Ashlee Adoko
Alaska Department of Natural Resources (ADNR)
550 W 7th Avenue, Suite 1430
Anchorage, AK 99501

Waste Rock Characterization-Handheld Niton XL5 XRF Modification to Plan of Operations

To whom it may concern,

Northern Star (Pogo) LLC proposes a modification to the waste rock characterization procedures. The proposed modification would replace the use of the Rigaku benchtop XRF with the handheld Niton XL5 XRF for waste rock characterization. The change will streamline the sample processing steps, enabling more efficient handling and disposal of the waste rock.

Current Process:

Currently the Rigaku benchtop XRF instrument is used to analyze waste rock samples for sulfur and arsenic. The analyses are used to segregate the rock based on mineralized and non-mineralized characterizations. Samples that are being analyzed are drill cuttings that are analyzed by the onsite Assay Lab with a Rigaku benchtop XRF. Sample preparation and analysis during this process typically takes several hours to complete.

Applicable Regulations:

The 2020 Pogo Plan of Operations states the following:

To classify the rock, drill cuttings from blast holes representing each development blast are sampled and assayed on site. If the material is above either 0.5% sulfur or 600 milligrams per kilogram (mg/kg) arsenic, the blasted rock is classified as "mineralized." If the assay does not exceed these thresholds, the material is classified as "non-mineralized."

The Waste Management Permit No. 2018DB001 states the following:

Section 1.2.1 Waste rock with a content greater than 0.5 percent sulfur or exceeding 600 milligrams per kilogram arsenic shall be classified as mineralized; whereas, waste rock below both of those criteria shall be classified as non-mineralized. Mineralized waste rock must be disposed of in either the DSTF or underground.

Section 1.5.2 The Pogo Mine Monitoring Plan must be updated within 90 days of permit issuance, as necessary to be consistent with the terms of this permit and shall contain the following:

Section 1.5.2.6 A program to track the classification and segregation of the mineralized and non-mineralized waste rock produced at the facility to ensure that the cutoff criteria contained in section 1.2.1 are being met.

PO Box 145, Delta Junction, AK 99737, USA
3204 International St, Fairbanks, AK 99701, USA
Tel +1 907 895 2500 | Fax +1 907 895 2866
Level 1, 388 Hay Street, Subiaco 6008, Western Australia
Tel: +61 8 6188 2100 | Fax: +61 8 6188 2111
Email: info@nsrltd.com Web: www.nsrltd.com

Proposed Process Modification:

The proposed modification is to analyze for arsenic and sulfur in samples of waste rock with the Niton XL5 handheld XRF in lieu of the Rigaku benchtop XRF. Drill cuttings are analyzed by trained personnel who are familiar with the Safe Work Practice developed for waste rock segregation. Each sample is homogenized by consolidating eight teaspoons of drill cuttings on the homogenization pad, rolling the sample inwards ten times. The pad is wiped clean after every use. The homogenized sample is placed in a snack size baggie and labelled according to the drill heading, date, and shift. Five points are taken and averaged for Arsenic, Sulfur, Calcium and Iron. Ten percent of samples are quality checked with the Rigaku benchtop XRF. This will enable more efficient handling and disposal of waste rock, by eliminating several sample processing steps.
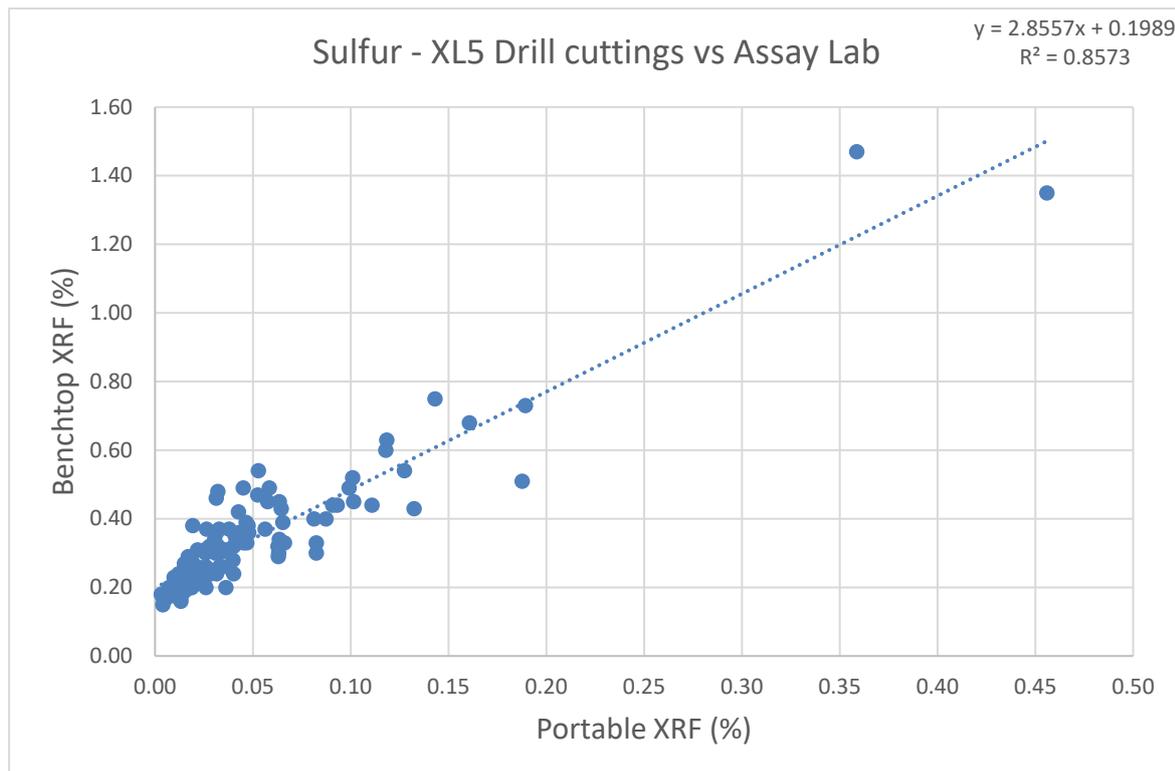
Correlation Data:

The correlation between the Rigaku benchtop XRF analysis and the handheld XRF (Niton XL5) between drill cuttings evaluated are shown in Table 1 below. R^2 is the correlation coefficient. An R^2 value of 1 is a 1:1 correlation. An R^2 value of 0.5 means there is no correlation and R^2 values less than 0.5 suggest an inverse correlation. An R^2 value of 0.85 suggests that the portable XRF and benchtop XRF analyses have an acceptable correlation. The portable XRF will be used if this correlation can be maintained.

Table 1: Correlation Data Summary

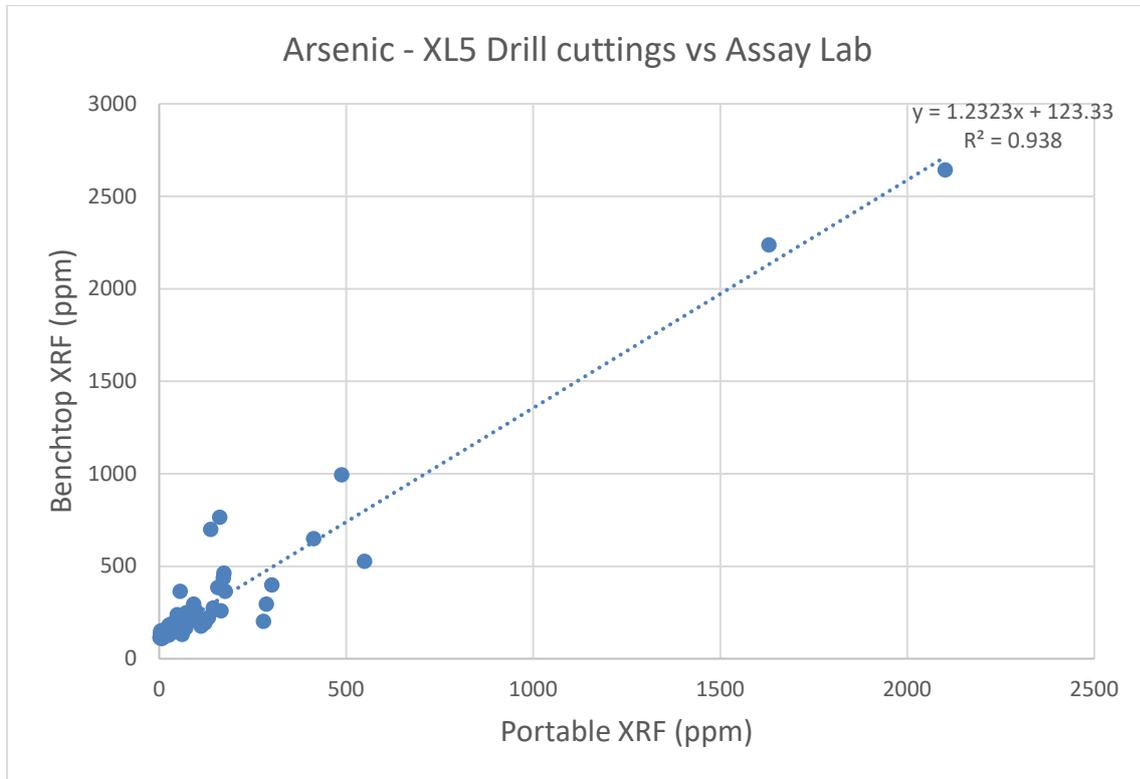| Constituent	Units	XL5 Action Level	Trendline Equation	R^2
Sulfur, Percent	%	0.105	Y=2.8557X+0.1989	0.857
Arsenic, Total	ppm	386	Y=1.2323X+1.23.33	0.938

Graph 1 below shows the scatterplot correlation of sulfur for the benchtop XRF and the handheld XRF.

Graph 1: Sulfur Correlation of Drill Cuttings on Benchtop XRF versus Handheld XRF

Graph 2 shows the scatterplot correlation of arsenic on the benchtop XRF and the handheld XRF.

Graph 2: Arsenic Correlation of Drill Cuttings on Benchtop XRF versus Handheld XRF

Arsenic - XL5 Drill cuttings vs Assay Lab

$y = 1.2323x + 123.33$
$R^2 = 0.938$

Benchtop XRF (ppm) — vertical axis
Portable XRF (ppm) — horizontal axis

Control Measures:

NSR implemented a control measure ensuring that ten percent of the samples are analysed using the Rigaku benchtop unit to ensure the correlation does not fall below 0.85 for either element. Data will be reviewed quarterly to revise the correlation and action levels as needed.

The following documents will be updated to reflect this procedure: QAPP, POO, and SWP - 042. Thank you for reviewing our proposal. If you have any questions or concerns, please contact me via email me at jladegard@nsrltd.com or 907-895-2789.

Sincerely,

Jillian Ladegard
Environmental Manager
Northern Star Resources Limited

CC: Timothy A. Pilon, Brent J. Martellaro, William M. Groom