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# Memorandum

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Subject: ***CPV Sentinel – Groundwater Flow Models – URS Project Specific Model Compared to Mission Spring Water District Model prepared by PSOMAS***

This memo discusses the relevance of groundwater flow models that were developed as part of two different projects; the CPV Sentinel Energy Project (CPVS) groundwater flow model prepared by URS Corporation (URS) and the Mission Springs Water District (MSWD) model prepared by PSOMAS.

The URS model was described in the *Technical Memorandum, Model Documentation*, submitted to the CEC as Appendix R-1 of the CPVS Application for Certification in June 2007. Additional groundwater flow model scenarios were submitted to the CEC as Appendix B of the Reponses to Data Requests (35, 38, 43, 50, 60 and 62 through 65) on January 22, 2008. The PSOMAS Groundwater Flow Model of the Mission Springs Sub-basin is described in a report prepared by PSOMAS dated April 2007.

The need to understand one model compared to the other is unnecessary to evaluate the project-specific effects on water levels in the Mission Creek Sub-basin because, for the most part, the two models are not relevant to each other. That is, they were developed and conducted for different purposes. The objective of the URS modeling efforts has been to evaluate the net effect of project-specific pumping and recharge volume and timing variations of the relative groundwater levels in the subbasin. The purpose of the PSOMAS model as stated in PSOMAS 2007 was “to estimate what changes to groundwater elevations, if any, could be expected to occur within the Subbasin from increased groundwater pumping coupled with proposed groundwater recharge efforts”. The overriding point is that the CPVS project-specific pumping and recharge effects would be the relative net change in the basin regardless of whatever other entities such as MSWD were doing in the basin in terms of groundwater pumping or recharge. Specifically, these net effects (the relative drawdown effects from project-specific pumping and mounding effects from project-specific recharge at the Desert Water Agency [DWA] recharge basins) are independent of those effects induced by others.

URS hydrogeologic evaluations for the CPVS project began with a thorough review of available geologic and hydrogeologic reports in the area, including any groundwater modeling efforts that were completed or underway. When groundwater modeling was recommended to evaluate project-specific pumping and recharge effects, URS sought the use of the existing PSOMAS model, as it would do in any basin type modeling effort where others had expended considerable effort in doing the background work in setting up a groundwater model. Hopefully, this would save considerable time, effort, expense, and would avoid duplication of effort. Typically what is done in these cases is to adopt an existing model (meaning all the model files), evaluate those files and cooperatively interface with that model’s staff in order to understand model set-up, parameters, and simulations, so that it can be effectively used for the specific project in question. An initial part of that interaction includes evaluating if the existing model is adequate for our purposes and, if not, what adjustments can be made to refine the model to achieve project-specific objectives. During the course of this project CPV approached MSWD about obtaining the PSOMAS groundwater model as well as data on wells, pumping schedules, water quality, etc., for use in its hydrogeologic evaluations. In response to these requests MSWD did not provide the PSOMAS groundwater model; however, they did eventually provide the PSOMAS model report (PSOMAS 2007).

Upon review of the PSOMAS Groundwater Model report, URS' opinion is that it would not have been usable for the CPVS project due to numerous apparent technical deficiencies. URS notes that it does not have the model or any model input/output files so the comments/conclusions from the review are based solely on the PSOMAS modeling report. As stated above, the PSOMAS model was developed to estimate the future groundwater elevation changes from the increased groundwater pumping and the proposed groundwater recharge efforts for Mission Creek Groundwater Subbasin. It was constructed using MODFLOW, a groundwater-modeling program developed by the U.S. Geological Survey (USGS). It is a transient flow model with one-single layer, using two hydraulic property zones to represent the heterogeneity of the aquifer. The model was calibrated with historical groundwater elevation data and predictive simulations were run for 30 years from 2006 to 2035. URS believes that the model was improperly setup and calibrated resulting in model predictions that are not reliable. The apparent deficiencies are summarized in Table 1. URS identified nine significant deficiencies, ranking them on a scale of 1 to 5, the most severe being 5 (with 5 of 9 deficiency items being 5 on that scale). Deficiency areas include: 1) Model Domain, 2) Grid Size, 3) Boundary Conditions, 4) Hydraulic Properties Setup, 5) Recharge, 6) Model Calibration,7) Calibration Results: General, 8) Calibration Results: Specific, and 9) Simulations and Results.

Table 1 – Summary of Apparent Deficiencies - PSOMAS April 2007 Groundwater Flow Model Report

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**Table 1**

**Summary of Apparent Deficiencies**
**PSOMAS April 2007 Groundwater Flow Model Report**

| No | Items | Description | Section, page, or Figure | Severity (scale 1-5) |
|---|---|---|---|---|
| 1 | **Model Domain** | It would be better if the western edge of the model extended to the San Bernardino Mountains (different geology). The current model edge is too close to DWA Recharge Basin so the boundary effect is not minimized. | Sec. 2.2, p. 2-6 | 3 |
| 2 | **Grid Size** | For this modeling purpose, the uniform grid size of 500 x 500 ft used is too coarse, especially in locations where the hydraulic gradients are subject to sharp changes (i.e., associated with drawdown from pumping wells and mounding from recharge basins). Variable grid sizes should be used, allowing much smaller grid sizes at well and recharge basin areas to better simulate and depict water level changes and water level contours. | Sec. 2.2, p. 2-6 | 3 |
| 3 | **Boundary Conditions** | The eastern edge of the model (and a small portion of western model edge) was not specified with boundary conditions. As such, these become no-flow boundaries, which are not real. General head boundary conditions with low conductance values would have been more appropriate in this case. | Sec. 2.2, p. 2-6 | 3 |
| 4 | **Hydraulic Properties Setup** | The model specified one or two zones of hydraulic properties, which is far from reality. The Mission Creek Subbasin Aquifer System is highly heterogeneous, and the transmissivity (i.e., hydraulic conductivity x aquifer thickness) changes by orders of magnitudes from space to space (Tyley, 1974). Much more detailed hydraulic properties zones are needed and should have been applied to the model. | Sec. 2.4, p. 2-12 to 2-13 | 5 |
| 5 | **Recharge** | Recharge at the Horton Waste Water Treatment Ponds (WWTP) was not included in the flow simulations. This would affect the model calibration. Also note that historical recharge volumes at the Mission Ck Recharge Basin (p. 4-8) are incorrect. Reported as 91 af (2003); 5,564 af (2005) and 18,778 (2006). But should be 5,564 (2004), 24,723 (2005) and 19,900 (2006). | Figure 2-7, P.5-6 and p. 4-8 | 2.5 to 5 |
| 6 | **Model Calibration** | 1. GW elevations at 7 pumping wells and 20 observation wells used as calibration targets. Per Item 2 (above), resolution is compounded or compromised by the 500 x 500 foot grid size, specifically for the 7 pumping wells. As such, the 7 pumping wells should not have been used as calibration targets.<br>2. The solution to the governing finite-difference flow equation is not unique. You cannot calibrate a model by varying the hydraulic input parameters (to the point they are unrealistic with respect to the hydrogeologic system) solely in order to match the observation point water levels (i.e., calibration points). The conceptual model and model set-up has to be correct and remain realistic throughout the various calibrations. | Sec. 3, p. 3-1 | 5 |
| 7 | **Calibration Results: General** | All four calibrations appear to be incorrect in terms of both transmissivity and storativity values to the point that they are unrealistic with respect to natural hydraulic conditions within the subbasin. In addition, all four calibrations are quite different from each other in terms of the hydraulic values used. If the model is correct the hydraulic input values should be fairly close to each other for the different calibration cases. | Sec. 3, p. 3-4 | 5 |
| 8 | **Calibration Results - Specific** | Even with the "two zone-anisotropic" alternative cited ("the so-called best calibration"), the calibration problem is more severe: a) Ky is ~20 times higher than Kx in west zone, b) Storativity in the east and west zones are quite different (2 orders of magnitude difference); and c) Storativity in West zone becomes so too small (0.0029 corresponding to specific storage of 0.00002), it acts as in confined system which is not the case as far as the historic literature indicates. | Sec. 3, p. 3-4 | 5 |
| 9 | **Simulations and Results** | 1) The simulated boundary inflow should not decrease sharply in 2005-2006, even with recharge at the DWA basins. This is because the main inflow is from west boundary, and recharge at DWA basins causes higher GW elevations, but not enough to affect the inflow from the western boundary. 2) Modeled drawdown near the interface of the two zones are low, to near zero in places (Fig 5-2), which does not make sense. 3) All simulation results show very high gradients at the south-west corner (Figure 5-3 through 5-10), which does not make any sense at all; 4) GW elevations in north of Mission Spring Fault are not correct (is it outside the model domain?); and 5) Simulation results in the western zone are not shown but the report does not indicate why. | Figure 5-2 through 5-10 | 5 |

**Note:** Scale of severity is from 1 to 5, and 5 is the most severe
**Ref:** PSOMAS, 2007. Groundwater Flow Model of the Mission Creek Subbasin, Desert Hot Springs, California. April.