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**Technical Memorandum**  
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<b>To:</b>	Kathy Arnold	<b>From:</b>	Michael E. Zeller, P.E., P.H.
<b>Company:</b>	Rosemont Copper Company	<b>Date:</b>	August 18, 2011
<b>Re:</b>	Response to PCRFC D Comments Regarding Hydrology	<b>Doc #:</b>	140/11-320878-5.3.
<b>CC:</b>	David Krizek, P.E. (Rosemont Copper Co.) Paul Ridlen and Mike Thornbrue (TtMM)		



Following are the Pima County Regional Flood Control District (PCRFC D) Comments regarding hydrology for Rosemont Mine, followed by Tetra Tech’s responses.

PCRFC D Comment No. 1

RFCD has guidance on implementing hydrologic investigation. Applicable Tech Polices include, but are not limited to:

- Tech 010 – Rainfall Input for Hydrologic Modeling
- Tech 015 – Acceptable Methods for Determining Peak Discharges
- Tech 018 – Acceptable Model Parameterization for Determining Peak Discharge

Tech Policies 010, 015, and 018 have not been followed in the hydrologic investigation. Therefore, the hydrology results are not suitable to evaluate for permitting purposes.

Tetra Tech Response to PCRFC D Comment No. 1

Tetra Tech maintains that the PCRFC D statement that the hydrology results are not suitable to evaluate for permitting purposes is incorrect. The proposed action falls under the review of various agencies, with a variety of policies and objectives. The method of hydrologic evaluation described in the DEIS was selected to address the requirements of the various agencies involved. The RFCD Technical Policies are guidelines written by the PCRFC D to “interpret” the intent of the ordinances upon which they are based, as indicated on the PCRFC D’s own website. They are not standards, and thus they do not supersede the expertise and judgment of the professional engineer(s) conducting the hydrologic investigation. The method used by Tetra Tech for hydrology investigation of the Rosemont Mine is not prohibited by the referenced policies and meets the requisite standard of care because it was performed in a manner consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar circumstances. Furthermore, in some cases the policies are in direct conflict with regulations of other agencies. For example, a requirement of at least one other reviewing agency that must approve Rosemont Mine (i.e., ADEQ) is that 24-hour storm durations be used when computing hydrology and assessing results.

### PCRFCF Comment No. 2

Tetra tech (Zeller 2010b) used PSIAC method to estimate sediment yield from the study site. PSIAC is developed for planning purposes by Pacific Southwest Inter Agency Committee for watershed basins of larger than 10 square mile (PSIAC, 1968). The watershed area is 8.2 sq mile for the Baseline condition and 1.9 sq mile for the post-mining condition. It is not appropriate to use the PSIAC method, especially for the post-mining condition. Additionally it is not clear how the sediment concentration was calculated (i.e. flow volume).

### Tetra Tech Response to PCRFCF Comment No 2

The RFCD statement regarding use of PSIAC is incorrect. While it is true that the original developers of the PSIAC method recommended that the procedure be used for watershed delineations of 10 square miles or greater, subsequent studies in the intervening 43 years have shown that the method can be used to reasonably characterize sediment yield from areas as small as 100 acres (see, for example, Rasely, RC. 1991, *“Proposed Revision of Sediment Yield Procedure Pacific Southwest Interagency Committee Report of the Water Management Subcommittee 1968.”* Upper Colorado River Basin Rangeland Salinity Control Project, Salt Lake City, UT, U.S. Department of Agriculture, Natural Resources Conservation Service, 17 p.; and Renard, KG., 1980, *“Estimating Erosion and Sediment Yield from Rangeland.”* Proceedings of the Symposium on Watershed Management, ASCE, Boise, Idaho, July 21 - 23, 1980, 12 p.). Over the past 30 years, Tetra Tech has used PSIAC to estimate sediment yield emanating from many small watersheds throughout southern Arizona, with highly satisfactory results.

The sediment concentration was calculated by dividing the weight of the average-annual sediment yield by the combined weight of the water-sediment mixture of the average-annual sediment yield and the average-annual stormwater runoff volume. This ratio was then converted to parts per million, by weight.

### PCRFCF Comment No. 3

The DEIS uses hydrologic methods that have not been verified in Pima County and result in erroneous peak discharge estimates. Methods that have been verified are described in Tech Policies 010, 015, and 018. Among the specific concerns are: The rainfall depths used in the Rosemont model are too low. The point for NOAA 14 atlas rainfall data is at 4,429' is from a location east of the mine, while the mine elevation is reported at 5,350' which means that because of the orographic effect noted in NOAA 14, the rainfall depth used in the hydrologic models is too low.

### Tetra Tech Response to PCRFCF Comment No 3

The PCRFCF Technical Policies do not prohibit the use of other methods, but merely recommend the preferred methods of the PCRFCF. Each of the various hydrologic methods available for estimating peak discharge produces somewhat varying results. The hydrologic results presented in the DEIS are not “erroneous,” but rather are achieved by using a variation of hydrologic methodology that differs from that preferred by the PCRFCF.

Tetra Tech maintains that the rainfall depth used in its analysis is appropriate. The RFCD suggests use of the upper 90% confidence interval rainfall values in NOAA Atlas 14---a suggestion that, to Tetra Tech’s knowledge, no other regulatory agency in Arizona makes. If the PCRFCF recommended depths for rainfall values were used, the computed rainfall would be, if anything, too high rather than too low---even if there were a slight disagreement over the location point used for characterizing the rainfall values. Tetra Tech selected rainfall values that, when applied, would produce  $Q_{100}$  peak-discharge estimates at the Compliance Points equal to or exceeding the  $Q_{100}$  peak-discharge estimates computed using the applicable USGS (i.e., Region 13)  $Q_{100}$  Regional Regression Equation (RRE). The applicability of the Region 13  $Q_{100}$  RRE was verified with results obtained using Bulletin 17B flood-frequency analysis of two applicable USGS gaged watersheds---Barrel Canyon and Davidson Canyon. That is, the Region 13 RRE for Barrel Canyon (DA = 14.10 square miles) yields a  $Q_{100}$  of 5,733 cfs, while

the Bulletin 17B flood-frequency analysis yields 5,671 cfs; and the Region 13 RRE for Davidson Canyon (DA = 50.50 square miles) yields a  $Q_{100}$  of 10,197 cfs, while the Bulletin 17B flood-frequency analysis yields 10,616 cfs. This excellent correlation supports Tetra Tech's use of the Region 13  $Q_{100}$  RRE to assure that the hydrologic modeling for Rosemont Mine would produce peak-discharge estimates at the Compliance Points that would equal or exceed results obtained when using the Region 13  $Q_{100}$  RRE, as is demonstrated from the final results, reproduced below:

Compliance Point (Initial)

DA = 8.2 square miles  
RRE  $Q_{100}$  = 4,365 cfs  
HEC-HMS  $Q_{100}$  = 5,360 cfs  
Ratio of HMS/RRE = 1.23

Compliance Point (Final)

DA = 14.0 square miles  
RRE  $Q_{100}$  = 5,713 cfs  
HEC-HMS  $Q_{100}$  = 8,072 cfs  
Ratio of HMS/RRE = 1.41

PCRFC D Comment No. 4

The DEIS uses hydrologic methods that have not been verified in Pima County and result in erroneous peak discharge estimates. Methods that have been verified are described in Tech Policies 010, 015 and 018. Among the specific concerns are: Use of a 24-hr storm for Peak Discharge determination in all cases: Peak discharge per unit area is higher at smaller areas, so that smaller watersheds produce 100-yr discharges on the order of 5 cfs/ac (which is the basis for estimating PC jurisdiction beginning with watersheds of 20 ac [i.e. 20 ac x 5 cfs/ac = 100 cfs]). By using the 24-hr, Rosemont has the potential to greatly underestimate the peak flow for most of the drainages.

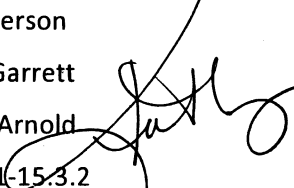
Tetra Tech Response to PCRFC D Comment No. 4

The PCRFC D statement that *"The DEIS uses hydrologic methods that have not been verified in Pima County and result in erroneous peak discharge estimates"* is incorrect. Tetra Tech used the Corps of Engineers HEC-HMS model to characterize peak discharges. HEC-HMS is a nationally recognized hydrologic model that, in the past, has been accepted by the PCRFC D for use to compute peak discharge estimates. The 24-hour storm used by Tetra Tech was required by ADEQ. Accordingly, the model was calibrated by Tetra Tech so that, at the Compliance Point(s), the predicted  $Q_{100}$  peak discharge emanating from Rosemont Mine would yield results consistent with observed peaks in Pima County. In fact, a comparison of the computed peak discharges the Compliance Point(s)—see Tetra Tech's preceding response to PCRFC D Comment No. 3—demonstrates that Tetra Tech's peak-discharge estimates are from 23 percent to 41 percent higher than the computed peak-discharge estimates at the Compliance Point(s) when using the USGS Region 13  $Q_{100}$  RRE.

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## Memorandum

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**To:** Bev Everson  
**Cc:** Chris Garrett  
**From:** Kathy Arnold   
**Doc #:** 090/11-15.3.2  
**Subject:** **Transmittal of Technical Data in Hard Copy and CD Format**  
**Date:** 6 September 2011

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Rosemont Copper Company is having delivered by courier, the following materials in hard copy and cd format as were previously submitted electronically:

- *Second Response to April 5, 2011 Selected Comments Provided by U.S. Forest Service Regarding Groundwater Flow Modeling Conducted for the Rosemont Project, Montgomery & Associates, May 17, 2011*
- *Equipment Emissions, Summary, Empire CAT, June 27, 2011*
- *Rosemont Pit Backfill Simulation, Montgomery & Associates, August 18, 2011*
- *Pit Backfill Simulation, Engineering Analytics, Inc., Technical Memorandum, August 17, 2011*
- *Predicted Groundwater Level Drawdown 20 Years after End of Operations (Layer 17), Engineering Analytics, Inc., Maps, August 2011*
- *Comments Regarding Memorandum Safety Bench Alternatives for Rosemont Pit Walls on Face of Santa Rita Mountains, Call & Nicholas, Inc., Memorandum, July 8, 2011*
- *Response to Golder Comments on Drop Chutes – Site Water Management Update Report, Rosemont Copper Company, Memorandum, June 8, 2011*
- *Response to SRK Pit Lake Comments, Rosemont Copper Company, Memorandum, May 13, 2011*
- *Predicted Regulatory (100-Yr) Hydrology and Average-Annual Runoff Downstream of the Rosemont Copper Project, Tetra Tech, Technical Memorandum, July 21, 2011*
- *Rosemont Facility Infiltration and Seepage Response to Comments, Tetra Tech, Technical Memorandum, April 22, 2011*
- *Response to Comments – Infiltration, Seepage, Fate and Transport Modeling, Tetra Tech, Technical Memorandum, June 9, 2011*
- *Additional Rosemont Response to FS/BLM Comments ES-1 on Tetra Tech Groundwater Model, Tetra Tech Technical Memorandum, May 18, 2011*
- *Response to PCRFCO Comments Regarding Hydrology, Tetra Tech, Technical Memorandum, August 18, 2011*

- *Rosemont Facility Fate and Transport Modeling Response to Comments*, Tetra Tech, Technical Memorandum, May 16, 2011
- *Pima Pineapple Cactus Survey for the Rosemont Mine Southern Utility Line Alternative, East of Sahuarita, Pima County, Arizona*, WestLand Resources, Inc., August 13, 2010
- *AERMOD Modeling Analyses for the Alternatives to the Proposed Action for the Rosemont Copper Project*, Applied Environmental Consultants, August 15, 2011
- *Response to Golder Comments*, Rosemont Copper Company, Technical Memorandum, May 6, 2011
- *Misc. Docs. Submitted via Email*, Rosemont, September 2011 CD

Please do not hesitate to contact me should you require anything further.