Dragon Mine PA/SI Project Proposal
CENE 476C

[Draft 3, Version 3]

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List of Abbreviations

ADEQ	Arizona Department of Environmental Quality
ADMMR	Arizona Department of Mines and Mineral Resources
ALM	Adult Lead Model
AZ	Arizona
AZSRS	Arizona Soil Remediation Standards
BLM	Bureau of Land Management
CECMEE	Civil Engineering, Construction Management, and Environmental Engineering
CENE	Civil and Environmental Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
ECM	Enterprise Content Management Consultants
ECOTOX	Environmental Toxicity
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
FAA	Flame Atomic Absorption
HASP	Health and Safety Plan
HHE	Human Health and the Environment
ICP	Inductively Coupled Plasma
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
NAU	Northern Arizona University
PA	Preliminary Assessment
QA	Quality Assurance
QC	Quality Control
SAP	Sampling and Analysis Plan
SCM	Site Conceptual Model
SI	Site Investigation
SRL	Soil Remediation Level

RAO	Remedial Action Objective
XRF	X-Ray Fluorescence

1.0 Project Understanding

1.1 Project Purpose

The purpose of this project is to conduct a Preliminary Assessment (PA) and Site Investigation (SI) of the Dragon Mine, located near Wickenburg, Arizona (AZ), to evaluate possible threats to Human Health and the Environment (HHE) and to ensure compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Using information from the PA/SI, a risk assessment will be conducted, and potential remedial actions will be explored.

1.2 Project Background

The Dragon Mine is an abandoned mine and milling site located in the south half of Section 23, Township 7 North, Range 4 West, Gila and Salt River Meridian, about 5.7 miles southeast of Wickenburg, in Maricopa County, Arizona. Figure 1-1 shows the location of the site within the state of Arizona and in relation to the major cities.

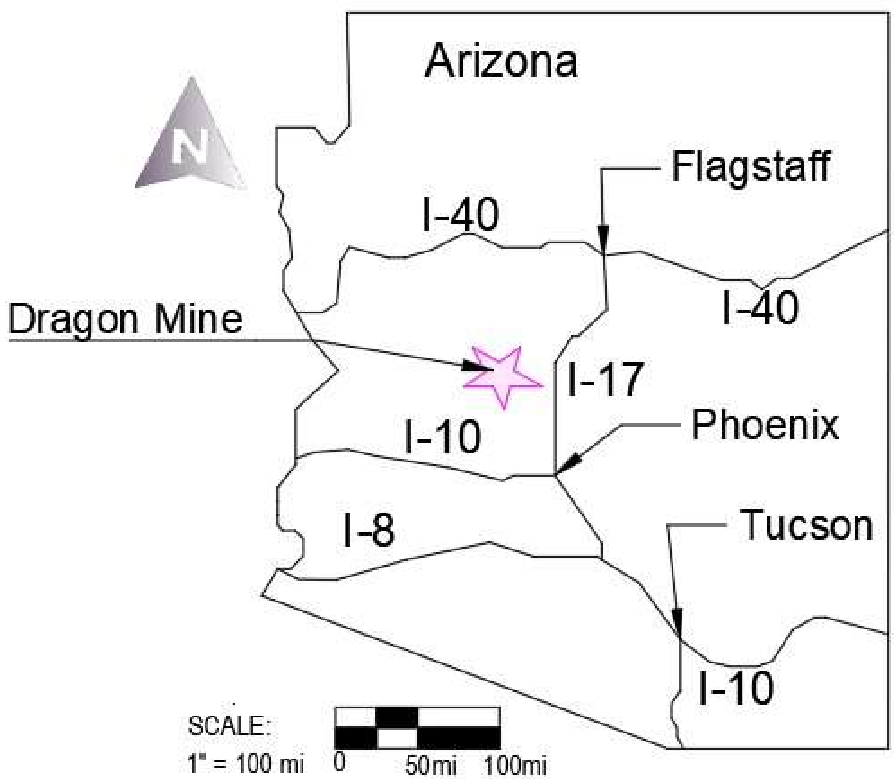

Figure 1-1. State of Arizona Location Map [1]

Figure 1-2 shows the location of the Dragon Mine within Maricopa County and in relation to the major cities. The location of Maricopa County within the State of Arizona is shown in red at the bottom right of Figure 1-2.

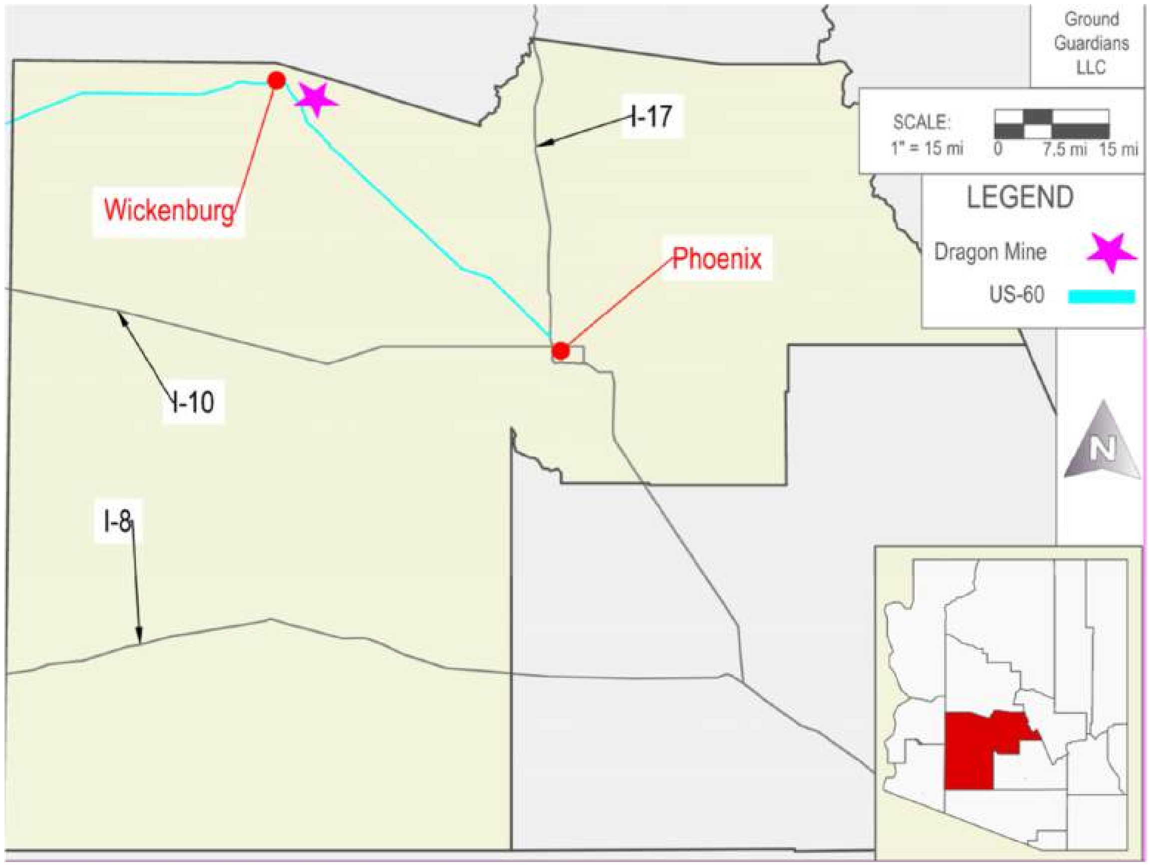

Figure 1-2. Maricopa County Location Map [2]

Figure 1-3 shows the location of the Dragon Mine relative to the city of Wickenburg, AZ and site access roads. Two separate access routes are shown in red. The west access route has a spur where mining occurred. The surrounding land is owned by the Bureau of Land Management (BLM).

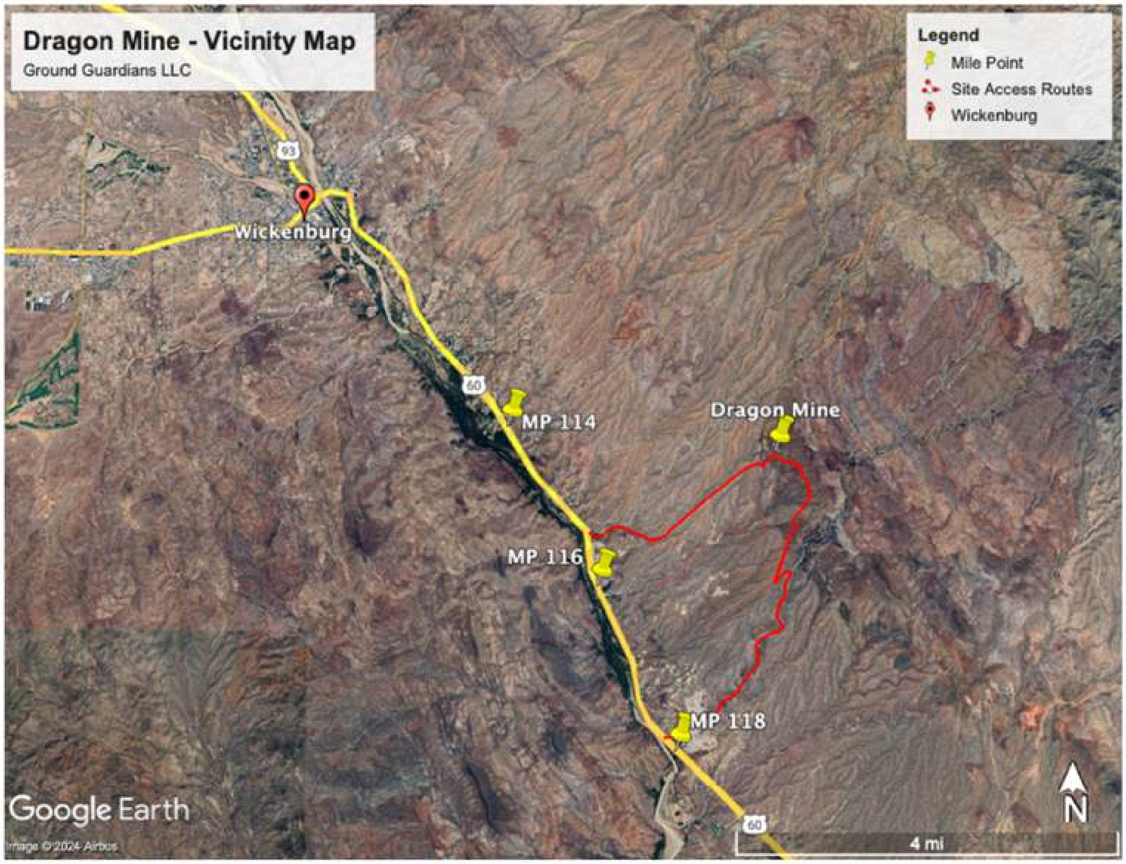

Figure 1-3. Vicinity Map [1]

The Dragon Mine was primarily used from the late 1800s to 1942, producing vanadinite, gold, and silver [3]. Two field inspections occurred at the Dragon Mine site first by the Arizona Department of Mines and Mineral Resources (ADMMR) personnel in 1989 and by Enterprise Content Management Consultants (ECM) personnel in 2019. The 1989 field inspection discovered that the site had evidence of a heap leaching operation. A heap with 5000 tons of material as well evidence of a small pond of pregnant solution that was neither neutralized nor fenced off remained from the operation. The 2019 field inspection found several adits, shafts, test pits, and concrete foundations. Several disheveled foundations can be found, including those of the old mill, burners, ore bins, and two large water troughs. There is a tunnel from the west side of the ridge that leads to an open excavation point. The ECM team determined that there was no public recreation going on at the site [3].

The wash at the northern boundary of the site flows from northeast to southwest. There is a range of hills to the east with elevations ranging from 2,400 to 2,600 feet. The site itself is relatively flat with a slope of around 2-3%. Down gradient are the Hassayampa River and Monarch Wash which are 2.3 miles southwest of the Dragon Mine.

Figure 1-3 below shows a map of the site characteristics and the proposed site boundary.

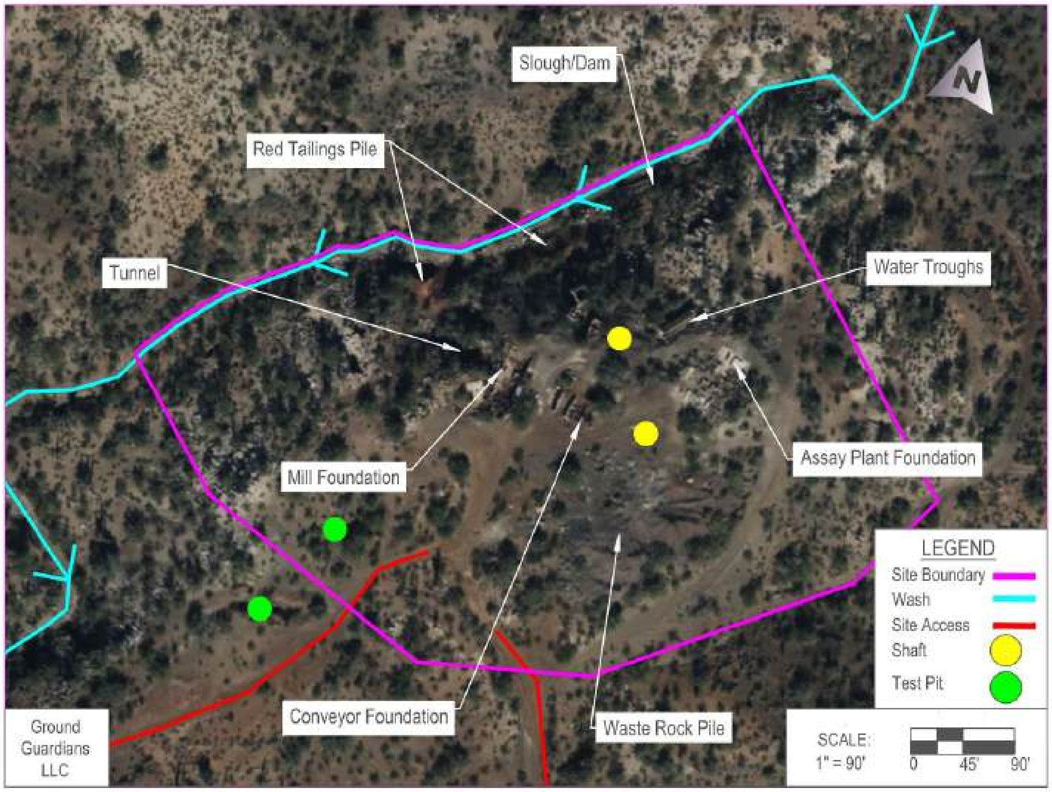

Figure 1-4. Site Characteristics [4]

ECM consultants conducted an SI on the Dragon mine site to determine concentrations of Contaminants of Concern (COCs). Figure 1-4 shows the sampling locations from the ECM site investigation [3].

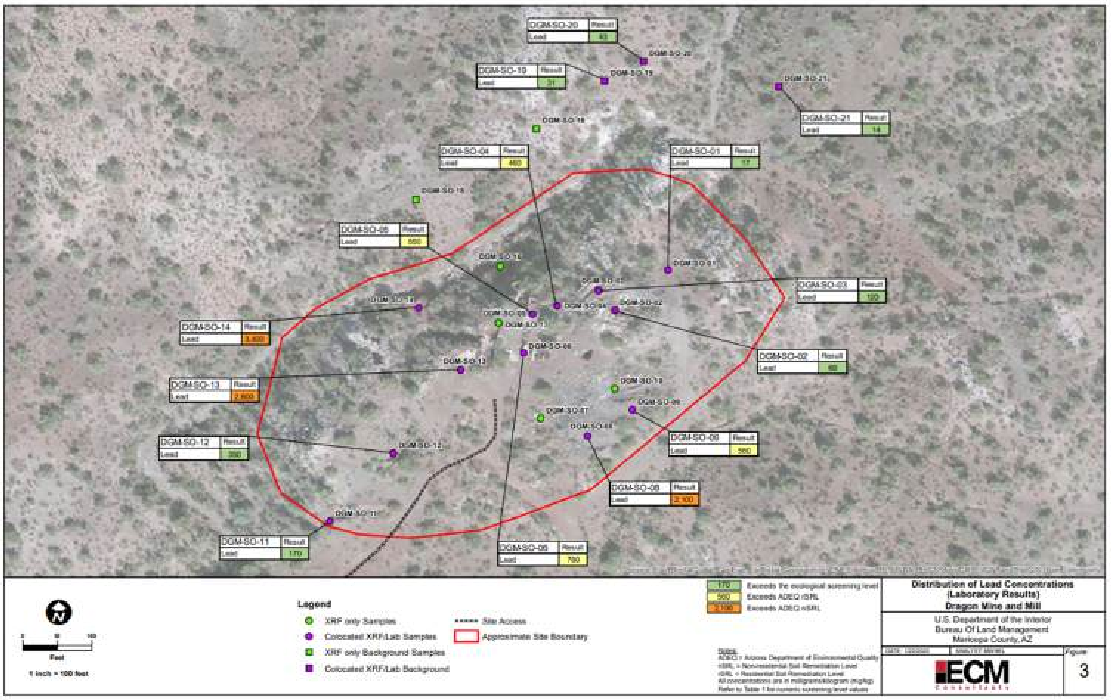

Figure 1-5. ECM Sampling [3]

The COCs determined were antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, vanadium, and zinc. Table 1-1 shows a summary of the results from the ECM X-Ray Fluorescence (XRF) analysis for the COCs exceeding the Arizona Department of Environmental Quality (ADEQ) residential Soil Remediation Levels (SRL).

Table 1-1. ECM XRF Analysis Summary [3]

Soil	Antimony	Arsenic	Lead	Molybdenum	Vanadium
Area of Concern	**(mg/kg)**				
Downgradient Debris	<394	5	16	<29	259
Mill Foundation	<437	**10**	**115**	<34	**368**
Water Troughs	<199	**15**	**101**	27	<56
Waste Pile	<368	<28	**667**	<28	**548**
Foundation	<579	**29**	**593**	12	**515**
Foundation for a conveyor	<447	**26**	**373**	<35	**409**
Heap Leach?	<396	<24	**414**	<30	**378**
Heap Leach?	<405	9	**141**	<31	295
Heap Leach?	<385	<36	**1062**	17	**455**
Heap Leach?	43	<33	**827**	5	**538**
Waste Rock Pile	<381	<18	**228**	<29	**1241**
Waste Rock Pile	<390	<14	**127**	<31	**347**
Mill Platform	<334	<60	**3967**	88	**581**
Red Tailings	<324	<65	**4894**	102	**440**
Red Tailings in the vicinity of collapsed structure	<226	<83	**10776**	485	**594**
Tailings near mill	<438	<38	**862**	<35	288
Background	<410	7	**91**	<32	**369**
Background	<380	5	49	<30	**432**
Background	<371	**10**	42	<29	**371**
Background	<426	7	57	<33	**335**
Background	<375	5	21	<29	323

Green shaded cells in Table 1-1 indicate concentrations that exceed the ecological screening levels set by ECM consulting. Yellow and red shaded cells exceed values for human health. Yellow shaded cells indicate concentrations that exceed the residential SRLs, and red shaded cells indicate the concentrations that exceed the non-residential SRLs. The arsenic ecological screening level determined was 18 mg/kg which is why the green cells have larger values than the yellow cells, which are exceeded for human, not ecological health. Bolded cells indicate concentrations three times greater than the background concentrations. The cells containing values with a less than symbol represent concentrations that are lower than the instrument's confidence range. Table 1-2 shows the ADEQ SRLs for the COCs in Table 1-1.

Table 1-2. ADEQ SRLs [5]

Contaminant	Residential (mg/kg)		Non-Residential (mg/kg)
	Carcinogenic (10^{-5} Risk)	Non-Carcinogenic	
Antimony		31	410
Arsenic	10	10	10
Lead		400	800
Molybdenum		390	5,100
Vanadium		78	1,000

There are no wells in Section 23 where the Dragon Mine is located. However, there are wells located in Sections 22 and 26, directly west and south of Section 23 respectively. Figure 1-5 shows a map of the existing wells near the site.

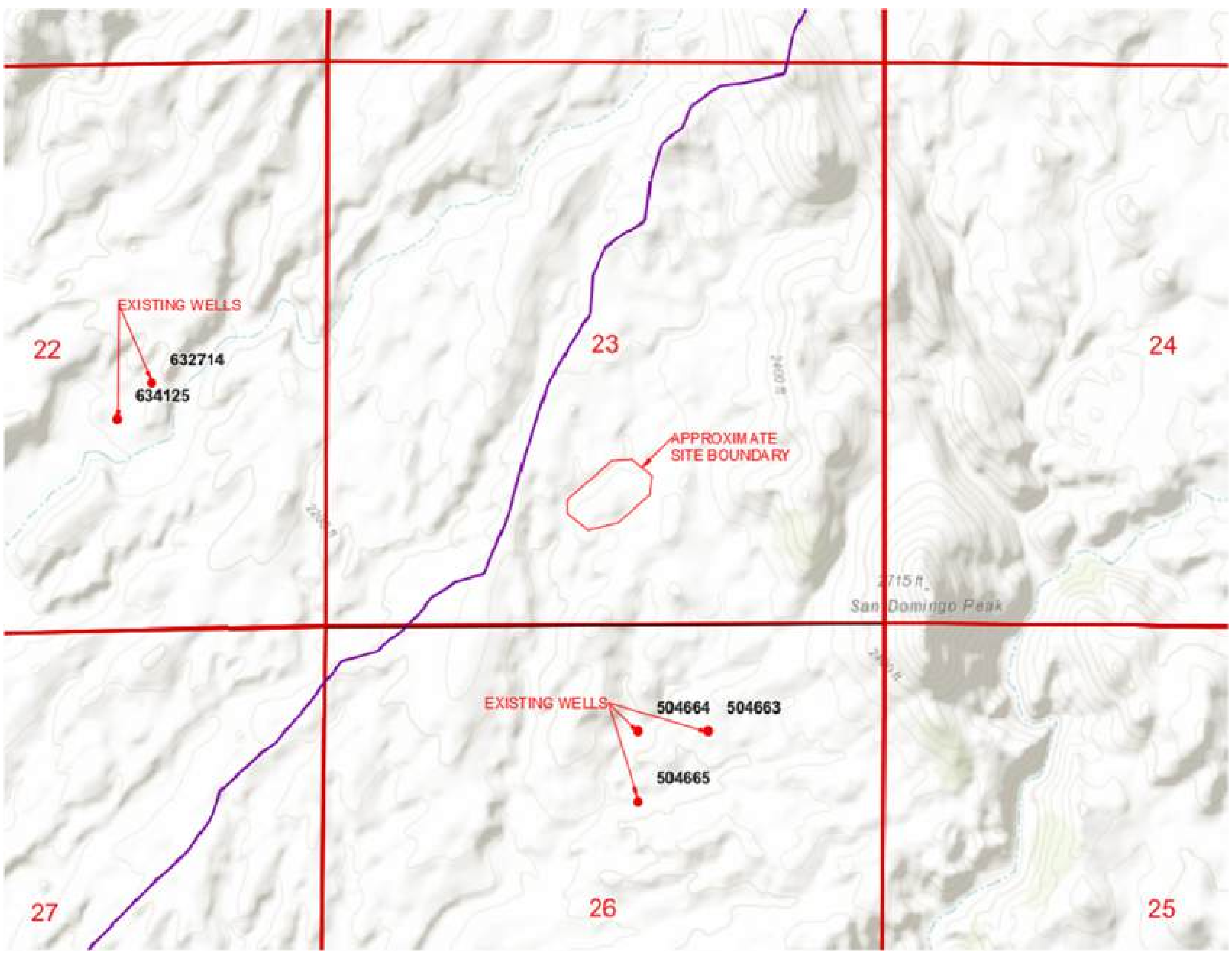

Figure 1-6. Existing Wells [6]

Table 1-2 shows information for the wells shown in Figure 1-5.

Table 1-3. Well Information

Registry Number	Use	Active or Inactive	Depth (feet)
504663	Mineral Exploration	Active	200
504664	Mineral Exploration	Active	200
504665	Mineral Exploration	Active	200
632714	Stockwater	Active	Unknown
634125	Stockwater	Active	Unknown

Dragon Mining and Development Company of Wickenburg Arizona was the claimant of the mine at the time of contamination of the mine; the owner of the Dragon mine is the BLM. The site is potentially under claim for lithium mining from San Domingo LLC.

1.3 Technical Considerations

For this project, the development of a Work Plan, including a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HASP), is required before starting field work. The plans developed will be based on the conditions of the site and the surrounding area. Soil samples will be collected during field work to determine the COCs and their concentrations, measured using both in situ and ex-situ XRF analysis.

A risk assessment for carcinogenic and noncarcinogenic risk will be determined prepared for both human health and ecological risk. A remedial action plan will also be designed for the site.

1.4 Potential Challenges

It is possible severe weather conditions could occur prior to and during field work, in that event, backup sampling dates will be planned. In the event of wet soil conditions at the site (in-situ XRF cannot be performed on wet soil), samples will be collected and dried in the laboratory prior to using the XRF device on the unsieved soil to approximate in-situ conditions.

1.5 Stakeholders

The primary stakeholder is the client, Bureau of Land Management (Eric Zielske of the BLM Phoenix State office). Secondary stakeholders include recreational visitors and the general public. These people are stakeholders because the Dragon Mine is on public land and easily accessible.

2.0 Scope of Services

2.1 Task 1.0 Work Plan

A Work Plan will be developed prior to investigating the site. The Work Plan will contain the SAP and HASP.

2.1.1 Task 1.1 Sampling and Analysis Plan

This SAP will be created according to Environmental Protection Agency (EPA) guidance [7]. The SAP includes agency responsible, project personnel and their responsibilities, project goals, data quality objectives, QA/QC measures for field and lab analysis number of samples to be collected, the location of the samples, type of sampling methods to be used, sampling labeling scheme, and equipment list. A minimum of two maps will be provided to depict where samples are taken.

2.1.2 Task 1.2 Health and Safety Plan

The HASP is created to comply with OSHA. The plan identifies the primary health and safety officer who is responsible for the well-being of other team members in the field and in the lab. This document includes potential field and laboratory hazards suggested mitigations/PPE to avoid the hazard, training requirements for equipment to be used, site control and operational procedures, personal decontamination procedures, emergency response procedures, and emergency contacts.

2.1.3 Task 1.3 Lab Binder/Lab Access

To gain access to the Civil and Environmental Engineering (CENE) Soils Lab for future analysis of the samples, a Lab Binder will be created before lab access is granted. This binder will document all laboratory safety, and cleanup protocols. This binder will be approved by the Civil Engineering, Construction Management, and Environmental Engineering (CECMEE) Lab Manager Dr. Adam Bringhurst.

2.2 Task 2.0 Site Investigation

A site visit to collect soil samples as outlined in the Work Plan will take place in mid-January with a second date in late January should weather cause a delay with the primary date.

2.3 Task 3.0 Laboratory Analysis

Samples gathered on-site will be transported back to the Northen Arizona University (NAU) CENE Soils Lab for further analysis. Samples will be oven-dried and sieved prior to XRF analysis.

2.3.1 Task 3.1 Sample Drying

To remove moisture content and homogenize the soil, samples will be dried according to ASTM Method D2216. After drying, soils are prepared for sieving. If soils are clumped, they will be broken up with a pestle to ensure an accurate sieving. [8]

2.3.2 Task 3.2 Sample Sieving

Heavy metals such as arsenic and lead tend to adsorb to finer soil particles. Thus, finer and more homogenous soil is desired for XRF analysis. Soil sieving will be performed according to ASTM Method D6913 [9]. Multiple sieve sizes will be used during the test, the smallest being the #60 sieve with a pore size of less than 250 μm. Once a distinct sample is sieved, the sieves will be washed and dried using compressed air to prepare for the next sample. Any oversized material will be appropriately discarded as solid waste.

2.3.3 Task 3.3 XRF Testing

XRF analysis will be performed in accordance with EPA Method 6200 [10]. Each sample will be further divided into nine different polyethylene XRF sample cups. Each sub-sample will undergo XRF analysis for 90 seconds. Resulting in nine unique measurements for each sample collected. All data will be transposed onto a spreadsheet. The maximum and minimum value for each element within a sample will be excluded.

2.3.4 Task 3.4 Acid Digestion

The presence of lead is known to cause inaccurate readings of arsenic concentrations using the XRF device. Acid digestions will be performed in accordance with EPA Method 3050B by an external laboratory to confirm the team's arsenic analysis [11].

2.3.5 Task 3.5 FAA/ICP

Following Acid Digestion, Flame Atomic Absorption (FAA) and Inductively Coupled Plasma (ICP) testing will be performed by the external laboratory for additional confirmation of chemical concentration. The FAA and ICP test will follow EPA methods 7000B, and 6010B, respectively [12] [13].

2.4 Task 4.0 Data Analysis

2.4.1 Task 4.1 Identification of Human Health and Ecological COCs

Results of XRF laboratory analysis will be compared to the Arizona Soil Remediation Standards (AZSRS) to determine the Human Health COCs. Ecological COCs will be determined by referencing the EPA's Environmental Toxicity (ECOTOX) database.

2.4.2 Task 4.2 Identify Exposure Point Concentrations for all COCs

Statistical analysis will be performed on the COC datasets to determine the distribution of the data to calculate the 50% and 95% Exposure Point Concentrations (EPCs) for each COC.

2.4.3 Task 4.3 XRF in-situ vs ex-situ Analysis

Statistical analysis will be performed on the XRF data from the ex-situ laboratory analysis to the in-situ analysis performed during the site investigation to determine the relationships between XRF in the field and the dried/sieved laboratory samples.

2.4.4 Task 4.4 XRF ex-situ vs FAA/ICP Analysis

Statistical analysis will be performed on the data from the XRF and FAA/ICP analysis to determine any relationships between the different analysis methods. If significant differences are found for any COC, XRF data will be corrected based upon the correlation obtained from this analysis, and EPCs will be recalculated as needed.

2.4.5 Task 4.5 QA/QC Analysis

Analysis of quality control samples will be performed to evaluate precision of soil concentration data.

2.5 Task 5.0 Contaminant Pathways

2.5.1 Task 5.1 Maps of Contaminant Distribution

Maps showing the distribution of COCs will be developed based on concentrations found through sampling and laboratory testing of the soil at the site.

2.5.2 Task 5.2 Migration Pathways

The migration pathways of the COCs will be identified. Migration pathways are needed to create a Site Conceptual Model (SCM), as well as when evaluating potential human health risks and ecological risks. COC migration pathways will be identified during the site visit coupled with the known physical properties of the COCs.

2.5.3 Task 5.3 Site Conceptual Model

An SCM will be developed based on the confirmed and assumed movement of contaminants at the project location. The SCM will include the contaminant source/sources, release/transport mechanisms, potentially contaminated media, potential exposure routes and receptors.

2.6 Task 6.0 Human Health Risk Assessment

2.6.1 Task 6.1 Toxicity Assessment

Using the COCs identified and EPA's Integrated Risk Information System (IRIS) database, reference doses and slope factors will be obtained for carcinogenic and noncarcinogenic risk respectively.

2.6.2 Task 6.2 Exposure Assessment

An exposure assessment will be performed to identify the type and magnitude of exposures to the COCs. Several potential exposure scenarios will be considered. The result of the exposure assessment is to determine COC dose for each scenario.

2.6.3 Task 6.3 Risk Characterization

The carcinogenic and noncarcinogenic risk for each COC, excluding lead, will be calculated for each exposure scenario.

The EPA's Adult Lead Model (ALM) and Integrated Exposure Uptake Biokinetic (IEUBK) model will be used to estimate the risk associated with potential lead exposure at Dragon Mine. The IEUBK model typically accounts for residential risk associated with lead to children aged 1-6; the model will be adjusted to account for non-residential exposure. The ALM estimates the risk associated with non-residential, adult exposure to lead. The ALM will also evaluate the probability that fetal blood-lead concentrations will exceed a target level

2.7 Task 7.0 Ecological Risk Assessment

Historical site-related activities require assessment to evaluate potential hazards to the environment.

2.7.1 Task 7.1 Potential At-Risk Species

Potentially at-risk fauna and flora species in and around the Dragon Mine site boundary will be identified and documented. Extra consideration will be taken if a selected species is endangered or threatened by the COCs.

2.7.2 Task 7.2 Area Use Factors

Future uses of the site will be evaluated and an analysis of the impacts on the surrounding environment will be determined. The severity of the impacts on ecosystems from the continued use of the site will be determined. The habitats will be characterized and evaluated as vegetative communities, reptiles and amphibians, fisheries, avians, mammals, and threatened or endangered species.

2.7.3 Task 7.3 Determination of Ecological Risk

A qualitative discussion of ecological risk characterization will be made and will be based on the estimated or measured exposure level for each stressor and plant, animal population, or ecosystem of concern. Expected harmful effects on the group will be listed and compared. Uncertainties will be acknowledged and discussed on how they might affect the assessment.

2.8 Task 8.0 Remedial Action

2.8.1 Task 8.1 Remedial Action Objectives

Remedial Action Objectives (RAOs) will be identified to describe the goals of cleaning the site in the future. They will specify the COCs, exposure pathways and receptors, and provide reasonable, measurable goals for the site.

2.8.2 Task 8.2 Develop Alternatives

Several possible remediation alternatives will be identified. Alternatives will be based on the physical characteristics of the site, contaminants present, and soil type. Alternatives must meet all the RAOs as well as follow federal and state soil remediation requirements. Alternatives will be combinations of technologies that have the potential to clean up the site effectively and at reasonable cost.

2.8.3 Task 8.3 Evaluate Alternatives and Select Preferred Alternative

Alternatives developed in Task 8.2 will be compared to each other using a weighted scoring system. The scoring system will evaluate the long-term effectiveness/reliability, short-term effectiveness, and cost of each alternative. Whichever alternative receives the highest score will be selected as the preferred alternative.

2.8.4 Task 8.4 Design of Preferred Alternative

The preferred alternative selected in Task 8.3 will be designed as required. AUTOCAD drawings of the solution will be created showing engineering details as required. Capital and operating costs of the solution will be estimated at the 50% engineering level for cost of implementation.

2.9 Task 9.0 Project Impacts

Environmental, human health, and economic impacts of the project will be discussed.

2.10 Task 10.0 Project Deliverables

2.10.1 Task 10.1 30% Deliverable

This deliverable will include a 30% report and presentation. Tasks 1.0-3.3 will be completed for this deliverable. Due February 13, 2025.

2.10.2 Task 10.2 60% Deliverable

This deliverable will include a 60% report and presentation. Tasks 3.4-5.0 will be completed for this deliverable. Due March 13, 2025.

2.10.3 Task 10.3 90% Deliverable

This deliverable will include a 90% report and draft of the project website. Tasks 6.0-8.0 will be completed for this deliverable. Due April 17, 2025.

2.10.4 Task 10.4 Final Deliverable

This deliverable will include a final report, presentation, and website. The final presentation will occur on May 2, 2025. Final report and website are due May 6, 2025.

2.11 Task 11.0 Project Management

2.11.1 Task 11.1 Meetings

Regularly scheduled meetings will be held with the team and the grading instructor/technical advisor. Meetings with the client will be scheduled at the client's request to view project progress. Team meetings will be held weekly at a minimum to ensure the team is on track, informed, and meeting the project requirements. The team will meet with the grading instructor/technical advisor to ensure the technical aspects of the project are being met.

A draft agenda for each meeting will be sent to each invitee at least 24 hours prior to the meeting. Minutes from each meeting are to be shared and approved by all attendees within 24 hours of the meeting's end. All agendas and minutes are to be organized in a meeting Memo Binder.

2.11.2 Task 11.2 Schedule Management

The schedule will be tracked following the Gantt Chart in Section 3.0. The Gantt Chart will be updated as needed to keep the team on track.

2.11.3 Task 11.3 Resource Management

The budget will be maintained by keeping track of expenses in an Excel spreadsheet and staffing hours in an Hours Log which will be updated weekly.

2.12 Exclusions

This project will not include any air or water sampling or analysis.

3.0 Schedule

The entire duration of the project will be 143 days excluding weekends, beginning October 17th, 2024, and ending May 6th, 2025.

The estimated time for each of the major tasks are as follows:

- Task 1.0 Work Plan (25 days)
- Task 2.0 Site Investigation (2 days)
- Task 3.0 Laboratory Analysis (24 days)
- Task 4.0 Data Analysis (25 days)
- Task 5.0 Contaminant Pathways (15 days)
- Task 6.0 Human Health Risk Assessment (17 days)
- Task 7.0 Ecological Risk Assessment (15 days)
- Task 8.0 Remedial Action (22 days)
- Task 9.0 Project Impacts (2 days)
- Task 10.0 Project Deliverables (76 days)
- Task 11.0 Project Management (143 days)

A Gantt chart displaying the project schedule for each task and deliverable is in Appendix A. The Gantt chart does not include weekends in the timeline, except for Task 2.

The critical path is the sequence of tasks in the project that must be completed on time to stay on schedule and complete the project on time. The critical path is shown in red on the Gantt chart and includes:

- Task 1.1 (Work Plan)
- Task 2.0 (Site Investigation)
- Task 3.0 (Laboratory Work)
- Tasks 4.4 and 4.5 (Data Analysis)
- Task 6.0 (Human Health Risk Assessment)
- Task 8.0 (Remedial Action Plan)
- Task 10.4 (Final Deliverable)

4.0 Staffing Plan

4.1 Staffing Positions and Qualifications

Ground Guardians LLC staff members include the following.

4.1.1 Senior Engineer

The Senior Engineer, with over 15 years of professional experience and a master's degree from an ABET-accredited institution, functions as the project manager. Certified as a Professional Engineer (PE), they possess an extensive background in environmental engineering, specifically site remediation and CERCLA actions, ensuring project deliverables align with deadlines and technical standards. Engineer

The Engineer, holding a bachelor's degree in environmental engineering and having passed the FE exam, will execute most of the project's technical tasks. With three years' experience specifically in soil analysis and risk assessment, they will apply their expertise under the guidance of the Senior Engineer, who will review the work to ensure it meets the required standards and quality benchmarks.

4.1.2 Lab Technician

The Lab Technician will operate under direct supervision from the Engineer, focusing on the collection of samples and adhering to laboratory procedures as outlined in the Work Plan. Trained in both lab safety protocols and the operation of equipment, their work ensures that all technical sampling and analytical processes are conducted accurately and safely, contributing essential data for the project's environmental assessments.

4.2 Project Staffing

The estimated hours of work expected for each staff member with respect to each task from the project scope can be seen in Table 4-1.

Table 4-1. Summary Staffing Hours

Task	Senior Engineer	Engineer	Lab Technician	Task Total
Task 1.0 Work Plan				
Task 1.1 Sampling and Analysis Plan	5	30	0	35
Task 1.2 Health and Safety Plan	5	15	0	20
Task 1.3 Lab Binder	0	5	15	20
Task 2.0 Site Investigation	25	50	50	125
Task 3.0 Laboratory Analysis				
Task 3.1 Sample Drying	0	2	50	52
Task 3.2 Sample Sieving	0	2	60	62
Task 3.3 XRF Testing	0	2	60	62
Task 3.4 Acid Digestion	0	1	1	2
Task 3.5 FAA/ICP	0	1	1	2
Task 4.0 Data Analysis				
Task 4.1 Identification of Human Health and Ecological COCs	2	5	0	7
Task 4.2 Identification of EPCs for all COCs	2	15	0	17
Task 4.3 XRF In-situ vs Ex-situ analysis	0	10	0	10
Task 4.4 XRF Ex-Situ vs FAA/ICP analysis	0	10	0	10
Task 4.5 QA/QC analysis	2	10	5	17
Task 5.0 Contaminant Pathways				
Task 5.1 Maps of Contaminant Distribution	2	15	0	17
Task 5.2 Migration Pathways	0	2	0	2
Task 5.3 Conceptual Site Model (CSM)	2	4	0	6
Task 6.0 Human Health Risk Assessment				
Task 6.1 Toxicity Assessment	0	8	0	8
Task 6.2 Exposure Assessment	0	20	0	20
Task 6.3 Risk Characterization	2	10	0	12
Task 7.0 Ecological Risk Assessment				
Task 7.1 Identification of Potentially at-risk Species	2	15	0	17
Task 7.2 Identification of Area Use Factors	2	15	0	17
Task 7.3 Determination of Ecological Risk	2	10	0	12

Task 8.0 Remedial Actions				
Task 8.1 Remedial Action Objectives	2	6	0	8
Task 8.2 Develop Alternatives	5	15	0	20
Task 8.3 Evaluate Alternatives and Select Preferred Alternative	1	5	0	6
Task 8.4 Design of Preferred Alternative	5	20	0	25
Task 9.0 Project Impacts	1	3	0	4
Task 10.0 Project Deliverables				
Task 10.1 30%	2	8	0	10
Task 10.2 60%	2	8	0	10
Task 10.3 90%	2	8	0	10
Task 10.4 Final	2	8	0	10
Task 11.0 Project Management				
Task 11.1 Meetings	30	60	30	120
Task 11.2 Schedule Management	10	5	0	15
Task 11.3 Resource Management	2	2	0	4
Subtotal Hours	117	405	272	
Total Hours	**794**			

5.0 Cost of Engineering Services

The total cost of engineering services for the project at Dragon Mine is $107,282. Costs include personnel, travel expenses for the site investigation, supplies and subcontract work. Supplies include rental of laboratory equipment and space. The detailed breakdown of cost can be seen in Table 5-1.

Table 5-1: Project Cost Summary

Project Costs Summary					
Subsection	**Classification**	**Qty**	**Rate**	**Unit**	**Cost**
Personnel	Senior Engineer	117	$300	$/hr	$35,100
	Engineer	405	$135	$/hr	$54,675
	Lab Technician	272	$35	$/hr	$9,520
	Total Personnel				**$99,295**
Travel	NAU Mileage Rate	300	$0.40	$/mile	$120
	Rental: NAU Suburban	2	$65	$/day	$130
	Hotel 1 Night	5	$100	$/room	$500
	PerDiem; 5 persons	2 days	$30	$/day-person	$300
	Total Travel				**$1,050**
Supplies	Ziplock Gallon Freezer Bags, 120 ct	1	$16	$/pack	$16
	Trowel	8	$10	EA	$80
	Rental: 2 GPS devices	2 days	$120	$/device-day	$480
	Soap	1	$6	$/bottle	$6
	Marker Flags, 50 pack	2	$7	$/pack	$14
	Plastic Bins, 2 pack	2	$57	$/pack	$114
	5 gal Buckets	4	$7	EA	$28
	Water, 12 pack	2	$4	$/pack	$8
	Paper Towels, 2 pack	1	$7	$/pack	$7
	Sharpie, 5 pack	1	$5	$/pack	$5
	Nitrile Gloves, 1000 pack	1	$45	$/pack	$45
	Trash Bags, 74 pack	1	$20	$/pack	$20
	Clipboards, 6 pack	1	$12	$/pack	$12
	Logbooks	2	$5	EA	$10
	Measuring Tapes	4	$20	EA	$80
	Scrub Brushes	4	$3	EA	$12
	Rental: NAU Soils Lab	20	$100	$/day	$2,000
	Rental: XRF Device	10	$300	$/day	$3,000
	Total Supplies				**$5,937**
Subcontract	Western Technologies	10	$100	$/sample	$1,000
Total Cost					**$107,282**

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6.0 Appendices

6.1 Appendix A: Gantt Chart

ID	Task Name
1	**Task 1.0 Work Plan**
2	Task 1.1 Sampling and Analysis Plan
3	Task 1.2 Health and Safety Plan
4	Task 1.3 Lab Binder/ Lab Access
5	**Task 2.0 Site Investigation**
6	**Task 3.0 Laboratory Analysis**
7	Task 3.1 Sample Drying
8	Task 3.2 Sample Sieving
9	Task 3.3 XRF Testing
10	Task 3.4 Acid Digestion
11	Task 3.5 FAA/ICP
12	**Task 4.0 Data Analysis**
13	Task 4.1 Identification of Human Health and Ecological CO
14	Task 4.2 Identify EPCs for all COCs
15	Task 4.3 XRF in-situ vs ex-situ Analysis
16	Task 4.4 XRF ex-situ vs FAA/ICP Analysis
17	Task 4.5 QA/QC Analysis
18	**Task 5.0 Contaminant Pathways**
19	Task 5.1 Maps of Contaminant Distribution
20	Task 5.2 Migration Pathways
21	Task 5.3 Site Conceptual Model
22	**Task 6.0 Human Health Risk Assessment**
23	Task 6.1 Toxicity Assessment
24	Task 6.2 Exposure Assessment
25	Task 6.3 Risk Characterization
26	**Task 7.0 Ecological Risk Assessment**
27	Task 7.1 Potentially at-risk Species
28	Task 7.2 Identify Area Use Factors
29	Task 7.3 Determination of Ecological Risk
30	**Task 8.0 Remedial Actions**
31	Task 8.1 Remedial Action Objectives
32	Task 8.2 Develop Alternatives
33	Task 8.3 Evaluate Alternatives and Select Preferred Alterna
34	Task 8.4 Design of Preferred Alternative
35	**Task 9.0 Project Impacts**
36	**Task 10.0 Project Deliverables**
37	Task 10.1 30% Deliverable
38	Task 10.2 60% Deliverable
39	Task 10.3 90% Deliverable
40	Task 10.4 Final Deliverable
41	**Task 11.0 Project Management**