2017	08:22:32	0.041
39	08/29/2017	08:23:02	0.044
40	08/29/2017	08:23:32	0.060
41	08/29/2017	08:24:02	0.045
42	08/29/2017	08:24:32	0.039
43	08/29/2017	08:25:02	0.041
44	08/29/2017	08:25:32	0.038
45	08/29/2017	08:26:02	0.062
46	08/29/2017	08:26:32	0.072
47	08/29/2017	08:27:02	0.046
48	08/29/2017	08:27:32	0.044
49	08/29/2017	08:28:02	0.062
50	08/29/2017	08:28:32	0.037
51	08/29/2017	08:29:02	0.042
52	08/29/2017	08:29:32	0.035
53	08/29/2017	08:30:02	0.054
54	08/29/2017	08:30:32	0.035
55	08/29/2017	08:31:02	0.044
56	08/29/2017	08:31:32	0.043
57	08/29/2017	08:32:02	0.042
58	08/29/2017	08:32:32	0.039
59	08/29/2017	08:33:02	0.033
60	08/29/2017	08:33:32	0.037
61	08/29/2017	08:34:02	0.032
62	08/29/2017	08:34:32	0.033
63	08/29/2017	08:35:02	0.035
64	08/29/2017	08:35:32	0.034
65	08/29/2017	08:36:02	0.032
66	08/29/2017	08:36:32	0.036
67	08/29/2017	08:37:02	0.030

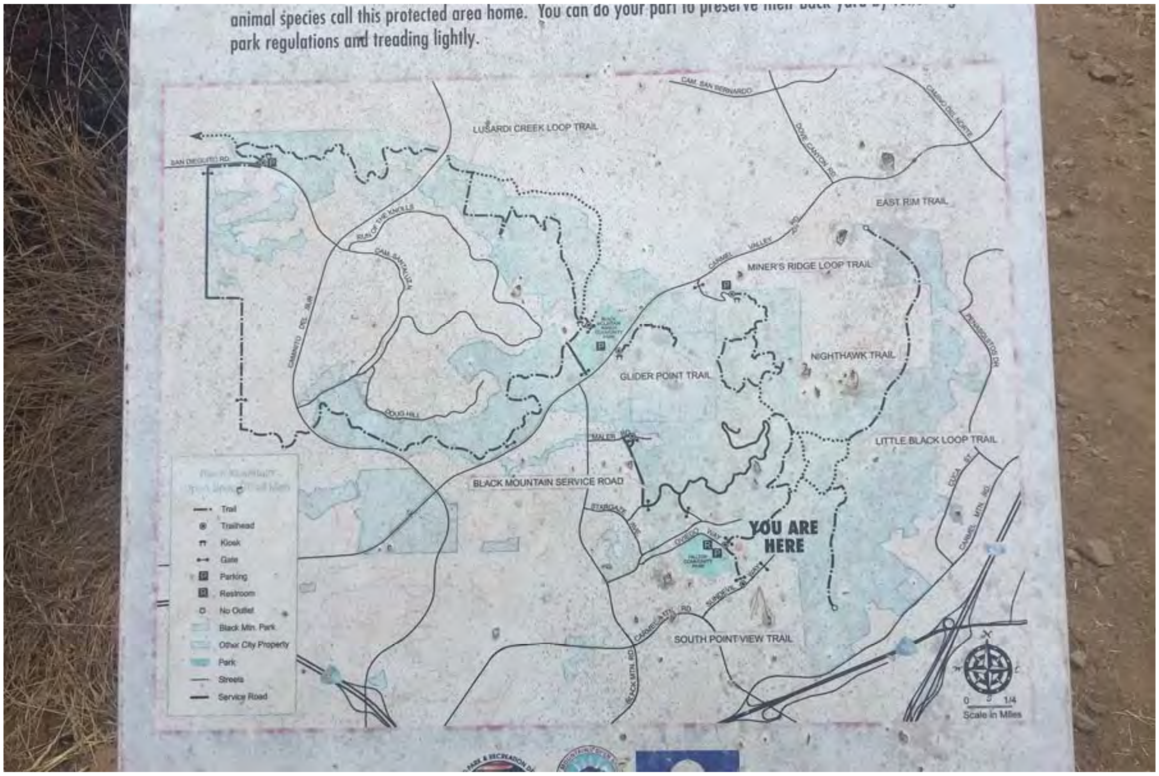
Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/29/2017	08:37:32	0.037
69	08/29/2017	08:38:02	0.033
70	08/29/2017	08:38:32	0.035
71	08/29/2017	08:39:02	0.033
72	08/29/2017	08:39:32	0.039
73	08/29/2017	08:40:02	0.036
74	08/29/2017	08:40:32	0.042
75	08/29/2017	08:41:02	0.039
76	08/29/2017	08:41:32	0.035
77	08/29/2017	08:42:02	0.046
78	08/29/2017	08:42:32	0.037
79	08/29/2017	08:43:02	0.031
80	08/29/2017	08:43:32	0.046
81	08/29/2017	08:44:02	0.036
82	08/29/2017	08:44:32	0.041
83	08/29/2017	08:45:02	0.041
84	08/29/2017	08:45:32	0.034
85	08/29/2017	08:46:02	0.035
86	08/29/2017	08:46:32	0.036
87	08/29/2017	08:47:02	0.043
88	08/29/2017	08:47:32	0.040
89	08/29/2017	08:48:02	0.035
90	08/29/2017	08:48:32	0.044
91	08/29/2017	08:49:02	0.042
92	08/29/2017	08:49:32	0.031
93	08/29/2017	08:50:02	0.038
94	08/29/2017	08:50:32	0.038
95	08/29/2017	08:51:02	0.041
96	08/29/2017	08:51:32	0.042
97	08/29/2017	08:52:02	0.032
98	08/29/2017	08:52:32	0.036
99	08/29/2017	08:53:02	0.033
100	08/29/2017	08:53:32	0.037
101	08/29/2017	08:54:02	0.062
102	08/29/2017	08:54:32	0.034
103	08/29/2017	08:55:02	0.041
104	08/29/2017	08:55:32	0.042
105	08/29/2017	08:56:02	0.043
106	08/29/2017	08:56:32	0.032
107	08/29/2017	08:57:02	0.040
108	08/29/2017	08:57:32	0.039
109	08/29/2017	08:58:02	0.034
110	08/29/2017	08:58:32	0.042
111	08/29/2017	08:59:02	0.029
112	08/29/2017	08:59:32	0.034
113	08/29/2017	09:00:02	0.036

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/29/2017	09:00:32	0.041
115	08/29/2017	09:01:02	0.039
116	08/29/2017	09:01:32	0.035
117	08/29/2017	09:02:02	0.031
118	08/29/2017	09:02:32	0.032
119	08/29/2017	09:03:02	0.041
120	08/29/2017	09:03:32	0.034
121	08/29/2017	09:04:02	0.048
122	08/29/2017	09:04:32	0.040
123	08/29/2017	09:05:02	0.028
124	08/29/2017	09:05:32	0.025
125	08/29/2017	09:06:02	0.032
126	08/29/2017	09:06:32	0.028
127	08/29/2017	09:07:02	0.029
128	08/29/2017	09:07:32	0.024
129	08/29/2017	09:08:02	0.026
130	08/29/2017	09:08:32	0.043
131	08/29/2017	09:09:02	0.031
132	08/29/2017	09:09:32	0.027
133	08/29/2017	09:10:02	0.026
134	08/29/2017	09:10:32	0.034
135	08/29/2017	09:11:02	0.037
136	08/29/2017	09:11:32	0.045
137	08/29/2017	09:12:02	0.040
138	08/29/2017	09:12:32	0.039
139	08/29/2017	09:13:02	0.040
140	08/29/2017	09:13:32	0.046
141	08/29/2017	09:14:02	0.043
142	08/29/2017	09:14:32	0.047
143	08/29/2017	09:15:02	0.038
144	08/29/2017	09:15:32	0.040
145	08/29/2017	09:16:02	0.038
146	08/29/2017	09:16:32	0.045
147	08/29/2017	09:17:02	0.032
148	08/29/2017	09:17:32	0.038
149	08/29/2017	09:18:02	0.046
150	08/29/2017	09:18:32	0.043
151	08/29/2017	09:19:02	0.042
152	08/29/2017	09:19:32	0.035
153	08/29/2017	09:20:02	0.046
154	08/29/2017	09:20:32	0.043
155	08/29/2017	09:21:02	0.035
156	08/29/2017	09:21:32	0.041
157	08/29/2017	09:22:02	0.045
158	08/29/2017	09:22:32	0.044
159	08/29/2017	09:23:02	0.045

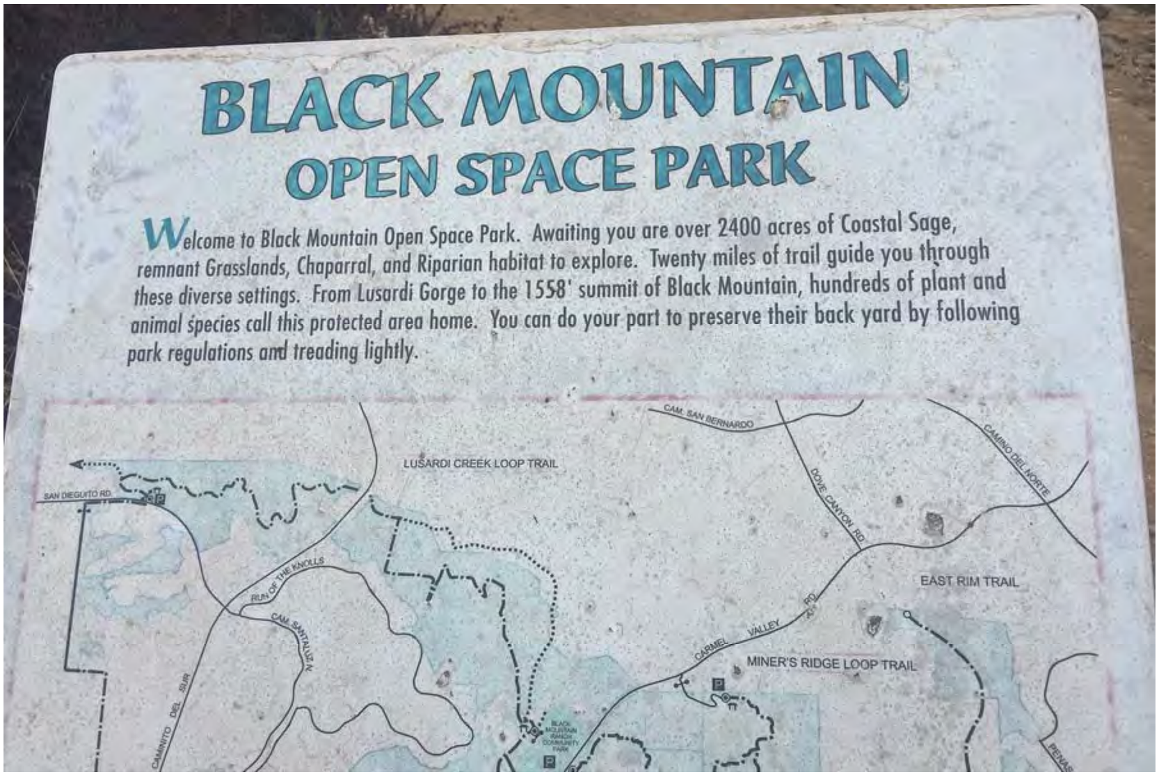
Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/29/2017	09:23:32	0.048
161	08/29/2017	09:24:02	0.145
162	08/29/2017	09:24:32	0.037
163	08/29/2017	09:25:02	0.042
164	08/29/2017	09:25:32	0.248
165	08/29/2017	09:26:02	0.039
166	08/29/2017	09:26:32	0.049
167	08/29/2017	09:27:02	0.046
168	08/29/2017	09:27:32	0.031
169	08/29/2017	09:28:02	0.034
170	08/29/2017	09:28:32	0.031
171	08/29/2017	09:29:02	0.031
172	08/29/2017	09:29:32	0.034
173	08/29/2017	09:30:02	0.035
174	08/29/2017	09:30:32	0.021
175	08/29/2017	09:31:02	0.034
176	08/29/2017	09:31:32	0.036
177	08/29/2017	09:32:02	0.028
178	08/29/2017	09:32:32	0.025
179	08/29/2017	09:33:02	0.030
180	08/29/2017	09:33:32	0.030
181	08/29/2017	09:34:02	0.054
182	08/29/2017	09:34:32	0.031
183	08/29/2017	09:35:02	0.028
184	08/29/2017	09:35:32	0.025
185	08/29/2017	09:36:02	0.036
186	08/29/2017	09:36:32	0.035
187	08/29/2017	09:37:02	0.023
188	08/29/2017	09:37:32	0.024
189	08/29/2017	09:38:02	0.023
190	08/29/2017	09:38:32	0.022
191	08/29/2017	09:39:02	0.025
192	08/29/2017	09:39:32	0.027
193	08/29/2017	09:40:02	0.020
194	08/29/2017	09:40:32	0.020
195	08/29/2017	09:41:02	0.021
196	08/29/2017	09:41:32	0.021
197	08/29/2017	09:42:02	0.023
198	08/29/2017	09:42:32	0.020
199	08/29/2017	09:43:02	0.025
200	08/29/2017	09:43:32	0.021
201	08/29/2017	09:44:02	0.024
202	08/29/2017	09:44:32	0.025
203	08/29/2017	09:45:02	0.029
204	08/29/2017	09:45:32	0.038
205	08/29/2017	09:46:02	0.033

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
206	08/29/2017	09:46:32	0.031
207	08/29/2017	09:47:02	0.035
208	08/29/2017	09:47:32	0.035
209	08/29/2017	09:48:02	0.033
210	08/29/2017	09:48:32	0.034
211	08/29/2017	09:49:02	0.039
212	08/29/2017	09:49:32	0.062
213	08/29/2017	09:50:02	0.044
214	08/29/2017	09:50:32	0.033
215	08/29/2017	09:51:02	0.041
216	08/29/2017	09:51:32	0.036
217	08/29/2017	09:52:02	0.036
218	08/29/2017	09:52:32	0.036
219	08/29/2017	09:53:02	0.043
220	08/29/2017	09:53:32	0.046
221	08/29/2017	09:54:02	0.045
222	08/29/2017	09:54:32	0.039
223	08/29/2017	09:55:02	0.039
224	08/29/2017	09:55:32	0.039
225	08/29/2017	09:56:02	0.041
226	08/29/2017	09:56:32	0.039
227	08/29/2017	09:57:02	0.043
228	08/29/2017	09:57:32	0.034
229	08/29/2017	09:58:02	0.047
230	08/29/2017	09:58:32	0.045
231	08/29/2017	09:59:02	0.038
232	08/29/2017	09:59:32	0.045
233	08/29/2017	10:00:02	0.039
234	08/29/2017	10:00:32	0.044
235	08/29/2017	10:01:02	0.039
236	08/29/2017	10:01:32	0.043
237	08/29/2017	10:02:02	0.041
238	08/29/2017	10:02:32	0.035
239	08/29/2017	10:03:02	0.036
240	08/29/2017	10:03:32	0.045
241	08/29/2017	10:04:02	0.041
242	08/29/2017	10:04:32	0.038
243	08/29/2017	10:05:02	0.038
244	08/29/2017	10:05:32	0.049
245	08/29/2017	10:06:02	0.048
246	08/29/2017	10:06:32	0.044
247	08/29/2017	10:07:02	0.038

Dust Monitoring Nighthawk Trailhead Aug 23, 2017



Dust Monitoring Nighthawk Trailhead Aug 23, 2017



BLACK MOUNTAIN
OPEN SPACE PARK

Welcome to Black Mountain Open Space Park. Awaiting you are over 2400 acres of Coastal Sage, remnant Grasslands, Chaparral, and Riparian habitat to explore. Twenty miles of trail guide you through these diverse settings. From Lusardi Gorge to the 1558' summit of Black Mountain, hundreds of plant and animal species call this protected area home. You can do your part to preserve their back yard by following park regulations and treading lightly.

Dust Monitoring Miners Loop Trail Aug 23, 2017

Dust Monitoring Miners Loop Trail Aug 23, 2017

MEDIA RELEASE

The City of SAN DIEGO

OR IMMEDIATE RELEASE
riday, Jan. 6, 2017

CONTACT:
Tim Graham at 619-253-9197 or tgraham@sandiego.gov

City Closes Trail to Conduct Tests in Black Mountain Ranch Open Space Park

SAN DIEGO – The City of San Diego, in collaboration with its research consultants, has detected higher than normal arsenic readings at the abandoned arsenic mine in Black Mountain Open Space Park. There is no conclusive evidence that there has been or is an imminent threat to the health of the public, plants or wildlife in and around the mine or along nearby trails as a result of this discovery.

Trails in close proximity to the mine are closed to allow researchers to conduct further testing, sampling and monitoring of the mine and trails in the area. Public access to the mine and surrounding area is prohibited. This includes a portion of the Miner's Ridge Loop Trail. Research and thorough testing is expected to take several months. Members of the public are advised to follow all signage and Ranger instructions in Black Mountain Ranch Open Space Park.

The Black Mountain Arsenic Mine is located on the north slope of Black Mountain at an elevation of 1,000 feet and was mined for naturally occurring white arsenic (arsenious oxide) in the 1920s for approximately eight to 10 years. Many remnants of the mine operation still exist on the site, but the mine has not been in use for more than eight decades. There are no designated trails that lead the public to the mine in the open space.

Access to Black Mountain Peak is still available to the public along with western portions of the park, and Rangers will continue to patrol the area as before. Hikers are reminded to always use designated trails when visiting the park.

Public updates will be provided as relevant information becomes available. An updated map indicating the locations of the trail closures is available to the public at Black Mountain Open Space Park as well as online at

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Dust Monitoring Nighthawk Trail Aug 29, 2017

Dust Monitoring Nighthawk Trail Aug 29, 2017

Dust Monitoring Nighthawk Trail Aug 29, 2017

APPENDIX G

Bioaccessibility Study

BIOACCESSIBLE ARSENIC ALONG THE MINER'S RIDGE LOOP TRAIL AND IN THE ADJACENT CANYON HOSTING MINING RUINS

Black Mountain Open Space Park, San Diego, CA

Determining risk to human health through accidental ingestion of arsenic enriched soils

October 2017

Additional Scope of Work added March 2018

Prepared by Dr. Beth O'Shea, Ph.D.
Reviewed by Eric Cathcart, P.G.
Lab and field contributions by Ninyo & Moore,
James Wright, Andrew Suski, and Bridget Kidd

University of San Diego®
COLLEGE OF ARTS AND SCIENCES
Environmental and Ocean Sciences

BACKGROUND

In 2015 the University of San Diego (USD) obtained a permit from the City of San Diego to study the geology at Black Mountain Open Space Park (the "Park"). During these geological studies[1] USD investigators measured elevated concentrations of arsenic in and around historic mining sites located in a canyon inside the Park. Further geologic mapping indicated naturally occurring arsenic-rich rocks were likely exposed along some sections of the nearby Miner's Ridge Loop Trail. Upon notifying the City of these findings, the section of the Miner's Ridge Loop Trail thought to include arsenic-rich surface soils was closed so that proper investigations could take place.

This report details the findings of field and laboratory work implemented to assist in determining the possible risk to human health through accidental ingestion of arsenic enriched soils. It focuses on both the Miner's Ridge Loop Trail and on soils collected in and around the mining ruins in an adjacent canyon off the Miner's Ridge Loop Trail.

This report corresponds to Goal IVa of USDs proposal, "Assessing the arsenic risk at Black Mountain Open Space Park, San Diego" submitted as sub-contractor to Ninyo & Moore, January 2017. The original proposed scope of work only included investigating the Miner's Ridge Loop Trail, however, USD had enough laboratory supplies and manpower to also extend their investigation to samples collected in and around the mining ruins ("Additional Goal IVa" data) and thus in good faith this data is also included herein. Furthermore, after the initial report was submitted in October 2017, Ninyo & Moore and USD collected additional samples to further delineate and characterize arsenic risk along some sections of the trail. This report also includes the results for that additional scope of work, which was completed in March 2018.

PURPOSE

Soil assessment investigations typically include soil collection followed by analysis of the amount of a contaminant present, which is then compared against standard regulatory guidelines to indicate the degree of contamination compared to 'normal' concentrations of contaminants found in soils (Figure 1). This process gives a fairly rapid indication of the risk posed by contaminant concentrations to people visiting a site and ensures the site owner performs the minimum site investigation required by appropriate regulatory authorities. Results of such investigations for the sites sampled herein were conducted for the City of San Diego by environmental consulting firm, Ninyo & Moore.

The purpose of this report was to expand upon general site investigation and characterization by conducting additional experiments that would improve our understanding of the risk to human health posed by this site (Figure 2). These experiments are designed to mimic conditions in the human body if soil or dust is accidentally (or purposefully) ingested. Bioaccessible arsenic is arsenic that is in a geochemical form likely to be easily absorbed by cells in the human body thereby increasing the likelihood of arsenic toxicity from the ingestion of arsenic-rich soil. In the absence of

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[1] Johnston, E. 2016. *Geochemical Investigation of Anomalous Arsenic Enrichment in the Santiago Peak Volcanics of Southern California*. Masters Thesis, University of San Diego. Thesis Chair: Dr. Beth O'Shea, Ph.D.

specialized experiments, the EPA recommend estimating bioaccessibility of arsenic (termed relative bioavailability or RBA) by calculating RBA at 60% of the total As reported in a soil. For this study, we wanted to develop site-specific bioaccessibility data since the geochemistry of As can sometimes make it very mobile (and hence easily incorporated into the human body) and sometimes not.

To determine the bioaccessibility of arsenic in samples collected at this site, researchers at the University of San Diego prepared a solution of synthetic gastric fluid, mixed the sampled soil with this gastric fluid heated to body temperature, and gently agitated the mixture for 2 hours. This process was designed to simulate conditions in the stomach during digestion. Upon completion of this process gastric fluid was separated from the soil and analyzed for arsenic.

The results of these site-specific bioaccessibility studies (termed USD-BA herein) were then used to perform standard calculations indicating cancer and non-cancer risk to humans that may come in contact with these soils at the Park. These calculations can be found in the human health risk assessment sections of the Ninyo and Moore report, to which this document is appended.

This bioaccessibility approach is consistent with the recommended methodology for evaluating site-specific arsenic bioavailability in California soils. Historically, regulatory agencies have required in vivo (processes taking place in a living organism, such as swine) animal studies in order to make site-specific adjustments to RBA. The 2016 Human Health Risk Assessment Note #6 authored by the CA Department of Toxic Substances and Control (DTSC) discusses a bioaccessibility experiment that effectively predicts RBA when compared to in vivo animal studies. At the time of writing the proposal for this work, and then completing the initial experiments, the exact protocol for these experiments was not publicly available, pending peer review and publication. At the time of writing this report, however, the publication and resulting protocol is now publicly available[2]. The experimental protocol that was used in the now available publication also involved digesting soils in a synthetic gastric fluid, and is thus very similar to the protocol used herein. This report therefore provides the City of San Diego with very current scientific and health risk assessment data to inform remedial actions for the Park.

METHODS

Collection of Soil Samples

Analyses conducted herein were performed on the same samples used in Ninyo & Moore's report to which this is appended. The reader is referred to their report for information on field collection procedures. Soils were then sent to USD once analyses for Ninyo & Moore's report were complete. The following methods were conducted under the supervision of Dr. Beth O'Shea, arsenic geochemist, at the University of San Diego.

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[2] Whitacre, S., Basta, n., Stevens, B., Hanley, V., Anderson, R., and Scheckel, K. 2017. Modification of an existing in vitro method to predict relative bioavailable arsenic in soils. *Chemosphere* **180**, pp. 545-552.

Separating Soil into Fine Fraction

To best simulate the accidental ingestion of soil, the smaller, dust-like (fine) fraction of soil is often separated from the bulk of the soil and targeted for analysis. The reason being that fine soil particles are most likely to settle on water bottles during hiking or adhere to fingers and hands. Later transfer to mouth is a possible way in which accidental ingestion of soil might occur.

The fine fraction was obtained by sieving original soil samples (called 'bulk' soil) through a 1mm diameter sieve. Fine soils therefore contain particles <1mm in diameter only. Sieves were cleaned with compressed air and/or acetone to avoid cross contamination between samples.

Analysis of Total As in Soil Fine Fraction

We analyzed the fine fraction of the soil for total As using an Innov-X 5000 model X-Ray Fluorescence (XRF) at USD. Two samples, however, did not contain sufficient fines for analysis of total As by XRF; BMT-65 and Pothole-23. In these two cases, total As was determined in the bulk fraction of the soil instead. Interestingly, preliminary comparison between total As in bulk vs fine fractions for each sample in our Black Mountain dataset suggests that there is no statistical difference in As concentration between bulk and fine and therefore using the bulk As concentration as a proxy for As concentration in fine fraction, at least for these two samples, seems reasonably justified in this case.

Bioaccessibility of Arsenic in Fine Fraction (USD-BA)

Only the fine fraction was used during the bioaccessibility experiments. The full protocol for this procedure is included in Appendix I. Analysis of arsenic in gastric fluid after digestion with soil was completed externally at EnviroMatrix Analytical (EMA) Laboratory in San Diego, following EPA Method 6010.

USD Quality Assurance/Quality Control (QA/QC)

All glassware used during experiments and analysis at USD was acid washed and rinsed three times with DI before use, and tubes for sample storage were brand new. Any equipment coming into contact with samples (spatulas, glass stir rods, sieves, pipettes) were cleaned between samples to avoid cross contamination.

During analyses, duplicates, certified reference materials from the National Institute of Standards and Technology (NIST), and blanks were routinely employed to check precision, accuracy, and false positives, respectively. Detailed records can be found in Appendix III.

Data passed QA/QC checks and is thus deemed reliable.

Descriptive Statistics

Three different soil As bioaccessible concentrations were calculated:

- Maximum bioaccessible As encountered (based on the maximum USD-BA reported herein for each of Miner's Ridge Loop Trail and the Canyon).
- Median bioaccessible As encountered. Median was chosen instead of mean to show the most commonly occurring USD-BA for each area.

- 95% UCL bioaccessible As encountered. When calculated, this value represents the true mean of USD-BA for each area of the site 95% of the time.

Descriptive statistics were calculated in Excel, 95% UCLs in ProUCL software. Arsenic concentration in the gastric fluids was reported as non-detect (ND) for more than half (52%) of all samples. To facilitate calculation of descriptive statistics any ND value was thus replaced with half the detection limit; 0.002 mg/L.

RESULTS: Miner's Ridge Loop Trail

All results are tabulated in Table 1.

Total As in Surface Soils

Total As along trails ranges from 5 to 2,330 mg/kg (Table 1). Background arsenic for soil derived from this rock type is typically only a few mg/kg, so soil in some sections of the trail is enriched above background. However, previous geological studies (Johnston, 2016) indicate that arsenic, present naturally in the minerals found within these rocks, can occur up to several thousand mg/kg in concentration. Samples numbered as BMT-60's and all samples collected as part of the Additional Scope of Work in particular, correspond to a zone of rocks geologically predicted to be naturally enriched in arsenic. These zones typically occur along a northwest trending fracture and likely contain arsenic minerals such as arsenian pyrite and it's weathering products, like scorodite. Soils developed from these rocks that are exposed at the surface today are thus expected to exhibit concentrations of arsenic that are higher than the average 'background' value published in the scientific literature. Further information regarding arsenic concentrations in these samples is described by Ninyo & Moore in their report.

EPA Default Relative Bioavailability of As (RBA) in Surface Soils

The United States Environmental Protection Agency (EPA) recommends a default relative bioavailability for arsenic (RBA) of 60% the total arsenic concentration. This value is used when there is no site-specific bioaccessible experimental data available. As a comparison, we present both this EPA default value and the site-specific bioaccessible data. Default RBA for the Miner's Ridge Loop Trail (Table 1) range from 3 to 1,398 mg/kg.

Site Specific As Bioaccessibility (USD-BA) in Surface Soils

The gastric fluid experiments performed by USD on soils from the trail indicate that much less arsenic is actually bioavailable than the default values reported above. In fact, bioaccessible arsenic in samples along Miner's Ridge Loop Trail only range from 0 to 25 mg/kg and are generally around 1 mg/kg (mean bioaccessible As is 1 mg/kg, median is 0.4 mg/kg).

RESULTS: Canyon (off-trail) Hosting the Mining Ruins

All results are tabulated in Table 2.

Total As in Surface Soils

A subset of soil samples collected by Ninyo and Moore in and around the former mining areas located in the canyon indicate that total As is both variable and in some locations, extremely enriched. Total As ranges from 10 to 21,500 mg/kg. It is uncommon to measure concentrations of arsenic in soils at concentrations in the tens of thousands. This enrichment is possibly the result of both the natural enrichment of rocks in arsenic and their former disturbance due to historic mining.

EPA Default Relative Bioavailability of As (RBA) in Surface Soils

Default RBA for samples collected in proximity to the mining ruins range from 6 to 12,900 mg/kg As. Both mean RBA (3,035 mg/kg) and median RBA (908 mg/kg) indicate that these soils could potentially release very high concentrations of bioavailable arsenic.

Site Specific As Bioaccessibility (USD-BA) in Surface Soils

Site specific bioaccessible As in proximity to the mining ruins range from 1 to 866 mg/kg. Unlike the soils outcropping on the nearby Miner's Ridge Loop Trail, gastric fluid experiments on these soils within the canyon indicate the arsenic here has the potential to be much more readily mobilized and thus they likely present a greater risk to human and ecological health.

IMPLICATIONS AND RECOMMENDATIONS

Data for the canyon, although exhibiting variable concentrations of bioaccessible arsenic throughout, suggest that areas in close proximity to former ore processing, such as near the concrete roaster, rock crushing area, and dust flue, generally show higher concentrations of bioaccessible arsenic. Similarly, areas thought to contain material transported from ore processing areas to other parts of the canyon (e.g., drainage varve) also exhibit high bioaccessibility.
In contrast, there are areas in the canyon and surrounds where bioaccessibility was much lower (e.g., pit mine and pothole).

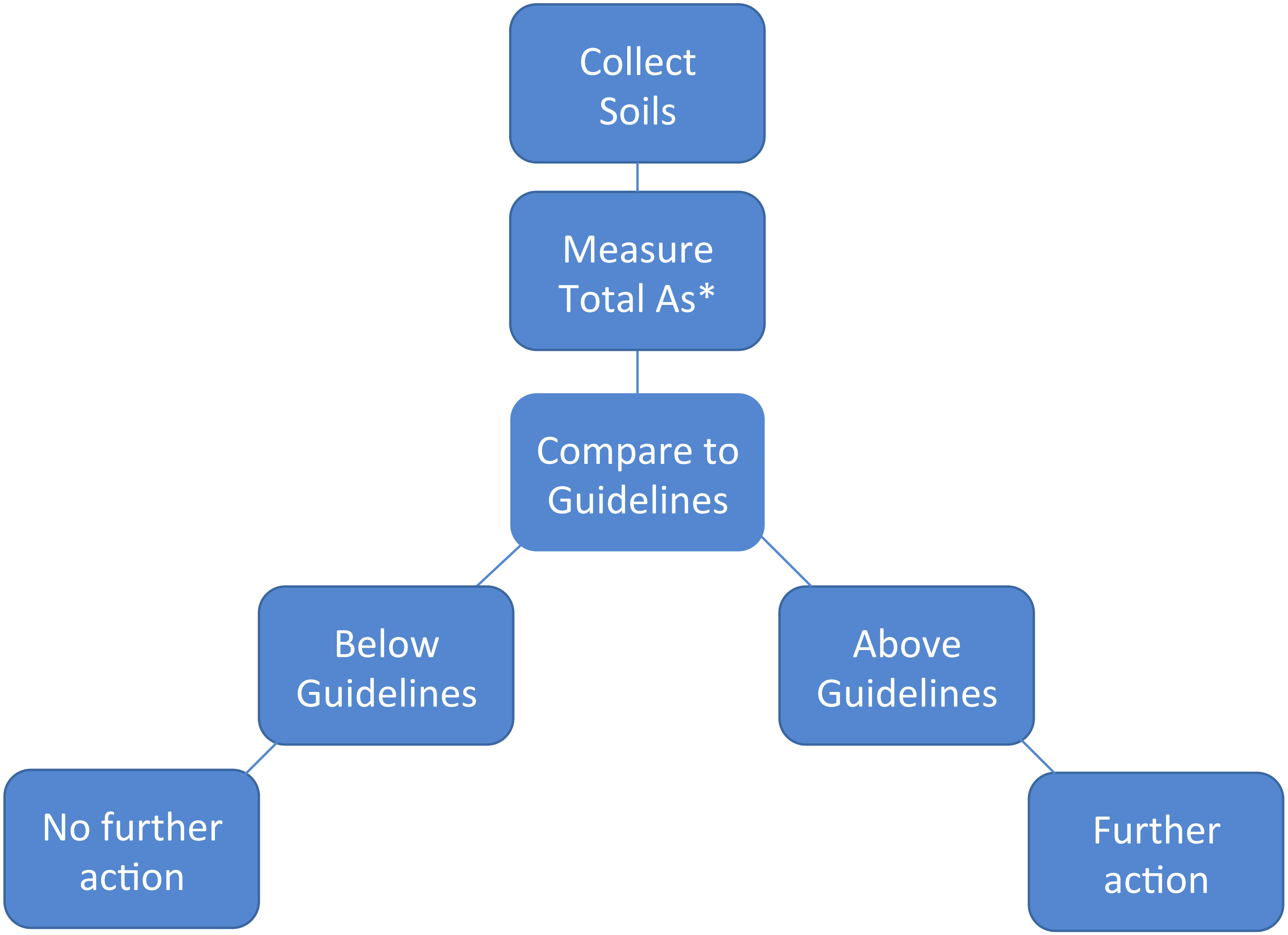
However, bioaccessible data for the Miner's Ridge Loop Trail indicate that the soils on site likely pose much less risk than the EPA default RBA value indicates. The EPA default value suggests using 60% of the total As as an estimate for bioavailability but when USD conducted site-specific gastric experiments on trail soils, we found that all the samples analyzed released less than 10% of the total As and most only released 1-3%, which is much less than the EPA default value of 60%. This indicates that arsenic present in the soils along the Miner's Ridge Loop Trail is likely in a geochemical form that is not easily released into synthetic gastric fluid.

FIGURES

TABLES

APPENDICES

What is a standard soil assessment procedure?



Collect Soils

Measure Total As*

Compare to Guidelines

Below Guidelines

Above Guidelines

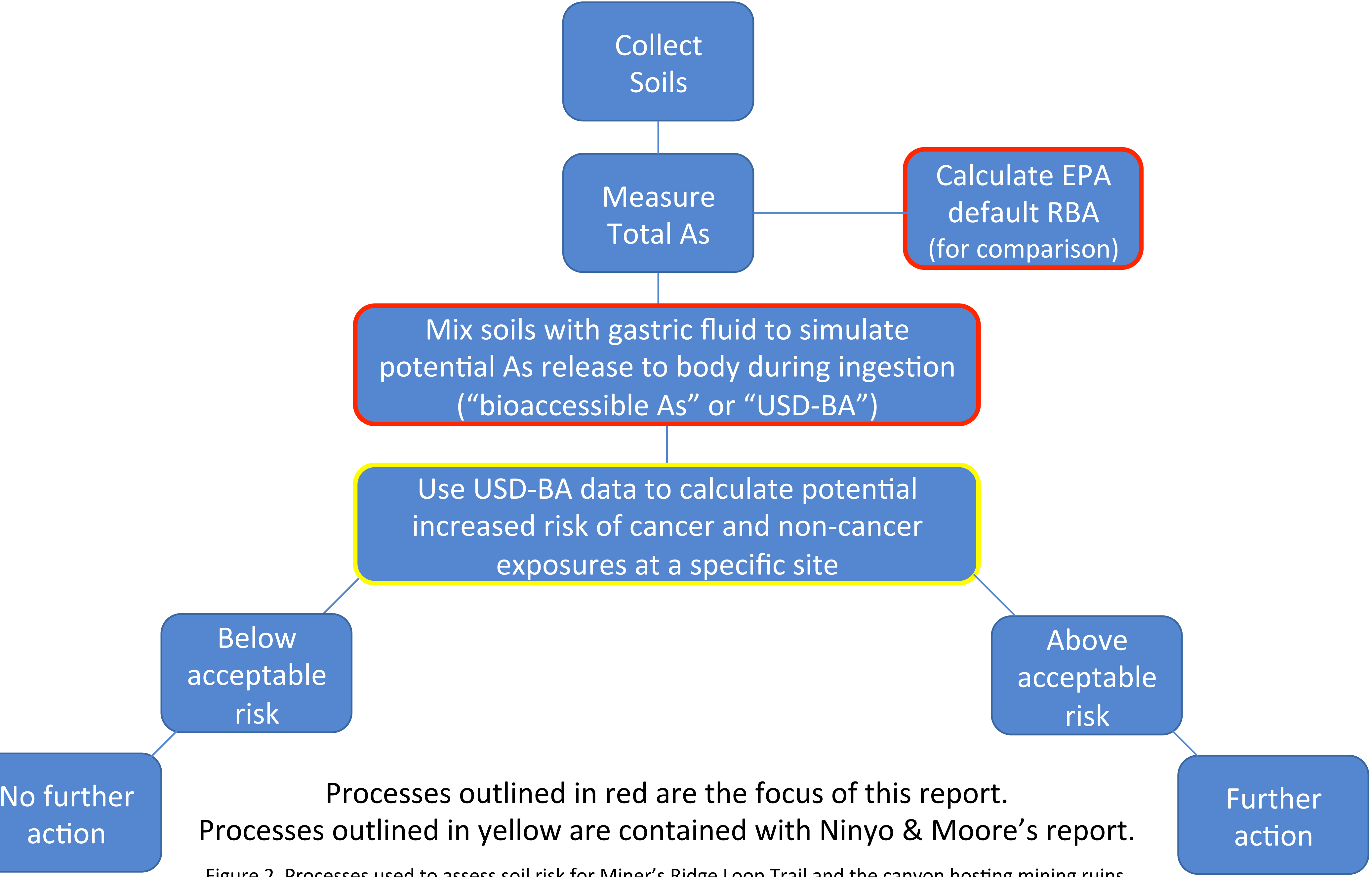
No further action

Further action

* Measuring Total As is fast, inexpensive, and readily available by most laboratories. However, it can lead to an over-or under-estimation of the risk posed by soils.

Figure 1. Example workflow for assessing soil risk at any given site.

How can we improve our understanding of soil risk at a particular site?



Collect Soils

Measure Total As

Calculate EPA default RBA (for comparison)

Mix soils with gastric fluid to simulate potential As release to body during ingestion (“bioaccessible As” or “USD-BA”)

Use USD-BA data to calculate potential increased risk of cancer and non-cancer exposures at a specific site

Below acceptable risk

No further action

Above acceptable risk

Further action

Processes outlined in red are the focus of this report.
Processes outlined in yellow are contained with Ninyo & Moore’s report.

Figure 2. Processes used to assess soil risk for Miner’s Ridge Loop Trail and the canyon hosting mining ruins.

Table 1. Site Specific Bioaccessibility (USD-BA) from gastric digestions performed at USD compared to EPA default recommendation for RBA and Total As measured in surface soils along Miner's Ridge Loop Trail at Black Mountain Open Space Park.

Trail samples 01-40

Sample ID	Total As in trail soils*	EPA default RBA^	Site Specific USD-BA[#]	
	mg/kg	mg/kg	mg/kg	%
BMT-01	72	43	1	1
BMT-02	13	8	1	4
BMT-03	16	9	0	3
BMT-04	10	6	0	2
BMT-05	11	7	0	2
BMT-06	10	6	0	2
BMT-07	21	13	0	1
BMT-08	11	7	1	5
BMT-09	5	3	0	4
BMT-10	7	4	0	3
BMT-11	5	3	0	4
BMT-12	6	3	0	3
BMT-13	10	6	0	2
BMT-14	7	4	0	3
BMT-15	7	4	0	5
BMT-16	12	7	0	2
BMT-17	10	6	1	5
BMT-18	12	7	0	1
BMT-19	7	4	1	9
BMT-20	9	5	0	4
BMT-21	9	5	0	2
BMT-22	11	6	0	2
BMT-23	10	6	0	2
BMT-24	7	4	0	3
BMT-25	30	18	0	1
BMT-26	23	14	0	1
BMT-27	38	23	0	1
BMT-28	7	4	0	3
BMT-29	9	6	0	2
BMT-30	6	4	0	7
BMT-31	9	6	0	2
BMT-32	17	10	0	1
BMT-33	18	11	1	4
BMT-34	9	6	0	2
BMT-35	32	19	0	1
BMT-36	7	4	0	3
BMT-37	7	4	0	2
BMT-38	7	4	0	2
BMT-39	11	7	0	2
BMT-40	9	5	0	2

Trail samples 41-79

Sample ID	Total As in trail soils*	EPA default RBA^	Site Specific USD-BA[#]	
	mg/kg	mg/kg	mg/kg	%
BMT-41	5	3	0	8
BMT-42	7	4	0	3
BMT-43	10	6	0	5
BMT-44	16	10	0	1
BMT-45	22	13	0	2
BMT-46	17	10	1	3
BMT-47	14	8	0	1
BMT-48	179	107	2	1
BMT-49	124	74	2	1
BMT-50	31	18	0	1
BMT-51	59	35	1	2
BMT-52	62	37	0	1
BMT-53	10	6	0	2
BMT-54	13	8	0	1
BMT-55	42	25	1	1
BMT-56	21	12	0	1
BMT-57	8	5	0	2
BMT-58	7	4	0	3
BMT-59	9	5	0	4
BMT-60	21	12	0	2
BMT-61	47	28	0	0
BMT-62	257	154	1	0
BMT-63	120	72	1	1
BMT-64	278	167	3	1
BMT-65	2330	1398	25	1
BMT-66	304	182	2	1
BMT-67	255	153	2	1
BMT-68	144	86	1	1
BMT-69	102	61	1	1
BMT-70	70	42	1	1
BMT-71	55	33	1	1
BMT-72	57	34	1	2
BMT-73	32	19	0	1
BMT-74	7	4	0	2
BMT-75	6	4	0	3
BMT-76	11	6	0	3
BMT-77	8	5	0	2
BMT-78	7	4	0	2
BMT-79	8	5	0	2

Trail samples 80-88, 95-104, and selected 400-level samples

Sample ID	Total As in trail soils*	EPA default RBA^	Site Specific USD-BA[#]	
	mg/kg	mg/kg	mg/kg	%
BMT-80	123	74	0	0
BMT-81	381	229	1	0
BMT-82	1123	674	10	1
BMT-83	1255	753	14	1
BMT-84	1978	1187	13	1
BMT-85	234	140	1	0
BMT-86	124	74	1	1
BMT-87	28	17	ND	ND
BMT-88	33	20	ND	ND
BMT-95	81	49	1	2
BMT-96	16	9	ND	ND
BMT-97	28	17	ND	ND
BMT-98	212	127	2	1
BMT-99	43	26	ND	ND
BMT-100	93	56	1	1
BMT-101	80	48	0	1
BMT-102	118	71	1	1
BMT-103	101	61	1	1
BMT-104	124	74	1	1
BMT-434	238	143	4	2
BMT-446	115	69	1	1
BMT-447	164	98	2	2
BMT-450	165	99	1	1
BMT-451	423	254	4	1
BMT-536	187	112	3	1

Samples in this column (greyed) were collected as part of the Additional Scope of Work

n=104	Total As in trail soils*	EPA default RBA^	Site Specific USD-BA[#]
	mg/kg	mg/kg	mg/kg
Mean	**123**	**74**	**1**
Median	**19**	**11**	**0.4**
95% UCL	**267**	**160**	**3**
Max	**2330**	**1398**	**25**

Chebyshev

* Total As measured by XRF at USD.

^ EPA recommends a default RBA value of 60% total As.

[#] USD-BA calculated from gastric fluid digestions performed at USD.

Table 2. Site Specific Bioaccessibility (USD-BA) from gastric digestions performed at USD compared to EPA default recommendation for RBA and Total As measured in surface soils outcropping in the canyon hosting mining ruins at Black Mountain Open Space Park.

Sample ID	**Total As in canyon soils***	**EPA default RBA^**	**Site Specific USD-BA[#]**	
n=20	**mg/kg**	**mg/kg**	**mg/kg**	**%**
Flume east end soil-13	284	170	21	7
Trail crossing-19	77	46	19	25
Pit Mine 2-22	10	6	1	7
Pit Mine 1 Tailings-18	1000	600	10	1
Pothole-23	115	69	2	2
Downslope M12-21	16700	10020	157	1
Glory Hole-03	2925	1755	25	1
Canyon Tailings-08	97	58	6	6
ranga adit-01	67	40	1	1
cyanide trail soil-17	17300	10380	119	1
koala adit soil-06	647	388	14	2
koala adit tailing-07	43	26	0	1
Ranga taillings-02	21500	12900	74	0
hobbit hole tailings-04	5660	3396	106	2
concrete roaster soil-09	2027	1216	866	43
east of cyanide vat 1-15	937	562	42	4
tailing south dust flume-10	12200	7320	127	1
hobbit hole tailings-05	5879	3527	223	4
rock crusher M4 soil-14	10900	6540	118	1
drainage varve-16	2788	1673	98	4
Mean	5058	3035	101	
Median	1514	908	33	
95% UCL	10973	6584	288	
Max	21500	12900	866	

* Total As measured by XRF at USD.

^ EPA recommends a default Relative Bioavailability (RBA) value of 60% of total As.

[#] USD-BA calculated from gastric fluid digestions performed at USD.
95% UCL for Total and EPA default are adjusted gamma; for USD-BA, Chebyshev.

APPENDIX I

Experimental Protocol for Synthetic Gastric Digestion

Bridget Kidd September 20, 2016
Updated by BOS on June 8, 2017

Experimental Protocol for Synthetic Gastric Digestion

Purpose:

To analyze the bioaccessibility of arsenic in Black Mountain soil samples. Bioaccessibility is defined as the amount of metal that is soluble in gastric fluid and is therefore available to be potentially taken up by the intestinal lumen.

Reference:

Method based on Hamel et al. 1998. *Bioaccessibility of metals in soils for different liquid to solid ratios in synthetic gastric fluid.* ES&T vol. 32, p. 358.

Equipment:

- 1L volumetric Flask
- Weigh paper
- Analytical balance
- small beaker for heating HCl(aq)
- 10.00mL, 50.00mL pipettes
- 250-500mL beaker
- glass stir rod
- water bath and thermometer
- 15mL falcon tubes
- 50mL centrifuge tubes

Reagents:

- Black Mountain soil samples, <1mm size
- ultrapure HCl (aq)
- pepsin, porcine stomach mucosa
- sodium chloride
- deionized water

Safety:

- Work in hood when mixing chemicals.
- Wear eye protection, gloves, and lab coat at all times.
- Wear mask over mouth and nose while measuring soil to prevent inhalation of soil.
- Dispose of wastes into appropriately labeled waste bottle.

Bridget Kidd September 20, 2016
Updated by BOS on June 8, 2017

Method:

Sample Preparation

1. **Measure total arsenic by XRF in BULK soil.**
    a. Transfer soil samples from glass jars into labeled Whirlpak bags. If samples have peds (soil clumps) gently use mortar and pestle to separate peds.
    b. Place Whirlpak bags directly on Innov-X 5000 for elemental analysis.

2. **Separating the fine fraction from the bulk soil sample**.
    a. Pass the dried bulk sample through the 1mm sieve. Place sample into two bags: <1mm (passed through the sieve) and >1mm (did not pass through the sieve). Label accordingly.

3. **Measure total arsenic in fine fraction.**
    a. Use the XRF to measure total arsenic in the sieved <1mm fraction.

Bridget Kidd September 20, 2016
Updated by BOS on June 8, 2017

Synthetic Gastric Fluid Prep

1. Weigh 2 g NaCl on analytical balance using weigh paper.
2. Using a 250-500mL beaker, dissolve NaCl in a solution of 7 mL of trace element grade hydrochloric acid and approximately 250 mL of deionized water. Use a glass stir rod to dissolve salt.
3. Add 3.2 g of pepsin to solution in beaker.
4. Bring solution to 1L using DI water in 1L volumetric flask. Use DI water to rinse residual pepsin from beaker flask and pour this into 1L volumetric flask. Use gastric fluid solution immediately.

Digestions

1. Bring a water bath to 3 degrees C.
2. Weigh 0.5 g of <1mm size soil. Record mass to 3 decimal places. Place weighed soil in a 50 mL centrifuge tube.
    i. If sample availability is limited use 0.25 g of soil and you may choose to add 22.5 mL of gastric fluid in the step below to maintain a constant 1:90 ratio of soil to gastric fluid.
    ii. For precision, randomly select one soil sample in approx. every 20 and run duplicate digestions.
3. Add 45 mL of gastric fluid for a 1:90 ratio of soil to gastric fluid. Cap tubes.
    i. For blank, add 45 mL to a centrifuge tube, no soil added. Perform at least one blank for each batch of samples sent for analysis.
4. Place capped centrifuge tubes in water bath at 37C and shake on level 17 for 2 hours.
5. Remove tubes from water bath and spin centrifuge tubes at 1000 rpm for 5 min.
6. Decant supernatant into acid washed Falcon tubes (at least 12 mL volume) and refrigerate in ST386 until analysis.

APPENDIX II

Calculations of site specific bioaccessibility data

Appendix IIa. Calculation of site specific bioaccessibility for Miner's Ridge Loop Trail using gastric digestion experimental data.

						Comparison values:	
Sample ID	Sample mass	Volume gastric fluid	As in gastric fluid*	Site Specific USD-BA$^{\#}$	Site Specific USD-BA	EPA default RBA^	Total As by XRF
	g	L	mg/L	mg/kg	%	mg/kg	mg/kg
BMT-01	0.513	0.045	0.012	1	1	43	72
BMT-02	0.505	0.045	0.006	1	4	8	13
BMT-03	0.534	0.045	0.005	0	3	9	16
BMT-04	0.487	0.045	ND	ND	0	6	10
BMT-05	0.499	0.045	ND	ND	0	7	11
BMT-06	0.509	0.045	ND	ND	0	6	10
BMT-07	0.520	0.045	ND	ND	0	13	21
BMT-08	0.499	0.045	0.006	1	5	7	11
BMT-09	0.520	0.045	ND	ND	0	3	5
BMT-10	0.509	0.045	ND	ND	0	4	7
BMT-11	0.499	0.045	ND	ND	0	3	5
BMT-12	0.487	0.045	ND	ND	0	3	6
BMT-13	0.502	0.045	ND	ND	0	6	10
BMT-14	0.500	0.045	ND	ND	0	4	7
BMT-15	0.504	0.045	0.004	0	5	4	7
BMT-16	0.505	0.045	ND	ND	0	7	12
BMT-17	0.493	0.045	0.006	1	5	6	10
BMT-18	0.507	0.045	ND	ND	0	7	12
BMT-19	0.490	0.045	0.007	1	9	4	7
BMT-20	0.503	0.045	0.004	0	4	5	9
BMT-21	0.518	0.045	ND	ND	0	5	9
BMT-22	0.494	0.045	ND	ND	0	6	11
BMT-23	0.521	0.045	ND	ND	0	6	10
BMT-24	0.515	0.045	ND	ND	0	4	7
BMT-25	0.501	0.045	ND	ND	0	18	30
BMT-26	0.494	0.045	ND	ND	0	14	23
BMT-27	0.496	0.045	0.004	0	1	23	38
BMT-28	0.498	0.045	ND	ND	0	4	7
BMT-28_duplicate	0.491	0.045	ND	ND	0	4	7
BMT-29	0.515	0.045	ND	ND	0	6	9
BMT-30	0.500	0.045	0.005	0	7	4	6
BMT-31	0.511	0.045	ND	ND	0	6	9
BMT-32	0.513	0.045	ND	ND	0	10	17
BMT-33	0.489	0.045	0.007	1	4	11	18
BMT-34	0.502	0.045	ND	ND	0	6	9
BMT-34_duplicate	0.492	0.045	0.006	1	6	6	9
BMT-35	0.505	0.045	ND	ND	0	19	32
BMT-36	0.496	0.045	ND	ND	0	4	7
BMT-37	0.499	0.045	ND	ND	0	4	7
BMT-38	0.507	0.045	ND	ND	0	4	7
BMT-39	0.499	0.045	ND	ND	0	7	11
BMT-40	0.493	0.045	ND	ND	0	5	9
BMT-41	0.500	0.045	0.004	0	8	3	5
BMT-42	0.507	0.045	ND	ND	0	4	7
BMT-43	0.511	0.045	0.005	0	5	6	10
BMT-44	0.503	0.045	ND	ND	0	10	16
BMT-45	0.496	0.045	0.005	0	2	13	22
BMT-45_duplicate	0.491	0.045	0.004	0	2	14	24
BMT-46	0.499	0.045	0.006	1	3	10	17

						Comparison values:	
Sample ID	Sample mass	Volume gastric fluid	As in gastric fluid*	Site Specific USD-BA#	Site Specific USD-BA	EPA default RBA^	Total As by XRF
	g	L	mg/L	mg/kg	%	mg/kg	mg/kg
BMT-47	0.493	0.045	ND	ND	0	8	14
BMT-48	0.499	0.045	0.021	2	1	107	179
BMT-49	0.496	0.045	0.020	2	1	74	124
BMT-50	0.495	0.045	ND	ND	0	18	31
BMT-51	0.513	0.045	0.011	1	2	35	59
BMT-52	0.496	0.045	0.005	0	1	37	62
BMT-53	0.500	0.045	ND	ND	0	6	10
BMT-54	0.509	0.045	ND	ND	0	8	13
BMT-55	0.508	0.045	0.006	1	1	25	42
BMT-56	0.493	0.045	ND	ND	0	12	21
BMT-57	0.492	0.045	ND	ND	0	5	8
BMT-58	0.508	0.045	ND	ND	0	4	7
BMT-59	0.496	0.045	0.004	0	4	5	9
BMT-60	0.500	0.045	0.004	0	2	12	21
BMT-61	0.508	0.045	ND	ND	0	28	47
BMT-62	0.502	0.045	0.013	1	0	154	257
BMT-63	0.508	0.045	0.010	1	1	72	120
BMT-64	0.505	0.045	0.029	3	1	167	278
BMT-65	0.243	0.045	0.136	25	1	1398	2330
BMT-66	0.500	0.045	0.022	2	1	182	304
BMT-67	0.499	0.045	0.022	2	1	153	255
BMT-68	0.500	0.045	0.013	1	1	86	144
BMT-69	0.504	0.045	0.008	1	1	61	102
BMT-70	0.509	0.045	0.008	1	1	42	70
BMT-71	0.500	0.045	0.006	1	1	33	55
BMT-72	0.505	0.045	0.011	1	2	34	57
BMT-73	0.498	0.045	ND	ND	0	19	32
BMT-74	0.497	0.045	ND	ND	0	4	7
BMT-75	0.496	0.045	ND	ND	0	4	6
BMT-76	0.499	0.045	0.004	0	3	6	11
BMT-77	0.509	0.045	ND	ND	0	5	8
BMT-78	0.508	0.045	ND	ND	0	4	7
BMT-79	0.495	0.045	ND	ND	0	5	8
BMT-79_duplicate	0.495	0.045	0.004	0	5	5	8
BMT-80	0.512	0.045	0.004	0	0	74	123
BMT-81	0.503	0.045	0.012	1	0	229	381
BMT-82	0.505	0.045	0.116	10	1	674	1123
BMT-83	0.503	0.045	0.161	14	1	753	1255
BMT-84	0.506	0.045	0.148	13	1	1187	1978
BMT-85	0.505	0.045	0.006	1	0	140	234
BMT-86	0.502	0.045	0.007	1	1	74	124
BMT-87	0.509	0.045	ND	ND	0	17	28
BMT-88	0.508	0.045	ND	ND	0	20	33
BMT-95	0.482	0.045	0.015	1	2	49	81
BMT-96	0.506	0.045	ND	ND	0	9	16
BMT-97	0.505	0.045	ND	ND	0	17	28
BMT-98	0.489	0.045	0.027	2	1	127	212
BMT-99	0.496	0.045	ND	ND	0	26	43
BMT-100	0.492	0.045	0.009	1	1	56	93
BMT-100-duplicate	0.490	0.045	0.011	1	1	56	94

						Comparison values:	
Sample ID	**Sample mass g**	**Volume gastric fluid L**	**As in gastric fluid* mg/L**	**Site Specific USD-BA$^{\#}$ mg/kg**	**Site Specific USD-BA %**	**EPA default RBA^ mg/kg**	**Total As by XRF mg/kg**
BMT-101	0.518	0.045	0.005	0	1	48	80
BMT-102	0.501	0.045	0.013	1	1	71	118
BMT-103	0.492	0.045	0.015	1	1	61	101
BMT-104	0.512	0.045	0.013	1	1	74	124
BMT-434	0.520	0.045	0.045	4	2	143	238
BMT-446	0.496	0.045	0.014	1	1	69	115
BMT-447	0.510	0.045	0.028	2	2	98	164
BMT-450	0.491	0.045	0.015	1	1	99	165
BMT-451	0.495	0.045	0.039	4	1	254	423
BMT-451-duplicate	0.507	0.045	0.040	4	1	254	423
BMT-536	0.505	0.045	0.030	3	1	112	187

* Measured by EPA 6010 at EMA. Reporting Limit 0.010 mg/L; anything less indicates an estimated As concentration.

$^{\#}$ USD-BA calculated as (As in gastric fluid*1000*volume gastric fluid)/mass of sample

^ EPA recommends a default Relative Bioavailability (RBA) value of 60% of total As.

ND non-detect (<0.004 mg/L).

Yellow cells indicate low mass of sample was available; calculations take this into account.

Grey cells indicate samples that were collected as part of additional scope of work to better characterize extent of As.

Appendix IIb. Calculation of site specific bioaccessibility for the canyon hosting mining ruins using gastric digestion experimental data.

						Comparison values:	
Sample ID	Sample mass	Volume gastric fluid	As in gastric fluid*	Site Specific USD-BA[#]	Site Specific USD-BA	EPA default RBA^	Total As by XRF
	g	L	mg/L	mg/kg	%	mg/kg	mg/kg
Flume east end soil-13	0.502	0.045	0.231	21	7	170	284
Trail crossing-19	0.505	0.045	0.213	19	25	46	77
Pit Mine 2-22	0.499	0.045	0.008	1	7	6	10
Pit Mine 2-22_duplicate	0.504	0.045	ND	ND	0	6	10
Pit Mine 1 Tailings-18	0.500	0.045	0.110	10	1	600	1000
Pothole-23	0.379	0.045	0.019	2	2	69	115
Downslope M12-21	0.497	0.045	1.73	157	1	10020	16700
Glory Hole-03	0.504	0.045	0.280	25	1	1755	2925
Canyon Tailings-08	0.503	0.045	0.064	6	6	58	97
ranga adit-01	0.499	0.045	0.008	1	1	40	67
cyanide trail soil-17	0.500	0.045	1.32	119	1	10380	17300
koala adit soil-06	0.514	0.045	0.155	14	2	388	647
koala adit tailing-07	0.501	0.045	0.005	0	1	26	43
Ranga taillings-02	0.502	0.045	0.823	74	0	12900	21500
hobbit hole tailings-04	0.502	0.045	1.18	106	2	3396	5660
concrete roaster soil-09	0.505	0.045	9.72	866	43	1216	2027
east of cyanide vat 1-15	0.500	0.045	0.466	42	4	562	937
tailing south dust flume-10	0.501	0.045	1.41	127	1	7320	12200
hobbit hole tailings-05	0.499	0.045	2.47	223	4	3527	5879
rock crusher M4 soil-14	0.507	0.045	1.33	118	1	6540	10900
drainage varve-16	0.498	0.045	1.09	98	4	1673	2788

* Measured by EPA 6010 at EMA. Reporting Limit 0.010 mg/L; anything less indicates As was detected and this is an estimated concentration.

[#] USD-BA calculated as (As in gastric fluid*1000*volume gastric fluid)/mass of sample

^ EPA recommends a default Relative Bioavailability (RBA) value of 60% of total As.

ND non-detect (<0.004 mg/L).

Yellow cells indicate low mass of sample was available; calculations take this into account.

APPENDIX III

QA/QC for USD XRF and bioaccessibility data

Appendix IIIa. Quality Assurance/Quality Control for Gastric Experiments at USD

Precision

If we perform a gastric digestion twice on the same soil sample, do we obtain the same result?
Assessed by calculating % Relative Standard Deviation (RSD) = (standard deviation of replicates / average of replicates) * 100
RSD% less than or equal to +/-5% show excellent precision

Sample ID	As (mg/L)	Precision	Explanation
BMT-28	ND		
BMT-28_duplicate	ND		
%RSD	not calculated	Excellent	
BMT-34	ND		
BMT-34_duplicate	0.006		
%RSD	not calculated	Good-Excellent	Since method detection limit is 0.004mg/L this result is very close to detection.
BMT-45	0.005		
BMT-45_duplicate	0.004		Small concentrations mathematically show larger RSDs but this does not indicate data is poor.
%RSD	15.7	Excellent	The difference between these two results is small (1 ppb) because instrument sensitivity is excellent.
BMT-79	ND		
BMT-79_duplicate	0.004		
%RSD	not calculated	Excellent	Since method detection limit is 0.004mg/L this result is at detection.
Pit Mine 2-22	0.008		
Pit Mine 2-22_duplicate	ND		
%RSD	not calculated	Good-Excellent	Since method detection limit is 0.004mg/L this result is very close to detection.
BMT-82	0.116		
Repeat BMT-82	0.153		
%RSD	19.5	Fair	Higher RSD could reflect homogeneity of sample.
BMT-84	0.148		
Repeat BMT-84	0.157		
%RSD	4.2	Excellent	Precision is within +/- 5%
BMT-100	0.009		
BMT-100-duplicate	0.011		
%RSD	14.1	Good	These concentrations are close to detection limit thus higher RSDs can be expected at this low sensitivity.
BMT-451	0.039		
BMT-451-duplicate	0.040		
%RSD	1.8	Excellent	Precision is within +/- 5%
BMT-82	0.116		
Repeat BMT-82	0.153		
%RSD	19.5	Fair	Higher RSD could reflect homogeneity of sample.
BMT-84	0.148		
Repeat BMT-84	0.157		
%RSD	4.2	Excellent	Precision is within +/- 5%
BMT-100	0.009		
BMT-100-duplicate	0.011		
%RSD	14.1	Good	These concentrations are close to detection limit thus higher RSDs can be expected at this low sensitivity.
BMT-451	0.039		
BMT-451-duplicate	0.040		
%RSD	1.8	Excellent	Precision is within +/- 5%

Accuracy

How well does the gastric digestion experiment performed at USD extract As at its true concentration?
There is no National Institute of Standards and Technology (NIST) certified reference material for this experimental method.

Blanks

Is As present in high amounts in the chemicals used during this experiment?
Blanks should measure As as low or non-detect (ND) to show chemicals used were not an additional source of As to the experiment.

Sample ID	As (mg/L)	
Gastric Fluid Blank-01	0.004	All blanks pass.
Gastric Fluid Blank-02	ND	Three blanks show As at the instrument detection limit of 0.004 mg/L.
Gastric fluid blank-03	ND	If As is present in the chemicals used it is present in such small quantities that it should not greatly influence remedial decisions.
Gastric fluid blank-04	0.004	
Blank gastric fluid (8/25/17)	ND	
Blank (10/23/17)	ND	
Blank (09/28/17)	0.004	

After samples were digested in gastric fluid at USD the fluid was sent to an external lab (EMA) for analysis.
EMA conducted their own QA/QC, which is included in their lab reports.

Appendix IIIb. Quality Assurance/Quality Control for Total As by XRF at USD

Precision

How well does the XRF repeatedly detect the same As concentration in a sample analyzed multiple times?
Assessed by calculating % Relative Standard Deviation (RSD) = (standard deviation of replicates / average of replicates) * 100
RSD% less than or equal to +/-5% show excellent precision

Sample ID		As (ppm)	Precision	Explanation
BMT-09		6		Smaller concentrations give larger RSDs.
BMT-09_duplicate		7.4		Precision good to a few ppm.
	%RSD	14.8	Good	To reflect precision and detection sensitivity no decimals will be used in final results table.
BMT-21		8		
BMT-21_duplicate		7.4		
	%RSD	5.5	Good	See previous.
BMT-45		20.9		
BMT-45_duplicate		21.4		
	%RSD	1.7	Excellent	
BMT-66		302		
BMT-66_duplicate		284		
	%RSD	4.3	Good	See previous.
Glory Hole-03		1477		
Glory Hole-03_duplicate		2943		
Glory Hole-03_replicate3		2256		
Glory Hole-03-B_replicate4		2476		
Glory Hole-03-B_replicate5		3319		
Glory Hole-03_replicate6		2848		
Glory Hole-03_replicate7		2183		
Glory Hole-03_replicate8		3666		
	%RSD	26.3	Poor	This enriched sample was chosen for multiple replicates to illustrate extreme sample heterogeneity when As concentrations are high. Precision in this case is likely poor not due to instrument capability but because As concentrations in the sample are so variable.
Trail crossing-19		79.5		
Trail crossing-19_duplicate		75.9		
	%RSD	3.3	Excellent	
drainage varve-16		2484		
drainage varve-16_duplicate		3035		
	%RSD	14.1	Poor	See previous for Poor.
NIST 2710a_1		1614		
NIST 2710a_2		1558		
NIST 2710a_3		1543		
NIST 2710a_4		1529		
NIST 2710a_5		1560		
NIST 2710a_6		1551		
NIST 2710a_7		1576		
	%RSD	1.8	Excellent	
NIST 2711a_1		101		
NIST 2711a_2		112		
NIST 2711a_3		109		
NIST 2711a_4		102		
NIST 2711a_5		100		
NIST 2711a_6		96		
NIST 2711a_7		90		
	%RSD	7.3	Good	Later duplicates may reflect lower precision since XRF was analyzing high As in samples towards the end of analysis. Overall, this instrument routinely shows excellent precision for As.
BMT-100		93		
BMT-100_duplicate		94		
	%RSD	0.8	Excellent	
BMT-82		1123		
Repeat BMT-82		1225		
	%RSD	6.1	Very good	
BMT-84		1978		
Repeat BMT-84		1982		
	%RSD	0.1	Excellent	
BMT-100		93		
BMT-100-duplicate		94		
	%RSD	0.8	Excellent	
BMT-451		423		
BMT-451-duplicate		423		
	%RSD	0.0	Excellent	

Accuracy

How well does the XRF detect the true concentration of As in a sample?

Assessed by calculating % Relative Percent Difference (RPD) = (XRF reported As - NIST certified As / NIST certified As) * 100

RPD% less than or equal to +/-5% show excellent accuracy

Sample ID	As (ppm)	
Certified concentration in NIST 2710a	1540	
NIST 2710a_1	1614	
NIST 2710a_2	1558	
NIST 2710a_3	1543	
NIST 2710a_4	1529	
NIST 2710a_5	1560	
NIST 2710a_6	1551	
NIST 2710a_7	1576	
NIST 2710a_1a	1543	
NIST 2710a_2a	1538	
NIST 2710a_3a	1528	
Average %RPD	0.9	Excellent accuracy
Certified concentration in NIST 2711a	107	
NIST 2711a_1	101	
NIST 2711a_2	112	
NIST 2711a_3	109	
NIST 2711a_4	102	
NIST 2711a_5	100	
NIST 2711a_6	96	
NIST 2711a_7	90	
NIST 2711a_1a	96	
NIST 2711a_2a	100	
NIST 2711a_3a	102	
Average %RPD	-5.8	Good-excellent accuracy

Blanks

Does the XRF detect As when it's not actually present in a sample?

Blanks should measure As as non-detect (ND) to show no false As is being measured

Sample ID	As (ppm)	
SiO2 Blank_1	ND	All blanks pass
SiO2 Blank_2	ND	
SiO2 Blank_3	ND	
SiO2 Blank_4	ND	
SiO2 Blank_5	ND	
SiO2 Blank_6	ND	
SiO2 Blank_7	ND	
SiO2 Blank_1a	ND	
SiO2 Blank_2a	ND	
SiO2 Blank_3a	ND	

APPENDIX IV

External Lab Reports from EMA

EnviroMatrix Analytical, Inc.

21 July 2017

University of San Diego
Attn: Beth O'Shea, PhD
5998 Alcala Park
San Diego, CA 92110

EMA Log #: 17G0263

Project Name: Black Mountain Bioaccessibility Canyon
Project Desc./#: Goal IVa Additional

Enclosed are the results of analyses for samples received by the laboratory on 07/10/17 14:00. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: University of San Diego

EMA Log #: 17G0263

Project Name: Black Mountain Bioaccessibility Canyon

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Flume east end soil-13	17G0263-01	Wastewater	06/26/17 13:00	07/10/17 14:00
Trail crossing-19	17G0263-02	Wastewater	06/26/17 13:00	07/10/17 14:00
pit mine 2-22	17G0263-03	Wastewater	06/26/17 13:00	07/10/17 14:00
pit mine 2-22-duplicate	17G0263-04	Wastewater	06/26/17 13:00	07/10/17 14:00
pit mine 1 tailings-18	17G0263-05	Wastewater	06/26/17 13:00	07/10/17 14:00
pothole-23	17G0263-06	Wastewater	06/26/17 13:00	07/10/17 14:00
Downslope M12-21	17G0263-07	Wastewater	06/26/17 13:00	07/10/17 14:00
Glory Hole-03	17G0263-08	Wastewater	06/26/17 13:00	07/10/17 14:00
Canyon Trailings-08	17G0263-09	Wastewater	06/26/17 13:00	07/10/17 14:00
ranga adit-01	17G0263-10	Wastewater	06/26/17 13:00	07/10/17 14:00
cyanide trails soil-17	17G0263-11	Wastewater	06/26/17 13:00	07/10/17 14:00
koala adit soil-06	17G0263-12	Wastewater	06/26/17 13:00	07/10/17 14:00
koala adit soil-07	17G0263-13	Wastewater	06/26/17 13:00	07/10/17 14:00
ranga trailings-02	17G0263-14	Wastewater	06/26/17 13:00	07/10/17 14:00
Hobbit hole trailings-04	17G0263-15	Wastewater	06/26/17 13:00	07/10/17 14:00
concrete roaster soil-09	17G0263-16	Wastewater	06/26/17 13:00	07/10/17 14:00
east of cyanide vat 1-15	17G0263-17	Wastewater	06/26/17 13:00	07/10/17 14:00
tailings south dust flume-10	17G0263-18	Wastewater	06/26/17 13:00	07/10/17 14:00
hobbit hole tailings-05	17G0263-19	Wastewater	06/26/17 13:00	07/10/17 14:00
rock crusher M4 soil-14	17G0263-20	Wastewater	06/26/17 13:00	07/10/17 14:00
drainage varve-16	17G0263-21	Wastewater	06/26/17 13:00	07/10/17 14:00
Gastric fluid blank-03	17G0263-22	Wastewater	06/26/17 13:00	07/10/17 14:00
Gastric fluid blank-04	17G0263-23	Wastewater	06/26/17 13:00	07/10/17 14:00

Client Name: University of San Diego **EMA Log #: 17G0263**
Project Name: Black Mountain Bioaccessibility Canyon

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Flume east end soil-13 (17G0263-01) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.231**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
Trail crossing-19 (17G0263-02) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.213**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
pit mine 2-22 (17G0263-03) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.008**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	J
pit mine 2-22-duplicate (17G0263-04) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
pit mine 1 tailings-18 (17G0263-05) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.110**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
pothole-23 (17G0263-06) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.019**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
Downslope M12-21 (17G0263-07) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**1.73**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
Glory Hole-03 (17G0263-08) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.280**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
Canyon Trailings-08 (17G0263-09) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.064**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	

Client Name: University of San Diego **EMA Log #: 17G0263**
Project Name: Black Mountain Bioaccessibility Canyon

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
ranga adit-01 (17G0263-10) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.008**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	J
cyanide trails soil-17 (17G0263-11) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**1.32**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
koala adit soil-06 (17G0263-12) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.155**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
koala adit soil-07 (17G0263-13) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.005**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	J
ranga trailings-02 (17G0263-14) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.823**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
Hobbit hole trailings-04 (17G0263-15) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**1.18**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
concrete roaster soil-09 (17G0263-16) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**9.72**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	
east of cyanide vat 1-15 (17G0263-17) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.466**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	
tailings south dust flume-10 (17G0263-18) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**1.41**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
hobbit hole tailings-05 (17G0263-19) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**2.47**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	
rock crusher M4 soil-14 (17G0263-20) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**1.33**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	
drainage varve-16 (17G0263-21) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**1.09**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	
Gastric fluid blank-03 (17G0263-22) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	
Gastric fluid blank-04 (17G0263-23) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071745	07/17/17	07/17/17	EPA 6010	J

Client Name: University of San Diego
Project Name: Black Mountain Bioaccessibility Canyon

EMA Log #: 17G0263

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7071744											
Blank (7071744-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071744-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	0.999	0.004	0.010	mg/l	1.00		100	75-125			
LCS Dup (7071744-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	0.993	0.004	0.010	mg/l	1.00		99	75-125	0.6	20	
Batch 7071745											
Blank (7071745-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071745-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.01	0.004	0.010	mg/l	1.00		101	75-125			
LCS Dup (7071745-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.01	0.004	0.010	mg/l	1.00		101	75-125	0.2	20	

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

CHAIN-OF-CUSTODY RECORD 1760263

– EnviroMatrix EMA Analytical, Inc. ——

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 1 of 3

EMA LOG #:

Client: USD

Attn: Beth O'Shea

Samplers(s): O'Shea & Wright

Address: 5998 Alcala Park, EOS-Dept.
San Diego CA 92110

Phone: 619 260 4243 ~~Fax~~

Email: bethoshea@sandiego.edu

Billing Address: As above

Project ID: Black Mountain Bioaccessibility Canyon

Project #: Goal IVa: Additional PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐413.1 ☐413.2 ☐1664	8015 (TPH) ☐Gas ☐Diesel ☐Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐pH ☐EC ☐TSS ☐TDS	☐Nitrate ☐Nitrite ☐TKN ☐NH3	CAC Title 22/CAM17 Metals ☐TTLC ☐STLC	TCLP (RCRA) ☐Metals ☐Organics	Cd Cr Cu Pb Ni Ag Zn ☐Dissolved	Coliform, ☐Total (MTF) ☐Fecal (MTF)	Colilert, T+E.Coli ☐P/A ☐Enumeration	Enterococcus, ☐MTF ☐Enterolert	Heterotrophic Plate Count (HPC)	☐BOD ☐COD ☐Cyanide	Total As				
1	Flume east end soil-13	6/26	1pm	WW	Falcon																			X				
2	Trail crossing-19	↓	↓	↓	tube																			↓				
3	Pit mine 2-22	↓	↓	↓	↓																			↓				
4	Pit mine 2-22-duplicate	↓	↓	↓	↓																			↓				
5	Pit mine 1 tailings-18	↓	↓	↓	↓																			↓				
6	Pothole-23	↓	↓	↓	↓																			↓				
7	Downslope M12-21	↓	↓	↓	↓																			↓				
8	Glory Hole-03	↓	↓	↓	↓																			↓				
9	Canyon Tailings-08	↓	↓	↓	↓																			↓				
10	ranga adit-01	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

[1]**Turn-Around-Time:** ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)

[1]**Reporting Requirements:** ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT

[1]**Sample Disposal:** ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A	Containers Properly Preseved: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]	Temp @ Receipt: 20°C
COC/Labels Agree: [✓ Yes] No N/A	Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B. O'Sh Print O'Shea Company: USD	7/10/17 1020	Signature Print Mark Rein Company: EMA
Signature Print Mark Reis Company: EMA	7.10.17 1400	Signature Print Milsa Mayor Company: Ema
Signature Print Company:		Signature Print Company:

Project/Sample Comments:

[1]Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2]EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

CHAIN-OF-CUSTODY RECORD

1760263

-EnviroMatrix EMA Analytical, Inc.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 2 of 3

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Samplers(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110
Phone: 619 260 4243 ~~Fax:~~
Email: bethoshea@sandiego.edu
Billing Address: As above

Project ID: Black Mountain Bioaccessibility Canyon
Project #: Goal IVa: Additional PO #: —

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease □413.1 □413.2 □1664	8015 (TPH) □ Gas □ Diesel □ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) □ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	□ pH □ EC □ TSS □TDS	□ Nitrate □ Nitrite □ TKN □NH3	CAC Title 22/CAM17 Metals □ TTLC □ STLC	TCLP (RCRA) □ Metals □ Organics	Cd Cr Cu Pb Ni Ag Zn □ Dissolved	Coliform, □ Total (MTF) □ Fecal (MTF)	Colilert, T+E.Coli □ P/A □ Enumeration	Enterococcus, □ MTF □ Enterolert	Heterotrophic Plate Count (HPC)	□ BOD □ COD □ Cyanide	Total As				
1	cyanide trail soil - 17	6/26	1pm	WW	Falcon tube																			X				
2	koala adit soil - 06																											
3	koala adit tailing - 07																											
4	Ranga tailings - 02																											
5	Hobbit hole tailings - 04																											
6	Concrete coaster soil - 09																											
7	east of cyanide vat 1 - 15																											
8	tailing south dust flume - 10																											
9	hobbit hole tailings - 05																											
10	rock crusher M4 soil - 14	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
[1]**Turn-Around-Time:** ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]**Reporting Requirements:** ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
[2]**Sample Disposal:** ☒ By Laboratory ☐ [1]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A	Containers Properly Preseved: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]	Temp @ Receipt: 20°C
COC/Labels Agree: [✓ Yes] No N/A	Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature	7/10/17 1020	Signature
Print O'Shea		Print Mark Kelly
Company: USD		Company: EM
Signature	7.10.17 1400	Signature
Print Mark Kelly		Print Nika Mayer
Company: EM		Company: Ena
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments:

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CHAIN-OF-CUSTODY RECORD 1760263

– EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 3 of 3

EMA LOG #:

Client: USD

Attn: Beth O'Shea

Samplers(s): O'Shea & Wright

Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110

Phone: 619 260 4243 ~~Fax:~~

Email: bethoshea@sandiego.edu

Billing Address: As above

Project ID: Black Mountain Bioaccessibility Canyon

Project #: Goal IVa: Additional PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	drainage varve - 16	6/26	1pm	WW	Falcon																			X				
2	Gastric fluid blank - 03				tube																							
3	Gastric fluid blank - 04	↓	↓	↓	↓																			↓				
4																												
5																												
6																												
7																												
8																												
9																												
10																												

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

[1]Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)

[1]Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT

[1]Sample Disposal: ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Preseved: [✓ Yes] No N/A
Temp @ Receipt: 22°c
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B.O.M	7/10/17	Signature
Print O'Shea	1020	Print Mark [illegible]
Company: USD		Company: EMA
Signature	7.10.17	Signature
Print Mark [illegible]	1400	Print Mika Mayer
Company: EMA		Company: EMA
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments:

---

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EnviroMatrix Analytical, Inc.

21 July 2017

University of San Diego
Attn: Beth O'Shea, PhD
5998 Alcala Park
San Diego, CA 92110

EMA Log #: 17G0262

Project Name: Black Mountain Bioaccessibility Miner's Ridge
Project Desc./#: USD Goal IVa

Enclosed are the results of analyses for samples received by the laboratory on 07/10/17 14:00. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: University of San Diego **EMA Log #: 17G0262**
Project Name: Black Mountain Bioaccessibility Miner's Ridge

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BMT-01	17G0262-01	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-02	17G0262-02	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-03	17G0262-03	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-04	17G0262-04	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-05	17G0262-05	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-06	17G0262-06	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-07	17G0262-07	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-08	17G0262-08	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-09	17G0262-09	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-10	17G0262-10	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-11	17G0262-11	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-12	17G0262-12	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-13	17G0262-13	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-14	17G0262-14	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-15	17G0262-15	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-16	17G0262-16	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-17	17G0262-17	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-18	17G0262-18	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-19	17G0262-19	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-20	17G0262-20	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-21	17G0262-21	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-22	17G0262-22	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-23	17G0262-23	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-24	17G0262-24	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-25	17G0262-25	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-26	17G0262-26	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-27	17G0262-27	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-28	17G0262-28	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-28 duplicate	17G0262-29	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-29	17G0262-30	Wastewater	06/19/17 14:00	07/10/17 14:00
BMT-30	17G0262-31	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-31	17G0262-32	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-32	17G0262-33	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-33	17G0262-34	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-34	17G0262-35	Wastewater	06/23/17 13:00	07/10/17 14:00

Client Name: University of San Diego **EMA Log #: 17G0262**
Project Name: Black Mountain Bioaccessibility Miner's Ridge

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BMT-34 duplicate	17G0262-36	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-35	17G0262-37	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-36	17G0262-38	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-37	17G0262-39	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-38	17G0262-40	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-39	17G0262-41	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-40	17G0262-42	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-41	17G0262-43	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-42	17G0262-44	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-43	17G0262-45	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-44	17G0262-46	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-45	17G0262-47	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-45 duplicate	17G0262-48	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-46	17G0262-49	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-47	17G0262-50	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-48	17G0262-51	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-49	17G0262-52	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-50	17G0262-53	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-51	17G0262-54	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-52	17G0262-55	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-53	17G0262-56	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-54	17G0262-57	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-55	17G0262-58	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-56	17G0262-59	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-57	17G0262-60	Wastewater	06/23/17 13:00	07/10/17 14:00
BMT-58	17G0262-61	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-59	17G0262-62	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-60	17G0262-63	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-61	17G0262-64	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-62	17G0262-65	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-63	17G0262-66	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-64	17G0262-67	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-65	17G0262-68	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-66	17G0262-69	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-67	17G0262-70	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-68	17G0262-71	Wastewater	06/26/17 13:00	07/10/17 14:00

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: University of San Diego **EMA Log #: 17G0262**
Project Name: Black Mountain Bioaccessibility Miner's Ridge

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BMT-69	17G0262-72	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-70	17G0262-73	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-71	17G0262-74	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-72	17G0262-75	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-73	17G0262-76	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-74	17G0262-77	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-75	17G0262-78	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-76	17G0262-79	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-77	17G0262-80	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-78	17G0262-81	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-79	17G0262-82	Wastewater	06/26/17 13:00	07/10/17 14:00
BMT-79 duplicate	17G0262-83	Wastewater	06/26/17 13:00	07/10/17 14:00
Gastric Fluid Blank-01	17G0262-84	Wastewater	06/26/17 13:00	07/10/17 14:00
Gastric Fluid Blank-02	17G0262-85	Wastewater	06/26/17 13:00	07/10/17 14:00

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-01 (17G0262-01) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.012**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-02 (17G0262-02) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-03 (17G0262-03) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.005**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-04 (17G0262-04) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-05 (17G0262-05) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-06 (17G0262-06) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-07 (17G0262-07) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-08 (17G0262-08) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-09 (17G0262-09) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	

Client Name: University of San Diego **EMA Log #: 17G0262**
Project Name: Black Mountain Bioaccessibility Miner's Ridge

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-10 (17G0262-10) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-11 (17G0262-11) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-12 (17G0262-12) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-13 (17G0262-13) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-14 (17G0262-14) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-15 (17G0262-15) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-16 (17G0262-16) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	
BMT-17 (17G0262-17) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-18 (17G0262-18) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-19 (17G0262-19) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.007**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-20 (17G0262-20) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071729	07/17/17	07/17/17	EPA 6010	J
BMT-21 (17G0262-21) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-22 (17G0262-22) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-23 (17G0262-23) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-24 (17G0262-24) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-25 (17G0262-25) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-26 (17G0262-26) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-27 (17G0262-27) Wastewater	**Sampled: 06/19/17 14:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	J

Client Name: University of San Diego **EMA Log #: 17G0262**
Project Name: Black Mountain Bioaccessibility Miner's Ridge

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-28 (17G0262-28) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-28 duplicate (17G0262-29) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-29 (17G0262-30) Wastewater Sampled: 06/19/17 14:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-30 (17G0262-31) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.005**	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	J
BMT-31 (17G0262-32) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-32 (17G0262-33) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-33 (17G0262-34) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.007**	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	J
BMT-34 (17G0262-35) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-34 duplicate (17G0262-36) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	J

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-35 (17G0262-37) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-36 (17G0262-38) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-37 (17G0262-39) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-38 (17G0262-40) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071730	07/17/17	07/17/17	EPA 6010	
BMT-39 (17G0262-41) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-40 (17G0262-42) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-41 (17G0262-43) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J
BMT-42 (17G0262-44) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-43 (17G0262-45) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.005**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-44 (17G0262-46) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-45 (17G0262-47) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.005**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J
BMT-45 duplicate (17G0262-48) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J
BMT-46 (17G0262-49) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J
BMT-47 (17G0262-50) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-48 (17G0262-51) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.021**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-49 (17G0262-52) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.020**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-50 (17G0262-53) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-51 (17G0262-54) Wastewater Sampled: 06/23/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.011**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-52 (17G0262-55) Wastewater	**Sampled: 06/23/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.005**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J
BMT-53 (17G0262-56) Wastewater	**Sampled: 06/23/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-54 (17G0262-57) Wastewater	**Sampled: 06/23/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-55 (17G0262-58) Wastewater	**Sampled: 06/23/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	J
BMT-56 (17G0262-59) Wastewater	**Sampled: 06/23/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-57 (17G0262-60) Wastewater	**Sampled: 06/23/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071731	07/17/17	07/17/17	EPA 6010	
BMT-58 (17G0262-61) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-59 (17G0262-62) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	J
BMT-60 (17G0262-63) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	J

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-61 (17G0262-64) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-62 (17G0262-65) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.013**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-63 (17G0262-66) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.010**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-64 (17G0262-67) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.029**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-65 (17G0262-68) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.136**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-66 (17G0262-69) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.022**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-67 (17G0262-70) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.022**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-68 (17G0262-71) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.013**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-69 (17G0262-72) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.008**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	J

Client Name: University of San Diego **EMA Log #: 17G0262**
Project Name: Black Mountain Bioaccessibility Miner's Ridge

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-70 (17G0262-73) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.008**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	J
BMT-71 (17G0262-74) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.006**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	J
BMT-72 (17G0262-75) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.011**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-73 (17G0262-76) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-74 (17G0262-77) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-75 (17G0262-78) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-76 (17G0262-79) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	J
BMT-77 (17G0262-80) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071743	07/17/17	07/17/17	EPA 6010	
BMT-78 (17G0262-81) Wastewater	**Sampled: 06/26/17 13:00**		**Received: 07/10/17 14:00**							
Arsenic	ND	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-79 (17G0262-82) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	
BMT-79 duplicate (17G0262-83) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	J
Gastric Fluid Blank-01 (17G0262-84) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	J
Gastric Fluid Blank-02 (17G0262-85) Wastewater Sampled: 06/26/17 13:00 Received: 07/10/17 14:00										
Arsenic	ND	0.004	0.010	mg/l	1	7071744	07/17/17	07/17/17	EPA 6010	

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7071729											
Blank (7071729-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071729-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	0.984	0.004	0.010	mg/l	1.00		98	75-125			
LCS Dup (7071729-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	0.981	0.004	0.010	mg/l	1.00		98	75-125	0.3	20	
Batch 7071730											
Blank (7071730-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071730-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.02	0.004	0.010	mg/l	1.00		102	75-125			
LCS Dup (7071730-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.01	0.004	0.010	mg/l	1.00		101	75-125	0.5	20	
Batch 7071731											
Blank (7071731-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071731-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.02	0.004	0.010	mg/l	1.00		102	75-125			

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7071731											
LCS Dup (7071731-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.02	0.004	0.010	mg/l	1.00		102	75-125	0.2	20	
Batch 7071743											
Blank (7071743-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071743-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.01	0.004	0.010	mg/l	1.00		101	75-125			
LCS Dup (7071743-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	1.00	0.004	0.010	mg/l	1.00		100	75-125	0.5	20	
Batch 7071744											
Blank (7071744-BLK1)					Prepared & Analyzed: 07/17/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7071744-BS1)					Prepared & Analyzed: 07/17/17						
Arsenic	0.999	0.004	0.010	mg/l	1.00		100	75-125			
LCS Dup (7071744-BSD1)					Prepared & Analyzed: 07/17/17						
Arsenic	0.993	0.004	0.010	mg/l	1.00		99	75-125	0.6	20	

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

Page 1 of 9

CHAIN-OF-CUSTODY RECORD 1760262

– EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:

Client: USD
Attn: Beth O'Shea
Samplers(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110
Phone: 619 260 4243 Fax:
Email: bethoshea@sandiego.edu
Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miner's Ridge
Project #: USD Goal IVa PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT-01	6/19	2pm	WW	Falcon																			X				
2	BMT-02				tube																							
3	BMT-03																											
4	BMT-04																											
5	BMT-05																											
6	BMT-06																											
7	BMT-07																											
8	BMT-08																											
9	BMT-09																											
10	BMT-10																											

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
[1]Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
[1]Sample Disposal: ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Preseved: [✓ Yes] No N/A
Temp @ Receipt: 20°C
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature	7/10/17 1020	Signature
Print O'Shea		Print M. Rai
Company: USD		Company: EM
Signature	7.10.17 1400	Signature
Print Marc Rai		Print nitsa mayer
Company: EM		Company: Em
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments:

[1] Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2] EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

Page 2 of 9

CHAIN-OF-CUSTODY RECORD 1760262

– EnviroMatrix Analytical, Inc. ——

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:

Client: USD

Attn: Beth O'Shea

Samplers(s): O'Shea & Wright

Address: 5998 Alcala Park EOS Dept.
San Diego CA 92110

Phone: 619 260 4243 ~~Fax~~

Email: bethoshea@sandiego.edu

Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miners Ridge

Project #: USD Goal IVa PO #: —

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT-11	6/19	2pm	WW	Falcon																			X				
2	BMT-12				tube																							
3	BMT-13																											
4	BMT-14																											
5	BMT-15																											
6	BMT-16																											
7	BMT-17																											
8	BMT-18																											
9	BMT-19																											
10	BMT-20	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

[1]**Turn-Around-Time:** ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)

[1]**Reporting Requirements:** ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT

[2]**Sample Disposal:** ☒ By Laboratory ☐ [1]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A

Custody Seals Intact: Yes No [✓ N/A]

COC/Labels Agree: [✓ Yes] No N/A

Containers Properly Preseved: [✓ Yes] No N/A

Temp @ Receipt: 20° C

Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature: B.O.Sh	7/10/17	Signature:
Print: O'Shea		Print: Mark Reh
Company: USD	1020	Company: EMA
Signature:	7.10.17	Signature:
Print: Mark Reh		Print: mitra mayer
Company: EMA	1400	Company: EMA
Signature:		Signature:
Print:		Print:
Company:		Company:

Project/Sample Comments:

[1] Additional costs may apply. Please note there is a $35 minimum charge for all clients.

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Page 3 of 9

CHAIN-OF-CUSTODY RECORD 1760262

– EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:

Client: USD

Attn: Beth O'Shea

Samplers(s): O'Shea & Wright

Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110

Phone: 619 260 4243 ~~Fax:~~

Email: bethoshea@sandiego.edu

Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miners Ridge

Project #: USD Goal IVa PO #: —

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT-21	6/19	2pm	WW	Falcon																			X				
2	BMT-22	↓	↓	↓	tube																			↓				
3	BMT-23	↓	↓	↓	↓																			↓				
4	BMT-24	↓	↓	↓	↓																			↓				
5	BMT-25	↓	↓	↓	↓																			↓				
6	BMT-26	↓	↓	↓	↓																			↓				
7	BMT-27	↓	↓	↓	↓																			↓				
8	BMT-28	↓	↓	↓	↓																			↓				
9	BMT-28 - duplicate	↓	↓	↓	↓																			↓				
10	BMT-29	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

[1]**Turn-Around-Time:** ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)

[1]**Reporting Requirements:** ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT

[1]**Sample Disposal:** ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A

Custody Seals Intact: Yes No [✓ N/A]

COC/Labels Agree: [✓ Yes] No N/A

Containers Properly Preseved: [✓ Yes] No N/A

Temp @ Receipt: 20°

Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B.O'Sh Print O'Shea Company: USD	7/10/17 1020	Signature Print Mark Rela Company: EMA
Signature Print Mark Rela Company: EMA	7.10.17 1400	Signature Print milta mayor Company: Ema
Signature Print Company:		Signature Print Company:

Project/Sample Comments:

[1] Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2] EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

CHAIN-OF-CUSTODY RECORD 1760262

- EnviroMatrix Analytical, Inc. -

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 4 of 9

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Samplers(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS-Dept.
San Diego CA 92110
Phone: 619 260 4243 ~~Fax~~
Email: bethoshea@sandiego.edu
Billing Address: As above
Project ID: Black Mountain Bioaccessibility Miner's Ridge
Project #: USD Goal IVa PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐413.1 ☐413.2 ☐1664	8015 (TPH) ☐Gas ☐Diesel ☐Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐pH ☐EC ☐TSS ☐TDS	☐Nitrate ☐Nitrite ☐TKN ☐NH3	CAC Title 22/CAM17 Metals ☐TTLC ☐STLC	TCLP (RCRA) ☐Metals ☐Organics	Cd Cr Cu Pb Ni Ag Zn ☐Dissolved	Coliform, ☐Total (MTF) ☐Fecal (MTF)	Colilert, T+E.Coli ☐P/A ☐Enumeration	Enterococcus, ☐MTF ☐Enterolert	Heterotrophic Plate Count (HPC)	☐BOD ☐COD ☐Cyanide	Total As					
1	BMT-30	6/23	1pm	WW	Falcon tube																			X					
2	BMT-31																												
3	BMT-32																												
4	BMT-33																												
5	BMT-34																												
6	BMT-34_duplicate																												
7	BMT-35																												
8	BMT-36																												
9	BMT-37																												
10	BMT-38	↓	↓	↓	↓																			↓					

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☒Courier ☐UPS ☐FedEx ☐USPS ☐Client Drop Off ☐Other
[1]Turn-Around-Time: ☐Same Day ☐1 day ☐2 day ☐3 day ☐4 day ☐5 day ☒STD (7 day)
[1]Reporting Requirements: ☐Fax ☒PDF ☒Excel ☐Geotracker/EDF ☐Hard Copy ☐EDT
[1]Sample Disposal: ☒By Laboratory ☐[2]Return to Client: P/U or Delivery ☐Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Presevad: [✓ Yes] No N/A
Temp @ Receipt: 20°
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature: B. O	7/10/17 1020	Signature:
Print: O'Shea		Print: Mark Rei
Company: USD		Company: EMA
Signature:	7.10.17 1400	Signature:
Print: Mark Rei		Print: mika mayer
Company: EMA		Company: EMA
Signature:		Signature:
Print:		Print:
Company:		Company:

Project/Sample Comments:

[1] Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2] EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

CHAIN-OF-CUSTODY RECORD

1760262

-EnviroMatrix Analytical, Inc.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 5 of 9

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Samplers(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110
Phone: 619 260 4243 ~~Fax~~
Email: bethoshea@sandiego.edu
Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miner's Ridge
Project #: USD Goal IVa
PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT - 39	6/23	1pm	WW	falcon tube																							
2	BMT - 40																							X				
3	BMT - 41																											
4	BMT - 42																											
5	BMT - 43																											
6	BMT - 44																											
7	BMT - 45																											
8	BMT - 45-duplicate																											
9	BMT - 46																											
10	BMT - 47	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
¹Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
¹Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
²Sample Disposal: ☒ By Laboratory ☐ ¹Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A	Containers Properly Preseved: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]	Temp @ Receipt: 20°C
COC/Labels Agree: [✓ Yes] No N/A	Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B. O. Print O'Shea Company: USD	7/10/17 1020	Signature Print Mark Rain Company: EMA
Signature Print Mark Kh Company: EMA	7-10-17 1400	Signature Print Mika Major Company: EMA
Signature Print Company:		Signature Print Company:

Project/Sample Comments:

¹Additional costs may apply. Please note there is a $35 minimum charge for all clients.

²EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

CHAIN-OF-CUSTODY RECORD 17G0262

– EnviroMatrix EMA Analytical, Inc. ——

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 6 of 9

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Samplers(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS-Dept.
San Diego CA 92110
Phone: 619 260 4243 ~~Fax:~~
Email: bethoshea@sandiego.edu
Billing Address: As above
Project ID: Black Mountain Bioaccessibility Miner's Ridge
Project #: USD Goal IVa PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐413.1 ☐413.2 ☐1664	8015 (TPH) ☐Gas ☐Diesel ☐Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐pH ☐EC ☐TSS ☐TDS	☐Nitrate ☐Nitrite ☐TKN ☐NH3	CAC Title 22/CAM17 Metals ☐TTLC ☐STLC	TCLP (RCRA) ☐Metals ☐Organics	Cd Cr Cu Pb Ni Ag Zn ☐Dissolved	Coliform, ☐Total (MTF) ☐Fecal (MTF)	Colilert, T+E.Coli ☐P/A ☐Enumeration	Enterococcus, ☐MTF ☐Enterolert	Heterotrophic Plate Count (HPC)	☐BOD ☐COD ☐Cyanide	Total As				
1	BMT-48	6/23	1pm	WW	Falcon tube																							
2	BMT-49																							X				
3	BMT-50																											
4	BMT-51																											
5	BMT-52																											
6	BMT-53																											
7	BMT-54																											
8	BMT-55																											
9	BMT-56																											
10	BMT-57	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒Courier ☐UPS ☐FedEx ☐USPS ☐Client Drop Off ☐Other
¹Turn-Around-Time: ☐Same Day ☐1 day ☐2 day ☐3 day ☐4 day ☐5 day ☒STD (7 day)
¹Reporting Requirements: ☐Fax ☒PDF ☒Excel ☐Geotracker/EDF ☐Hard Copy ☐EDT
¹Sample Disposal: ☒By Laboratory ☐²Return to Client: P/U or Delivery ☐Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Preseved: [✓ Yes] No N/A
Temp @ Receipt: 20°
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B.O.	7/10/17	Signature
Print O'Shea	1020	Print Marc Reta
Company: USD		Company: EM
Signature	7.10.17	Signature
Print Marc Reta	1400	Print mifa m[illegible]
Company: EM		Company: F/T
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments:

¹Additional costs may apply. Please note there is a $35 minimum charge for all clients.

²EMA reserves the right to return any samples that do not match our waste profile.

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CHAIN-OF-CUSTODY RECORD 1760262

– EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 7 of 9

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Sampler(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS-Dept.
San Diego CA 92110
Phone: 619 260 4243 ~~Fax:~~
Email: bethoshea@sandiego.edu
Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miner's Ridge
Project #: USD Goal IVa PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT-58	6/26	1pm	WW	Falcon tube																			X				
2	BMT-59																											
3	BMT-60																											
4	BMT-61																											
5	BMT-62																											
6	BMT-63																											
7	BMT-64																											
8	BMT-65																											
9	BMT-66																											
10	BMT-67																											

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
¹Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
¹Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
¹Sample Disposal: ☒ By Laboratory ☐ ²Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A	Containers Properly Preseved: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]	Temp @ Receipt: 20°
COC/Labels Agree: [✓ Yes] No N/A	Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature D.O. Print O'Shea Company: USD	7/10/17 1020	Signature Print Mark Reb Company: EMA
Signature Print Mark Reb Company: EMA	7.10.17 1400	Signature Print Mika Mayer Company: EMA
Signature Print Company:		Signature Print Company:

Project/Sample Comments:

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CHAIN-OF-CUSTODY RECORD 1760262

- EnviroMatrix Analytical, Inc. -

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 8 of 9

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Sampler(s): O'Shea & Wright
Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110
Phone: 619 260 4243 ~~Fax:~~
Email: bethoshea@sandiego.edu
Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miner Ridge
Project #: USD Goal IVa
PO #: –

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	BMT-68	6/26	1pm	WW	Falcon tube
2	BMT-69	↓	↓	↓	↓
3	BMT-70	↓	↓	↓	↓
4	BMT-71	↓	↓	↓	↓
5	BMT-72	↓	↓	↓	↓
6	BMT-73	↓	↓	↓	↓
7	BMT-74	↓	↓	↓	↓
8	BMT-75	↓	↓	↓	↓
9	BMT-76	↓	↓	↓	↓
10	BMT-77	↓	↓	↓	↓

Requested Analysis

ID #	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1																			X				
2																			↓				
3																			↓				
4																			↓				
5																			↓				
6																			↓				
7																			↓				
8																			↓				
9																			↓				
10																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
¹Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
¹Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
¹Sample Disposal: ☒ By Laboratory ☐ ²Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Preseved: [✓ Yes] No N/A
Temp @ Receipt: 20°
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B.O'Shea Print O'Shea Company: USD	7/10/17 1020	Signature Print Mark Rely Company: EMA
Signature Print Mark Rely Company: EMA	7.10.17 1400	Signature Print mike major Company: Em
Signature Print Company:		Signature Print Company:

Project/Sample Comments:

¹Additional costs may apply. Please note there is a $35 minimum charge for all clients.

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CHAIN-OF-CUSTODY RECORD

17G0262

– EnviroMatrix Analytical, Inc. –

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 9 of 9

EMA LOG #:

Client: USD

Attn: Beth O'Shea

Sampler(s): O'Shea & Wright

Address: 5998 Alcala Park, EOS Dept.
San Diego CA 92110

Phone: 619 260 4243 ~~Fax:~~

Email: bethoshea@sandiego.edu

Billing Address: As above

Project ID: Black Mountain Bioaccessibility Miner's Ridge

Project #: USD Goal IVa

PO #: –

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐413.1 ☐413.2 ☐1664	8015 (TPH) ☐Gas ☐Diesel ☐Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐pH ☐EC ☐TSS ☐TDS	☐Nitrate ☐Nitrite ☐TKN ☐NH3	CAC Title 22/CAM17 Metals ☐TTLC ☐STLC	TCLP (RCRA) ☐Metals ☐Organics	Cd Cr Cu Pb Ni Ag Zn ☐Dissolved	Coliform, ☐Total (MTF) ☐Fecal (MTF)	Colilert, T+E.Coli ☐P/A ☐Enumeration	Enterococcus, ☐MTF ☐Enterolert	Heterotrophic Plate Count (HPC)	☐BOD ☐COD ☐Cyanide	Total As				
1	BMT-78	6/26	1pm	WW	Falcon																			X				
2	BMT-79				tube																							
3	BMT-79_duplicate																											
4	Gastric Fluid Blank-01																											
5	Gastric Fluid Blank-02	↓	↓	↓	↓																			↓				
6																												
7																												
8																												
9																												
10																												

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒Courier ☐UPS ☐FedEx ☐USPS ☐Client Drop Off ☐Other

¹Turn-Around-Time: ☐Same Day ☐1 day ☐2 day ☐3 day ☐4 day ☐5 day ☒STD (7 day)

¹Reporting Requirements: ☐Fax ☒PDF ☒Excel ☐Geotracker/EDF ☐Hard Copy ☐EDT

¹Sample Disposal: ☒By Laboratory ☐²Return to Client: P/U or Delivery ☐Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Preseved: [✓ Yes] No N/A
Temp @ Receipt: 20°
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY		DATE/TIME	RECEIVED BY	
Signature	B. O'Sh	7/19/17 1020	Signature	
Print	O'Shea		Print	Mark Ben
Company:	USD		Company:	EMA
Signature		7.20.17 1400	Signature	
Print	Mark Ben		Print	Mitra Mayer
Company:	EMA		Company:	EMA
Signature			Signature	
Print			Print	
Company:			Company:	

Project/Sample Comments:

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EnviroMatrix Analytical, Inc.

21 September 2017

University of San Diego
Attn: Beth O'Shea, PhD
5998 Alcala Park
San Diego, CA 92110

EMA Log #: 17I0345

Project Name: **Black Mountain Bioaccessibility Trail Extra**
Project Desc./#: **Goal IVa Additional**

Enclosed are the results of analyses for samples received by the laboratory on 09/12/17 12:30. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: University of San Diego
Project Name: Black Mountain Bioaccessibility Trail Extra

EMA Log #: 17I0345

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BMT 80	17I0345-01	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 81	17I0345-02	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 82	17I0345-03	Wastewater	08/25/17 14:00	09/12/17 12:30
Repeat BMT 82	17I0345-04	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 83	17I0345-05	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 84	17I0345-06	Wastewater	08/25/17 14:00	09/12/17 12:30
Repeat BMT 84	17I0345-07	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 85	17I0345-08	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 86	17I0345-09	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 87	17I0345-10	Wastewater	08/25/17 14:00	09/12/17 12:30
BMT 88	17I0345-11	Wastewater	08/25/17 14:00	09/12/17 12:30
Blank gastric fluid	17I0345-12	Wastewater	08/25/17 14:00	09/12/17 12:30

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT 80 (17I0345-01) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	J
BMT 81 (17I0345-02) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.012**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
BMT 82 (17I0345-03) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.116**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
Repeat BMT 82 (17I0345-04) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.153**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
BMT 83 (17I0345-05) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.161**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
BMT 84 (17I0345-06) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.148**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
Repeat BMT 84 (17I0345-07) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.157**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
BMT 85 (17I0345-08) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.006**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	J
BMT 86 (17I0345-09) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	**0.007**	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	J

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT 87 (17I0345-10) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	ND	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
BMT 88 (17I0345-11) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	ND	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	
Blank gastric fluid (17I0345-12) Wastewater Sampled: 08/25/17 14:00 Received: 09/12/17 12:30										
Arsenic	ND	0.004	0.010	mg/l	1	7091353	09/13/17	09/18/17	EPA 6010	

Client Name: University of San Diego **EMA Log #: 17I0345**
Project Name: Black Mountain Bioaccessibility Trail Extra

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7091353											
Blank (7091353-BLK1)					Prepared: 09/13/17 Analyzed: 09/18/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7091353-BS1)					Prepared: 09/13/17 Analyzed: 09/18/17						
Arsenic	0.987	0.004	0.010	mg/l	1.00		99	75-125			
LCS Dup (7091353-BSD1)					Prepared: 09/13/17 Analyzed: 09/18/17						
Arsenic	0.987	0.004	0.010	mg/l	1.00		99	75-125	0.06	20	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: University of San Diego | **EMA Log #: 17I0345**
Project Name: Black Mountain Bioaccessibility Trail Extra

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

Page 1 of 2

CHAIN-OF-CUSTODY RECORD

177034５

– EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:
Client: University of San Diego
Attn: Beth O'Shea
Samplers(s): Eric Cathcart, Ninyo & Moore
Address: 5998 Alcala Park
San Diego CA 92110
Phone: 619·260·4243 Fax: —
Email: bethoshea@sandiego.edu
Billing Address: above

Project ID: Black Mountain Bioaccessibility Trail Extra
Project #: Goal IVa Additional PO #: —

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT 80	8/25	2p	WW	falcon																			X				
2	BMT 81				tube																							
3	BMT 82																											
4	Repeat BMT 82																											
5	BMT 83																											
6	BMT 84																											
7	Repeat BMT 84																											
8	BMT 85																											
9	BMT 86																											
10	BMT 87	↓	↓	↓	↓																			↓				

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
[1]**Turn-Around-Time:** ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]**Reporting Requirements:** ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
[1]**Sample Disposal:** ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Presevead: [✓ Yes] No N/A
Temp @ Receipt: 4° on ice
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B. O'Shea Print O'Shea Company: USD	9.12.17 1200	Signature Print Marya Pela Company: EM
Signature Print M. Pel Company: EM	9.12.17 1230	Signature Print mika mugar Company: EMA
Signature Print Company:		Signature Print Company:

Project/Sample Comments: Matrix is synthetic gastric fluid (dilute HCl and NaCl with pepsin)

[1]Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2]EMA reserves the right to return any samples that do not match our waste profile.

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Page 2 of 2

CHAIN-OF-CUSTODY RECORD 1710345

–EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:

Client: University of San Diego
Attn: Beth O'Shea
Samplers(s): Eric Cathcart, Ninyo & Moore
Address: 5998 Alcala Park
San Diego CA 92110
Phone: 619-260-4247 Fax: —
Email: bethoshea@sandiego.edu
Billing Address: above

Project ID: Black Mountain Bioaccessibility Trail Extra
Project #: Goal IVa Additional PO #: —

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐413.1 ☐413.2 ☐1664	8015 (TPH) ☐Gas ☐Diesel ☐Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐pH ☐EC ☐TSS ☐TDS	☐Nitrate ☐Nitrite ☐TKN ☐NH3	CAC Title 22/CAM17 Metals ☐TTLC ☐STLC	TCLP (RCRA) ☐Metals ☐Organics	Cd Cr Cu Pb Ni Ag Zn ☐Dissolved	Coliform, ☐Total (MTF) ☐Fecal (MTF)	Colilert, T+E.Coli ☐P/A ☐Enumeration	Enterococcus, ☐MTF ☐Enterolert	Heterotrophic Plate Count (HPC)	☐BOD ☐COD ☐Cyanide	Total As				
1	BMT 88	8/25	2p	WW	falcon																			X				
2	Blank gastric fluid	↓	↓	↓	tube																			↓				
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☑Courier ☐UPS ☐FedEx ☐USPS ☐Client Drop Off ☐Other
[1]Turn-Around-Time: ☐Same Day ☐1 day ☐2 day ☐3 day ☐4 day ☐5 day ☑STD (7 day)
[1]Reporting Requirements: ☐Fax ☑PDF ☐Excel ☐Geotracker/EDF ☐Hard Copy ☐EDT
[1]Sample Disposal: ☑By Laboratory ☐[2]Return to Client: P/U or Delivery ☐Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Presevd: [✓ Yes] No N/A
Temp @ Receipt: 4°C ice
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B. O'Sh	9.12.17 1220	Signature
Print O'Shea		Print Mark [illegible]
Company: USD		Company: EM
Signature	9.12.17 1230	Signature Mr
Print Mark [illegible]		Print Mika mayer
Company: EMs		Company: Ema
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments:

[1]Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2]EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

EnviroMatrix Analytical, Inc.

01 November 2017

University of San Diego
Attn: Beth O'Shea, PhD
5998 Alcala Park
San Diego, CA 92110

EMA Log #: 17J0803

Project Name: **Black Mountain Bioaccessibility Trail Extra**
Project Desc./#: **#3**

Enclosed are the results of analyses for samples received by the laboratory on 10/25/17 11:44. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: University of San Diego	**EMA Log #: 17J0803**
Project Name: Black Mountain Bioaccessibility Trail Extra	

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BMT-95	17J0803-01	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-96	17J0803-02	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-97	17J0803-03	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-98	17J0803-04	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-99	17J0803-05	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-100	17J0803-06	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-100-duplicate	17J0803-07	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-101	17J0803-08	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-102	17J0803-09	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-103	17J0803-10	Wastewater	10/23/17 15:00	10/25/17 11:44
BMT-104	17J0803-11	Wastewater	10/23/17 15:00	10/25/17 11:44
BLANK-20171023	17J0803-12	Wastewater	10/23/17 15:00	10/25/17 11:44

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-95 (17J0803-01) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.015**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-96 (17J0803-02) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	ND	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-97 (17J0803-03) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	ND	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-98 (17J0803-04) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.027**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-99 (17J0803-05) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	ND	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-100 (17J0803-06) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.009**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	J
BMT-100-duplicate (17J0803-07) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.011**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-101 (17J0803-08) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.005**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	J
BMT-102 (17J0803-09) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.013**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	

Client Name: University of San Diego **EMA Log #: 17J0803**
Project Name: Black Mountain Bioaccessibility Trail Extra

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-103 (17J0803-10) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.015**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BMT-104 (17J0803-11) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	**0.013**	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	
BLANK-20171023 (17J0803-12) Wastewater Sampled: 10/23/17 15:00 Received: 10/25/17 11:44										
Arsenic	ND	0.004	0.010	mg/l	1	7103048	10/30/17	10/30/17	EPA 6010	

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7103048											
Blank (7103048-BLK1)					Prepared & Analyzed: 10/30/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7103048-BS1)					Prepared & Analyzed: 10/30/17						
Arsenic	0.912	0.004	0.010	mg/l	1.00		91	75-125			
LCS Dup (7103048-BSD1)					Prepared & Analyzed: 10/30/17						
Arsenic	0.937	0.004	0.010	mg/l	1.00		94	75-125	3	20	

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

1750803
~~1750804~~

CHAIN-OF-CUSTODY RECORD

EnviroMatrix Analytical, Inc.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 1 of 2

EMA LOG #:
Client: USD
Attn: BETH O'SHEA
Samplers(s): OSHEA + WRIGHT
Address: 5998 Alcala Park EOS Dept
San Diego, CA 92110
Phone: (619) 260-4243 Fax:
Email: bethoshea@sandiego.edu
Billing Address: As above

Project ID: Black Mountain Bioaccessibility Trail Extra
Project #: #3 PO #:

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As
1	BMT-95	10/23/17	15:00	WW	falcon tube																			X
2	BMT-96																							X
3	BMT-97																							X
4	BMT-98																							X
5	BMT-99																							X
6	BMT-100																							X
7	BMT-100_duplicate																							X
8	BMT-101																							X
9	BMT-102																							X
10	BMT-103																							X

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other
[1]Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
[1]Sample Disposal: ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A
Custody Seals Intact: Yes No [✓ N/A]
COC/Labels Agree: [✓ Yes] No N/A
Containers Properly Preseved: [✓ Yes] No N/A
Temp @ Receipt: 6°C On ice
Sampled By: [✓ Client] EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature B.O'Sh Print Beth O'Shea Company: USD	10/25/17 1028	Signature Print Brett Carroll Company: EMA
Signature Print Brett Carroll Company: EMA	10/25/17 11:44	Signature mm Print Milka Mayer Company: EMA
Signature Print Company:		Signature Print Company:

Project/Sample Comments:
Samples matrix is synthetic gastric fluid: dilute HCl, NaCl and pepsin.

[1]Additional costs may apply. Please note there is a $35 minimum charge for all clients.
[2]EMA reserves the right to return any samples that do not match our waste profile.
NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

1750807
~~1750804~~

CHAIN-OF-CUSTODY RECORD

EnviroMatrix Analytical, Inc.
4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 2 of 2

EMA LOG #:
Client: USD
Attn: Beth O'Shea
Samplers(s): OShea + Nelott
Address: 5998 Alcala Park EOS Dept,
San Diego, CA 92110
Phone: (619) 260-4245 Fax:
Email: bethoshea@sandiego.edu
Billing Address: As above
Project ID: Black Mountain Bioaccessibility Trail Extra
Project #: #3
PO #:

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	BMT-104	10/23/17	15:00	WW	falcon
2	BLANK-20171023	"	15:00	WW	tube
3					
4					
5					
6					
7					
8					
9					
10					

Requested Analysis

ID #	Oil & Grease ☐413.1 ☐413.2 ☐1664	8015 (TPH) ☐Gas ☐Diesel ☐Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐pH ☐EC ☐TSS ☐TDS	☐Nitrate ☐Nitrite ☐TKN ☐NH3	CAC Title 22/CAM17 Metals ☐TTLC ☐STLC	TCLP (RCRA) ☐Metals ☐Organics	Cd Cr Cu Pb Ni Ag Zn ☐Dissolved	Coliform, ☐Total (MTF) ☐Fecal (MTF)	Colilert, T+E.Coli ☐P/A ☐Enumeration	Enterococcus, ☐MTF ☐Enterolert	Heterotrophic Plate Count (HPC)	☐BOD ☐COD ☐Cyanide	Total As				
1																			X				
2																			X				
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

¹Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)

¹Reporting Requirements: ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT

¹Sample Disposal: ☒ By Laboratory ☐ ²Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: Yes No N/A
Custody Seals Intact: Yes No N/A
COC/Labels Agree: Yes No N/A
Containers Properly Preseved: Yes No N/A
Temp @ Receipt:
Sampled By: Client EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature D. O'S Print Beth O'Shea Company: USD	10/25/17 1028	Signature Print Brett Carroll Company: EMA
Signature Print Brett Carroll Company: EMA	10/25/17 11:44	Signature Print mikamayn Company: EMA
Signature Print Company:		Signature Print Company:

Project/Sample Comments:

¹Additional costs may apply. Please note there is a $35 minimum charge for all clients.

²EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

EnviroMatrix Analytical, Inc.

02 October 2017

University of San Diego
Attn: Beth O'Shea, PhD
5998 Alcala Park
San Diego, CA 92110

EMA Log #: 17I0941

Project Name: **Black Mountain Bioaccessibility Trail Extra**
Project Desc./#: **#2**

Enclosed are the results of analyses for samples received by the laboratory on 09/28/17 14:05. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: University of San Diego **EMA Log #: 17I0941**
Project Name: Black Mountain Bioaccessibility Trail Extra

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BMT-434	17I0941-01	Wastewater	09/27/17 13:00	09/28/17 14:05
BMT-446	17I0941-02	Wastewater	09/27/17 13:00	09/28/17 14:05
BMT-447	17I0941-03	Wastewater	09/27/17 13:00	09/28/17 14:05
BMT-450	17I0941-04	Wastewater	09/27/17 13:00	09/28/17 14:05
BMT-451	17I0941-05	Wastewater	09/27/17 13:00	09/28/17 14:05
BMT-451-duplicate	17I0941-06	Wastewater	09/27/17 13:00	09/28/17 14:05
BMT-536	17I0941-07	Wastewater	09/27/17 13:00	09/28/17 14:05
BLANK_20170927	17I0941-08	Wastewater	09/27/17 13:00	09/28/17 14:05

Client Name: University of San Diego **EMA Log #: 17I0941**
Project Name: Black Mountain Bioaccessibility Trail Extra

Total Metals by EPA 6000/7000 Series Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
BMT-434 (17I0941-01) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.045**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BMT-446 (17I0941-02) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.014**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BMT-447 (17I0941-03) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.028**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BMT-450 (17I0941-04) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.015**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BMT-451 (17I0941-05) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.039**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BMT-451-duplicate (17I0941-06) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.040**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BMT-536 (17I0941-07) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.030**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	
BLANK_20170927 (17I0941-08) Wastewater Sampled: 09/27/17 13:00 Received: 09/28/17 14:05										
Arsenic	**0.004**	0.004	0.010	mg/l	1	7092923	09/29/17	10/02/17	EPA 6010	J

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: University of San Diego **EMA Log #: 17I0941**
Project Name: Black Mountain Bioaccessibility Trail Extra

Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	MDL	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 7092923											
Blank (7092923-BLK1)					Prepared: 09/29/17 Analyzed: 10/02/17						
Arsenic	ND	0.004	0.010	mg/l							
LCS (7092923-BS1)					Prepared: 09/29/17 Analyzed: 10/02/17						
Arsenic	0.998	0.004	0.010	mg/l	1.00		100	75-125			
LCS Dup (7092923-BSD1)					Prepared: 09/29/17 Analyzed: 10/02/17						
Arsenic	1.01	0.004	0.010	mg/l	1.00		101	75-125	1	20	

Notes and Definitions

J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis (if indicated in units column)
RPD	Relative Percent Difference
MDL	Method detection limit (indicated per client's request)

Page 1 of 1

CHAIN-OF-CUSTODY RECORD 17I0941

-EnviroMatrix Analytical, Inc.

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

EMA LOG #:

Client: USD

Attn: BETH O'SHEA

Samplers(s): OSHEA + WRIGHT

Address: 5998 ALCALA PARK EOS DEPT
SAN DIEGO, CA 92110

Phone: 619-260-4243 Fax:

Email: bethoshea@sandiego.edu

Billing Address: As above

Project ID: BLACK MOUNTAIN BIOACCESSIBILITY TRAIL EXTRA #2

Project #: PO #:

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☐ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide	Total As				
1	BMT-434	9/27	13:00	NW	falcon tube																			X				
2	BMT-446	↓	↓	↓	↓																			X				
3	BMT-447																							X				
4	BMT-450																							X				
5	BMT-451																							X				
6	BMT-451-duplicate																							X				
7	BMT-536																							X				
8	BLANK-20170927	↓	↓	↓	↓																			X				
9																												
10																												

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid

Shipped By: ☒ Courier ☐ UPS ☐ FedEx ☐ USPS ☐ Client Drop Off ☐ Other

[1]**Turn-Around-Time:** ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)

[1]**Reporting Requirements:** ☐ Fax ☒ PDF ☒ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT

[1]**Sample Disposal:** ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: [✓ Yes] No N/A	Containers Properly Preseved: [✓ Yes] No N/A
Custody Seals Intact: ~~Yes~~ No [✓ N/A]	Temp @ Receipt: 20°C angle
COC/Labels Agree: [✓ Yes] No N/A	Sampled By: [✓ Client] EMA Autosampler

Project/Sample Comments:

RELINQUISHED BY		DATE/TIME	RECEIVED BY	
Signature		9.28.17 1400	Signature	
Print	STAFF		Print	Marie Rdz
Company:			Company:	EMA
Signature		9.28.17 1405	Signature	
Print	Marie Rdz		Print	Mika Mayer
Company:	EMA		Company:	EMA
Signature			Signature	
Print			Print	
Company:			Company:	

[1]Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2]EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

APPENDIX H

Human Health Risk Assessment

APPENDIX H

HUMAN HEALTH RISK ASSESSMENT
BLACK MOUNTAIN OPEN SPACE PARK
SAN DIEGO, CALIFORNIA

Table of Contents

SECTION PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

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1.0 STATISTICAL ANALYSIS

A statistical analysis of soil arsenic data was conducted to define the statistical distribution of the data, the mean concentration, standard deviation, coefficient of variability, the 95 percent upper confidence limit on the mean concentration (95UCL) and the maximum concentration detected.

The statistical analysis of soil arsenic data was conducted using the U.S. Environmental Protection Agency (USEPA) developed software ProUCL (Version 5.1; Singh and Maichle, 2015). ProUCL was chosen because it was specifically developed to evaluate environmental data and it calculates multiple types of confidence limits. According to ProUCL, the 95UCL soil arsenic concentration at the trails is 319.1 milligrams per kilogram (mg/Kg). The ProUCL printout showing the 95UCL estimated for arsenic in soil is included in Attachment A.

As stated in Section 6.2.3 of the main report, at areas where the XRF readings were at or above 80 mg/kg soil samples and XRF readings were obtained at a higher sampling density than anywhere else on the trails. Due to the biased sampling approach, the arsenic trail data (both analytical and XRF) are biased towards high arsenic concentrations. Since the soil analytical data is biased towards high arsenic concentrations, all statistical parameters are also biased towards high arsenic concentrations. Although biased data should not be used to establish Exposure Point Concentrations (EPCs; USEPA 1989 and DTSC 2015), the biased data was used here since one of the objectives of this Human Health Risk Assessment (HHRA) is to evaluate potential health risks and hazards under a “worst-case” exposure scenario. Thus, the use of biased, upper-end EPC is considered to be acceptable for this evaluation. The soil arsenic data used in the statistical analysis is presented in Table 1.

It should be noted again that since soil sampling density was higher at the local “hot spots,” the estimated 95UCL is an unrealistically high estimate of prevailing soil arsenic concentrations at the trails. Nonetheless, the estimated 95UCL soil arsenic concentration was selected as the EPC so that potential risks and hazards posed by the site would not be underestimated. The statistical parameters obtained from the soil arsenic data are presented in Table 2.

2.0 HUMAN HEALTH RISK ASSESSMENT

California health and environmental protection agencies require the remediation of anthropogenic chemical-impacted soil if the chemicals are found to represent a threat to human health and the environment. Similarly, cleanup of chemical-impacted soil must be conducted to the extent that the threat posed by the release is reduced to acceptable levels. The purpose of this risk evaluation was to determine if arsenic detected in surface soils (down to a depth of 5 feet bgs) at the Park represent a threat to human health.

2.1 CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) shows all potentially complete exposure pathways for a given environmental source. The CSM identifies potential chemical sources, release mechanisms, transport media, routes of chemical migration through the environment, exposure media, and potential receptors. The CSM for the site is presented in Figure 1. The following paragraphs define the exposure pathways evaluated in this risk evaluation and the rationale for their inclusion or elimination from consideration.

Potential receptors whom may come in contact with site-related chemicals are current and future visitors to the Park and construction and maintenance workers during upkeep and maintenance of the tails. Exposure parameters used to characterize recreational receptors (visitors) whom may walk or bike on the trails are presented in Table 3. Exposure parameters used to characterize construction and maintenance workers whom may come in contact with site-related chemicals are presented in Table 4.

Both workers and recreational receptors were deemed to have the potential to come in contact with arsenic through the inhalation of ambient air and direct contact with soil. Ambient air may become impacted by airborne dust, therefore the inhalation of dust is considered to be a complete exposure pathway. Construction workers and recreational receptors may also come in contact with surficial soils when conducting outdoor activities. Therefore, the incidental ingestion and dermal contact with impacted soil are considered to be complete exposure pathways.

It is safe to assume that construction workers and recreational receptors will receive their drinking water from municipal sources and will not depend on surface water or groundwater wells for their water needs. Therefore, the surface water and groundwater exposure pathways are not considered to be complete exposure pathways for onsite receptors.

2.2 EXPOSURE POINT CONCENTRATIONS IN AMBIENT AIR

Exposure to arsenic detected along the hiking trails may occur via inhalation of fugitive dust. Inhalation exposure to non-volatile compounds is typically minor in fugitive dust when compared to direct ingestion exposure (USEPA, 2002). Nevertheless, a relationship must be estimated between the chemical concentration in soil and the concentration in air due to fugitive dust emissions from surface soil.

On August 23 and 29, 2017, dust monitoring was conducted on Black Mountain Park trails. The purpose of the dust monitoring was to obtain site specific information about the amount of dust generated on Park tails during walking/hiking and biking. Site-specific dust monitoring data was collected by Ninyo & Moore staff using a portable personal dust monitor (TSI-AM510) that was strapped onto a day pack at a height and location generally corresponding to the breathing zone. The monitor uses light scattering technology to determine mass concentration of dust in real-time. The monitor was calibrated each day against a gravimetric reference in accordance with the manufactures specifications. Copies of the respirable dust monitoring reports are included in Attachment B. The average dust concentration in air obtained from seven sampling events was estimated to be 0.047 milligrams per cubic meter (mg/m^3).

The USEPA (2002) and DTSC (2015) recommend using a particulate emission factor (PEF) to model chemical concentrations in airborne dust. The PEF's units are in cubic meters per kilogram (m^3/kg). The average dust concentration obtained from the dust monitoring events was converted to PEF. The average dust concentration obtained from the sampling events (Attachment B) is equivalent to a PEF of 2.13E+07 m^3/kg. The ambient arsenic air concentrations due to dust emissions for recreational receptors were obtained by dividing the soil arsenic concentrations by the PEF.

Default PEF values for construction and maintenance workers published by the DTSC (2014) were used in this risk evaluation. The industrial PEF value of 1.3E+09 m^3/kg was used to estimate dust emissions for maintenance workers. The construction worker PEF of 1.0E+06 m^3/kg was used to estimate dust exposures for construction workers. The estimated ambient air exposure point concentrations were used below to estimate dust inhalation exposures for onsite receptors.

2.3 TOXICITY ASSESSMENT

In order to evaluate the potential adverse effects associated with exposure to chemicals, the relationship between the dose of each chemical and the incidence or potential of an adverse health effect in an exposed population must be determined. This is known as dose-response assessment and is based on data collected from animal studies and theoretical precepts about what might occur in humans.

This risk assessment considers both carcinogenic and non-carcinogenic health effects associated with chemical exposures based on dose-response criteria published by various regulatory agencies.

In this evaluation, chronic toxicity criteria were selected (in order of preference) from the following sources: (1) Cal-EPA OEHHA Toxicity Criteria Database, online (DTSC, 2017), (2) USEPA's Integrated Risk Information System (IRIS; USEPA, 2017a) and (3) USEPA Region IX Regional Screening Level (RSL) tables (EPA, 2017b).

2.3.1 Non-Carcinogenic Dose-Response Criteria

It is widely accepted that most biological effects of chemical substances occur only after a threshold dose is reached. For the purpose of establishing non-carcinogenic criteria levels, this threshold dose is usually derived from either the no observed adverse effect level (NOAEL) or the lowest observed adverse effect level (LOAEL), as determined in chronic animal exposure studies. The NOAEL is defined as the highest dose at which no adverse effects occur, while the LOAEL is defined as the lowest dose at which adverse effects begin to appear. NOAELs and LOAELs are used by the USEPA to establish reference doses (RfDs) for acceptable levels of human intake.

A RfD is the dose of a chemical that is not expected to cause adverse health effects over a lifetime of daily exposure in the most sensitive population. Uncertainty factors are used to set RfDs, representing an attempt to account for limitations in the quality or quantity of available data. Most RfDs include a 100-fold safety factor that is based on 1) a factor of 10 to account for uncertainties in extrapolating animal data to human health effects, and 2) another 10-fold safety factor to account for differences in sensitivity within the human population. Furthermore, if an available database is incomplete, or if the involved chemical is persistent or bioacumulative, additional 10-fold safety factors may be applied. Reference doses for arsenic are compiled in Table 5.

The default RfD developed for arsenic assumes that one-hundred percent of the arsenic ingested is absorbed DTSC (2017). However, the DTSC (2017) now recommends the use of a relative bioavailability (RBA) factor of 60 percent for arsenic in soil. Specifically, the DTSC (2017) recommends that the RBA factors be used to adjust default oral toxicity values (reference doses and slope factors) to account for differences in absorption seen in environmental media at the site vs. the default absorption value of 100 percent.

For non-cancer effects, the default oral reference dose (RfDdefault) can be adjusted (RfDadjusted) as follows:

$$RfD_{adjusted} = \frac{RfD_{default}}{RBA}$$

In this HHRA, the $RfD_{default}$ of 3.5E-06 mg/Kg/day was converted to a $RfD_{adjusted}$ of 5.8E-06 mg/Kg/day. The $RfD_{adjusted}$ was used in this risk assessment to estimate non-carcinogenic health effects associated with incidental ingestion of soil.

For the dermal exposure pathway, The USEPA (2017) recommends the use of a default dermal absorption factor of 0.03 for arsenic. The default dermal absorption factor is the fraction of arsenic in contact with the skin that can be absorbed into the body. The default factor was derived from absorption studies where arsenic was dissolved in water and then in contact with bare skin (G. Post, 2003). The use of the default absorption factor assumes that essentially one-hundred percent of the arsenic in soil and/or dust is soluble in water and hence available for dermal absorption. However, the bioaccessibility studies conducted using Black Mountain soil samples (see Section 12.0 of main report), have demonstrated that arsenic at the site is tightly bound to rock and soil matrix. The bioaccessibility studies have also demonstrated that it takes strong acidic solutions to extract arsenic from rock matrix and that, on average, the maximum amount of arsenic extractable is no more than 3-percent of the total amount of arsenic in the rock.

In an effort to account for the low solubility of local soil arsenic in the calculation of non-carcinogenic effects, the default dermal absorption factor (0.03) was modified by including a solubility factor of 0.03. Thus, the arsenic soil-to-skin absorption factor used in this HHRA was 0.001 (see Tables C-2 and C-10 of Attachment C).

2.3.2 Carcinogenic Dose-Response Criteria

The currently accepted regulatory approach assumes that all potentially carcinogenic chemicals should be treated as if they do not have thresholds. This regulatory approach, which was used to evaluate carcinogenic risks for this document, assumes that the dose-response curve for carcinogens allows for zero risk at zero dose (i.e., for all doses, some cancer risk is assumed to be present). Since animal testing is performed at relatively high doses for the purposes of eliciting a carcinogenic response, various mathematical models are used to estimate the theoretically plausible response at low doses. The accuracy of the projected risk depends on how well the model predicts the true relationship between dose and risk at levels where this relationship cannot actually be measured.

Health risks for exposures to carcinogens are defined in terms of probabilities. The probabilities quantify the likelihood of a carcinogenic response in an individual that receives a given dose of a particular carcinogen. These probabilities are calculated based on the potential dose and the carcinogenic slope factor (SF) for a chemical.

The SF, which is expressed in units of inverse milligrams per kilogram-day $(mg/Kg\text{-}day)^{-1}$, is the 95UCL of the probability of carcinogenic response per unit daily intake of a chemical over a lifetime. The SF multiplied by the lifetime average daily intake of the chemical (dose) provides an estimate of the 95UCL of the theoretical cancer risk for the specific dose. The SFs used in this HHRA to estimate carcinogenic dose-assessment risks are presented in Table 5.

As in the case of the RfD, the default oral-SF assumes that one-hundred percent of the arsenic ingested is absorbed (DTSC, 2016). However, the DTSC (2016) now recommends that the RBA factors be used to adjust default oral SFs to account for differences in absorption seen in environmental media at the site vs. the default absorption value of 100 percent.

For cancer effects, the default slope factor (SFdefault) can be adjusted (SFadjusted) as follows:

$$SF_{adjusted} = SF_{default} * RBA$$

In this HHRA, the $SF_{default}$ of 9.5 $(mg/Kg/day)^{-1}$ was converted to a $SF_{adjusted}$ of 5.7 $(mg/Kg/day)^{-1}$. The $SF_{adjusted}$ was used in this HHRA to estimate incremental cancer risks associated with incidental ingestion of soil.

Again, in an effort to account for the low solubility of local soil arsenic, the default dermal absorption factor (0.03) was modified by including a solubility factor of 0.03. Thus, the arsenic soil-to-skin absorption factor used in the cancer risk calculations was 0.001 (see Tables C-6 and C-14 of Attachment C).

2.4 RISK CHARACTERIZATION

Risk characterization involves estimating the magnitude of the potential adverse health effects of the hazardous chemicals under study and making judgments about the nature of the health threat to the defined receptor populations. It combines the results of the dose-response (toxicity) and exposure assessment.

Health risks associated with environmental exposures are directly related to the duration of exposure. Provided the chemical concentrations in environmental media remain constant, the populations facing longer exposures will receive the highest dose and hence would face the highest estimated health risk. Therefore, it is customary to assess health risks based on the populations expected to receive a higher dose. If the health risks estimated for the “high dose populations” are found to be within acceptable levels, then other populations having lower intensity of exposure do not have to be evaluated as their exposures and health risks can be concluded to fall within acceptable levels.

2.4.1 Soil Ingestion and Dermal Dose Estimation

Two types of chronic, chemical intake doses were calculated. Chemical intakes associated with non-carcinogenic adverse health effects were estimated by calculating the average daily intake (ADI). Non-carcinogenic exposures are expected as long as the receptor has contact with the site, which is typically less than a lifetime. In contrast, chemical intakes associated with carcinogenic health effects are averaged of a lifetime of 70 years, even though actual site exposures are also typically less than a lifetime. Thus, carcinogenic chemical intakes were estimated by calculating the lifetime average daily intake (LADI). The equation used to calculate soil exposure ADI and/or LADI values for each exposure pathway and COPC is shown below:

$$(L)ADI = EPC * \frac{RIF \cdot EF \cdot ED}{BW \cdot AT}$$

Where:

(L)ADI = (Lifetime) Average daily intake (mg/Kg-day)
EPC = Exposure point concentration (units vary by media)
RIF = Route-specific intake factor (mg/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)

For ingestion, the RIF equals the soil ingestion rate. For dermal contact, RIF = SA * AF * ABS where SA = skin surface area, AF = soil to skin adherence factor and ABS = dermal absorption factor (chemical specific). These exposure parameters used to calculate the ADI and LADI for recreational receptors and construction workers are listed in Tables 3 and 4, respectively.

2.4.2 Inhalation Exposure Dose Estimation

This section discusses the methods used to quantify inhalation doses for potential receptors at the site. Exposure assumptions, including absorption and bioavailability factors, exposure route and duration, and contact rates, were used to calculate the exposure concentrations (EC).

The estimated ECs for airborne arsenic were used in the risk characterization section to estimate the potential for carcinogenic health risks and non-carcinogenic adverse health effects associated with inhalation of arsenic in dust.

$$EC = \frac{CA \bullet ET \bullet EF \bullet ED}{AT}$$

Where:

EC = Exposure concentration, micrograms per cubic meter (ug/m^3)
CA = Chemical concentration in air, ug/m^3
ET = Exposure time, hours/day
EF = Exposure frequency, days/year
ED = Exposure duration, years
AT = Averaging time, hours (used the equivalent of 70 years for carcinogens and same value as ED for non-carcinogens)

Inhalation intake factors were combined with estimated outdoor dust concentrations to obtain the exposure concentration for construction workers and recreational receptors.

2.4.3 Incremental Cancer Risk

Excess cancer risks were estimated by multiplying the LADI by the chemical carcinogenic toxicity criteria. The equation used to estimate the excess cancer risk is:

$$Excess\ Cancer\ Risk = LADI \times CSF$$

The excess cancer risks were compared to the risk level considered acceptable by federal and state regulatory agencies. The target cancer risk level identified by the DTSC (2015) is 1 in one million (1E-06). However, USEPA has established acceptable incremental cancer risk levels to be within the risk range of 1 in 10,000 (1E-04) and 1E-06; risks greater than 1E-04 are generally considered unacceptable. Cal-EPA has defined a risk of 1 in 100,000 (1E-05) as the “no significant level” for carcinogens under California’s Safe Drinking Water and Toxic Enforcement Act (Proposition 65). Further, most California air districts use the 1E-05 risk level as the notification trigger level under California’s AB2588 Toxic Hot Spots Program. Thus, although agencies will exercise caution in determining whether risks within the range of 1E-04 and 1E-06 require additional investigation or some form of risk management, there is a general precedent that predicted cancer risks that are on the low end of this range will generally be considered acceptable and not warrant further evaluation.

For this risk assessment, estimated cancer risks below 1E-06 are considered acceptable for recreational receptors. While for construction and maintenance workers the acceptable cancer risk was set at 1E-05 in accordance with California Proposition 65.

The detailed cancer risk and non-cancer hazard calculation tables are presented in Attachment C. The estimated cancer risks and hazard index (HI) for recreational receptors are presented on Table 6. The estimated cancer risk and HI for construction workers are presented on Table 7.

Using the 95UCL soil arsenic concentration, the incremental cancer risk for recreational receptor and construction and maintenance workers were estimated to be:

- 6E-06 for recreational receptors (Table 6).
- 2E-06 for construction workers (Table 7).
- 2E-05 for maintenance workers (Table 7).

The estimated cancer risk for recreational receptors exceeds the acceptable cancer risk of 1E-06. The estimated cancer risks for maintenance workers exceeds the acceptable cancer risk of 1E-05. Supporting calculations are presented in Attachment C.

2.4.4 Non-Cancer Health Hazards

Hazard quotients were estimated by calculating the ratio of the average daily dose (ADD) to the corresponding chronic reference dose for non-carcinogenic effects. The equation used to estimate the hazard quotient is:

$$\text{Hazard Quotient} = \frac{ADD}{RfD}$$

The hazard quotients were then compared to an acceptable hazard level. Hazard quotients less than the DTSC benchmark hazard level of 1.0 indicate that no adverse health effects are predicted from exposure to arsenic in soil.

Using the 95UCL soil arsenic concentration, the hazard indices for recreational receptors and construction workers were estimated to be:

- 1.0 for adult recreational receptors (Table 6).
- 0.5 for children recreational receptors (Table 6).
- 3.0 for construction workers (Table 7).
- 6.0 for maintenance workers (Table 7).

The estimated hazard indices for construction and maintenance workers exceed the point of departure of 1.0 for non-cancer effects. Supporting calculations are presented in Attachment C.

2.5 RISK-BASED CLEANUP LEVEL

Results of the risk evaluation show that estimated cancer risks associated with exposure to arsenic in surface soil could exceed levels considered acceptable to California health and environmental protection agencies. In light of these results, a virtual remediation was conducted by gradually removing from the assessment maximum detected soil arsenic concentrations. The virtual remediation was conducted until the estimated soil arsenic 95UCL was reduced to a level that was estimated to results in risks at or below 1E-06. Following the virtual remediation, when all soil arsenic concentrations higher than 210 mg/Kg were removed from the evaluation, the estimated 95UCL was estimated to be 44.76 mg/Kg (Table 2).

Using the risk assessment methodology described above and a 95UCL soil arsenic concentration of 44.76 mg/Kg, the estimated cancer risk for recreational receptors was estimated to be less than 1E-06 (Table 8). Using the risk assessment methodology described above and a 95UCL soil arsenic concentration of 44.76 mg/Kg, the estimated cancer risk for construction workers and maintenance workers (Table 9) were estimated to be 2E-07 and 3E-06, respectively. These estimated cancer risks are within levels considered acceptable to California health and environmental protection agencies. Based on these results, it is recommended soil arsenic concentrations in excess of 210 mg/Kg at the Park be removed, covered or remediated. Supporting cancer risk and health hazard calculations are presented in Attachment D.

3.0 REFERENCES

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APPENDIX H

Tables

Table 1
Summary of Black Mountain Trail Samples - Arsenic
Black Mountain Open Space Park
San Diego County, California

Sample Identification	Trail Routes	Arsenic (mg/kg)
BMT-01	A, C ,E	52
BMT-02	A, C, E	7.7
BMT-03	A, C, E	9.3
BMT-04	A, C, E	6.0
BMT-05	A, C, E	5.5
BMT-06	A, C, E	4.2
BMT-07	A, C, E	13
BMT-08	A, C, E	5.4
BMT-09	A, C, E	3.4
BMT-10	A, C, E	3.1
BMT-11	C, E	2.1
BMT-12	C, E	4.4
BMT-13	C, E	5.0
BMT-14	C, E	3.3
BMT-15	C, E	2.7
BMT-16	C, E	7.2
BMT-17	C, E	5.4
BMT-18	C, E	7.0
BMT-19	C, E	4.6
BMT-20	C, E	4.6
BMT-21	C, E	5.2
BMT-22	C, E	3.5
BMT-23	C, E	5.3
BMT-24	C, E	4.4
BMT-25	C, E	14
BMT-26	C, E	12
BMT-27	C, E	17
BMT-28	C, E	3.7
BMT-29	C, E	3.4
BMT-30	C, E	2.4
BMT-31	C, E	3.3
BMT-32	C, E	7.0
BMT-33	D, E	9.5
BMT-34	D, E	2.6
BMT-35	D, E	16
BMT-36	D, E	2.8
BMT-37	D, E	3.2
BMT-38	D, E	4.2
BMT-39	C, D, E	5.1
BMT-40	C, D, E	2.3
BMT-41	C, D, E	2.4
BMT-42	C, D, E	4.6
BMT-43	A, E	4.1
BMT-44	A, E	9.4
BMT-45	A, E	8.8
BMT-46	A, E	8.8
BMT-47	A, E	6.7
BMT-48	A, E	110
BMT-49	A, E	87
BMT-50	A, E	12
BMT-51	A, E	32
BMT-52	A, E	73
BMT-53	A, E	3.9
BMT-54	A, E	5.3
BMT-55	A, E	20
BMT-56	A, E	10
BMT-57	A, E	2.0
BMT-58	A, E	5.0

Table 1
Summary of Black Mountain Trail Samples - Arsenic
Black Mountain Open Space Park
San Diego County, California

Sample Identification	Trail Routes	Arsenic (mg/kg)
BMT-59	A, E	3.6
BMT-60	A, E	9.6
BMT-61	A, E	29
BMT-62	A, E	110
BMT-63	A, E	67
BMT-64	A, E	200
BMT-65	A, E	6,400
BMT-66	A, E	210
BMT-67	A, E	170
BMT-68	A, E	83
BMT-69	A, E	66
BMT-70	A, E	38
BMT-71	A, E	30
BMT-72	A, E	35
BMT-73	A, E	17
BMT-74	A, E	4.1
BMT-75	A, E	4.7
BMT-76	A, E	5.4
BMT-77	A, E	3.5
BMT-78	A, E	4.0
BMT-79	A, E	2.9
BMT-80 (325)	A, B, F	66
BMT-81 (327)	A, B, F	220
BMT-82 (330)	A, B, F	1,300
BMT-83 (331)	A, B, F	1,300
BMT-84 (332)	A, B, F	3,000
BMT-85 (334)	A, B, F	390
BMT-86	A, B, F	130
BMT-87	A, B, F	24
BMT-88	A, B, F	26
BMT-89 (434)	G	200
BMT-90 (446)	G	78
BMT-91 (447)	G	130
BMT-92 (450)	G	130
BMT-93 (451)	G	360
BMT-94 (536)	G	150
BMT-95	G	45
BMT-96	G	9.6
BMT-97	G	15
BMT-98	G	150
BMT-99	G	20
BMT-100	G	70
BMT-101	G	57
BMT-102	G	89
BMT-103	G	70
BMT-104	G	87
BMT-105	G	87
BMT-106 (537)	G	48
BMT-107 (538)	G	49
BMT-108 (539)	G	22
BMT-109 (351)	D	5.6
BMT-110 (356)	A, C, D	4.8
BMT-111 (362)	A, B, C, D, F	15
BMT-112 (367)	B, C, D, F	36
BMT-113 (372)	B, C, D, F	5.2
BMT-114 (377)	B, C, D, F	5.3
BMT-115 (382)	B, C, D, F	5.6
BMT-116 (387)	B, C, D, F	20

Table 1
Summary of Black Mountain Trail Samples - Arsenic
Black Mountain Open Space Park
San Diego County, California

Sample Identification	Trail Routes	Arsenic (mg/kg)
BMT-117 (392)	X	6.1
BMT-118 (397)	D	10
BMT-119 (402)	D	19
BMT-120 (407)	D	<2.0
BMT-121 (412)	D	2.6
BMT-122 (417)	D	4.1
BMT-123 (422)	A, B, F, G	33
BMT-124 (427)	G	47
BMT-125 (432)	G	30
BMT-128 (448)	G	51
BMT-129 (452)	G	35
BMT- 130 (457)	G	83
BMT-142 (528)	G	5.1
BMT-144 (523)	G	9.6
BMT-145 (533)	G	18
BMT-146 (544)	G	26
BMT-152 (574)	A, B	24
BMT-151 (569)	A, B, F	21
BMT-153 (579)	A, G	30
BMT-126 (438)	X	9.1
BMT-127 (443)	X	7.3
BMT-131 (462)	X	9.4
BMT-132 (467)	X	5.0
BMT-133 (473)	X	3.7
BMT-134 (478)	X	3.1
BMT-135 (483)	X	8.9
BMT-136 (488)	X	13
BMT-137 (494)	X	6.9
BMT-138 (498)	X	9.6
BMT-139 (503)	X	6.5
BMT-140 (508)	X	10
BMT-141 (513)	X	6.6
BMT-143 (518)	X	19
BMT-147 (549)	X	43
BMT-148 (554)	X	9.2
BMT-149 (559)	X	6.8
BMT-150 (564)	X	8.4

NOTES:
A - Miner's Ridge to Hilltop Park
B - Hilltop Park to Black Mountain Peak
C - Miner's Ridge to Black Mountain Peak
D - Miner's Ridge to Hilltop Park
E - Glider Port to Black Mountain Peak
F - Miner's Ridge to Hilltop Park
G - Miner's Ridge to Hilltop Park
X - Not on trails

< - less than respective laboratory reporting limit (or method detection limit)
-- - not analyzed
mg/kg - Milligrams per kilogram

Table 2
Statistical Parameters for Soil Arsenic Data
Black Mountain Open Space Park
San Diego County, California

Statistical Parameter (units)	Arsenic Using All Available Data	Arsenic Parameters Using Only Arsenic Analytical Data with Concentrations Less than 210 mg/Kg
Number of Samples	153	146
Number Detected	152	145
Number of Not Detected	1	1
Detection Frequency (%)	99.35	99.32
Minimum Detected (mg/Kg)	2	2
Maximum Detected (mg/Kg)	6400	210
Mean Detected Concentration (mg/Kg)	113.4	29.45
Median Detected Concentration (mg/Kg)	9.6	9.4
Standard Deviation	587.4	43.05
Coefficient of Variability	5.18	1.46
95UCL (mg/Kg)	319.1	44.76

Notes:

mg/Kg = Milligrams per kilogram
95UCL = 95 percent upper confidence limit on the arithmetic mean concentration

Table 3
Exposure Parameters for Onsite Receptors
Black Mountain Open Space Park
San Diego, California

Exposure Parameters	**Units**	**Recreational Scenario**		
		Adult	**Child**	**Source**
Soil Ingestion Rate (IR-S)	mg/day	3	0	Site-specific
Skin Surface Area (SA)	cm^2/day	6,032	2,900	DTSC 2014
Soil to Skin Adsorption Factor (ABS)	unitless	0.001	0.001	Site-specific
Adherence Factor (AF)	mg/cm^2	0.07	0.20	DTSC 2014
Fraction of Soil Exposed (FE)	unitless	1.0	1.0	DTSC 2014
Inhalation Rate of Air (IR-A)	m^3/day	25	10	Site-specific
Particulate Emission Factor (PEF)	m^3/Kg	21341463.41		Site-specific
Exposure Frequency (EF)	days/year	156	52	Site-specific
Exposure Frequency (dermal; EFd)	days/year	156	52	Site-specific
Exposure Duration (ED)	years	10	1	Site-specific
Exposure Time (ET)	hours/day	2	1	Site-specific
Conversion Factor (CF)	kg/mg	1.0E-06	1.0E-06	--
Body Weight (BW)	kg	80	15	DTSC 2014
Averaging Time for Noncarcinogens (AT_n)	days	3,650	365	USEPA 1989 (ED*365 dys/yr)
Averaging Hours for Noncarcinogens (AT_n)	hours	87,600	8,760	USEPA 2009
Averaging Time for Carcinogens (AT_c)	days	25,550	25,550	USEPA 1989
Averaging Hours for Carcinogens (AT_c)	hours	613,200	613,200	USEPA 2009

Table 4
Exposure Parameters for Onsite Receptors
Black Mountain Open Space Park
San Diego, California

		Exposure Parameters		
Exposure/Site Specific Parameters	Units	Construction Worker	Maintenance Worker	Source
Soil Ingestion Rate (IR-S)	mg/day	330	100	DTSC 2014
Skin Surface Area (SA)	cm^2/day	6,032	6,032	DTSC 2014
Soil to Skin Adsorption Factor (ABS)	unitless	0.001	0.001	Site-specific
Adherence Factor (AF)	mg/cm^2	0.80	0.20	DTSC 2014
Fraction of Soil Exposed (FE)	unitless	1	1	Site-specific
Inhalation Rate of Air (IR-A)	m^3/day	20	20	DTSC 2014
Exposure Frequency (EF)	days/year	5	32	Site-specific
Exposure Duration (ED)	years	1	6	Site-specific
Exposure Time (ET)	hours	8	8	DTSC 2014
Body Weight (BW)	kg	80	80	DTSC 2014

Note:

Based on information provided by the City, on average it was conservatively estimated that City staff/park rangers are at Black Mountain Open Space Park approximately four hours per week. As indicated by the City, the estimated weekly average City staff is working at the park is punctuated by periods of higher use related to spring brushing projects and winter trail construction work. For these periods, which are estimated to last approximately 16 weeks per year, the estimated time City park rangers spend at the Black Mountain Open Space Park is 16 hours/week.

The above is equivalent to 8 hours per day for 32 days per year.

Table 5
Toxicity Criteria of Chemicals of Potential Concern
Black Mountain Open Space Park
San Diego, California

Chemical	Chronic Oral Reference Dose (RfDo) [mg/kg-day]		Inhalation Reference Concentration (RfCi) [ug/m^3]		Oral Cancer Slope Factor (CSFo) $[mg/kg\text{-}day]^{-1}$		Inhalation Unir Risk (IUR) $[ug/m^3]^{-1}$	
Metals								
Arsenic	3.5E-06	c	1.5E-02	c	9.5E+00	c	3.3E-03	c

Notes:
c = Cal/EPA Cancer Potency Database 2018

Table 6
Estimated Cumulative Risks and Hazards
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Recreational Exposure Scenario			
	Exposure Point Concentration (mg/kg)	Cancer Risk	Hazard Index	
		Adult & Child	Adult	Child
Metals				
Arsenic	319.1	6.E-06	1.E+00	5.E-01
TOTAL RISKS and HAZARDS		6.E-06	1.E+00	5.E-01

Notes:
mg/kg = Milligrams per kilogram
Includes Incidental Soil Ingestion, Dermal Contact, and Fugitive Dust Inhalation.
EPC: Exposure Point Concentration in milligrams per kilogram used in the risk and hazard calculations

Table 7
Estimated Cumulative Risks and Hazards
Black Mountain Open Space Park
San Diego, California

COPC	Worker Exposure Scenario				
	Worker EPC (mg/kg)	Cancer Risk		Hazard Index	
		Construction Worker	Maintenance Worker	Construction Worker	Maintenance Worker
Arsenic	319.1	2.E-06	2.E-05	3.E+00	6.E+00
TOTAL RISKS and HAZARDS		2.E-06	2.E-05	3.E+00	6.E+00

Notes:
mg/kg = Milligrams per kilogram
Includes Incidental Soil Ingestion, Dermal Contact, and Fugitive Dust Inhalation
EPC: Exposure Point Concentration in milligrams per kilogram used in the risk and hazard calculations

Table 8
Estimated Cumulative Risks and Hazards
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Recreational Exposure Scenario			
	Exposure Point Concentration (mg/kg)	Cancer Risk	Hazard Index	
		Adult & Child	Adult	Child
Metals				
Arsenic	44.76	8.E-07	2.E-01	7.E-02
TOTAL RISKS and HAZARDS		8.E-07	2.E-01	7.E-02

Notes:
mg/kg = Milligrams per kilogram
Includes Incidental Soil Ingestion, Dermal Contact, and Fugitive Dust Inhalation.
EPC: Exposure Point Concentration in milligrams per kilogram used in the risk and hazard calculations

Table 9
Estimated Cumulative Risks and Hazards
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Worker Exposure Scenario				
	Worker EPC (mg/kg)	Cancer Risk		Hazard Index	
		Construction Worker	Maintenance Worker	Construction Worker	Maintenance Worker
Metals					
Arsenic	44.76	2.E-07	3.E-06	5.E-01	9.E-01
TOTAL RISKS and HAZARDS		2.E-07	3.E-06	5.E-01	9.E-01

Notes:
mg/kg = Milligrams per kilogram
Includes Incidental Soil Ingestion, Dermal Contact, and Fugitive Dust Inhalation
EPC: Exposure Point Concentration in milligrams per kilogram used in the risk and hazard calculations

APPENDIX H

Figure

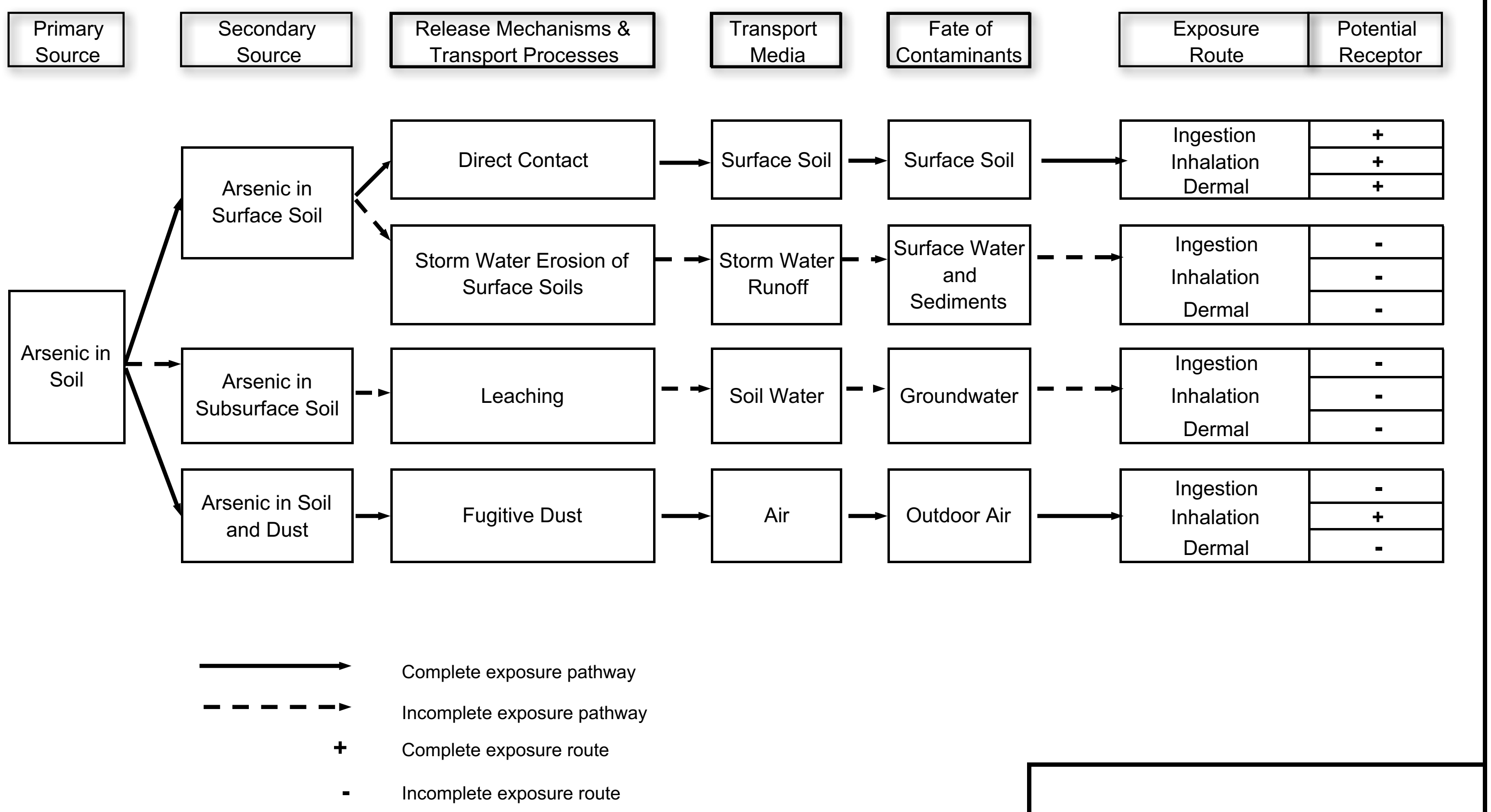

Figure 1

Conceptual Site Model

Date:	
Project:	
Source:	

APPENIX H

Attachment A

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.13/16/2018 10:52:08 AM
From File	Black Mountain As Stats 03-2018.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic (mg/kg)

General Statistics

Total Number of Observations	153	Number of Distinct Observations	99
Number of Detects	152	Number of Non-Detects	1
Number of Distinct Detects	99	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	6400	Maximum Non-Detect	2
Variance Detects	345081	Percent Non-Detects	0.654%
Mean Detects	113.4	SD Detects	587.4
Median Detects	9.6	CV Detects	5.179
Skewness Detects	9.129	Kurtosis Detects	91.57
Mean of Logged Detects	2.77	SD of Logged Detects	1.533

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.199	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.425	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0723	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	112.7	KM Standard Error of Mean	47.34
KM SD	583.7	95% KM (BCA) UCL	209.8
95% KM (t) UCL	191	95% KM (Percentile Bootstrap) UCL	202
95% KM (z) UCL	190.6	95% KM Bootstrap t UCL	432.3
90% KM Chebyshev UCL	254.7	95% KM Chebyshev UCL	319.1
97.5% KM Chebyshev UCL	408.3	99% KM Chebyshev UCL	583.7

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	18.48	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.858	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.228	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.0821	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.344	k star (bias corrected MLE)	0.341
Theta hat (MLE)	329.8	Theta star (bias corrected MLE)	332.2
nu hat (MLE)	104.5	nu star (bias corrected)	103.8
Mean (detects)	113.4		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	112.7
Maximum	6400	Median	9.6
SD	585.6	CV	5.197
k hat (MLE)	0.338	k star (bias corrected MLE)	0.335
Theta hat (MLE)	333.7	Theta star (bias corrected MLE)	335.9
nu hat (MLE)	103.3	nu star (bias corrected)	102.7
Adjusted Level of Significance (β)	0.0484		
Approximate Chi Square Value (102.65, α)	80.27	Adjusted Chi Square Value (102.65, β)	80.09
95% Gamma Approximate UCL (use when n>=50)	144.1	95% Gamma Adjusted UCL (use when n<50)	144.4

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	112.7	SD (KM)	583.7
Variance (KM)	340651	SE of Mean (KM)	47.34
k hat (KM)	0.0373	k star (KM)	0.0409
nu hat (KM)	11.41	nu star (KM)	12.52
theta hat (KM)	3023	theta star (KM)	2755
80% gamma percentile (KM)	6.853	90% gamma percentile (KM)	127.1
95% gamma percentile (KM)	547.5	99% gamma percentile (KM)	2643

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.52, α)	5.57	Adjusted Chi Square Value (12.52, β)	5.526
95% Gamma Approximate KM-UCL (use when n>=50)	253.3	95% Gamma Adjusted KM-UCL (use when n<50)	255.3

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.898	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	6.661E-16	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0723	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	112.7	Mean in Log Scale	2.743
SD in Original Scale	585.6	SD in Log Scale	1.565
95% t UCL (assumes normality of ROS data)	191	95% Percentile Bootstrap UCL	200.6
95% BCA Bootstrap UCL	262.7	95% Bootstrap t UCL	400.8
95% H-UCL (Log ROS)	75.25		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.757	KM Geo Mean	15.74
KM SD (logged)	1.532	95% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.124	95% H-UCL (KM -Log)	71.64
KM SD (logged)	1.532	95% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.124		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	112.7	Mean in Log Scale	2.752
SD in Original Scale	585.6	SD in Log Scale	1.544
95% t UCL (Assumes normality)	191	95% H-Stat UCL	72.98

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	319.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.13/16/2018 10:50:33 AM
From File	Black Mountain As Stats 03-2018_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic (mg/kg)

General Statistics

Total Number of Observations	146	Number of Distinct Observations	93
Number of Detects	145	Number of Non-Detects	1
Number of Distinct Detects	93	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	210	Maximum Non-Detect	2
Variance Detects	1853	Percent Non-Detects	0.685%
Mean Detects	29.45	SD Detects	43.05
Median Detects	9.4	CV Detects	1.462
Skewness Detects	2.352	Kurtosis Detects	5.516
Mean of Logged Detects	2.57	SD of Logged Detects	1.236

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.65	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.262	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.074	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	29.27	KM Standard Error of Mean	3.556
KM SD	42.81	95% KM (BCA) UCL	35.61
95% KM (t) UCL	35.15	95% KM (Percentile Bootstrap) UCL	35.6
95% KM (z) UCL	35.11	95% KM Bootstrap t UCL	36.39
90% KM Chebyshev UCL	39.93	95% KM Chebyshev UCL	44.76
97.5% KM Chebyshev UCL	51.47	99% KM Chebyshev UCL	64.64

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	7.12	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.797	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.204	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.081	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.738	k star (bias corrected MLE)	0.728
Theta hat (MLE)	39.89	Theta star (bias corrected MLE)	40.47
nu hat (MLE)	214.1	nu star (bias corrected)	211
Mean (detects)	29.45		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	29.25
Maximum	210	Median	9.4
SD	42.97	CV	1.469
k hat (MLE)	0.706	k star (bias corrected MLE)	0.696
Theta hat (MLE)	41.42	Theta star (bias corrected MLE)	42.01
nu hat (MLE)	206.2	nu star (bias corrected)	203.3
Adjusted Level of Significance (β)	0.0484		
Approximate Chi Square Value (203.30, α)	171.3	Adjusted Chi Square Value (203.30, β)	171
95% Gamma Approximate UCL (use when n>=50)	34.71	95% Gamma Adjusted UCL (use when n<50)	34.77

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	29.27	SD (KM)	42.81
Variance (KM)	1833	SE of Mean (KM)	3.556
k hat (KM)	0.467	k star (KM)	0.462
nu hat (KM)	136.4	nu star (KM)	135
theta hat (KM)	62.63	theta star (KM)	63.32
80% gamma percentile (KM)	47.86	90% gamma percentile (KM)	80.45
95% gamma percentile (KM)	115.6	99% gamma percentile (KM)	202.7

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (134.96, α)	109.1	Adjusted Chi Square Value (134.96, β)	108.9
95% Gamma Approximate KM-UCL (use when n>=50)	36.19	95% Gamma Adjusted KM-UCL (use when n<50)	36.27

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.911	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	4.870E-12	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.074	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	29.25	Mean in Log Scale	2.547
SD in Original Scale	42.97	SD in Log Scale	1.264
95% t UCL (assumes normality of ROS data)	35.14	95% Percentile Bootstrap UCL	35.33
95% BCA Bootstrap UCL	35.62	95% Bootstrap t UCL	36.53
95% H-UCL (Log ROS)	36.74		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.557	KM Geo Mean	12.9
KM SD (logged)	1.237	95% Critical H Value (KM-Log)	2.43
KM Standard Error of Mean (logged)	0.103	95% H-UCL (KM -Log)	35.62
KM SD (logged)	1.237	95% Critical H Value (KM-Log)	2.43
KM Standard Error of Mean (logged)	0.103		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	29.26	Mean in Log Scale	2.553
SD in Original Scale	42.97	SD in Log Scale	1.25
95% t UCL (Assumes normality)	35.14	95% H-Stat UCL	36.16

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	44.76

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX H

Attachment B

Test 003

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11306011	Start Time	07:54:30
		Stop Date	08/23/2017
		Stop Time	09:15:30
		Total Time	0:01:21:00
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.047 mg/m^3
Max	0.312 mg/m^3
Max Date	08/23/2017
Max Time	08:41:00
Min	0.031 mg/m^3
Min Date	08/23/2017
Min Time	08:28:30
TWA (8 hr)	0.008
TWA Start Date	08/23/2017
TWA Start Time	07:54:30
TWA End Time	09:15:30

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	07:55:00	0.048
2	08/23/2017	07:55:30	0.040
3	08/23/2017	07:56:00	0.037
4	08/23/2017	07:56:30	0.039
5	08/23/2017	07:57:00	0.036
6	08/23/2017	07:57:30	0.038
7	08/23/2017	07:58:00	0.036
8	08/23/2017	07:58:30	0.048
9	08/23/2017	07:59:00	0.038
10	08/23/2017	07:59:30	0.041
11	08/23/2017	08:00:00	0.041
12	08/23/2017	08:00:30	0.040
13	08/23/2017	08:01:00	0.037
14	08/23/2017	08:01:30	0.050
15	08/23/2017	08:02:00	0.045
16	08/23/2017	08:02:30	0.034
17	08/23/2017	08:03:00	0.041
18	08/23/2017	08:03:30	0.043
19	08/23/2017	08:04:00	0.050
20	08/23/2017	08:04:30	0.044
21	08/23/2017	08:05:00	0.041

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	08:05:30	0.049
23	08/23/2017	08:06:00	0.065
24	08/23/2017	08:06:30	0.043
25	08/23/2017	08:07:00	0.044
26	08/23/2017	08:07:30	0.045
27	08/23/2017	08:08:00	0.062
28	08/23/2017	08:08:30	0.047
29	08/23/2017	08:09:00	0.045
30	08/23/2017	08:09:30	0.041
31	08/23/2017	08:10:00	0.041
32	08/23/2017	08:10:30	0.044
33	08/23/2017	08:11:00	0.042
34	08/23/2017	08:11:30	0.044
35	08/23/2017	08:12:00	0.045
36	08/23/2017	08:12:30	0.040
37	08/23/2017	08:13:00	0.044
38	08/23/2017	08:13:30	0.043
39	08/23/2017	08:14:00	0.045
40	08/23/2017	08:14:30	0.047
41	08/23/2017	08:15:00	0.036
42	08/23/2017	08:15:30	0.041
43	08/23/2017	08:16:00	0.038
44	08/23/2017	08:16:30	0.048
45	08/23/2017	08:17:00	0.051
46	08/23/2017	08:17:30	0.040
47	08/23/2017	08:18:00	0.041
48	08/23/2017	08:18:30	0.048
49	08/23/2017	08:19:00	0.044
50	08/23/2017	08:19:30	0.050
51	08/23/2017	08:20:00	0.044
52	08/23/2017	08:20:30	0.046
53	08/23/2017	08:21:00	0.046
54	08/23/2017	08:21:30	0.046
55	08/23/2017	08:22:00	0.046
56	08/23/2017	08:22:30	0.052
57	08/23/2017	08:23:00	0.048
58	08/23/2017	08:23:30	0.039
59	08/23/2017	08:24:00	0.050
60	08/23/2017	08:24:30	0.045
61	08/23/2017	08:25:00	0.047
62	08/23/2017	08:25:30	0.045
63	08/23/2017	08:26:00	0.043
64	08/23/2017	08:26:30	0.056
65	08/23/2017	08:27:00	0.043
66	08/23/2017	08:27:30	0.042
67	08/23/2017	08:28:00	0.068

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	08:28:30	0.031
69	08/23/2017	08:29:00	0.041
70	08/23/2017	08:29:30	0.050
71	08/23/2017	08:30:00	0.049
72	08/23/2017	08:30:30	0.048
73	08/23/2017	08:31:00	0.120
74	08/23/2017	08:31:30	0.049
75	08/23/2017	08:32:00	0.046
76	08/23/2017	08:32:30	0.063
77	08/23/2017	08:33:00	0.063
78	08/23/2017	08:33:30	0.041
79	08/23/2017	08:34:00	0.042
80	08/23/2017	08:34:30	0.042
81	08/23/2017	08:35:00	0.054
82	08/23/2017	08:35:30	0.051
83	08/23/2017	08:36:00	0.044
84	08/23/2017	08:36:30	0.095
85	08/23/2017	08:37:00	0.064
86	08/23/2017	08:37:30	0.044
87	08/23/2017	08:38:00	0.042
88	08/23/2017	08:38:30	0.042
89	08/23/2017	08:39:00	0.035
90	08/23/2017	08:39:30	0.039
91	08/23/2017	08:40:00	0.043
92	08/23/2017	08:40:30	0.072
93	08/23/2017	08:41:00	0.312
94	08/23/2017	08:41:30	0.057
95	08/23/2017	08:42:00	0.038
96	08/23/2017	08:42:30	0.038
97	08/23/2017	08:43:00	0.042
98	08/23/2017	08:43:30	0.052
99	08/23/2017	08:44:00	0.036
100	08/23/2017	08:44:30	0.038
101	08/23/2017	08:45:00	0.042
102	08/23/2017	08:45:30	0.047
103	08/23/2017	08:46:00	0.050
104	08/23/2017	08:46:30	0.058
105	08/23/2017	08:47:00	0.043
106	08/23/2017	08:47:30	0.039
107	08/23/2017	08:48:00	0.034
108	08/23/2017	08:48:30	0.033
109	08/23/2017	08:49:00	0.038
110	08/23/2017	08:49:30	0.035
111	08/23/2017	08:50:00	0.032
112	08/23/2017	08:50:30	0.031
113	08/23/2017	08:51:00	0.033

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/23/2017	08:51:30	0.045
115	08/23/2017	08:52:00	0.034
116	08/23/2017	08:52:30	0.033
117	08/23/2017	08:53:00	0.034
118	08/23/2017	08:53:30	0.044
119	08/23/2017	08:54:00	0.044
120	08/23/2017	08:54:30	0.036
121	08/23/2017	08:55:00	0.044
122	08/23/2017	08:55:30	0.048
123	08/23/2017	08:56:00	0.034
124	08/23/2017	08:56:30	0.039
125	08/23/2017	08:57:00	0.037
126	08/23/2017	08:57:30	0.036
127	08/23/2017	08:58:00	0.039
128	08/23/2017	08:58:30	0.038
129	08/23/2017	08:59:00	0.033
130	08/23/2017	08:59:30	0.040
131	08/23/2017	09:00:00	0.034
132	08/23/2017	09:00:30	0.036
133	08/23/2017	09:01:00	0.070
134	08/23/2017	09:01:30	0.064
135	08/23/2017	09:02:00	0.103
136	08/23/2017	09:02:30	0.039
137	08/23/2017	09:03:00	0.058
138	08/23/2017	09:03:30	0.142
139	08/23/2017	09:04:00	0.033
140	08/23/2017	09:04:30	0.042
141	08/23/2017	09:05:00	0.085
142	08/23/2017	09:05:30	0.040
143	08/23/2017	09:06:00	0.033
144	08/23/2017	09:06:30	0.041
145	08/23/2017	09:07:00	0.036
146	08/23/2017	09:07:30	0.037
147	08/23/2017	09:08:00	0.036
148	08/23/2017	09:08:30	0.035
149	08/23/2017	09:09:00	0.036
150	08/23/2017	09:09:30	0.039
151	08/23/2017	09:10:00	0.037
152	08/23/2017	09:10:30	0.056
153	08/23/2017	09:11:00	0.039
154	08/23/2017	09:11:30	0.035
155	08/23/2017	09:12:00	0.039
156	08/23/2017	09:12:30	0.047
157	08/23/2017	09:13:00	0.041
158	08/23/2017	09:13:30	0.039
159	08/23/2017	09:14:00	0.034

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/23/2017	09:14:30	0.036
161	08/23/2017	09:15:00	0.036
162	08/23/2017	09:15:30	0.038

Test 004

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11306011	Start Time	09:40:31
		Stop Date	08/23/2017
		Stop Time	10:28:31
		Total Time	0:00:48:00
		Logging Interval	30 seconds

Statistics

	Aerosol
Avg	0.041 mg/m^3
Max	0.111 mg/m^3
Max Date	08/23/2017
Max Time	10:09:01
Min	0.028 mg/m^3
Min Date	08/23/2017
Min Time	09:45:01
TWA (8 hr)	0.004
TWA Start Date	08/23/2017
TWA Start Time	09:40:31
TWA End Time	10:28:31

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	09:41:01	0.034
2	08/23/2017	09:41:31	0.031
3	08/23/2017	09:42:01	0.035
4	08/23/2017	09:42:31	0.035
5	08/23/2017	09:43:01	0.038
6	08/23/2017	09:43:31	0.030
7	08/23/2017	09:44:01	0.034
8	08/23/2017	09:44:31	0.029
9	08/23/2017	09:45:01	0.028
10	08/23/2017	09:45:31	0.031
11	08/23/2017	09:46:01	0.080
12	08/23/2017	09:46:31	0.047
13	08/23/2017	09:47:01	0.054
14	08/23/2017	09:47:31	0.042
15	08/23/2017	09:48:01	0.040
16	08/23/2017	09:48:31	0.041
17	08/23/2017	09:49:01	0.042
18	08/23/2017	09:49:31	0.038
19	08/23/2017	09:50:01	0.054
20	08/23/2017	09:50:31	0.043
21	08/23/2017	09:51:01	0.038

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	09:51:31	0.037
23	08/23/2017	09:52:01	0.040
24	08/23/2017	09:52:31	0.042
25	08/23/2017	09:53:01	0.040
26	08/23/2017	09:53:31	0.037
27	08/23/2017	09:54:01	0.039
28	08/23/2017	09:54:31	0.050
29	08/23/2017	09:55:01	0.040
30	08/23/2017	09:55:31	0.044
31	08/23/2017	09:56:01	0.040
32	08/23/2017	09:56:31	0.042
33	08/23/2017	09:57:01	0.042
34	08/23/2017	09:57:31	0.031
35	08/23/2017	09:58:01	0.036
36	08/23/2017	09:58:31	0.040
37	08/23/2017	09:59:01	0.034
38	08/23/2017	09:59:31	0.032
39	08/23/2017	10:00:01	0.042
40	08/23/2017	10:00:31	0.039
41	08/23/2017	10:01:01	0.047
42	08/23/2017	10:01:31	0.043
43	08/23/2017	10:02:01	0.036
44	08/23/2017	10:02:31	0.039
45	08/23/2017	10:03:01	0.035
46	08/23/2017	10:03:31	0.039
47	08/23/2017	10:04:01	0.038
48	08/23/2017	10:04:31	0.044
49	08/23/2017	10:05:01	0.041
50	08/23/2017	10:05:31	0.038
51	08/23/2017	10:06:01	0.037
52	08/23/2017	10:06:31	0.037
53	08/23/2017	10:07:01	0.040
54	08/23/2017	10:07:31	0.043
55	08/23/2017	10:08:01	0.043
56	08/23/2017	10:08:31	0.038
57	08/23/2017	10:09:01	0.111
58	08/23/2017	10:09:31	0.048
59	08/23/2017	10:10:01	0.040
60	08/23/2017	10:10:31	0.038
61	08/23/2017	10:11:01	0.065
62	08/23/2017	10:11:31	0.087
63	08/23/2017	10:12:01	0.038
64	08/23/2017	10:12:31	0.046
65	08/23/2017	10:13:01	0.042
66	08/23/2017	10:13:31	0.075
67	08/23/2017	10:14:01	0.040

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	10:14:31	0.041
69	08/23/2017	10:15:01	0.036
70	08/23/2017	10:15:31	0.034
71	08/23/2017	10:16:01	0.034
72	08/23/2017	10:16:31	0.038
73	08/23/2017	10:17:01	0.037
74	08/23/2017	10:17:31	0.039
75	08/23/2017	10:18:01	0.049
76	08/23/2017	10:18:31	0.033
77	08/23/2017	10:19:01	0.035
78	08/23/2017	10:19:31	0.040
79	08/23/2017	10:20:01	0.040
80	08/23/2017	10:20:31	0.038
81	08/23/2017	10:21:01	0.046
82	08/23/2017	10:21:31	0.037
83	08/23/2017	10:22:01	0.047
84	08/23/2017	10:22:31	0.056
85	08/23/2017	10:23:01	0.041
86	08/23/2017	10:23:31	0.031
87	08/23/2017	10:24:01	0.032
88	08/23/2017	10:24:31	0.030
89	08/23/2017	10:25:01	0.033
90	08/23/2017	10:25:31	0.039
91	08/23/2017	10:26:01	0.034
92	08/23/2017	10:26:31	0.034
93	08/23/2017	10:27:01	0.041
94	08/23/2017	10:27:31	0.037
95	08/23/2017	10:28:01	0.046
96	08/23/2017	10:28:31	0.039

Test 001

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11403008	Start Time	07:54:25
		Stop Date	08/23/2017
		Stop Time	09:15:55
		Total Time	0:01:21:30
		Logging Interval	30 seconds

Statistics

	Aerosol
Avg	0.043 mg/m^3
Max	0.317 mg/m^3
Max Date	08/23/2017
Max Time	07:57:25
Min	0.015 mg/m^3
Min Date	08/23/2017
Min Time	08:39:55
TWA (8 hr)	0.007
TWA Start Date	08/23/2017
TWA Start Time	07:54:25
TWA End Time	09:15:55

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	07:54:55	0.037
2	08/23/2017	07:55:25	0.036
3	08/23/2017	07:55:55	0.036
4	08/23/2017	07:56:25	0.035
5	08/23/2017	07:56:55	0.062
6	08/23/2017	07:57:25	0.317
7	08/23/2017	07:57:55	0.035
8	08/23/2017	07:58:25	0.040
9	08/23/2017	07:58:55	0.050
10	08/23/2017	07:59:25	0.041
11	08/23/2017	07:59:55	0.056
12	08/23/2017	08:00:25	0.045
13	08/23/2017	08:00:55	0.047
14	08/23/2017	08:01:25	0.041
15	08/23/2017	08:01:55	0.044
16	08/23/2017	08:02:25	0.208
17	08/23/2017	08:02:55	0.047
18	08/23/2017	08:03:25	0.054
19	08/23/2017	08:03:55	0.035
20	08/23/2017	08:04:25	0.038
21	08/23/2017	08:04:55	0.108

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	08:05:25	0.053
23	08/23/2017	08:05:55	0.045
24	08/23/2017	08:06:25	0.048
25	08/23/2017	08:06:55	0.041
26	08/23/2017	08:07:25	0.065
27	08/23/2017	08:07:55	0.043
28	08/23/2017	08:08:25	0.060
29	08/23/2017	08:08:55	0.043
30	08/23/2017	08:09:25	0.035
31	08/23/2017	08:09:55	0.040
32	08/23/2017	08:10:25	0.044
33	08/23/2017	08:10:55	0.041
34	08/23/2017	08:11:25	0.067
35	08/23/2017	08:11:55	0.053
36	08/23/2017	08:12:25	0.044
37	08/23/2017	08:12:55	0.062
38	08/23/2017	08:13:25	0.053
39	08/23/2017	08:13:55	0.040
40	08/23/2017	08:14:25	0.047
41	08/23/2017	08:14:55	0.039
42	08/23/2017	08:15:25	0.040
43	08/23/2017	08:15:55	0.042
44	08/23/2017	08:16:25	0.035
45	08/23/2017	08:16:55	0.040
46	08/23/2017	08:17:25	0.025
47	08/23/2017	08:17:55	0.036
48	08/23/2017	08:18:25	0.041
49	08/23/2017	08:18:55	0.040
50	08/23/2017	08:19:25	0.049
51	08/23/2017	08:19:55	0.041
52	08/23/2017	08:20:25	0.050
53	08/23/2017	08:20:55	0.041
54	08/23/2017	08:21:25	0.041
55	08/23/2017	08:21:55	0.044
56	08/23/2017	08:22:25	0.039
57	08/23/2017	08:22:55	0.036
58	08/23/2017	08:23:25	0.044
59	08/23/2017	08:23:55	0.042
60	08/23/2017	08:24:25	0.038
61	08/23/2017	08:24:55	0.037
62	08/23/2017	08:25:25	0.035
63	08/23/2017	08:25:55	0.041
64	08/23/2017	08:26:25	0.042
65	08/23/2017	08:26:55	0.037
66	08/23/2017	08:27:25	0.041
67	08/23/2017	08:27:55	0.037

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	08:28:25	0.049
69	08/23/2017	08:28:55	0.043
70	08/23/2017	08:29:25	0.049
71	08/23/2017	08:29:55	0.053
72	08/23/2017	08:30:25	0.044
73	08/23/2017	08:30:55	0.048
74	08/23/2017	08:31:25	0.037
75	08/23/2017	08:31:55	0.036
76	08/23/2017	08:32:25	0.039
77	08/23/2017	08:32:55	0.038
78	08/23/2017	08:33:25	0.031
79	08/23/2017	08:33:55	0.038
80	08/23/2017	08:34:25	0.037
81	08/23/2017	08:34:55	0.059
82	08/23/2017	08:35:25	0.044
83	08/23/2017	08:35:55	0.040
84	08/23/2017	08:36:25	0.041
85	08/23/2017	08:36:55	0.040
86	08/23/2017	08:37:25	0.038
87	08/23/2017	08:37:55	0.019
88	08/23/2017	08:38:25	0.037
89	08/23/2017	08:38:55	0.037
90	08/23/2017	08:39:25	0.045
91	08/23/2017	08:39:55	0.015
92	08/23/2017	08:40:25	0.032
93	08/23/2017	08:40:55	0.038
94	08/23/2017	08:41:25	0.038
95	08/23/2017	08:41:55	0.036
96	08/23/2017	08:42:25	0.052
97	08/23/2017	08:42:55	0.041
98	08/23/2017	08:43:25	0.034
99	08/23/2017	08:43:55	0.032
100	08/23/2017	08:44:25	0.032
101	08/23/2017	08:44:55	0.032
102	08/23/2017	08:45:25	0.044
103	08/23/2017	08:45:55	0.046
104	08/23/2017	08:46:25	0.035
105	08/23/2017	08:46:55	0.039
106	08/23/2017	08:47:25	0.038
107	08/23/2017	08:47:55	0.038
108	08/23/2017	08:48:25	0.033
109	08/23/2017	08:48:55	0.037
110	08/23/2017	08:49:25	0.037
111	08/23/2017	08:49:55	0.036
112	08/23/2017	08:50:25	0.029
113	08/23/2017	08:50:55	0.039

Test Data

Data Point	Date	Time	Aerosol mg/m^3
114	08/23/2017	08:51:25	0.036
115	08/23/2017	08:51:55	0.032
116	08/23/2017	08:52:25	0.029
117	08/23/2017	08:52:55	0.034
118	08/23/2017	08:53:25	0.033
119	08/23/2017	08:53:55	0.036
120	08/23/2017	08:54:25	0.029
121	08/23/2017	08:54:55	0.028
122	08/23/2017	08:55:25	0.042
123	08/23/2017	08:55:55	0.028
124	08/23/2017	08:56:25	0.033
125	08/23/2017	08:56:55	0.042
126	08/23/2017	08:57:25	0.028
127	08/23/2017	08:57:55	0.033
128	08/23/2017	08:58:25	0.033
129	08/23/2017	08:58:55	0.038
130	08/23/2017	08:59:25	0.036
131	08/23/2017	08:59:55	0.032
132	08/23/2017	09:00:25	0.036
133	08/23/2017	09:00:55	0.044
134	08/23/2017	09:01:25	0.039
135	08/23/2017	09:01:55	0.046
136	08/23/2017	09:02:25	0.033
137	08/23/2017	09:02:55	0.036
138	08/23/2017	09:03:25	0.034
139	08/23/2017	09:03:55	0.033
140	08/23/2017	09:04:25	0.039
141	08/23/2017	09:04:55	0.034
142	08/23/2017	09:05:25	0.038
143	08/23/2017	09:05:55	0.043
144	08/23/2017	09:06:25	0.032
145	08/23/2017	09:06:55	0.033
146	08/23/2017	09:07:25	0.032
147	08/23/2017	09:07:55	0.035
148	08/23/2017	09:08:25	0.033
149	08/23/2017	09:08:55	0.035
150	08/23/2017	09:09:25	0.033
151	08/23/2017	09:09:55	0.032
152	08/23/2017	09:10:25	0.033
153	08/23/2017	09:10:55	0.034
154	08/23/2017	09:11:25	0.037
155	08/23/2017	09:11:55	0.038
156	08/23/2017	09:12:25	0.034
157	08/23/2017	09:12:55	0.034
158	08/23/2017	09:13:25	0.041
159	08/23/2017	09:13:55	0.038

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/23/2017	09:14:25	0.035
161	08/23/2017	09:14:55	0.035
162	08/23/2017	09:15:25	0.031
163	08/23/2017	09:15:55	0.038

Test 002

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/23/2017
Meter S/N	11403008	Start Time	09:40:42
		Stop Date	08/23/2017
		Stop Time	10:40:12
		Total Time	0:00:59:30
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.035 mg/m^3
Max	0.196 mg/m^3
Max Date	08/23/2017
Max Time	10:34:12
Min	0.024 mg/m^3
Min Date	08/23/2017
Min Time	10:22:42
TWA (8 hr)	0.004
TWA Start Date	08/23/2017
TWA Start Time	09:40:42
TWA End Time	10:40:12

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/23/2017	09:41:12	0.031
2	08/23/2017	09:41:42	0.035
3	08/23/2017	09:42:12	0.035
4	08/23/2017	09:42:42	0.031
5	08/23/2017	09:43:12	0.030
6	08/23/2017	09:43:42	0.033
7	08/23/2017	09:44:12	0.036
8	08/23/2017	09:44:42	0.031
9	08/23/2017	09:45:12	0.027
10	08/23/2017	09:45:42	0.028
11	08/23/2017	09:46:12	0.034
12	08/23/2017	09:46:42	0.000
13	08/23/2017	09:47:12	0.027
14	08/23/2017	09:47:42	0.035
15	08/23/2017	09:48:12	0.038
16	08/23/2017	09:48:42	0.040
17	08/23/2017	09:49:12	0.032
18	08/23/2017	09:49:42	0.035
19	08/23/2017	09:50:12	0.035
20	08/23/2017	09:50:42	0.030
21	08/23/2017	09:51:12	0.032

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/23/2017	09:51:42	0.031
23	08/23/2017	09:52:12	0.000
24	08/23/2017	09:52:42	0.035
25	08/23/2017	09:53:12	0.035
26	08/23/2017	09:53:42	0.034
27	08/23/2017	09:54:12	0.040
28	08/23/2017	09:54:42	0.033
29	08/23/2017	09:55:12	0.029
30	08/23/2017	09:55:42	0.033
31	08/23/2017	09:56:12	0.032
32	08/23/2017	09:56:42	0.032
33	08/23/2017	09:57:12	0.033
34	08/23/2017	09:57:42	0.030
35	08/23/2017	09:58:12	0.042
36	08/23/2017	09:58:42	0.033
37	08/23/2017	09:59:12	0.031
38	08/23/2017	09:59:42	0.031
39	08/23/2017	10:00:12	0.031
40	08/23/2017	10:00:42	0.037
41	08/23/2017	10:01:12	0.039
42	08/23/2017	10:01:42	0.040
43	08/23/2017	10:02:12	0.034
44	08/23/2017	10:02:42	0.038
45	08/23/2017	10:03:12	0.034
46	08/23/2017	10:03:42	0.032
47	08/23/2017	10:04:12	0.033
48	08/23/2017	10:04:42	0.032
49	08/23/2017	10:05:12	0.033
50	08/23/2017	10:05:42	0.043
51	08/23/2017	10:06:12	0.035
52	08/23/2017	10:06:42	0.029
53	08/23/2017	10:07:12	0.035
54	08/23/2017	10:07:42	0.035
55	08/23/2017	10:08:12	0.041
56	08/23/2017	10:08:42	0.035
57	08/23/2017	10:09:12	0.041
58	08/23/2017	10:09:42	0.036
59	08/23/2017	10:10:12	0.035
60	08/23/2017	10:10:42	0.035
61	08/23/2017	10:11:12	0.037
62	08/23/2017	10:11:42	0.034
63	08/23/2017	10:12:12	0.034
64	08/23/2017	10:12:42	0.036
65	08/23/2017	10:13:12	0.031
66	08/23/2017	10:13:42	0.030
67	08/23/2017	10:14:12	0.031

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/23/2017	10:14:42	0.035
69	08/23/2017	10:15:12	0.030
70	08/23/2017	10:15:42	0.038
71	08/23/2017	10:16:12	0.035
72	08/23/2017	10:16:42	0.034
73	08/23/2017	10:17:12	0.033
74	08/23/2017	10:17:42	0.033
75	08/23/2017	10:18:12	0.032
76	08/23/2017	10:18:42	0.032
77	08/23/2017	10:19:12	0.031
78	08/23/2017	10:19:42	0.034
79	08/23/2017	10:20:12	0.028
80	08/23/2017	10:20:42	0.029
81	08/23/2017	10:21:12	0.027
82	08/23/2017	10:21:42	0.029
83	08/23/2017	10:22:12	0.029
84	08/23/2017	10:22:42	0.024
85	08/23/2017	10:23:12	0.032
86	08/23/2017	10:23:42	0.027
87	08/23/2017	10:24:12	0.028
88	08/23/2017	10:24:42	0.028
89	08/23/2017	10:25:12	0.029
90	08/23/2017	10:25:42	0.031
91	08/23/2017	10:26:12	0.034
92	08/23/2017	10:26:42	0.033
93	08/23/2017	10:27:12	0.035
94	08/23/2017	10:27:42	0.034
95	08/23/2017	10:28:12	0.033
96	08/23/2017	10:28:42	0.028
97	08/23/2017	10:29:12	0.030
98	08/23/2017	10:29:42	0.032
99	08/23/2017	10:30:12	0.041
100	08/23/2017	10:30:42	0.033
101	08/23/2017	10:31:12	0.037
102	08/23/2017	10:31:42	0.031
103	08/23/2017	10:32:12	0.029
104	08/23/2017	10:32:42	0.030
105	08/23/2017	10:33:12	0.033
106	08/23/2017	10:33:42	0.026
107	08/23/2017	10:34:12	0.196
108	08/23/2017	10:34:42	0.054
109	08/23/2017	10:35:12	0.046
110	08/23/2017	10:35:42	0.031
111	08/23/2017	10:36:12	0.034
112	08/23/2017	10:36:42	0.032
113	08/23/2017	10:37:12	0.056

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/23/2017	10:37:42	0.035
115	08/23/2017	10:38:12	0.026
116	08/23/2017	10:38:42	0.069
117	08/23/2017	10:39:12	0.029
118	08/23/2017	10:39:42	0.066
119	08/23/2017	10:40:12	0.033

Dust Data 08232017

BAB

Instrument [S/N]	Test #	Date	Start Time	Duration dd:hh:mm:ss	Average	Units	Channel	Maximum	Minimum
SidePak AM 11403008	002	08/23/2017	09:40:42	0:00:59:30	0.035	mg/m^3	Aerosol	0.196	0.024
SidePak AM 11403008	003	08/23/2017	10:59:22	0:00:27:00	0.063	mg/m^3	Aerosol	1.734	0.019
SidePak AM 11403008	001	08/23/2017	07:54:25	0:01:21:30	0.043	mg/m^3	Aerosol	0.317	0.015

Dust Data 08232017

BMC

Instrument [S/N]	Test #	Date	Start Time	Duration dd:hh:mm:ss	Average	Units	Channel	Maximum	Minimum
SidePak AM 11306011	004	08/23/2017	09:40:31	0:00:48:00	0.041	mg/m^3	Aerosol	0.111	0.028
SidePak AM 11306011	003	08/23/2017	07:54:30	0:01:21:00	0.047	mg/m^3	Aerosol	0.312	0.031

Test 004

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/29/2017
Meter S/N	11403008	Start Time	08:05:18
		Stop Date	08/29/2017
		Stop Time	10:15:48
		Total Time	0:02:10:30
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.046 mg/m^3
Max	1.895 mg/m^3
Max Date	08/29/2017
Max Time	08:06:18
Min	0.012 mg/m^3
Min Date	08/29/2017
Min Time	09:11:48
TWA (8 hr)	0.012
TWA Start Date	08/29/2017
TWA Start Time	08:05:18
TWA End Time	10:15:48

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/29/2017	08:05:48	0.058
2	08/29/2017	08:06:18	1.895
3	08/29/2017	08:06:48	0.209
4	08/29/2017	08:07:18	0.045
5	08/29/2017	08:07:48	0.045
6	08/29/2017	08:08:18	0.046
7	08/29/2017	08:08:48	0.043
8	08/29/2017	08:09:18	0.050
9	08/29/2017	08:09:48	0.042
10	08/29/2017	08:10:18	0.040
11	08/29/2017	08:10:48	0.045
12	08/29/2017	08:11:18	0.048
13	08/29/2017	08:11:48	0.048
14	08/29/2017	08:12:18	0.044
15	08/29/2017	08:12:48	0.042
16	08/29/2017	08:13:18	0.039
17	08/29/2017	08:13:48	0.058
18	08/29/2017	08:14:18	0.057
19	08/29/2017	08:14:48	0.053
20	08/29/2017	08:15:18	0.046
21	08/29/2017	08:15:48	0.047

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/29/2017	08:16:18	0.044
23	08/29/2017	08:16:48	0.043
24	08/29/2017	08:17:18	0.042
25	08/29/2017	08:17:48	0.055
26	08/29/2017	08:18:18	0.056
27	08/29/2017	08:18:48	0.040
28	08/29/2017	08:19:18	0.056
29	08/29/2017	08:19:48	0.045
30	08/29/2017	08:20:18	0.042
31	08/29/2017	08:20:48	0.050
32	08/29/2017	08:21:18	0.045
33	08/29/2017	08:21:48	0.054
34	08/29/2017	08:22:18	0.044
35	08/29/2017	08:22:48	0.043
36	08/29/2017	08:23:18	0.042
37	08/29/2017	08:23:48	0.048
38	08/29/2017	08:24:18	0.045
39	08/29/2017	08:24:48	0.046
40	08/29/2017	08:25:18	0.042
41	08/29/2017	08:25:48	0.041
42	08/29/2017	08:26:18	0.038
43	08/29/2017	08:26:48	0.039
44	08/29/2017	08:27:18	0.038
45	08/29/2017	08:27:48	0.052
46	08/29/2017	08:28:18	0.044
47	08/29/2017	08:28:48	0.041
48	08/29/2017	08:29:18	0.048
49	08/29/2017	08:29:48	0.039
50	08/29/2017	08:30:18	0.044
51	08/29/2017	08:30:48	0.040
52	08/29/2017	08:31:18	0.038
53	08/29/2017	08:31:48	0.044
54	08/29/2017	08:32:18	0.039
55	08/29/2017	08:32:48	0.036
56	08/29/2017	08:33:18	0.038
57	08/29/2017	08:33:48	0.044
58	08/29/2017	08:34:18	0.038
59	08/29/2017	08:34:48	0.042
60	08/29/2017	08:35:18	0.033
61	08/29/2017	08:35:48	0.036
62	08/29/2017	08:36:18	0.037
63	08/29/2017	08:36:48	0.059
64	08/29/2017	08:37:18	0.037
65	08/29/2017	08:37:48	0.041
66	08/29/2017	08:38:18	0.060
67	08/29/2017	08:38:48	0.034

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/29/2017	08:39:18	0.042
69	08/29/2017	08:39:48	0.030
70	08/29/2017	08:40:18	0.037
71	08/29/2017	08:40:48	0.123
72	08/29/2017	08:41:18	0.083
73	08/29/2017	08:41:48	0.032
74	08/29/2017	08:42:18	0.031
75	08/29/2017	08:42:48	0.026
76	08/29/2017	08:43:18	0.026
77	08/29/2017	08:43:48	0.028
78	08/29/2017	08:44:18	0.027
79	08/29/2017	08:44:48	0.033
80	08/29/2017	08:45:18	0.030
81	08/29/2017	08:45:48	0.030
82	08/29/2017	08:46:18	0.029
83	08/29/2017	08:46:48	0.033
84	08/29/2017	08:47:18	0.034
85	08/29/2017	08:47:48	0.030
86	08/29/2017	08:48:18	0.032
87	08/29/2017	08:48:48	0.065
88	08/29/2017	08:49:18	0.026
89	08/29/2017	08:49:48	0.025
90	08/29/2017	08:50:18	0.027
91	08/29/2017	08:50:48	0.023
92	08/29/2017	08:51:18	0.022
93	08/29/2017	08:51:48	0.021
94	08/29/2017	08:52:18	0.021
95	08/29/2017	08:52:48	0.019
96	08/29/2017	08:53:18	0.019
97	08/29/2017	08:53:48	0.019
98	08/29/2017	08:54:18	0.021
99	08/29/2017	08:54:48	0.021
100	08/29/2017	08:55:18	0.017
101	08/29/2017	08:55:48	0.021
102	08/29/2017	08:56:18	0.021
103	08/29/2017	08:56:48	0.023
104	08/29/2017	08:57:18	0.019
105	08/29/2017	08:57:48	0.019
106	08/29/2017	08:58:18	0.061
107	08/29/2017	08:58:48	0.041
108	08/29/2017	08:59:18	0.040
109	08/29/2017	08:59:48	0.022
110	08/29/2017	09:00:18	0.023
111	08/29/2017	09:00:48	0.017
112	08/29/2017	09:01:18	0.025
113	08/29/2017	09:01:48	0.016

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/29/2017	09:02:18	0.017
115	08/29/2017	09:02:48	0.016
116	08/29/2017	09:03:18	0.017
117	08/29/2017	09:03:48	0.017
118	08/29/2017	09:04:18	0.018
119	08/29/2017	09:04:48	0.017
120	08/29/2017	09:05:18	0.017
121	08/29/2017	09:05:48	0.018
122	08/29/2017	09:06:18	0.018
123	08/29/2017	09:06:48	0.017
124	08/29/2017	09:07:18	0.021
125	08/29/2017	09:07:48	0.018
126	08/29/2017	09:08:18	0.018
127	08/29/2017	09:08:48	0.016
128	08/29/2017	09:09:18	0.018
129	08/29/2017	09:09:48	0.018
130	08/29/2017	09:10:18	0.014
131	08/29/2017	09:10:48	0.052
132	08/29/2017	09:11:18	0.015
133	08/29/2017	09:11:48	0.012
134	08/29/2017	09:12:18	0.023
135	08/29/2017	09:12:48	0.086
136	08/29/2017	09:13:18	0.026
137	08/29/2017	09:13:48	0.018
138	08/29/2017	09:14:18	0.016
139	08/29/2017	09:14:48	0.020
140	08/29/2017	09:15:18	0.019
141	08/29/2017	09:15:48	0.015
142	08/29/2017	09:16:18	0.015
143	08/29/2017	09:16:48	0.016
144	08/29/2017	09:17:18	0.014
145	08/29/2017	09:17:48	0.063
146	08/29/2017	09:18:18	0.037
147	08/29/2017	09:18:48	0.022
148	08/29/2017	09:19:18	0.019
149	08/29/2017	09:19:48	0.016
150	08/29/2017	09:20:18	0.018
151	08/29/2017	09:20:48	0.020
152	08/29/2017	09:21:18	0.018
153	08/29/2017	09:21:48	0.018
154	08/29/2017	09:22:18	0.020
155	08/29/2017	09:22:48	0.018
156	08/29/2017	09:23:18	0.027
157	08/29/2017	09:23:48	0.029
158	08/29/2017	09:24:18	0.030
159	08/29/2017	09:24:48	0.022

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/29/2017	09:25:18	0.020
161	08/29/2017	09:25:48	0.020
162	08/29/2017	09:26:18	0.022
163	08/29/2017	09:26:48	0.019
164	08/29/2017	09:27:18	0.017
165	08/29/2017	09:27:48	0.022
166	08/29/2017	09:28:18	0.022
167	08/29/2017	09:28:48	0.019
168	08/29/2017	09:29:18	0.022
169	08/29/2017	09:29:48	0.034
170	08/29/2017	09:30:18	0.028
171	08/29/2017	09:30:48	0.026
172	08/29/2017	09:31:18	0.031
173	08/29/2017	09:31:48	0.028
174	08/29/2017	09:32:18	0.034
175	08/29/2017	09:32:48	0.037
176	08/29/2017	09:33:18	0.030
177	08/29/2017	09:33:48	0.027
178	08/29/2017	09:34:18	0.029
179	08/29/2017	09:34:48	0.033
180	08/29/2017	09:35:18	0.032
181	08/29/2017	09:35:48	0.059
182	08/29/2017	09:36:18	0.033
183	08/29/2017	09:36:48	0.039
184	08/29/2017	09:37:18	0.036
185	08/29/2017	09:37:48	0.040
186	08/29/2017	09:38:18	0.035
187	08/29/2017	09:38:48	0.031
188	08/29/2017	09:39:18	0.033
189	08/29/2017	09:39:48	0.036
190	08/29/2017	09:40:18	0.038
191	08/29/2017	09:40:48	0.039
192	08/29/2017	09:41:18	0.037
193	08/29/2017	09:41:48	0.036
194	08/29/2017	09:42:18	0.038
195	08/29/2017	09:42:48	0.045
196	08/29/2017	09:43:18	0.043
197	08/29/2017	09:43:48	0.045
198	08/29/2017	09:44:18	0.045
199	08/29/2017	09:44:48	0.045
200	08/29/2017	09:45:18	0.040
201	08/29/2017	09:45:48	0.040
202	08/29/2017	09:46:18	0.041
203	08/29/2017	09:46:48	0.295
204	08/29/2017	09:47:18	0.057
205	08/29/2017	09:47:48	0.044

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
206	08/29/2017	09:48:18	0.063
207	08/29/2017	09:48:48	0.038
208	08/29/2017	09:49:18	0.038
209	08/29/2017	09:49:48	0.055
210	08/29/2017	09:50:18	0.045
211	08/29/2017	09:50:48	0.042
212	08/29/2017	09:51:18	0.035
213	08/29/2017	09:51:48	0.042
214	08/29/2017	09:52:18	0.035
215	08/29/2017	09:52:48	0.046
216	08/29/2017	09:53:18	0.035
217	08/29/2017	09:53:48	0.040
218	08/29/2017	09:54:18	0.036
219	08/29/2017	09:54:48	0.036
220	08/29/2017	09:55:18	0.036
221	08/29/2017	09:55:48	0.040
222	08/29/2017	09:56:18	0.038
223	08/29/2017	09:56:48	0.044
224	08/29/2017	09:57:18	0.037
225	08/29/2017	09:57:48	0.333
226	08/29/2017	09:58:18	0.043
227	08/29/2017	09:58:48	0.041
228	08/29/2017	09:59:18	0.044
229	08/29/2017	09:59:48	0.042
230	08/29/2017	10:00:18	0.041
231	08/29/2017	10:00:48	0.041
232	08/29/2017	10:01:18	0.051
233	08/29/2017	10:01:48	0.041
234	08/29/2017	10:02:18	0.040
235	08/29/2017	10:02:48	0.039
236	08/29/2017	10:03:18	0.050
237	08/29/2017	10:03:48	0.040
238	08/29/2017	10:04:18	0.037
239	08/29/2017	10:04:48	0.044
240	08/29/2017	10:05:18	0.044
241	08/29/2017	10:05:48	0.038
242	08/29/2017	10:06:18	0.037
243	08/29/2017	10:06:48	0.042
244	08/29/2017	10:07:18	0.044
245	08/29/2017	10:07:48	0.039
246	08/29/2017	10:08:18	0.042
247	08/29/2017	10:08:48	0.042
248	08/29/2017	10:09:18	0.039
249	08/29/2017	10:09:48	0.046
250	08/29/2017	10:10:18	0.039
251	08/29/2017	10:10:48	0.040

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
252	08/29/2017	10:11:18	0.052
253	08/29/2017	10:11:48	0.037
254	08/29/2017	10:12:18	0.050
255	08/29/2017	10:12:48	0.044
256	08/29/2017	10:13:18	0.041
257	08/29/2017	10:13:48	0.039
258	08/29/2017	10:14:18	0.041
259	08/29/2017	10:14:48	0.037
260	08/29/2017	10:15:18	0.039
261	08/29/2017	10:15:48	0.039

Test 001

Instrument		Data Properties	
Model	SidePak Aerosol Monitor	Start Date	08/29/2017
Meter S/N	11009042	Start Time	08:03:32
		Stop Date	08/29/2017
		Stop Time	10:07:02
		Total Time	0:02:03:30
		Logging Interval	30 seconds

Statistics	
	Aerosol
Avg	0.041 mg/m^3
Max	0.248 mg/m^3
Max Date	08/29/2017
Max Time	09:25:32
Min	0.020 mg/m^3
Min Date	08/29/2017
Min Time	09:40:02
TWA (8 hr)	0.010
TWA Start Date	08/29/2017
TWA Start Time	08:03:32
TWA End Time	10:07:02

Test Data

Data Point	Date	Time	Aerosol mg/m^3
1	08/29/2017	08:04:02	0.059
2	08/29/2017	08:04:32	0.051
3	08/29/2017	08:05:02	0.059
4	08/29/2017	08:05:32	0.056
5	08/29/2017	08:06:02	0.047
6	08/29/2017	08:06:32	0.050
7	08/29/2017	08:07:02	0.044
8	08/29/2017	08:07:32	0.051
9	08/29/2017	08:08:02	0.049
10	08/29/2017	08:08:32	0.045
11	08/29/2017	08:09:02	0.043
12	08/29/2017	08:09:32	0.041
13	08/29/2017	08:10:02	0.062
14	08/29/2017	08:10:32	0.047
15	08/29/2017	08:11:02	0.050
16	08/29/2017	08:11:32	0.040
17	08/29/2017	08:12:02	0.043
18	08/29/2017	08:12:32	0.060
19	08/29/2017	08:13:02	0.066
20	08/29/2017	08:13:32	0.063
21	08/29/2017	08:14:02	0.044

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
22	08/29/2017	08:14:32	0.055
23	08/29/2017	08:15:02	0.043
24	08/29/2017	08:15:32	0.055
25	08/29/2017	08:16:02	0.071
26	08/29/2017	08:16:32	0.043
27	08/29/2017	08:17:02	0.060
28	08/29/2017	08:17:32	0.060
29	08/29/2017	08:18:02	0.042
30	08/29/2017	08:18:32	0.044
31	08/29/2017	08:19:02	0.049
32	08/29/2017	08:19:32	0.041
33	08/29/2017	08:20:02	0.041
34	08/29/2017	08:20:32	0.056
35	08/29/2017	08:21:02	0.042
36	08/29/2017	08:21:32	0.049
37	08/29/2017	08:22:02	0.047
38	08/29/2017	08:22:32	0.041
39	08/29/2017	08:23:02	0.044
40	08/29/2017	08:23:32	0.060
41	08/29/2017	08:24:02	0.045
42	08/29/2017	08:24:32	0.039
43	08/29/2017	08:25:02	0.041
44	08/29/2017	08:25:32	0.038
45	08/29/2017	08:26:02	0.062
46	08/29/2017	08:26:32	0.072
47	08/29/2017	08:27:02	0.046
48	08/29/2017	08:27:32	0.044
49	08/29/2017	08:28:02	0.062
50	08/29/2017	08:28:32	0.037
51	08/29/2017	08:29:02	0.042
52	08/29/2017	08:29:32	0.035
53	08/29/2017	08:30:02	0.054
54	08/29/2017	08:30:32	0.035
55	08/29/2017	08:31:02	0.044
56	08/29/2017	08:31:32	0.043
57	08/29/2017	08:32:02	0.042
58	08/29/2017	08:32:32	0.039
59	08/29/2017	08:33:02	0.033
60	08/29/2017	08:33:32	0.037
61	08/29/2017	08:34:02	0.032
62	08/29/2017	08:34:32	0.033
63	08/29/2017	08:35:02	0.035
64	08/29/2017	08:35:32	0.034
65	08/29/2017	08:36:02	0.032
66	08/29/2017	08:36:32	0.036
67	08/29/2017	08:37:02	0.030

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
68	08/29/2017	08:37:32	0.037
69	08/29/2017	08:38:02	0.033
70	08/29/2017	08:38:32	0.035
71	08/29/2017	08:39:02	0.033
72	08/29/2017	08:39:32	0.039
73	08/29/2017	08:40:02	0.036
74	08/29/2017	08:40:32	0.042
75	08/29/2017	08:41:02	0.039
76	08/29/2017	08:41:32	0.035
77	08/29/2017	08:42:02	0.046
78	08/29/2017	08:42:32	0.037
79	08/29/2017	08:43:02	0.031
80	08/29/2017	08:43:32	0.046
81	08/29/2017	08:44:02	0.036
82	08/29/2017	08:44:32	0.041
83	08/29/2017	08:45:02	0.041
84	08/29/2017	08:45:32	0.034
85	08/29/2017	08:46:02	0.035
86	08/29/2017	08:46:32	0.036
87	08/29/2017	08:47:02	0.043
88	08/29/2017	08:47:32	0.040
89	08/29/2017	08:48:02	0.035
90	08/29/2017	08:48:32	0.044
91	08/29/2017	08:49:02	0.042
92	08/29/2017	08:49:32	0.031
93	08/29/2017	08:50:02	0.038
94	08/29/2017	08:50:32	0.038
95	08/29/2017	08:51:02	0.041
96	08/29/2017	08:51:32	0.042
97	08/29/2017	08:52:02	0.032
98	08/29/2017	08:52:32	0.036
99	08/29/2017	08:53:02	0.033
100	08/29/2017	08:53:32	0.037
101	08/29/2017	08:54:02	0.062
102	08/29/2017	08:54:32	0.034
103	08/29/2017	08:55:02	0.041
104	08/29/2017	08:55:32	0.042
105	08/29/2017	08:56:02	0.043
106	08/29/2017	08:56:32	0.032
107	08/29/2017	08:57:02	0.040
108	08/29/2017	08:57:32	0.039
109	08/29/2017	08:58:02	0.034
110	08/29/2017	08:58:32	0.042
111	08/29/2017	08:59:02	0.029
112	08/29/2017	08:59:32	0.034
113	08/29/2017	09:00:02	0.036

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
114	08/29/2017	09:00:32	0.041
115	08/29/2017	09:01:02	0.039
116	08/29/2017	09:01:32	0.035
117	08/29/2017	09:02:02	0.031
118	08/29/2017	09:02:32	0.032
119	08/29/2017	09:03:02	0.041
120	08/29/2017	09:03:32	0.034
121	08/29/2017	09:04:02	0.048
122	08/29/2017	09:04:32	0.040
123	08/29/2017	09:05:02	0.028
124	08/29/2017	09:05:32	0.025
125	08/29/2017	09:06:02	0.032
126	08/29/2017	09:06:32	0.028
127	08/29/2017	09:07:02	0.029
128	08/29/2017	09:07:32	0.024
129	08/29/2017	09:08:02	0.026
130	08/29/2017	09:08:32	0.043
131	08/29/2017	09:09:02	0.031
132	08/29/2017	09:09:32	0.027
133	08/29/2017	09:10:02	0.026
134	08/29/2017	09:10:32	0.034
135	08/29/2017	09:11:02	0.037
136	08/29/2017	09:11:32	0.045
137	08/29/2017	09:12:02	0.040
138	08/29/2017	09:12:32	0.039
139	08/29/2017	09:13:02	0.040
140	08/29/2017	09:13:32	0.046
141	08/29/2017	09:14:02	0.043
142	08/29/2017	09:14:32	0.047
143	08/29/2017	09:15:02	0.038
144	08/29/2017	09:15:32	0.040
145	08/29/2017	09:16:02	0.038
146	08/29/2017	09:16:32	0.045
147	08/29/2017	09:17:02	0.032
148	08/29/2017	09:17:32	0.038
149	08/29/2017	09:18:02	0.046
150	08/29/2017	09:18:32	0.043
151	08/29/2017	09:19:02	0.042
152	08/29/2017	09:19:32	0.035
153	08/29/2017	09:20:02	0.046
154	08/29/2017	09:20:32	0.043
155	08/29/2017	09:21:02	0.035
156	08/29/2017	09:21:32	0.041
157	08/29/2017	09:22:02	0.045
158	08/29/2017	09:22:32	0.044
159	08/29/2017	09:23:02	0.045

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
160	08/29/2017	09:23:32	0.048
161	08/29/2017	09:24:02	0.145
162	08/29/2017	09:24:32	0.037
163	08/29/2017	09:25:02	0.042
164	08/29/2017	09:25:32	0.248
165	08/29/2017	09:26:02	0.039
166	08/29/2017	09:26:32	0.049
167	08/29/2017	09:27:02	0.046
168	08/29/2017	09:27:32	0.031
169	08/29/2017	09:28:02	0.034
170	08/29/2017	09:28:32	0.031
171	08/29/2017	09:29:02	0.031
172	08/29/2017	09:29:32	0.034
173	08/29/2017	09:30:02	0.035
174	08/29/2017	09:30:32	0.021
175	08/29/2017	09:31:02	0.034
176	08/29/2017	09:31:32	0.036
177	08/29/2017	09:32:02	0.028
178	08/29/2017	09:32:32	0.025
179	08/29/2017	09:33:02	0.030
180	08/29/2017	09:33:32	0.030
181	08/29/2017	09:34:02	0.054
182	08/29/2017	09:34:32	0.031
183	08/29/2017	09:35:02	0.028
184	08/29/2017	09:35:32	0.025
185	08/29/2017	09:36:02	0.036
186	08/29/2017	09:36:32	0.035
187	08/29/2017	09:37:02	0.023
188	08/29/2017	09:37:32	0.024
189	08/29/2017	09:38:02	0.023
190	08/29/2017	09:38:32	0.022
191	08/29/2017	09:39:02	0.025
192	08/29/2017	09:39:32	0.027
193	08/29/2017	09:40:02	0.020
194	08/29/2017	09:40:32	0.020
195	08/29/2017	09:41:02	0.021
196	08/29/2017	09:41:32	0.021
197	08/29/2017	09:42:02	0.023
198	08/29/2017	09:42:32	0.020
199	08/29/2017	09:43:02	0.025
200	08/29/2017	09:43:32	0.021
201	08/29/2017	09:44:02	0.024
202	08/29/2017	09:44:32	0.025
203	08/29/2017	09:45:02	0.029
204	08/29/2017	09:45:32	0.038
205	08/29/2017	09:46:02	0.033

Test Data			
Data Point	**Date**	**Time**	**Aerosol mg/m^3**
206	08/29/2017	09:46:32	0.031
207	08/29/2017	09:47:02	0.035
208	08/29/2017	09:47:32	0.035
209	08/29/2017	09:48:02	0.033
210	08/29/2017	09:48:32	0.034
211	08/29/2017	09:49:02	0.039
212	08/29/2017	09:49:32	0.062
213	08/29/2017	09:50:02	0.044
214	08/29/2017	09:50:32	0.033
215	08/29/2017	09:51:02	0.041
216	08/29/2017	09:51:32	0.036
217	08/29/2017	09:52:02	0.036
218	08/29/2017	09:52:32	0.036
219	08/29/2017	09:53:02	0.043
220	08/29/2017	09:53:32	0.046
221	08/29/2017	09:54:02	0.045
222	08/29/2017	09:54:32	0.039
223	08/29/2017	09:55:02	0.039
224	08/29/2017	09:55:32	0.039
225	08/29/2017	09:56:02	0.041
226	08/29/2017	09:56:32	0.039
227	08/29/2017	09:57:02	0.043
228	08/29/2017	09:57:32	0.034
229	08/29/2017	09:58:02	0.047
230	08/29/2017	09:58:32	0.045
231	08/29/2017	09:59:02	0.038
232	08/29/2017	09:59:32	0.045
233	08/29/2017	10:00:02	0.039
234	08/29/2017	10:00:32	0.044
235	08/29/2017	10:01:02	0.039
236	08/29/2017	10:01:32	0.043
237	08/29/2017	10:02:02	0.041
238	08/29/2017	10:02:32	0.035
239	08/29/2017	10:03:02	0.036
240	08/29/2017	10:03:32	0.045
241	08/29/2017	10:04:02	0.041
242	08/29/2017	10:04:32	0.038
243	08/29/2017	10:05:02	0.038
244	08/29/2017	10:05:32	0.049
245	08/29/2017	10:06:02	0.048
246	08/29/2017	10:06:32	0.044
247	08/29/2017	10:07:02	0.038

APPENDIX H

Attachment C

Table C-1
Health Hazards from Incidental Soil Ingestion
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Reference Dose (mg/kg-d)	Recreational Scenario			
			Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
			Adult	Child	Adult	Child
Metals						
Arsenic	319.1	5.8E-06	5.E-06	0.E+00	9.E-01	0.E+00
Total Hazard Index					9.E-01	0.E+00

Notes:

"--" not applicable or not available

Equations:

Child INTAKEnoncancer (mg/kg-day) = ((CSRecreational * IR-Schild * EFchild * EDchild * CF) / (BWchild * ATnoncancer))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table C-2
Health Hazards from Dermal Contact with Soil
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Reference Dose (mg/kg-d)	Recreational Scenario			
				Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
				Adult	Child	Adult	Child
Metals							
Arsenic	319.1	0.001	3.5E-06	7.E-07	2.E-06	2.E-01	5.E-01
Total Hazard Index						2.E-01	5.E-01

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Child INTAKEnoncancer (mg/kg-day) = ((CSRecreational * SAchild * AFchild * ABS * EFchild * EDchild * CF) / (BWchild * ATnoncancer))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table C-3
Health Hazards from Inhalation of Outdoor Air
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	PEF or VEF (m^3/kg)	Inhalation Reference Concentration[a] (ug/m^3)	Recreational Scenario: Exposure Concentration (ug/m^3) Adult	Recreational Scenario: Exposure Concentration (ug/m^3) Child	Recreational Scenario: Hazard Quotient (Unitless) Adult	Recreational Scenario: Hazard Quotient (Unitless) Child
Metals							
Arsenic	319.1	2.13E+07	1.5E-02	5.E-04	9.E-05	4.E-02	6.E-03
Total Hazard Index						4.E-02	6.E-03

Notes:

"--" not applicable or not available

Equations:

Particulate: Child Exposure-noncancer (ug/m^3) = (CSRecreational *(1/PEF) * EFchild * EDchild * ETchild) / (ATnoncancer))

VOCs: Child Exposure-noncancer (ug/m^3) = (CSRecreational * Etchild * EFchild * EDchild * (1/VF)) / (ATnoncancer))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table C-4
Cumulative Health Hazards from Multipathway Soil Exposure
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Recreational Noncancer Hazard							
		Adult Recreational Receptor				Child Recreational Receptor			
		Ingestion of Soil	Dermal	Inhalation	Total HI	Ingestion of Soil	Dermal	Inhalation	Total HI
Metals									
Arsenic	319.1	9.E-01	2.E-01	4.E-02	1.E+00	0.E+00	5.E-01	6.E-03	5.E-01
tal Hazard Index					1.E+00				5.E-01

Note:
"--" not applicable or not available

Table C-5
Cancer Risks from Incidental Soil Ingestion
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Recreational Scenario	
			Average Daily Intake (mg/kg-d) **Adult & Child**	Cancer Risk (Unitless) **Adult & Child**
Metals				
Arsenic	319.1	5.7E+00	7.E-07	4.E-06
Total Cancer Risk				4.E-06

Notes:
"--" not applicable or not available
Equations:
Adult/Child INTAKEcancer (mg/kg-day) = (CSRecreational * EF * INGadjusted * CF) / (ATcancer)
Where $ING_{adjusted} = [(IR\text{-}S_{child} * ED_{child} / BW_{child}) + (IR\text{-}S_{adult} * ED_{adult} / BW_{adult})]$
Cancer Risk = $(INTAKE_{cancer} * CSF)$

Table C-6
Cancer Risks from Dermal Contact with Soil
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Slope Factor $(mg/kg\text{-}d)^{-1}$	Recreational Scenario	
				Average Daily Intake (mg/kg-d) **Adult & Child**	Cancer Risk (Unitless) **Adult & Child**
Metals					
Arsenic	319.1	0.001	9.5E+00	1.E-07	1.E-06
Total Cancer Risk					1.E-06

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Adult/Child INTAKEcancer (mg/kg-day) = (CSRecreational * SAFadjusted * ABS * CF) / (ATcancer)

Where $SAF_{adjusted} = [(SA_{child} * AF_{child} * EF_{child} * ED_{child} / BW_{child}) + (SA_{adult} * AF_{adult} * EF_{adult} * ED_{adult} / BW_{adult})]$

Cancer Risk = $(INTAKE_{cancer} * CSF)$

Table C-7
Cancer Risks from Inhalation of Outdoor Air
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	PEF or VF (m3/kg)	Inhalation Unit Risk $(ug/m^3)^{-1}$	Recreational Scenario	
				Exposure Concentration (ug/m^3) Adult & Child	Cancer Risk (Unitless) Adult & Child
Metals					
Arsenic	319.1	2.13E+07	3.3E-03	8.E-05	3.E-07
Total Cancer Risk					3.E-07

Notes:
"--" not applicable or not available
Equations:
Particulate Exposure Concentartion (ug/m^3) = $(CS*EF_{child}*ED_{child}*ET_{child})/(PEF*AT_c))+(CS*EF_{adult}*ED_{adult}*ET_{adult})/(PEF*AT_c))$
VOC Exposure Concentration (ug/m^3) = $(CS * EF * ED * ET) / (VF * ATc)$
Cancer Risk = $(INTAKE_{cancer} * CSF)$

Table C-8
Cumulative Cancer Risks from Multipathway Soil Exposure
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Recreational Cancer Risk			
		Adult & Child Resident			
		Ingestion	Dermal	Inhalation	Total Risk
Metals					
Arsenic	319.1	4.E-06	1.E-06	3.E-07	6.E-06
Total Cancer Risk					6.E-06

Note:

"--" not applicable or not available

Table C-9
Health Hazards from Incidental Soil Ingestion
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Reference Dose (mg/kg-d)	Worker Exposure Scenario: Average Daily Intake (mg/kg-d) Construction Worker	Worker Exposure Scenario: Average Daily Intake (mg/kg-d) Maintenance Workers	Worker Exposure Scenario: Hazard Quotient (Unitless) Construction Worker	Worker Exposure Scenario: Hazard Quotient (Unitless) Maintenance Workers
Metals						
Arsenic	319.1	5.8E-06	2.E-05	3.E-05	3.E+00	6.E+00
Total Hazard Index					3.E+00	6.E+00

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil
Equations:
Construction Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * IR-iw * FE * EFiw * EDiw * CF) / (BWiw * $AT_{noncancer}$))
Maintenance Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * IR-Scw * FE * EFcw * EDcw * CF) / (BWcw * $AT_{noncancer}$))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table C-10
Health Hazards from Dermal Contact with Soil
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Reference Dose (mg/kg-d)	Worker Exposure Scenario			
				Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
				Construction Worker	Maintenance Worker	Construction Worker	Maintenance Worker
Metals							
Arsenic	319.1	0.001	3.5E-06	8.E-07	1.E-06	2.E-01	4.E-01
Total Hazard Index						2.E-01	4.E-01

Notes:
* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.
Equations:
Construction Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * SAiw * AFiw * ABS * FE * EFiw * EDiw * CF) / (BWiw * $AT_{noncancer}$))
Maintenance Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * SAcw * AFcw * ABS * FE * EFcw * EDcw * CF) / (BWcw * $AT_{noncancer}$))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table C-11
Health Hazards from Inhalation of Outdoor Air
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Inhalation Reference Concentration (ug/m^3)	Worker Exposure Scenario: Average Daily Intake (ug/m^3)		Worker Exposure Scenario: Hazard Quotient (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	319.1	1.5E-02	1.E-03	7.E-06	1.E-01	5.E-04
Total Hazard Index					1.E-01	5.E-04

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Intake Equations:

Intake (ug/m^3) = (CS * ET * EF * ED) / (VF * AT$_{noncancer}$))

Noncancer Hazard = (INTAKE$_{noncancer}$ / RfC)

PEF Construction Worker	m^3/kg	1.00E+06
PEF Maintenance Worker	m^3/kg	1.32E+09

Table C-12
Cumulative Health Hazards from Multipathway Soil Exposure
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Worker Exposure Scenario							
		Construction Worker				Maintenance Worker			
		Ingestion	Dermal	Inhalation	Total HI	Ingestion	Dermal	Inhalation	Total HI
Metals									
Arsenic	319.1	3.E+00	2.E-01	1.E-01	3.E+00	6.E+00	4.E-01	5.E-04	6.E+00
Total Hazard Index					3.E+00				6.E+00

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Table C-13
Cancer Risks from Incidental Soil Ingestion
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Worker Exposure Scenario			
			Average Daily Intake (mg/kg-d)		Cancer Risk (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	319.1	5.7E+00	3.E-07	3.E-06	1.E-06	2.E-05
Total Cancer Risk					1.E-06	2.E-05

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil
Equations:
Construction Worker INTAKE$_{cancer}$ (mg/kg-day) = ((CS * IR-Siw * FE * EFiw * Ediw * CF) / (BWiw * AT$_{cancer}$))
Maintenance Worker INTAKE$_{cancer}$ (mg/kg-day) = ((CS * IR-Scw * FE * EFcw * EDcw * CF) / (BW$_{cw}$ * AT$_{cancer}$))

Cancer Risk = (INTAKE$_{cancer}$ * CSF)

Table C-14
Cancer Risks from Dermal Contact with Soil
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Slope Factor $(mg/kg\text{-}d)^{-1}$	Worker Exposure Scenario: Average Daily Intake (mg/kg-d) Construction Worker	Worker Exposure Scenario: Average Daily Intake (mg/kg-d) Maintenance Workers	Worker Exposure Scenario: Cancer Risk (Unitless) Construction Worker	Worker Exposure Scenario: Cancer Risk (Unitless) Maintenance Workers
Metals							
Arsenic	319.1	0.001	9.5E+00	1.E-08	1.E-07	1.E-07	1.E-06
Total Cancer Risk						1.E-07	1.E-06

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Construction Worker $INTAKE_{cancer}$ (mg/kg-day) = ((CS * SAiw * AFiw * ABS * FE * EFiw * EDiw * CF) / (BWiw * AT_{cancer}))

Maintenance Worker $INTAKE_{cancer}$ (mg/kg-day) = ((CS * SAcw * AFcw * ABS * FE * EFcw * EDcw * CF) / (BWcw * AT_{cancer}))

Cancer Risk = ($INTAKE_{cancer}$ * CSF)

Table C-15
Cancer Risks from Inhalation of Outdoor Air
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Inhalation Unit Risk $(ug/m^3)^{-1}$	Worker Exposure Scenario			
			Average Daily Intake (ug/m^3)		Cancer Risk (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	319.1	3.3E-03	2.E-05	6.E-07	7.E-08	2.E-09
Total Cancer Risk					7.E-08	2.E-09

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Intake Equations:

VOC Exposure Concentration ($INTAKE_{cancer}$ (mg/kg-day) = (CS * EFiw * EDiw * (1/PEF) * IR-Aiw) / (BWiw * AT_{cancer}))

Cancer Risk = ($INTAKE_{canc}$ $INTAKE_{cancer}$ (mg/kg-day) = (CS * EFcw * EDcw * (1/PEF) * IR-Acw) / (BWcw * AT_{cancer}))

PEF Construction Worker m^3/kg 1.00E+06

Maintenance Worker m^3/kg 1.32E+09

Table C-16
Cumulative Cancer Risks from Multipathway Soil Exposure
Using All Soil Arsenic Data
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Worker Exposure Scenario							
		Construction Worker				Maintenance Worker			
		Ingestion	Dermal	Inhalation	Total Risk	Ingestion	Dermal	Inhalation	Total Risk
Metals									
Arsenic	319.1	1.E-06	1.E-07	7.E-08	2.E-06	2.E-05	1.E-06	2.E-09	2.E-05
Total Cancer Risk					2.E-06				2.E-05

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

APPENDIX H

Attachment D

Table D-1
Health Hazards from Incidental Soil Ingestion
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Reference Dose (mg/kg-d)	Recreational Scenario			
			Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
			Adult	Child	Adult	Child
Metals						
Arsenic	44.76	5.8E-06	7.E-07	0.E+00	1.E-01	0.E+00
Total Hazard Index					1.E-01	0.E+00

Notes:
"--" not applicable or not available
Equations:
Child INTAKEnoncancer (mg/kg-day) = ((CSRecreational * IR-Schild * EFchild * EDchild * CF) / (BWchild * ATnoncancer))
Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table D-2
Health Hazards from Dermal Contact with Soil
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Reference Dose (mg/kg-d)	Recreational Scenario			
				Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
				Adult	Child	Adult	Child
Metals							
Arsenic	44.76	0.001	3.5E-06	1.E-07	2.E-07	3.E-02	7.E-02
Total Hazard Index						3.E-02	7.E-02

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Child INTAKEnoncancer (mg/kg-day) = ((CSRecreational * SAchild * AFchild * ABS * EFchild * EDchild * CF) / (BWchild * ATnoncancer))

Noncancer Hazard = (INTAKE$_{noncancer}$ / RfD)

Table D-3
Health Hazards from Inhalation of Outdoor Air
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	PEF or VEF (m^3/kg)	Inhalation Reference Concentration[a] (ug/m^3)	Recreational Scenario Exposure Concentration (ug/m^3)		Recreational Scenario Hazard Quotient (Unitless)	
				Adult	Child	Adult	Child
Metals							
Arsenic	44.76	2.13E+07	1.5E-02	7.E-05	1.E-05	5.E-03	8.E-04
Total Hazard Index						5.E-03	8.E-04

Notes:
"--" not applicable or not available
Equations:
Particulate: Child Exposure-noncancer (ug/m^3) = (CSRecreational *(1/PEF) * EFchild * EDchild * ETchild) / (ATnoncancer))
VOCs: Child Exposure-noncancer (ug/m^3) = (CSRecreational * Etchild * EFchild * EDchild * (1/VF)) / (ATnoncancer))
Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table D-4
Cumulative Health Hazards from Multipathway Soil Exposure
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Recreational Noncancer Hazard							
		Adult Recreational Receptor				Child Recreational Receptor			
		Ingestion of Soil	Dermal	Inhalation	Total HI	Ingestion of Soil	Dermal	Inhalation	Total HI
Metals									
Arsenic	44.76	1.E-01	3.E-02	5.E-03	2.E-01	0.E+00	7.E-02	8.E-04	7.E-02
Total Hazard Index					2.E-01				7.E-02

Note:
"--" not applicable or not available

Table D-5
Cancer Risks from Incidental Soil Ingestion
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Recreational Scenario	
			Average Daily Intake (mg/kg-d) **Adult & Child**	Cancer Risk (Unitless) **Adult & Child**
Metals				
Arsenic	44.76	5.7E+00	1.E-07	6.E-07
Total Cancer Risk				6.E-07

Notes:
"--" not applicable or not available
Equations:
Adult/Child INTAKEcancer (mg/kg-day) = (CSRecreational * EF * INGadjusted * CF) / (ATcancer)
Where $ING_{adjusted} = [(IR\text{-}S_{child} * ED_{child} / BW_{child}) + (IR\text{-}S_{adult} * ED_{adult} / BW_{adult})]$
Cancer Risk = $(INTAKE_{cancer} * CSF)$

Table D-6
Cancer Risks from Dermal Contact with Soil
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Slope Factor $(mg/kg\text{-}d)^{-1}$	Recreational Scenario	
				Average Daily Intake (mg/kg-d) **Adult & Child**	Cancer Risk (Unitless) **Adult & Child**
Metals					
Arsenic	44.76	0.001	9.5E+00	2.E-08	2.E-07
Total Cancer Risk					2.E-07

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Adult/Child INTAKEcancer (mg/kg-day) = (CSRecreational * SAFadjusted * ABS * CF) / (ATcancer)

Where $SAF_{adjusted} = [(SA_{child} * AF_{child} * EF_{child} * ED_{child} / BW_{child}) + (SA_{adult} * AF_{adult} * EF_{adult} * ED_{adult} / BW_{adult})]$

Cancer Risk = $(INTAKE_{cancer} * CSF)$

Table D-7

Cancer Risks from Inhalation of Outdoor Air

Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg

Black Mountain Open Space Park

San Diego, California

COPC	Exposure Point Concentration (mg/kg)	PEF or VF (m3/kg)	Inhalation Unit Risk $(ug/m^3)^{-1}$	Recreational Scenario	
				Exposure Concentration (ug/m^3) **Adult & Child**	Cancer Risk (Unitless) **Adult & Child**
Metals					
Arsenic	44.76	2.13E+07	3.3E-03	1.E-05	4.E-08
Total Cancer Risk					4.E-08

Notes:

"--" not applicable or not available

Equations:

Particulate Exposure Concentartion (ug/m^3) = $(CS*EF_{child}*ED_{child}*ET_{child})/(PEF*AT_{c}))+(CS*EF_{adult}*ED_{adult}*ET_{adult})/(PEF*AT_{c}))$

VOC Exposure Concentration (ug/m^3) = (CS * EF * ED * ET) / (VF * ATc)

Cancer Risk = $(INTAKE_{cancer} * CSF)$

Table D-8
Cumulative Cancer Risks from Multipathway Soil Exposure
Using Soil Arsenic Data Up to A Maximum of 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Recreational Cancer Risk Adult & Child Resident			
		Ingestion	Dermal	Inhalation	Total Risk
Metals					
Arsenic	44.76	6.E-07	2.E-07	4.E-08	8.E-07
Total Cancer Risk					8.E-07

Note:
"--" not applicable or not available

Table D-9
Health Hazards from Incidental Soil Ingestion
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Reference Dose (mg/kg-d)	Worker Exposure Scenario			
			Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	44.76	5.8E-06	3.E-06	5.E-06	4.E-01	8.E-01
Total Hazard Index					4.E-01	8.E-01

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Equations:

Construction Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * IR-iw * FE * EFiw * EDiw * CF) / (BWiw * $AT_{noncancer}$))

Maintenance Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * IR-Scw * FE * EFcw * EDcw * CF) / (BWcw * $AT_{noncancer}$))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table D-10
Health Hazards from Dermal Contact with Soil
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Reference Dose (mg/kg-d)	Worker Exposure Scenario			
				Average Daily Intake (mg/kg-d)		Hazard Quotient (Unitless)	
				Construction Worker	Maintenance Worker	Construction Worker	Maintenance Worker
Metals							
Arsenic	44.76	0.001	3.5E-06	1.E-07	2.E-07	3.E-02	5.E-02
Total Hazard Index						3.E-02	5.E-02

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Construction Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * SAiw * AFiw * ABS * FE * EFiw * EDiw * CF) / (BWiw * $AT_{noncancer}$))

Maintenance Worker $INTAKE_{noncancer}$ (mg/kg-day) = ((CS * SAcw * AFcw * ABS * FE * EFcw * EDcw * CF) / (BWcw * $AT_{noncancer}$))

Noncancer Hazard = ($INTAKE_{noncancer}$ / RfD)

Table D-11
Health Hazards from Inhalation of Outdoor Air
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Inhalation Reference Concentration (ug/m^3)	Worker Exposure Scenario			
			Average Daily Intake (ug/m^3)		Hazard Quotient (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	44.76	1.5E-02	2.E-04	1.E-06	1.E-02	7.E-05
Total Hazard Index					1.E-02	7.E-05

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil
Intake Equations:
Intake (ug/m^3) = (CS * ET * EF * ED) / (VF * $AT_{noncancer}$))
Noncancer Hazard = ($INTAKE_{noncancer}$ / RfC)

Table D-12
Cumulative Health Hazards from Multipathway Soil Exposure
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Worker Exposure Scenario							
		Construction Worker				Maintenance Worker			
		Ingestion	Dermal	Inhalation	Total HI	Ingestion	Dermal	Inhalation	Total HI
Metals									
Arsenic	44.76	4.E-01	3.E-02	1.E-02	5.E-01	8.E-01	5.E-02	7.E-05	9.E-01
Total Hazard Index					5.E-01				9.E-01

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Table D-13
Cancer Risks from Incidental Soil Ingestion
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Worker Exposure Scenario			
			Average Daily Intake (mg/kg-d)		Cancer Risk (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	44.76	5.7E+00	4.E-08	4.E-07	2.E-07	2.E-06
Total Cancer Risk					2.E-07	2.E-06

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Equations:

Construction Worker $INTAKE_{cancer}$ (mg/kg-day) = ((CS * IR-Siw * FE * EFiw * Ediw * CF) / (BWiw * AT_{cancer}))

Maintenance Worker $INTAKE_{cancer}$ (mg/kg-day) = ((CS * IR-Scw * FE * EFcw * EDcw * CF) / (BW_{cw} * AT_{cancer}))

Cancer Risk = ($INTAKE_{cancer}$ * CSF)

Table D-14
Cancer Risks from Dermal Contact with Soil
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Soil-to-Skin Absorption Factor* (unitless)	Oral/Dermal Slope Factor $(mg/kg\text{-}d)^{-1}$	Worker Exposure Scenario			
				Average Daily Intake (mg/kg-d)		Cancer Risk (Unitless)	
				Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals							
Arsenic	44.76	0.001	9.5E+00	2.E-09	2.E-08	2.E-08	2.E-07
Total Cancer Risk						2.E-08	2.E-07

Notes:

* Modified to account for site-specific soil arsenic bioavaiability of less than 3.0%.

Equations:

Construction Worker INTAKE$_{cancer}$ (mg/kg-day) = ((CS * SAiw * AFiw * ABS * FE * EFiw * EDiw * CF) / (BWiw * AT$_{cancer}$))
Maintenance Worker INTAKE$_{cancer}$ (mg/kg-day) = ((CS * SAcw * AFcw * ABS * FE * EFcw * EDcw * CF) / (BWcw * AT$_{cancer}$))
Cancer Risk = (INTAKE$_{cancer}$ * CSF)

Table D-15
Cancer Risks from Inhalation of Outdoor Air
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Concentration (mg/kg)	Inhalation Unit Risk $(ug/m^3)^{-1}$	Worker Exposure Scenario			
			Average Daily Intake (ug/m^3)		Cancer Risk (Unitless)	
			Construction Worker	Maintenance Workers	Construction Worker	Maintenance Workers
Metals						
Arsenic	44.76	3.3E-03	3.E-06	9.E-08	1.E-08	3.E-10
Total Cancer Risk					1.E-08	3.E-10

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

Intake Equations:

VOC Exposure Concentration (INTAKE$_{cancer}$ (mg/kg-day) = (CS * EFiw * EDiw * (1/PEF) * IR-Aiw) / (BWiw * AT$_{cancer}$))

Cancer Risk = (INTAKE$_{canc}$ INTAKE$_{cancer}$ (mg/kg-day) = (CS * EFcw * EDcw * (1/PEF) * IR-Acw) / (BWcw * AT$_{cancer}$))

PEF Construction Worker	m^3/kg	1.00E+06

Table D-16
Cumulative Cancer Risks from Multipathway Soil Exposure
Assuming Site Remediation Where Maximum Residual Concentration is at or Below 210 mg/Kg
Black Mountain Open Space Park
San Diego, California

COPC	Exposure Point Conc. (mg/kg)	Worker Exposure Scenario							
		Construction Worker				Maintenance Worker			
		Ingestion	Dermal	Inhalation	Total Risk	Ingestion	Dermal	Inhalation	Total Risk
Metals									
Arsenic	44.76	2.E-07	2.E-08	1.E-08	2.E-07	2.E-06	2.E-07	3.E-10	3.E-06
Total Cancer Risk					2.E-07				3.E-06

Notes: "nd" not detected; "--" not applicable or not available; " * " chemical not a COPC for combined soil

APPENDIX I

Ecological Risk Assessment

APPENDIX I

ECOLOGICAL RISK ASSESSMENT
BLACK MOUNTAIN OPEN SPACE PARK
SAN DIEGO, CALIFORNIA

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1.0 STATISTICAL ANALYSIS

A statistical analysis of soil arsenic data was conducted to define the statistical distribution of the data, the mean concentration, standard deviation, coefficient of variability, the 95 percent upper confidence limit on the mean concentration (95UCL) and the maximum concentration detected.

As stated in Section 6.2.3 of the main report, at areas where the XRF readings were at or above 80 milligrams per kilogram (mg/kg) soil samples and XRF readings were obtained at a higher sampling density than anywhere else on the trails. Due to the biased sampling approach, the arsenic trail data (both analytical and XRF) are biased towards high arsenic concentrations. In an effort to assess prevailing soil arsenic concentrations at the site, soil arsenic data known to be collected for delineation purposes were excluded from the statistical analysis. The data subset selected is believed to provide an unbiased and realistic representation of the prevailing soil arsenic concentrations at the Black Mountain site. The unbiased dataset selected is made of all the soil arsenic analytical data collected at regular intervals at the trails and away from the identified soil arsenic "hot spots." Given the random sampling nature of these samples, the data was considered to be appropriate to establish the upper limit soil arsenic concentrations prevailing at the site. The soil arsenic data used in the statistical analysis is presented in Table 1.

The statistical analysis of soil arsenic data was conducted using the USEPA developed software ProUCL (Version 5.1; Singh and Maichle, 2015). ProUCL was chosen because it was specifically developed to evaluate environmental data and it calculates multiple types of confidence limits. According to ProUCL, the 95UCL soil arsenic concentration at the site is 38.81 milligrams per kilogram (mg/kg). The ProUCL printout showing the 95UCLs estimated for arsenic in soil is included in Attachment A.

For this evaluation, the "unbiased" 95UCL soil arsenic concentration was selected as the representative soil arsenic concentration in accordance with USEPA and DTSC (2015) risk assessment guidance. The USEPA (1992) recommends that the one-sided upper 95UCL be used as an upper bound chemical concentration that can be expected at a site. The 95UCL provides reasonable confidence that the true site average will not be underestimated (USEPA, 1992). According to the USEPA (1989) and DTSC (2015), risk assessment exposure concentrations should use the 95UCL as exposure point concentrations unless the 95UCL exceeds the maximum detected concentration. When the 95UCL exceeds the maximum detected concentration, the maximum detected concentration is used as the upper limit exposure concentration (USEPA, 1989). The 95UCL can exceed the maximum detected concentration for several reasons, including small sample sizes and large sample variances.

The statistical parameters obtained from the soil arsenic data are:

Statistical Parameter	**Arsenic**
Number of Samples	82
Number of Detections	82
Number of Non-detected	0
Detection Frequency	100 %
Minimum detected value	1.0 mg/kg
Maximum detected value	210 mg/kg
Mean concentration	29.71 mg/kg
Median	13.5 mg/kg
Standard Deviation	40.51
Skewness	2.82
Coefficient of Variation	1.36
95UCL	38.81 mg/kg

2.0 ECOLOGICAL RISK ASSESSMENT

2.1 INTRODUCTION

An Ecological Risk Assessment (ERA), as defined by the DTSC (1996), is a qualitative and/or quantitative appraisal of the potential effects an impacted site might have on plants and animals other than people. This section describes the tasks required to conduct an evaluation of the potential adverse effects that arsenic in soil at the site may have on ecological receptors. The primary guidance followed for the development of the ERA was the "Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities" (DTSC, 1996).

2.2 EXPOSURE ASSESSMENT

The Exposure Assessment section of the ERA evaluates the potential for chemicals detected at the Site to migrate to locations where ecological receptors may be exposed. The potential chemical sources, release mechanisms, exposure media and potential receptors evaluated in this ERA are presented in the Ecological Conceptual Site Model (ECSM) developed for the Site (see Figure 1). The ECSM integrates the exposure pathways judged to be potentially complete with the potentially exposed ecological receptors to focus the ecological assessment on critical ecological components and functions. The ECSM also identifies complete exposure pathways that might exist at the Site (a complete exposure pathway is one in which the chemical can be traced or expected to travel from the source to a receptor).

An exposure pathway is considered complete when all four of the following elements are present:

- A site-related source of a chemical (i.e., naturally occurring arsenic);
- A mechanism of release of the chemical from the source to the environment;
- A mechanism of transport of the chemical to the receptor exposure point; and
- A route by which the receptor is exposed to the chemical.

A quantitative exposure analysis was performed in the ERA for the potentially complete exposure pathways identified for ecological receptors at the Site. Only potentially complete and significant pathways were considered relevant in the ERA, as there can be no effects without exposure.

2.2.1 Potential Exposure Pathways

The ECSM illustrates the potential chemical exposure scenarios relevant to ecological receptors at the Site and depicts Site-specific transport pathways (Figure1). Available Site information, including soil data collected by Ninyo & Moore and professional judgment were used to determine the completeness and importance of these pathways. In the ECSM, the importance of each exposure route is represented by a red circle for potentially complete and significant pathways, by a hollow circle for complete, but minor pathways, and by the letters "IC" for incomplete pathways.

Although several potentially complete exposure pathways may exist at a site, not all pathways are comparable in magnitude or significance. The significance of a pathway as a mode of exposure depends on the identity and nature of the chemicals present and the magnitude of the likely exposure dose. For wildlife receptors, ingestion is usually the most significant exposure pathway. Food web exposures become significant only for chemicals with a tendency to bioaccumulate or biomagnify. Incidental ingestion of soil is also considered in the evaluation for wildlife, but this exposure pathway is expected to contribute far less to the overall dose than food consumption for most chemicals (USEPA, 2015). The inhalation of volatile organic compounds in soil is an important exposure pathway for burrowing animals. However, arsenic is not volatile.

For arsenic in soil at the Site, root uptake or direct contact are potentially complete exposure pathways for both terrestrial plants and soil invertebrates, respectively, and incidental soil ingestion is another exposure pathway for soil invertebrates. The potentially complete pathways for birds and mammals include direct contact with and incidental ingestion of soil and consumption of dietary items (e.g., prey).

Dermal contact refers to the physiochemical mechanisms involved in soil to skin contact transfer. This potentially complete pathway is difficult to quantify due to the barriers offered by fur and feathers and the paucity of data available to develop dermal absorption factors for many chemicals in soil.

Chemicals in subsurface soils at the Site may leach into groundwater, which is generally inaccessible to ecological receptors and is considered a medium of exposure only after it exits the ground and discharges to the surface. Groundwater and groundwater discharge to surface water exposure pathways are considered to be incomplete for onsite ecological receptors since there are no surface water bodies at the Site.

In summary, complete exposure pathways for ecological receptors (both plants and animals) were identified and evaluated in the ERA. Potentially complete exposure pathways resulting in receptor contact may include contact with soils, soil ingestion and food-chain transfer.

2.2.2 Exposure Point Concentrations

The exposure point concentration (EPC) is the concentration of a chemical in a specific environmental medium at the point of contact with a receptor. For example, the EPC for ecological receptors in contact with soil (i.e., plants and invertebrates) is estimated as a function of the chemical concentration measured in soil (e.g., in mg/kg). Since the objective of this ERA is to assess potential risks posed by arsenic in soil to ecological populations, the 95UCL soil arsenic concentration was used as the EPCs. The use of the 95UCL is justified since ecological receptors forage over a wide area and are exposed to average concentrations.

2.2.3 Assessment and Measurement Endpoints

An assessment endpoint can be defined as the environmental attributes considered being critical to the function of the biological community or population and are the ultimate focus of the ecological risk assessment. A measurement endpoint can be defined as the measurable observable change that is used to evaluate the effects of the chemicals of concern on the selected assessment endpoints.

An assessment endpoint is a characteristic of an ecological component (e.g., increased plant mortality, animal reproductive or developmental impairment) that may be affected by exposure to a chemical contaminant. The assessment endpoints for this evaluation are the protection of ecological receptors that may live or visit the Park now or in the future.

2.2.4 Representative Species

The functional groups included in the assessment included primary producers, primary consumers, and secondary consumers. In an effort to simplify the analysis, only upper level mammal and avian consumers were selected for the evaluation. The representative species selected for this assessment are the California ground squirrel (*Spermophilus beecheyi*) and the Northern Harrier (*Circus cyaneus*). These species were conservatively selected based upon availability of toxicity and life history data, their known occurrence in the Site (City of San Diego, 2014), and relatively high exposure potentials compared to other species.

Plants and invertebrates form the basis of the food chain in the Site and provide the primary link from soil arsenic to higher life forms. Grass, forbs, shrubs and trees are expected to provide forage for herbivores and omnivores. Likewise, invertebrates are expected to be important prey for many animals at the Site.

2.3 TOXICITY ASSESSMENT

The potential for adverse effects on vertebrates are usually conducted by estimating the potential chemical doses that may be absorbed by a given receptor and then comparing the absorbed dose to reference doses. Reference doses are chemical doses known to produce no adverse effect on animal species even if exposures were to last a lifetime. Reference doses selected for vertebrates were the Toxicity Reference Values (TRVs). TRVs are screening level benchmark values for higher trophic-level receptors such as birds and mammals. A TRV is a daily dose level resulting in no known biological effects on laboratory animals. Mammal and avian TRVs were obtained from USEPA's Terrestrial Toxicity Reference Values (TRV) manual (USEPA 1999).

Each TRV represents a critical exposure level from a toxicological study and is supported by a data set of toxicological exposures and effects. A low TRV is a conservative value consistent with a chronic no effect level and represents a value believed to have no adverse effects on wildlife species. A high TRV represents a mid-range of the lowest observable adverse effect level (LOAEL) for a given chemical when the toxicity endpoint was ecologically relevant. In the Risk Characterization section below, Site-specific daily maximum doses were compared to the receptor-specific low and high TRVs.

2.4 RISK CHARACTERIZATION

At this step of the ERA, the potential adverse effects of exposure to chemical stressors on ecological receptors are evaluated. The relationship between the degree of exposure and ecological effects was assessed based on available field measurements and eco-toxicological literature.

The Risk Characterization phase of the ERA comprises the integration of the results of the exposure and effects assessment to describe the nature and likelihood of the adverse effects associated with exposure to Site-related arsenic in soil.

2.4.1 Hazard Quotient Evaluation for Plants and Invertebrates

Potential threats to plants and invertebrates were quantitatively evaluated by calculating hazard quotients (HQs). The HQ provides a mathematically derived index that expresses the relationship between the predicted EPC and a representative "safe" concentration. If the HQ is larger than 1, that is, exposure is greater than the toxicity-related threshold, the potential for adverse effects to local ecological receptors has to be considered in greater detail. If, on the other hand, the HQ is lower than 1, then adverse effects are not expected. The magnitude of the HQ provides a general indication of the potential for ecological risk for a chemical if a reasonable level of confidence exists in the estimated EPC and the corresponding medium- and receptor-specific benchmark.

The equation used to calculate HQs for plants and invertebrates is presented below:

$$Plant\ and\ Invertebrate\ HQ = \frac{EPC}{Benchmark}$$

Where:

HQ = Hazard Quotient for a specific chemical and receptor (unitless)
EPC = Exposure point concentration for chemicals in soil (mg of chemical per kg of soil)
Benchmark = Screening benchmark representing a safe exposure concentration for the represented ecological receptor (units consistent with EPC)

HQs for plants and invertebrates were calculated using the 95UCL soil arsenic concentration as the EPC and the Ecological Soil Screening Values (USEPA, 2015), as the benchmark. The HQs calculated for plants and invertebrates are presented in Table 2.

The results obtained do indicate that plants and invertebrates living within the area impacted by arsenic in soils could be at risk given that the estimated HQ exceed the value of 1 for both plants and invertebrates. The potential for adverse effects depends upon the amount of chemical present in the soil that is available for uptake (bioavailable) as well as the chemical-specific toxicity. According to DTSC (1996) Ecological Risk Assessment guidance, if the results of a scoping-level assessment indicate the potential for adverse effects, the assessment should be followed by a more detailed evaluation. The detailed evaluation should include evaluation of primary consumers and higher-level consumers. Since we know local birds and mammals feed on local plants and invertebrates (City of San Diego, 2014), the potential health threat to birds and mammals were evaluated in the section below.

2.4.2 Hazard Quotient Evaluation for Vertebrates

The evaluation of health threats to birds and mammals focused on exposures through the ingestion pathway, consisting of incidental ingestion of soils during feeding and ingestion of food contaminated as a result of uptake of chemicals in soil. Other pathways (inhalation of particulates and dermal contact) were not evaluated in this ERA. The inhalation pathway is difficult to evaluate because data are limited regarding toxicity and exposure factors. However, exposure through this pathway is expected to be low compared to ingestion. Dermal exposure routes were not addressed quantitatively because dermal exposure is expected to contribute a very minor percentage of total risk and because limited data exist concerning exposure and absorption rates.

Food chain modeling was conducted to estimate chemical doses (or the Site-specific concentrations of chemicals ingested by vertebrate ecological receptors). Doses were estimated using realistic ecological exposure scenarios for selected receptors and pathways. For example, direct soil ingestion by ground squirrels was estimated.

Doses were calculated using average to “worst-case” exposure conditions as well as the 95UCL soil arsenic concentration. For higher trophic animals (such as the Northern Harrier), dose calculation included estimated concentrations of chemicals in prey.

Potential health threats to vertebrates were evaluated based on the HQ approach. In the HQ approach, Site-specific daily doses determined through food chain modeling were compared to TRVs. TRVs are screening level benchmark values for higher trophic-level receptors such as birds and mammals. A TRV is a daily dose level resulting in known biological effects on laboratory animals. Mammal and avian TRVs were obtained from the USEPA's Environmental Restoration Division, Terrestrial Toxicity Reference Values (USEPA, 1999).

Site-specific daily dose estimates were compared to high- and low-TRVs to estimate the potential adverse biological effects on each receptor. Based on this comparison, the potential threat to representative receptors was characterized. This comparison was performed in a manner consistent with USEPA's HQ methodology as follows (USEPA, 1997):

$$\textit{Vertebrate}\ \mathrm{HQ} = \frac{\mathrm{Dose}}{\mathrm{TRV}} = \frac{(\mathrm{mg/kg/day})}{(\mathrm{mg/kg/day})}$$

Where:

HQ = Hazard quotient (unitless)
Dose = Chemical-, receptor-, and site-specific daily dose estimate (mg/kg/day)
TRV = Chemical- and receptor-specific toxicity reference value (mg/kg/day)

Vertebrate HQs are used to estimate the level of threat posed to vertebrate receptors from the Site-specific maximum total daily dose of arsenic. Site-specific daily maximum doses were compared to the receptor-specific low and high TRV (HQ low and HQ high).

Tissue samples were not collected as part of the ERA. Therefore, estimates of chemical concentrations in tissue were only based on results of food-chain modeling.

In an effort to account for the relatively low area of the arsenic-impacted area and the fact that both mammals and birds have large foraging areas, it was assumed that ground squirrels receive 10 percent of their diet from the Site. For the Northern Harrier, it was assumed the birds receive only 1-percent of their diet from the Site. For each receptor, exposure was assessed within the context of the following linear food chains:

Soil → Plants → Small Mammals → Northern Harrier
Soil → Plants → California Ground Squirrel

The following equations were used to estimate daily doses to the representative receptors serving as measurement endpoints:

$$\text{Northern Harrier Dose} = (\text{SUF})\,\frac{[(C_{\text{sm mammal}})(\text{IR}) + (C_{\text{soil}})(\text{IR})]}{\text{BW}}$$

$$\text{California Ground Squirrel Dose} = (\text{SUF})\,\frac{[(C_{\text{plant}})(\text{IR}) + (C_{\text{soil}})(\text{IR})]}{\text{BW}}$$

Where:

Dose	=	In milligrams per kilogram per day (mg/kg/day)
C_{soil}	=	Concentration of arsenic in soil (mg/kg)
$C_{sm\ mammal}$	=	(C_{soil})(small mammal BAF) (unitless)
BAF	=	Bioaccumulation factor (unitless)
C_{plant}	=	(C_{soil})(plant BAF) (unitless)
IR	=	Ingestion rate (of prey items or soil ingested per day) (kilograms per day [kg/day])
BW	=	Body weight of receptor species (kilograms)
SUF	=	Site use factor to account for amount of time that the organism spends using the SHP and MP sites based on site area and receptor home range; assumed to be 1.0 for all receptors.

Because of the conservative nature of the ERA, all receptors were considered to be exposed to the 95UCL soil arsenic concentration 100 percent of the time (SUF = 1). Because the goal of the ERA is protection of populations rather than individuals, average parameters such as body weight and ingestion rate were used to calculate the total daily doses. Dose parameter inputs for each receptor are discussed in detail below.

2.4.3 Northern Harrier Dose Calculation Parameters

Protection of the survival, growth, and reproduction of carnivorous birds was identified as an assessment endpoint. The Northern Harrier (*Circus cyaneus*) has been identified at the Site (City of San Diego, 2014) and was selected as a surrogate for carnivorous birds. Estimated doses were calculated using food chain modeling. Table 3 summarizes parameters used in dose calculations for the Northern Harrier.

2.4.4 California Ground Squirrel Dose Calculation Parameters

Protection of reproduction and physiology of herbivorous mammals was identified as an assessment endpoint. The California ground squirrel (*Spermophilus beecheyi*) was selected as it has been seen at the Park (City of San Diego, 2014) and was selected as surrogate for herbivorous mammals. Estimated doses were calculated using food chain modeling. Table 4 summarizes the parameters used in dose calculations for the ground squirrel.

Vertebrate Hazard Quotients

Site-specific daily dose estimates were compared to high- and low-TRVs to estimate the potential adverse biological effects on each receptor. Based on this comparison, the potential threat to representative receptors was characterized; this comparison was performed in a manner consistent with USEPA's HQ methodology as follows (USEPA, 1997):

$$\textit{Vertebrate}\ \mathrm{HQ} = \frac{\mathrm{Dose}}{\mathrm{TRV}} = \frac{(\mathrm{mg/kg/day})}{(\mathrm{mg/kg/day})}$$

Where:

HQ	=	Hazard quotient (unitless)
Dose	=	Chemical-, receptor-, and site-specific daily dose estimate (mg/kg/day)
TRV	=	Chemical- and receptor-specific toxicity reference value (mg/kg/day)

Vertebrate HQs are used to estimate the level of threat posed to vertebrate receptors from the Site-specific average total daily dose of arsenic in soil. Site-specific daily doses were compared to the receptor-specific low- and high-TRV (HQ low and HQ high).

It should be noted that TRVs published by the USEPA were developed for generic mammal and avian species that may or may not be entirely applicable to the species evaluated in this ERA. It is known that different animal species respond differently to a chemical insult. However, the uncertainties associated with differences in animal sensitivity were reduced in this assessment by the use of low- and high-TRVs.

Threat Characterization: Birds

The estimated daily arsenic doses, high- and low-TRVs and the estimated HQs for the Northern Harrier are presented in Table 5. According to the calculations, the HQ values estimated for the Northern Harrier range from 0.0008 to 0.02. Therefore, the overall health threat posed by arsenic in soil is considered to be low and insignificant for avian species.

Threat Characterization: Mammals

This section discusses the results of the food chain modeling evaluation to assess potential health threat to mammals. Based on life history and foraging habits, daily dose estimates were calculated for the California ground squirrel. Daily dose estimates were calculated using the 95UCL soil arsenic concentration and were based on the assumptions and equations discussed in Section 2.4.2. Daily dose estimates were then compared to low- and high-TRVs to calculate HQs.

The estimated daily arsenic doses, high- and low-TRVs and the estimated HQs for the California ground squirrel are presented in Table 6. According to the calculations, the HQ values estimated for the California ground squirrel range from 0.2 to 2. Since the HQ calculated using the TRV-low is below 1.0 and the HQ calculated using the TRV-high is only 2, the overall health hazard posed by arsenic in soil is considered to be low for mammals.

2.5 DOMESTIC DOGS

Park visitor surveys conducted by Ninyo & Moore in August of 2017 revealed that some hikers bring dogs to the Park. Since pets (mostly dogs) could be exposed to soil and dust when walking with their owners, this section evaluates whether arsenic detected in soil at the Park could be high enough to pose a health threat to pet dogs.

The risk evaluation for pet dogs was conducted following guidance established by the USEPA (2015) for the evaluation of risks to animals other than humans. Specifically, the evaluation was conducted by comparing arsenic concentrations to which dogs could be exposed while at the Site to arsenic concentrations deemed to pose no significant risk to wild dogs or canids. This is a very conservative comparison since it's known domestic dogs will only be at the Park for a few hours and will not be eating or consuming any local animals as prey.

The soil arsenic concentration deemed to pose no risk to wild mammals was obtained from the USEPA's soil screening values for ecological receptors (USEPA 2015). According to the USEPA, arsenic soil concentrations up to 46 mg/Kg (Table 3 in USEPA, 2015) pose no health threat to wild mammalian species.

Since pet dogs will be exposed to soils under similar conditions to those potentially encountered by wild canids, the exposure point concentration used above for wild animals (38.81 mg/Kg) was used as the exposure point concentration for pet dogs.

Since the soil arsenic exposure point concentration for pet dogs (38.81 mg/Kg) is lower than the USEPA's soil arsenic screening level (46.0 mg/Kg), it can be concluded that arsenic in soil at the site does not pose a health threat to domestic dogs.

2.6 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, food foraging and soil ingestion for ecological receptors (including domestic dogs) that may live or visit the Site are expected to be low or insignificant. As a result, ecological receptors are expected to have low intakes of Site-related arsenic. Therefore, the overall health hazard posed by arsenic in soil is considered to be low to insignificant for ecological receptors. In other words, results of the risk evaluation indicate that exposures to arsenic in soil, at average concentrations, do not pose a significant health threat to ecological receptors (including domestic dogs).

All conclusions are based on reported soil arsenic concentrations for the trails and the current land use of the property. The conclusions presented in this report are professional opinions based solely upon the data described in this report. Potential ecological risks posed by metals at historical and abandoned mining areas within the Site have not been evaluated in this report.

Given that the scope of services for this investigation was limited, and that conditions may vary between the points explored, it is possible that currently unrecognized arsenic contamination may be present at the Site. Should site use or conditions change, the information and conclusions in this report may no longer apply. Opinions relating to environmental and public health conditions are based on limited data and actual conditions may vary from those encountered at the times and locations where data were obtained. No express or implied representation or warranty is included or intended in this report except that the work was performed within the limits prescribed by the Client with the customary thoroughness and competence of professionals working in the same area on similar projects.

Based on the results of this evaluation, no further remediation is deemed necessary at trails with respect to ecological receptors as long as the future land use remains open land. In the event that modifications are made to the Site and those modifications attract wildlife, the potential threat posed by the modifications should be property evaluated in an Ecological Risk Assessment.

3.0 REFERENCES

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APPENDIX I

Tables

Table 1
Soil Arsenic Analytical Data Collected at Random at Park Trails
Black Mountain Open Space Park
San Diego, California

Sample Identification	Arsenic (mg/kg)	Arsenic XRF (ppm)
BMT- 130	83	61.2
BMT-01	52	66.91
BMT-02	7.7	14.92
BMT-07	13	26.68
BMT-106	48	62.3
BMT-107	49	63.7
BMT-108	22	31.2
BMT-109	5.6	13.6
BMT-110	4.8	10.4
BMT-111	15	21.2
BMT-112	36	42.8
BMT-113	5.2	13.8
BMT-114	5.3	16.3
BMT-115	5.6	12.6
BMT-116	20	28
BMT-117	6.1	13.2
BMT-118	10	28.7
BMT-119	19	25.4
BMT-120	1	4.3
BMT-121	2.6	7.2
BMT-122	4.1	11.2
BMT-123	33	36.6
BMT-124	47	64.8
BMT-125	30	62.5
BMT-126	9.1	9.5
BMT-127	7.3	15.2
BMT-128	51	70.1
BMT-129	35	40.6
BMT-131	9.4	12
BMT-132	5.0	6.2
BMT-133	3.7	8.1
BMT-134	3.1	6
BMT-135	8.9	14.8
BMT-136	13	12.5
BMT-137	6.9	12.4
BMT-138	9.6	15
BMT-139	6.5	8.9
BMT-140	10	9.6
BMT-141	6.6	10.4
BMT-142	5.1	6.8
BMT-143	19	26.8
BMT-144	9.6	11.8
BMT-145	18	21.1
BMT-146	26	41.4
BMT-147	43	48.2
BMT-148	9.2	13.3
BMT-149	6.8	8.8
BMT-150	8.4	12.7
BMT-151	21	25.8
BMT-152	24	36.3
BMT-153	30	38.8
BMT-16	7.2	19.04
BMT-25	14	32.41
BMT-27	17	21.66
BMT-33	9.5	24.49
BMT-34	2.6	18.44

Table 1
Soil Arsenic Analytical Data Collected at Random at Park Trails
Black Mountain Open Space Park
San Diego, California

Sample Identification	Arsenic (mg/kg)	Arsenic XRF (ppm)
BMT-35	16	31.91
BMT-45	8.8	19.27
BMT-46	8.8	19.25
BMT-48	110	193.63
BMT-49	87	137.68
BMT-50	12	30.66
BMT-51	32	53.2
BMT-52	73	60.18
BMT-53	3.9	20.82
BMT-55	20	50.34
BMT-56	10	28.95
BMT-60	9.6	32.46
BMT-61	29	170.41
BMT-62	110	300.09
BMT-63	67	117.64
BMT-64	200	308.49
BMT-66	210	269.84
BMT-67	170	241.23
BMT-68	83	141.22
BMT-69	66	109.63
BMT-70	38	138.94
BMT-71	30	72
BMT-72	35	79.1
BMT-73	17	42.51
BMT-74	4.1	30.57
BMT-76	5.4	19.57
Statistical Parameters		
Number of Samples	82	82
Minimum Concentration	1.0	4.3
Maximum Concentration	210.0	308.5
Mean Concentration	29.7	50.2
Median Concentration	13.5	26.7
Standard Deviation	40.5	65.0
95UCL	38.81	61.01

Notes:
95UCL = 95 percent upper confidence limit
mg/kg - Milligrams per kilogram
ppm - Parts per million

Table 2

Ecological Soil Screening Levels and Hazard Quotients for Invertebrates and Plants

Black Mountain Open Space Park

San Diego, California

Chemical of Potential Ecological Concern	95UCL Concentration mg/kg	Inverts Soil Benchmark mg/kg	Invertebrate Hazard Quotient	Plants Soil Benchmark mg/kg	Plant Hazard Quotient
Arsenic	38.81	18	2	18	2

Notes:

95UCl	95 Percent upper confidence limit
mg/kg	Milligrams per kilogram

Table 3
Dose Calculation Parameters for the Northern Harrier
Black Mountain Open Space Park
San Diego, California

Parameter	Average Adult	Unit	References and Comments
Ingestion Rate$_{total}$	0.0413	kg/day	Calculated with an average adult body weight of 441 grams using the Nagy (2001) dry matter intake food requirement equation for all birds (a= 0.638; b= 0.685)
Ingestion Rate$_{soil}$	0.000289	kg/day	0.7 percent of total ingestion rate based on bald eagle data from Pascoe and others (1996).
Soil Concentrations	95UCL	mg/kg	Representative of average soil chemical concentration throughout the Subject Property.
Ingestion Rate$_{prey}$	0.04104	kg/day	99.3 percent of total ingestion rate based on soil ingestion rate percentage.
Prey Concentrations	BAF	Unitless	Bioaccumulation factors (BAFs) were obtained from the RAIS website.
SUF	1	Unitless	Conservative estimate.
Body Weight	0.441	Kilogram	Average of males and females from Dunning (1993).

Notes:

kg/day	Kilogram per day
mg/kg	Milligram per kilogram

Table 4
Dose Calculation Parameters for the California Ground Squirrel
Black Mountain Open Space Park
San Diego, California

Parameter	Average Adult	Unit	References and Comments
Ingestion Rate $_{total}$	0.0225	kg/day	Obtained from OEHHA's Cal/Ecotox database.
Ingestion Rate $_{soil}$	0.0021	kg/day	Assumed to be the same as that reported for raccoons (9.4 percent) by Boyer and others (1994).
Soil Concentrations	95UCL	mg/kg	Representative of average soil chemical concentration throughout the Subject Property.
Ingestion Rate $_{plant}$	0.0204	kg/day	90.6 percent of total ingestion rate based on soil ingestion rate percentage
Feed Concentrations	BAF	Unitless	BAFs were obtained from the RAIS website.
SUF	1	Unitless	Conservative estimate.
Body Weight	0.467	Kilogram	Average adult body weight from two squirrels collected in Orange, California (as reported in OEHHA's Cal/Ecotox database).

Notes:

kg/day	Kilogram per day
mg/kg	Milligram per kilogram

Table 5

Northern Harrier Dose and Hazard Quotient Calculations

Black Mountain Open Space Park

San Diego, California

COPEC	Soil Concentration[g] (mg/kg)	BAF[c] (unitless)	Prey Concentration[d] (mg/kg wet weight)	Total Ingestion Rate[a] (kg/day)	Percent of Prey Obtained from Site (%)	Prey from Site Ingestion Rate[b] (mg/kg)	Prey Concentration[d] (mg/kg dry weight)	Prey Daily Dose[e] (mg/day)	Soil Ingestion Rate[f] (kg/day)	Soil Daily Dose[h] (mg/day)	SUF	Receptor Body Weight[i] (kg)	Total Daily Dose[j] (mg/kg/day)	TRV[k] (mg/kg/day)	Hazard Quotient
Arsenic															
Average Dose/High TRV	38.81	0.09	3.49	4.13E-02	1.00	4.13E-04	1.1E+01	4.5E-03	2.9E-06	1.1E-04	1.00	0.441	1.0E-02	12.80	8.E-04
Average Dose/Low TRV	38.81	0.09	3.49	4.13E-02	1.00	4.13E-04	1.1E+01	4.5E-03	2.9E-06	1.1E-04	1.00	0.441	1.0E-02	0.51	2.E-02

Notes:

Highlighted cells indicate HQs greater than 1.0.

a	Total ingestion rate was calculated using an average adult body weight of 441 grams and the Navy (2001) dry matter intake food requirement equation for all birds (a=0.638; b=0.685).
b	Prey ingestion rate equals 99.3 percent of the total ingestion rate based on a soil ingestion rate equal to 0.7 percent of the total ingestion rate.
c	BCFs for soil-to-dry plant uptake were used to calculate prey concentrations. It was assumed that once the chemical is in plant tissue it is 100 percent available to foraging animals and avian predators. BCFs were obtained from the Risk Assessment Information System's website (http://rais.ornl.gov/cgi-bin/tox).
d	The wet weight prey concentration was calculated by multiplying the soil concentration by the BAF. Prey concentrations were then converted to dry weight using the following formula: dry weight concentration = (wet weight concentration) / (1-percentage of water in medium). Percent tissue moisture used to convert wet weight prey concentrations to dry weight was 68 percent. This percentage represents mouse tissue moisture from USEPA (1993).
e	Prey daily dose was calculated by multiplying the prey ingestion rate by the dry weight prey concentration.
f	Soil ingestion rate equals 0.7 percent of the total ingestion rate based on bald eagle data from Pascoe and others (1996).
g	Soil concentration for average dose calculation equals the 95UCL of all site-collected soil samples.
h	Soil daily dose was calculated by multiplying the soil ingestion rate by the soil concentration.
i	Average of male and female Northern Harrier body weights from Dunning (1993).
j	Total daily dose is calculated using the following equation: total daily dose = ((soil daily dose + prey daily dose)*SUF)/receptor species body weight.
k	TRVs taken from Terrestrial Toxicity Values (TRVs), Manual: ERD-AG-003 (1999).
l	The HQ was calculated using the following equatiuon: total daily dose/TRV.
m	Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.

BAF	Bioaccumulation factor	kg/day	Kilogram per day
BCF	Bioconcentration factor	mg/day	Milligram per day
HQ	Hazard quotient	mg/kg	Milligram per kilogram
LMW	Low-molecular-weight	mg/kg/day	Milligram per kilogram per day
kg	Kilogram	NA	Not available

Table 6

California Ground Squirrel Dose and Hazard Quotient Calculations

Black Mountain Open Space Park

San Diego, California

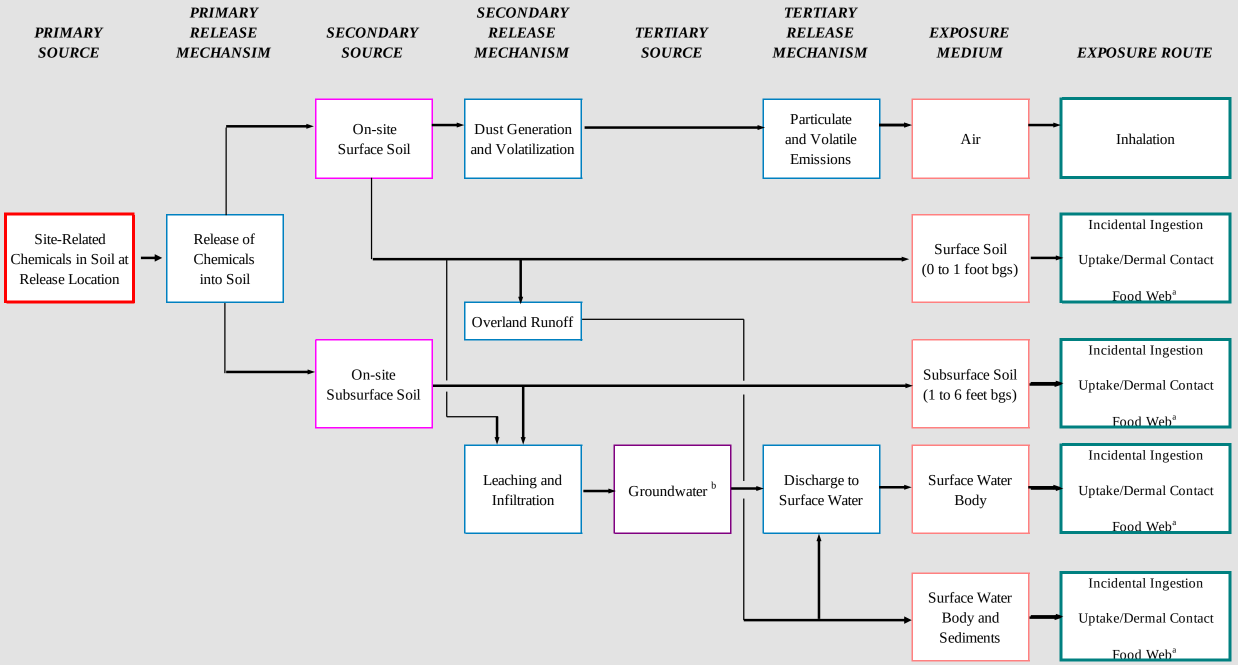
COPEC	Soil Concentration[g] (mg/kg)	BAF[c] (unitless)	Plant Concentration[d] (mg/kg dry weight)	Total Ingestion Rate[a] (kg/day)	Plant Ingestion Rate[b] (mg/kg)	Plant Daily Dose[e] (mg/day)	Soil Ingestion Rate[f] (kg/day)	Soil Daily Dose[h] (mg/day)	SUF	Receptor Body Weight[i] (kg)	Total Daily Dose[j] (mg/kg/ day)	TRV[k] (mg/kg/day)	Hazard Quotient[l]
Arsenic													
Average Dose/High TRV	38.81	0.04	1.55	2.25E-02	2.04E-02	3.2E-02	2.12E-03	0.08	1.0	0.467	0.24	1.26	2.E-01
Average Dose/Low TRV	38.81	0.04	1.55	2.25E-02	2.04E-02	3.2E-02	2.12E-03	0.08	1.0	0.467	0.24	0.126	2.E+00

Notes:	Highlighted cells indicate HQs greater than 1.0.
a	Total ingestion rate obtained from "Cal/Tox, Exposure Factors for California Ground Squirrel (Spermophilus beechely). www.oehha.ca.gov/cal_ecotox/report/spermef.pdf.
b	Plant ingestion rate equals 90.6 percent of the total ingestion rate based on a soil ingestion rate equal to 9.4 percent of the total ingestion rate.
c	BCFs for soil-to-dry plant uptake were used to calculate prey concentrations. BCFs were obtained from the Risk Assessment Information website (http://rais.ornl.gov/tox/rap_toxp.shtml).
d	The plant concentration was calculated by multiplying the soil concentration by the BAF.
e	Plant daily dose was calculated by multiplying the plant ingestion rate by the plant concentration.
f	Soil ingestion rate equals 9.4 percent of the total ingestion rate based on raccoon data from Beyer and others (1994).
g	Soil concentration for average dose calculation equals the 95UCL of all samples.
h	COPC daily dose was calculated by multiplying the soil ingestion rate by the COPC concentration in soil.
i	Average squrrel body weight obtained form "Cal/Ecotox, Exposure Factors for California Ground Squrrel (Spermophilus beecheyl)." Average body weight for two squirrels collected in Orange, California.
j	Total daily dose was calculated using the following equation: total daily dose = ((soil daily dose + plant daily dose)*SUF)/ body weight.
k	The derivation of TRVs is described in EFA West (1998) and Sample and others (1996).
l	The HQ was calculated using total daily dose/TRV.

BAF	Bioaccumulation factor	mg/kg/day	Milligram per kilogram per day
BCF	Bioconcentration factor	NA	Not available
HQ	Hazard quotient	SUF	Site use factor
kg	Kilogram	TRV	Toxicity reference value
kg/day	Kilogram per day		
mg/day	Milligram per day		
mg/kg	Milligram per kilogram		

APPENDIX I

Figure



POTENTIAL ECOLOGICAL RECEPTORS

Exposure Medium	Exposure Route	Terrestrial Plants	Soil Invertebrates	Herbivorous Small Mammals	Carnivorous and Omnivorous Small Mammals	Predatory Large Mammals	Herbivorous and Omnivorous Birds	Raptors	Reptiles and Amphibians	Benthic Invertebrates	Aquatic Organisms
Air	Inhalation	NA	NA	○	○	○	IC	○	○	NA	NA
Surface Soil (0 to 1 foot bgs)	Incidental Ingestion	NA	●	●	●	●	●	●	○	IC	IC
	Uptake/Dermal Contact	●	●	○	○	○	○	○	○	IC	IC
	Food Web[a]	NA	NA	●	●	●	●	●	○	IC	IC
Subsurface Soil (1 to 6 feet bgs)	Incidental Ingestion	NA	●	●	●	●	●	●	○	IC	IC
	Uptake/Dermal Contact	●	●	○	○	○	○	○	○	IC	IC
	Food Web[a]	NA	NA	●	●	●	●	●	○	IC	IC
Surface Water Body	Incidental Ingestion	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC
	Uptake/Dermal Contact	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC
	Food Web[a]	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC
Surface Water Body and Sediments	Incidental Ingestion	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC
	Uptake/Dermal Contact	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC
	Food Web[a]	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC

Legend:
- ● Potentially complete pathway
- ○ Minor or insignificant pathway
- IC Incomplete pathway
- NA Not an applicable pathway for the particular receptor.

[a] Food web exposure occurs when upper trophic levels consume dietary items that have accumulated site-related chemicals.

[b] Groundwater is only a medium of concern for ecological receptors if it has the potential to discharge to a surface water body.

Ecological Conceptual Site Model

Figure 1

APPENIX I

Attachment A

```
                          UCL Statistics for Uncensored Full Data Sets

       User Selected Options
    Date/Time of Computation   ProUCL 5.110/30/2017 10:39:30 AM
                   From File   BMT Arsenic Stats.xls
              Full Precision   OFF
      Confidence Coefficient   95%
 Number of Bootstrap Operations   2000


Arsenic  (mg/kg)

                                        General Statistics
            Total Number of Observations    82                 Number of Distinct Observations    65
                                                                Number of Missing Observations     0
                                 Minimum     1                                            Mean    29.71
                                 Maximum   210                                          Median    13.5
                                      SD    40.51                             Std. Error of Mean    4.474
                Coefficient of Variation    1.364                                     Skewness    2.815

                                        Normal GOF Test
               Shapiro Wilk Test Statistic   0.646                 Shapiro Wilk GOF Test
               5% Shapiro Wilk P Value      0              Data Not Normal at 5% Significance Level
                 Lilliefors Test Statistic   0.24                  Lilliefors GOF Test
             5% Lilliefors Critical Value   0.098          Data Not Normal at 5% Significance Level
                              Data Not Normal at 5% Significance Level

                                  Assuming Normal Distribution
         95% Normal UCL                                  95% UCLs (Adjusted for Skewness)
                    95% Student's-t UCL     37.15           95% Adjusted-CLT UCL (Chen-1995)    38.55
                                                            95% Modified-t UCL (Johnson-1978)    37.38

                                        Gamma GOF Test
                       A-D Test Statistic   2.383              Anderson-Darling Gamma GOF Test
                      5% A-D Critical Value   0.785      Data Not Gamma Distributed at 5% Significance Level
                       K-S Test Statistic   0.161            Kolmogorov-Smirnov Gamma GOF Test
                      5% K-S Critical Value   0.102      Data Not Gamma Distributed at 5% Significance Level
                          Data Not Gamma Distributed at 5% Significance Level

                                        Gamma Statistics
                              k hat (MLE)   0.926                   k star (bias corrected MLE)    0.9
                          Theta hat (MLE)   32.08               Theta star (bias corrected MLE)    32.99
                             nu hat (MLE)   151.9                        nu star (bias corrected)   147.7
                   MLE Mean (bias corrected)   29.71                       MLE Sd (bias corrected)    31.31
                                                               Approximate Chi Square Value (0.05)   120.6
             Adjusted Level of Significance   0.0471                      Adjusted Chi Square Value   120.1

                                  Assuming Gamma Distribution
 95% Approximate Gamma UCL (use when n>=50))   36.38          95% Adjusted Gamma UCL (use when n<50)    36.51


                                        Lognormal GOF Test
```

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.274	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.125	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.098	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0	Mean of logged Data	2.762
Maximum of Logged Data	5.347	SD of logged Data	1.104

Assuming Lognormal Distribution

95% H-UCL	38.81	90% Chebyshev (MVUE) UCL	41.76
95% Chebyshev (MVUE) UCL	47.63	97.5% Chebyshev (MVUE) UCL	55.77
99% Chebyshev (MVUE) UCL	71.77		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	37.07	95% Jackknife UCL	37.15
95% Standard Bootstrap UCL	36.71	95% Bootstrap-t UCL	39.54
95% Hall's Bootstrap UCL	39	95% Percentile Bootstrap UCL	37.28
95% BCA Bootstrap UCL	38.97		
90% Chebyshev(Mean, Sd) UCL	43.13	95% Chebyshev(Mean, Sd) UCL	49.21
97.5% Chebyshev(Mean, Sd) UCL	57.65	99% Chebyshev(Mean, Sd) UCL	74.22

Suggested UCL to Use

95% H-UCL	38.81

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

APPENDIX J

Laboratory Analytical Reports

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client: Ninyo & Moore

Laboratory Reference: NAM 22941

Project Name: Black Mt Open Space Park

Project Number: 108246002

Date Received: 4/17/2017

Date Reported: 4/27/2017

Chain of Custody Received: ☑

Analytical Method: 6010B,

Mark Noorani
Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Discrepency between sampled date on containers (04/13/17) and first page of COC (04/12/17) existed. Client has confirmed that 04/13/17 is the correct date and has been used in this report.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-01	22941-001	4/17/2017	4/13/2017	Soil
BMT-02	22941-002	4/17/2017	4/13/2017	Soil
BMT-03	22941-003	4/17/2017	4/13/2017	Soil
BMT-04	22941-004	4/17/2017	4/13/2017	Soil
BMT-05	22941-005	4/17/2017	4/13/2017	Soil
BMT-06	22941-006	4/17/2017	4/13/2017	Soil
BMT-07	22941-007	4/17/2017	4/13/2017	Soil
BMT-08	22941-008	4/17/2017	4/13/2017	Soil
BMT-09	22941-009	4/17/2017	4/13/2017	Soil
BMT-10	22941-010	4/17/2017	4/13/2017	Soil
BMT-11	22941-011	4/17/2017	4/13/2017	Soil
BMT-12	22941-012	4/17/2017	4/13/2017	Soil
BMT-13	22941-013	4/17/2017	4/13/2017	Soil
BMT-14	22941-014	4/17/2017	4/13/2017	Soil
BMT-15	22941-015	4/17/2017	4/13/2017	Soil
BMT-16	22941-016	4/17/2017	4/13/2017	Soil
BMT-17	22941-017	4/17/2017	4/13/2017	Soil
BMT-18	22941-018	4/17/2017	4/13/2017	Soil
BMT-19	22941-019	4/17/2017	4/13/2017	Soil
BMT-20	22941-020	4/17/2017	4/13/2017	Soil
BMT-21	22941-021	4/17/2017	4/13/2017	Soil
BMT-22	22941-022	4/17/2017	4/13/2017	Soil
BMT-23	22941-023	4/17/2017	4/13/2017	Soil
BMT-24	22941-024	4/17/2017	4/13/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-01	22941-001	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	52	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-02	22941-002	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	7.7	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-03	22941-003	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.3	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-04	22941-004	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.0	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-05	22941-005	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.5	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-06	22941-006	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.2	mg/kg	04/20/17	04/21/17	--	1

Ms. Beth Abramson-Beck
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Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-07	22941-007	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	13	mg/kg	04/20/17	04/21/17	--	1

BMT-08	22941-008	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.4	mg/kg	04/20/17	04/21/17	--	1

BMT-09	22941-009	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.4	mg/kg	04/20/17	04/21/17	--	1

BMT-10	22941-010	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.1	mg/kg	04/20/17	04/21/17	--	1

BMT-11	22941-011	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.1	mg/kg	04/20/17	04/21/17	--	1

BMT-12	22941-012	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.4	mg/kg	04/20/17	04/21/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-13	22941-013	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.0	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-14	22941-014	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.3	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-15	22941-015	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.7	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-16	22941-016	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	7.2	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-17	22941-017	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.4	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-18	22941-018	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	7.0	mg/kg	04/20/17	04/21/17	--	1

Ms. Beth Abramson-Beck
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Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-19	22941-019	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.6	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-20	22941-020	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.6	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-21	22941-021	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.2	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-22	22941-022	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.5	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-23	22941-023	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.3	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-24	22941-024	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.4	mg/kg	04/20/17	04/21/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0420171	Arsenic	6010B	<0.50	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0420172	Arsenic	6010B	<0.50	mg/kg	04/20/17	04/21/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22941

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Arsenic	4/20/2017	4/21/2017	4/21/2017	22941-001	52.0	20.0	62.7	63.4	54	57	1	75-125	20	M3,
Arsenic	4/20/2017	4/21/2017	4/21/2017	22941-021	5.20	20.0	19.4	19.7	71	73	2	75-125	20	M3,

Laboratory Control Sample

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	4/20/2017	4/21/2017	4/21/2017	JA0420171	20.0	17.5	16.9	88	84	3	80-120	20	--
Arsenic	4/20/2017	4/21/2017	4/21/2017	JA0420172	20.0	17.3	16.6	86	83	4	80-120	20	--

Data Qualifier Definitions

Qualifier

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22941-001	6010B	Arsenic	MS/MSD
22941-021	6010B	Arsenic	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22941
Page 1 of 2

REQUIRED TURN AROUND TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ningo & Moore
SEND REPORT TO: Beth Abramson Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS:
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108246002
ADDRESS: 5710 Ruffin Road
P.O. #:
SAMPLED BY:

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE: Arsenic 6010B	REMARKS/PRECAUTIONS
BMT-01	1	4/17/17	0737	Soil	Jar	X	
BMT-02			0744			X	
BMT-03			0750			X	
BMT-04			0755			X	
BMT-05			0758			X	
BMT-06			0804			X	
BMT-07			0807			X	
BMT-08			0812			X	
BMT-09			0820			X	
BMT-10			0825			X	
BMT-11			0830			X	
BMT-12			0837			X	
BMT-13			0845			X	
BMT-14			0847			X	

Total No. of Samples: Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
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(714) 832-0064 Fax (714) 832-0067

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(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22941
Page 2 of 2

REQUIRED TURN AROUND TIME: Standard: ______
[✓ 72 Hours:] ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO:
EMAIL:
ADDRESS:
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME:
NUMBER:
ADDRESS:
P.O. #:
SAMPLED BY:

See Page 1

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Title 22 mtls (6010B)	Arsenic (6010B)	Lead							REMARKS/PRECAUTIONS
BMT-15	1	4/13/17	0850	Soil	Jar		X									
BMT-16			0855				X									
BMT-17			0927				X									
BMT-18			0930				X									
BMT-19			0935				X									
BMT-20			0945				X									
BMT-21			0955				X									
BMT-22			1000				X									
BMT-23			1006				X									
BMT-24			1015				X									
~~BMT-~~				↓												
Pit Mine 2-22	↓	↓	1030	×	↓		×									
Processed slurry SE M12-20	↓	4/12/17	1005	×	↓	×										
Downslope M12 21	↓	↓	1020	×	↓	×										

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/13/17 11:45	Sample Matrix: DW - Drinking Water GW - Groundwater WW - Wastewater SS - Soil/Solid OT- Other
Relinquished By:	Date/Time:	Received By:	Date/Time:	
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:	Sample Integrity: Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client.

Sample Receipt Report

Laboratory Reference NAM 22941

Logged in by CT

Received: 04/17/17 11:45

Method of Shipment: Lab Pick-Up

Shipping Container: Cooler

Shipping Containers: 1

Company Name: Ninyo & Moore

Project Manager: Ms. Beth Abramson-Beck

Project Name: Black Mt Open Space Park

Project #: 108246002

Sample Quantity
27 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	3°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☐	N/A ☐	No ☑

Notes

Discrepency between sampled date on containers (04/13/17) and first page of COC (04/12/17) existed. Client has confirmed that 04/13/17 is the correct date and has been used in this report.

Client Notified ____________ By ____________ On ____________

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LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 22942
Project Name:	Black Mt Open Space Park
Project Number:	108246002
Date Received:	4/17/2017
Date Reported:	4/26/2017
Chain of Custody Received:	☑
Analytical Method:	6010B, 7471A,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 5ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-25	22942-001	4/17/2017	4/14/2017	Soil
BMT-26	22942-002	4/17/2017	4/14/2017	Soil
BMT-27	22942-003	4/17/2017	4/14/2017	Soil
BMT-28	22942-004	4/17/2017	4/14/2017	Soil
BMT-29	22942-005	4/17/2017	4/14/2017	Soil
BMT-30	22942-006	4/17/2017	4/14/2017	Soil
BMT-31	22942-007	4/17/2017	4/14/2017	Soil
BMT-32	22942-008	4/17/2017	4/14/2017	Soil
BMT-33	22942-009	4/17/2017	4/14/2017	Soil
BMT-34	22942-010	4/17/2017	4/14/2017	Soil
BMT-35	22942-011	4/17/2017	4/14/2017	Soil
BMT-36	22942-012	4/17/2017	4/14/2017	Soil
BMT-37	22942-013	4/17/2017	4/14/2017	Soil
BMT-38	22942-014	4/17/2017	4/14/2017	Soil
BMT-39	22942-015	4/17/2017	4/14/2017	Soil
BMT-40	22942-016	4/17/2017	4/14/2017	Soil
BMT-41	22942-017	4/17/2017	4/14/2017	Soil
BMT-42	22942-018	4/17/2017	4/14/2017	Soil
BMT-43	22942-019	4/17/2017	4/14/2017	Soil
BMT-44	22942-020	4/17/2017	4/14/2017	Soil
BMT-45	22942-021	4/17/2017	4/14/2017	Soil
BMT-46	22942-022	4/17/2017	4/14/2017	Soil
BMT-47	22942-023	4/17/2017	4/14/2017	Soil
BMT-48	22942-024	4/17/2017	4/14/2017	Soil
BMT-49	22942-025	4/17/2017	4/14/2017	Soil
BMT-50	22942-026	4/17/2017	4/14/2017	Soil
BMT-51	22942-027	4/17/2017	4/14/2017	Soil
BMT-52	22942-028	4/17/2017	4/14/2017	Soil
BMT-53	22942-029	4/17/2017	4/14/2017	Soil
BMT-54	22942-030	4/17/2017	4/14/2017	Soil
BMT-55	22942-031	4/17/2017	4/14/2017	Soil
BMT-56	22942-032	4/17/2017	4/14/2017	Soil
BMT-57	22942-033	4/17/2017	4/14/2017	Soil
BMT-58	22942-034	4/17/2017	4/14/2017	Soil
BMT-59	22942-035	4/17/2017	4/14/2017	Soil
BMT-60	22942-036	4/17/2017	4/14/2017	Soil
BMT-61	22942-037	4/17/2017	4/14/2017	Soil
BMT-62	22942-038	4/17/2017	4/14/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-63	22942-039	4/17/2017	4/14/2017	Soil
BMT-64	22942-040	4/17/2017	4/14/2017	Soil
BMT-65	22942-041	4/17/2017	4/14/2017	Soil
BMT-67	22942-042	4/17/2017	4/14/2017	Soil
BMT-66	22942-043	4/17/2017	4/14/2017	Soil
BMT-68	22942-044	4/17/2017	4/14/2017	Soil
BMT-69	22942-045	4/17/2017	4/14/2017	Soil
BMT-70	22942-046	4/17/2017	4/14/2017	Soil
BMT-71	22942-047	4/17/2017	4/14/2017	Soil
BMT-72	22942-048	4/17/2017	4/14/2017	Soil
BMT-73	22942-049	4/17/2017	4/14/2017	Soil
BMT-74	22942-050	4/17/2017	4/14/2017	Soil
BMT-75	22942-051	4/17/2017	4/14/2017	Soil
BMT-76	22942-052	4/17/2017	4/14/2017	Soil
BMT-77	22942-053	4/17/2017	4/14/2017	Soil
BMT-78	22942-054	4/17/2017	4/14/2017	Soil
BMT-79	22942-055	4/17/2017	4/14/2017	Soil

Ms. Beth Abramson-Beck
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Lab Reference #: NAM 22942
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-25	22942-001	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	14	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-26	22942-002	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	12	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-27	22942-003	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	17	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-28	22942-004	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.7	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-29	22942-005	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.4	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-30	22942-006	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.4	mg/kg	04/20/17	04/21/17	--	1

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Lab Reference #: NAM 22942
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Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-31	22942-007	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.3	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-32	22942-008	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	7.0	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-33	22942-009	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.5	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-34	22942-010	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.6	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-35	22942-011	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	16	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-36	22942-012	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.8	mg/kg	04/20/17	04/21/17	--	1

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Lab Reference #: NAM 22942
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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-37	22942-013	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.2	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-38	22942-014	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.2	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-39	22942-015	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.1	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-40	22942-016	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.3	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-41	22942-017	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.4	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-42	22942-018	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.6	mg/kg	04/20/17	04/21/17	--	1

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Lab Reference #: NAM 22942
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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-43	22942-019	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.1	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-44	22942-020	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.4	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-45	22942-021	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	8.8	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-46	22942-022	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	8.8	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-47	22942-023	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.7	mg/kg	04/20/17	04/21/17	--	1

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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-48	22942-024	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	77	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.50	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	2.9	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	4.7	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	5.2	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	12	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	6.1	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	1.9	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	37	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	29	mg/kg	04/19/17	04/21/17	--	1

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Lab Reference #: NAM 22942
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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-49	22942-025	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	87	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	130	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.51	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	2.4	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	9.9	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	9.0	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	13	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	9.9	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	4.1	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	63	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	42	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-50	22942-026	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	12	mg/kg	04/20/17	04/21/17	--	1

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Lab Reference #: NAM 22942
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-51	22942-027	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	32	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-52	22942-028	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	73	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-53	22942-029	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.9	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-54	22942-030	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.3	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-55	22942-031	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	20	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-56	22942-032	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	10	mg/kg	04/20/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-57	22942-033	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.0	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-58	22942-034	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.0	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-59	22942-035	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.6	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-60	22942-036	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.6	mg/kg	04/20/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-61	22942-037	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	29	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	100	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	1.2	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	13	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	15	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	9.1	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	7.5	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	4.2	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	1.3	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	92	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	35	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-62	22942-038	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	98	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.52	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	3.2	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	13	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	15	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	11	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	9.4	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	3.6	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	1.6	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	91	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	41	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-63	22942-039	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	67	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	8.2	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-64	22942-040	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	200	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.59	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	5.2	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	12	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	17	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	12	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	10	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	3.2	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	1.9	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	120	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	57	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-65	22942-041	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	6.8	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	6400	mg/kg	04/19/17	04/21/17	D2,	10
Barium	6010B	120	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	1.7	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	130	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	4.2	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	7.5	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	120	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	190	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	1.7	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	0.55	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	2.3	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	260	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	250	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-67	22942-042	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	170	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.57	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	4.6	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	14	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	20	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	11	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	10	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	3.5	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	1.1	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	45	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-66	22942-043	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	210	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	120	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.52	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	5.4	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	13	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	19	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	13	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	10	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	2.2	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	120	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	61	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-68	22942-044	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	83	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.57	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	2.5	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	15	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	16	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	11	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	9.0	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	3.8	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	2.0	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	39	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-69	22942-045	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	66	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	0.57	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	2.1	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	16	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	18	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	12	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	7.7	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	4.0	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	110	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	41	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-70	22942-046	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	38	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	100	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	1.4	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	12	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	16	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	11	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	7.3	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	2.8	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	2.1	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	92	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	38	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-71	22942-047	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	30	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	7.4	mg/kg	04/19/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-72	22942-048	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	35	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	9.4	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-73	22942-049	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	17	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-74	22942-050	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.1	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-75	22942-051	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.7	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-76	22942-052	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.4	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-77	22942-053	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.5	mg/kg	04/20/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-78	22942-054	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.0	mg/kg	04/20/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-79	22942-055	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.9	mg/kg	04/20/17	04/21/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0419171	Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Arsenic	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Barium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Beryllium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Cadmium	6010B	<0.20	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Chromium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Cobalt	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Copper	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Lead	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419172	Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Nickel	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Vanadium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Zinc	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0420172	Arsenic	6010B	<0.50	mg/kg	04/20/17	04/21/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0420173	Arsenic	6010B	<0.50	mg/kg	04/20/17	04/21/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22942

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B/7471A**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Antimony	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	3.59	3.46	18	17	4	75-125	20	M2,
Arsenic	4/19/2017	4/21/2017	4/21/2017	22942-024	110	20.0	119	135	45	125	13	75-125	20	M3,
Barium	4/19/2017	4/21/2017	4/21/2017	22942-024	77.0	20.0	96.6	93.6	98	83	3	75-125	20	--
Beryllium	4/19/2017	4/21/2017	4/21/2017	22942-024	0.500	20.0	16.9	17.0	82	82	1	75-125	20	--
Cadmium	4/19/2017	4/21/2017	4/21/2017	22942-024	2.90	20.0	19.2	20.1	82	86	5	75-125	20	--
Chromium	4/19/2017	4/21/2017	4/21/2017	22942-024	4.70	20.0	19.4	20.0	74	76	3	75-125	20	M3,
Cobalt	4/19/2017	4/21/2017	4/21/2017	22942-024	5.20	20.0	21.6	21.9	82	84	1	75-125	20	--
Copper	4/19/2017	4/21/2017	4/21/2017	22942-024	12.0	20.0	27.5	29.3	77	86	6	75-125	20	--
Lead	4/19/2017	4/21/2017	4/21/2017	22942-024	6.10	20.0	20.7	21.2	73	75	2	75-125	20	M3,
Mercury	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	1.00	1.03	1.03	103	103	0	80-120	20	--
Molybdenum	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	11.0	11.7	55	58	6	75-125	20	M2,
Nickel	4/19/2017	4/21/2017	4/21/2017	22942-024	1.90	20.0	17.6	18.4	79	82	4	75-125	20	--
Selenium	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	15.1	16.4	75	82	8	75-125	20	--
Silver	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	15.2	15.6	76	78	3	75-125	20	--
Thallium	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	12.7	13.2	63	66	4	75-125	20	M2,
Vanadium	4/19/2017	4/21/2017	4/21/2017	22942-024	37.0	20.0	52.9	53.7	80	84	2	75-125	20	--
Zinc	4/19/2017	4/21/2017	4/21/2017	22942-024	29.0	20.0	45.0	45.7	80	84	2	75-125	20	--
Arsenic	4/20/2017	4/21/2017	4/21/2017	22941-021	5.20	20.0	19.4	19.7	71	73	2	75-125	20	M3,
Arsenic	4/20/2017	4/21/2017	4/21/2017	22942-006	2.40	20.0	12.8	12.9	52	52	1	75-125	20	M2,

QA/QC Report
for
Metals

Reference #: NAM 22942 Reporting units: ppm

Laboratory Control Sample

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Antimony	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.9	17.0	89	85	5	80-120	20	--
Arsenic	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.1	16.4	86	82	4	80-120	20	--
Barium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.8	17.2	89	86	3	80-120	20	--
Beryllium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.7	16.5	89	82	7	80-120	20	--
Cadmium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.7	17.2	89	86	3	80-120	20	--
Chromium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.1	16.5	86	82	4	80-120	20	--
Cobalt	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.2	17.5	91	88	4	80-120	20	--
Copper	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	19.1	17.6	96	88	8	80-120	20	--
Lead	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.2	17.3	91	86	5	80-120	20	--
Molybdenum	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.5	17.6	93	88	5	80-120	20	--
Nickel	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	19.2	18.1	96	91	6	80-120	20	--
Selenium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.8	16.6	89	83	7	80-120	20	--
Silver	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.8	17.4	89	87	2	80-120	20	--
Thallium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.7	17.0	89	85	4	80-120	20	--
Vanadium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.0	17.3	90	86	4	80-120	20	--
Zinc	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	19.4	18.7	97	94	4	80-120	20	--
Mercury	4/19/2017	4/21/2017	4/21/2017	JA0419172	1.00	1.05	1.08	105	108	3	80-120	20	--
Arsenic	4/20/2017	4/21/2017	4/21/2017	JA0420172	20.0	17.3	16.6	86	83	4	80-120	20	--
Arsenic	4/20/2017	4/21/2017	4/21/2017	JA0420173	20.0	16.8	16.8	84	84	0	80-120	20	--

Data Qualifier Definitions

Qualifier

D2 = Sample required dilution due to high concentration of target analyte.

M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.

22942-006	6010B	Arsenic	MS/MSD
22942-024	6010B	Antimony	MS/MSD
22942-024	6010B	Molybdenum	MS/MSD
22942-024	6010B	Thallium	MS/MSD

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22941-021	6010B	Arsenic	MS/MSD
22942-024	6010B	Arsenic	MS/MSD
22942-024	6010B	Chromium	MS/MSD
22942-024	6010B	Lead	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

Lab Job No: 22942
Page 1 of 4

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4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

REQUIRED TURN AROUND TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson - Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Rd
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Openspace Park
NUMBER: 108246002
ADDRESS:
P.O. #:
SAMPLED BY: JM

ANALYSIS REQUEST / PRESERVATIVE: Arsenic

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic									REMARKS/PRECAUTIONS
BMT-25	1	4/14/17	0725	Jar	soil	X									
BMT-26	↓	↓	0730	↓	↓	↓									
BMT-27	↓	↓	0735	↓	↓	↓									
BMT-28	↓	↓	0801	↓	↓	↓									
BMT-29	↓	↓	0805	↓	↓	↓									
BMT-30	↓	↓	0810	↓	↓	↓									
BMT-31	↓	↓	0812	↓	↓	↓									
BMT-32	↓	↓	0815	↓	↓	↓									
BMT-33	↓	↓	0823	↓	↓	↓									
BMT-34	↓	↓	0825	↓	↓	↓									
BMT-35	↓	↓	0830	↓	↓	↓									
BMT-36	↓	↓	0835	↓	↓	↓									
BMT-37	↓	↓	0840	↓	↓	↓									
BMT-38	↓	↓	0845	↓	↓	↓									

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By: C Moore	Date/Time: 4/17/17 1445
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sampl

Analysis Request and Chain of Custody Record

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Phoenix, AZ 85040
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Lab Job No: 22942
Page 2 of 74

REQUIRED TURN AROUND TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108244002
ADDRESS:
P.O. #:
SAMPLED BY:

ANALYSIS REQUEST / PRESERVATIVE

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)	Arsenic + Lead	Title 22	REMARKS/PRECAUTIONS
BMT-39			0850			X			if necc crush up to 10 samples then please c if more nee Title 22 priorit
BMT-40			0852			X			
BMT-41			0855			X			
BMT-42			0857			X			
BMT-43			0900			X			
BMT-44			0905			X			
BMT-45			0907			X			
BMT-46			0910			X			
BMT-47			0915			X			
BMT-48			0917					X	
BMT-49			0920					X	
BMT-50			0922			X			
BMT-51			0935			X			
BMT-52			0940			X			

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/12/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 5 °C

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Analysis Request and Chain of Custody Record

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Lab Job No: 22943
Page 3 of 4

REQUIRED ~~TURN AROUND~~ TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL:
ADDRESS: See Page 1
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME:
NUMBER:
ADDRESS: See page 1
P.O. #:
SAMPLED BY:

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Arsenic (6010B)	Arsenic + Lead (6010B)	Title 22 (6010B)							REMARKS/PRECAUTIONS
BMT-53			0943			X										
BMT-54			0945			X										
BMT-55			0950			X										
BMT-56			0952			X										
BMT-57			1000			X										
BMT-58			1005			X										
BMT-59			1015			X										
BMT-60			1017			X										
BMT-61			1020			ocr		X								
BMT-62			1022					X								
BMT-63			1025				X									
BMT-64			1030					X								
BMT-65			1032					X								
BMT-~~66~~ 67 ocr			1035					X								

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished ~~By~~: Date/Time:
Received By: Date/Time: 4/09 11:45

Relinquished By: Date/Time:
Received By: Date/Time:

Relinquished By: Date/Time:
Received For Lab By: Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc.

Analysis Request and Chain of Custody Record

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Lab Job No: 22943
Page ~~2~~ 4 of ~~3~~ 4

REQUIRED TURN AROUND TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson Beck
EMAIL: ~~Be~~ Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open space park
NUMBER: 108246002
ADDRESS:
P.O. #:
SAMPLED BY:

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Arsenic (6010B)	Arsenic + Lead	Title 22							REMARKS/PRECAUTIONS
BMT-6~~7~~6 rm			1040					X								
BMT-68			~~704~~ 1045					X								
BMT-69			~~1045~~ 1042					X								
BMT-70			1047					X								
BMT-71			1048				X									
BMT-72			1050				X									
BMT-73			1051			X										
BMT-74			1055			X										
BMT-75			1057			X										
BMT-76			1058			X										
BMT-77			1100			X										
BMT-78			1105			X										
BMT-79			1120			X										
Pothole-23			1130					X								report separately with others

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to

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LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 23050
Project Name:	Black Mt Open Space Park
Project Number:	108246002
Date Received:	6/21/2017
Date Reported:	6/29/2017
Chain of Custody Received:	☑
Analytical Method:	6010B, 7471A,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23050
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23050
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-80	23050-001	6/21/2017	6/20/2017	Soil
BMT-81	23050-002	6/21/2017	6/20/2017	Soil
BMT-82	23050-003	6/21/2017	6/20/2017	Soil
BMT-83	23050-004	6/21/2017	6/20/2017	Soil
BMT-84	23050-005	6/21/2017	6/20/2017	Soil
BMT-85	23050-006	6/21/2017	6/20/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23050
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-80	23050-001	6/21/2017	6/20/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	66	mg/kg	06/23/17	06/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-81	23050-002	6/21/2017	6/20/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	220	mg/kg	06/23/17	06/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-82	23050-003	6/21/2017	6/20/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	1300	mg/kg	06/23/17	06/26/17	D2,	2

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-83	23050-004	6/21/2017	6/20/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	1300	mg/kg	06/23/17	06/26/17	D2,	2

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23050
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-84	23050-005	6/21/2017	6/20/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
Arsenic	6010B	3000	mg/kg	06/22/17	06/23/17	D2,	5
Barium	6010B	410	mg/kg	06/22/17	06/23/17	--	1
Beryllium	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
Cadmium	6010B	54	mg/kg	06/22/17	06/23/17	--	1
Chromium	6010B	9.3	mg/kg	06/22/17	06/23/17	--	1
Cobalt	6010B	7.6	mg/kg	06/22/17	06/23/17	--	1
Copper	6010B	39	mg/kg	06/22/17	06/23/17	--	1
Lead	6010B	17	mg/kg	06/22/17	06/23/17	--	1
Mercury	7471A	<0.10	mg/kg	06/22/17	06/28/17	--	1
Molybdenum	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
Nickel	6010B	2.8	mg/kg	06/22/17	06/23/17	--	1
Selenium	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
Silver	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
Thallium	6010B	<2.0	mg/kg	06/22/17	06/23/17	--	1
Vanadium	6010B	65	mg/kg	06/22/17	06/23/17	--	1
Zinc	6010B	46	mg/kg	06/22/17	06/23/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23050
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-85	23050-006	6/21/2017	6/20/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
Arsenic	6010B	390	mg/kg	06/22/17	06/23/17	--	1
Barium	6010B	180	mg/kg	06/22/17	06/23/17	--	1
Beryllium	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
Cadmium	6010B	8.6	mg/kg	06/22/17	06/23/17	--	1
Chromium	6010B	13	mg/kg	06/22/17	06/23/17	--	1
Cobalt	6010B	9.3	mg/kg	06/22/17	06/23/17	--	1
Copper	6010B	13	mg/kg	06/22/17	06/23/17	--	1
Lead	6010B	18	mg/kg	06/22/17	06/23/17	--	1
Mercury	7471A	<0.10	mg/kg	06/22/17	06/28/17	--	1
Molybdenum	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
Nickel	6010B	4.5	mg/kg	06/22/17	06/23/17	--	1
Selenium	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
Silver	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
Thallium	6010B	<2.0	mg/kg	06/22/17	06/23/17	--	1
Vanadium	6010B	72	mg/kg	06/22/17	06/23/17	--	1
Zinc	6010B	43	mg/kg	06/22/17	06/23/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23050
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0622174	Antimony	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Arsenic	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Barium	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Beryllium	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Cadmium	6010B	<0.20	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Chromium	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Cobalt	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Copper	6010B	<2.0	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Lead	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622175	Mercury	7471A	<0.10	mg/kg	06/22/17	06/28/17	--	1
MBJA0622174	Molybdenum	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Nickel	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Selenium	6010B	<1.0	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Silver	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Thallium	6010B	<2.0	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Vanadium	6010B	<0.50	mg/kg	06/22/17	06/23/17	--	1
MBJA0622174	Zinc	6010B	<2.0	mg/kg	06/22/17	06/23/17	--	1

Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0623171	Arsenic	6010B	<0.50	mg/kg	06/23/17	06/26/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 23050

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

6010B/7471A

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Antimony	6/22/2017	6/23/2017	6/23/2017	23042-010	0.00	20.0	2.69	2.64	13	13	2	75-125	20	M2,
Arsenic	6/22/2017	6/23/2017	6/23/2017	23042-010	3.60	20.0	20.5	21.2	84	88	3	75-125	20	--
Barium	6/22/2017	6/23/2017	6/23/2017	23042-010	110	20.0	117	120	35	50	3	75-125	20	M3,
Beryllium	6/22/2017	6/23/2017	6/23/2017	23042-010	0.00	20.0	17.6	17.3	88	86	2	75-125	20	--
Cadmium	6/22/2017	6/23/2017	6/23/2017	23042-010	0.460	20.0	18.2	18.4	89	90	1	75-125	20	--
Chromium	6/22/2017	6/23/2017	6/23/2017	23042-010	16.0	20.0	32.3	32.9	81	85	2	75-125	20	--
Cobalt	6/22/2017	6/23/2017	6/23/2017	23042-010	6.50	20.0	23.2	23.4	84	84	1	75-125	20	--
Copper	6/22/2017	6/23/2017	6/23/2017	23042-010	21.0	20.0	37.4	38.6	82	88	3	75-125	20	--
Lead	6/22/2017	6/23/2017	6/23/2017	23042-010	21.0	20.0	37.6	38.4	83	87	2	75-125	20	--
Mercury	6/22/2017	6/28/2017	6/28/2017	23042-010	0.00	1.00	0.979	1.00	98	100	2	80-120	20	--
Molybdenum	6/22/2017	6/23/2017	6/23/2017	23042-010	0.00	20.0	16.8	16.7	84	84	1	75-125	20	--
Nickel	6/22/2017	6/23/2017	6/23/2017	23042-010	20.0	20.0	43.7	48.7	119	144	11	75-125	20	M3,
Selenium	6/22/2017	6/23/2017	6/23/2017	23042-010	0.00	20.0	17.9	18.7	89	94	4	75-125	20	--
Silver	6/22/2017	6/23/2017	6/23/2017	23042-010	0.00	20.0	16.2	17.5	81	88	8	75-125	20	--
Thallium	6/22/2017	6/23/2017	6/23/2017	23042-010	0.00	20.0	14.9	15.0	75	75	1	75-125	20	--
Vanadium	6/22/2017	6/23/2017	6/23/2017	23042-010	28.0	20.0	44.4	44.6	82	83	0	75-125	20	--
Zinc	6/22/2017	6/23/2017	6/23/2017	23042-010	87.0	20.0	114	121	135	170	6	75-125	20	M3,
Arsenic	6/23/2017	6/26/2017	6/26/2017	23042-025	5.10	20.0	23.1	24.1	90	95	4	75-125	20	--

QA/QC Report
for
Metals

Reference #: NAM 23050 Reporting units: ppm

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Antimony	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.8	19.2	94	96	2	80-120	20	--
Arsenic	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.5	18.2	93	91	2	80-120	20	--
Barium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.6	19.7	98	99	1	80-120	20	--
Beryllium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.0	18.2	90	91	1	80-120	20	--
Cadmium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.8	18.9	94	94	1	80-120	20	--
Chromium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.0	19.2	95	96	1	80-120	20	--
Cobalt	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.9	19.1	94	96	1	80-120	20	--
Copper	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.2	20.3	96	101	6	80-120	20	--
Lead	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.8	20.2	99	101	2	80-120	20	--
Molybdenum	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.0	19.4	95	97	2	80-120	20	--
Nickel	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.7	20.1	99	100	2	80-120	20	--
Selenium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.1	17.7	91	89	2	80-120	20	--
Silver	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	20.0	20.3	100	101	1	80-120	20	--
Thallium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.3	19.8	96	99	3	80-120	20	--
Vanadium	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	18.8	19.1	94	96	2	80-120	20	--
Zinc	6/22/2017	6/23/2017	6/23/2017	JA0622174	20.0	19.8	20.3	99	101	2	80-120	20	--
Mercury	6/22/2017	6/28/2017	6/28/2017	JA0622175	1.00	0.982	0.980	98	98	0	80-120	20	--
Arsenic	6/23/2017	6/26/2017	6/26/2017	JA0623171	20.0	18.1	18.2	91	91	1	80-120	20	--

Data Qualifier Definitions

Qualifier

D2 = Sample required dilution due to high concentration of target analyte.

M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.

23042-010	6010B	Antimony	MS/MSD

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

23042-010	6010B	Barium	MS/MSD
23042-010	6010B	Nickel	MS/MSD
23042-010	6010B	Zinc	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 23050
Page 1 of 1

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours:
48 Hours: ______
24 Hours: ______

CUSTOMER INFORMATION	PROJECT INFORMATION
COMPANY: Ninyo & Moore	PROJECT NAME: Black Mountain Open Space Park
SEND REPORT TO: Beth Abramson Beck / Adrian Olivares	NUMBER: 108246002
EMAIL: babramsonbeck@ninyoandmoore.com	ADDRESS:
ADDRESS: AOlivares@ninyoandmoore.com	
5710 Ruffin Road	P.O. #:
PHONE: 858 576-1000 FAX:	SAMPLED BY: BML

ANALYSIS REQUEST / PRESERVATIVE

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic	CAM metals (6010)								REMARKS/PRECAUTIONS
BMT-80	1	6/21/17	0715	soil	jar	X									
BMT-81	↓	↓	0720	↓	↓	X									
BMT-82	↓	↓	0730	↓	↓	X									
BMT-83	↓	↓	0735	↓	↓	X									
BMT-84	↓	↓	0738	↓	↓		X								
BMT-85	↓	↓	0745	↓	↓		X								

Total No. of Samples:
Method of Shipment:
Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 6/21/17 1620	Received By:	Date/Time: 6/21/17 1620
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sampl

Sample Receipt Report

Laboratory Reference **NAM 23050**

Logged in by MM

Received: 06/21/17 16:20
Method of Shipment: Lab Pick-Up
Shipping Container: Cooler
Shipping Containers: 1

Company Name: Ninyo & Moore
Project Manager: Ms. Beth Abramson-Beck
Project Name: Black Mt Open Space Park
Project #: 108246002

Sample Quantity
6 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	3°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ____________ By ____________ On ____________

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 23153
Project Name:	Black Mt Open Space Park
Project Number:	108246002
Date Received:	8/23/2017
Date Reported:	8/28/2017
Chain of Custody Received:	☑
Analytical Method:	6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23153
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 24.4ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23153
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-86	23153-001	8/23/2017	8/23/2017	Soil
BMT-87	23153-002	8/23/2017	8/23/2017	Soil
BMT-88	23153-003	8/23/2017	8/23/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23153
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-86	23153-001	8/23/2017	8/23/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	130	mg/kg	08/25/17	08/28/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-87	23153-002	8/23/2017	8/23/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	24	mg/kg	08/25/17	08/28/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-88	23153-003	8/23/2017	8/23/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	26	mg/kg	08/25/17	08/28/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0825171	Arsenic	6010B	<0.50	mg/kg	08/25/17	08/28/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 23153 Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Arsenic	8/25/2017	8/28/2017	8/28/2017	23154-001	2.20	20.0	18.9	18.7	83	82	1	75-125	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	8/25/2017	8/28/2017	8/28/2017	JA0825171	20.0	17.8	18.9	89	94	6	80-120	20	--

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 23153
Page ______ of ______

REQUIRED TURN AROUND TIME: Standard: X
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION	PROJECT INFORMATION
COMPANY: Ningo & Moore	PROJECT NAME: Black Mountain Open Space Park
SEND REPORT TO: Beth Abramsonbeck	NUMBER: 108246002
EMAIL: beth b.abramsonbeck@ningo	ADDRESS:
ADDRESS:	
	P.O. #:
PHONE: FAX:	SAMPLED BY: RME / BAB

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE Arsenic										REMARKS/PRECAUTIONS
BMT - 86	1	8/23/17	1045	Soil	jar	×										
BMT - 87	↓	↓	1049	↓	↓	↓										
BMT - 88	↓	↓	1055	↓	↓	↓										

Total No. of Samples: 3 Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Othe

Relinquished By:	Date/Time: 8/23/17	Received By:	Date/Time: 8/23/17 2:30 pm	Sample Matrix: DW - Drinking Water GW - Groundwater WW - Wastewater [✓ SS - Soil/Solid] OT- Other
Relinquished By:	Date/Time:	Received By:	Date/Time:	
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:	Sample Integrity: ✓ Intact ✓ On Ice ✓ Blue 24.4°C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due withi
30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup samp

Sample Receipt Report

Laboratory Reference **NAM 23153**

Logged in by MM

Received:	08/23/17 14:30	Company Name:	Ninyo & Moore
Method of Shipment:	Lab Pick-Up	Project Manager:	Ms. Beth Abramson-Beck
Shipping Container:	Cooler	Project Name:	Black Mt Open Space Park
# Shipping Containers:	1	Project #:	108246002

Sample Quantity
3 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☐	Yes, Blue ☑	No ☐
Temperature	24.4°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ____________ By ____________ On ____________

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4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 23201
Project Name:	Black Mountain Open Space Park
Project Number:	108246002
Date Received:	9/29/2017
Date Reported:	10/2/2017
Chain of Custody Received:	☑
Analytical Method:	6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Mr. Adrian Olivares
Ninyo & Moore
5710 Ruffin Rd
San Diego, CA, 92123

Lab Reference #: NAM 23201
Project Name: Black Mountain Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 4.0ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Mr. Adrian Olivares
Ninyo & Moore
5710 Ruffin Rd
San Diego, CA, 92123

Lab Reference #: NAM 23201
Project Name: Black Mountain Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-89 (434)	23201-001	9/29/2017	9/8/2017	Soil
BMT-90 (446)	23201-002	9/29/2017	9/8/2017	Soil
BMT-91 (447)	23201-003	9/29/2017	9/8/2017	Soil
BMT-92 (450)	23201-004	9/29/2017	9/8/2017	Soil
BMT-93 (451)	23201-005	9/29/2017	9/8/2017	Soil
BMT-94 (536)	23201-006	9/29/2017	9/8/2017	Soil

Mr. Adrian Olivares
Ninyo & Moore
5710 Ruffin Rd
San Diego, CA, 92123

Lab Reference #: NAM 23201
Project Name: Black Mountain Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-89 (434)	23201-001	9/29/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	200	mg/kg	09/29/17	10/01/17	--	1

BMT-90 (446)	23201-002	9/29/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	78	mg/kg	09/29/17	10/01/17	--	1

BMT-91 (447)	23201-003	9/29/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	130	mg/kg	09/29/17	10/01/17	--	1

BMT-92 (450)	23201-004	9/29/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	130	mg/kg	09/29/17	10/01/17	--	1

BMT-93 (451)	23201-005	9/29/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	360	mg/kg	09/29/17	10/01/17	--	1

BMT-94 (536)	23201-006	9/29/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	150	mg/kg	09/29/17	10/01/17	--	1

Mr. Adrian Olivares
Ninyo & Moore
5710 Ruffin Rd
San Diego, CA, 92123

Lab Reference #: NAM 23201
Project Name: Black Mountain Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0929172	Arsenic	6010B	<2.0	mg/kg	09/29/17	10/01/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 23201

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Arsenic	9/29/2017	10/1/2017	10/1/2017	23201-001	200	20.0	214	216	70	80	1	75-125	20	M3,

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	9/29/2017	10/1/2017	10/1/2017	JA0929172	20.0	17.6	17.4	88	87	1	80-120	20	--

Data Qualifier Definitions

Qualifier

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

23201-001	6010B	Arsenic	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

Lab Job No: 23201
Page 1 of 1

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REQUIRED TURN AROUND TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: X

CUSTOMER INFORMATION	PROJECT INFORMATION
COMPANY: Ninyo & Moore	PROJECT NAME: Black Mountain Open Space Park
SEND REPORT TO: Aolivares / Beth Abramson-Beck	NUMBER: 108246002
EMAIL: Babramsonbeck@ninyoandmoore	ADDRESS:
ADDRESS: 5710 Ruffin Road	
	P.O. #: 108246002
PHONE: 858 576-1000 FAX:	SAMPLED BY: BM

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)										REMARKS/PRECAUTIONS
1	BMT-89 (434)	1	9/8/17		Soil	BAG	X										RUSH
2	BMT-90 (446)	1	9/8/17		↓	↓	X										
3	BMT-91 (447)	1	9/8/17				X										
4	BMT-92 (450)	1	9/8/17				X										
5	BMT-93 (451)	1	9/8/17				X										
6	BMT-94 (536)	1	9/10/17				X										

Total No. of Samples: 6 Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 9:40 Am 9/29/17	Received By:	Date/Time: 9:40 am 09.27.17
Relinquished By:	Date/Time:	Received By:	Date/Time: 9/29/17 1:40pm
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity: Intact ✓ On Ice ✓ 4.0 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sampl

Sample Receipt Report

Laboratory Reference **NAM 23201**

Logged in by MM

Received: 09/29/17 13:40
Method of Shipment: Lab Pick-Up
Shipping Container: Cooler
Shipping Containers: 1

Company Name: Ninyo & Moore
Project Manager: Mr. Adrian Olivares
Project Name: Black Mountain Open Space Park
Project #: 108246002

Sample Quantity
6 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	4.0°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ____________ By ____________ On ____________

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LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 23218
Project Name:	Black Mtn
Project Number:	108246002
Date Received:	10/6/2017
Date Reported:	10/12/2017
Chain of Custody Received:	☑
Analytical Method:	6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23218
Project Name: Black Mtn
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 4.4ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23218
Project Name: Black Mtn
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-95	23218-001	10/6/2017	10/6/2017	Soil
BMT-96	23218-002	10/6/2017	10/6/2017	Soil
BMT-97	23218-003	10/6/2017	10/6/2017	Soil
BMT-98	23218-004	10/6/2017	10/6/2017	Soil
BMT-99	23218-005	10/6/2017	10/6/2017	Soil
BMT-100	23218-006	10/6/2017	10/6/2017	Soil
BMT-101	23218-007	10/6/2017	10/6/2017	Soil
BMT-102	23218-008	10/6/2017	10/6/2017	Soil
BMT-103	23218-009	10/6/2017	10/6/2017	Soil
BMT-104	23218-010	10/6/2017	10/6/2017	Soil
BMT-105	23218-011	10/6/2017	10/6/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23218
Project Name: Black Mtn
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-95	23218-001	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	45	mg/kg	10/11/17	10/12/17	--	1

BMT-96	23218-002	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.6	mg/kg	10/11/17	10/12/17	--	1

BMT-97	23218-003	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	15	mg/kg	10/11/17	10/12/17	--	1

BMT-98	23218-004	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	150	mg/kg	10/11/17	10/12/17	--	1

BMT-99	23218-005	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	20	mg/kg	10/11/17	10/12/17	--	1

BMT-100	23218-006	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	70	mg/kg	10/11/17	10/12/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23218
Project Name: Black Mtn
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-101	23218-007	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	57	mg/kg	10/11/17	10/12/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-102	23218-008	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	89	mg/kg	10/11/17	10/12/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-103	23218-009	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	70	mg/kg	10/11/17	10/12/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-104	23218-010	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	87	mg/kg	10/11/17	10/12/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-105	23218-011	10/6/2017	10/6/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	87	mg/kg	10/11/17	10/12/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA1011171	Arsenic	6010B	<2.0	mg/kg	10/11/17	10/12/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 23218

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Arsenic	10/11/2017	10/12/2017	10/12/2017	23218-001	45.0	20.0	65.7	64.4	103	97	2	75-125	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	10/11/2017	10/12/2017	10/12/2017	JA1011171	20.0	18.4	18.3	92	91	1	80-120	20	--

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

Lab Job No: 23218
Page 1 of 1

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

STANDARD
REQUIRED TURN AROUND TIME: Standard: [✓ X]
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION	PROJECT INFORMATION
COMPANY: Ninyo & Moore	PROJECT NAME: Black Mtn
SEND REPORT TO: Beth Abramson Beck	NUMBER: 108246002
EMAIL: BABRAmsonbeck@ninyoamoore.com	ADDRESS:
ADDRESS:	
	P.O. #:
PHONE: 858 576 1000 FAX:	SAMPLED BY:

ANALYSIS REQUEST / PRESERVATIVE: Arsenic 6010B

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic 6010B	REMARKS/PRECAUTIONS
1	BMT-95	1	10/6/17	8:42	Soil	Glass	/	north of BMT-89 front of bench
2	BMT-96	1	↓	8:43	↓	↓	/	west of 89 ~25 either side of fn
3	BMT-97	1		8:44			/	west of 89 ~50'
4	BMT-98	1		8:53			/	~~east of BMT 89~~
5	BMT-99	1		9:01			/	South of BMT 89 ~~East BMT 89~~ South of BMT 89
6	BMT-100	1		9:10			/	25' east of BMT 93 ~~South of BMT 89~~ ~~[illegible]~~
7	BMT-101	1		9:12			/	50' east of BMT-93
8	BMT-102	1		9:36			/	east of BMT-94
9	BMT-103	1		9:37			/	east of BMT-~~94~~
10	BMT-104	1		9:41			/	West of BMT-94
11	BMT-105	1	↓	9:43	↓	baggie	/	West of BMT-94

Total No. of Samples:
Method of Shipment:
Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 10/6/17 11:45 AM	Received By:	Date/Time: 10/6/17 11:48
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ✓
On Ice ✓ 4.4 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sample

Sample Receipt Report

Laboratory Reference **NAM 23218**

Logged in by MM

Received: 10/06/17 11:48

Method of Shipment: Lab Pick-Up

Shipping Container: Cooler

Shipping Containers: 1

Company Name: Ninyo & Moore

Project Manager: Ms. Beth Abramson-Beck

Project Name: Black Mtn

Project #: 108246002

Sample Quantity
11 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	4.4°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ____________ By ____________ On ____________

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 23244
Project Name:	Black Mountain
Project Number:	108246002
Date Received:	10/20/2017
Date Reported:	10/27/2017
Chain of Custody Received:	☑
Analytical Method:	6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 6.0ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 106 (537)	23244-001	10/20/2017	9/8/2017	Soil
BMT 107 (538)	23244-002	10/20/2017	9/8/2017	Soil
BMT 108 (539)	23244-003	10/20/2017	9/8/2017	Soil
BMT 109 (351)	23244-004	10/20/2017	9/8/2017	Soil
BMT 110 (356)	23244-005	10/20/2017	9/8/2017	Soil
BMT 111 (362)	23244-006	10/20/2017	9/8/2017	Soil
BMT 112 (367)	23244-007	10/20/2017	9/8/2017	Soil
BMT 113 (372)	23244-008	10/20/2017	9/8/2017	Soil
BMT 114 (377)	23244-009	10/20/2017	9/8/2017	Soil
BMT 115 (382)	23244-010	10/20/2017	9/8/2017	Soil
BMT 116 (387)	23244-011	10/20/2017	9/8/2017	Soil
BMT 117 (392)	23244-012	10/20/2017	9/8/2017	Soil
BMT 118 (397)	23244-013	10/20/2017	9/8/2017	Soil
BMT 119 (402)	23244-014	10/20/2017	9/8/2017	Soil
BMT-120 (407)	23244-015	10/20/2017	9/8/2017	Soil
BMT-121 (412)	23244-016	10/20/2017	9/8/2017	Soil
BMT-122 (417)	23244-017	10/20/2017	9/8/2017	Soil
BMT-123 (422)	23244-018	10/20/2017	9/8/2017	Soil
BMT-124 (427)	23244-019	10/20/2017	9/8/2017	Soil
BMT-125 (432)	23244-020	10/20/2017	9/8/2017	Soil
BMT-126 (438)	23244-021	10/20/2017	9/8/2017	Soil
BMT-127 (443)	23244-022	10/20/2017	9/8/2017	Soil
BMT-128 (448)	23244-023	10/20/2017	9/8/2017	Soil
BMT-129 (452)	23244-024	10/20/2017	9/8/2017	Soil
BMT-130 (457)	23244-025	10/20/2017	9/8/2017	Soil
BMT-131 (462)	23244-026	10/20/2017	9/8/2017	Soil
BMT-132 (467)	23244-027	10/20/2017	9/8/2017	Soil
BMT-133 (473)	23244-028	10/20/2017	9/8/2017	Soil
BMT-134 (478)	23244-029	10/20/2017	9/8/2017	Soil
BMT-135 (483)	23244-030	10/20/2017	9/8/2017	Soil
BMT-136 (488)	23244-031	10/20/2017	9/8/2017	Soil
BMT-137 (494)	23244-032	10/20/2017	9/8/2017	Soil
BMT-138 (498)	23244-033	10/20/2017	9/8/2017	Soil
BMT-139 (503)	23244-034	10/20/2017	9/8/2017	Soil
BMT-140 (508)	23244-035	10/20/2017	9/8/2017	Soil
BMT-141 (513)	23244-036	10/20/2017	9/8/2017	Soil
BMT-142 (528)	23244-037	10/20/2017	9/8/2017	Soil
BMT-143 (518)	23244-038	10/20/2017	9/8/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
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Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-144 (523)	23244-039	10/20/2017	9/8/2017	Soil
BMT-145 (533)	23244-040	10/20/2017	9/8/2017	Soil
BMT-146 (544)	23244-041	10/20/2017	9/8/2017	Soil
BMT-147 (549)	23244-042	10/20/2017	9/8/2017	Soil
BMT-148 (554)	23244-043	10/20/2017	9/8/2017	Soil
BMT-149 (559)	23244-044	10/20/2017	9/8/2017	Soil
BMT-150 (564)	23244-045	10/20/2017	9/8/2017	Soil
BMT-151 (569)	23244-046	10/20/2017	9/8/2017	Soil
BMT-152 (574)	23244-047	10/20/2017	9/8/2017	Soil
BMT-153 (579)	23244-048	10/20/2017	9/8/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 106 (537)	23244-001	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	48	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 107 (538)	23244-002	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	49	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 108 (539)	23244-003	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	22	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 109 (351)	23244-004	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.6	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 110 (356)	23244-005	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.8	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 111 (362)	23244-006	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	15	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
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Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 112 (367)	23244-007	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	36	mg/kg	10/25/17	10/26/17	--	1

BMT 113 (372)	23244-008	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.2	mg/kg	10/25/17	10/26/17	--	1

BMT 114 (377)	23244-009	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.3	mg/kg	10/25/17	10/26/17	--	1

BMT 115 (382)	23244-010	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.6	mg/kg	10/25/17	10/26/17	--	1

BMT 116 (387)	23244-011	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	20	mg/kg	10/25/17	10/26/17	--	1

BMT 117 (392)	23244-012	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.1	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
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Lab Reference #: NAM 23244
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Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 118 (397)	23244-013	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	10	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT 119 (402)	23244-014	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	19	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-120 (407)	23244-015	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	<2.0	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-121 (412)	23244-016	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	2.6	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-122 (417)	23244-017	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4.1	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-123 (422)	23244-018	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	33	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
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Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-124 (427)	23244-019	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	47	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-125 (432)	23244-020	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	30	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-126 (438)	23244-021	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.1	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-127 (443)	23244-022	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	7.3	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-128 (448)	23244-023	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	51	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-129 (452)	23244-024	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	35	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-130 (457)	23244-025	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	83	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-131 (462)	23244-026	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.4	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-132 (467)	23244-027	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.0	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-133 (473)	23244-028	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.7	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-134 (478)	23244-029	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	3.1	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-135 (483)	23244-030	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	8.9	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
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Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-136 (488)	23244-031	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	13	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-137 (494)	23244-032	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.9	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-138 (498)	23244-033	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.6	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-139 (503)	23244-034	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.5	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-140 (508)	23244-035	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	10	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-141 (513)	23244-036	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.6	mg/kg	10/25/17	10/26/17	--	1

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Lab Reference #: NAM 23244
Project Name: Black Mountain
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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-142 (528)	23244-037	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.1	mg/kg	10/25/17	10/26/17	--	1

BMT-143 (518)	23244-038	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	19	mg/kg	10/25/17	10/26/17	--	1

BMT-144 (523)	23244-039	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.6	mg/kg	10/25/17	10/26/17	--	1

BMT-145 (533)	23244-040	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	18	mg/kg	10/25/17	10/26/17	--	1

BMT-146 (544)	23244-041	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	26	mg/kg	10/25/17	10/26/17	--	1

BMT-147 (549)	23244-042	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	43	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
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Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-148 (554)	23244-043	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	9.2	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-149 (559)	23244-044	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	6.8	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-150 (564)	23244-045	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	8.4	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-151 (569)	23244-046	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	21	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-152 (574)	23244-047	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	24	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-153 (579)	23244-048	10/20/2017	9/8/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	30	mg/kg	10/25/17	10/26/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23244
Project Name: Black Mountain
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA1025172	Arsenic	6010B	<2.0	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA1025173	Arsenic	6010B	<2.0	mg/kg	10/25/17	10/26/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA1025174	Arsenic	6010B	<2.0	mg/kg	10/25/17	10/26/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 23244 Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) 6010B

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Arsenic	10/25/2017	10/26/2017	10/26/2017	23244-001	48.0	20.0	65.5	59.7	88	59	9	75-125	20	M3,
Arsenic	10/25/2017	10/26/2017	10/26/2017	23244-021	9.10	20.0	24.7	25.9	78	84	5	75-125	20	--
Arsenic	10/25/2017	10/26/2017	10/26/2017	23244-041	26.0	20.0	45.6	48.2	98	111	6	75-125	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	10/25/2017	10/26/2017	10/26/2017	JA1025172	20.0	19.7	20.0	99	100	2	80-120	20	--
Arsenic	10/25/2017	10/26/2017	10/26/2017	JA1025173	20.0	20.4	19.4	102	97	5	80-120	20	--
Arsenic	10/25/2017	10/26/2017	10/26/2017	JA1025174	20.0	19.1	18.1	96	91	5	80-120	20	--

Data Qualifier Definitions

Qualifier

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

23244-001	6010B	Arsenic	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 23244
Page 1 of 4

REQUIRED TURN AROUND TIME: Standard: ✓
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION		PROJECT INFORMATION	
COMPANY:	Ninyo & Moore	PROJECT NAME:	Black Mountain
SEND REPORT TO:	Beth Abramson Beck	NUMBER:	108246002
EMAIL:	babramsonbeck@ninyoandmoore.	ADDRESS:	
ADDRESS:	5710 Ruffin Road		
	San Diego	P.O. #:	108246002
PHONE:	(858) 576-1000 FAX:	SAMPLED BY:	EC

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)										REMARKS/PRECAUTIONS
1	Bmt 106 (537)	1	09/08/17		SS	plastic	X										
2	Bmt 107 (538)	↓	↓		↓	↓	X										
3	Bmt 108 (539)						X										
4	Bmt 109 (351)						X										
5	Bmt 110 (356)						X										
6	Bmt 111 (362)						X										
7	Bmt 112 (367)						X										
8	Bmt 113 (372)						X										
9	Bmt 114 (377)						X										
10	Bmt 115 (382)						X										
11	Bmt 116 (387)						X										
12	Bmt 117 (392)						X										
13	Bmt 118 (397)						X										
14	Bmt 119 (402)						X										

Total No. of Samples: [illegible] Method of Shipment: [✓ Pick-up] Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By: Eric R	Date/Time: 10/20/17 12:00	Received By:	Date/Time: 10/20/17 12:30pm
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
GW - Groundwater
WW - Wastewater
SW - Stormwater
DW - Drinking Water
W - Water
SS - Soil/Solid
OT - Other

Sample Integrity:
Intact: ✓ On Ice: [✓ Yes] / No @ 6.0 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sample.

Analysis Request and Chain of Custody Record

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4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 23244
Page 2 of 24

REQUIRED TURN AROUND TIME: Standard: ✓
72 Hours: 48 Hours: 24 Hours:

CUSTOMER INFORMATION		PROJECT INFORMATION	
COMPANY:	Ninyo & Moore	PROJECT NAME:	Black Mountain
SEND REPORT TO:	Beth Abramson Beck	NUMBER:	108246002
EMAIL:	babramsonbeck@ninyoandmoore.	ADDRESS:	
ADDRESS:	5710 Ruffin Road		
	San Diego	P.O. #:	108246002
PHONE:	(858) 576-1000 FAX:	SAMPLED BY:	EC

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE: Arsenic (6010B)										REMARKS/PRECAUTIONS
15	Bmt-120 (407)	1	09/08/17		SS	plastic	X										
16	Bmt-121 (412)	↓	↓		↓	↓	X										
17	Bmt-122 (417)	↓	↓		↓	↓	X										
18	Bmt-123 (422)	↓	↓		↓	↓	X										
19	Bmt-124 (427)	↓	↓		↓	↓	X										
20	Bmt-125 (432)	↓	↓		↓	↓	X										
21	Bmt-126 (438)	↓	↓		↓	↓	X										
22	Bmt-127 (443)	↓	↓		↓	↓	X										
23	Bmt-128 (448)	↓	↓		↓	↓	X										
24	Bmt-129 (452)	↓	↓		↓	↓	X										
25	Bmt-130 (457)	↓	↓		↓	↓	X										
26	Bmt-131 (462)	↓	↓		↓	↓	X										
27	Bmt-132 (467)	↓	↓		↓	↓	X										
28	Bmt-133 (473)	↓	↓		↓	↓	X										

Total No. of Samples: 8 Method of Shipment: **Pick-up** Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 10/20/17 12:00	Received By:	Date/Time: 10/20/17 12:30
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
GW - Groundwater
WW - Wastewater
SW - Stormwater
DW - Drinking Water
W - Water
SS - Soil/Solid
OT - Other

Sample Integrity:
Intact: ✓ On Ice: [✓ Yes] / No @ 6.0 °C

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Analysis Request and Chain of Custody Record

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Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 23244
Page 3 of 34

REQUIRED TURN AROUND TIME: Standard: ✓
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION		PROJECT INFORMATION	
COMPANY:	Ninyo & Moore	PROJECT NAME:	Black Mountain
SEND REPORT TO:	Beth Abramson Beck	NUMBER:	108246002
EMAIL:	babramsonbeck@ninyoandmoore.	ADDRESS:	
ADDRESS:	5710 Ruffin Road		
	San Diego	P.O. #:	108246002
PHONE:	(858) 576-1000 FAX:	SAMPLED BY:	EC

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)									REMARKS/PRECAUTIONS
29	Bmt -134 (478)	1	09/08/17		SS	plastic	X									
30	Bmt -135 (483)	↓	↓		↓	↓	X									
31	Bmt - 136 (488)	↓	↓		↓	↓	X									
32	Bmt - 137 (494)	↓	↓		↓	↓	X									
33	Bmt - 138 (498)	↓	↓		↓	↓	X									
34	Bmt - 139 (503)	↓	↓		↓	↓	X									
35	Bmt - 140 (508)	↓	↓		↓	↓	X									
36	Bmt - 141 (513)	↓	↓		↓	↓	X									
37	Bmt - 142 (528)	↓	↓		↓	↓	X									
38	Bmt - 143 (518)	↓	↓		↓	↓	X									
39	Bmt - 144 (523)	↓	↓		↓	↓	X									
40	Bmt - 145 (533)	↓	↓		↓	↓	X									
41	Bmt - 146 (544)	↓	↓		↓	↓	X									
42	Bmt - 147 (549)	↓	↓		↓	↓	X									

Total No. of Samples: **8** Method of Shipment: **Pick-up** Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 10/20/17 12:00	Received By:	Date/Time: 10/20/17 12:35 pm
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
GW - Groundwater
WW - Wastewater
SW - Stormwater
DW - Drinking Water
W - Water
SS - Soil/Solid
OT - Other

Sample Integrity: ✓
Intact: ✓ On Ice: [✓ Yes] No @ 6.0°C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sample.

Analysis Request and Chain of Custody Record

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Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 23244
Page 4 of 4

REQUIRED TURN AROUND TIME: Standard: ✓
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION		**PROJECT INFORMATION**	
COMPANY:	Ninyo & Moore	PROJECT NAME:	Black Mountain
SEND REPORT TO:	Beth Abramson Beck	NUMBER:	108246002
EMAIL:	babramsonbeck@ninyoandmoore.	ADDRESS:	
ADDRESS:	5710 Ruffin Road		
	San Diego	P.O. #:	108246002
PHONE:	(858) 576-1000 FAX:	SAMPLED BY:	EC

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)	REMARKS/PRECAUTIONS
43	Bmt-148 (S54)	1	09/08/17		SS	plastic	X	
44	Bmt-149 (S59)	↓	↓		↓	↓	X	
45	Bmt-150 (S64)	↓	↓		↓	↓	X	
46	Bmt-151 (S69)	↓	↓		↓	↓	X	
47	Bmt-152 (S74)	↓	↓		↓	↓	X	
48	Bmt-153 (S79)	↓	↓		↓	↓	X	

Total No. of Samples: **8** Method of Shipment: **Pick-up** Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 10/20/17 12:00	Received By:	Date/Time: 10/20/17 12:3[illegible]
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
GW - Groundwater
WW - Wastewater
SW - Stormwater
DW - Drinking Water
W - Water
SS - Soil/Solid
OT - Other

Sample Integrity: ✓
Intact: ✓ On Ice: [✓ Yes] No @ 6.0 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sample.

Sample Receipt Report

Laboratory Reference **NAM 23244**

Logged in by MM

Received: 10/20/17 12:30

Method of Shipment: Lab Pick-Up

Shipping Container: Cooler

Shipping Containers: 1

Company Name: Ninyo & Moore

Project Manager: Ms. Beth Abramson-Beck

Project Name: Black Mountain

Project #: 108246002

Sample Quantity

48 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	6.0°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ______ By ______ On ______

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4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2018
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 23559
Project Name:	Black Mountain Open Space Park
Project Number:	108246003
Date Received:	4/5/2018
Date Reported:	4/9/2018
Chain of Custody Received:	☑
Analytical Method:	6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23559
Project Name: Black Mountain Open Space Park
Project #: 108246003

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 20.2ºC.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23559
Project Name: Black Mountain Open Space Park
Project #: 108246003

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Bmt 92A	23559-001	4/5/2018	4/4/2018	Soil
Bmt 92B	23559-002	4/5/2018	4/4/2018	Soil
Bmt 92C	23559-003	4/5/2018	4/4/2018	Soil
Bmt 92D	23559-004	4/5/2018	4/4/2018	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 23559
Project Name: Black Mountain Open Space Park
Project #: 108246003

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Bmt 92A	23559-001	4/5/2018	4/4/2018	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	160	mg/kg	04/06/18	04/06/18	--	1

Bmt 92B	23559-002	4/5/2018	4/4/2018	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	180	mg/kg	04/06/18	04/06/18	--	1

Bmt 92C	23559-003	4/5/2018	4/4/2018	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	200	mg/kg	04/06/18	04/06/18	--	1

Bmt 92D	23559-004	4/5/2018	4/4/2018	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	300	mg/kg	04/06/18	04/06/18	--	1

Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJQ0406181	Arsenic	6010B	<2.0	mg/kg	04/06/18	04/06/18	--	1

QA/QC Report
for
Metals

Reference #: NAM 23559 Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Arsenic	4/6/2018	4/6/2018	4/6/2018	23561-001	5.00	20.0	26.3	24.9	106	100	5	75-125	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	4/6/2018	4/6/2018	4/6/2018	JQ0406181	20.0	19.6	19.1	98	96	3	80-120	20	--

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

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Lab Job No: 235559
Page 1 of 1

REQUIRED TURN AROUND TIME: **Standard:** ✓
72 Hours: ____ **48 Hours:** ____ **24 Hours:** ____

CUSTOMER INFORMATION		**PROJECT INFORMATION**	
COMPANY:	Ninyo & Moore	PROJECT NAME:	Black Mountain Open Space Park
SEND REPORT TO:		NUMBER:	108246003
EMAIL:	babramsonbeck@ninyoandmoore.com	ADDRESS:	
ADDRESS:	5710 Ruffin Road		
	San Diego	P.O. #:	
PHONE:	(858) 576-1000 FAX:	SAMPLED BY:	Eric Cathcart

ANALYSIS REQUEST / PRESERVATIVE

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	6010 - Arsenic Only										REMARKS/PRECAUTIONS
BMT 92A	1	4/4/18	9:15	Soil	BAG	X										
BMT 92B	1	↓	9:20	↓	↓	X										
BMT 92C	1	↓	9:25	↓	↓	X										
BMT 92D	1	↓	9:30	↓	↓	X										

Total No. of Samples: 4
Method of Shipment:
Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4/4/18 11:10AM	Received By:	Date/Time: 04.04.18 11:10AM	Sample Matrix: GW - Groundwater WW - Wastewater SW - Stormwater DW - Drinking Water W - Water SS - Soil/Solid OT - Other
Relinquished By:	Date/Time:	Received By:	Date/Time:	
Relinquished By:	Date/Time:	Received For Lab By: OCACA	Date/Time: 4/5/18 0920	Sample Integrity: Intact: ✓ On Ice: Yes / [✓ No] @ 20.2 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sample.

Sample Receipt Report

Laboratory Reference NAM 23559

Logged in by MM

Received:	04/05/18 09:20	Company Name:	Ninyo & Moore
Method of Shipment:	OnTrac	Project Manager:	Ms. Beth Abramson-Beck
Shipping Container:	Shipping Envelope	Project Name:	Black Mountain Open Space Park
# Shipping Containers:	1	Project #:	108246003

Sample Quantity
4 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☐	Yes, Blue ☐	No ☑
Temperature	20.2°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ________ By ________ On ________

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client: Ninyo & Moore

Laboratory Reference: NAM 22935

Project Name: Black Mt Open Space Park

Project Number: 108246002

Date Received: 4/12/2017

Date Reported: 4/21/2017

Chain of Custody Received: ☑

Analytical Method: 6010B, 7471A,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Ranga adit-01	22935-001	4/12/2017	4/10/2017	Soil
Ranga tailings-02	22935-002	4/12/2017	4/10/2017	Soil
Glory hole tailings-03	22935-003	4/12/2017	4/10/2017	Soil
Hobbit hole tailings-04	22935-004	4/12/2017	4/10/2017	Soil
Hobbit hole tailings-05	22935-005	4/12/2017	4/10/2017	Soil
Koala adit soil-06	22935-006	4/12/2017	4/10/2017	Soil
Koala adit tailings-07	22935-007	4/12/2017	4/10/2017	Soil
Canyon tailings-08	22935-008	4/12/2017	4/10/2017	Soil
Concrete roaster soil-09	22935-009	4/12/2017	4/10/2017	Soil
Tailings south dust flume-10	22935-011	4/12/2017	4/10/2017	Soil
Flume soil 3rd opening-11	22935-013	4/12/2017	4/10/2017	Soil
Flume soil 15th opening-12	22935-017	4/12/2017	4/10/2017	Soil
Flume east end soil-13	22935-020	4/12/2017	4/10/2017	Soil
Rock Crusher M4 soil-14	22935-022	4/12/2017	4/10/2017	Soil
East of cyanide vat 1-15	22935-024	4/12/2017	4/10/2017	Soil
Drainage varve-16	22935-026	4/12/2017	4/10/2017	Soil
Cyanide trail soil-17	22935-027	4/12/2017	4/10/2017	Soil
Pit mine tailings soil-18	22935-028	4/12/2017	4/10/2017	Soil
Trail crossing-19	22935-029	4/12/2017	4/10/2017	Soil

Ms. Beth Abramson-Beck
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Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Ranga adit-01	22935-001	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	33	mg/kg	04/17/17	04/18/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Ranga tailings-02	22935-002	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	15	mg/kg	04/17/17	04/18/17	D1,	5
Arsenic	6010B	32000	mg/kg	04/17/17	04/18/17	D2,	50
Barium	6010B	420	mg/kg	04/17/17	04/18/17	D1,	5
Beryllium	6010B	<2.5	mg/kg	04/17/17	04/18/17	D1,	5
Cadmium	6010B	750	mg/kg	04/17/17	04/18/17	D1,	5
Chromium	6010B	<2.5	mg/kg	04/17/17	04/18/17	D1,	5
Cobalt	6010B	11	mg/kg	04/17/17	04/18/17	D1,	5
Copper	6010B	96	mg/kg	04/17/17	04/18/17	D1,	5
Lead	6010B	40	mg/kg	04/17/17	04/18/17	D1,	5
Mercury	7471A	0.23	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<5.0	mg/kg	04/17/17	04/18/17	D1,	5
Nickel	6010B	<2.5	mg/kg	04/17/17	04/18/17	D1,	5
Selenium	6010B	<5.0	mg/kg	04/17/17	04/18/17	D1,	5
Silver	6010B	<2.5	mg/kg	04/17/17	04/18/17	D1,	5
Thallium	6010B	<10	mg/kg	04/17/17	04/18/17	D1,	5
Vanadium	6010B	180	mg/kg	04/17/17	04/18/17	D1,	5
Zinc	6010B	160	mg/kg	04/17/17	04/18/17	D1,	5

Ms. Beth Abramson-Beck
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Lab Reference #: NAM 22935
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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Glory hole tailings-03	22935-003	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	4400	mg/kg	04/17/17	04/18/17	D2,	20

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Hobbit hole tailings-04	22935-004	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5500	mg/kg	04/17/17	04/18/17	D2,	20

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Lab Reference #: NAM 22935
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Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Hobbit hole tailings-05	22935-005	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	2.3	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	7300	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	91	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	160	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	10	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	13	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	65	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	23	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	1.3	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	1.6	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	3.2	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	65	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	46	mg/kg	04/17/17	04/18/17	--	1

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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Koala adit soil-06	22935-006	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	690	mg/kg	04/17/17	04/18/17	--	1
Barium	6010B	42	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	16	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	2.1	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	3.5	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	20	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	10	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	0.14	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	1.3	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	1.4	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	19	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	28	mg/kg	04/17/17	04/18/17	--	1

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Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Koala adit tailings-07	22935-007	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	83	mg/kg	04/17/17	04/18/17	--	1
Barium	6010B	65	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	2.5	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	11	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	13	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	11	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	12	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	<0.10	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	2.8	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	2.3	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	79	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	45	mg/kg	04/17/17	04/18/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Canyon tailings-08	22935-008	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	150	mg/kg	04/17/17	04/18/17	--	1

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Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Concrete roaster soil-09	22935-009	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	1800	mg/kg	04/17/17	04/18/17	D2,	20

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Tailings south dust flume-10	22935-011	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	4.0	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	14000	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	190	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	300	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	4.9	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	9.4	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	48	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	19	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	1.9	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	1.3	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	1.8	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	58	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	64	mg/kg	04/17/17	04/18/17	--	1

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Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume soil 3rd opening-11	22935-013	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	3200	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	85	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	74	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	16	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	6.4	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	26	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	74	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	0.27	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	19	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	1.6	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	28	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	150	mg/kg	04/17/17	04/18/17	--	1

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Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume soil 15th opening-12	22935-017	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	2300	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	85	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	53	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	19	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	6.3	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	25	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	68	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	0.31	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	16	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	2.5	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	26	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	120	mg/kg	04/17/17	04/18/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume east end soil-13	22935-020	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	190	mg/kg	04/17/17	04/18/17	--	1

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Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Rock Crusher M4 soil-14	22935-022	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	2.5	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	7400	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	47	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	170	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	2.0	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	2.7	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	14	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	120	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	0.54	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	15	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	23	mg/kg	04/17/17	04/18/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
East of cyanide vat 1-15	22935-024	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	770	mg/kg	04/17/17	04/18/17	--	1

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Lab Reference #: NAM 22935
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Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Drainage varve-16	22935-026	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	1.4	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	3100	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	110	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	70	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	6.0	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	2.6	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	10	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	7.4	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	0.43	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	1.3	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	1.5	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	18	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	21	mg/kg	04/17/17	04/18/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Cyanide trail soil-17	22935-027	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	630	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	10000	mg/kg	04/17/17	04/18/17	D2,	20
Barium	6010B	110	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	230	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	6.3	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	7.7	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	62	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	2500	mg/kg	04/17/17	04/18/17	D2,	5
Mercury	7471A	0.70	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	2.7	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	37	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	48	mg/kg	04/17/17	04/18/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Pit mine tailings soil-18	22935-028	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	1800	mg/kg	04/17/17	04/18/17	D2,	20

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Trail crossing-19	22935-029	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Arsenic	6010B	22	mg/kg	04/17/17	04/18/17	--	1
Barium	6010B	33	mg/kg	04/17/17	04/18/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Cadmium	6010B	0.77	mg/kg	04/17/17	04/18/17	--	1
Chromium	6010B	2.1	mg/kg	04/17/17	04/18/17	--	1
Cobalt	6010B	2.2	mg/kg	04/17/17	04/18/17	--	1
Copper	6010B	4.5	mg/kg	04/17/17	04/18/17	--	1
Lead	6010B	5.8	mg/kg	04/17/17	04/18/17	--	1
Mercury	7471A	<0.10	mg/kg	04/17/17	04/18/17	--	1
Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
Nickel	6010B	1.2	mg/kg	04/17/17	04/18/17	--	1
Selenium	6010B	1.4	mg/kg	04/17/17	04/18/17	--	1
Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
Vanadium	6010B	15	mg/kg	04/17/17	04/18/17	--	1
Zinc	6010B	15	mg/kg	04/17/17	04/18/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0417171	Antimony	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Arsenic	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Barium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Beryllium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Cadmium	6010B	<0.20	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Chromium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Cobalt	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Copper	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Lead	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417172	Mercury	7471A	<0.10	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Molybdenum	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Nickel	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Selenium	6010B	<1.0	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Silver	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Thallium	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Vanadium	6010B	<0.50	mg/kg	04/17/17	04/18/17	--	1
MBJA0417171	Zinc	6010B	<2.0	mg/kg	04/17/17	04/18/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22935

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B/7471A**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Antimony	4/17/2017	4/18/2017	4/18/2017	22935-002	15.0	20.0	19.5	17.6	22	13	10	75-125	20	M2,
Arsenic	4/17/2017	4/18/2017	4/18/2017	22935-002	32000	20.0	23000	24000	0	0	4	75-125	20	M3,
Barium	4/17/2017	4/18/2017	4/18/2017	22935-002	420	20.0	386	354	0	0	9	75-125	20	M3,
Beryllium	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	18.0	19.1	90	96	6	75-125	20	--
Cadmium	4/17/2017	4/18/2017	4/18/2017	22935-002	750	20.0	581	586	0	0	1	75-125	20	M3,
Chromium	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	17.8	16.6	89	83	7	75-125	20	--
Cobalt	4/17/2017	4/18/2017	4/18/2017	22935-002	11.0	20.0	28.6	29.4	88	92	3	75-125	20	--
Copper	4/17/2017	4/18/2017	4/18/2017	22935-002	96.0	20.0	126	109	150	65	14	75-125	20	M3,
Lead	4/17/2017	4/18/2017	4/18/2017	22935-002	40.0	20.0	56.2	63.0	81	115	11	75-125	20	M3,
Mercury	4/17/2017	4/18/2017	4/18/2017	22935-002	0.230	1.00	1.26	1.23	103	100	2	80-120	20	--
Molybdenum	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	15.9	15.9	79	79	0	75-125	20	--
Nickel	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	16.7	16.7	84	84	0	75-125	20	--
Selenium	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	23.2	24.8	116	124	7	75-125	20	--
Silver	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	17.4	16.5	87	82	5	75-125	20	--
Thallium	4/17/2017	4/18/2017	4/18/2017	22935-002	0.00	20.0	16.5	12.7	82	63	26	75-125	20	M2, R2,
Vanadium	4/17/2017	4/18/2017	4/18/2017	22935-002	180	20.0	178	233	0	265	27	75-125	20	M3,
Zinc	4/17/2017	4/18/2017	4/18/2017	22935-002	160	20.0	167	193	35	165	14	75-125	20	M3,

QA/QC Report
for
Metals

Reference #: NAM 22935 Reporting units: ppm

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Antimony	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.4	16.6	82	83	1	80-120	20	--
Arsenic	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.7	16.6	84	83	1	80-120	20	--
Barium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	17.6	17.7	88	89	1	80-120	20	--
Beryllium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.5	16.5	82	82	0	80-120	20	--
Cadmium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.9	16.9	84	84	0	80-120	20	--
Chromium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.3	16.4	81	82	1	80-120	20	--
Cobalt	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	17.3	17.3	86	86	0	80-120	20	--
Copper	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	17.9	17.7	89	89	1	80-120	20	--
Lead	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.9	16.9	84	84	0	80-120	20	--
Molybdenum	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	17.4	17.4	87	87	0	80-120	20	--
Nickel	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	18.1	18.2	91	91	1	80-120	20	--
Selenium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.1	17.0	81	85	5	80-120	20	--
Silver	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	18.0	18.0	90	90	0	80-120	20	--
Thallium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	16.6	16.6	83	83	0	80-120	20	--
Vanadium	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	17.4	17.4	87	87	0	80-120	20	--
Zinc	4/17/2017	4/18/2017	4/18/2017	JA0417171	20.0	18.6	18.3	93	91	2	80-120	20	--
Mercury	4/17/2017	4/18/2017	4/18/2017	JA0417172	1.00	1.06	1.05	106	105	1	80-120	20	--

Data Qualifier Definitions

Qualifier

D1 = Sample required dilution due to matrix.

D2 = Sample required dilution due to high concentration of target analyte.

M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.

22935-002	6010B	Antimony	MS/MSD
22935-002	6010B	Thallium	MS/MSD

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22935-002	6010B	Arsenic	MS/MSD
22935-002	6010B	Barium	MS/MSD
22935-002	6010B	Cadmium	MS/MSD
22935-002	6010B	Copper	MS/MSD
22935-002	6010B	Lead	MS/MSD
22935-002	6010B	Vanadium	MS/MSD
22935-002	6010B	Zinc	MS/MSD

R2 = RPD/RSD exceeded the laboratory acceptance limit.

22935-002	6010B	Thallium	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 1 of 3

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo and Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
San Diego CA
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108246002
ADDRESS:
P.O. #: 108246002
SAMPLED BY: BMC / BAB

ANALYSIS REQUEST / PRESERVATIVE

- repor samples together or on one report

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 metals (6010B)	Arsenic (6010B)	Cyanide (9014)	Arsenic (Osha 105)	Soluble Arsenic	Soluble As + Cd	Soluble As + Pb	Soluble As + Cd + Pb	Soluble As + Cd + Pb + Sb	Soluble As + Cd + Pb + Hg	Soluble As + Cd + Pb + Zn	REMARKS/PRECAUTIONS
1	Bango adit - 01	1	4/10/17	0945	Soil	jar		X										Please analyze the following SPLP ☒ by 05.09.17
2	Ranger tailings - 02	1	"	0950	"	"	X					X						
3	Glory hole tailings - 03			1015				X										
4	Hobbit hole tailings - 04			1035				X			X							
5	Hobbit hole tailings - 05			1040			X					X						
6	Koala adit soil - 06			1100			X											
7	Koala adit tailings - 07			1107			X											
8	Canyon tailings - 08			1117				X										
9	Concrete roaster? soil - 09			1127				X										
10	Concrete roaster? wipe - 01			1135		wipe		BMC		X								
11	tailings south dust flume - 10			1147	soil	jar	X					X						
12	dust flume east end wipe 02			1153		wipe		BMC		X								
13	flume soil 3rd opening - 11			1214	soil	jar								X				
14	flume west wall 3rd opening wipe 03			1215		wipe		BMC		X								

Total No. of Samples: Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO3 4 = H2SO4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: Mark Noori OCA, CA	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc.

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

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Phoenix, AZ 85040
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Lab Job No: 22935
Page 2 of 3

REQUIRED TURN AROUND TIME: Standard: ______
[✓ 72 Hours:] ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION	
COMPANY:	Ninyo & Moore
SEND REPORT TO:	Beth Abramson-Beck
EMAIL:	Babramsonbeck@ninyoandmoore.com
ADDRESS:	5710 Ruffin Road San Diego CA
PHONE:	858 576-1000
FAX:	858-576-9600

PROJECT INFORMATION	
PROJECT NAME:	Black Mountain Open Space Park
NUMBER:	108246002
ADDRESS:	
P.O.#:	108246002
SAMPLED BY:	BMC / BAB

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 metals (6010)	Arsenic (6010B)	(Cyanide (9014))	Arsenic (Own 105 [illegible])	Soluble Arsenic	Soluble As+Cd	Soluble As+Pb	Soluble As+Cd+Pb	Soluble As+Cd+Pb+Sb	Soluble As+Cd+Pb+Hg	Soluble As+Cd+Pb+Zn
15	Flume east wall 8th opening wipe -04	1	4/10/17	1219	wipe	→				X							
16	Flume ceiling 15th opening wipe -06	↓	↓	1227	"	→				X							
17	Flume soil 15th opening -12	↓	↓	1225	jar	→	X							X			
18	Flume west wall 23rd opening wipe -07	↓	↓	1237	wipe					X							
19	Flume west wall 30th opening wipe -08	↓	↓	1240		wipe				X							
20	Flume east end soil -13	↓	↓	1250	soil	jar		X									
21	Cyanide vat 1 wipe - 09	↓	↓	1300		wipe			X								
22	Rock crusher M4 soil -14	↓	↓	1320	soil	jar	X							X			
23	Roaster M12 wipe -10	↓	↓	1311		wipe				X							
24	East of cyanide vat 1 -15	↓	↓	1327	soil	jar		X									
25	Cyanide vat 4 wipe -11	↓	↓	1340		wipe			X								
	temp blank																

REMARKS/PRECAUTIONS
…ase repo
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separte r
~~for~~ grouped
soil

Total No. of Samples: Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: OCAL	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
WW - Wastewater
GW - Groundwater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc. All samples remain the property of the client.

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 2 of 3

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ Hours: ______

CUSTOMER INFORMATION	**PROJECT INFORMATION**
COMPANY: Ninyo & Moore	PROJECT NAME: Black Mt Open Space Park
SEND REPORT TO: Beth Abramson-Beck	NUMBER:
EMAIL: Babramsonbeck@ ninyo and moore.	ADDRESS: TIM
ADDRESS: 5710 Ruffin Road	
	P.O. #:
PHONE: 858 576-1000 FAX:	SAMPLED BY:

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Title 22 metals (6010B)	Arsenic (6010B)		Soluble Arsenic	Soluble As+Cd	Soluble As+Pb	Soluble As+Cd+Pb	Soluble As+Cd+Pb+Sb	Soluble As+Cd+Pb+Hg	Soluble As+Cd+Pb+Zn	REMARKS/PRECAUTIONS
26	Drainage ravine -16	1	4/10/17	1345	Soil	Jar	☒					☒						
27	Cyanide trail soil -17	"	"	1350	Soil	Jar	☒								☒			
28	Pit mine tailings soil -18	"	"	1410	"	"		☒										
29	trail crossing 10-19	"	"	1434	"	"	☒											

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: Mark Morris OCA, LA	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc.

From: "Mark Noorani" <markn@ocalab.com>
Date: Tuesday, May 09, 2017 9:40 AM
To: "Orange Coast Analytical" <ocalab@sbcglobal.net>
Attach: 4946_001.pdf
Subject: Fwd: Additional analyses SPLP

-------- Original Message --------

Subject: Additional analyses SPLP
Date:2017-05-09 09:34
From: Beth Abramson-Beck <babramsonbeck@ninyoandmoore.com>
To: Mark Noorani <markn@ocalab.com>
Cc: Eric Cathcart <cathcart@sandiego.edu>, Bethany O'Shea <bethoshea@sandiego.edu>, Brianne Cortright <bcortright@ninyoandmoore.com>

Good morning Mark,

Could you please additionally analyze the following samples by Synthetic Precipitation Leaching Procedure (SPLP) as indicated with a blue X and highlighted yellow.

Also, would you please provide me the cost for these additional analyses? You already provided a cost to conduct soluble testing for arsenic and arsenic+lead; however, not sure of costs for those samples with more than two soluble tests.

As previously mentioned, we need to obtain all the remaining samples as soon as possible. Can these be dropped off when you come down here for a sample pickup?

Thank you!

Beth S.Abramson-Beck, PG 4580

Principal Geologist

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

(858) 576-1000 (San Diego) | (949) 753-7070 (Irvine) | (909) 758-5860 (Rancho Cucamonga)

babramsonbeck@ninyoandmoore.com

30 Years of Quality Service

--

Mark Noorani | Laboratory Director
Orange Coast Analytical, Inc.
3002 Dow Ave. Ste. 532 Tustin, CA, 92780
Office: 714-832-0064   480-736-0960
markn@ocalab.com

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client: Ninyo & Moore

Laboratory Reference: NAM 22941A

Project Name: Black Mt Open Space Park

Project Number: 108246002

Date Received: 4/17/2017

Date Reported: 4/27/2017

Chain of Custody Received: ☑

Analytical Method: 6010B, 7471A,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941A
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941A
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Pit Mine 2-22	22941-025	4/17/2017	4/13/2017	Soil
Processed Slurry SEM12-20	22941-026	4/17/2017	4/12/2017	Soil
Downslope M12-21	22941-027	4/17/2017	4/12/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Pit Mine 2-22	22941-025	4/17/2017	4/13/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	5.6	mg/kg	04/18/17	04/19/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Processed Slurry SEM12-20	22941-026	4/17/2017	4/12/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	64	mg/kg	04/18/17	04/19/17	--	1
Arsenic	6010B	92000	mg/kg	04/18/17	04/19/17	D2,	200
Barium	6010B	51	mg/kg	04/18/17	04/19/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
Cadmium	6010B	2600	mg/kg	04/18/17	04/19/17	D2,	50
Chromium	6010B	170	mg/kg	04/18/17	04/19/17	--	1
Cobalt	6010B	14	mg/kg	04/18/17	04/19/17	--	1
Copper	6010B	66	mg/kg	04/18/17	04/19/17	--	1
Lead	6010B	480	mg/kg	04/18/17	04/19/17	--	1
Mercury	7471A	210	mg/kg	04/18/17	04/18/17	D2,	100
Molybdenum	6010B	5.0	mg/kg	04/18/17	04/19/17	--	1
Nickel	6010B	51	mg/kg	04/18/17	04/19/17	--	1
Selenium	6010B	1.7	mg/kg	04/18/17	04/19/17	--	1
Silver	6010B	5.3	mg/kg	04/18/17	04/19/17	--	1
Thallium	6010B	<2.0	mg/kg	04/18/17	04/19/17	--	1
Vanadium	6010B	20	mg/kg	04/18/17	04/19/17	--	1
Zinc	6010B	76	mg/kg	04/18/17	04/19/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Downslope M12-21	22941-027	4/17/2017	4/12/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	4.7	mg/kg	04/18/17	04/19/17	--	1
Arsenic	6010B	13000	mg/kg	04/18/17	04/19/17	D2,	20
Barium	6010B	57	mg/kg	04/18/17	04/19/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
Cadmium	6010B	290	mg/kg	04/18/17	04/19/17	--	1
Chromium	6010B	21	mg/kg	04/18/17	04/19/17	--	1
Cobalt	6010B	3.9	mg/kg	04/18/17	04/19/17	--	1
Copper	6010B	23	mg/kg	04/18/17	04/19/17	--	1
Lead	6010B	58	mg/kg	04/18/17	04/19/17	--	1
Mercury	7471A	5.0	mg/kg	04/18/17	04/18/17	D2,	5
Molybdenum	6010B	<1.0	mg/kg	04/18/17	04/19/17	--	1
Nickel	6010B	5.0	mg/kg	04/18/17	04/19/17	--	1
Selenium	6010B	<1.0	mg/kg	04/18/17	04/19/17	--	1
Silver	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
Thallium	6010B	<2.0	mg/kg	04/18/17	04/19/17	--	1
Vanadium	6010B	19	mg/kg	04/18/17	04/19/17	--	1
Zinc	6010B	34	mg/kg	04/18/17	04/19/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0418171	Antimony	6010B	<1.0	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Arsenic	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Barium	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Beryllium	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Cadmium	6010B	<0.20	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Chromium	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Cobalt	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Copper	6010B	<2.0	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Lead	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418172	Mercury	7471A	<0.10	mg/kg	04/18/17	04/18/17	--	1
MBJA0418171	Molybdenum	6010B	<1.0	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Nickel	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Selenium	6010B	<1.0	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Silver	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Thallium	6010B	<2.0	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Vanadium	6010B	<0.50	mg/kg	04/18/17	04/19/17	--	1
MBJA0418171	Zinc	6010B	<2.0	mg/kg	04/18/17	04/19/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22941A

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B/7471A**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Antimony	4/18/2017	4/19/2017	4/19/2017	22936-001	0.00	20.0	4.01	3.39	20	17	17	75-125	20	M2,
Arsenic	4/18/2017	4/19/2017	4/19/2017	22936-001	71.0	20.0	74.8	72.9	19	10	3	75-125	20	M3,
Barium	4/18/2017	4/19/2017	4/19/2017	22936-001	150	20.0	134	140	0	0	4	75-125	20	M3,
Beryllium	4/18/2017	4/19/2017	4/19/2017	22936-001	1.40	20.0	16.6	16.7	76	77	1	75-125	20	--
Cadmium	4/18/2017	4/19/2017	4/19/2017	22936-001	2.00	20.0	18.9	19.3	84	86	2	75-125	20	--
Chromium	4/18/2017	4/19/2017	4/19/2017	22936-001	12.0	20.0	24.7	25.1	64	66	2	75-125	20	M3,
Cobalt	4/18/2017	4/19/2017	4/19/2017	22936-001	1.00	20.0	16.1	16.8	75	79	4	75-125	20	--
Copper	4/18/2017	4/19/2017	4/19/2017	22936-001	21.0	20.0	38.1	36.3	85	76	5	75-125	20	--
Lead	4/18/2017	4/19/2017	4/19/2017	22936-001	15.0	20.0	27.3	27.4	61	62	0	75-125	20	M3,
Mercury	4/18/2017	4/18/2017	4/18/2017	22936-001	0.150	1.00	1.20	1.19	105	104	1	80-120	20	--
Molybdenum	4/18/2017	4/19/2017	4/19/2017	22936-001	22.0	20.0	35.2	34.6	66	63	2	75-125	20	M3,
Nickel	4/18/2017	4/19/2017	4/19/2017	22936-001	4.10	20.0	18.7	19.6	73	77	5	75-125	20	M3,
Selenium	4/18/2017	4/19/2017	4/19/2017	22936-001	1.70	20.0	14.5	14.1	64	62	3	75-125	20	M2,
Silver	4/18/2017	4/19/2017	4/19/2017	22936-001	0.00	20.0	17.6	17.6	88	88	0	75-125	20	--
Thallium	4/18/2017	4/19/2017	4/19/2017	22936-001	0.00	20.0	14.2	14.3	71	72	1	75-125	20	M2,
Vanadium	4/18/2017	4/19/2017	4/19/2017	22936-001	4.60	20.0	20.2	21.0	78	82	4	75-125	20	--
Zinc	4/18/2017	4/19/2017	4/19/2017	22936-001	1300	20.0	1030	904	0	0	13	75-125	20	M3,

QA/QC Report
for
Metals

Reference #: NAM 22941A

Reporting units: ppm

Laboratory Control Sample

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Antimony	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.7	16.3	84	81	2	80-120	20	--
Arsenic	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.0	16.1	80	81	1	80-120	20	--
Barium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.3	17.3	86	86	0	80-120	20	--
Beryllium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.2	16.1	81	81	1	80-120	20	--
Cadmium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.5	16.4	82	82	1	80-120	20	--
Chromium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.3	16.1	81	81	1	80-120	20	--
Cobalt	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.5	16.4	82	82	1	80-120	20	--
Copper	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.5	17.4	88	87	1	80-120	20	--
Lead	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.6	16.4	83	82	1	80-120	20	--
Molybdenum	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.1	16.7	86	84	2	80-120	20	--
Nickel	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.6	17.3	88	86	2	80-120	20	--
Selenium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.4	16.9	82	84	3	80-120	20	--
Silver	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.0	16.9	85	84	1	80-120	20	--
Thallium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	16.3	16.2	81	81	1	80-120	20	--
Vanadium	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.0	17.0	85	85	0	80-120	20	--
Zinc	4/18/2017	4/19/2017	4/19/2017	JA0418171	20.0	17.9	17.4	89	87	3	80-120	20	--
Mercury	4/18/2017	4/18/2017	4/18/2017	JA0418172	1.00	1.07	1.05	107	105	2	80-120	20	--

Data Qualifier Definitions

Qualifier

D2 = Sample required dilution due to high concentration of target analyte.

M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.

22936-001	6010B	Antimony	MS/MSD
22936-001	6010B	Selenium	MS/MSD
22936-001	6010B	Thallium	MS/MSD

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22936-001	6010B	Arsenic	MS/MSD
22936-001	6010B	Barium	MS/MSD
22936-001	6010B	Chromium	MS/MSD
22936-001	6010B	Lead	MS/MSD
22936-001	6010B	Molybdenum	MS/MSD
22936-001	6010B	Nickel	MS/MSD
22936-001	6010B	Zinc	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22941
Page 1 of 2

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS:
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108246002
ADDRESS: 5710 Ruffin Road
P.O. #:
SAMPLED BY:

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE: Arsenic 6010B	REMARKS/PRECAUTIONS
BMT-01	1	4/17/17	0737	Soil	Jar	X	
BMT-02	↓	↓	0744	↓	↓	X	
BMT-03			0750			X	
BMT-04			0755			X	
BMT-05			0758			X	
BMT-06			0804			X	
BMT-07			0807			X	
BMT-08			0812			X	
BMT-09			0820			X	
BMT-10			0825			X	
BMT-11			0830			X	
BMT-12			0837			X	
BMT-13			0845			X	
BMT-14			0847			X	

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22941
Page 2 of 2

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ✓ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO:
EMAIL:
ADDRESS:
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME:
NUMBER:
ADDRESS:
P.O. #:
SAMPLED BY:

See Page 1

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 mtls (6010)	Arsenic (6010B) Lead									REMARKS/PRECAUTIONS
BMT-15	1	4/13/17	0850	Soil	Jar		X									
BMT-16			0855				X									
BMT-17			0927				X									
BMT-18			0930				X									
BMT-19			0935				X									
BMT-20			0945				X									
BMT-21			0955				X									
BMT-22			1000				X									
BMT-23			1006				X									
BMT-24			1015	↓			X									
~~BMT-~~																
Pit Mine 2-22	↓	↓	1030	x	↓		x									
Processed slurry SE M12-20	↓	4/12/17	1005	X	↓	X										
Downslope M12 21	↓	↓	1020	X	↓	X										

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By: Date/Time:
Received By: Date/Time: 4/13/17 11:45

Relinquished By: Date/Time:
Received By: Date/Time:

Relinquished By: Date/Time:
Received For Lab By: Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client.

Sample Receipt Report

Laboratory Reference NAM 22941A

Logged in by CT

Received: 04/17/17 11:45

Method of Shipment: Lab Pick-Up

Shipping Container: Cooler

Shipping Containers: 1

Company Name: Ninyo & Moore

Project Manager: Ms. Beth Abramson-Beck

Project Name: Black Mt Open Space Park

Project #: 108246002

Sample Quantity
3 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	3°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☐	N/A ☐	No ☑

Notes

Client Notified ______ By ______ On ______

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 22942A
Project Name:	Black Mt Open Space Park
Project Number:	108246002
Date Received:	4/17/2017
Date Reported:	4/26/2017
Chain of Custody Received:	☑
Analytical Method:	6010B, 7471A,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942A
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 5ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942A
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Pothole-23	22942-056	4/17/2017	4/14/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Pothole-23	22942-056	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Antimony	6010B	5.3	mg/kg	04/19/17	04/21/17	--	1
Arsenic	6010B	190	mg/kg	04/19/17	04/21/17	--	1
Barium	6010B	66	mg/kg	04/19/17	04/21/17	--	1
Beryllium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Cadmium	6010B	5.1	mg/kg	04/19/17	04/21/17	--	1
Chromium	6010B	9.6	mg/kg	04/19/17	04/21/17	--	1
Cobalt	6010B	7.7	mg/kg	04/19/17	04/21/17	--	1
Copper	6010B	37	mg/kg	04/19/17	04/21/17	--	1
Lead	6010B	710	mg/kg	04/19/17	04/21/17	--	1
Mercury	7471A	0.33	mg/kg	04/19/17	04/21/17	--	1
Molybdenum	6010B	3.2	mg/kg	04/19/17	04/21/17	--	1
Nickel	6010B	1.2	mg/kg	04/19/17	04/21/17	--	1
Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
Vanadium	6010B	63	mg/kg	04/19/17	04/21/17	--	1
Zinc	6010B	55	mg/kg	04/19/17	04/21/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0419171	Antimony	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Arsenic	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Barium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Beryllium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Cadmium	6010B	<0.20	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Chromium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Cobalt	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Copper	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Lead	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419172	Mercury	7471A	<0.10	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Molybdenum	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Nickel	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Selenium	6010B	<1.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Silver	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Thallium	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Vanadium	6010B	<0.50	mg/kg	04/19/17	04/21/17	--	1
MBJA0419171	Zinc	6010B	<2.0	mg/kg	04/19/17	04/21/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22942A   Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)   **6010B/7471A**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Antimony	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	3.59	3.46	18	17	4	75-125	20	M2,
Arsenic	4/19/2017	4/21/2017	4/21/2017	22942-024	110	20.0	119	135	45	125	13	75-125	20	M3,
Barium	4/19/2017	4/21/2017	4/21/2017	22942-024	77.0	20.0	96.6	93.6	98	83	3	75-125	20	--
Beryllium	4/19/2017	4/21/2017	4/21/2017	22942-024	0.500	20.0	16.9	17.0	82	82	1	75-125	20	--
Cadmium	4/19/2017	4/21/2017	4/21/2017	22942-024	2.90	20.0	19.2	20.1	82	86	5	75-125	20	--
Chromium	4/19/2017	4/21/2017	4/21/2017	22942-024	4.70	20.0	19.4	20.0	74	76	3	75-125	20	M3,
Cobalt	4/19/2017	4/21/2017	4/21/2017	22942-024	5.20	20.0	21.6	21.9	82	84	1	75-125	20	--
Copper	4/19/2017	4/21/2017	4/21/2017	22942-024	12.0	20.0	27.5	29.3	77	86	6	75-125	20	--
Lead	4/19/2017	4/21/2017	4/21/2017	22942-024	6.10	20.0	20.7	21.2	73	75	2	75-125	20	M3,
Mercury	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	1.00	1.03	1.03	103	103	0	80-120	20	--
Molybdenum	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	11.0	11.7	55	58	6	75-125	20	M2,
Nickel	4/19/2017	4/21/2017	4/21/2017	22942-024	1.90	20.0	17.6	18.4	79	82	4	75-125	20	--
Selenium	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	15.1	16.4	75	82	8	75-125	20	--
Silver	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	15.2	15.6	76	78	3	75-125	20	--
Thallium	4/19/2017	4/21/2017	4/21/2017	22942-024	0.00	20.0	12.7	13.2	63	66	4	75-125	20	M2,
Vanadium	4/19/2017	4/21/2017	4/21/2017	22942-024	37.0	20.0	52.9	53.7	80	84	2	75-125	20	--
Zinc	4/19/2017	4/21/2017	4/21/2017	22942-024	29.0	20.0	45.0	45.7	80	84	2	75-125	20	--

QA/QC Report
for
Metals

Reference #: NAM 22942A

Reporting units: ppm

Laboratory Control Sample

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Antimony	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.9	17.0	89	85	5	80-120	20	--
Arsenic	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.1	16.4	86	82	4	80-120	20	--
Barium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.8	17.2	89	86	3	80-120	20	--
Beryllium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.7	16.5	89	82	7	80-120	20	--
Cadmium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.7	17.2	89	86	3	80-120	20	--
Chromium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.1	16.5	86	82	4	80-120	20	--
Cobalt	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.2	17.5	91	88	4	80-120	20	--
Copper	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	19.1	17.6	96	88	8	80-120	20	--
Lead	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.2	17.3	91	86	5	80-120	20	--
Molybdenum	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.5	17.6	93	88	5	80-120	20	--
Nickel	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	19.2	18.1	96	91	6	80-120	20	--
Selenium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.8	16.6	89	83	7	80-120	20	--
Silver	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.8	17.4	89	87	2	80-120	20	--
Thallium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	17.7	17.0	89	85	4	80-120	20	--
Vanadium	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	18.0	17.3	90	86	4	80-120	20	--
Zinc	4/19/2017	4/21/2017	4/21/2017	JA0419171	20.0	19.4	18.7	97	94	4	80-120	20	--
Mercury	4/19/2017	4/21/2017	4/21/2017	JA0419172	1.00	1.05	1.08	105	108	3	80-120	20	--

Data Qualifier Definitions

Qualifier

M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.

22942-024	6010B	Antimony	MS/MSD
22942-024	6010B	Molybdenum	MS/MSD
22942-024	6010B	Thallium	MS/MSD

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22942-024	6010B	Arsenic	MS/MSD
22942-024	6010B	Chromium	MS/MSD
22942-024	6010B	Lead	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22942
Page 1 of 4

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson - Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Rd
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Openspace Park
NUMBER: 108246002
ADDRESS:
P.O. #:
SAMPLED BY: JM

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE: Arsenic	REMARKS/PRECAUTIONS
BMT-25	1	4/14/17	0725	Jar	soil	X	
BMT-26	↓	↓	0730	↓	↓	↓	
BMT-27			0735				
BMT-28			0801				
BMT-29			0805				
BMT-30			0810				
BMT-31			0812				
BMT-32			0815				
BMT-33			0823				
BMT-34			0825				
BMT-35			0830				
BMT-36			0835				
BMT-37			0840				
BMT-38			0845				

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By: C Moore	Date/Time: 4/17/17 1445
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup sampl

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22942
Page 2 of 74

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5700 Ruffin Road
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 1082~~4~~6002
ADDRESS:
P.O. #:
SAMPLED BY:

ANALYSIS REQUEST / PRESERVATIVE

REMARKS/PRECAUTIONS: if necc
crush up to
10 samples
then please c
if more nee
T.Hc 22 priorit

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)	Arsenic + Lead	T.Hc 22								REMARKS/PRECAUTIONS
BMT-39			0850			X										
BMT-40			0852			X										
BMT-41			0855			X										
BMT-42			0857			X										
BMT-43			0900			X										
BMT-44			0905			X										
BMT-45			0907			X										
BMT-46			0910			X										
BMT-47			0915			X										
BMT-48			0917					X								
BMT-49			0920					X								
BMT-50			0922			X										
BMT-51			0935			X										
BMT-52			0940			X										

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/12/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails t

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22943
Page 3 of 4

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL:
ADDRESS: See Page 1
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME:
NUMBER:
ADDRESS: See page 1
P.O. #:
SAMPLED BY:

ANALYSIS REQUEST / PRESERVATIVE

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)	Arsenic + Lead (6010B)	Title 22 (6010B)								REMARKS/PRECAUTIONS
BMT-53			0943			X										
BMT-54			0945			X										
BMT-55			0950			X										
BMT-56			0952			X										
BMT-57			1000			X										
BMT-58			1005			X										
BMT-59			1015			X										
BMT-60			1017			X										
BMT-61			1020			oc		X								
BMT-62			1022					X								
BMT-63			1025				X									
BMT-64			1030					X								
BMT-65			1032					X								
BMT-~~66~~ 67 oc			1035					X								

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By: Date/Time:
Received By: Date/Time: 4/09 11:45

Relinquished By: Date/Time:
Received By: Date/Time:

Relinquished By: Date/Time:
Received For Lab By: Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22943
Page ~~2~~4 of ~~3~~4

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson Beck
EMAIL: ~~Be~~ Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
PHONE:
FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open space park
NUMBER: 108246002
ADDRESS:
P.O. #:
SAMPLED BY:

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)	Arsenic + Lead	Title 22								REMARKS/PRECAUTIONS
BMT-6~~7~~6			1040					X								
BMT-68			~~1041~~ 1045					X								
BMT-69			~~1045~~ 1042					X								
BMT-70			1047					X								
BMT-71			1048				X									
BMT-72			1050				X									
BMT-73			1051			X										
BMT-74			1055			X										
BMT-75			1057			X										
BMT-76			1058			X										
BMT-77			1100			X										
BMT-78			1105			X										
BMT-79			1120			X										
Pothole-23			1130					X								report separately with others

Total No. of Samples:
Method of Shipment:
Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/10/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client.

Sample Receipt Report

Laboratory Reference **NAM 22942A**

Logged in by CT

Received: 04/17/17 11:45

Method of Shipment: Lab Pick-Up

Shipping Container: Cooler

Shipping Containers: 1

Company Name: Ninyo & Moore

Project Manager: Ms. Beth Abramson-Beck

Project Name: Black Mt Open Space Park

Project #: 108246002

Sample Quantity

1 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	5°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ________ By ________ On ________

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client: Ninyo & Moore

Laboratory Reference: NAM 22935A

Project Name: Black Mt Open Space Park

Project Number: 108246002

Date Received: 4/12/2017

Date Reported: 4/21/2017

Chain of Custody Received: ☑

Analytical Method: 6010B, SM4500-CN E,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935A
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935A
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Concrete roaster wipe-01	22935-010	4/12/2017	4/10/2017	Wipe
Dust flume east end wipe-02	22935-012	4/12/2017	4/10/2017	Wipe
Flume west wall 3rd opening wipe-03	22935-014	4/12/2017	4/10/2017	Wipe
Flume west wall 8th opening wipe-04	22935-015	4/12/2017	4/10/2017	Wipe
Flume ceiling 15th opening wipe-06	22935-016	4/12/2017	4/10/2017	Wipe
Flume west wall 23rd opening wipe-07	22935-018	4/12/2017	4/10/2017	Wipe
Flume west wall 30th opening wipe-08	22935-019	4/12/2017	4/10/2017	Wipe
Cyanide vat 1 wipe-09	22935-021	4/12/2017	4/10/2017	Wipe
Roaster M12 wipe-10	22935-023	4/12/2017	4/10/2017	Wipe
Cyanide vat 4 wipe-11	22935-025	4/12/2017	4/10/2017	Wipe

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935A
Project Name: Black Mt Open Space Park
Project #: 108246002

Inorganics

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Cyanide vat 1 wipe-09	22935-021	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Cyanide, Total	SM4500-CN E	<1	µg/wipe	4/19/2017	4/19/2017	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Cyanide vat 4 wipe-11	22935-025	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Cyanide, Total	SM4500-CN E	<1	µg/wipe	4/19/2017	4/19/2017	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Water

ANALYTE	MB ID	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Cyanide, Total	MBSLN041917	SM4500-CN E	<1	µg/wipe	4/19/2017	4/19/2017	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Concrete roaster wipe-01	22935-010	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	48	µg/wipe	04/13/17	04/14/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Dust flume east end wipe-02	22935-012	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	99	µg/wipe	04/13/17	04/14/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume west wall 3rd opening wipe-03	22935-014	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	980	µg/wipe	04/13/17	04/18/17	D2,	2

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume west wall 8th opening wipe-04	22935-015	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	220	µg/wipe	04/13/17	04/14/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume ceiling 15th opening wipe-06	22935-016	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	10	µg/wipe	04/13/17	04/14/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume west wall 23rd opening wipe-07	22935-018	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	65	µg/wipe	04/13/17	04/14/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935A
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume west wall 30th opening wipe-08	22935-019	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	250	µg/wipe	04/13/17	04/14/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Roaster M12 wipe-10	22935-023	4/12/2017	4/10/2017	Wipe

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Arsenic	6010B	110	µg/wipe	04/13/17	04/14/17	--	1

Method Blank — Wipe

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0413171	Arsenic	6010B	<0.50	mg/kg	04/13/17	04/14/17	--	1

QA/QC Report
for Inorganics

Reference #: NAM 22935A Reporting units: mg/L

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Cyanide, Total	4/19/2017	4/19/2017	4/19/2017	SLN0419171	0.100	0.0942	0.0884	94	88	6	80-120	20	--

QA/QC Report
for
Metals

Reference #: NAM 22935A

Reporting units: ppm

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Arsenic	4/13/2017	4/14/2017	4/14/2017	JA0413171	20.0	16.2	16.4	81	82	1	80-120	20	--

Data Qualifier Definitions

Qualifier

D2 = Sample required dilution due to high concentration of target analyte.

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 1 of 3

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo and Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
San Diego CA
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108246002
ADDRESS:
P.O.#: 108246002
SAMPLED BY: BMC / BAB

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 metals (6010)	Arsenic (6010B)	Cyanide (9014)	Arsenic (Osha 105 [illegible])								REMARKS/PRECAUTIONS
1	Range adit - 01	1	4/10/17	0945	Soil	Jar		X										Please report wipe samples together or on separate report
2	Range tailings - 02	1	"	0950	"	"	X											
3	Glory hole tailings - 03			1015	↓	↓		X										
4	Hobbit hole tailings - 04			1035				X										
5	Hobbit hole tailings - 05			1040			X											
6	Koala adit soil - 06			1100			X											
7	Koala adit tailings - 07			1107			X											
8	Canyon tailings - 08			1117				X										
9	Concrete roaster? soil - 09			1127				X										
10	Concrete roaster? wipe - 01			1135		wipe		[illegible]		X								
11	tailings south dust flume - 10			1147	soil	jar	X											
12	dust flume east end wipe 02			1153		wipe		[illegible]		X								
13	flume soil 3rd opening - 11			1214	soil	jar												
14	flume west wall 3rd opening wipe 03			1215		wipe		[illegible]		X								

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: Mark Nomi OCA, CA	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 2 of 3

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ✓ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION	**PROJECT INFORMATION**
COMPANY: Ninyo & Moore	PROJECT NAME: Black Mountain Open Space Park
SEND REPORT TO: Beth Abramson-Beck	NUMBER: 108246002
EMAIL: Babramsonbeck@ninyoandmoore.com	ADDRESS:
ADDRESS: 5710 Ruffin Road	
San Diego CA	P.O. #: 108246002
PHONE: 858 576-1000 FAX: 858-576-9600	SAMPLED BY: BMC / BAB

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 metals (6010)	Arsenic (6010B)	Cyanide (9014)	Arsenic (Osha 105 - Analytics)
15	Flume east wall 8th opening wipe -04	1	4/10/17	1219	wipe →					X
16	Flume ceiling 15th opening wipe -06	↓	↓	1227	" →					X
17	Flume soil 15th opening -12			1225	jar →		X			
18	Flume west wall 23rd opening wipe -07			1237	wipe					X
19	Flume west wall 30th opening wipe -08			1240		wipe				X
20	Flume east end soil -13			1250	soil	jar		X		
21	Cyanide vat 1 wipe -09			1300		wipe			X	
22	Rock crusher M4 soil -14			1320	soil	jar	X			
23	Roaster M12 wipe -10			1311		wipe				X
24	East of cyanide vat 1 -15			1327	soil	jar		X		
25	Cyanide vat 4 wipe -11	↓	↓	1340		wipe			X	
	temp blank									

REMARKS/PRECAUTIONS

Please repo
wipe samp
in seperate r
or ~~to~~ grouped
toget

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: OCAL	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due withi 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup samp

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. *www.ocalab.com*

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 2 of 3

REQUIRED TURN AROUND TIME: Standard: ______ 72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION	**PROJECT INFORMATION**
COMPANY: Ninyo & Moore	PROJECT NAME: Black Mt Open Space Park
SEND REPORT TO: Beth Abramson Beck	NUMBER:
EMAIL: Babramsonbeck@ninyoandmoore.com	ADDRESS:
ADDRESS: 5710 Ruffin Road	
	P.O. #:
PHONE: 858 576-1000 FAX:	SAMPLED BY:

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE: TTLC 22 metals (6010B)	Arsenic (6010B)									REMARKS/PRECAUTIONS
26	Drainage ravine -16	1	4/10/17	1345	Soil	Jar	X										
27	Cyanide trail soil -17	"	"	1350	Soil	Jar	X										
28	Pit mine tailings soil -18	"	"	1410	"	"		X									
29	trail crossing 10 cm - 19	"	"	1434	"	"	X										

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: Mark Norris OCA, LA	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon, in writing, with Orange Coast Analytical, Inc. All samples remain the property of the client. A disposal fee may be imposed if client fails to pickup samples

Sample Receipt Report

Laboratory Reference **NAM 22935**

Logged in by MM

Received: 04/12/17 10:15

Method of Shipment: Lab Pick-Up

Shipping Container: Cooler

Shipping Containers: 1

Company Name: Ninyo & Moore

Project Manager: Ms. Beth Abramson-Beck

Project Name: Black Mt Open Space Park

Project #: 108246002

Sample Quantity
19 Soil

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Temperature	3°C		
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ________ By ________ On ________

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client: Ninyo & Moore

Laboratory Reference: NAM 22935B

Project Name: Black Mt Open Space Park

Project Number: 108246002

Date Received: 5/9/2017

Date Reported: 5/18/2017

Chain of Custody Received: ☑

Analytical Method: 6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck	Lab Reference #: NAM 22935B
Ninyo & Moore	Project Name: Black Mt Open Space Park
475 Goddard Ste 200	Project #: 108246002
Irvine, CA, 92618	

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935B
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Ranga tailings-02	22935-002	4/12/2017	4/10/2017	Soil
Hobbit hole tailings-04	22935-004	4/12/2017	4/10/2017	Soil
Hobbit hole tailings-05	22935-005	4/12/2017	4/10/2017	Soil
Tailings south of dust flume-10	22935-011	4/12/2017	4/10/2017	Soil
Flume soil 3rd opening-11	22935-013	4/12/2017	4/10/2017	Soil
Flume soil 5th opening-12	22935-017	4/12/2017	4/10/2017	Soil
Rock Crusher M4 soil-14	22935-022	4/12/2017	4/10/2017	Soil
Drainage Varve-16	22935-026	4/12/2017	4/10/2017	Soil
Cyanide trail soil-17	22935-027	4/12/2017	4/10/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Ranga tailings-02	22935-002	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.98	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.021	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Hobbit hole tailings-04	22935-004	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	1.2	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Hobbit hole tailings-05	22935-005	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	1.7	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.037	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Tailings south of dust flume-10	22935-011	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	1.9	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.039	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume soil 3rd opening-11	22935-013	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	1.8	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.038	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	<0.080	mg/l	05/16/17	05/17/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Flume soil 5th opening-12	22935-017	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	1.0	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.022	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	<0.080	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Rock Crusher M4 soil-14	22935-022	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	12	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.25	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	0.12	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Drainage Varve-16	22935-026	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.59	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.013	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Cyanide trail soil-17	22935-027	4/12/2017	4/10/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Antimony	6010B	<0.20	mg/l	05/16/17	05/17/17	--	1
SPLP Arsenic	6010B	5.7	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.12	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	<0.080	mg/l	05/16/17	05/17/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22935B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0516173	SPLP Antimony	6010B	<0.20	mg/kg	05/16/17	05/17/17	--	1
MBJA0516173	SPLP Arsenic	6010B	<0.020	mg/kg	05/16/17	05/17/17	--	1
MBJA0516173	SPLP Cadmium	6010B	<0.0080	mg/kg	05/16/17	05/17/17	--	1
MBJA0516173	SPLP Lead	6010B	<0.080	mg/kg	05/16/17	05/17/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22935B

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

6010B

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
SPLP Antimony	5/16/2017	5/17/2017	5/17/2017	22935-002	0.00	0.400	0.402	0.380	100	95	6	75-125	20	--
SPLP Arsenic	5/16/2017	5/17/2017	5/17/2017	22935-002	0.980	0.400	1.30	1.27	80	72	2	75-125	20	M3,
SPLP Cadmium	5/16/2017	5/17/2017	5/17/2017	22935-002	0.0210	0.400	0.403	0.393	95	93	3	75-125	20	--
SPLP Lead	5/16/2017	5/17/2017	5/17/2017	22935-002	0.00	0.400	0.391	0.389	98	97	1	75-125	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
SPLP Antimony	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.415	0.403	104	101	3	80-120	20	--
SPLP Arsenic	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.376	0.389	94	97	3	80-120	20	--
SPLP Cadmium	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.403	0.403	101	101	0	80-120	20	--
SPLP Lead	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.417	0.420	104	105	1	80-120	20	--

Data Qualifier Definitions

Qualifier

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22935-002	6010B	SPLP Arsenic	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 1 of 3

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION	
COMPANY:	Ninyo and Moore
SEND REPORT TO:	Beth Abramson-Beck
EMAIL:	Babramsonbeck@ninyoandmoore
ADDRESS:	5710 Ruffin Road San Diego CA
PHONE:	858 576-1000
FAX:	

PROJECT INFORMATION	
PROJECT NAME:	Black Mt Open Space Park
NUMBER:	108246002
ADDRESS:	
P.O. #:	108246002
SAMPLED BY:	BMC / BAB

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 metals (6010B)	Arsenic (6010B)	Cyanide (9014)	Arsenic (Osha 105 or [illegible])	Soluble Arsenic	Soluble As + Cd	Soluble As + Pb	Soluble As + Cd + Pb	Soluble As + Cd + Pb + Sb	Soluble As + Cd + Pb + Hg	Soluble As + Cd + Pb + Zn
1	Range adit - 01	1	4/10/17	0945	Soil	jar		X									
2	Range tailings - 02	1	"	0950	"	"	X					X					
3	Glory hole tailings - 03			1015				X									
4	Hobbit hole tailings - 04			1035				X			X						
5	Hobbit hole tailings - 05			1040			X					X					
6	Koala adit soil - 06			1100			X										
7	Koala adit tailings - 07			1107			X										
8	Canyon tailings - 08			1117				X									
9	Concrete roaster? soil - 09			1127	↓	↓		X									
10	Concrete roaster? wipe - 01			1135		wipe				X							
11	tailings south dust flume - 10			1147	soil	jar	X					X					
12	dust flume east end wipe 02			1153		wipe				X							
13	flume soil 3rd opening - 11			1214	soil	jar								X			
14	flume west wall 3rd opening wipe 03			1215		wipe				X							

- report samples either w an [illegible] report

REMARKS/PRECAUTIONS

Please analyze the following ☒ by 05.09.17 SPLP

Total No. of Samples:
Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time: 4-12-17 1015	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By: Mark Noori OCA, CA	Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT - Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc.

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 2 of 3

REQUIRED TURN AROUND TIME: Standard: ______
[✓ 72 Hours] 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
San Diego CA
PHONE: 858 576 1000 FAX: 858-576-9600

PROJECT INFORMATION

PROJECT NAME: Black Mountain Open Space Park
NUMBER: 108246002
ADDRESS:
P.O. #: 108246002
SAMPLED BY: BMC/BAB

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Title 22 metals (6010)	Arsenic (6010B)	Cyanide (9014)	Arsenic (Osha 105	Soluble Arsenic	Soluble As+Cd	Soluble As+Pb	Soluble As+Cd+Pb	Soluble As+Cd+Pb+Sb	Soluble As+Cd+Pb+Hg	Soluble As+Cd+Pb+Zn	REMARKS/PRECAUTIONS
15	Flume east wall 8th opening wipe -04	1	4/10/17	1219	wipe	→				X								
16	Flume ceiling 15th opening wipe -06	↓	↓	1227	"	→				X								
17	Flume soil 15th opening -12			1225	jar	→	X							X				
18	Flume west wall 23rd opening wipe -07			1237	wipe	"				X								
19	Flume west wall 30th opening wipe -08			1240		wipe				X								
20	Flume east end soil -13			1250	soil	jar		X										
21	Cyanide vat 1 wipe -09			1300		wipe			X									
22	Rock crusher M4 soil -14			1320	soil	jar	X							X				
23	Booster M2 wipe -10			1311		wipe				X								
24	East of cyanide vat 1 -15			1327	soil	jar		X										
25	Cyanide vat 4 wipe -11			1340		wipe			X									
	Temp blank																	

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Total No. of Samples:
Method of Shipment:
Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:
Date/Time: 4-12-17 1015
Received By:
Date/Time:

Relinquished By:
Date/Time:
Received By:
Date/Time:

Relinquished By:
Date/Time:
Received For Lab By: OCA
Date/Time: 4-12-17 1015

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due withi
30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc. All samples remain the property of the client.

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22935
Page 2 of 3

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson Beck
EMAIL: Babramsonbeck@ninyo and moore
ADDRESS: 5710 Ruffin Road
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER:
ADDRESS: 7/11
P.O. #:
SAMPLED BY:

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Title 22 metals (6010B)	Arsenic (6010B)		Soluble Arsenic	Soluble As+Cd	Soluble As+Pb	Soluble As+Cd+Pb	Soluble As+Cd+Pb+Sb	Soluble As+Cd+Pb+Hg	Soluble As+Cd+Pb+Zn	REMARKS/PRECAUTIONS
26	Drainage ravine -16	1	4/10/17	1345	Soil	Jar	X					X						
27	Cyanide trail soil -17	"	"	1350	Soil	Jar	X								X			
28	Pit mine tailings soil -18	"	"	1410	"	"		X										
29	trail crossing 10 -19	"	"	1434	"	"	X											

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By: Date/Time: 4-12-17 1015
Received By: Date/Time:

Relinquished By: Date/Time:
Received By: Date/Time:

Relinquished By: Date/Time:
Received For Lab By: Mark [illegible] OCA/LA Date/Time: 4-12-17 1015

Sample Matrix:
~~DW - Drinking Water~~
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc. All samples remain the

From: "Mark Noorani" <markn@ocalab.com>
Date: Tuesday, May 09, 2017 9:40 AM
To: "Orange Coast Analytical" <ocalab@sbcglobal.net>
Attach: 4946_001.pdf
Subject: Fwd: Additional analyses SPLP

-------- Original Message --------

Subject: Additional analyses SPLP
Date:2017-05-09 09:34
From: Beth Abramson-Beck <babramsonbeck@ninyoandmoore.com>
To: Mark Noorani <markn@ocalab.com>
Cc: Eric Cathcart <cathcart@sandiego.edu>, Bethany O'Shea <bethoshea@sandiego.edu>, Brianne Cortright <bcortright@ninyoandmoore.com>

Good morning Mark,

Could you please additionally analyze the following samples by Synthetic Precipitation Leaching Procedure (SPLP) as indicated with a blue X and highlighted yellow.

Also, would you please provide me the cost for these additional analyses? You already provided a cost to conduct soluble testing for arsenic and arsenic+lead; however, not sure of costs for those samples with more than two soluble tests.

As previously mentioned, we need to obtain all the remaining samples as soon as possible. Can these be dropped off when you come down here for a sample pickup?

Thank you!

Beth S.Abramson-Beck, PG 4580

Principal Geologist

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

(858) 576-1000 (San Diego) | (949) 753-7070 (Irvine) | (909) 758-3900 (Rancho Cucamonga)

babramsonbeck@ninyoandmoore.com

30 Years of Quality Service

--

Mark Noorani | Laboratory Director
Orange Coast Analytical, Inc.
3002 Dow Ave. Ste. 532 Tustin, CA, 92780
Office: 714-832-0064   480-736-0960
markn@ocalab.com

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3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
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LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 22941B
Project Name:	Black Mt Open Space Park
Project Number:	108246002
Date Received:	5/9/2017
Date Reported:	5/18/2017
Chain of Custody Received:	☑
Analytical Method:	6010B, 7471A,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941B
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 3ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941B
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-01	22941-001	4/17/2017	4/12/2017	Soil
Processed Slurry SEM12-20	22941-026	4/17/2017	4/12/2017	Soil
Downslope M12-21	22941-027	4/17/2017	4/12/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22941B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-01	22941-001	4/17/2017	4/12/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.036	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Processed Slurry SEM12-20	22941-026	4/17/2017	4/12/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	6.5	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.13	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	0.32	mg/l	05/16/17	05/17/17	--	1
SPLP Mercury	7470A	<0.010	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Downslope M12-21	22941-027	4/17/2017	4/12/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	7.2	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.15	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	<0.080	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0516173	SPLP Arsenic	6010B	<0.020	mg/L	05/16/17	05/17/17	--	1
MBJA0516173	SPLP Cadmium	6010B	<0.0080	mg/L	05/16/17	05/17/17	--	1
MBJA0516173	SPLP Lead	6010B	<0.080	mg/L	05/16/17	05/17/17	--	1
MBJA0516171	SPLP Mercury	7470A	<0.010	mg/L	05/16/17	05/17/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22941B

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD) **6010B/7471A**

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
SPLP Arsenic	5/16/2017	5/17/2017	5/17/2017	22935-002	0.980	0.400	1.30	1.27	80	72	2	75-125	20	M3,
SPLP Cadmium	5/16/2017	5/17/2017	5/17/2017	22935-002	0.0210	0.400	0.403	0.393	95	93	3	75-125	20	--
SPLP Lead	5/16/2017	5/17/2017	5/17/2017	22935-002	0.00	0.400	0.391	0.389	98	97	1	75-125	20	--
SPLP Mercury	5/16/2017	5/17/2017	5/17/2017	22941-026	0.00	0.0500	0.0512	0.0510	102	102	0	80-120	20	--

Laboratory Control Sample

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
SPLP Mercury	5/16/2017	5/17/2017	5/17/2017	JA0516171	0.0500	0.0537	0.0542	107	108	1	80-120	20	--
SPLP Arsenic	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.376	0.389	94	97	3	80-120	20	--
SPLP Cadmium	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.403	0.403	101	101	0	80-120	20	--
SPLP Lead	5/16/2017	5/17/2017	5/17/2017	JA0516173	0.400	0.417	0.420	104	105	1	80-120	20	--

Data Qualifier Definitions

Qualifier

M3 = The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to spike level. The associated blank spike recovery was acceptable.

22935-002	6010B	SPLP Arsenic	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22941
Page 1 of 2

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS:
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108246002
ADDRESS: 5710 Ruffin Road
P.O. #:
SAMPLED BY:

ANALYSIS REQUEST / PRESERVATIVE

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic 6010B				Soluble Arsenic						REMARKS/PRECAUTIONS
BMT-01	1	4/17/17	0737	Soil	Jar	X				X						
BMT-02			0744			X										
BMT-03			0750			X										
BMT-04			0755			X										
BMT-05			0758			X										
BMT-06			0804			X										
BMT-07			0807			X										
BMT-08			0812			X										
BMT-09			0820			X										
BMT-10			0825			X										
BMT-11			0830			X										
BMT-12			0837			X										
BMT-13			0845			X										
BMT-14	↓	↓	0847	↓	↓	X										

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 22941
Page 2 of 2

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ✓ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO:
EMAIL:
ADDRESS: See Page 1
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME:
NUMBER:
ADDRESS:
P.O. #:
SAMPLED BY:

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Title 22 Mtls (6010B)	Arsenic (6010B)	Lead	Soluble arsenic	Soluble As+Cd	Soluble As+Pb	Soluble As+Cd+Pb	Soluble As+Cd+Pb+Sb	Soluble As+Cd+Pb+Hg	Soluble As+Cd+Pb+Zn	REMARKS/PRECAUTIONS
BMT-15	1	4/13/17	0850	Soil	Jar		X										
BMT-16	↓	↓	0855	↓	↓		X										
BMT-17	↓	↓	0927	↓	↓		X										
BMT-18	↓	↓	0930	↓	↓		X										
BMT-19	↓	↓	0935	↓	↓		X										
BMT-20	↓	↓	0945	↓	↓		X										
BMT-21	↓	↓	0955	↓	↓		X										
BMT-22	↓	↓	1000	↓	↓		X										
BMT-23	↓	↓	1006	↓	↓		X										
BMT-24	↓	↓	1015	↓	↓		X										
~~BMT-~~																	
Pit Mine 2-22	↓	↓	1030	x	↓		x										
Processed slurry SE/M12-20	↓	4/12/17	1005	x	↓	X									X		
Downslope M12-21	↓	↓	1020	x	↓	X							X				

Total No. of Samples: Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 11:45	Sample Matrix:	
				DW - Drinking Water	WW - Wastewater
Relinquished By:	Date/Time:	Received By:	Date/Time:	GW - Groundwater	SS - Soil/Solid
					OT- Other
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:	Sample Integrity:	
				Intact ______	On Ice ✓ 3 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within

Orange Coast Analytical

From: "Mark Noorani" <markn@ocalab.com>
Date: Tuesday, May 09, 2017 9:40 AM
To: "Orange Coast Analytical" <ocalab@sbcglobal.net>
Attach: 4946_001.pdf
Subject: Fwd: Additional analyses SPLP

-------- Original Message --------

Subject: Additional analyses SPLP
Date:2017-05-09 09:34
From: Beth Abramson-Beck <babramsonbeck@ninyoandmoore.com>
To: Mark Noorani <markn@ocalab.com>
Cc: Eric Cathcart <cathcart@sandiego.edu>, Bethany O'Shea <bethoshea@sandiego.edu>, Brianne Cortright <bcortright@ninyoandmoore.com>

Good morning Mark,

Could you please additionally analyze the following samples by Synthetic Precipitation Leaching Procedure (SPLP) as indicated with a blue X and highlighted yellow.

Also, would you please provide me the cost for these additional analyses? You already provided a cost to conduct soluble testing for arsenic and arsenic+lead; however, not sure of costs for those samples with more than two soluble tests.

As previously mentioned, we need to obtain all the remaining samples as soon as possible. Can these be dropped off when you come down here for a sample pickup?

Thank you!

Beth S.Abramson-Beck, PG 4580

Principal Geologist

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

(858) 576-1000 (San Diego) | (949) 753-7070 (Irvine) | (909) 758-5960 (Rancho Cucamonga)

babramsonbeck@ninyoandmoore.com

30 Years of Quality Service

--

Mark Noorani | Laboratory Director
Orange Coast Analytical, Inc.
3002 Dow Ave. Ste. 532 Tustin, CA, 92780
Office: 714-832-0064   480-736-0960
markn@ocalab.com

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.: 2576
Expiration Date: 2017
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:

Mark Noorani

Client:	Ninyo & Moore
Laboratory Reference:	NAM 22942B
Project Name:	Black Mt Open Space Park
Project Number:	108246002
Date Received:	5/9/2017
Date Reported:	5/19/2017
Chain of Custody Received:	☑
Analytical Method:	6010B,

Mark Noorani

Mark Noorani, Laboratory Director

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942B
Project Name: Black Mt Open Space Park
Project #: 108246002

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 5ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942B
Project Name: Black Mt Open Space Park
Project #: 108246002

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-48	22942-024	4/17/2017	4/14/2017	Soil
BMT-49	22942-025	4/17/2017	4/14/2017	Soil
BMT-62	22942-038	4/17/2017	4/14/2017	Soil
BMT-63	22942-039	4/17/2017	4/14/2017	Soil
BMT-64	22942-040	4/17/2017	4/14/2017	Soil
BMT-65	22942-041	4/17/2017	4/14/2017	Soil
BMT-67	22942-042	4/17/2017	4/14/2017	Soil
BMT-66	22942-043	4/17/2017	4/14/2017	Soil
BMT-68	22942-044	4/17/2017	4/14/2017	Soil
BMT-69	22942-045	4/17/2017	4/14/2017	Soil
BMT-70	22942-046	4/17/2017	4/14/2017	Soil
BMT-71	22942-047	4/17/2017	4/14/2017	Soil
BMT-72	22942-048	4/17/2017	4/14/2017	Soil
Pothole-23	22942-056	4/17/2017	4/14/2017	Soil

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-48	22942-024	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.073	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-49	22942-025	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.053	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-62	22942-038	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.029	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-63	22942-039	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.075	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-64	22942-040	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.39	mg/l	05/16/17	05/17/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-65	22942-041	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	2.6	mg/l	05/16/17	05/17/17	--	1
SPLP Cadmium	6010B	0.060	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	<0.080	mg/l	05/16/17	05/17/17	--	1
SPLP Zinc	6010B	0.11	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-67	22942-042	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.11	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-66	22942-043	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.31	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-68	22942-044	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.11	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-69	22942-045	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	<0.020	mg/l	05/16/17	05/17/17	--	1

Ms. Beth Abramson-Beck
Ninyo & Moore
475 Goddard Ste 200
Irvine, CA, 92618

Lab Reference #: NAM 22942B
Project Name: Black Mt Open Space Park
Project #: 108246002

Metals

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-70	22942-046	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.031	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-71	22942-047	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.033	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
BMT-72	22942-048	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	<0.020	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Pothole-23	22942-056	4/17/2017	4/14/2017	Soil

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
SPLP Arsenic	6010B	0.16	mg/l	05/16/17	05/17/17	--	1
SPLP Lead	6010B	0.49	mg/l	05/16/17	05/17/17	--	1

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
Method Blank				Soil

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBJA0516174	Arsenic	6010B	<0.020	mg/kg	05/16/17	05/17/17	--	1
MBJA0516174	Cadmium	6010B	<0.0080	mg/kg	05/16/17	05/17/17	--	1
MBJA0516174	Lead	6010B	<0.080	mg/kg	05/16/17	05/17/17	--	1
MBJA0516174	Zinc	6010B	<0.040	mg/kg	05/16/17	05/17/17	--	1

QA/QC Report
for
Metals

Reference #: NAM 22942B

Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

6010B

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
SPLP Arsenic	5/16/2017	5/17/2017	5/17/2017	22942-025	0.0530	0.400	0.445	0.414	98	90	7	75-125	20	--
SPLP Cadmium	5/16/2017	5/17/2017	5/17/2017	22942-025	0.00	0.400	0.398	0.375	100	94	6	75-125	20	--
SPLP Lead	5/16/2017	5/17/2017	5/17/2017	22942-025	0.00	0.400	0.411	0.384	103	96	7	75-125	20	--
SPLP Zinc	5/16/2017	5/17/2017	5/17/2017	22942-025	0.00	0.400	0.422	0.396	105	99	6	75-125	20	--

Laboratory Control Sample

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
SPLP Arsenic	5/16/2017	5/17/2017	5/17/2017	JA0516174	0.400	0.388	0.404	97	101	4	80-120	20	--
SPLP Cadmium	5/16/2017	5/17/2017	5/17/2017	JA0516174	0.400	0.402	0.415	100	104	3	80-120	20	--
SPLP Lead	5/16/2017	5/17/2017	5/17/2017	JA0516174	0.400	0.420	0.436	105	109	4	80-120	20	--
SPLP Zinc	5/16/2017	5/17/2017	5/17/2017	JA0516174	0.400	0.417	0.433	104	108	4	80-120	20	--

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Lab Job No: 22942
Page 1 of 4

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson - Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Rd
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Openspace Park
NUMBER: 108246002
ADDRESS:
P.O. #:
SAMPLED BY: JM

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic	Soluble Arsenic	REMARKS/PRECAUTIONS
1	BMT-25	1	4/14/17	0725	Jar	soil	X		
2	BMT-26	↓	↓	0730	↓	↓	↓		
3	BMT-27	↓	↓	0735	↓	↓	↓		
4	BMT-28	↓	↓	0801	↓	↓	↓		
5	BMT-29	↓	↓	0805	↓	↓	↓		
6	BMT-30	↓	↓	0810	↓	↓	↓		
7	BMT-31	↓	↓	0812	↓	↓	↓		
8	BMT-32	↓	↓	0815	↓	↓	↓		
9	BMT-33	↓	↓	0823	↓	↓	↓		
10	BMT-34	↓	↓	0825	↓	↓	↓		
11	BMT-35	↓	↓	0830	↓	↓	↓		
12	BMT-36	↓	↓	0835	↓	↓	↓		
13	BMT-37	↓	↓	0840	↓	↓	↓		
14	BMT-38	↓	↓	0845	↓	↓	↓		

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 1445p
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ______ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
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Lab Job No: 22942
Page 2 of 34

REQUIRED TURN AROUND TIME: Standard: ____
72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL: Babramsonbeck@ninyoandmoore.com
ADDRESS: 5700 Ruffin Road
PHONE: 858 576-1000 FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open Space Park
NUMBER: 108244002
ADDRESS:
P.O. #:
SAMPLED BY:

ANALYSIS REQUEST / PRESERVATIVE

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Arsenic (6010B)		Arsenic + Lead Title 22		Soluble Arsenic						REMARKS/PRECAUTIONS if necca crush up to 10 samples then please c if more nee Title 22 priorit
15	BMT-39			0850			X										
16	BMT-40			0852			X										
17	BMT-41			0855			X										
18	BMT-42			0857			X										
19	BMT-43			0900			X										
20	BMT-44			0905			X										
21	BMT-45			0907			X										
22	BMT-46			0910			X										
23	BMT-47			0915			X										
24	BMT-48			0917					X		X						
25	BMT-49			0920					X		X						
26	BMT-50			0922			X										
27	BMT-51			0935			X										
28	BMT-52			0940			X										

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By: Date/Time:
Received By: Date/Time: 4/12/17 11:45

Relinquished By: Date/Time:
Received By: Date/Time:

Relinquished By: Date/Time:
Received For Lab By: Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 5 °C

By signing above, client acknowledges responsibility for payment of all services requested on this chain of custody form and any additional services provided in support of this project. Payment is due within 30 days of invoice date unless otherwise agreed upon in writing with Orange Coast Analytical, Inc.

Analysis Request and Chain of Custody Record

Lab Job No: ~~22943~~ 22942
Page 3 of 4

ORANGE COAST ANALYTICAL, INC. *www.ocalab.com*

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

REQUIRED TURN AROUND TIME: Standard: ____ 72 Hours: ____ 48 Hours: ____ 24 Hours: ____

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Abramson-Beck
EMAIL:
ADDRESS: See Page 1
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME:
NUMBER:
ADDRESS: See Page 1
P.O. #:
SAMPLED BY:

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Arsenic (6010 B)	Arsenic + Lead (6010B)	Title 22 (6010B)	Soluble Arsenic						Soluble As+Cd + Pot[illegible]	REMARKS/PRECAUTIONS
29	BMT-53			0943			X											
30	BMT-54			0945			X											
31	BMT-55			0950			X											
32	BMT-56			0982			X											
33	BMT-57			1000			X											
34	BMT-58			1005			X											
35	BMT-59			1015			X											
36	BMT-60			1017			X											
37	BMT-61			1020			[illegible]		X									
38	BMT-62			1022					X		X							
39	BMT-63			1025				X			X							
40	BMT-64			1030					X		X							
41	BMT-65			1032					X								X	
42	BMT-~~66~~ 67			1035					X		X							

Total No. of Samples: Method of Shipment: Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time: 4/17/17 11:45
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:

Sample Matrix:
DW - Drinking Water
GW - Groundwater
WW - Wastewater
SS - Soil/Solid
OT- Other

Sample Integrity:
Intact ____ On Ice ✓ 5 °C

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Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

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Tustin, CA 92780
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22942
Lab Job No: ~~22943~~
Page ~~3~~ 4 of ~~3~~ 4

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION

COMPANY: Ninyo & Moore
SEND REPORT TO: Beth Babramson-Beck
EMAIL: Beth Babramsonbeck@ninyoandmoore.com
ADDRESS: 5710 Ruffin Road
PHONE: FAX:

PROJECT INFORMATION

PROJECT NAME: Black Mt Open space park
NUMBER: 108246002
ADDRESS:
P.O. #:
SAMPLED BY:

	SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	ANALYSIS REQUEST / PRESERVATIVE	Arsenic (6010B)	Arsenic Flea…	Title 22	Soluble AS	Soluble As+Cd	Soluble As+Pb	Soluble As+Cd+Pb	Soluble As+Cd+Pb+Sb	Soluble As+Cd+Pb+Hg	Soluble As+Cd+Pb+Zn	REMARKS/PRECAUTIONS
43	BMT-66			1040					X		X							
44	BMT-68			~~1047~~ 1045					X		X							
45	BMT-69			~~1045~~ 1042					X		X							
46	BMT-70			1047					X		X							
47	BMT-71			1048				X			X							
48	BMT-72			1050				X			X							
49	BMT-73			1051			X											
50	BMT-74			1055			X											
51	BMT-75			1057			X											
52	BMT-76			1058			X											
53	BMT-77			1100			X											
54	BMT-78			1105			X											
55	BMT-79			1120			X											
56	Pothole-23			1130					X				X					report separately with others

Total No. of Samples: Method of Shipment: Presorvative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By: Date/Time:
Received By: Date/Time: 4/17/17 11:45

Relinquished By: Date/Time:
Received By: Date/Time:

Relinquished By: Date/Time:
Received For Lab By: Date/Time:

Sample Matrix:
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Sample Integrity:
Intact ______ On Ice ✓ 5 °C

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Orange Coast Analytical

From: "Mark Noorani" <markn@ocalab.com>
Date: Tuesday, May 09, 2017 9:40 AM
To: "Orange Coast Analytical" <ocalab@sbcglobal.net>
Attach: 4946_001.pdf
Subject: Fwd: Additional analyses SPLP

-------- Original Message --------

Subject: Additional analyses SPLP
Date:2017-05-09 09:34
From: Beth Abramson-Beck <babramsonbeck@ninyoandmoore.com>
To: Mark Noorani <markn@ocalab.com>
Cc: Eric Cathcart <cathcart@sandiego.edu>, Bethany O'Shea <bethoshea@sandiego.edu>, Brianne Cortright <bcortright@ninyoandmoore.com>

Good morning Mark,

Could you please additionally analyze the following samples by Synthetic Precipitation Leaching Procedure (SPLP) as indicated with a blue X and highlighted yellow.

Also, would you please provide me the cost for these additional analyses? You already provided a cost to conduct soluble testing for arsenic and arsenic+lead; however, not sure of costs for those samples with more than two soluble tests.

As previously mentioned, we need to obtain all the remaining samples as soon as possible. Can these be dropped off when you come down here for a sample pickup?

Thank you!

Beth S.Abramson-Beck, PG 4580

Principal Geologist

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

(858) 576-1000 (San Diego) | (949) 753-7070 (Irvine) | (909) 758-5960 (Rancho Cucamonga)

babramsonbeck@ninyoandmoore.com

30 Years of Quality Service

--

Mark Noorani | Laboratory Director
Orange Coast Analytical, Inc.
3002 Dow Ave. Ste. 532 Tustin, CA, 92780
Office: 714-832-0064 480-736-0960
markn@ocalab.com

APPENDIX K

Mine Features Recommended for Closure Black Mountain Mine: San Diego, Department of Conservation, Division of Mine Reclamation

Mine Features Recommended for Closure
Black Mountain Mine: San Diego

Prepared for:
Casey Smith
City of San Diego
Open Space Division
202 C Street, 5th Floor MS 5D
San Diego, CA 92102

Prepared by:
Craig Turner
Senior Environmental Scientist

August 2017

STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF MINE RECLAMATION
Abandoned Mine Lands Program
801 K Street, MS 09-06
Sacramento, California 95814

Table of Contents

List of Figures

Introduction

The Abandoned Mined Lands Program (AMLP) of the California Department of Conservation (DOC) performs abandoned mine inventories on public lands around the state. The AMLP prepares reports summarizing the results of inventories at specific locations and provides recommendations for closure of hazardous mine features found on public lands. This report summarizes a field assessment of mine features performed on April 12th, 2017 at a former arsenic mine located on the Black Mountain Open Space Park, owned by the City of San Diego.

Site Description

The abandoned mines feature assessment took place at Black Mountain Open Space Park, owned by the City of San Diego. The 2,350-acre park is located in the Rancho Peñasquitos area of northern San Diego, situated between Camino Del Sur to the west, Peñasquitos Drive to the east, Lusardi Creek to the north and Carmel Mountain Road to the south. Black Mountain Open Space Park is owned and managed by the City of San Diego and is made up of a series of chaparral and sage covered hills, ridges, and canyons. This assessment targeted the historic Black Mountain Mine which is located on the North slope of Black Mountain at an elevation of 1,000 feet. The site was mined for white arsenic (also known as arsenious oxide, arsenious acid or anhydride) in the 1920s. Remnants of the historical Black Mountain Mine still exist onsite. Additional names associated with areas of the historic site include the Ranga, Koala, Glory Hole, and Hobbit Hole mines. The site consists of 2 adits, 1 shallow shaft, 1 incline, 4 excavations, 4 associated mine waste piles, 3 concrete impoundments (cyanide vats), 1 collapsed wooden ore bin, and 3 pieces of production machinery (cyanide dust flue and two ore roasters).

Background

The City of San Diego Park and Recreation Department are conducting a Preliminary Assessment and Site Investigation for the Black Mountain Mine. They also want to assess physical features of this abandoned mine that may be hazardous to the public, and provide recommendations for remediating these. To do this, they requested assistance from the Department of Conservation, Abandoned Mine Lands Program. After contact and coordination, AMLP staff person Craig Turner joined Casey Smith (City of San Diego), Beth Abramson-Beck (Ninyo and Moore - Geotechnical Consultants) and Eric Cathcart (University of San Diego) on a site visit to assess the physical features.

Methods

The inventory was conducted using the AMLP's standard protocol and data collection methodology, which includes office research and preparation, field data collection, and subsequent data entry. In office preparation includes determining areas for inventory using ArcGIS analysis, input from agency partners, or other direction. Once sites are prioritized for inventory, historical information is gathered about the site to gain further knowledge of the extent of mine workings as well as any potential for chemical contamination. Along with historical research, an examination of the most recent aerial photography of the site area is conducted to locate additional potential features not mapped on topographic maps.

The inventory consists of documenting the location and the physical and qualitative characteristics of features on mine sites. Data are collected with a GPS and ESRI Collector Application on an Apple IOS device. All location datum is projected in NAD 1983 Teale Albers. Collected data includes feature type, dimensions, condition, access rank (a scale from 1 to 3, for easy to difficult access to the mine site), hazard rank (a scale from 0 to 3, for no hazard to high hazard for the feature), bat rank (a scale from A to D, bats or bat sign present to no bat habitat), aspect (one of eight compass directions), color and volume of waste rock, and any odor observed. Also collected is a written description of the feature, including a description of the surface area around a feature, subsurface conditions observed from the surface, any hazards, existing remediations, and cultural or biological resources. At least one photo is taken of each feature. Multiple photos are taken for complex features, such as to show the inside of a shaft or adit, the approach or ‘run in’ to an adit, the details of a structure, and the relationship of multiple features to each other. All mining-related features are inventoried and every effort is made to inventory the full site unless an administrative decision to not do so has been made.

Data entry occurs in the office where data is downloaded from Apple IOS units to create a Geo-database using ESRI ArcGIS software. Features are given a Feature Identification Number (Feature ID #) and the feature data are entered into a Microsoft Access database and data from the Geo-database are imported into the same database to create individual records for the mine site and each mine feature. Once entered in the AMLP database, analysis of data can be made to provide further information to partner agencies and facilitate reports to aid in future remediation projects.

Various site conditions influence the recommendation for what type of closure is appropriate for potentially hazardous adits and shafts. These conditions include biological resources present (e.g. bats), cultural resources, competency of bedrock of the opening, height of standing water in wet/dry years, human visitation levels, and the risk of vandalism. During this inventory, underground features were not entered by AMLP staff, which limited information gathering for variables such as bedrock competency. External observations of all visible conditions were made during the inventory and used to make a closure recommendation.

Results and Recommendations

During the abandoned mine inventory for the Black Mountain Mine site visit, 14 mine related features were inventoried, and of those, 14 features were identified as potentially hazardous with a hazard rank of 2 or higher and access rank of 2 or higher. *Note: Two additional features were located by non DOC field staff, and the information sent to DOC (Pothole-23 aka Pit Mine 4, and a small ore roaster). They are included in this report.

The mine features discussed in this field report are only those for which AMLP provided a hazard rank of 2 and above and an access rank of 2 and above. Each of these mine features is identified by a GPS filename, feature type, feature dimensions, closure recommendation, and GPS latitude and longitude coordinates. Feature dimensions are expressed as X (width), Y (height) and Z (depth). Depth is a key determinant of the hazard rank, as well as orientation (horizontal vs. vertical). Because underground features were not entered, some features may have two recommendations that will require further investigation (e.g. internal stability, rock competency) to determine which is the most appropriate. In this report each feature has associated photos with labels describing the documented portion of the feature. The types of remediation considered for the features assessed at the mine site, are described below.

- Bat Gate: This involves installation inside an adit of a stout, angle-iron gate with bat-compatible bar spacing, and would provide a solid, difficult-to-breach closure. The installation might be challenging or not possible, depending on whether the surrounding portal material is stable and competent enough for the gate to be bolted into it. The costs are also higher versus other remediation approaches.

- Culvert Gate: This involves installation of a culvert inside an adit with stout angle-iron bat gate set inside the culvert. The culvert would provide some stabilization to the portal area. As the culverts are typically round, one or two could be put in place depending on the size of the portal. This approach would be less expensive than a full bat gate, but would reduce the size of the portal; this can restrict wildlife access (e.g. bat flyway) and alter airflow and temperature regimes inside the mine. A culvert gate would modify the historical portal area to a greater extent than a bat gate.

- Cupola: This involves installation of an angle iron structure built over a shaft collar. This can include a stabilizing culvert being used vertically, with a cupola/grate on the top. This provides an imposing physical barrier to the shaft feature, making it more difficult to vandalize. A cupola allows bat and other wildlife access, and also preserves the historical aspect of the feature.

- Cable Net: This involves installation of cable netting material to appropriate specs over the opening of an adit or shaft to provide a warning and a barrier to entry, which also maintains the adit or shaft in a mostly unmodified state. However, it can be bypassed if cut or installed incorrectly and might actually encourage visitation by making the feature more visible.

- Fence: Installation of fencing (e.g. smooth wire, barbed wire, chain-link) around a feature can provide a warning and a barrier to entry. Warning signage could provide additional information about the dangers of underground mine workings. This is a relatively inexpensive and typically easily-installed option, which maintains the adit or shaft in an unmodified state. However, it can be easily bypassed and might actually encourage visitation by making the feature more visible.

- PUF (Polyurethane Foam): The adit or shaft could be closed with expanding polyurethane foam (PUF), including an appropriate cover (e.g. soil, concrete) over the foam, to seal the opening from entry. This would provide a permanent closure. However, this would have some impact on the cultural resource, and possibly on biological resources, if they are present. *Note: Foam is technically not considered a permanent closure type, as it could be cut out or burnt out if needed or through vandalism.

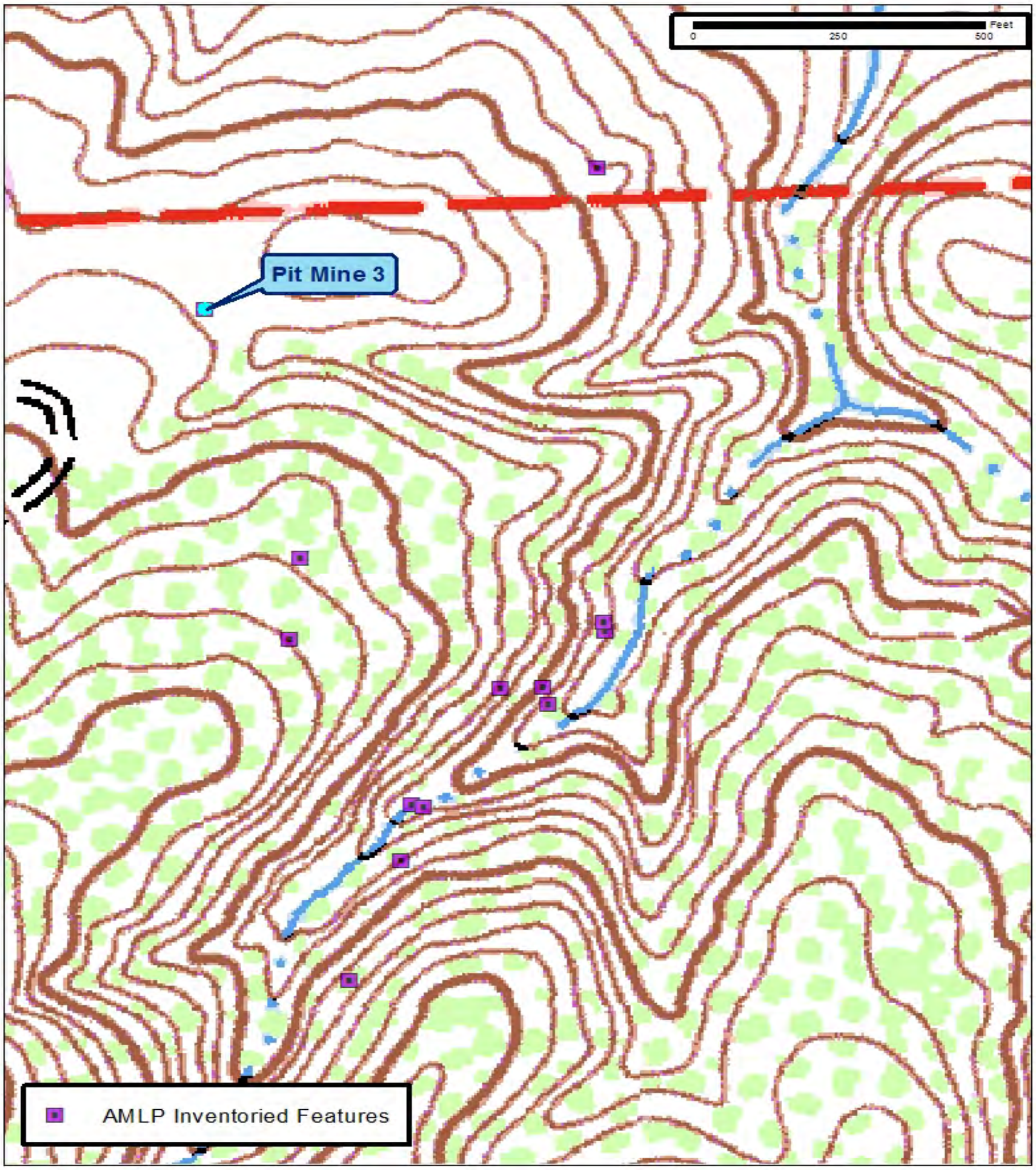
- Backfill: The adit could be closed by backfilling or collapsing of the portal area. This would provide a permanent closure. However, this would also impact the cultural and biological resources, and would require heavy equipment activity to and on site.

Summary

Figures 1 through 14 present the location and a brief description and table summarizing key information associated with each feature assessed at Black Mountain Open Space Park. With information from the DOC assessment of physical safety hazards, the city can then perform any required surveys (e.g. biological, cultural) and develop any necessary environmental documentation to implement remediation of hazardous openings. DOC can also assist with specifications and example cost estimates for the various types of closures recommended.

Pit Mine 3 (Feature ID # 72773)

<u>Figure 1:</u> Pit Mine 3.



This feature consists of an excavation pit cut into upper hillside. It is seasonally flooded with up to four feet of water. The following photos and table identify the hazard that was found at time of inventory and the recommended type of remediation.

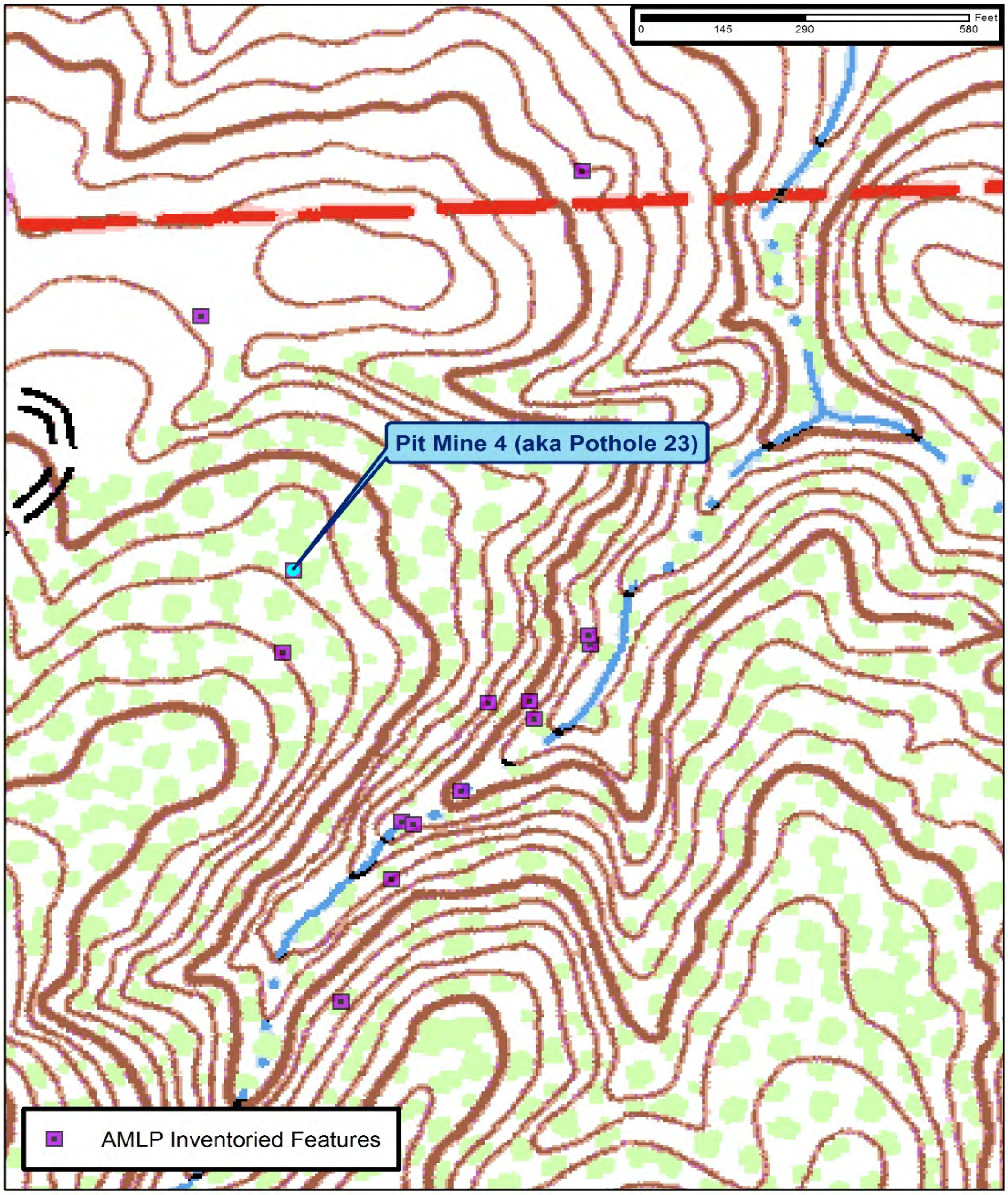
Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Excavation Pit	72773	32.9925709847, -117.1130645984	15’x50’x10’	Fence and sign or backfill

Excavation pit with water.

*Note: This is good wildlife habitat. If fencing, use smooth wire fencing and consider large mammal access in fence design.

Pit Mine 4 (aka Pothole 23) (Feature Id # 72791)

<u>Figure 2:</u> Pit mine 4.



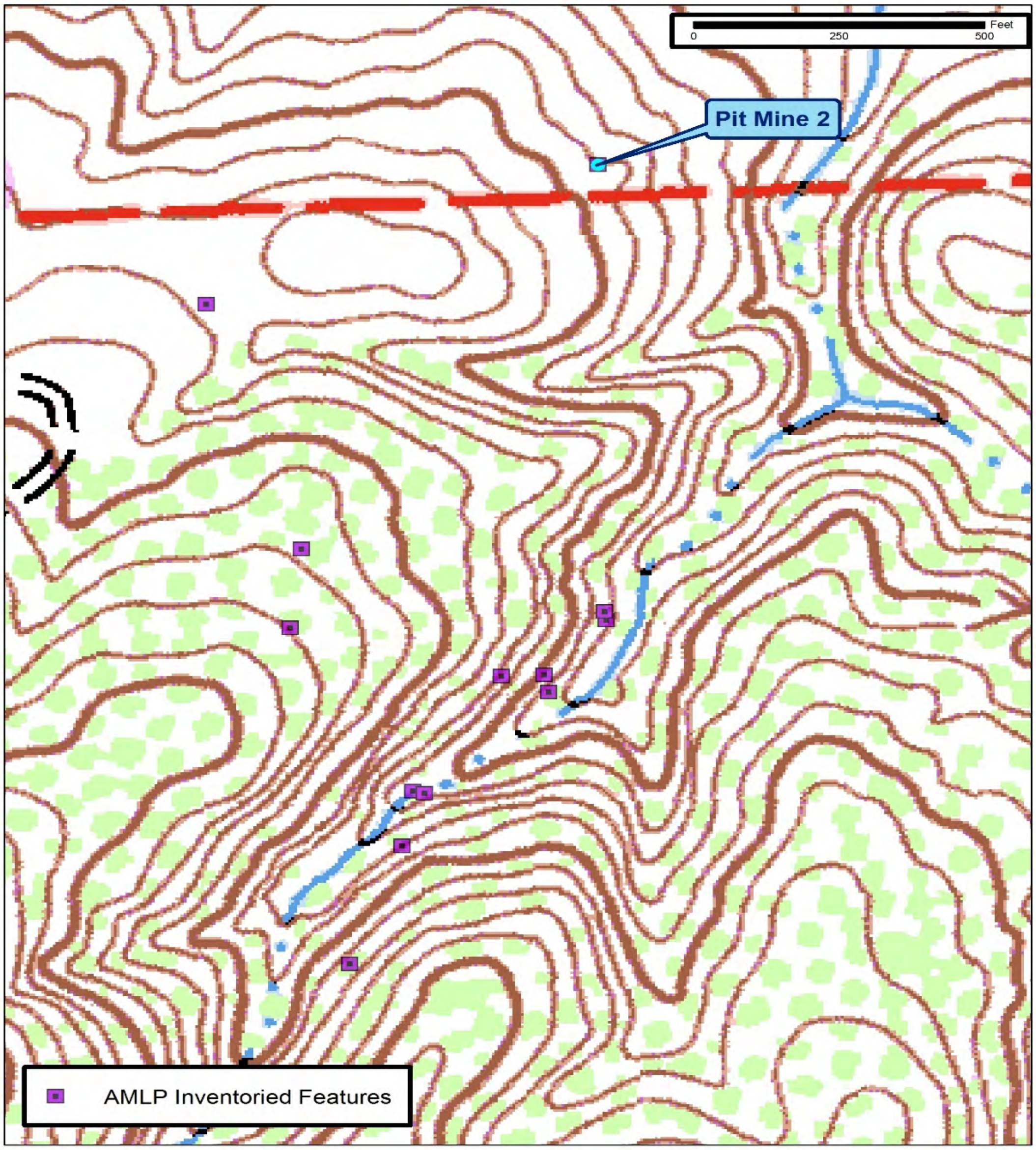
This feature is an excavation trench dozer/machine cut. Gently sloping edges surrounded by thick vegetation. The following photo and table identify the hazard that was found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Excavation Pit	# 72791	32.991181, -117.112590	10’x15’x5’	Fence and sign or backfill.

Pit Mine 4 (Pothole-23)

Pit Mine 2 (Feature Id # 72790)

Figure 3: **Pit Mine 2.**



This feature is an excavation trench cut trending east-west. Dozer/machine cut. Filled with 3 feet of water with aquatic plants. Old wooden dock at western end. The following photo and table identify the hazard that was found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Excavation Pit	# 72790	32.9932939845928, -117.110840932215	15’x40’x10’	Fence and sign. Remove wooden dock.

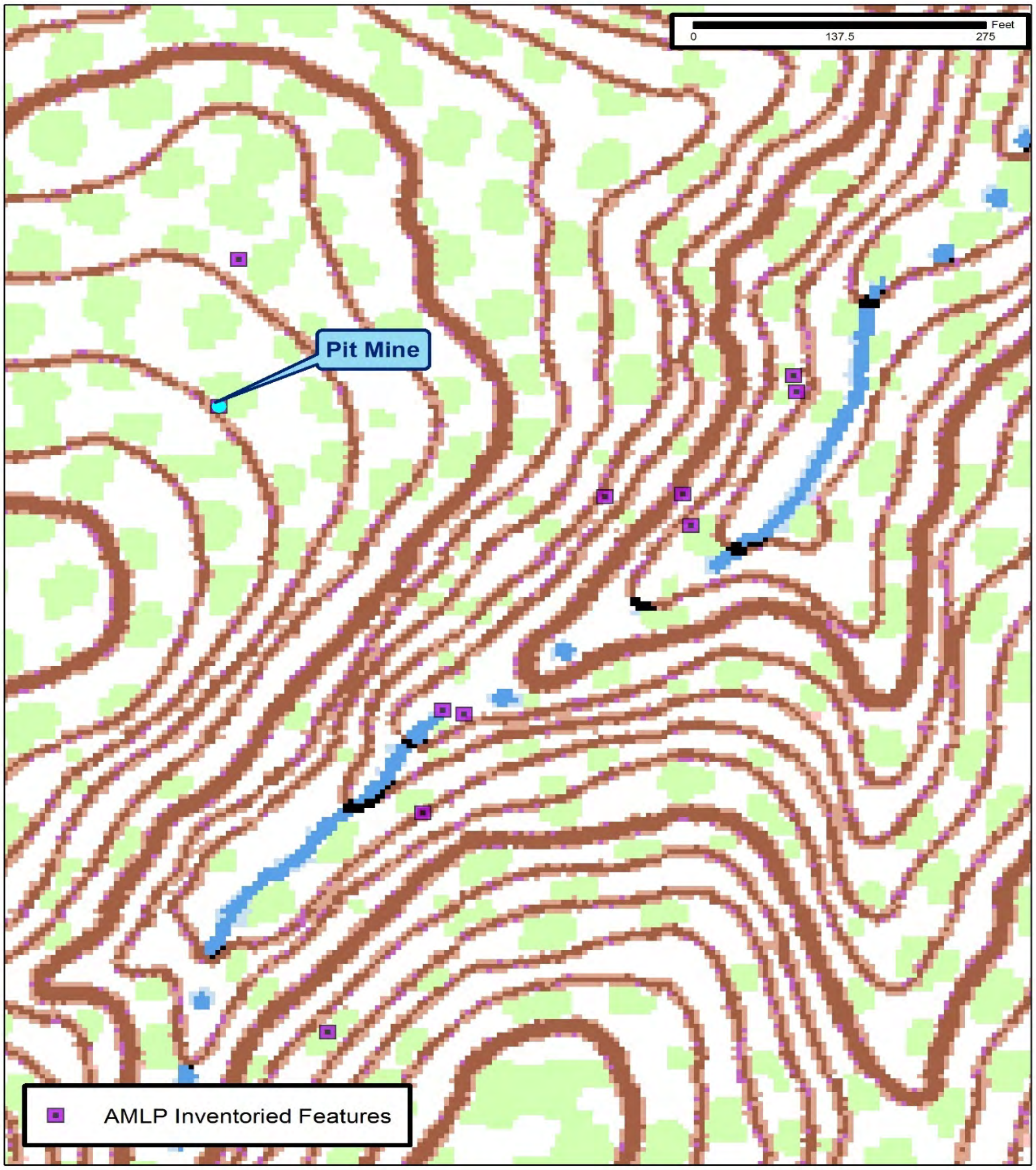
Flooded excavation pit. View from southern approach and wooden dock.

Wooden dock-western edge, and eastern part of excavation.

*Note: This is good wildlife habitat. If fencing, use smooth wire fencing and consider large mammal access in fence design.

Pit Mine (Feature Id # 72775)

Figure 4: Pit Mine.



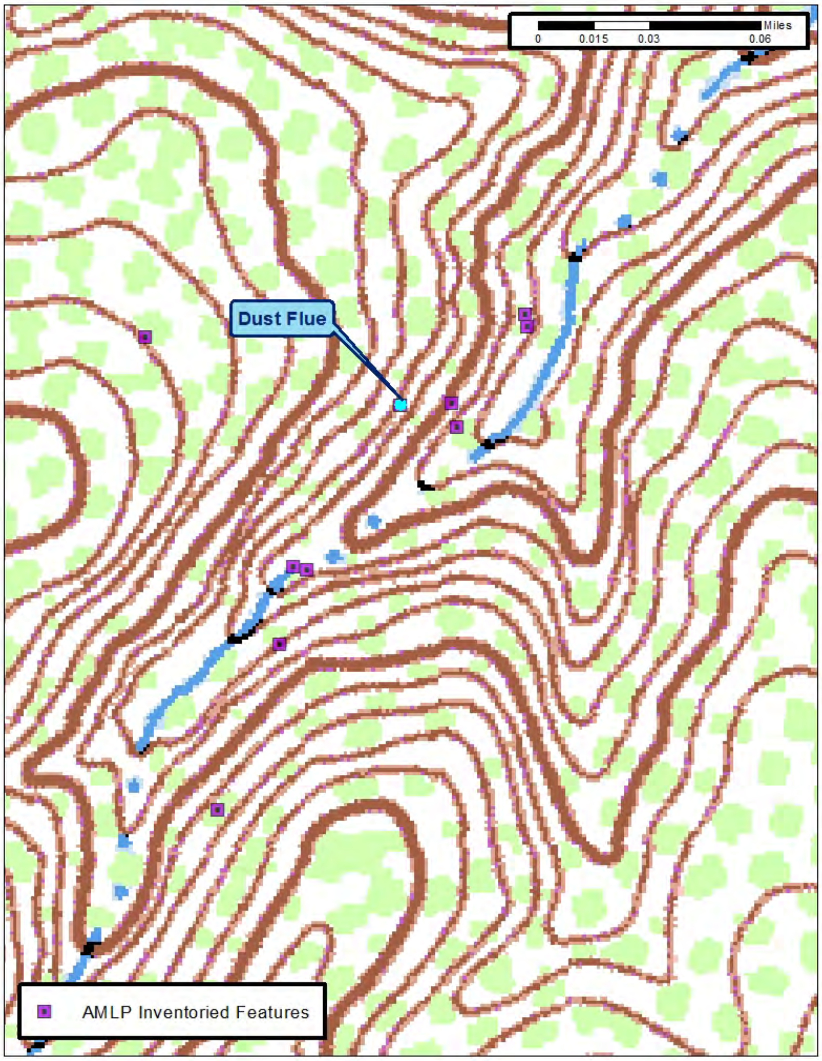
This feature is a shallow excavation trench in thick low vegetation. The following photos and table identify the hazards that was found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Excavation Pit	# 72775	32.99074898481, -117.1126574431	6'x15'x5'	Fence and sign or backfill

Shallow excavation pit.

Concrete Dust Chamber (Feature Id # 72777)

Figure 5: Concrete Dust Chamber.



This site consists of the historic Arsenic Dust Flue/Chamber located on a steep hillside. The concrete chamber contains one large entrance point on the lower eastern end, and 30 smaller access portals on its northern sides. The interior also contains wall baffles made of asbestos material, and arsenic dust on the floors. The following photos and table identify the hazard that was found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Dust Chamber	72777	32.990448152303, -117.11148393202	7'x180'x6'	Cover/seal all entrances. Assess for hazardous material/asbestos if entrances not covered

Lower end of dust flue.

Northern side of flue showing access portals.

Side access portal on flue

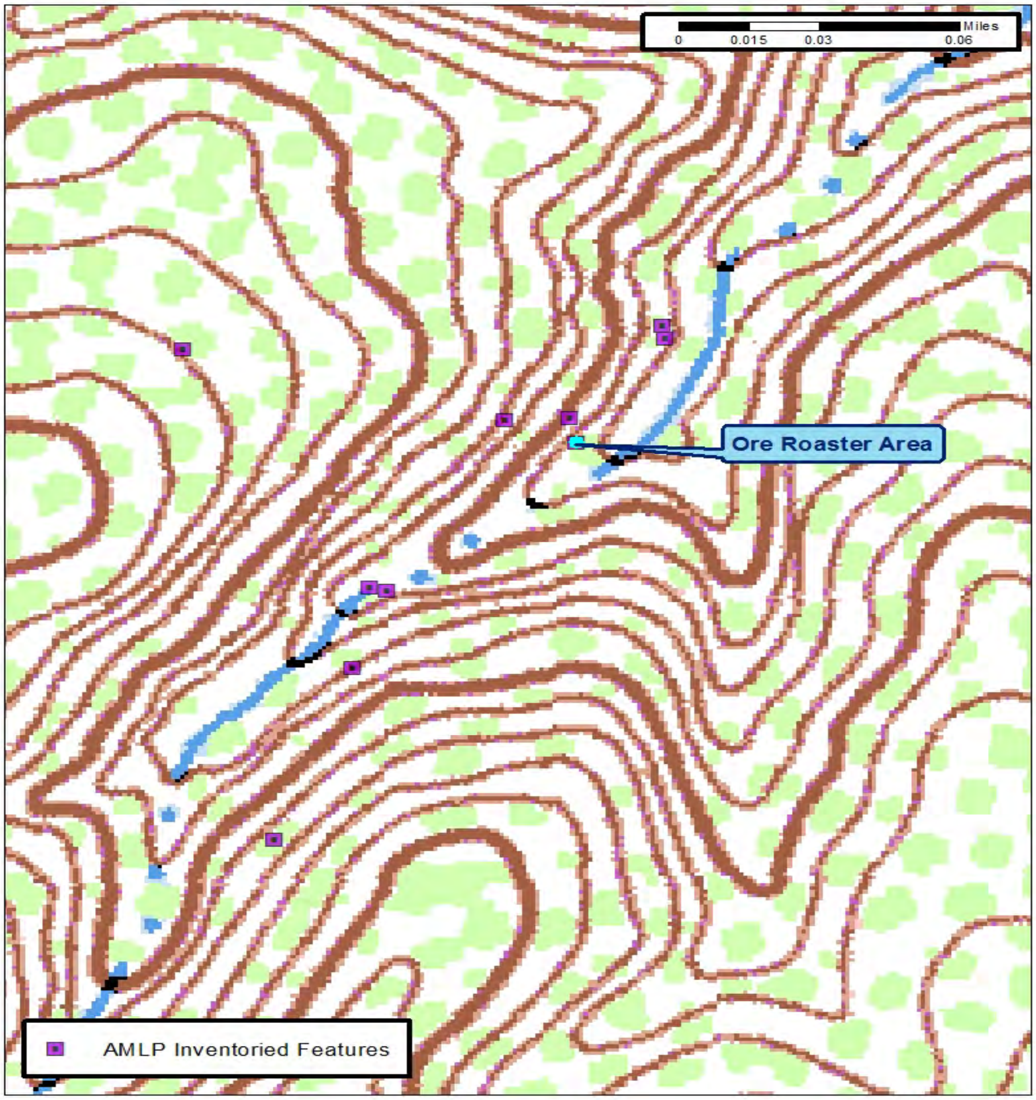
A side access portal on lower flue

Discarded cover of side access portal.

Interior asbestos baffles in dust flue.

Ore Roaster Area (Feature Id # 72781)

<u>Figure 6:</u> Ore Roaster Area.



This site consists of a furnace on top of concrete pad. Remains of the second phase of ore processing include the footings for a rotary roaster, large steel pipe and a trellis support for the pipe that connected the roaster with the flue dust chamber built on the hill above the mill site terrace. The following photos and table identify the hazard that was found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Ore Roaster/ Production area	72781	32.990354151462, -117.11122409015	20’x30’x10’	Fence and sign entire area. Possibly cap soil or revegetate area. Assess structures for stability, and stabilize if needed for safety and cultural preservation.

Ore roaster support structure.

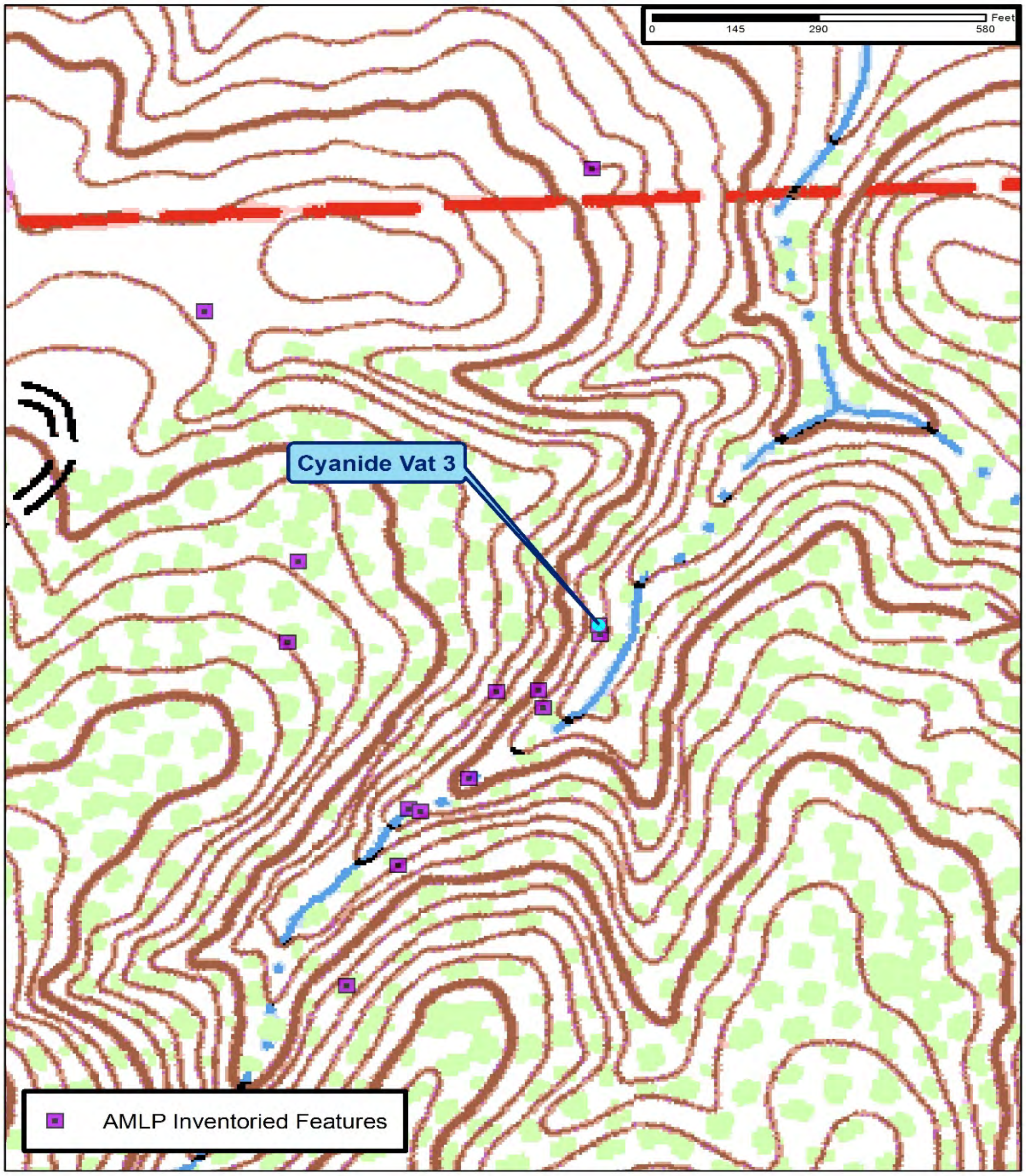
Inside of ore roaster.

Ore roaster pipe.

Friable concrete foundation - ore roaster area.

Cyanide Vat 3 (Feature Id # 72779)

Figure 7: **Cyanide Vat 3.**



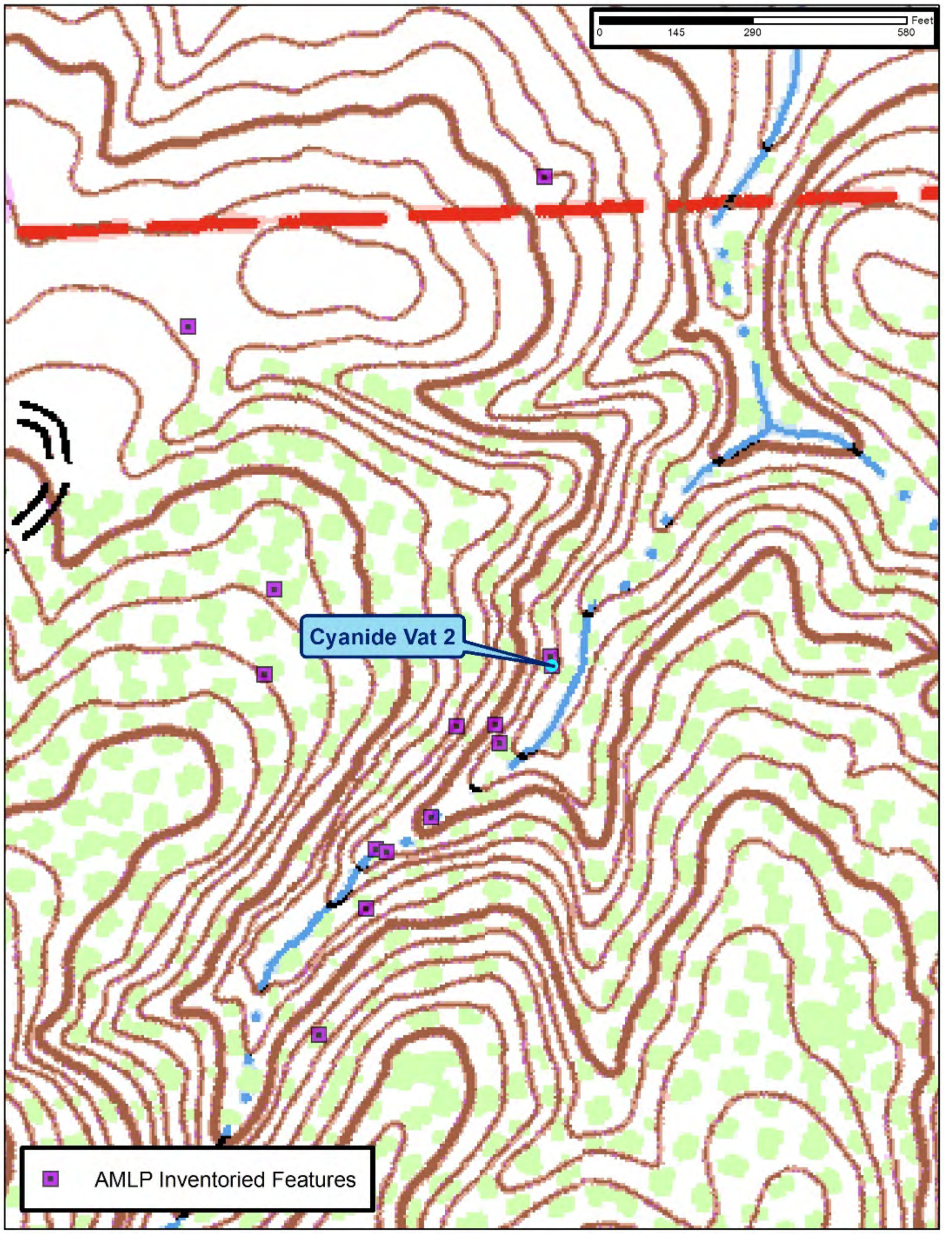
This site consists of a two compartmented concrete cyanide vat. Modern graffiti on inside and outside walls. Holds seasonal water. The following photos and tables identify the hazards that were found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Concrete Vat	72779	32.9907964875, -117.110893766	12’x30’x7’	Cover or Cable net. Assess for possible removal.

Concrete Cyanide vat.

Cyanide Vat 2 (Feature Id # 72780)

Figure 8: Cyanide Vat 2.



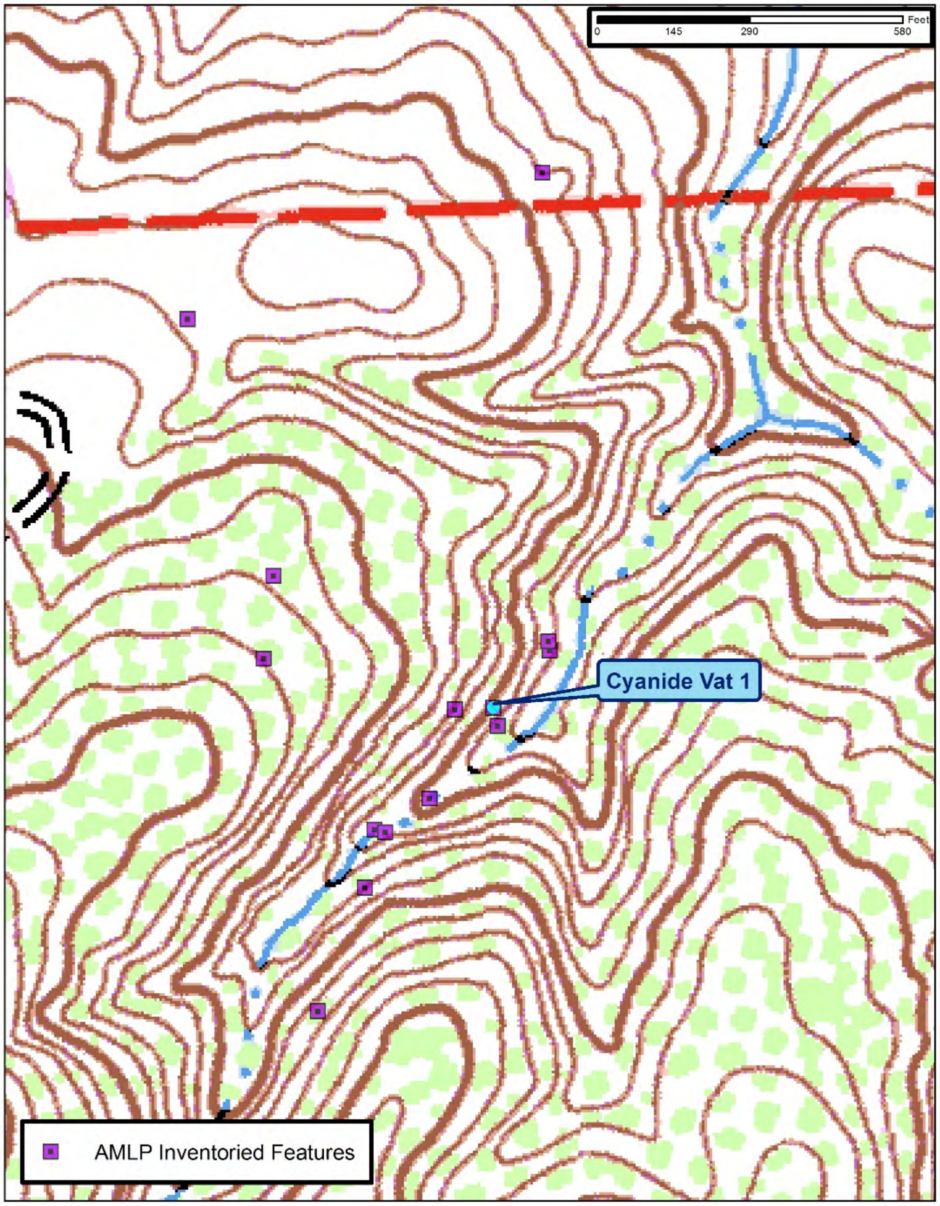
This site consists of a concrete cyanide vat. Water in bottom. Intact and stable. Modern graffiti on inside and outside walls. The following photos and tables identify the hazards that were found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Concrete Vat	72780	32.99074665171, -117.1108855980	12’x15’x6’	Cover or cable net. Assess for possible removal.

Concrete cyanide vat.

Cyanide Vat 1 (Feature Id # 72778)

Figure 9: Cyanide Vat 1.



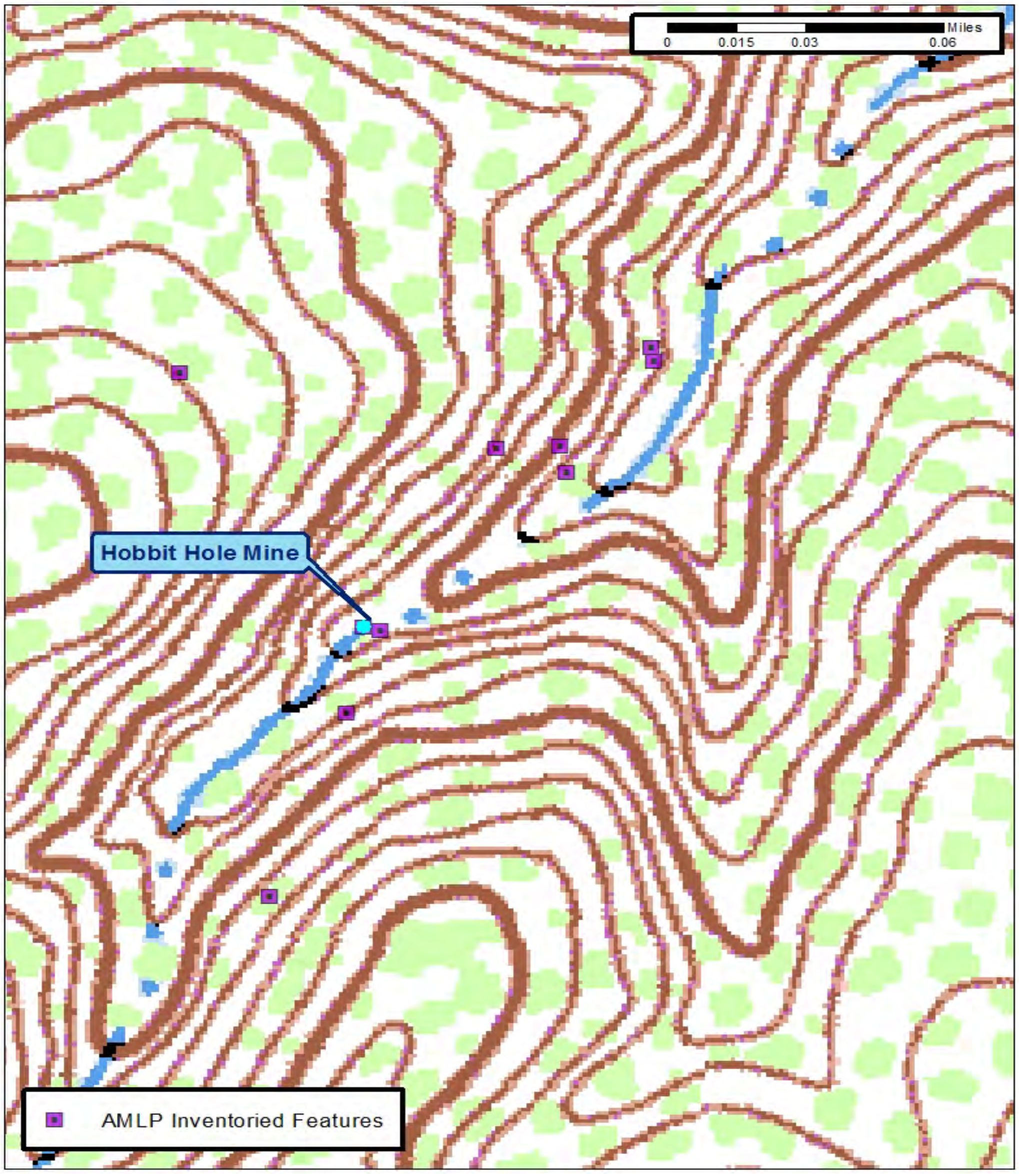
This site consists an empty concrete Cyanide vat. The following photos and tables identify the hazards that were found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Concrete Vat	72778	32.99045031857, -117.1112462653	15’x15’x6’	Cover or cable net. Assess for possible removal.

Concrete Cyanide vat.

Hobbit Hole Mine (Feature Id # 72785)

<u>Figure 10:</u> Hobbit Hole Mine.



This site consists of an open adit. Located on northern edge of canyon wall. Narrow portal, but opens up inside to 5’x 6'. Non-eroding, clean walls. Debris has sloughed in from above the portal gradually half-filling in the portal area with fine debris. The following photos and tables identify the hazards that were found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Adit	72785	32.98982031853, -117.1120044317	4’x3’x30’	Culvert Gate due to loose portal area

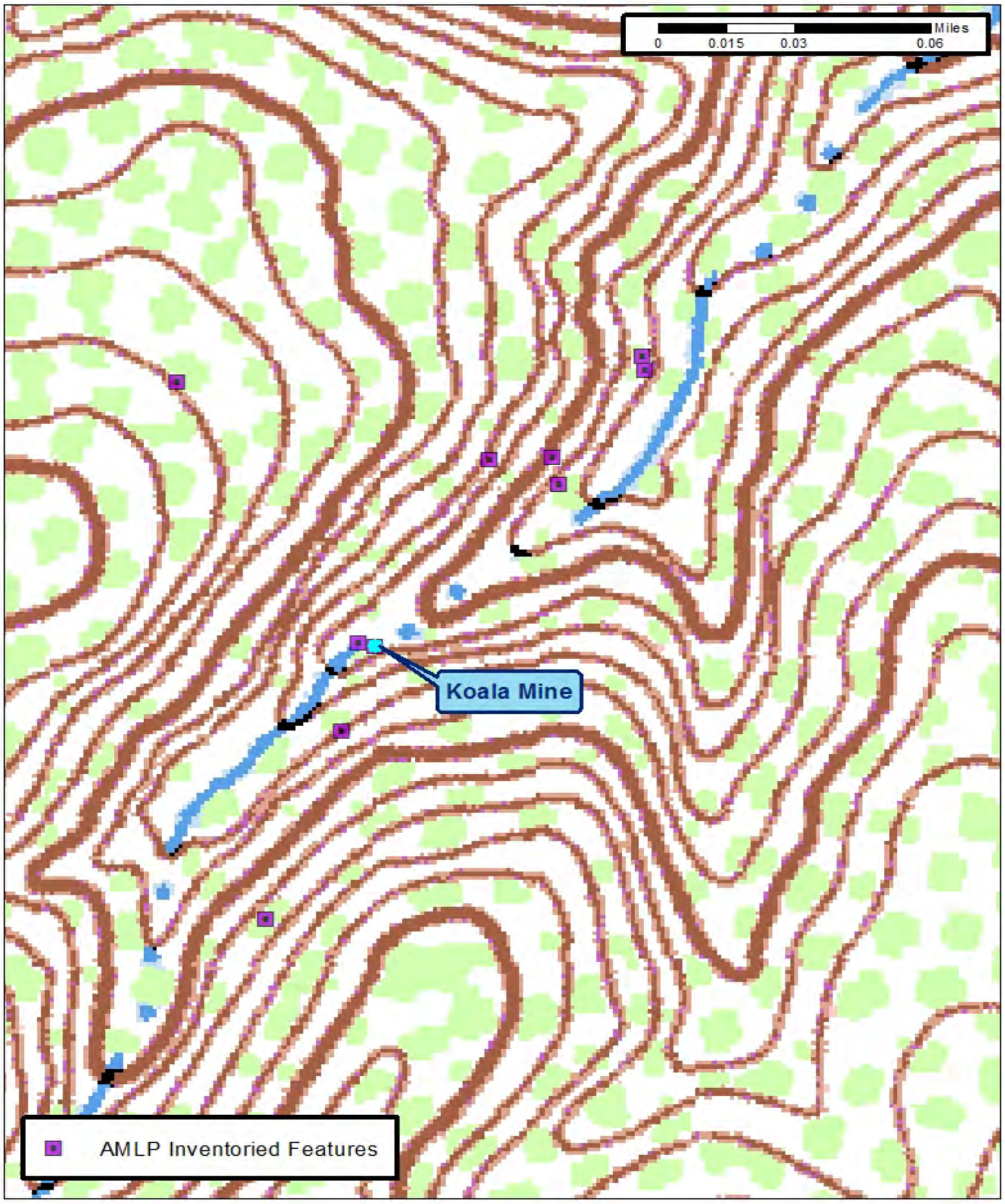

Portal of adit.


Inside of adit.


Inside view of adit.

Koala Mine (Feature Id # 72784)

<u>Figure 11</u>: Koala Mine.



The site consists of one open and stable adit cut into hard rock. Rhyolite material. Non-eroding walls and clean floor. Some debris has fallen from above the portal. Graffiti and campfire ring out front indicate high use area. The following photos and table identify the hazard that was found at time of inventory and the recommended type of remediation.

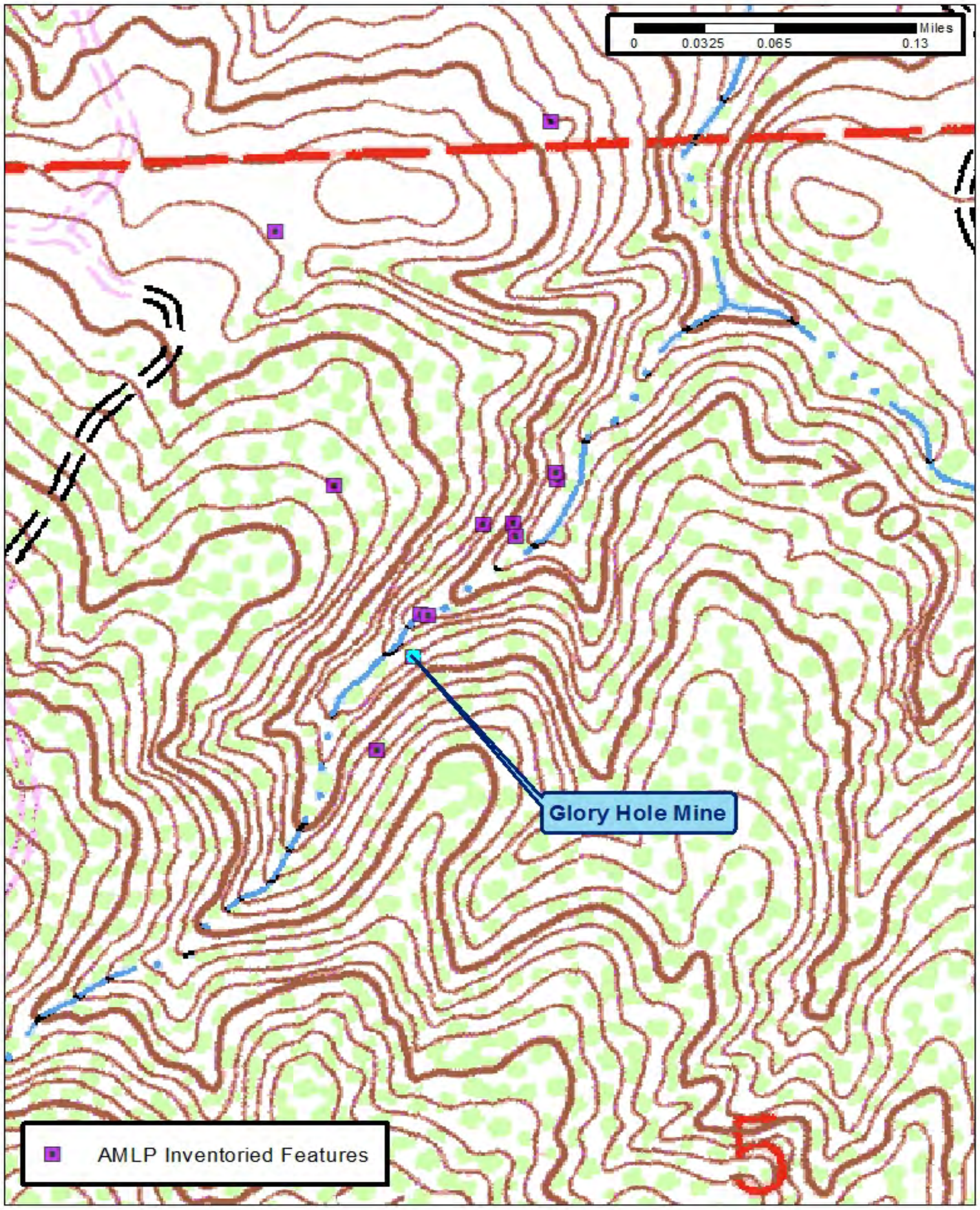
Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Adit	72784	32.98980598542, -117.1119400981	6’x5’x50’	Bat Gate

Mine portal.

Inside view of adit.

Glory Hole Mine (Feature Id # 72786)

Figure 12: Glory Hole Mine.



This feature is a shallow excavation shaft. Steep walls. Located on steep hillside. Mine waste (talus) is located down steep slope to canyon below. The following photos and tables identify the hazards that were found at time of inventory and the recommended type of remediation.

Feature Type	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Shaft/Pit	72786	32.98951398469, -117.1120765990	10’x12’x12’	Fence and sign or backfill

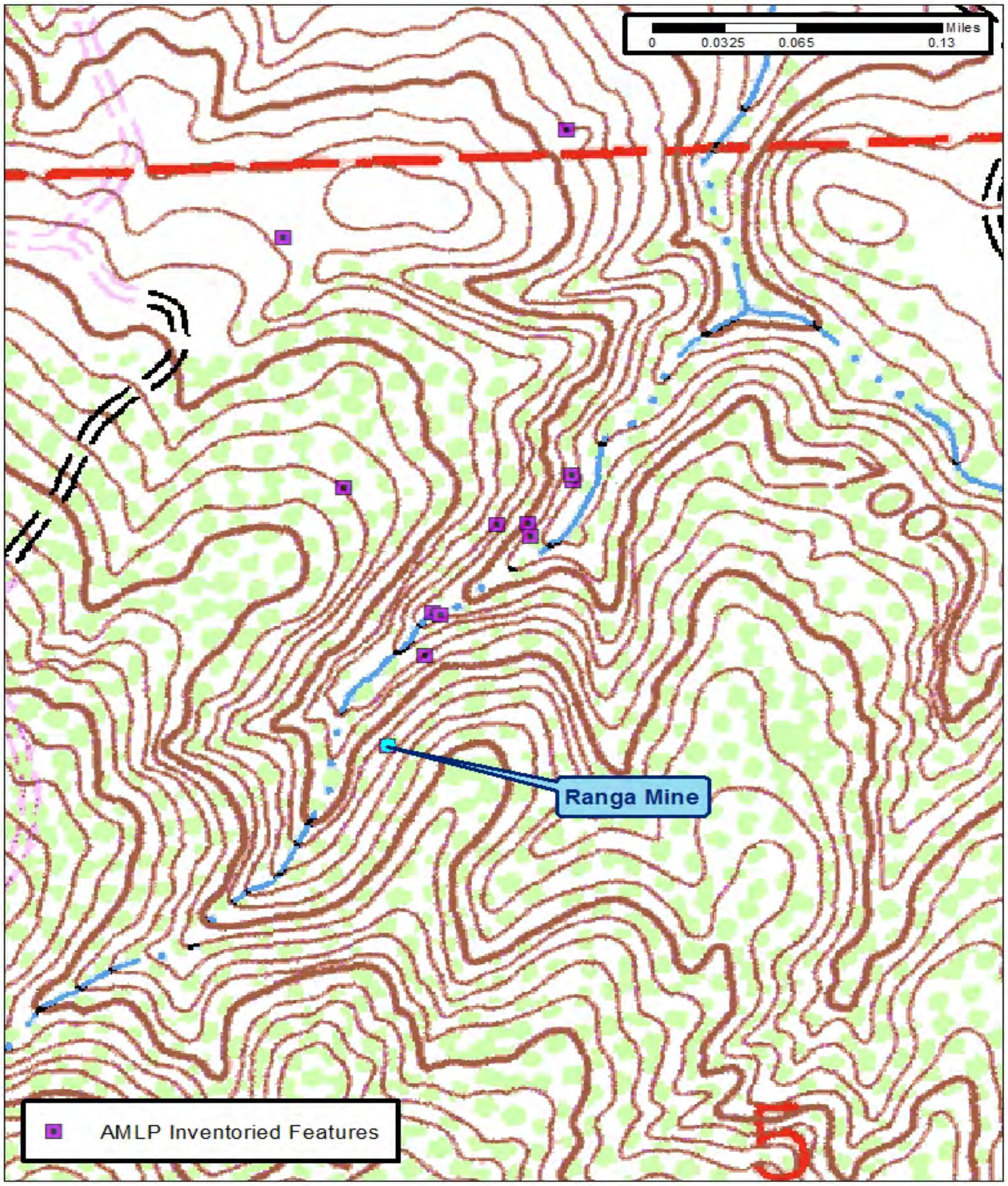

Shaft view.


Inside of shaft.


Walls and floor of shaft.

Ranga Mine (Feature Id # 72787)

Figure 13: Ranga Mine.



The site consists of an open inclined shaft on steep hillside. Large timber cap posts in bottom. Fractured material overhang above portal. The following photos and table identify the hazard that was found at time of inventory and the recommended type of remediation.

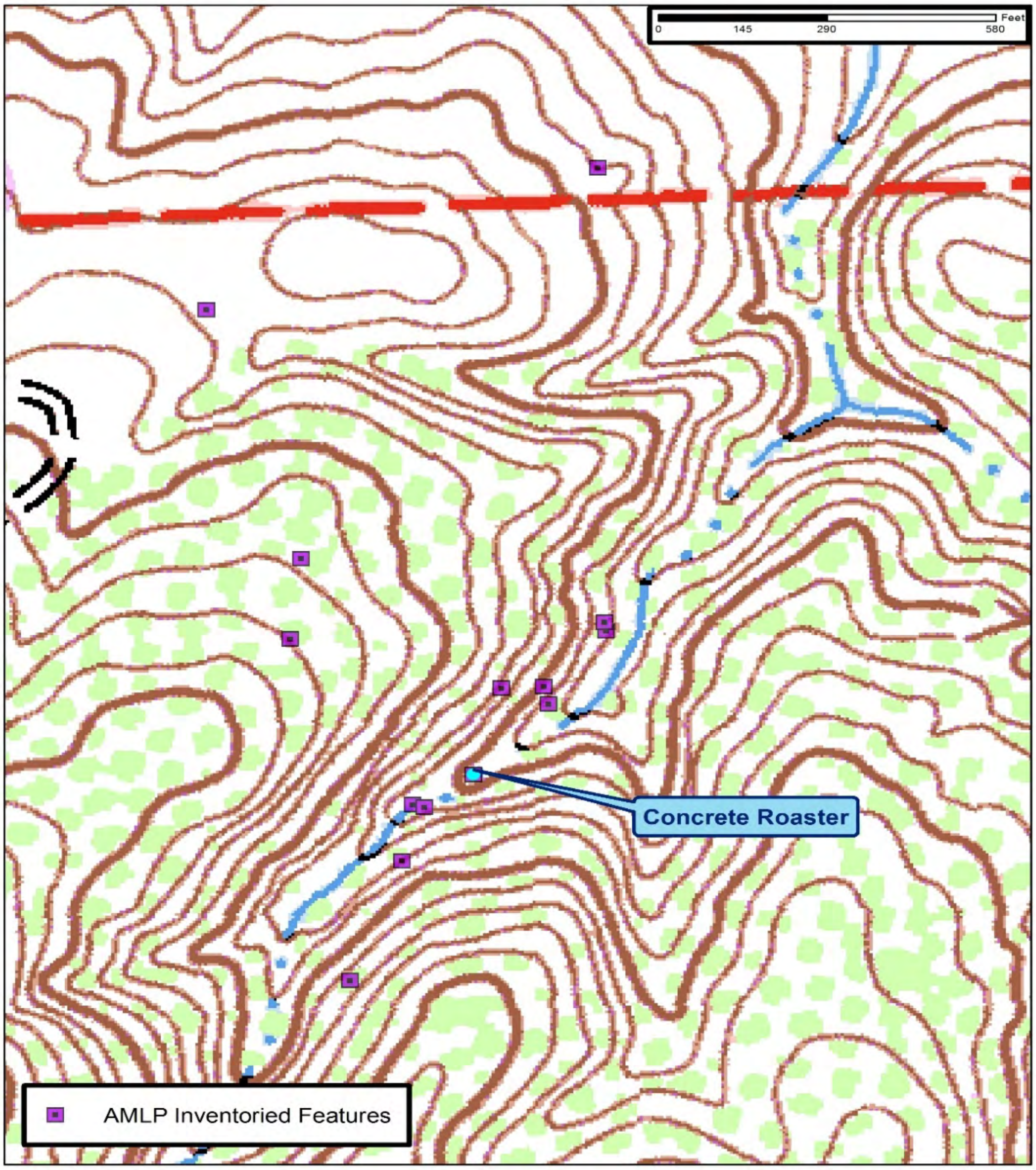
	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Incline	72787	32.98886381917, -117.1123919316	6’x5’x25’	Cable net or fence and sign

Incline portal.

View inside incline.

Concrete Roaster (Feature Id # 72792)

Figure 14: Concrete Roaster.



The site consists of a small concrete ore roaster made or reinforced concrete. Front part of roaster appears to be vandalized revealing the inner rebar, and leaving chunks of concrete at the base. The following photos and table identify the hazard that was found at time of inventory and the recommended type of remediation.

	Feature ID	Lat/Long	Dimensions (X,Y,Z)	Remediation Type
Ore Roaster	72792	32.989991, -117.111661	3’x4’x5’	Fence and Sign or cap/remove material and revegetate

Concrete ore roaster

Soil sample at base of concrete ore roaster

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