



Tyrone Operations
P.O. Box 571
Tyrone, NM 88065

March 31, 2023

Electronic Email

Ms. Carmen Rose
Energy, Minerals and Natural Resources Department
Mining and Minerals Division
Mining Act Reclamation Program
1220 South St. Francis Drive
Santa Fe, NM 87505

Dear Ms. Rose:

**Re: Modification 22-1 to Little Rock Mine, Permit No. GR007RE; and
Modification 22-1 to Tyrone Mine, Permit No. GR010RE; Freeport-McMoRan
Tyrone Inc; Sampling and Analysis Plan for 9A/9AX Waste Rock Stockpiles**

In letters dated August 2, 2022, and August 17, 2022, Freeport-McMoRan Tyrone, Inc. (Tyrone) applied for modifications to Little Rock permit GR007RE and Tyrone permit GR010RE for the approval of Precambrian granite as Reclamation Cover Material and the termination of the USNR Test Plot Study. On November 21, 2022, Tyrone received comments from Mining and Minerals Division (MMD) including a request for Tyrone to perform confirmation sampling and analysis of the Precambrian granite in the 9A and 9AX Waste Rock Stockpiles. Tyrone also met with MMD on March 23, 2023 to discuss constituents to be sampled and numbers/locations prior to submitting this letter.

Enclosed is a Sampling and Analysis Plan for the 9A and 9AX Waste Rock Stockpiles which includes sampling locations, collection methods, and an analyses suite to be performed on each sample.

Please contact Ms. Raechel Roberts at (575) 956-3290 if you have questions.

Sincerely,

Thomas L. Shelley
Environmental Services Manager

TLS:rnr
Attachment
20230330-102

- c. Holland Shepherd – MMD
- Brad Reid – NMED
- Ron Kellermueller – NMDG&F



WORKPLAN

Sampling and Analysis Plan for Precambrian Granite Reclamation Cover Materials

Freeport McMoRan Tyrone and Little Rock Mines

Submitted to:

Freeport McMoRan Tyrone Mine Operations

P.O. Box 571

Tyrone, New Mexico 88065

Submitted by:

WSP USA Inc.

2440 Louisiana Boulevard NE, Suite 400

Albuquerque, New Mexico 87110

March 30, 2023



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Figure 1: Proposed Precambrian Granite Sample Locations

1.0 INTRODUCTION

Freeport-McMoRan Tyrone, Inc. (Tyrone) operates the Little Rock copper mine approximately 10 miles southwest of Silver City, New Mexico. The Little Rock mine is permitted as an existing mine by the Mining and Minerals Division (MMD) under Mining Act Permit No. GR007RE. The majority of the overburden excavated at the Little Rock open pit is comprised of Precambrian granite (PCG). According to Revision 20-1 to Permit GR007RE, Section 3.S, PCG is conditionally approved to be used as a reclamation cover material (RCM) to complete the closeout plan.

Over the past several years, Tyrone has strategically placed PCG mined from the Little Rock mine at the 9A Waste and 9AX (9A/9AX) Waste stockpiles in preparation for reclamation activities at the Tyrone Mine and at the West In-Pit Waste Stockpile at Little Rock. PCG is also stored in the historic North and West Canyon Waste rock stockpiles. The PCG materials have also been used to construct soil covers. In 2010, borrow materials from the North Waste rock stockpile were used as cover for the Copper Leach Stockpile reclamation at Little Rock. Precambrian granite overburden sourced directly from the Little Rock pit were used as a cover material for the successful reclamation at the USNR test plots (2015) and larger reclaimed USNR site (2016).

Tyrone applied for a modification to the Little Rock Mine Permit No. GR007RE on August 2, 2022 to request approval of the Little Rock PCG to be used as RCM at the Little Rock Mine and to terminate the USNR Test Plot Study. On August 17, 2022, Tyrone also applied for a modification to the Tyrone Mine Permit No. GR010RE for approved use of the same RCM at the Tyrone Mine.

The MMD provided combined comments to the permit modifications in a letter dated November 21, 2022. Comment 2 of the letter stated:

“Prior to approval of the Precambrian granite in the 9A and 9AX stockpiles as RCM, MMD requests that Tyrone performs confirmation sampling and analysis of the Precambrian granite in these waste rock piles. Tyrone shall provide a sampling and analysis work plan to MMD within 90-days for the chemical and physical sampling and analyses that will be performed.”

In an additional comment response letter, Tyrone requested the sampling and analysis plan (SAP) submittal date be extended to March 31, 2023. MMD granted the approval on February 19, 2023. WSP USA Inc. (WSP), formally Golder Associates USA Inc. (Golder), has prepared this SAP on behalf of Tyrone to provide a scope of work to further evaluate PGC materials at the 9A/9AX stockpiles as well as other stockpiles and existing reclaimed sites that used PCG as a cover material. This SAP was developed in consultation with the MMD including a virtual meeting on January 24, 2023, and a meeting at Tyrone on March 23, 2023.

1.1 BACKGROUND

The Precambrian Granite comprises the bulk of the overburden rock mined from the Little Rock open pit. It is composed primarily of coarse-grained quartz, orthoclase, plagioclase and biotite with secondary minerals goethite and hematite, which are weathering products of oxidation of the pre-existing pyrite and chalcopyrite. No sulfide minerals are known to occur in the PCG leach cap and acid-base account (ABA) data strongly suggest that it will not generate acid and has a moderate potential to neutralize acid. Laboratory analyses indicate that the overburden is relatively uniform and has few apparent limitations as a plant growth media when compared to the surrounding native soils. The suitability of Precambrian Granite as reclamation cover material is further supported by observations of the establishment of perennial native vegetation within the pit area and on the historical North Waste and West Canyon Waste rock stockpiles at Little Rock.

Extensive testing and reporting on the geochemistry and soil suitability of over 600 PCG samples has been provided in the following reports:

- Characterization and Volumetrics of Gila Conglomerate and Precambrian Granite Reclamation Cover Materials (Golder 2020)
- United States Natural Resources (USNR) Test Plot Annual Report No. 1. (Golder 21017)
- USNR Site and Copper Mountain South Pit Expansion CQA/CQC Report (Telesto Solutions 2014)
- DP-1236 Semiannual Monitoring Reports (Tyrone 2011 to present)
- Little Rock Mine Project - Geochemical Evaluation Technical Report (SARB Consulting 1995)
- Geochemical Modeling Update - Little Rock Mine (DBSA, 2020)
- Waste Rock Characterization and Handling Plan - 9A and 9AX Waste Rock Stockpiles Tyrone Mine, DP-435 (Golder 2016)

Lastly, MMD stated in their comment letter from January 11, 2023, that

While Tyrone has done extensive sampling of the Little Rock Precambrian granite under DP-435 to fulfill requirements under the Water Quality Act, growth medium suitability parameters such as total metals concentrations (emphasis added), cation exchange capacity, and organic carbon/organic matter were nonexistent or limited in scope of what was analyzed and reported on both the USNR test plots and the 9A/9AX stockpiles. Leachability studies do not provide total metals concentrations, which are a better indicator for identifying any potential concerns related to bioaccumulation of metals throughout the nutrient cycling process.

Tyrone has agreed to collect additional samples to confirm the suitability of the PCG and will test the materials for cation exchange and organic matter in addition to other soil suitability parameters. However, total metal analyses will not be conducted because they are not typical soil suitability parameters (MMD 1996, 2022) and their interpretation relative to potential plant toxicity is poorly correlated. For example, the International Network for Acid Prevention, Global Acid Rock Drainage guide (INEP 2009) states:

“Total solid phase elemental analysis does not distinguish the form (e.g., mineral) in which the element exists. Therefore, this analysis is not on its own a measure of potential elemental concentrations in drainage or the threat to the environment.”

The Canadian Mine Environment Neutral Drainage (MEND) initiative (MEND 2009) reiterates this point that:

[Total element] “analyses do not reveal the forms in which an element occurs...solid phase levels, whether high or low are not on their own measures of the potential aqueous concentrations in drainage or of the threat to the environment.”

It is WSP's position that the use of total metals to compare to different soil screening guidelines tends to overestimate the potential for risks to plants and animals. For plant bioavailability, ammonium bicarbonate-diethylenetriaminepentaacetic acid (AB-DTPA) or saturated paste extractions for metals, proposed herein, are generally accepted techniques that provide a more realistic understanding of pore water metal concentrations.

2.0 SAMPLING AND ANALYSIS PLAN

Execution of the proposed SAP will provide additional information concerning the suitability of the PCG as an RCM. Sampling will be conducted the 9A/9AX stockpiles, as well as the USNR Test Plots, USNR Reclamation, and the Copper Leach Stockpile reclamation at Little Rock. Additional samples will be collected from the West In-

Pit Stockpile and the North Waste rock stockpile. Samples will be collected from test pits or as bulk grab samples at the surface to capture the different stockpile lifts or mining time intervals when the PCG was deposited or used as a cover material.

2.1 Field Methods

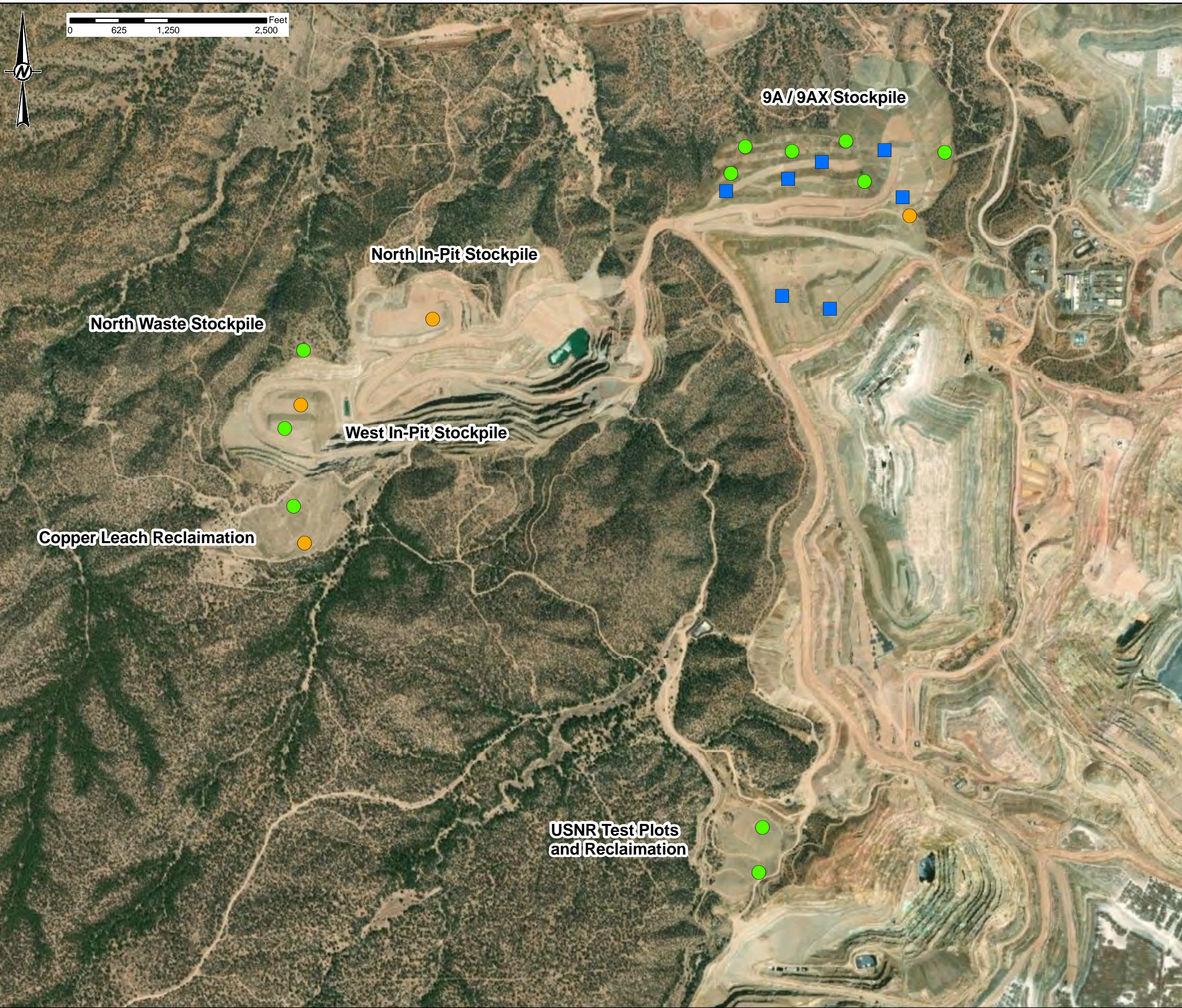
The sampling for stockpiled PCG characterization will be conducted at the proposed sample sites illustrated in Figure 1. Seven test pits are proposed on the 9A/9AX stockpiles. Test pits will be excavated to 10 or 15 feet depending on the reach of the excavation equipment. Excavated materials will be segregated into two-foot intervals to facilitate logging and sampling. Each test pit will be described by a WSP field soil scientist following the USDA National Soil Survey Standards (Soil Survey Division Staff 2017). The materials will be described with respect to soil texture, rock fragment volume and size classes (i.e., gravel, cobble, and stone), moisture, color, and reaction to weak acid. An additional 11 surface grab samples will be collected on the 9A/9AX stockpiles as well as other locations with PCG stockpiled or cover materials (Figure 1). Surface grab samples will be collected along berms or from shallow hand excavations (18-24 inches). If a sample location is not accessible or is not representative of salvageable materials (i.e., at the base of a slope with excess gravity-segregated rock), an alternative location will be selected as identified in Figure 1. Photographs of each sample location, test pit and excavated materials will be taken as part of the investigation.

Prior to sample collection, volumetric rock content will be estimated in each sample location, then measured in the field using the following method. WSP will use a field protocol to compare the total volumetric rock ocular estimates with dry sieved samples to determine if estimates were within ± 5 percent on average. After field personnel estimate rock content, a 5-gallon bucket of the <3-inch material will be collected and passed through a #10 sieved (2 mm) and the fine-earth fraction will be placed in a graduated bucket. The retained gravels will be placed in a second graduated bucket. Field staff will compare the volume of fine-earth to gravels fractions in the two buckets. Each bucket will be weighed on a portable field scale and converted to a volume (mass of gravel X 0.38 and the mass fine earth X 0.65). The calculated gravel volume will then be divided the total volume of the sample (gravel + fine earth) to determine the volume of gravels. The volume of oversized rock greater than 3 inches will then be added to the volume of gravel and a total rock volume for the sample will be calculated and compared to the ocular estimate of total rock volume.

Samples of the fine-earth fraction for laboratory testing will be placed directly in gallon-sized plastic bags. The sample identification, collection date, and times will be recorded on each bag. Samples will then be placed in a cooler for shipping. After describing and sampling the cover materials, all excavations will be backfilled and smoothed to match preexisting surface conditions.

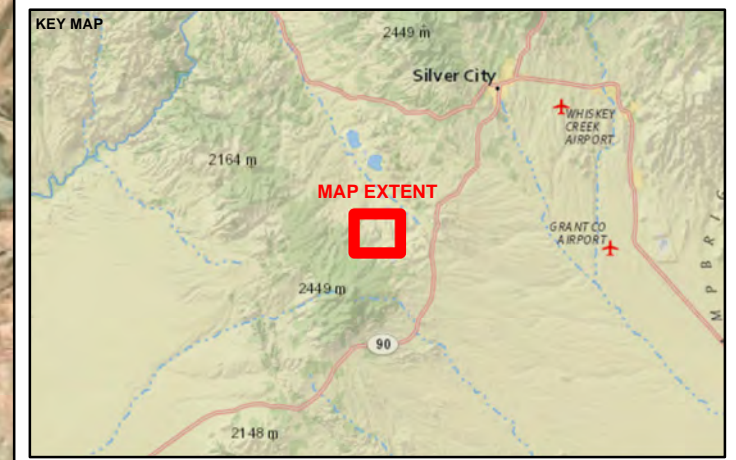
2.2 Laboratory Methods

Samples for physiochemical testing will be recorded on chain of custody forms and shipped to Energy Laboratory in Billings, Montana at ambient temperatures. The samples will be air-dried at the laboratory prior to testing for the parameters listed in Table 1 to determine suitability relative to MMD's suitability guidelines (MMD 1996, 2022). The primary references for the analytical techniques include Agricultural Handbook No. 60 (Salinity Laboratory Staff [SLS] 1954), and Methods of Soil Analysis (Agronomy Society of America [ASA] 1982). Testing methods to characterize the PCG materials are included in Table 1.



LEGEND

- GRAB SAMPLE
- ALTERNATIVE GRAB SAMPLE
- TEST PIT



REFERENCES
 1. AERIAL IMAGERY: ESRI PROVIDED BASEMAP SERVICE. VIVID. MAXAR. IMAGERY CAPTURED 4/24/2022.

CLIENT
 FREEPORT MCMORAN TYRONE MINE OPERATIONS
 TYRONE, NEW MEXICO

PROJECT
 PRECAMBRIAN GRANITE SAMPLING AND ANALYSIS PLAN

TITLE
PROPOSED PRECAMBRIAN GRANITE SAMPLE LOCATIONS

	CONSULTANT	YYYY-MM-DD	2023-03-30
	DESIGNED	DR	
	PREPARED	RHG	
	REVIEWED	-	
	APPROVED	-	

PROJECT NO. **GL19122576** FIGURE **1**

PATH: M:\FEML_Tyrone\202303\GL19122576_Tyrone_Fig01_ProposedSampleLocations.mxd PRINTED ON: 2023-03-30 AT: 11:24:49 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSIB

Table 1: Analytical Methods for Precambrian Granite Characterization

Analysis/Parameter	Source-Method	Lab	Field
Saturated Paste pH	SLS 1954, Method 2 and 21a	X	
Electrical Conductivity, saturated paste	SLS 1954, Method 3a and 4b	X	
Saturation Percentage	SLS 1954, Method 27a	X	
Particle Size Analysis	ASA 1982, Method 15-5	X	
Rock Fragment (>2mm)	Dry sieve (No. 10)/gravimetric		X
Organic Matter (Carbon)	ASA 1982, Method 29-3.5.2	X	
N as Nitrate	ASA 1982, Method 33-8.1	X	
Phosphorous (Olsen)	ASA 1982, Method 24-5.4	X	
Potassium	ASA 1982, Method 13-3.5	X	
Acid Base Accounts with sulfur forms*	Modified Sobek et al. (1978)	X	
Cation Exchange Capacity	SLS 1954, Method 19	X	
AB-DTPA extraction	ASA 1982, Method 3-5.2	X	
Saturate Paste extraction	ASA 1982, Method 10-2.3.1	X	
Extractable Metals (As, Cd, Cu, Fe, Pb, Mn, Mo, Ni, and Zn)	EPA Method 6010/6020	X	

Note: * for samples with pH<5

3.0 SCHEDULE AND DELIVERABLES

The schedule for implementation of the PCG SAP is presented below. The schedule assumes approval of this workplan by MMD by April 15, 2023 and is contingent on staff and equipment availability.

- Field Sampling: May 16 - 18
- Laboratory Testing: May 22 – June 9
- Data Assembly and Analysis: June 12 – 30
- Report Submittal: July 15

Tyrone will notify the MMD two weeks prior to the field work so they can observe the PCG sampling.

A final report will be developed to convey the results of the testing program and provide interpretation of the PCG's physical and chemical suitability as a reclamation cover material. The report will also compile and interpret other pertinent geochemical and soil suitability data that has been presented in the past. The characterization report, in addition to the scheduled quantitative vegetation monitoring of the USNR Test Plots and Reclamation in August 2023, will provide a demonstration that the PCG cover materials can support a diverse and resilient reclaimed plant community capable of maintaining a wildlife post-mining land use.

4.0 REFERENCES

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