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DATE APR 1 0 2008
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April 10, 2008

Mr. Bill Pfanner,
Project Manager
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, CA 95814-5504

Subject: CPV Sentinel Energy Project Docket 07-AFC-3

Dear Mr. Pfanner:

The district received CEC's data request regarding the Modeling of the Mission Creek Sub Basin. Due to the technical nature of the questions, the district's response will be solely from its consultant, Psomas.

Psomas recently sent two letters that should provide you with the information you need to answer these questions, which are attached.

Please contact us if you need any additional information.

Sincerely,

Arden Wallum
General Manager

Attachments

PSOMAS

March 24, 2008

Mr. Arden Wallum
General Manager
Mission Springs Water District
66575 Second Street
Desert Hot Springs, CA 92240-3711

Re: Review of URS Technical Memorandums on Groundwater Modeling for the Proposed CPV Sentinel Energy Project

Dear Mr. Wallum:

The following are preliminary comments on the URS Technical Memorandums: Model Documentation, Proposed CPV Sentinel Energy Project, Mission Creek Sub-Basin, Riverside County, California, URS, June 2007 and Additional Groundwater Flow Model Scenarios, Proposes CPV Sentinel Energy Project, January 2008. These comments are based on a preliminary review of the aforementioned documents. A detailed and exhaustive review was not conducted.

The URS model is based on an analog model developed and published by S. Tyley in 1974. The Tyley model was then converted to the Modflow code using the GMS pre and post processor. **No new or current data such as wells, pumpage, recharge or water level changes since 1974 were included.** They used the information and groundwater conditions based on information and conditions as they existed in 1974. URS then added the DWA and Horton recharge ponds as well as the proposed Sentinel wells. URS then ran various pumping and recharge scenarios with 550 acre-feet per year (afy) recharged at DWA and 1,500 afy at Horton and identified the changes in groundwater levels as the model predicted. Their premise is that this approach will accurately predict changes in groundwater levels resulting from the Sentinel project.

The biggest flaw in this approach is they assumed the basin has been static since 1974 and ignored the additional wells, changes in pumping pattern and recharge in the basin that has occurred over the last **34 years**. In addition, there has been more recent modeling efforts including Mayer and May 1998, (Michigan Technological University) and Psomas 2004 and 2007 as well as additional information on geology and hydrogeologic conditions (from new wells placed in the basin).

Other factors affecting basin conditions include that the population has changed by a factor of at least six times since 1974 and land use has changed

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(golf courses) increasing water consumption. The resultant increased water use and pumping has changed by a similar factor and DWA and CVWD have recharged CRA water periodically to the Mission Creek and Whitewater sub basins. As a result of the significant changes that have occurred over the last 34 years in not only the Mission Creek but adjacent Garnet and Whitewater sub basins; water levels, boundary conditions and water movement in and between the basins have significantly changed since the modeling effort by Tyley.

The MSWD has seen steady decreases in groundwater levels in the Mission Creek sub basin. Groundwater pumpage has increased to the current level of over 16,000 afy. This has resulted in changes in boundary conditions and resulted in groundwater storage declines of about 8,000 afy during the late 1990s and early 2000s. The spreading of CRA water has initially resulted in a reduction of the storage decline. It is anticipated that CVWD and DWA will recharge an annual average of 16,000 afy during the near future according the CVWD and MSWD Urban Water Management Plans. These factors as well as many others were not considered in the URS modeling efforts leading to erroneous results and conclusions on the change in groundwater levels and movement resulting from the Sentinel project.

In summary, the URS groundwater model does not accurately predicted current and projected conditions within the basin and the resultant changes in groundwater levels in the Mission Creek Sub Basin as a result of the CPV Sentinel project. The results in their June 2007 and January 2008 reports are misleading and need to be re-evaluated with current conditions. If you have any questions or need clarification, please feel free to contact me at your earliest convenience.

Sincerely,
PSOMAS

Michael P. Donovan, P.G., C.Hg.
Senior Hydrogeologist

MEMORANDUM

Date: March 24, 2008

To: Arden Wallum, Mission Springs Water District

From: Mr. Michael P. Donovan, P.G., C.Hg., Psomas

Subject: Response to URS Comments on Apparent Deficiencies in the Psomas Groundwater Model

On March 10, 2008, URS (Dale Shileikis) submitted a Memorandum to the CEC (Bill Pfanner) regarding CPV Sentinel – Groundwater Flow Models – URS Project Specific Model Compared to Mission Springs Water District Model prepared by Psomas. The memo discusses the relevance of the groundwater flow models that were developed for two different projects: 1) the CPV Sentinel Energy Project (CPVS) groundwater flow model prepared by URS Corporation (URS) for the CPVS Project and 2) the Mission Springs Water District (MSWD) model prepared by Psomas. In addition, the memorandum includes a list of alleged deficiencies in the Psomas Groundwater Model for the Mission Creek Sub-Basin (MCSB).

This memorandum documents Psomas' responses to comments made by URS regarding apparent deficiencies in the Psomas April 2007 Groundwater Flow Model Report.

BACKGROUND

Psomas prepared a report entitled "Groundwater Flow Model of the Mission Creek Subbasin Desert Hot Springs, California" dated April 2007 as a summary report only of several groundwater modeling efforts and the report was prepared in support of the Water System Master Plan environmental documentation. The stated purpose was:

> *"estimating what changes to groundwater elevations, if any, can be expected to occur within the Subbasin from increased groundwater pumping coupled with the proposed groundwater recharge efforts."*

The model is a regional groundwater model and was not intended to provide detailed information on a specific area. That concept is why the model grid spacing was set at a 500 by 500 foot spacing.

In developing the Psomas groundwater model for the MCSB, Psomas initially used four conceptual models that were documented in Table 3-1 in Psomas' report. The last conceptual model, Two Zones – Anisotropic had the best Sum of Squared Errors ($feet^2$) [a lower number indicating better agreement between observed conditions with modeled conditions], however as URS points out, the transmissivity and storativity values were not realistic and we agree and believed that other factors were influencing the conceptual model of the MCSB.

After completion of this initial calibration effort, a meeting was held on September 14, 2006 with Jim Burton of Psomas and Joe Birman of GSI/Water to discuss the preliminary findings. At this meeting, the consensus was that in order to accommodate this anomaly the model should include a geological feature which will be modeled as a north-south low hydraulic conductivity vertical feature that extends the width of the model domain along the trace of the short fault segment shown in the various figures. Subsequent to that meeting, data from the DWA well were obtained to further assist in model calibration.

The model was rerun and calibrated using the values in Table 4-1, which indicated values for transmissivity and storativity more in line with what would be expected with a North-South trending low hydraulic conductivity vertical feature with a conductance of 2.63E-03 $feet^2$/day. The sum of Squared Errors was 3,629 $feet^2$.

RESPONSE TO COMMENTS

General

1. A majority of the comments appear to be related to the misunderstanding of the calibration process used by Psomas along with the final calibration numbers used in the overall modeling analysis. Hopefully, the information contained within this memorandum will clear up the misconceptions that URS had regarding the parameters used as part of the Psomas groundwater model for the MCSB.

2. Some of the comments appear related to URS' intended use of Psomas' groundwater model as part of the evaluation process for the CPV Sentinel Energy Project (CPVS). We do not believe that the Psomas Groundwater Model would be appropriate for the CPVS evaluation process, however URS would have to decide what elements of the Psomas groundwater model (if any) would be appropriate or if additional site-specific information would have to be collected in order to meet the goals associated with the evaluation process.

Specific Comments

1. **URS stated *"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."***

The term "better" connotes that the reviewer has some specific information on the geology and hydrogeology of the area west of the model. At the time of development of the Psomas groundwater model, there was little known about the geology of the area west of the assumed north-south low hydraulic conductivity vertical feature that was inferred in the model. We agree that the boundary is close to the DWA Recharge Basin and that its proximity results in a limitation that was discussed with in the report results.

However, it is also clear that the objective of Psomas groundwater model was to understand broad regional changes resulting from increased pumping in the eastern zone. Therefore, there was little reason to spend time and effort to improve the aesthetics of the western zone. If URS is focused on the western zone for its activities, it would be inappropriate to use the Psomas groundwater model in that area.

2. **URS stated *"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."***

If the term "For this modeling purpose" refers to the URS effort, then we agree that the inherent limitation of a 500 by 500 ft grid may prevent a detailed analysis of drawdown near the wells proposed by CPVS. In fact, this limitation is clearly stated in the Psomas report on page 7-1. The 500 by 500 grid is not a limitation in developing regional conclusions related to groundwater elevation changes and changes to the groundwater budget.

3. **URS stated *"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."***

The use of the judgmental term "*which are not real*" highlights a serious problem with an approach that many modelers take. In this inappropriate approach, this group of modelers discards the principle of parsimony that is generally followed in the practice and adds boundaries and parameters to satisfy some preconceived notion of what the model should contain without regard to the significance of adding these boundaries and parameters to the explanation of the observed changes in fluxes and heads. Hill and Tiedeman (2007, pg 261) summarized the application of the principle of parsimony as "start simple and add complexity as warranted by the hydrology and hydrogeology, the inability of the model to reproduce observations, and the complexity that can be supported by the available observations".

The reviewer seems to be under the impression that no-flow boundaries are always wrong because they are not "real". At best, this comment connotes that the reviewer has information or data that suggests that there is some significant flow coming into the model area from the east. At worst, this is a weak attempt to cast doubt on the Psomas groundwater model because it applied the principle of parsimony.

The specification of no-flow boundaries along the eastern edge of the model used in the Psomas groundwater model is parsimonious as it is assumed that, due to the geologic setting, that any flow coming from this area into the model is insignificant. It might be instructive for the reviewer to test this assumption by running sensitivity analyses of the model with increasing fluxes across the eastern boundary and checking the magnitude of the improved calibration. We strongly suspect that improvements to the model calibration when adding flow across this boundary would be insignificant. Moreover, there would be little independent evidence to check against any flux used for the boundary except for the argument that "it is what the model calculates", which is inappropriate in nearly all cases.

4. **URS states *"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."***

The objective of developing and "calibrating" the four conceptual models described in Section 3 of the Psomas report was to test simple, parsimonious conceptual models to explain changes in groundwater levels due to pumping. As a result of the effort, and the above described meeting with Jim Burton and Joe Birman, complexity was added (a geological feature modeled as a north-south low hydraulic conductivity vertical feature) to the two hydraulic zones with anisotropy model. The model was then recalibrated. The calibration was considered successful and documented in the report. To add additional hydraulic parameter zones would have been pointless for the objectives of the Psomas groundwater modeling effort.

We have extreme concern with the last sentence of the comment. The first part seems to suggest that URS needed to add additional zones for its purposes. That is certainly appropriate as URS is in the best position to develop a model to meet their goals and objectives. However, the last part of the sentence is inappropriate. At best, URS is attempting to suggest that the Psomas groundwater model is flawed because it only used two hydraulic parameter zones. At worst, they are suggesting that the Psomas groundwater model should have included more zones to make it more useful for other, unstated purposes.

Using two zones is entirely appropriate for the objectives of the Psomas groundwater model. The calibration results and use of the model bear this out. The possibility that URS is suggesting that the model should have used more hydraulic parameter zones because it would have made it more useful for others fails to understand the use of models, and their role in developing conclusions and recommendations regarding the impacts of groundwater pumping.

5. **URS stated *"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)."***

At the time of the Psomas modeling effort, the historical recharge volumes at the Mission Creek Recharge Basin were reported as stated in the Psomas report. If these values have changed, then URS should use the revised numbers. However, if the numbers that URS reported are accurate and the numbers that were provided to Psomas are inaccurate, we cannot see how these would significantly change the calibration.

6. **URS Stated *"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. 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."***

The reviewer takes an incredibly narrow view of the use of groundwater elevation data for calibration. In a perfect world, there would be a network of observation wells surrounding each pumping well in existence, and the data from these wells would provide information to use in establishing aquifer parameters, including anisotropy, for use by modelers. However, in the real world, static groundwater levels from pumping wells are frequently used with the understanding that data need to be reviewed and checked.

Responses to comments on the 500 by 500 grid comments have been provided above. However, as explained on page 7-1 of the Psomas report, the use of a coarse grid has limitations. The objective of the Psomas groundwater model and the use of the Psomas groundwater model were entirely consistent with a 500 by 500 grid. If URS needed a model that had a finer grid in a specific area, they are in the best position to develop it and use it as they see fit.

7. **URS stated *"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."***

This comment highlights the confusion between the parameters of the calibration used in the initial steps detailed in Section 3 and the final parameter values used in Section 4 of the Psomas report. While the Psomas report was not entirely clear on the link between the models described in the two sections, the comments demonstrate a lack of understanding of the objectives associated with the development and testing of the conceptual models. The issue of "unrealistic" aquifer parameters is discussed in the response to Comment 8.

8. **URS stated *"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."***

This comment, again, highlights the confusion that resulted from reading the Psomas report. The reviewer makes an attempt to cast doubt on the Psomas groundwater model by discussing the parameter estimates from Section 3 of the report. As described above, this was not the final calibrated model and the issues associated with these parameters were the precise reason to hold the meeting on September 14, 2006 with Jim Burton and Joe Birman.

As previously described, the model was finalized based on these discussions and the final model is presented in Section 4 of the Psomas report (Table 4-1). The anisotropy in western zone of the final model is about 2, the storativities are more consistent with unconfined conditions, and the eastern zone parameters are consistent with previous investigations.

It is curious that there were no comments regarding the differences in the parameter estimates of Sections 3 and 4 of the Psomas report. The clear difference in parameter estimates could have led to legitimate questions regarding the discrepancy. However, URS chose to exploit the situation and develop comments around the parameter estimates in Section 3.

9. **URS stated *"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."***

The sharp decrease in the western boundary outflow is precisely because of the head increase associated with spreading. This condition highlights the fact that, if there was a need to understand the details of groundwater response in the area of the DWA spreading basin, the Psomas groundwater model would need to be enhanced, or a new model developed.

The other comments deal with issues related to the western zone. Again, the western zone was not the focus of the investigation and the existence of the low hydraulic conductivity vertical feature was a way to explain conditions in the western zone that were significantly different than conditions in the eastern zone (e.g. higher groundwater elevations, more rapid response to stress etc.). The focus was on the eastern zone where MSWD wells were located.

Given sufficient time and money, a model of the entire area could be developed that would satisfy the legitimate needs of understanding the entire groundwater flow system in the Mission Creek Sub-Basin. It should be pointed out that the budgetary constraints and time constraints of this effort resulted in a set of modeling objectives. The resulting model met those objectives and answered MSWD's questions and concerns regarding regional changes to groundwater elevations that could result from increased pumping and changes to spreading. In fact, one of the most important conclusions was related to the location of the spreading basin and the efficacy of spreading at that location.

We fully recognized the limitations of the model, especially the western portion. We would add the following language to the report:

> *"Given the limitations of this modeling effort, the conclusions related to the efficacy of the spreading basin and the location of the fault or other geologic feature between the spreading basin and production wells should be considered tentative until additional studies are completed and additional modeling is attempted."*

CONCLUSIONS

URS identification of alleged deficiencies in Psomas' Groundwater Model of the MCSB is related to their misunderstanding of the development of the conceptual model and the values used in the final calibration process. In addition, URS is attempting to identifying deficiencies related to using the model for their purposes, which the Psomas groundwater model was never intended to serve.

We trust the information provided is helpful and should you have any questions concerning the information contained in this memorandum, please contact Michael Donovan with Psomas at (714) 751-7373 or via e-mail at mdonovan@psomas.com