Letter of Transmittal

To: Matt Plis

From: ASK Haz Waste

Date: May 5, 2015

Re: Final Proposal

BLM Staff,

Please find attached ASK Haz Wastes Preliminary Assessment & Site Inspection document regarding the Sonoran Desert National Monument Recreational Shooting Site Project. This document has been transmitted on Tuesday May 5th 2015 by the ASK Haz Waste Team.

Signed,

Abdullah Ashkanani	Shane Klotzman	Kamran Kahn
Aaa369@nau.edu	srk74@nau.edu	kfk29@nau.edu

Prepared for the Bureau of Land Management:
Matt Plis, William Harris, and Eric Zielske

Preliminary Assessment
Focused Site Inspection

Sonoran Desert National Monument
Maricopa County, Arizona

May 2015
ASK Haz Waste
Flagstaff, AZ 86001

Bureau of Land Management

Preliminary Assessment and Focused Site Inspection

Sonoran Desert National Monument
Maricopa County, Arizona

May 2015

Kamran Khan
Environmental Engineer

Shane Klotzman
Environmental Engineer

Abdullah Ashkanani
Environmental Engineer

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ASK	ASK Haz Waste
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
COC	Contaminant of Concern
EPA	Environmental Protection Agency
FAA	Flame Atomic Absorption
GPS	Global Positioning System
IUEBK	Integrated Exposure Uptake Biokinetic Model
ND	Non Detect
NHANES	National Health and Nutrition Examination Survey
nrSRL	Non-Residential Standard Regulatory Limit
PA/SI	Preliminary Assessment and Site Inspection
PPM	Parts Per Million
QA/QC	Quality Assurance / Quality Control
rSRL	Residential Standard Regulatory Limit
SAP	Sampling and Analysis Plan
SRL	Standard Regulatory Limit
XRF	X-Ray Fluorescence
RSSP	Recreational Shooting Site Project
NAU	Northern Arizona University
SDNM	Sonoran Desert National Monument

Executive Summary

This Preliminary Assessment & Site Inspection (PA/SI) has been created for the Bureau of Land Management (BLM), with regards to the Sonoran Desert National Monument (SDNM) Recreational Shooting Site Project (RSSP). This joint project between Northern Arizona University (NAU) and the BLM is an educational exercise, as well as an opportunity for the BLM to have areas of interest analyzed for risks associated with heavy metals contamination. ASK Haz Waste's findings are the Hill Sites show higher average concentrations of the contaminants of concern (COC), as compared to the Road Sites. In addition, these Hill Sites contain areas that are over Arizona's residential and nonresidential concentrations for the COCs. It is ASK Haz Waste's recommendation that the BLM seek further investigation into the extent of contamination of the hill sites, as well as, commission studies into the extent of contamination of the ephemeral natural channels that run adjacent to the hill sites.

This PA/SI outlines:

- Project objectives
- Site Background
- Field Activities
- Analytical Protocol & QA/QC
- Migration / Exposure Pathways and Targets
- Human & Ecological Risk Assessments
- Conclusions
- Recommendations

1.0 Introduction

This PA/SI has been written by ASK Haz Waste for the SDNM RSSP. This collaborative project between Northern Arizona University (NAU) and the Bureau of Land Management (BLM) was tasked to create a PA/SI document, per the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Therefore, in accordance with CERCLA, this PA/SI has been created.

The investigation was focused on determining the extent of heavy metals contamination at 15 sites specified by the BLM. Said sites have historically been used as informal recreational shooting sites. Moreover, a human and ecological risk assessment as also been conducted regarding the sites in question.

1.1 Project Objectives

Objectives of the PA/SI were:

- Identification of environmental issues with recreational firearms shooting
- Determination of extent of contamination within the predetermined areas
- Characterization of sites and compare to Arizona soil remediation levels
- Evaluation of Results & make recommendations

1.2 Project Scope

The scope of services for this project included:

- Site research: research information available for the sites in question
- Combined Work Plan: create documentation required for field work, which includes: Work Plan, Health & Safety Plan, and Sampling & Analysis Plan
- Identify sample locations & conduct surface soil sampling
- X-ray Fluorescence (XRF) total metals analysis: in a lab setting homogenize soil samples and analyze using XRF technology following the guidance of EPA Method 6200
- FAA laboratory testing: using the Colorado Plateau Analytical Laboratory, perform Flame Atomic Absorption (FAA) spectroscopy (EPA Method 3050B)

- Validation of laboratory results: perform data correlation between XRF and FAA results

- Human & ecological risk assessment: using the National Health & Nutrition Examination Survey Adult Risk Model and Integrated Exposure Uptake Biokinetic Child Risk Model

- Data presentation: present data in table and concentration map form

- Documentation (PA/SI report): preparation and presentation of draft and final versions of PA/SI report to technical advisor and/or client

2.0 Site Background

Below, the location (Figure 1), description, and previous work regarding the project are discussed. Regarding previous investigations, ASK Haz Waste was unable to find any that pertained to the 15 sites in question.

2.1 Site Location

The entire project is located within the Arizona BLM Phoenix District. The sites are located in Sections 9, 10, and 15 of Township 3S and Range 2W Gila-Salt River Meridian. These 15 sites are located along the northern border of the park roughly 50 miles from Buckeye, and found 8 miles east of the Arizona State Route 85. Figure 1 on the next page shows the general area of the 15 sites.

Figure 1: General Site Location

2.2 Site Description

The collection of sites the SDNM RSSP encompasses includes 11.2 acres. These sites range from .1 to 2 acres, and are located south of W. Komatke Road and north of a range of hills that run along the northern edge of the park. This layout creates a topography that slopes from south to north towards W Komatke Rd. Unnamed washes run in a general southwest to northeast direction throughout the area. Infrastructure close to the site includes an underground natural gas pipeline north of the sites, and structures associated with power lines that run along W Komatke Road. The 15 sites, including the 5 background sample locations, can be seen in Figure 2 below.

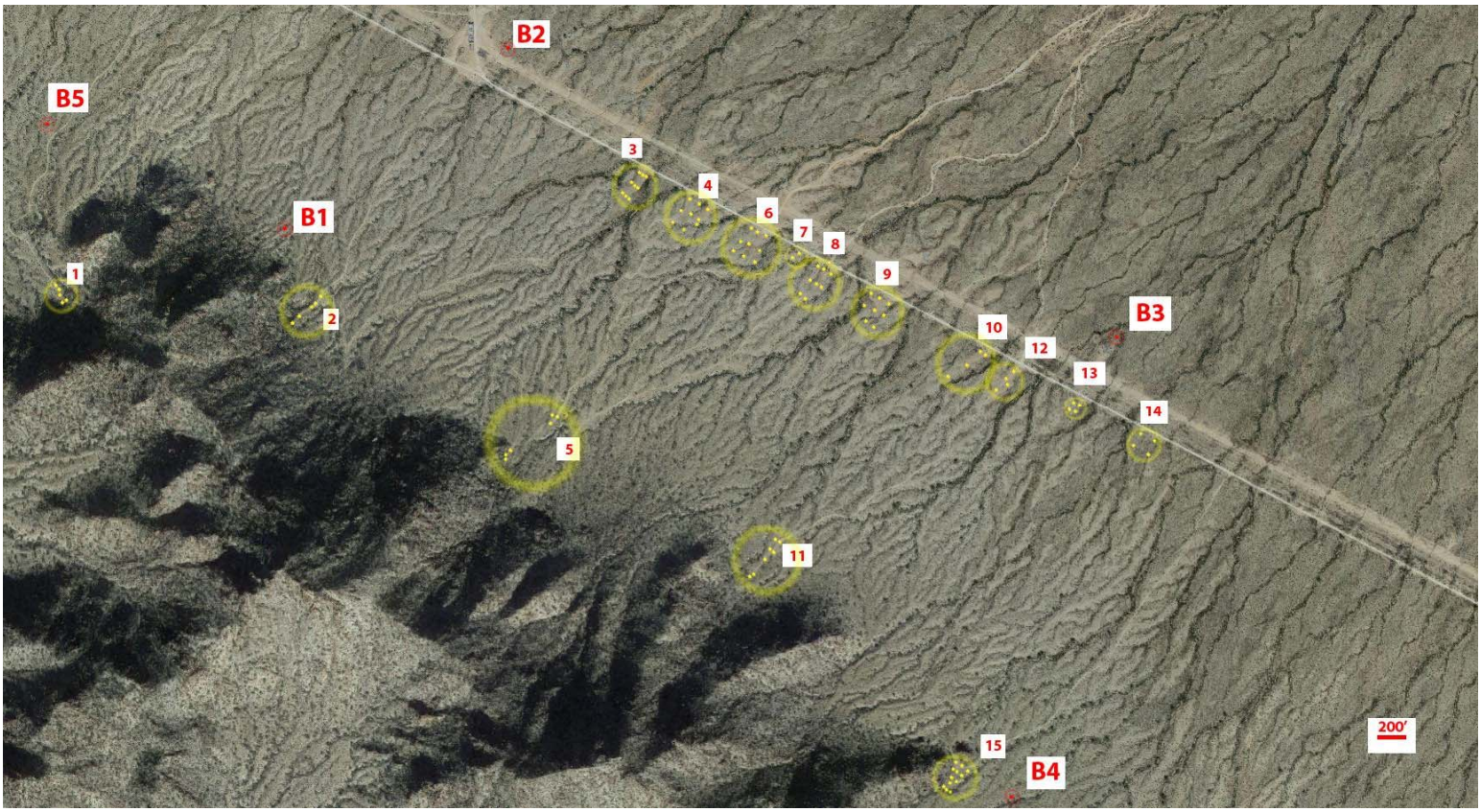


Figure 2: Site Overview

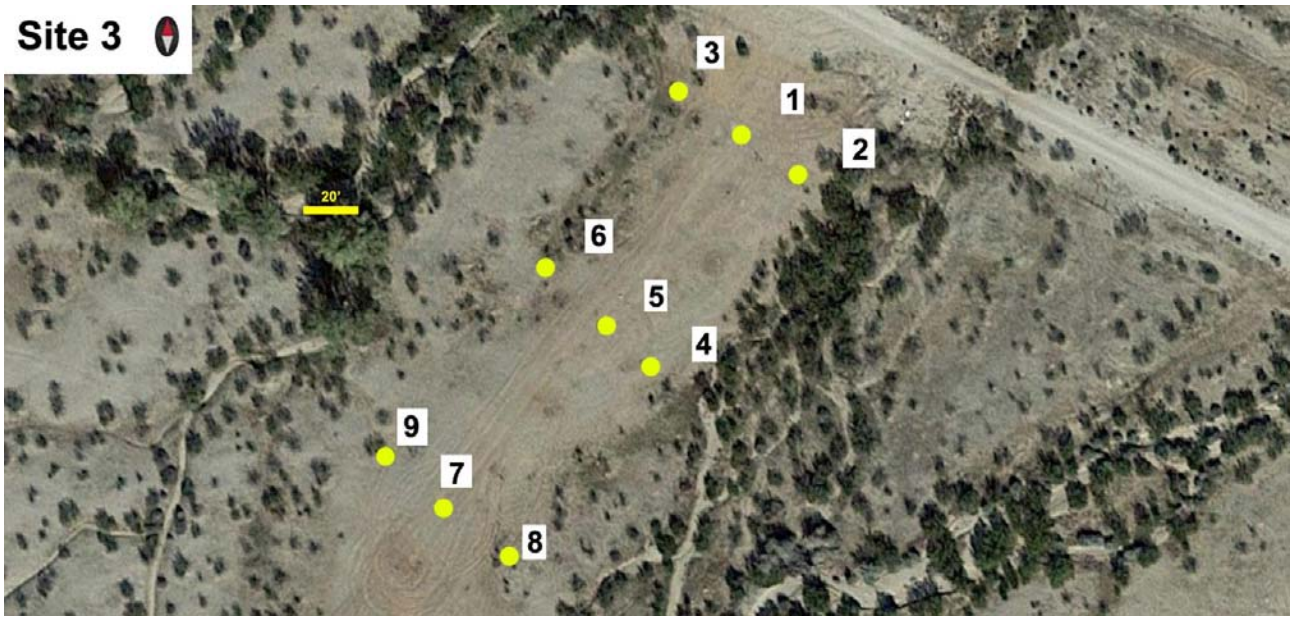
During ASK Haz Wastes investigation two types of sites were defined. These site types are Hill Sites and Road Sites. Below are the classification of these sites.

Road Sites	Hill Sites
Site 3	Site 1
Site 4	Site 2
Site 6	Site 5
Site 7	Site 11
Site 8	Site 15
Site 9	
Site 10	
Site 12	
Site 13	
Site14	

2.3 Road Sites

The 10 road sites are newer and less recreated in comparison to the hill sites. These sites are adjacent to W Komatke Rd., as well as power line utilities and natural gas infrastructure. A representative Road Site (Site 3) can be seen below in Figure 3. Like all road sites, Site 3 had little variation in topography, and had shallow ephemeral natural channels running on either side of the site. A more detailed account of these sites can be found in Appendix F (Field Notes).

Figure 3: Road Site



2.3 Hill Sites

The 5 hill sites are older, and therefore more recreational shooting has taken place within them. A representative Hill Site (Site 2) can be seen below in Figure 4. Unlike the Road Sites, Hill Sites had more varying topography, and were adjacent to deep ephemeral natural channels. In addition, vegetation at these sites was less dense, as compared to the road sites. A more detailed account of these sites can be found in Appendix F (Field Notes).

Figure 4: Hill Site

3.0 Field Activities

This section describes the site investigation objectives and site investigation general approach. The field investigation focused on the 15 sites identified by the BLM. In total 104 grab samples were taken at these locations. Said samples were then analyzed at NAU with an XRF analyzer and using flame atomic spectroscopy. No XRF data was collected in the field. Data gathered in the field included: sample location (GPS coordinates), collection date and time, sample identification, a photographic log, and additional observations. Field analysis was conducted from February 19th – 20th 2015. This site visit was conducted by the ASK Haz Waste team along with BLM staff. This included Abandoned Mines & Hazmat Coordinator Matt Plis, and Environmental Engineer Eric Zielske.

3.1 Sample Locations and Methodologies

Samples were collected over a two day period at each of the 15 sites. A mixture of two methods were used. These methods were a grid and approximate range features approach (hotspot approach). These features are: firing line, range floor, and impact area. The approximate range feature approach was implemented for the hill sites due to their more obvious layout. In comparison, the road sites followed the grid approach due to their larger size and less defined features.

In addition, five background samples were taken at locations which met certain criteria. These criteria are as follows. The area needed to be clean of target debris within a reasonable distance, samples were taken in areas which had more dense grass vegetation,

as well as away from roads.

3.2 Soil Investigation Standards

This PA/SI has utilized the Arizona Department of Environmental Quality's soil remediation levels (SRL). This SRL consist of two portions, a residential (rSRL) and non-residential (nrSRL) concentration which is measured in mg/kg (or parts per million). These standards represent the total contamination in the soil medium, as opposed to environmentally available, and conservatively characterize the risk posed to human and environmental health. Table 1 below displays the concentrations provided in Appendix A of the Arizona Administrative Code (I).

Table 1: Soil Remediation Levels

Compound	Residential (ppm)	Non-Residential (ppm)
Antimony	31	410
Arsenic	10	10
Copper	3100	41000
Lead	400	800
Tin	47000	610000
Zinc	23000	310000

3.3 Deviations from Work Plan

Deviations from the original Work Plan submitted to the client are discussed at length in the Field Notes (Appendix F). These deviations mainly pertain to sampling rationale.

4.0 Analytical Protocol

Site samples were packed and transported as described within the work plan attached in Appendix A. Protocols for using the XRF to analyze the samples are detailed below. In addition, the methods and protocols used during the Flame Atomic Absorption spectroscopy analysis are also detailed in the following section.

4.1 Methods

For analysis of the 99 site samples and 5 background site samples a mixture of BLM procedure and EPA Method 6200 was used. This method involved homogenizing all samples through a number 200 sieve into gallon sized zip lock bags. These bags were

then marked into a grid with nine sections for XRF testing. Once all sections were tested the Olympic average for the sample was found by throwing out the highest and lowest value from the nine sections. The final homogenized soil sample can be seen in the figure below.

Figure 5: XRF Sample

For flame atomic absorption testing a mix of random and deliberate sample selection was used. The sample preparation method for the flame atomic absorption is EPA Method 3050B Acid Digestion of Sediments, Sludge, and Soils.

This method breaks down as follows:

- Mix five grams of sample with two milliliters of Hydrogen Peroxide and ten milliliters of Nitric Acid
- Placing the mixture into a microwave digester for ten minutes at 165 degrees Celsius

- Once microwave digestion has finished, add five milliliters of Cesium Chloride and 5 milliliters of Lanthanum Chloride and topping a 50 milliliter centrifuge tube with Deionized water
- Centrifuge the samples then filter through a #40 filter
- Run samples though the Flame AA, diluting samples as needed
- Convert from absorbance values to parts per million concentrations

From this the two sets of data were correlated and validated. The methods for this are discussed below. In Figures 6 and 7 the microwave digester and filtration process can be seen.

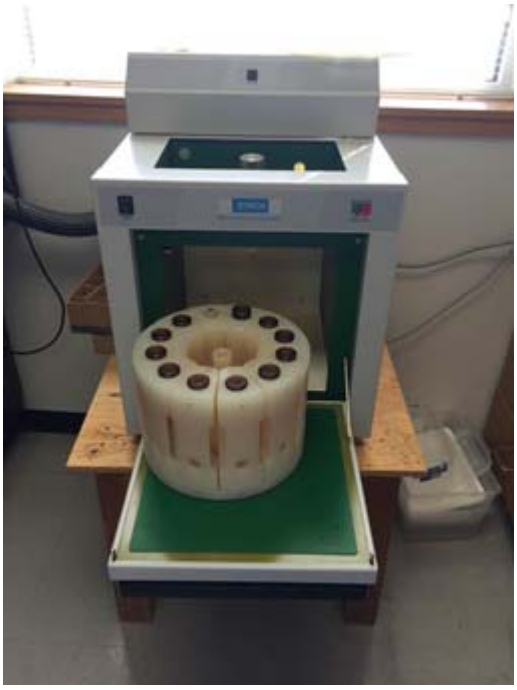


Figure 6: Microwave Digester

Figure 7: Sample Filtration

4.2 Protocol for Selecting Laboratory Samples

A mix of random and deliberate sample selection was used when determining the samples to be sent to the laboratory for flame atomic absorption testing. These selected samples were roughly 20% of the total samples. For random selection a number between one and fifteen was selected. Depending on how many samples were taken at that site, a number was randomly generated to select which site sample would be chosen. This method was done fifteen times. Finally five more samples were selected based on values

above the regulatory limits for arsenic, antimony, and lead. There were eight lab duplicates randomly selected. The samples chosen by each method are show below:

- All five background samples: B-1, B-2, B-3, B-4, B-5
- The fifteen randomly selected samples were: 1-3, 1-4, 2-5, 5-3, 6-3, 6-9, 7-1,7-2, 8-7, 8-2, 12-3, 13-1, 13-4, 14-2, 15-4
- The five deliberately selected samples were: 2-4, 5-5, 11-8, 15-6, 15-10
- The eight random lab duplicates: 1-3, 1-4, 2-4, 7-1, 8-2, 13-1, 14-2, 15-10

These samples form the thirty three samples that were prepared through EPA Method 3050B and tested through flame atomic absorption. Duplicates were done in order to insure QA/QC standards were being met.

4.3 Analytical Results

The following sections discuss the results recorded from the XRF and FAA analysis. It also includes the correlation procedure and validation for the results.

4.3.1 XRF Results

For the XRF results all 104 samples were tested. The five background samples were taken in order to get the base value for what elements were located within the soil. Below you can see the summary table for the five background samples. The contaminants included in the table are Potassium (K), Calcium (Ca), Copper (Cu), Lead (Pb), Chlorine (Cl), Zinc (Zn), Antimony (Sb), Arsenic (As), and Tin (Sn).

Table 2: Background XRF Results

Location	Contaminants of Concern (ppm)								
Back	K	Ca	Cu	Pb	Cl	Zn	Sb	As	Sn
B1	17614	9927	35	42	893	68	19	8	19
B2	16809	16717	24	21	824	53	19	5	19
B3	16930	14098	28	21	888	56	19	5	19
B4	17601	10314	29	20	767	57	19	6	19
B5	16529	10596	28	18	838	59	19	7	19

The table above shows all the elements that were recorded by the handheld XRF. Potassium, calcium, chlorine, and zinc were not recorded in the site samples because these elements are not associated with shooting site and are not limited by regulatory

standards. From this table none of the background sample elements were found to be over the regulatory standard.

The five hill sites consisted of S1, S2, S5, S11, and S15. There was a total of 36 samples taken at these locations. From these samples 20 were found to be over the residential regulatory limit for lead of 400 ppm with values ranging from 417 to 22290 ppm. Three samples were found to be over the regulatory limit of 10 ppm for arsenic with the highest value being 36 ppm. Twelve samples were found to be over the regulatory limit of 31 ppm for antimony with the highest being 299 ppm. Table 3 below shows the results for S15 with COCs over the regulatory limit marked in orange. Data entries marked with ND were non detects because they were below the reading limit for the handheld XRF.

Table 3: Site 15 XRF Results

Location	Contaminants of Concern (ppm)					
Site 15	Sb	As	Cu	Pb	Sn	Zn
S15-1	ND	8	36	96	ND	71
S15-2	ND	5	36	59	ND	71
S15-3	ND	ND	38	309	ND	109
S15-4	ND	5	33	215	ND	72
S15-5	22	7	46	901	ND	114
S15-6	77	12	96	4422	ND	231
S15-7	ND	9	34	218	ND	69
S15-8	ND	10	49	915	ND	82
S15-9	ND	5	31	169	ND	69
S15-10	52	ND	107	4466	ND	105
S15-11	ND	7	35	64	ND	73
S15-12	21	ND	31	455	ND	73

The ten road sites consisted of S3, S4, S6, S7, S8, S9, S10, S12, S13, and S14. There was a total of 59 samples taken from these locations. Only one sample recorded a concentration about the regulatory standard for lead. No samples were recorded as having values greater than the regulator limit for the other elements. This is believed to be due to these sites being newer and less recreated. All sites did show some rise in contamination above what was found in the background samples. Table 4 below is the table for S3 this is the site that had the one concentration over 400ppm.

Table 4: Site 3 XRF Results

Location	Contaminants of Concern (ppm)					
Site 3	Sb	As	Cu	Pb	Sn	Zn
S3-1	ND	ND	33	139	ND	59
S3-2	ND	5	33	37	ND	55
S3-3	ND	5	29	54	ND	62
S3-4	ND	ND	37	412	ND	65
S3-5	ND	5	28	74	ND	55
S3-6	ND	ND	27	64	ND	54
S3-7	ND	ND	32	98	ND	57
S3-8	ND	5	29	41	ND	51
S3-9	ND	5	28	25	ND	53

A comprehensive look at all Sites and there break down can be found in Appendix D.

4.3.2 Flame Atomic Absorption Results

For the Flame Atomic Absorption test five background samples, ten hill site samples, and ten road site samples were tested. There was also eight duplicates ran with four coming from road sites and four from hill sites. Table 5 below shows the comparison between the FAA and XRF for the background site samples.

Table 5: Comparison of FAA and XRF for Background Samples

Sample ID	FAA (ppm)	XRF (ppm)
B-1	53.1	42.1
B-2	16.8	20.7
B-3	16.0	20.7
B-4	14.9	20.0
B-5	13.9	17.6

From the table above it can be seen the FAA gave lower numbers for the majority of data as compared to the XRF analysis. The table below shows the duplicates and how they compare to the XRF data.

Table 6: Comparison of Duplicates

Sample ID	FAA (ppm)	XRF (ppm)	RPD (%)
1-3A	24.0	26.7	17
1-3B	28.9	26.7	
1-4A	1584.6	488.4	94
1-4B	96.6	488.4	
2-4A	2384.9	2621.1	24
2-4B	1819.5	2621.1	
7-1A	15.9	19.4	52
7-1B	33.0	19.4	
8-2A	491.8	161.4	29
8-2B	351.0	161.4	
13-1A	20.0	21.0	3
13-1B	19.3	21.0	
14-2A	18.3	20.1	9
14-2B	20.2	20.1	
15-10A	24756.0	4466.4	57
15-10B	10528.7	4466.4	

As seen above most of the samples were within a 25% relative percent difference from each other. A complete list of all samples and data can be found in Appendix D.

5.0 Quality Assurance / Quality Control

Procedures regarding steps taken to ensure quality control are discussed with in the Work Plan in Appendix A. This section provides a summary of what happened at each step throughout the project. These processes and procedures are as follows:

- During field work decontamination of all work materials was performed between each sample and five background samples were taken

- During travel all chain of custody procedures were followed and samples stayed with the ASK team
- During lab work proper protection equipment was used at all times and proper decontamination procedures were used to prevent cross contamination
- During lab testing duplicate samples were run in order to determine accuracy
- All instruments used (handheld XRF, weighing scales, FAA machine) were tested for accuracy
- The handheld XRF and scales were calibrated or zeroed between each sample to ensure accuracy
- A working standard was used throughout FAA testing to ensure no deviation occurred within the instrument

6.0 Migration Pathways

The section below discusses the migration potential of COCs within the study area.

6.1 Surface Water Migration Pathway

The 15 sites being focused on encompass roughly 11 acres, and are bound by W Komatke Rd. and the unnamed hill range along the northern border of the Phoenix BLM District. Figure 8 shows this area as well as the average lead concentrations.

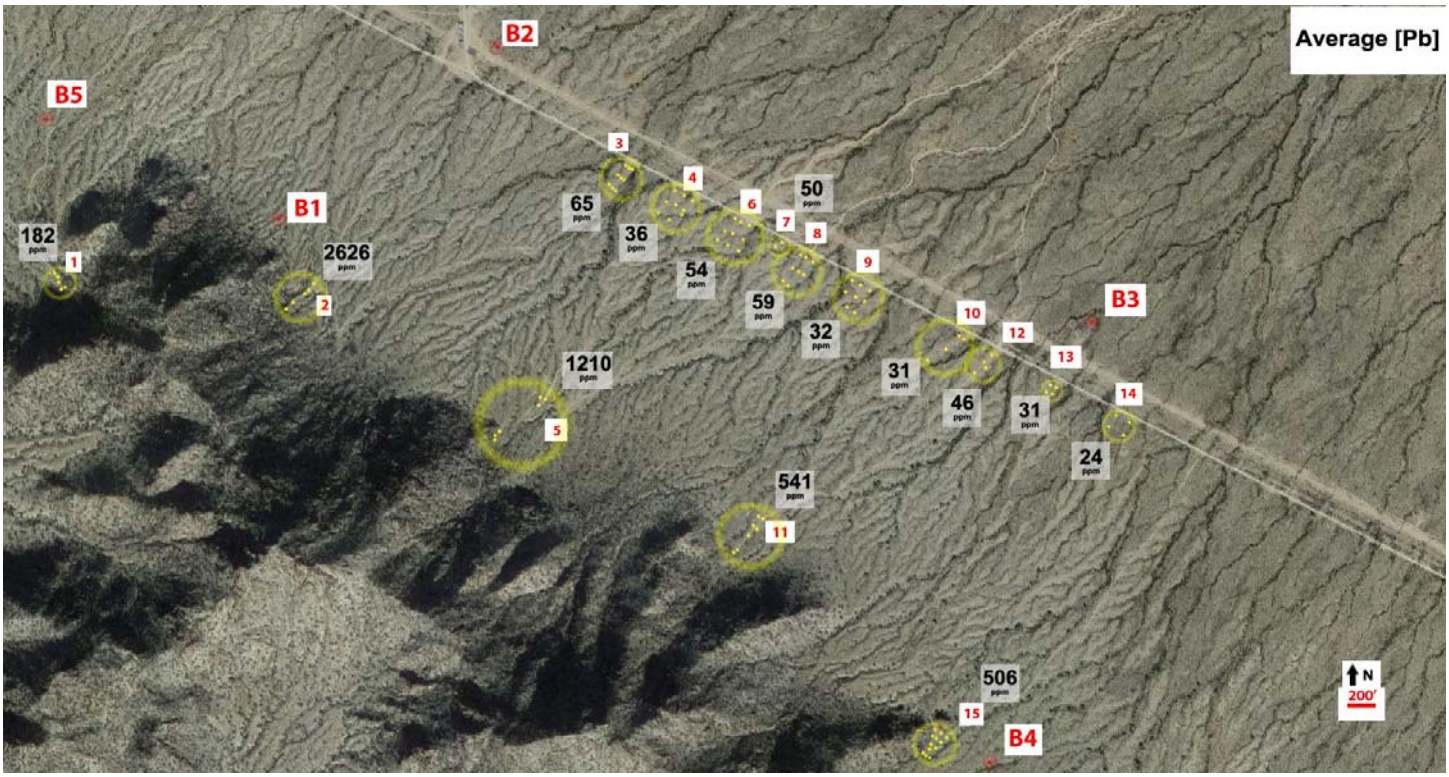
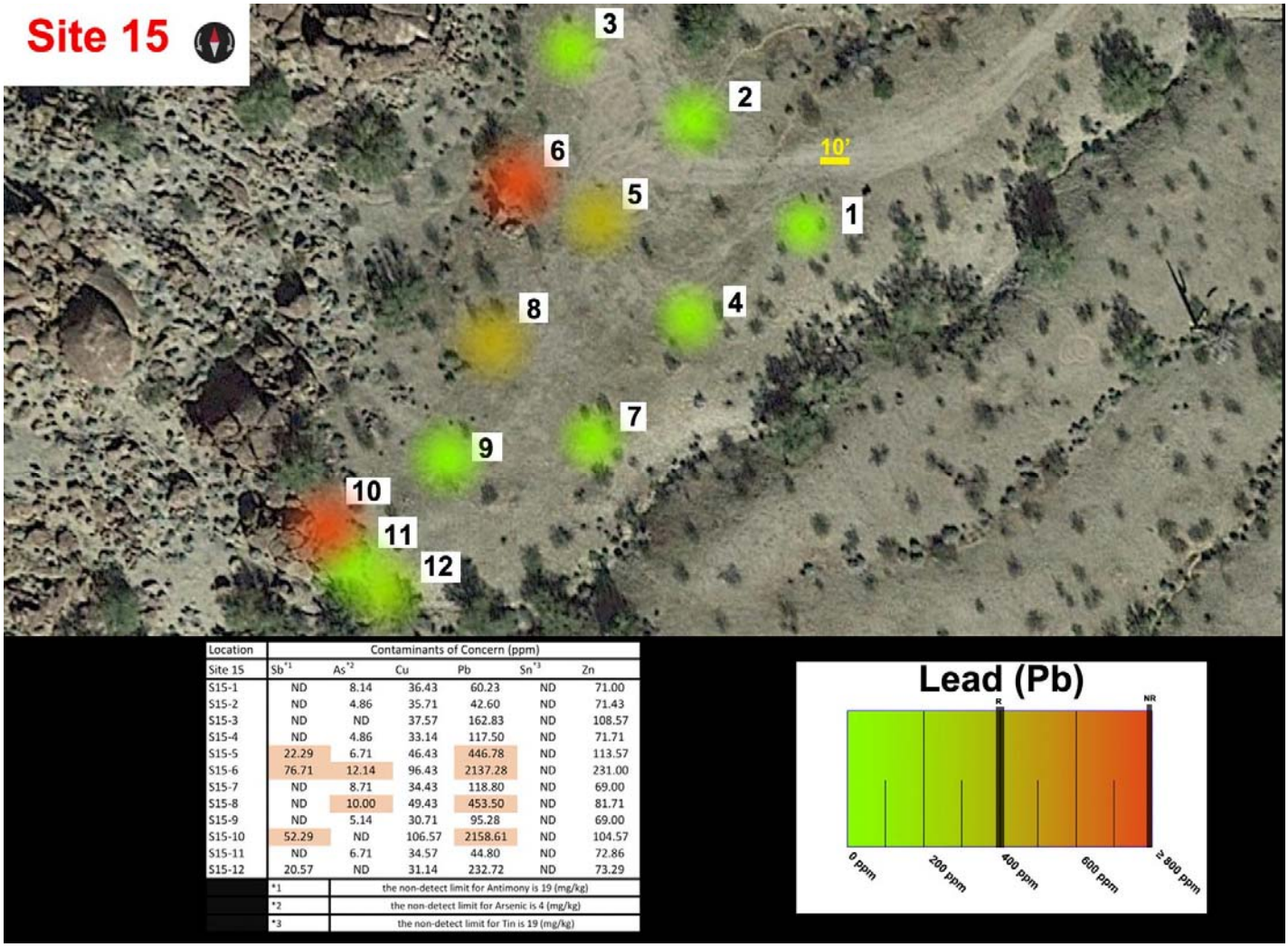


Figure 8: Overall Site Map & Ave3rage Lead Concentrations

The topography of the area can be summarized as sloping downward from the unnamed hill range to W Komatke Rd.. Along this slope runs numerous unnamed ephemeral washes. These washes decrease in depth as they approach W Komatke Rd. and eventually cross this road in the absence of any engineered structures.

These surface water drainages are of concern because the Hill Sites are found at a higher elevation and contain greater contamination. Although characterizing the washes for contamination was not the main concern of the client, a sample was taken at site 15 in an adjacent wash. The sample in question is Sample 12 (Figure 9). This surface sample was taken at the bottom of the slope as seen in Figure 10.This wash can be seen below in Figure 9.



Location	Contaminants of Concern (ppm)					
Site 15	Sb *1	As *2	Cu	Pb	Sn *3	Zn
S15-1	ND	8.14	36.43	60.23	ND	71.00
S15-2	ND	4.86	35.71	42.60	ND	71.43
S15-3	ND	ND	37.57	162.83	ND	108.57
S15-4	ND	4.86	33.14	117.50	ND	71.71
S15-5	22.29	6.71	46.43	446.78	ND	113.57
S15-6	76.71	12.14	96.43	2137.28	ND	231.00
S15-7	ND	8.71	34.43	118.80	ND	69.00
S15-8	ND	10.00	49.43	453.50	ND	81.71
S15-9	ND	5.14	30.71	95.28	ND	69.00
S15-10	52.29	ND	106.57	2158.61	ND	104.57
S15-11	ND	6.71	34.57	44.80	ND	72.86
S15-12	20.57	ND	31.14	232.72	ND	73.29

*1	the non-detect limit for Antimony is 19 (mg/kg)
*2	the non-detect limit for Arsenic is 4 (mg/kg)
*3	the non-detect limit for Tin is 19 (mg/kg)

Figure 9: Site 15 Concentration Map

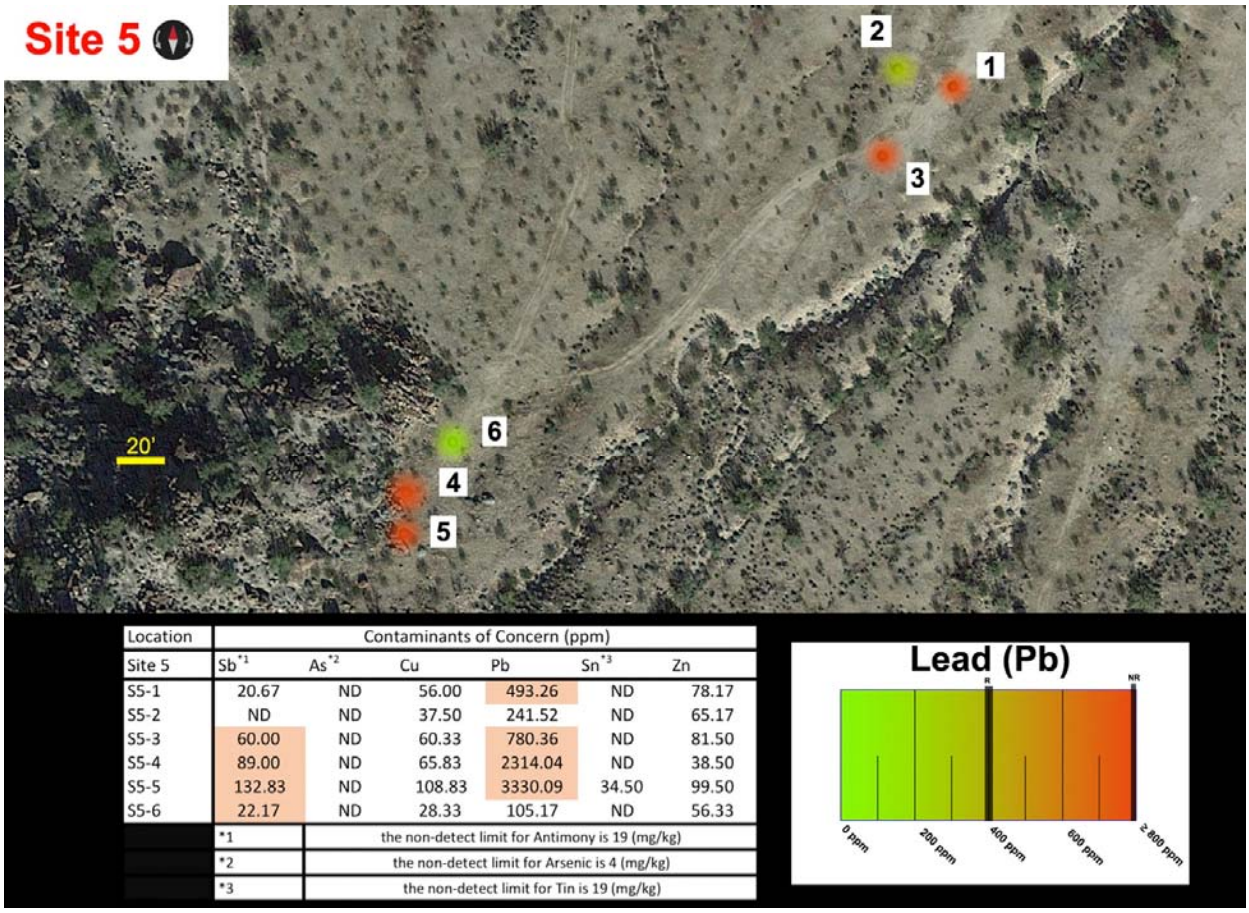
Figure 10: Wash Sample

Sample 12 was found to have lead and antimony concentrations an order of magnitude greater than the average background concentration. This suggests migration is occurring via these surface water drainages. It's worth noting, of the 5 hill sites, Site 15 had the 4th lowest average lead concentration. Therefore, it's ASK Haz Wastes recommendation that further studies be conducted regarding the contamination of these channels.

6.2 Soil Exposure Pathway

Exposure pathways consist of an initial release and conclude with interaction with a receptor. The initial release pertaining to recreational shooting can be considered the gaseous mixture that is ejected from the barrel of a gun after being shot. These gases then condense and particles are deposited in front of the firing line or range floor.

However, during the course of ASK Haz Wastes PA/SI, it was found the greatest source of contamination (regarding the 6 COCs) was with respect to the soil adjacent to large rocks which had been eroded by bullet impacts, or the soil in the impact areas. The release mechanism regarding these areas would be the collision of the bullets with the rocks themselves. These impact areas can be seen in figure 11 below at sample locations 4 and 5.



Location	Contaminants of Concern (ppm)					
Site 5	Sb*1	As*2	Cu	Pb	Sn*3	Zn
S5-1	20.67	ND	56.00	493.26	ND	78.17
S5-2	ND	ND	37.50	241.52	ND	65.17
S5-3	60.00	ND	60.33	780.36	ND	81.50
S5-4	89.00	ND	65.83	2314.04	ND	38.50
S5-5	132.83	ND	108.83	3330.09	34.50	99.50
S5-6	22.17	ND	28.33	105.17	ND	56.33
	*1	the non-detect limit for Antimony is 19 (mg/kg)				
	*2	the non-detect limit for Arsenic is 4 (mg/kg)				
	*3	the non-detect limit for Tin is 19 (mg/kg)				

Figure 11: High Contamination Areas

As can be seen in the table in Figure 11, the concentration of lead at sample sites 4 & 5 (impact area) are an order of magnitude greater than sample sites 1 & 3 (firing line). This would suggest that the gaseous release at the firing line poses less of a risk as compared to the release of contaminants from the impact area.

Important transport medium regarding these impact areas could include air (windblown dust) and surface water (runoff). Water runoff was discussed above, however, windblown dust has not been considered due to a lack of data. The exposure pathway which poses the greatest threat to the receptor (human or animal), would not consist of a transport medium, but would involve direct contact with the exposure medium (contaminated soil in impact area).

This could possibly occur while a patron is setting up targets within these impact areas. For example, dust could be suspended in the air by the activity and the contaminant could then take the exposure route of inhalation. In addition, this exposure medium could be suspended and make dermal contact, as well as, be ingested (by eating) after making said

dermal contact.

7.0 Human Risk Assessment

In the past lead was used in many of products like paint, pipes, solder, crystal, and ceramics. However nobody knew the health effects of this metal on the human body. There is no doubt now that lead can have a bad effect when exposed to it. This is especially true for children six years and younger. These children have a higher susceptibility to the effect of lead. Lead can have many effects like: behavior and learning disorders, lower IQ, hyperactivity, slowed growth, hearing problems, and anemia. In severe cases high level of lead can cause coma and even death. Lead also has bad effects on pregnant women because lead can accumulate in the bones with calcium, and it can transfer to the fetus when it needs calcium. This can result in a reduced growth of the fetus and premature birth. Lead also can have some effects on adults; it can increase blood pressure, incidence of hypertension, decreased kidney function and create reproductive problems.

For this human risk assessment three different human health scenarios were looked at. The scenarios were as follows:

- Adult recreational shooter
- Adult volunteer worker
- Child of recreational shooter

7.1 Adult Risk Assessment

For the adult model the EPA Adult Lead Methodology program was used. This program uses analysis through both Phase 1 & 2 of the National Health and Nutrition Examination Survey (NHANES). The NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. NHANES findings are also the basis for national standards for such measurements as height, weight, and blood pressure. Data from this survey are used in epidemiological studies and health sciences research, which help develop sound public health policy, direct and design health programs and services, and expand the health knowledge for the nation (II). From this the EPA was able to create this program to assess the risks associated with non-residential adult exposures to lead in soil. The methodology focuses on estimating the fetal blood lead concentration in women exposed to lead contaminated soil. This is because pregnant women have the highest chance for effects from high concentrations of lead (III). This model looks at the following parameters:

- PbS: Soil lead concentration
- BKSF: Biokinetic slope factor
- GSDi: Geometric standard deviation
- IRs: Soil ingestion rate
- IRs+d: Total ingestion rate of outdoor soil and indoor dust
- Ws: Weighting factor of IRs+d as outdoor soil
- Ksd: Mass fraction of soil in dust
- AFs,d: Absorption fraction
- EFs,d: Exposure Frequency
- ATs,d: Averaging time
- PbBfetal,0.95: 95th percentile blood lead level among fetuses of adult workers
- PbBt: Target blood lead level

All of this helps to find the PbBadult (blood lead level of adult worker) and the P[PbBfetal>PbBt] (probability that fetal PbB>PbBt). For these scenarios the default parameter values were used for all except the Pbs, AFsd, and EFsd. For the soil lead concentration value a 90% max of 1237 ppm and average value of 64 ppm was used. For an adult recreational shooter it was found that on average someone will go shooting 22 times a year (IV). From the Bureau of Labor Statistics it was found that on average people volunteer in an outdoor project eight times a year (V). Tables 7 and 8 below show the outcomes for the Adult Scenarios.

Table 7: Adult Blood Lead Concentration for an Adult Shooter

		Adult Shooter	
	Units	90% max	Mean
Soil Lead Concentration	ppm	1237	64
Exposure Frequency	days/yr	22	22
Averaging Time	days/yr	365	365
Blood Level Concentration	ug/dL	2.4	1.5

Table 8: Adult Blood Lead Concentration for an Adult Volunteer Worker

		Adult Volunteer	
	Units	90% max	Mean
Soil Lead Concentration	ppm	1237	64
Exposure Frequency	days/yr	8	8
Averaging Time	days/yr	365	365
Blood Level Concentration	ug/dL	1.8	1.5

From the tables above it can be seen that there is no increase in blood lead concentration for the mean concentration of the sites. For the 90% max concentration a raise in blood lead concentration can be seen for both the adult shooter and worker. If the averaging time was reduced the blood lead level concentrations would increase. Both of these models are below the regulatory standard of 10 micrograms per deciliter for adults.

7.2 Child Risk Assessment

For children the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) was used. The IEUBK model looks at the following:

- Outdoor Soil Lead Concentration
- Soil/indoor dust concentration
- Soil/dust ingested daily
- Outdoor air lead concentration
- Inputs for different ages
- Dietary lead intake
- Water consumption
- Lead concentration in drinking water
- Absorption fraction percent for each media

All these factors are used to determine the blood lead concentration for a child in the age ranges from .5-7 years old. The IEUBK model takes a look at exposure to concentrations

on a daily basis so an average of each concentration was used for each scenario. Table 9 below shows the outcome of a child receiving the 90% Max dose.

Table 9: IEUBK Model for a Child of an Adult shooter for the 90% Max

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	1.291	2.795	1.5
1-2	2.045	3.992	1.7
2-3	2.053	4.158	1.6
3-4	2.063	4.156	1.5
4-5	1.538	3.639	1.3
5-6	1.387	3.628	1.1
6-7	1.312	3.659	1.0

From this table a raise in blood level concentration can be seen up to 1.7 micrograms per deciliter. The regulatory limit for a child is five micrograms per deciliter. All preset parameters were used except for the outdoor soil lead concentration. It should be noted that because this model take the concentration on a daily basis it is less accurate for predicting outcomes. The results for each run of these models can be found in Appendix E.

8.0 Ecological Risk Assessment

For the SDNM project, flora and fauna present are typical of the high desert environment, with the exception of the Saguaro cactus (Carnegiea gigantean), which is native to the Sonoran Desert. This particular flora is protected by state law in Arizona and has a conservation status of "least concern" (VI). The concern with this species is the threat from being shot by recreational shooters. Even though law protects it, the saguaro can become a target for recreational shooters.

Additional flora of concern in the study area include sub tree species such as: the Velvet Mesquite, Palo Verde, and Ocotillo. Also, smaller shrubbery includes: the Creosote Bush, Bur Sage, and Indigo Bush. The density of these flora generally increase as you move away from the Hill Sites toward the Road Sites. This is not necessarily a symptom of contamination but most likely a product of the local topography/hydrology.

Lead can affect these flora by becoming concentrated in the upper organic layers of soil. This particular COC has been shown to have detrimental impacts on microorganisms found in the soil at concentrations of 1000 ppm (VII). This reduction in microbes in turn slows the decomposition of organics into nutrients needed by the plants. In addition to reducing available food, lead can

be concentrated in plant roots and then transported throughout the plant. The concern is not with harming the plants with these lead concentrations themselves, because most plants can withstand relatively high concentrations of lead, the concern is of lead moving up the trophic levels.

Therefore, fauna of concern include ground dwelling rodents and raptor species that could potentially move contaminants to higher trophic levels. Some specific rodent species includes: the cactus mouse (Peromyscus eremicus), the Arizona cotton rat (Sigmodon arizonae), and the desert woodrat (Neotoma lepida) (VIII). Specific raptor species include: the Horned Owl, the Chihuahuan Raven, the Prairie Falcon, and the common Barn Owl (IX).

The majority of rodent species listed above are herbivores which have the potential to consume lead contaminated plants. A diet of 2-8 mg of lead per kilogram of body weight per day over time has been seen to cause death in most grazing animals (VII). However, making more conclusive statements regarding the ecological risk posed by recreational shooting within the study area would require more studies to be conducted.

9.0 Summary of Project Costs

In reference to the submitted proposal costs and project management schedule, not many changes were made. The overall cost of the project was determined to be $88,000, a little under the estimated $89,000. It was originally estimated that 449 hours would be spent on this project and the final count came out to 444 hours. The project engineers spent less time than proposed, however more time was spent by the field techs. The full breakdown of the project costs can be found in Appendix G.

The differences in the proposed Gantt chart and the final Gantt chart came from the distribution of time spent on a certain task. The differences in days allot per task are as follows:

- Task 2 Background Research was allotted 195 days to be completed but was completed in 70 days
- Task 3 Work Plan was given 52 days to be completed but was completed in 70 days

It is important to note that some of these task overlap with their beginning and end date so summing up the total days to complete a task would not be appropriate. Background Research was originally scheduled to run the entire length of the project, which was not correct. The work plan took longer than projected as complications arouse with getting edits identified between client and team. The PA/SI was scheduled to run longer than necessary because was originally planned to start after field-testing was done. However fieldwork got pushed back by the client giving a shorter amount of time to complete the task. In summary the project came in under budget and all tasks were completed on time. For a more in-depth breakdown of the Gantt charts

they can be found in Appendix G.

10.0 Recommendations

Based on the findings by the ASK Haz Waste team it is recommended that further site inspection be completed. These recommendations include the following:

- Further soil investigation of the hill sites by increasing the number of samples taken in the area
- Further investigation of the extent of contamination within the washes around the sites and the potential impact
- Further identification of other possible recreational shooting sites in the area near the hill and on the roads
- Further investigation of exposure pathways
- Further investigation to determine leach ability and vertical extent of impacted surface soil at the hill sites

These recommendations should provide more information on the need for remediation and the risk the sites pose to people using the sites.

11.0 Conclusions

This Preliminary Assessment & Site Inspection (PA/SI), conducted for the Bureau of Land Management (BLM) with regards to the Sonoran Desert National Monument (SDNM) Recreational Shooting Site Project (RSSP), characterized 15 sites with respect to six metals. These metals are: lead, antimony, arsenic, copper, tin, and zinc. ASK Haz Waste's findings were the Hill Sites showed higher average concentrations of the contaminants of concern (COC), as compared to the Road Sites. In fact, these Hill Sites contained areas that were significantly over Arizona's residential and nonresidential concentrations for the COCs. It is ASK Haz Waste's recommendation that the BLM seek further investigation into the extent of contamination of the hill sites, as well as, commission studies into the extent of contamination of the ephemeral natural channels that run adjacent to the hill sites.

References

I - Arizona Administrative Code - Remediation Action, Title 18 - Appendix A § 7 (Department of Environmental Quality 2009). Print.

II- "About NHANES." *Centers for Disease Control and Prevention*. 3 Feb. 2014. Web. 5 May 2015. <http://www.cdc.gov/nchs/nhanes/about_nhanes.htm>.

III- "Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil." Environmental Protection Agency, 1 Jan. 2003. Web. 5 May 2015. <http://www.epa.gov/superfund/health/contaminants/lead/products/adultpb.pdf>.

IV - "Target Shooting in America." National Shooting Sports Foundation Inc. Web. 5 May 2015. <http://www.nssf.org/PDF/research/TargetShootingInAmericaReport.pdf>.

V - "About the Charts." *U.S. Bureau of Labor Statistics*. U.S. Bureau of Labor Statistics. Web. 5 May 2015. http://www.bls.gov/tus/charts/

VI - "Carnegiea Gigantea." *Carnegiea Gigantea (saguaro Cactus)*. N.p., http://www.kew.org/science-conservation/plants-fungi/carnegiea-gigantea-saguaro-cactus Web. 30 Jan. 2015.

VII - Greene, Deni. "Effects of Lead on the Environment." *Effects of Lead on the Environment*. Lead Education and Abatement Design, July 1993. Web. 04 May 2015.

VIII - "Muridae: Mice & Rats." *Muridae: Mice & Rats*. N.p., n.d. Web. 30 Jan. 2015. <https://www.desertmuseum.org/books/nhsd_muridae.php>.

IX - "Arizona-Sonora Desert Museum." *Raptors at the Arizona-Sonora Desert Museum*. N.p., n.d. Web. 30 Jan. 2015. <https://www.desertmuseum.org/visit/raptors.php>

Appendices