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Technical Memorandum

To:	Kathy Arnold	**From:**	David Krizek
Company:	Rosemont Copper Company	**Date:**	August 24, 2010
Re:	Rosemont Geochemical Pit Lake Predictive Model Summary	**Doc #:**	229/10-320877-5.3
CC:	Mark Williamson (Tetra Tech)		

1.0 Introduction

This Technical Memorandum summarizes the results of a predictive pit lake water quality analysis prepared for the proposed Rosemont Copper Project (Project) in Pima County, Arizona. The report titled *Geochemical Pit Lake Predictive Model – Rosemont Copper Company* (Tetra Tech, 2010) is provided in Attachment 1.

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 submitted to ADEQ in February 2009 (Tetra Tech, 2009). Specifically, this Technical Memorandum answers item no. 1 on pages 1 and 2 of 18.

- *The application and supporting documents identify a number of reports that are either pending or completed, but do not appear to have been submitted for review. The following documents are necessary to continue the review of the application. They are identified by title, with the location if the reference indicated in parentheses:*

  Pit Lake Geochemical Model (Application, Table 7.41)

Section 2.0 below summarizes the results of the geochemical pit lake predictive modeling effort. Groundwater inflow estimates into the pit for this February 2010 geochemical modeling effort were based on the initial groundwater model results prepared by Montgomery & Associates (M&A, 2009). Once mining and mineral processing activities cease, dewatering of the Open Pit will be terminated. Montgomery's 2009 groundwater flow model for the Rosemont site yielded the following general conclusions:

- A pit lake is expected to form in the Open Pit; and
- Based on the expected inflows to the pit lake (groundwater seepage and precipitation) in relation to the annual evaporation from the pit lake surface, the pit lake will be a hydraulic sink. The overall effect of the hydraulic sink will be to draw

water into the system and not allow water or its associated chemical mass to exit the pit (M&A, 2009).

2.0 Geochemical Model Summary

In addition to the hydrogeological analysis performed by M&A, the expected chemical conditions within the pit lake were analyzed by Tetra Tech. This analysis included geochemical testing of the non-ore rock expected to comprise the final pit wall. Tetra Tech used M&A's pit filling data as an input to a geochemical pit lake predictive model.

The geochemical model (attached) showed the quality of the pit lake water was only slightly changed from local groundwater after 200 years of simulation. The conclusions of the predictive geochemical modeling effort performed for the Rosemont Copper Project by Tetra Tech can be summarized as follows:

- The majority of the inflow water entering the Open Pit will be from groundwater sources seeping through the pit walls. About 95 percent of the contribution to the pit lake will be from groundwater. Direct precipitation, and runoff from the pit walls, will contribute to the pit lake water balance as well. Over time, the contribution from direct precipitation will increase as a percentage of annual inflow as the pit lake surface area increases;

- The pit lake is anticipated to be similar to the local groundwater with a pH of 8, which is slightly alkaline; and

- Because the pit lake is expected to be a hydraulic sink, with water leaving only through evaporation, dissolved chemical constituents are expected to concentrate over time. At the 200 year simulation mark, the model showed evapo-concentration of some constituents about 1.3 times that of local groundwater.

As indicated above, the quality of the pit lake water was only slightly changed from local groundwater after 200 years of model simulation. At that time, the pH of the pit lake water is anticipated to be 8, which is also similar to local groundwater. Sulfide minerals are largely absent from the non-ore rock at the Rosemont site and carbonate minerals, such as limestone, are abundant. Therefore, the development of an acidic pit lake is not expected, even beyond the 200 year modeling period.

From the results of the geochemical model, it was estimated that 95 percent of the water reporting to the pit lake will come from local groundwater, with the remaining comprised of direct precipitation and runoff from the pit walls. Therefore, the majority of chemical loading to the pit lake will also come from groundwater sources.

3.0 Additional Modeling

Based on comments received during the Environmental Impact Statement (EIS) process, updated groundwater flow models are being prepared by both M&A and Tetra Tech for the Project. An update to the February 2010 *Geochemical Pit Lake Predictive Model* is also currently underway with an expected completion date of September 2010. The updated pit lake geochemical model will be based on the pit infilling estimates and ultimate pit lake water surface

based on Tetra Tech's groundwater flow model results. Additionally, in response to comments also received during the EIS process, some assumptions will be modified in the updated geochemical model concerning first flush chemical source terms from the pit wall rocks. This will increase the rate of chemical loading to the pit lake in the short term (200-300 years). In general, however, the updated model is expected to reflect similar long-term results to the February 2010 model as a hydraulic sink will still be maintained and evapo-concentration is anticipated to lead to elevated total dissolved solids.

REFERENCES

Montgomery & Associates (M&A, 2009). *Groundwater Flow Modeling Conducted for Simulation of Proposed Rosemont Pit Dewatering and Post-Closure Rosemont Project Pima County, Arizona*. Prepared for Rosemont Copper Company. Report Dated October 28, 2009.

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

Tetra Tech (2010). Geochemical *Pit Lake Predictive Model – Rosemont Copper Project.* Prepared for Rosemont Copper Company. Report Dated February 2010.

ATTACHMENT 1

GEOCHEMICAL PIT LAKE PREDICTIVE MODEL (FEBRUARY 2010)

Rosemont Copper Project
Locator Sheet

Record # 012105 Document Date 2010 02

Document Title: Geochemical Pit Lake Predictive Model

Author/Recipient Tetra Tech

Description Based on pit filling data from M+A's hydrogeological model, a geochem. pit lake predictive model was developed by TT.

Other Notes Attachment 1 of 013377

This document is located in the following: [CIRCLE THE CATEGORY (from the list below) IN WHICH THIS ITEM IS FILED]

1. **Project Management**
   - a. Formal recommendations & Directions
   - b. Formal meeting minutes & memos
   - c. General Correspondence
   - d. Contracts, Agreements, & MOUs (Rosemont, Udall, SWCA)
   - e. Other
2. **Public Involvement**
   - a. Announcements & Public Meetings
   - b. Mailing Lists
   - c. Scoping Period Comments
   - d. Udall Foundation Working Group
   - e. Scoping Reports
   - f. Comments after Scoping Period
   - g. DEIS Public Comments
3. **Agency Consultation & Permits**
   - a. Army Corps of Engineers (404 permit)
   - b. US Fish & Wildlife Service (Sec. 7 T&E)
   - c. State Historic Preservation Office (Sec. 106)
   - d. Tribes (Sec. 106)
   - e. Advisory Council on Historic Preservation (Sec. 106)
   - f. Other
   - g. AZ Dept of Environmental Quality (APP)
4. **Communication**
   - a. Congressional
   - b. Cooperating Agencies
   - c. Organizations
   - d. Individuals
   - e. FOIA
   - f. Internal
   - g. Proponent
5. **Proposed Action**
   - a. Mine Plan (including compilation)
   - b. Supporting Documents
   - c. Detailed Designs
   - d. References
6. **Alternatives**
   - a. Cumulative Effects Catalog
   - b. Connected Actions
   - c. Dismissed from Detailed Analysis
   - d. Analyzed in Detail
     - i. Barrel McCleary
     - ii. Barrel Only
     - iii. Scholefield McCleary
7. **Resources**
   - a. Air Quality & Climate Change
   - b. Biological
   - c. Dark Skies
   - d. Fuels & Fire Management
   - e. Hazardous Materials
   - f. Heritage
   - g. Land Use
   - h. Livestock Grazing
   - i. Noise & Vibration
   - j. Public Health & Safety
   - k. Recreation & Wilderness
   - l. Riparian
   - m. Socioeconomics & Environmental Justice
   - n. Soils & Geology
   - o. Transportation & Access
   - p. Visual
   - q. Water
8. **Reclamation**
   - a. Plans & Reports
   - b. Notes & Correspondence
   - c. References
   - d. Other
9. **DEIS**
   - a. DEIS
   - b. References
10. **FEIS**
11. **Geospatial Analysis (GIS Data)**
12. **FOIA Exempt Documents**
13. **ROD (including BLM & ACOE)**