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CENE 476: Emerald Isle PA/SI Proposal

SPNG Engineering Consultants

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FROM: SPNG ENVIRONMENTAL CONSULTANTS
TO: MR. ERIC ZIELSKE, BUREAU OF LAND MANAGEMENT ABANDONED MINE LAND DIVISION
DATE: DECEMBER 10TH, 2019
SUBJECT: EMERALD ISLE PA/SI FINAL PROPOSAL

Dear Mr. Eric Zielske

This letter of transmittal is being sent to inform you that SPNG has completed the Emerald Isle PA/SI Proposal as requested by BLM. This document is being sent to confirm that SPNG has received the information provided by the Bureau of Land Management's Abandoned Mine Land division and that the project details are understood in their entirety. Contained in the document is the project understanding, scope, schedule, staffing plan, and cost of engineering services required for completion of the Emerald Isle Mine PA/SI.

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1.0 Project Understanding

1.1 Project Purpose

The purpose of this project is to complete a Preliminary Assessment and Site Investigation (PA/SI) for the Emerald Isle mine in northwest Arizona. This decommissioned metal mining site was primarily used for the extraction of copper ore. The PA/SI document will assess the extent of contamination, human and ecological risk for the future management or remediation of the site. The Bureau of Land Management's Abandoned Mine Land (AML) division is administering the project and has primacy over the CERCLA process and therefore, handles PA/SI documents with different methods. This subsidiary of the BLM categorizes and gathers documentation on mine sites that were abandoned before 1981.

1.2 Project Background

The majority of background information pulled from media outlets such as Arizona Mining Journal, Arizona Mining Association, World Mining and other mining magazines and articles, as well as federal/state regulatory divisions such as the Arizona Department of Mines and Mineral Resources were compiled by ALM Records and provided by the client, Eric Zielske.

Emerald Isle Mine is located in the northwest corner of Arizona at 35º21'43.98" N 114º11'32.84" W in Mohave County. The mine sits about 20 miles northwest of Kingman, Arizona and four miles south of the town of Chloride, Arizona, at an elevation of 3680 feet, as shown in Figure 1.1.

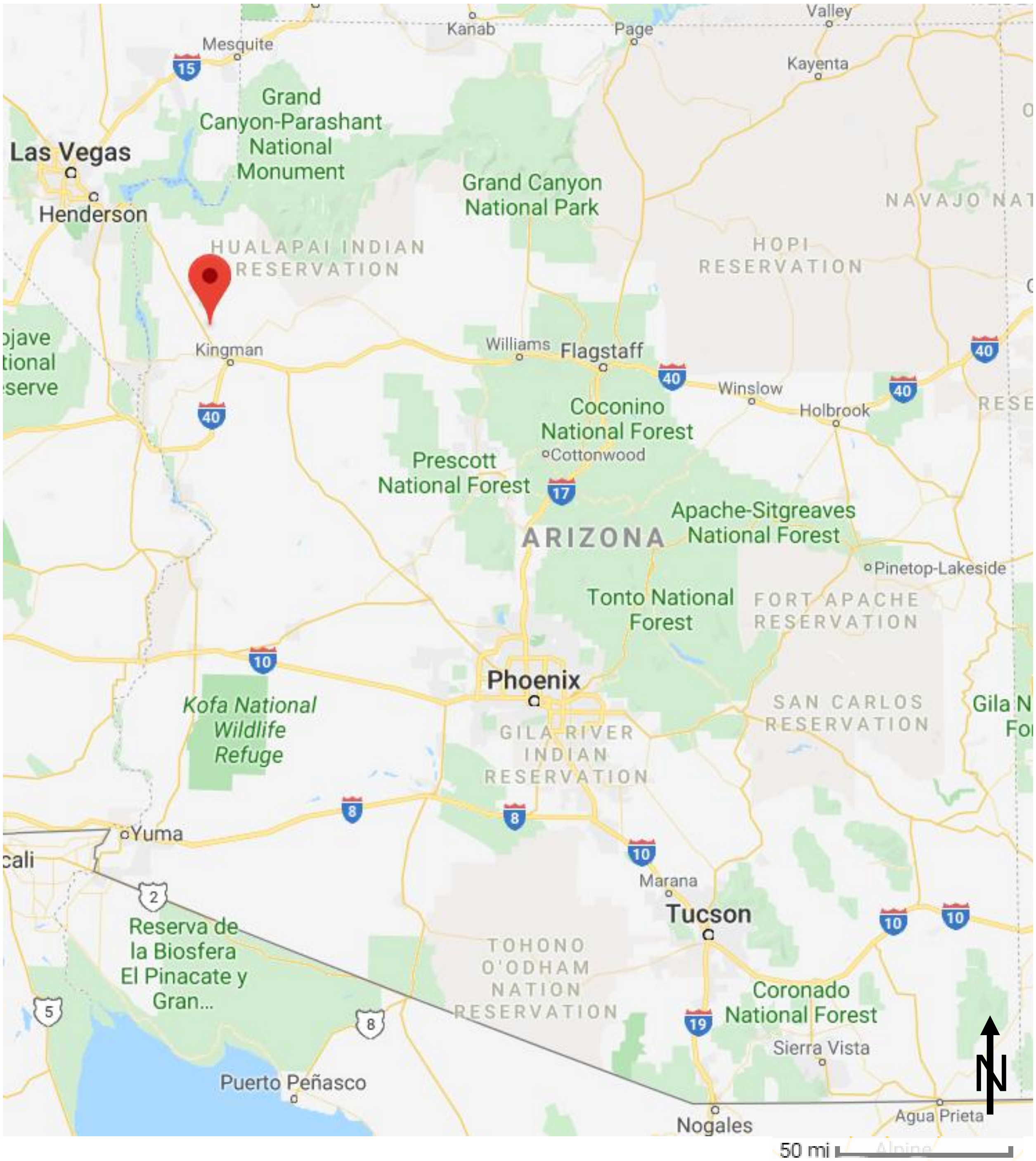

Figure 1.1: Vicinity Map for Emerald Isle Mine

In the second Figure 1.2 below, the mine is shown by the yellow pin to show its proximity to Kingman and the Cerbat Mountains rising above the mine directly to the East. This mountain range is home to many old mining operations. Additionally, to avoid misconception, the large white spot near the yellow indicator of the Emerald Isle mine is the much larger Mineral Park mine site.

Figure 1.2: Emerald Isle Mine Location

In the third map, Figure 1.3, specific site components that will be used as decision units for sample separation and organization. The final decision unit formation and mine site maps will be included in the sampling action plan.

Figure 1.3: Emerald Isle Site Features

00 ft

The mine is approximately 440 acres and includes a small open pit mine, a Solvent Extraction/Electrowinning (SX/EW) plant shown in Figure 1.4, a leach pad for heap leaching, a pad with tailings from a previous operation, three small low-grade stockpiles, and some various mine infrastructure (buildings, office trailer, equipment). Mining operations began in 1917 and continued at various times until 1943. From 1944 to 1948, about 55,000 tons of copper were reported to have been recovered. The El Paso Natural Gas Company and Arimetco, Inc. were the primary operators from mid-20th century until the mid 1970s. All of the blasting and leaching from the open pit was carried out in the 1970’s by El Paso. TSC Enterprises Inc. purchased the property from El Paso in 1980, but the property remained inactive until 1987, when Arimetco Inc. purchased the property and resumed copper production. In 2004, Suite Genevieve Resources Ltd. drilled and extracted core samples for total copper in addition to soluble copper and zinc; since that time, the mine has remained unoperated [1].

Figure 1.4: Abandoned Electrowinning Equipment (photo credit-Sydney Adamonis)

The mine was left in decrepit condition with barrels of aromatic oxime and a few buildings on the site. There is a building which can be assumed to be the SX/EW building along with two large tanks that must have been used to hold chemicals during production, this can be seen in Figure 1.5 [2]. The building still contains the electrowinning tubs used to plate pure copper. The open pit has clearly not been operated in years considering the amount of brush and dirt, from storm events that has washed into it. The leaching lixiviant pits are in similar condition except for a few newer looking pumps and piping, which can be seen in Figure 1.6. The lining underneath the lixiviant pits is fraying at the surface and it can be assumed that it is also weathering underneath the remaining chemical. The majority of structures on the site are rusted through, including fuel tanks, drill frames and housings, and large amounts of scrap metal. The heap leach pile still has pipes running into it and along its sides, but it is unclear when these were last operated. The leach pile rises about 20 feet above the lixiviant pond and contains nearly all of the tailings from the last operation. Other tailings on the site are in large piles that are fairly distinguishable from native soil. A small arroyo runs through the middle of the site and contains a bed made of fine sediment deposits from storm events. The arroyo runs very near the leaching pile and the lixiviant pond, making it a point of concern for future research.

Figure 1.5: Basin and Old Emerald Isle Mining Equipment (photo credit-Sydney Adamonis)

Figure 1.6: Pregnant Leachate Pond (photo credit-Sydney Adamonis)

Overall, the site's dry climate and low annual rainfall make the condition of the site fairly stable. Since the last activity at the mine was in 2004, little has changed since mining operations halted.

1.3 Technical Considerations

The primary consideration of risk in both the PA and SI components are focused on human health with a secondary focus of ecological risk. In sites like the Emerald Isle Mine which are located on public land where recreational activities are quite common, the risk associated with past mining activity remains very high. Exposure routes and concentrations of mine contaminants are the focus in determining both human health and ecological risk. Heavy metals and reagents used for the mining processes such as acids and organic solvents present the highest risk and will be the focus of analysis and risk calculation.

Another substantial factor throughout this analysis is to understand that the site will remain open to the public despite the results of future analysis. The Bureau of Land Management grants free access to the public on all lands that aren't of prior significant risk classification, so long as they are deemed not to require emergency response, they remain open for full access. This is a deviation from classifiable sites on private or more restricted public lands and eliminates the possibility of closing the site and/or restricting access.

A preliminary assessment includes:

- Reviewing existing information about the site
- Conducting a site reconnaissance
- Collecting additional target information about the site
- Evaluating the information to determine a site score
- Prepare a site summary report and site characteristics form [3]

The site investigation will identify substances present, possible releases of contaminants, and if the contaminants have migrated. The "four major activities" of the SI according to the Site Inspection Guidance Manual [3] are:

- Reviewing available information and data
- Organize and develop SI work plan, sample plan, health and safety plan, and waste plan.
- Visually inspect site and collect samples.
- Evaluate all data and prepare the SI report

1.4 Potential Challenges

The weather will be a challenge during sampling trips and may cause the team to deviate from the schedule. Also, the safety of the team will be important for unknown dangers such as abandoned shafts and deteriorating infrastructure. Being knowledgeable of the layout of the site, and the site reconnaissance will increase the team's safety when at the site.

1.5 Stakeholders

The client (Eric Zielske) presented this project under the Bureau of Land Management's Abandoned Mine Land (AML) division. He, and Paul Misiaszek, the current geologist of the BLM Kingman Field Office, are invested in the results of this investigation. Mining claimants, recreational users, as well as the general public would also be impacted by the results due to the possible exposure and/or remediation requirements.

2.0 Scope of Services

This section highlights each task to be completed for the PA/SI. Each subsection (i.e. 2.1) represents a parent task with subtasks being numbered further (i.e. 2.1.1, 2.2.2).

2.1 Task 1.0: Work Plan

SPNG will develop a Work Plan for all work to be completed on the project. The Work Plan details all field work, lab work, safety considerations and measures of quality assurance/control used in the project.

2.1.1: Task 1.1 Sampling Analysis Plan (SAP)

This document will include a detailed sampling plan with mapped surface and soil sampling schema to execute in the field. The SAP will also include all aspects of sample processing and lab analysis.

2.1.2: Task 1.2 Health and Safety Plan (HASP)

This document will highlight all planned health and safety actions for field work and lab analysis.

2.2 Task 2.0: Field Investigation

Sampling will be conducted to identify the contaminants of concern. Then, spatial distributions of waste and quantities of contaminants will be investigated in accordance with the Work Plan.

2.3 Task 3.0: Analysis

Analysis will be performed on the samples taken from the site to determine the concentrations of contaminants within the soil. The analysis task will follow the Work Plan and will include sample preparation, lab analysis, and data analysis steps.

2.3.1 Task 3.1 Dry and Sieve the Samples

Samples will be dried in an oven and then sieved to a recommended particle size as required for both the XRF and acid digestion.

2.3.2 Task 3.2: X-Ray Fluorescence (XRF) Analysis

XRF will be used to analyze the elemental composition of site soil samples. The handheld Niton XL3t XRF Analyzer by ThermoFisher Scientific, can give readouts on elemental composition accurate to the ppm (mg/kg) range which is very useful when comparing sample composition to soil screening standards. From these data, contaminants of concern (COC's) will be identified for both human health and ecological risks of the soil.

COC's will be determined based on comparison to both ADEQ and US-EPA non-residential soil screening levels. Elements that consistently exceed these levels will be researched for human health adverse effects. Possible COC's include arsenic, copper and possibly: cadmium, lead, manganese and other metals commonly associated with copper mine tailings.

2.3.4 Task 3.3: Acid Digestion of Soil and Sample Prep

To verify XRF results, FAAS or ICP-MS will be performed. For both methods, samples must be introduced in a diluted liquid solution. In order to do this with soil samples, an acid digestion must be conducted in order to fully dissolve the soil matrix.

2.3.5 Task 3.4 ICP-MS or FAAS Analysis

20% of the XRF analyzed soil samples will be sourced to the department of Chemistry and Biochemistry at Northern Arizona University. As reference concentrations of contaminants of concern become apparent, the instrumental method of choice will be chosen. For instance, ICP-MS will be utilized to analyze arsenic because of its low abundance in soil (US-EPA SSL 10ppm). For higher concentrated elements in soil such as Cu, Zi, Ni, and Mn, flame atomic absorption (FAAS) can be used as its detection limits are higher but sample analysis is lower cost. Since arsenic is a potential contaminant of concern identified by the client, it may be necessary to verify the sub-set of samples with both FAAS and ICP-MS analysis.

2.3.6 Task 3.5: Correlation of ICP/FAA and XRF/FAA Data

Results of elemental concentrations will be correlated using statistical difference measures such as a regression analysis. A correlation curve will be created to compare XRF analyses with ICP-MS verified analyses. The data will also be analyzed using statistical tests such as the Grubbs test for outliers, t-test of the mean, and p-test of the sample sets.

2.4 Task 4.0: Risk Assessment

The Risk Assessment includes analyses of toxicities of the COC's, contaminant transport, exposure routes, and primary groups affected to determine human and ecological risk.

2.4.1 Task 4.1: Human Health Risk Assessment (HHRA)

A human health risk assessment will be conducted to determine the potential health hazard the site possesses. Physical hazards will also be discussed.

2.4.1.1 Task 4.1.1 Determine Exposure Point Concentrations

Fifty and ninety-five percent exposure point concentrations will be determined for the COC's. This task is strongly tied to the Task 4.1.3: exposure assessment as it determines the average and maximum exposures of humans to the COC's.

2.4.1.2 Task 4.1.2 Toxicity Assessment

The toxicity assessment will determine reference doses/concentrations (RfD/RfC) and slope factors (SF) of COC's from the EPA IRIS database as well as the literature. These values are derived from pharmacokinetic modeling toxicity studies on animals and humans with SF's being based on carcinogenic data and reference doses being based on a broad spectrum of non-carcinogenic, adverse health effects. These values are a direct representation of the COC's toxicities.

2.4.1.3 Task 4.1.3 Exposure Assessment

An exposure assessment will then be conducted based on population exposure scenarios and set exposure factors by the US EPA. Additionally, the exposure pathways (ingestion, inhalation, and dermal contact) will be chosen based on relevance revealed by site info and exposure factors. Using this information, the intakes for the average and maximum exposed individual for each scenario will be determined and used in task 4.1.4 to calculate risk.

2.4.1.4 Task 4.1.4 Risk Calculations

Risk will be computed for each exposure scenario for both carcinogenic and non-carcinogenic (as Hazard Index) COC's using the equations below.

$$Carcinogenic\ Risk = Slope\ Factor\ \left(\frac{kg-day}{mg}\right) * Chronic\ Daily\ Intake\left(\frac{mg}{kg-day}\right)$$

Equation 1: Carcinogenic Risk Equation [4]

$$Hazard\ Index\ (noncarc) = \frac{Chronic\ Daily\ Intake\left(\frac{mg}{kg-day}\right)}{Reference\ Dose\ \left(\frac{mg}{kg-day}\right)}$$

Equation 2: Hazard Index for Non-carcinogenic Risk Equation [4]

Physical hazards independent of COC's will also be incorporated into risk calculations.

2.4.2 Task 4.2: Ecological Risk Assessment

Ecological risk assessment begins by identifying what wildlife (endangered/sensitive) (plant/animal) species will be exposed to the hazards associated with the site. This information can be researched and accessed through the BLM's various ecological documents. Exposure levels will then be quantified as intake values which can be used to determine the effects of contaminants on certain populations.

2.4.2.1 Task 4.2.1: Characterization of Ecology

This task will identify what species will be evaluated in the ecological risk assessment, as well as articulate the relationship between the potential stressor and the ecological makeup of the site.

2.4.2.2 Task 4.2.2: Toxicity Assessment

The toxicity assessment will use data provided in the EPA IRIS database as well as peer-reviewed literature to determine potential risk to native flora/fauna species.

2.4.2.3 Task 4.2.3: Exposure Assessment

An exposure assessment will then be conducted; this will identify the environmental exposure pathways, release/transport of contaminants, exposed non-human populations and the determination of exposure point concentrations and intake dosages where appropriate.

2.4.2.4 Task 4.2.4: Risk Characterization

Risk will be estimated and calculated in a similar fashion as the HHRA to identify adverse effects of the contaminants on various plants and animals. Quantitative representation of the eco-risk calculations (such as risk in the HHRA) are not guaranteed because of a lesser amount of data available. For example, very few studies are present for risk to plant species from common mining contaminants.

2.5 Task 5.0: Project Impacts

The triple bottom line of environmental, economic, and social impacts will be addressed and outlined at the conclusion of the analysis phase of the project.

2.6 Task 6.0: Project Management

2.6.1 Task 6.1: Meetings

In order to stay updated and on track, a sufficient number of meetings will be scheduled and reliably attended by all team members. When deemed necessary, meetings with the client will be organized to ensure that the project is on track. Weekly meetings will be held with technical advisors to ensure quality of submittals.

2.6.1.1 Task 6.1.1: Client Meetings

Client Meetings will be held with the client after the finished proposal, and at other stages of the project as needed. Detailed minutes and agendas for each meeting will be maintained for each meeting.

2.6.1.2 Task 6.1.2: Technical Advisor and Grading Instructor Meetings

Meetings will be held after each deliverable and major scope take for feedback and guidance with Dr. Bero. Detailed minutes and agendas for each meeting will be maintained for each meeting.

2.6.1.3 Task 6.1.3: Team Meetings

Team meetings will be conducted weekly during the semester with breaks for the Winter holiday and week of spring break in March of 2020. Detailed minutes and agendas for each meeting will be maintained for each meeting.

2.6.2 Task 6.2: Scheduling and Resource Management

This task will maximize efficiency amongst team members and ensure deliverable quality and timeliness. Time spent on each task will be documented in staffing tables. Strict adherence to the schedule will ensure on-time project completion.

2.6.3 Task 6.3: Project Deliverables

2.6.3.1 Task 6.3.1: 30% Report and Presentation

Tasks up through 3.1 (Drying and Sieving of Samples) will be finished and included in the 30% report and presentation submission on Thursday, 02/20/2020.

2.6.3.2 Task 6.3.2: 60% Report and Presentation

Tasks up through 3.5 (Correlation of ICP/FAA and XRF/FAA Data) will be finished and included in the 60% report and presentation submission on Thursday, 03/19/2020.

2.6.3.3 Task 6.3.3: 90% Report and Website

All tasks through 5.0 (Project Impacts) will be completed at this point and included in the 90% report and website draft submission on Thursday, 04/16/2020

2.6.3.4 Task 6.3.4: PA/SI Final Report and Presentation:

The final report including all revisions and corrections from the previous draft submissions will be submitted on Thursday, 04/23/2020.

2.6.3.5 Task 6.3.5: Final Presentation

The final presentation will summarize the project and will be conducted at NAU's Undergraduate Research Symposium on Friday, 04/24/2020.

2.6.3.6 Task 6.3.6: Final Website

The website will include the summaries and visual representations of all tasks completed on the project. It will be professional and aesthetically detailed and include general site information, completed written reports and presentations, and any other relevant information produced from the completion of the project. It will fulfill the purpose of archiving the information for future student and academic use but not publicly available.

2.7 Project Exclusions

The following are excluded activities/tasks associated with the Emerald Isle site and are not included in the Work Plan for SPNG Engineering Consultants.

2.7.1 Remediation Alternatives:

The established guidelines of a PA/SI do not include any aspects of site remediation.

2.7.2 Water Sampling:

No water sampling will be completed by SPNG and will require outside contracting.

3.0 Project Schedule

A schedule for the project's duration and a general timeline was created using Microsoft Project. Outlined within the Gantt chart, Figure 3.1 attached, are the durations and dates assigned to each task (major and minor) and deliverables specified in section 2.0. The stated durations in the

Gantt chart include float. While the durations may be slightly longer than the minimum time necessary for each task and sub-task, the stated dates will be closely followed. The latest start date is October 21, 2019, and the latest finish date is April 24, 2020.

3.1 Critical Path

Within the Gantt chart the critical path can be seen. The critical path, seen in blue, shows the shortest amount of time by which the project can be completed. The critical path does not include every task outlined in section 2.0 because there are tasks that will be completed over the same period of time. For the tasks with overlap, only the task of the longest duration is included in the critical path.

4.0 Staffing Plan

The following section describes the staffing and personnel assigned to the Emerald Isle PA/SI between November 2019 and April 2020. Below are the titles, qualifications and estimated work totals of each of the three staffing consultants.

4.1: Personnel and Titles

Three total staff of SPNG Engineering Consultants will be assigned work roles on the PA/SI project. Any other consulted individual will be contracted outside of this proposed work.
Professional Engineer (PE): SPNG's professional engineer will be overseeing technical details throughout the entire project.
Engineer in Training (EIT): One of SPNG's full-time employed engineers in training will be conducting the breadth of the engineering design, planning, and environmental specific analysis.
Lab Technician (LAB): A junior lab technician working full-time with SPNG will be responsible for the completion of the majority of sample preparation and analysis of soil samples.

4.2: Personnel Qualifications

Professional Engineer (PE): SPNG's senior engineer has both a Bachelor of Science and master's degree in environmental engineering. They have a professional engineer certification and have active licensure with the Arizona State Board of Technical Registration. Their experience in professional practice exceeds 10 years and 15 totals in post-collegiate engineering related work.
Engineer in Training (EIT): The EIT assigned has a four-year Bachelor of Science degree in environmental engineering from an ABET accredited university. This is their fifth year in environmental engineering specific consulting and has been with SPNG the entirety of their professional career. Additionally, the EIT has performed a PA/SI on a similar sized mine in Southern Arizona.
Lab Technician (LAB): The lab technician has a four-year Bachelor of Science degree in geological sciences and has two years of professional experience. Their professional career has been primarily focused on environmental sampling of soils, water and other natural media along with various instrumental analyses of such samples.

4.3: Work Total Estimation of Personnel

Table 4.1 below shoes the estimated hours by each member assigned to the project. The majority of work done by the PE will be overseeing the LAB and EIT's work on the project tasks. The EIT will be responsible for all work requiring a licensed engineer while the technician will conduct the bulk of soil analysis.

Table 4.1: SPNG Staffing Totals for Scope of Work

Task	PE (hrs)	EIT (hrs)	LAB (hrs)	Task Total
TASK 1: Work Plan				88
1.1 Sampling Analysis Plan (SAP)	8	24	12	
1.2 Health and Safety Plan (HASP)	8	24	12	
TASK 2.0: Field Investigation	16	16	16	48
TASK 3.0: Analysis				134
3.1 Dry and Sieve the Samples	2	4	12	
3.2: X-Ray Fluorescence (XRF) Analysis	4	20	40	
3.3: Acid Digestion of Soil and Sample Prep	1	4	10	
3.4 ICP-MS or FAAS Analysis	2	8	16	
3.5: Correlation of ICP/FAA and XRF/FAA Data	1	2	8	
TASK 4.0: Risk Assessment				76
4.1: Human Health Risk Assessment				
4.1.1: Determine Exposure Point Concentrations	1	6		
4.1.2: Toxicity Assessment	1	6		
4.1.3: Exposure Assessment	1	6		
4.1.4: Risk Calculations	1	6		
4.2: Ecological Risk Assessment				
4.2.1: Characterization of Ecology	4	12		
4.2.2: Toxicity Assessment	4	12		
4.2.3: Exposure Assessment	2	6		
4.2.4: Risk Characterization	2	6		
TASK 5.0: Project Impacts	4	8	4	16
TASK 6.0: Project Management				304
6.1: Meetings				
6.1.1: Client Meetings	4	16	8	
6.1.2: Technical Advisor and Grading Instructor Meetings	4	16	8	
6.1.3: Team Meetings	16	32	32	
6.2: Scheduling and Resource Management	8	16	8	
6.3: Project Deliverables				
6.3.1: 30% Report and Presentation	4	16	8	
6.3.2: 60% Report and Presentation	4	16	8	
6.3.3: 90% Report and Website	2	8	16	
6.3.4: PA/SI Final Report	2	8	4	
6.3.5: Final Presentation	2	8	4	
6.3.6: Final Website	2	8	16	
TOTALS (hrs)	**110**	**314**	**242**	**666**

4.4: Staffing Summary

Below in Table 4.2 is the summarized table of personnel and total hours estimated to be invested in the project.

Table 4.2: Staffing Summary

Position	Hour Total	Major Tasks
Professional Engineer (PE)	110	Dispersed oversight, Work Plan, Field Investigation and Report Review
Engineer in Training (EIT)	314	Overall Analysis, Work Plan, PA/SI Primary Authorship
Lab Technician (LAB)	242	Analysis, Website, Secondary Authorship

5.0 Cost of Engineering Services

Table 5.1 below shows the cost of engineering services for the Emerald Isle Mine PA/SI. The proposed cost includes personnel hours and rates, travel costs, supply costs, and laboratory analysis costs. The project total cost of engineering services is of $58,593.

5.1: Personnel Costs

All costs for personnel are based on billable hours of engineering services spent on the tasks above in the Scope of Work. Rates of each staffing member are based on experience relevant to project, seniority, market trends and SPNG's discretion. This service is the greatest share of the project costs at $54,104.

5.2: Travel

Because of the site's proximity to NAU, travel costs will be relatively low. In Table 5.1 below, travel costs are outlined, including the IRS standard rate per mile driven for business use ($0.58/mile). The travel costs also include the hotel stay in Kingman, Arizona, priced at $94 per night, per room. The Arizona per diem cost is $55 per day, per person for the two days of sampling. The total for the project travel is $770.

5.3: Supplies

The supplies section of the table includes all necessary equipment for the two-day sampling trip. This includes, Ziplock bags, disposable gloves, plastic auger liners, sample marking flags, garbage bags, and water. The Ziplock bags are necessary for storing the samples in transit from the field to the lab. The disposable gloves will be worn for each sample to avoid cross contamination as well as for personal protection. Plastic auger liners will be used to take core samples of the soil in areas of concern, and the marking flags will mark exact locations where all samples were taken. Garbage bags will be used to dispose of contaminated gloves and any other trash accumulated on site.

It should be noted, that the list of items listed under supplies in the cost estimate is not a comprehensive list of all materials necessary for the completion of the project, but rather only those needed to be purchased. The expected cost of all supplies is $659.

For environmental lab access, SPNG will be using room 117 in NAU’s Engineering Building. This room is lab certified and will be the space for drying, sieving and XRF analysis. Also, by renting this space, SPNG will be granted access to the XRF instrument and materials like a core auger for depth sampling, shovels, sterilization buckets and sample storage materials.

There will be two separate laboratory access components to the analysis of the soil samples. First, the verification of XRF-derived COC concentrations will be done on an ICP-MS or FAAS instrument in Dr. Jani Ingram’s lab in NAU’s Department of Chemistry and Biochemistry. This fee accounts for instrument, reagent, and other lab material use for the digestion and analysis of soil samples. SPNG consultants will be completing the analysis. The total cost of lab fees is $2,400.

Table 5.1 below shows a tabulated summary of the various costs of engineering services.

Table 5.1: Costs of Engineering Services

1.0 Personnel	Classification	Hours/Quantity	Rate, $/hr	Cost
	PE	110	195	$ 21,450
	EIT	314	67	$ 21,038
	LAB TECH	242	48	$ 11,616
	TOTAL	666		$ 54,104
2.0 Travel				
	Mileage, 1 trip	652	$0.58/mile	$ 378
	Hotel Rooms in Kingman	3 Rooms for 1 Night	$94/room,night	$ 282
	Meals	7 persons, 2 days	$55/day/person	$ 770
3.0 Supplies				
	Ziplocks	4	$18/152 count Freezer Bag, Gallon	$ 72
	Lab Disposable Gloves	4	$10/100 ct. box	$ 40
	1 1/2" X 5' Plastic Liner for Auger/Samples	8 (= 40 1 ft tubes)	$4/liner	$ 32
	Buckets	15	$3.25/bucket	$ 49
	Sample Marker Flags	Bundle of 100	$8/bundle	$ 8
	Garbage Bags	55 Gallon, 80 Count, heavy duty	$24/Box	$ 24
	Trowels	7	$10/trowel	$ 70
	Pens	box of 36	$7/box	$ 7
	Tape Measure	7	$8 each	$ 56
	Water	2.5 Gallon Jug (x7)	$3/jug	$ 21
	GPS Unit Rental	7	$20/day	$ 280.00
	Lab Notebooks	Individual		$ -
Chemistry Lab	Acid Digestion Reagents/Materials + ICP-MS Analysis (including reagents)	20 Samples	$50/sample	$ 1,000
CENE Lab Access	Soil Sieving	7 days	$100/day	$ 700
ENE Lab Use	XRF Analysis	7 days	$100/day	$ 700
4.0 TOTAL				**$ 58,593**

6.0 References

[1] SVG Resources, Ltd. "TECHNICAL REPORT ON THE EMERALD ISLE COPPER DEPOSIT, ARIZONA, U.S.A." March 10, 2006. [online]. http://www.napierventuresinc.com/i/pdf/Emerald-NI43101-Mar2006.pdf

[2] Unknown. "Arizona Mining History: Emerald Isle Mine, Mohave County" https://winfirst.wixsite.com/arizonamininghistory/emerald-isle-mine

[3] EPA. "About the Superfund Cleanup Process: Preliminary Assessment/ Site Investigation" June 4, 2018. [Online]. https://www.epa.gov/superfund/about-superfund-cleanup-process

[4] LaGrega, P. Buckingham, J. Evans, *Hazardous Waste Management 2nd edition*, Waveland Press INC, Long Grove, Illinois, 2010.