Responses to Peer Review Comments

Responses to Dr. Alexandra Lutz's Peer Review Comments (Reviewed Conclusions 1, 2, 4, and 5)

Lutz Summary of Conclusion 1: *Groundwater Basin Storage Capacity is appropriately estimated using well driller's reports.*

Response: Noted.

Lutz Summary of Conclusion 2: *Sufficient evidence is given for appropriately applying the CSRM model to compute historical water quality.*

Response: Noted.

Lutz Summary of Conclusion 4: *Various data sources are used and sound approaches are employed to derive appropriate groundwater modeling input parameters.*

Response: Noted.

Lutz Summary of Conclusion 5: *Various data sources are used and sound approaches are employed. The method used to establish current ambient water quality and assimilative capacity is appropriate.*

Response: Noted.

Lutz Summary of Peer Review: *A substantial amount of work has been done, as reflected in the staff report and evidenced by supporting documents. Within all this information, two very small items are unclear - evaporation at percolation ponds and evapotranspiration of crops. Evaporation at ponds is probably insignificant due to rapid percolation, and evapotranspiration of crops is probably already accounted for in irrigation water. These two small details are very small portions of a large values and do not diminish the overall work. The approaches use extensive, comprehensive, and measured information for aquifer parameters, groundwater quality, groundwater pumping, and some modeling parameters. When approaches are employed, assumptions are sound and stated and methods are explained. A substantial amount of work is accumulated into the staff report and is supported by numerous other documents.*

Response:

- Yes, the study did assume that evaporation at ponds was insignificant due to their small size and minor contribution to the total recharge to the groundwater basin.
- Yes, the study's approach to computing the deep infiltration of applied water incorporated crop evapotranspiration. Assumptions were based on typical ET values for irrigated land use types.

Responses to Dr. Gretchen Miller's Peer Review Comments (Reviewed Conclusions 1, 2, 4, 5, and 6)

Miller Summary of Conclusion 1: *The method described should provide a reasonable, if highly uncertain, volume of stored water in the aquifer. However, inconsistencies in the calculations and the lack of support for the parameter assumptions leads to lower confidence that the storage volumes presented are correct.*

Response: In your review, you correctly identified that the reported range of storage volumes were not consistent with the formulas and assumptions presented in the report. As noted in your review comments, the reported values should have been 25,500 to 50,900 acre-feet based on the reported formula and reported assumptions of the length, average width, average depth, and specific yield of the

groundwater basin. During the development of the technical approach, a larger range of assumptions for the width, depth, and specific yield of the sediments was used to initially identify that the storage volume of the Upper Temescal Valley GMZ could range from 25,000 to 100,000 acre-feet. The range of specific yield values tested was 0.1 to 0.3, based on literature values for the mix of younger, older, and very old quaternary alluvium that comprise the water bearing sediments of the basin. The final report did not accurately document the full range of assumptions considered. While the reported values are inconsistent with the reported formulas and assumptions, through the CSRM parameter testing process applied in Section 3, the lower upper range of storage volumes (25,000 and 100,000 acre-feet) were ruled out as unlikely based on observed variability in the water quality concentrations measured at wells. Thus, the report assumption that the groundwater storage volume is likely around 75,000 acre-feet is still appropriate for the study.

Miller Summary of Conclusion 2: Se*veral simple statistical tests should be performed to ensure that the set of model parameters selected is the one that best fits the available data. More extensive justification should be provided for the storage capacity selected for the final model.*

Response: The use of goodness of fit plots to compare modeled and measured data, or other similar statistical analyses, is not possible for the technical approach used for this study. There was insufficient data to build or calibrate complex numerical models where such statistics could be applied. The technical approach used for the study relied on an approach that estimated the reasonable range of various parameters based on data and local hydrogeologic conditions. The CSRM model was used to test the range of parameters and select/use those parameters that produced an aggregate basin-wide estimate of water quality that tracked the trend in measured TDS concentrations at wells. The parameter testing process was described in Section 3.2 of the report. Although there are uncertainties in the parameters, this approach is appropriate given the limited availability of data for the study area. With regard to storage capacity, please see response to the summary of Conclusion 1.

Miller Summary of Conclusion 4: *Input parameters specific to this analysis appear to be scientifically defensible, although subject to considerable uncertainty.*

Response:

- With regard to the inconsistent values noted in the first paragraph of the detailed response, the nitrate value of 3 mgl stated in the text in Section 4.2.2 on page 2-3 is a typo. The nitrate value of 5 mgl as stated in Table 4-A on page 4-2 is the correct value and is the value relied on in the analysis.
- With regard to the estimation of the rising groundwater term noted in the third paragraph of the detailed response, its derivation was described in Section 3.2 of the report. The basis for assuming rising groundwater is occurring is the geology and geometry of the basin, which includes at least three bedrock narrows. The annual rising groundwater volume was estimated annually based on the total recharge for the year and the assumption that the basin storage is always near full. The latter assumption is based on the review of the significant water level data record that exists for the historical period and the results of the parameter testing process described in Section 3.2 of the report.

Miller Summary of Conclusion 5: *Appropriate changes to the model have been made to allow for calculations representative of the current period.*

Response: In the third paragraph of the detailed response, it is noted that the 25 percent nitrogen-loss rate assumed in the study is likely conservative and its basis cited. The conservative estimate errors in favor of protecting groundwater quality. It is the Santa Ana Regional Board's practice to allow a minimum of a 25 percent nitrogen-loss assumption in the absence of field studies to estimate site specific nitrogen losses. Larger loss rates are allowed if field studies confirm that loss rates are greater than 25 percent. No field studies on nitrogen loss have been performed in the Upper Temescal Valley.

Miller Summary of Conclusion 6: *The scenarios selected and overall analysis are appropriate; however, several notable details of the modeling are internally inconsistent and should be clarified. The long-term implications of the scenarios associated with urbanization (#3, #4) are potentially troublesome, making the regular monitoring and reporting detailed in Section 6 critical for ongoing aquifer protection.*

Response:

- With regard to the inconsistent values noted in the third paragraph of the detailed response, the nitrate value of 5 mgl as stated in Table 4-A on page 4-2 is the correct value and is the value relied on in the analysis.
- With regard to the conversion issues noted in the fourth paragraph of the detailed response, the confusion is related to incorrect column and unit headings in Table 5-A. The model input was checked by the consultant and confirmed that the correct data was used for the projections.

Miller Summary of Peer Review: *Given the lack of data available for the Upper Temescal Valley GMZ, a number of assumptions and approximations were needed to complete its Salt and Nutrient Management Plan. In general, the analysis used a defensible set of best practices, with two notable exceptions. The first is the characterization of the storage capacity, which appears to have been insufficiently detailed and/or documented. The second is the failure to appropriately compare the modeling results with the available data and provide an assessment of the uncertainty inherent in the computations. For example, the results of the modeling are not sufficiently presented for the lower storage capacity values. To fully understand the uncertainty associated with the modeling, the full range of current ambient water quality (i.e., Table 4-B) predicted by the range of simulations (i.e., Table 4-A) should be shown. This step would allow for more informed decision making.*

Throughout the report, I also noted that few to no mass-balance calculations or comparisons were performed for water quantity or the constituents under study. Such calculations are frequently conducted under similar circumstances, and their lack made it difficult to check for errors or to understand the big picture with regard to mass fluxes into and out of the basin. While the flow weighted concentrations were helpful, an accounting of the annual TDS mass entering and leaving the basin categorized by route would be illustrative. In this way, it could quickly be demonstrated, for instance, that intakes from the Colorado River accounted for a certain percent of annual salt accumulations in the aquifer. Such an analysis should be straightforward given the data already presented in the document and could greatly aid management decisions.

Response:

- With regard to the limitations noted in the first paragraph of the summary, please see responses to Conclusions 1 and 2.
- The mass balance calculations for the projection period are presented in Appendix C of the report.

Responses to Dr. David Hyndman's Peer Review Comments (Reviewed Conclusions 1, 2, 3, 4, 5, and 6)

Hyndman Summary of Conclusion 1: *Although the estimates of aquifer storage made here were simplified with the triangular assumption and back of the envelope estimates of specific yield, the general approach is workable. Depending on the importance of the storage volume for any corrective measures, it would be worth updating these estimates using more sophisticated methods.*

Response: With regard to the limitations noted in the third paragraph of the detailed response to this conclusion regarding the assumptions for specific yield, there were no available pumping test data that could be used to better estimate the values. Note that the requirement for the SNMP participants to update the SNMP every five years, including consideration of improved methods to compute current and projected water quality conditions, enables the use of more sophisticated methods in the future based on new data that might be collected in the study area over time.

Hyndman Summary of Conclusion 2: *Although more advanced methods exist to estimate changes in solute concentrations in such an alluvial aquifer system, the CSTR method appears to be adequate for this case.*

Response: Noted.

Hyndman Summary of Conclusion 3: *For the purpose of evaluating concentrations within the range of land use conditions that have been observed, this appears to be a reasonable approach.*

Response: Noted.

Hyndman Summary of Conclusion 4: *Overall, the approach used for groundwater quality modeling parameters are reasonable. There are a few choices that appear to be somewhat arbitrary, such as the 50% and 25% efficiency coefficients, that could be improved with further data and modeling.*

Response: Although the report could have better described the specifics of how the irrigation efficiencies used for the historical and current periods (50% and 75%, respectively) were derived from prior work, they were based on the publications noted on Page 2-12 of the report, including:

- Historical Period Values for agriculture: California Department of Water Resources. (1975). Vegetative Water Use in California, 1974. Bulletin No. 113-3
- Historical Period Values for urban: Water Resources Engineers, Inc. (1970a) Unit Water Requirements and Waste Increments, a Final Report on Task VI-6.
- Current Period Values for agriculture and urban: WEI. (2015a). Draft 2013 Chino Basin Groundwater Model Update and Recalculation of Safe Yield Pursuant to the Peace Agreement. Prepared for the Chino Basin Watermaster.

In the seventh bullet of the detailed response, it is noted that the 25 percent nitrogen-loss rate assumed in the study is arbitrary. It is the Santa Ana Regional Board's practice to allow a minimum of a 25 percent nitrogen-loss assumption in the absence of field studies to estimate site specific nitrogen losses. This conservative estimate errors in favor of protecting groundwater quality. Larger loss rates are allowed if field studies confirm that loss rates are greater than 25 percent. No field studies on nitrogen loss have been performed in the Upper Temescal Valley.

Hyndman Summary of Conclusion 5:

- Since the WLAM model has been successfully used in this basin historically, it is reasonable to use similar assimilative capacity numbers for TDS and nitrate to assess current water quality issues.
- The methods and assumptions used for the WLAM and CSRM for the current period are similar to those used for the analysis in the historical period.
- The changes to the simulation start date and initial TDS and nitrate concentrations are reasonable.
- Recharge of recycled water via the streambed and percolation ponds is reasonably accounted for in the recharge term with concentrations based on known recycled water concentrations. The annual assumption is likely adequate for the system, although seasonal exceedances might be important to quantify.
- The assumption that recharge can be calculated based on the volume discharged to the ponds, with TDS and nitrate concentrations based on measured values is reasonable.
- It would again be helpful to check the assumed irrigation efficiency of 75% for deep infiltration of applied water. This number again seems to be somewhat arbitrary.
- Basing groundwater production and ET for the current period on reported production data for a recent 20-year period is reasonable.

Response: Noted.

Hyndman Summary of Conclusion 6: *Scenarios are always challenging to address, however they are one of the most important aspects of modeling. Here, the approach has been to evaluate the most likely change in factors including land cover including urbanization, which would also affect the changes in groundwater production.*

Response: The fifth bullet of the detailed response notes that the projections don't consider changes in agricultural practices for nitrate application, which are likely to be reduced in the future. Table 2-1 in the report shows that agricultural land is decreasing in this area through build-out. The assumptions applied are conservative and more protective of groundwater quality in terms of interpretation of regulatory compliance outcomes.