



BUILDING A BETTER WORLD

TECHNICAL MEMORANDUM

TO: Tom Furgason
SWCA Environmental Consultants

DATE: January 18, 2011

FROM: Nathan W. Haws, MWH Americas, Inc.
Toby Leeson, MWH Americas, Inc.

REFERENCE: 1005979

CC: Dale Ortman, Consultant
Stephen Taylor, MWH Americas, Inc.

SUBJECT: Technical Review of Addendum to Groundwater Flow Modeling Conducted for Rosemont Copper Company Mine Supply Pumping

At your request, MWH Americas, Inc. (MWH) has reviewed the *Addendum to Groundwater Flow Modeling Conducted for Simulation of Rosemont Copper's Proposed Mine Supply Pumping* (Report Addendum) prepared by Montgomery & Associates (M&A) and dated November 11, 2010. Also at your request, MWH has reviewed the memorandum prepared by M&A regarding *Additional Discussion of Rosemont Mine Water Supply Modeling and Analysis of Calibration* (Additional Discussion memorandum), which was submitted to Rosemont Copper Company (RCC) on January 6, 2011. The Report Addendum was prepared in response to action items from a meeting held on August 30, 2010 (Meeting). The meeting was attended by representatives of the United States Department of Agriculture (USDA) Forest Service's (USFS) Coronado National Forest (CNF), RCC, SWCA Environmental Consultants, M&A, and MWH.

The purpose of the Meeting was to discuss and reach consensus on the requirements of the National Environmental Protection Act (NEPA) relating to the groundwater flow model used for the evaluation of anticipated impacts from Rosemont Copper Company's (RCC's) mine supply pumping. The two key questions posed in the Meeting were (1) Does the groundwater flow model meet industry standards for use as a tool for predicting groundwater impacts from RCC mine supply pumping? and (2) Are the model construction methods and simulations results clearly explained and interpreted? During the Meeting, those present agreed on additional analyses and explanations that would clarify the methods and results of the numerical modeling of mine supply pumping and that would be included in the Report Addendum. These agreements were formalized in the Meeting minutes.

After reviewing the Report Addendum and Additional Discussion memorandum, it is MWH's opinion that the groundwater flow model developed by M&A meets industry standards for groundwater flow models and is adequate for predicting potential groundwater level changes caused by Rosemont mine supply pumping. However, a few agreement items noted in the Meeting minutes are not satisfactorily fulfilled in the Report Addendum. Fulfillment of these items is needed to clearly communicate the simulation predictions. The remainder of this memorandum presents MWH's evaluation of the Report Addendum relative to these agreements. Each of the Meeting agreements are quoted below (in bold), followed by MWH's evaluation.

Agreement: Additional modeling work and model explanations will be documented in an addendum to the modeling report.

In general, and with the exceptions noted below, the Report Addendum fulfills this agreement. For clarity, the explanations in M&A's Additional Discussion memorandum that was submitted to Kathy Arnold on January 6, 2011 (including the corrections to Figures A-2 and A-5) should be incorporated into a single document for the final Report Addendum.

Agreement: Water level changes at the Rosemont Wellfield from potential Community Water CAP recharge and potential Sierrita Mitigation pumping will be discussed, based on published data for these projects:

- **Water level changes from potential Community Water CAP recharge will be estimated from the results of simulations reported in *Technical Memorandum: Modeling Results for Proposed Community Water Company of Green Valley Recharge* (Montgomery & Associates, 2010).**
- **Water level changes from potential Sierrita Mitigation pumping will be estimated from results of simulations reported in *Sierrita Mitigation Feasibility Study* (Hydro Geo Chem, 2008).**
- **The effects of potential CAP recharge and Sierrita Mitigation Pumping will be explained in a separate section of the addendum.**

Water level changes from potential Community Water Company (CWC) CAP recharge are satisfactorily explained. The demonstration of potential impacts from CWC CAP recharge could be strengthened by including a figure that shows groundwater level changes throughout the Sahuarita/Green Valley area caused by CWC CAP recharge. If including such a figure would not be appropriate because of confidentiality requirements, the statement of groundwater level rise at the east and west RCC properties will suffice.

Water level changes from potential Sierrita Mitigation pumping are not satisfactorily explained. The Report Addendum states that projected drawdown resulting solely from the mitigation pumping "is not provided in any reports", making the determination of Sierrita Mitigation pumping "impossible." These conclusions are not valid. First, regardless of whether or not the drawdown caused by Sierrita Mitigation pumping has been previously reported, an estimation of mitigation pumping drawdown could be made using the Rosemont model, similar to how the estimation of CWC CAP recharge impacts were made. (MWH understands that objections were raised during the August 30, 2010 meeting regarding using the Rosemont Model to estimate water level changes from Sierrita Mitigation pumping.) Second, estimated water level changes caused by Sierrita Mitigation pumping is provided in the *Feasibility Study for Sulfate with Respect to Drinking Water Supplies in the Vicinity of Freeport-McMoRan Sierrita, Inc. Tailing Impoundment* (Hydro Geo Chem, Inc., 2008). Alternative 5 of the Feasibility Study is very similar to the Non-State Land Option presented in the Final Conceptual Wellfield Design Report (Hydro Geo Chem, Inc. and Clear Creek Associates, P.L.C, 2010). Figure 24 of the Feasibility Study (Hydro Geo Chem, Inc., 2008) should be sufficient to estimate groundwater level changes caused by Sierrita Mitigation pumping.

Agreement: Conduct a predictive sensitivity simulation where simulated aquifer parameters and layer thicknesses at the Rosemont RC-2 and E-1 well locations, which were modified for this current EIS model, are changed back to how they are originally specified in the ADWR model. The simulation will be from steady-state through 2032. Projected drawdown at 2032 from Rosemont pumping for the EIS model will be compared to projected drawdown using the original ADWR aquifer parameters.

This agreement is satisfactorily fulfilled by the explanation in the Report Addendum and by Figure A-6 in the Report Addendum and the corrected Figure A-5 in the Additional Discussion memorandum. The final Report Addendum should include the corrected Figure A-2 and A-5. Furthermore, there appears to be an error in Figure A-6, which shows increased drawdown southeast of the Rosemont East well for the Rosemont model compared to the Rosemont model with ADWR TAMA model aquifer parameters. The explanation given in the Report Addendum, and the expectation based on the lower permeabilities of the ADWR TAMA model, is that the drawdown should be less in the Rosemont model. Please verify that the figure is correctly labeled.

Agreement: Things to clarify in report:

- **The hydrogeology of the Santa Cruz Fault in the vicinity of the Rosemont Wellfield and its effects, or lack thereof, on the flow system.**

The Report Addendum discusses the Santa Cruz fault and explains that it predates the deposition of the principal aquifer units. The Report Addendum further notes that the ADWR TAMA model incorporates the Santa Cruz fault characteristics, implying that, therefore, the fault characteristics are inherently incorporated into the Rosemont model. This discussion satisfactorily fulfills this agreement.

- **The base model for the simulations was the ADWR TAMA model, which is an accepted, calibrated model. Corrections were made to historic stresses in the model, as documented in the Montgomery & Associates April 27, 2009 Technical Memorandum: “Second Update to ADWR Model in Sahuarita/Green Valley Area”, and discrete changes were made to hydraulic conductivity and model layer thicknesses to bring the model into conformity with data obtained at Rosemont wells RC-2 and E-1. The model grid was refined in the Rosemont pumping area to provide a higher precision in the predictions. The model report shall explain that the changes made to the ADWR model did not bring the model out of calibration – i.e. the calibration was insensitive to or improved by the changes, and therefore the current revised model is in calibration.**

The Report Addendum explains that, except for two wells located south-southwest from the Rosemont wellfield, that the Rosemont model better simulates observed groundwater elevations than the ADWR TAMA model. This is also shown in the corrected Figure A-2. The Additional Discussion memorandum provides a good discussion of the rationale for using the TAMA model as the basis for the Rosemont model and on the calibration of the Rosemont model. To fulfill this agreement, this discussion should be incorporated into the final Report Addendum along with the corrected Figure A-2.

- **Provide a map of the EIS model calibration based on the most recent observed groundwater level data set.**

The corrected Figure A-2 fulfills this agreement.

- **Clearly and thoroughly state the objectives of the model. Demonstrate that the model meets the objectives and that these objectives are suitable for the EIS.**

The discussion of the model objectives, and the model's ability to meet these objectives, needs to be strengthened with the explanations provided in the Additional Discussion. If the final Report Addendum incorporates this discussion, it will fulfill the agreement.

- **Review the uncertainties in: 1) the future model stresses such as ASLD land and Town of Sahuarita committed demand pumping, Sierrita Mitigation pumping, and Community Water CAP recharge; and 2) aquifer parameters.**

The Report Addendum, along with the corrected Figure A-5, fulfills this agreement, with the exception of the Sierrita Mitigation pumping, as discussed above.

- **Demonstrate that the model results are insensitive to the southern constant head boundary. This can be done by showing that the influence of drawdown from the Rosemont pumping does not extend to the southern boundary.**

Figure A-4 fulfills this agreement.

- **Provide cross-section plots that show projected water level changes at different times at critical locations.**

The cross-section drawdown plot is provided in Figure A-3. The drawdown profiles in the figure are difficult to interpret because of the vertical scale. We recommend that the vertical exaggeration be increased. Also, Figure A-3 shows a thickness for model Layer 3, although the Rosemont model only uses a transmissivity (i.e., no explicit thickness) for Layer 3. If Layer 3 was converted to have explicit thickness and hydraulic conductivity values, then this needs to be properly documented in the modeling report.