TETRA TECH

Tucson Office
3031 West Ina Road
Tucson, AZ 85741
Tel 520.297.7723 Fax 520.297.7724
www.tetratech.com

Technical Memorandum

To:	Kathy Arnold	**From:**	David Krizek
Company:	Rosemont Copper Company	**Date:**	August 31, 2010
Re:	Rosemont Waste Rock Segregation Plan	**Doc #:**	244/10-320877-5.3
CC:	Amy Hudson (Tetra Tech)		

1.0 Introduction

This Technical Memorandum provides a Waste Rock Segregation Plan (Plan) associated with the proposed Rosemont Copper Project (Project) in Pima County, Arizona. This information is in response to the April 14, 2010 Comprehensive Request for Additional Information from the Arizona Department of Environmental Quality (ADEQ) to Rosemont Copper Company (Rosemont) as part of the aquifer protection permit (APP) application (Tetra Tech, 2009) submitted to ADEQ in February 2009. Specifically, this Technical Memorandum answers item no. 30a on page 13 of 18:

Application Vol. 1, February 2009, states "Waste rock will be managed by monitoring potentially acid generating (PAG) and non-acid generating (NAG) materials and placing materials in designated areas." It further states, "Because waste rock will be placed by segregating materials based on acid generating potential and testing results by source type and Waste Rock Storage Area will achieve greater engineering control potential compared to a typical unsegregated waste rock pile."

Please provide the following:

a) *A detailed work plan for segregating potentially acid generating materials, including method of sampling, frequency of sampling, and what triggers or activates segregation and testing procedures;*

   For characterizing waste rock to determine if the material is non-acid generating. Rosemont is referred to the guidelines specified under CHARACTERIZATION OF TAILING, SPENT ORE AND WASTE ROCK contained in the Arizona Mining BADCT Guidance Manual.

2.0 General Project Information

The Project will include both sulfide and oxide ore mining and processing activities. Throughout active mining operations, grade control sampling and analysis will be performed as part of the overall mining process to control plant operations, to verify metals recovery, and to ensure proper segregation of materials.

Oxide ore will be placed on a lined heap leach pad and leached with dilute sulfuric acid. Sulfide ore will be processed in the milling and flotation circuit, with concentrate being shipped off-site

for further processing. Tailings will be stored in the Dry Stack Tailings Facility. Waste rock, depending upon its type and characterization, will be placed in the Waste Rock Storage Area, used as buttress material for the Dry Stack Tailings, screening berms, or for various fill requirements.

Table 1 identifies the rock types, anticipated material tonnages, and the percentage of that rock type compared to the total anticipated waste rock volume. These tonnages are based on the current P673 pit configuration. Table 1 also lists some of the geochemical characterization tests previously performed on the various waste rock types. Analyses performed included Acid Base Accounting (ABA), net acid generation pH test (NAG pH), whole rock analysis, Synthetic Precipitation Leaching Procedure (SPLP), and Meteoric Water Mobility Procedure (MWMP).

Table 1 Summary of Rosemont Waste Rock Types and Tonnages

Rock Type	Tons of Material	Percent of Material (by weight)	No. of ABA/NAG pH Tests	No. of SPLP Tests	No. of MWMP Tests
Arkose	546,336,000	44.38%	55	8	8
Tertiary Gravel	141,227,000	11.47%	5	0	0
Abrigo	113,815,000	9.24%	6	5	0
Horquilla	87,141,000	7.08%	26	8	2
Glance	80,841,000	6.57%	4	0	0
Andesite	49,118,000	3.99%	38	4	6
Concha	34,107,000	2.77%	6	1	1
Martin	32,304,000	2.62%	7	4	0
Earp	29,577,000	2.40%	14	6	0
Epitaph	27,150,000	2.21%	16	6	0
Escabrosa	22,859,000	1.86%	10	4	0
Bolsa	23,447,000	1.90%	13	6	0
Colina	16,145,000	1.31%	11	4	0
Quartz Monzonite Porphyry	13,047,000	1.06%	9	2	1
Scherrer	8,524,000	0.69%	0	0	0
Pre-Cambrian Granodiorite	4,203,000	0.34%	0	0	0
Undefined	941,000	0.08%	0	0	0
Overburden	391,000	0.03%	6	2	2
Total Amounts	**1,231,173,000**	**100%**	**226**	**60**	**20**

3.0 Summary of Material Classification

As referenced in Section 1 above, the non-acid generating nature of the material will be based on the section in the Arizona Best Available Demonstrated Control Technology (BADCT) Guidance Manual (ADEQ, 2004) titled Characterization of Tailing, Spent Ore, and Waste Rock (Part A of Appendix B).

ABA analyses previously conducted for the waste rock samples evaluated the potential of the waste rock to generate acid based on the Part A. Characterization of Tailing, Spent Ore and Waste Rock of Appendix B of the Arizona Mining BADCT Guidance Manual (ADEQ, 2004). The ABA analyses included a determination of the sulfur content, acid neutralization potential (ANP), and the acid generating potential (AGP) of the waste rock. The sulfur and sulfide content indicates the likelihood of whether the rock type may be acid generating. There are two (2) methods for evaluating ABA analysis results: the net neutralization potential and the neutralization potential ratio.

3.1 Net Neutralization Potential (NNP)

The ANP and the AGP are expressed in units of tons of calcium carbonate (CaCo3) per kiloton of rock (tons $CaCO_3$/kton rock). The difference between the ANP and AGP is defined as the net neutralization potential (NNP) (NNP = ANP-AGP).

In general, a sample would be acid-generating if it has a significant amount of sulfur or sulfide minerals or if its net neutralization potential (NNP) was less than zero (0); however, the risk of acid rock drainage (ARD) has been found to be highest for samples with NNP values less than -20 tons $CaCO_3$/kton rock and is low when the NNP is greater than +20 tons $CaCO_3$/kton rock (Price, 1997).

Appendix B of the BADCT Manual (ADEQ, 2004) provides the following guidance:

- If the NNP is less than –20 tons $CaCO_3$/kton (NNP ≤ –20), then the sample is acid generating;
- If the NNP is between –20 and +20 (–20 < NNP < +20), then the sample is potentially acid generating; and
- If the NNP is greater than +20 (NNP > +20), then the sample is considered non-acid generating.

If NNP is less than -20 tons of $CaCO_3$/kton, it can be considered acid generating. Between -20 and +20, the potential exists for the waste rock to be acid generating. The more positive the NNP, the lower is the risk for the waste rock to be acid generating. When the NNP is above +20, the material can generally be considered non-acid generating. Prediction of the acid generating potential when the NNP is between +20 and -20 tons of $CaCO_3$/kton of sample is more difficult due to uncertainty in analysis and conversion factors.

3.2 Neutralization Potential Ratio

The ratio of ANP to AGP, the neutralization potential ratio (NPR) (NPR = ANP/AGP), can also be used to assess risk of developing acidic rock drainage (ARD). An NPR greater than 3 is thought to have a low ARD risk while samples with an NPR less than one (1) have a high ARD risk (Price, 1997).

The BADCT manual (ADEQ, 2004) provides the following guidance for evaluating the NPR:

- If the ratio is less than or equal to one (1) (ANP/AGP ≤ 1), the sample is likely to be acid generating;

- If the ratio is greater than one (1) but less than three (3), then the sample is potentially acid generating; and
- If the ratio is greater than three (3) to one (1) (ANP/AGP ≥ 3), then the sample is considered non-acid generating.

Ratios of ANP/AGP can also be used to assess the acid generation potential. An ANP/AGP ratio of 1:1 is equivalent to an NNP of zero (0). If the ratio of a sample's neutralization potential and acid production potential is greater than 3:1, then there is a low risk for acid drainage to develop. For samples with a NPR between 1:1 and 3:1, the uncertainty increases. As a result, additional testing is usually necessary using kinetic test methods as described under the Tire #2 protocols (ADEQ, 2004). Samples with a ratio of 1:1 or less are more likely to generate acid (Smith and Barton-Bridges, 1991).

3.3 Waste Rock Sampling

A total of 226 waste rock samples have been tested to date to evaluate the acid generating and acid neutralizing potential of the material. Based on previous characterization work:

- 12 of the 226 waste rock samples analyzed for NPR were identified as being likely acid generating;
- Five (5) of 38 samples of Andesite had NPRs indicating that were likely acid generating; and
- One (1) of 55 Arkose samples had an NPR indicating that the sample was likely acid generating.

The remaining potentially acid generating samples included five (5) Bolsa and one (1) Abrigo sample.

Twenty-four (24) samples from Andesite, Arkose, Bolsa, Earp, and Qmp rock types had NPR ranges that indicated that the rock types were moderate or uncertain acid generation potential.

In summary, the NNPs for the 226 samples indicated that only one (1) sample of Andesite was likely acid generating, and approximately 51 samples of Abrigo, Andesite, Arkose, Bolsa, Earp, overburden, and Qmp, contained NNPs indicative of the type being moderately acid generating or uncertain. Most of these 51 samples were from Andesite, Arkose, and Qmp rock types.

Based on this information, very little of the waste rock at Rosemont has the potential to generate acidic conditions. Therefore, sampling and analysis of waste rock during operation will target specific rock types as well as incorporate an overall characterization plan.

4.0 Waste Rock Segregation Plan

In general, the plan to segregate acid generating waste rock will be activated based on observations, sampling, and characterization of samples completed during mining operations.

During the mining operations, drilling will be completed on 50-foot benches and overseen by a Rosemont Copper geologist. Variations in lithology and mineralogy/geology, as well as degree and extent of fracturing, will be evaluated by the geologist. Composites from the drill holes will

be assayed as needed to characterize the material. If however, the presence or layer of one of the units (i.e., Andesite, Arkose, etc.) is identified as potentially being acid generating based on past characterization work, the individual layer will be discretely sampled and characterized.

Characterization of these samples could include Acid Base Accounting (ABA) or net acid generation pH test (NAG pH). The degree of sulfide and oxide mineralization would be determined as part of the aforementioned characterization.

Decisions for segregation, particularly of any potentially acid generating waste rock, will be based on the results of the characterization. Non-acid generating waste rock will be preferentially placed on the east and south haul roads and buttresses, the dry stack tailings buttresses and exterior haul roads, screening berms, drain fills, permanent diversion crossings, the crusher haul road, and the leach pad. Acid generating waste rock will be placed to the interior of the waste rock pile and possibly mixed (comingled) with non-acid generating waste rock. Additionally, potentially acid generating waste rock will not be placed beneath areas designated for water management ponds as part of the final landform.

Specific waste rock segregation requirements will be detailed in operating plans that will be modified as appropriate. In general, however, these plans will include Rock Inspection and Classification, and Rock Type Monitoring as specified below.

4.1 Rock Inspection and Classification

A geologist or trained technician will inspect each pile of blasted and broken rock before removal from the active mining face. A fizz test will be conducted at the active heading with dilute hydrochloric acid (HCL). The visual inspection and fizz test will guide the preferential placement of waste rock as described. If the results are questionable, or if there is the presence of potentially acid generating material as defined in the preliminary characterizations work, additional testing may be necessary or material may be preferentially treated as acid generating and placed appropriately.

Mine staff shall maintain records that indicates the personnel involved in the decision, the testing or review involved, and if the rock was determined to be acid generating or not. Placement of the material should also be verified. The records shall be maintained on site and available for inspection.

4.2 Type Monitoring

In addition to the determination of testing as described in Section 4.1, ABA tests shall completed on at least two (2) random samples per week up to a maximum of ten (10) samples during a month. ABA testing includes a measurement of the Acid Neutralization Potential (ANP) and the Acid Generating Potential (AGP) of the waste rock. SPLP (Synthetic Precipitation Leaching Potential EPA Method 1312), shall be completed quarterly on samples used as buttress or drain materials. These records should also be maintained on site.

REFERENCES

Arizona Department of Environmental Quality (ADEQ) (2004). *Arizona Mining Best Available Demonstrated Control Technology (BADCT) Guidance Manual*. Aquifer Protection Program. Publication TB-04-01.

Hem, J.D. (1985). *Study and Interpretation of the Chemical Characteristics of Natural Water. USGS Water Supply Paper 2254*. US Government. Print Office. Washington DC 263 pgs.

Price, W.A. (1997). Draft: *Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*. British Columbia Mine Reclamation Services (MRS). British Columbia Ministry of Employment and Investment, Energy and Minerals Division, Smithers, BC (April) 143 pgs.

Smith, A. and J.B. Barton Bridges, (1991). *Some Consideration in the Prediction and Control of Acid Mine Drainage Impact on Groundwater from Mining in North America*. Proceedings of the EPPIC Water Symposium. May 16-17, 1991, Johannesburg, South Africa.

Tetra Tech (2009). *Aquifer Protection Permit (APP) Application*. Prepared for Rosemont Copper Company. Report Dated February 2009.