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Dave Decker
10260 Shenandoah Dr
Reno NV 89508-8277

Eric Solorio
Siting, Transmission, and EPD
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, CA 95814-5504
esolorio@energy.state.ca.us

Janet Eubanks, Project Manager
California Desert District
Bureau of Land Management
22835 Calle San Juan De Los Lagos
Moreno Valley, CA 92553-9046
jeubanks@ca.blm.gov

SUBJECT: Proposed Solar Millennium Ridgecrest Solar Power Project (SMRSPP), Docket Number 09-AFC-9

Mr. Solorio and Ms. Eubanks:

Thank you for providing the opportunity to comment on the Staff Assessment and Draft Environmental Impact Statement (SA/DEIS) prepared for the proposed Ridgecrest Solar Power Project (RSSP). I have a few comments regarding Section 5.17 of the SA/DEIS. These comments are specifically directed toward the numerical modeling, model interpretation and graphical presentation of the model results that are used in support of a 'no impact' finding to the Indian Wells Valley (IWV) groundwater resources resulting from the construction and subsequent operation of the SMRSPP.

I claim that the numerical model results presented by the applicant in defense of a 'no impact' finding are misleading and erroneous. I present below a simple calculation and a set of observations to support my claim. I am a research professor in the Nevada System of Higher Education (the Nevada University system) and my specialties are in civil engineering, flow and transport in variably saturated media, and geochemistry. I hold a Ph.D. in hydrogeology and an EIT certificate from California.

A complex numerical hydrogeologic groundwater model is not required to determine the project's impact to the local groundwater table. Following the logic progression presented in Section 5.17, we can simply compare the groundwater decline resulting from the difference in additional water withdrawn for construction and follow-on operation from that of the baseline annual water use present today. Details such as groundwater recharge, aquifer heterogeneity, boundary conditions, subsurface structure, etc. are all important to a numerical model, but are not needed for a simple difference calculation because these details are common to both baseline and project conditions – and as such they can be ignored in a simple calculation as given below.

There are two end-member types of alluvial aquifers – so called confined, and unconfined. The Brown and Caldwell report identifies the aquifers located within the IWV hydrographic basin as a mix of these two types. The two aquifers produce water by dramatically different mechanisms with the result that an unconfined aquifer can produce many orders of magnitude more water than a confined aquifer for a given aquifer volume. On the basis of the difference in magnitude of water produced, this analysis will assume that nearly all the water removed by pumping from the IWV groundwater resource is from unconfined aquifers.

A key descriptive parameter for an unconfined aquifer is the specific yield (S_y)– a unitless parameter that describes the fraction of water that drains out of the saturated sand/rock by gravity following water removal by pumping. It is expressed as a ratio of lengths – for example feet of water drained per feet of sand/rock the water drains from. The Brown and Caldwell report found that the S_y for IWV was between

0.05 and 0.15. Using the average S_y of 0.1, this means that for a ten-foot thick section of aquifer, one-foot of water can be produced from it before this section of aquifer is dry and has no more water to remove by pumping. Now expand this calculation to an aquifer that underlies an area of 10,000 acres and if 10,000 acre-ft of water is pumped out (so visualize removing 1 foot of water from 10,000 acres of aquifer – it's the same thing as my first example) this will result in a groundwater table decline of 10-feet.

Expressed as a mathematical relationship, the volume of water drained from an aquifer, V_w can be calculated as:

$$V_w = S_y A \Delta h$$

where A is the horizontal area of the aquifer, and Δh is the decline in the groundwater table[1]. This equation simply expresses the relationship between volume of water removed and the decline in groundwater table – which is precisely what SM attempted to do in Section 5.17 of the SA/DEIS.

'WHAT IS THE IMPACT OF SM WATER WITHDRAWAL TO IWV GROUNDWATER RESOURCES?'

To answer this question does not require an invocation of the mathematics that describe subsurface flow (e.g. Darcy's Law) because we don't care about the rate of impact nearly as much as what the total impact may be from SM's water withdrawal for the RSPP. While the annual groundwater table decline may be 'small', because the IWV hydrographic basin is in overdraft per both the Brown and Caldwell report and the SM SA/DEIS, each annual decline in the groundwater table, no matter how larger or small, adds to the last and after 30 years may sum to a significant total impact.

Now let's use this equation to answer the question posed above for the SMRSPP. To do that, we need to know how much water is being pumped.

a. Per conversation with the IWV Water District (IWVWD) on average each residential service connection consumes 0.64 acre feet[2] per year (afy).
b. Construction water use for dust control and soil compaction:
    - The CEC believes that at least 8,000 afy will be needed during construction for dust control, etc.[3] For a 28-month construction period, the total water withdrawal is 18,667 af.
    - The SA/DEIS section 5.17 indicates that a total water use of 1500 af is required.
    - The IWVWD operating agreement with SM indicates that a maximum of 1500 af will be supplied.
c. SM's mailed brochure claims it will create 800 new jobs during construction and 85 permanent jobs in perpetuity.
    - Assume the 85 permanent jobs is equivalent to 85 new families or residences to the IWV.
        - To operate the RSSP, staff that work at it (presumably new to the IWV) need an additional 85*0.64 afy = 54.4 afy.
    - Assume the 800 construction jobs are transient workers who travel to the IWV from elsewhere and reside in local hotels/motels. Assume that each worker uses 1/3 of the residential consumption, or 0.21 afy. This is a guess at how much water it takes to support a hotel guest with daily laundry, room cleaning, landscaping, etc.
        - To support construction personnel the RSSP needs 800*0.64afy*0.33 = 170 afy for the first 28 months of the project.
d. During construction, the construction workers alone will consume 170 afy. Once the plant becomes operational, 150 afy (RSSP plant operations) + 54.4 afy (RSSP operators) = 204.4 afy.

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[1] C.W. Fetter, Applied Hydrogeology, 2nd Edition, ISBN 0675208874, page 107, equation 4-21.
[2] http://en.wikipedia.org/wiki/Acre-foot
[3] http://www.energy.ca.gov/sitingcases/solar_millennium_ridgecrest/documents/2009-12-28_Issues_Identification_Report_TN-54597%20.pdf

e. Assume specific yield (S_y) of 0.1 which is the average S_y from the Brown and Caldwell report.
f. The SA/DEIS model used a baseline water consumption of 470 gpm or 1,768.93 afy, or 2,764 IWVWD water connections at 0.64 afy each. To be consistent with the SM modeling effort, I'll use this same baseline water consumption value.
g. By examination of the Brown and Caldwell historic water level contour maps, Figures 16 and 17, the average annual baseline groundwater decline from 1985 to 2006 in the vicinity of Well 18 is approximately 2 ft per year.
   - Well 18 was chosen as the modeled pumping well in SM's modeling of the SMRSPP impact to the IWV groundwater resources as documented in Section 5.17 of the SA/DEIS – so this location is chosen in this analysis to again be consistent with SM's approach.
   - Well 18 is one of the IWVWD municipal water supply wells and as such it is used throughout the year to supply water to the IWVWD rate payers. Therefore, it is a reasonable, if simplistic, assumption that Well 18 supplies water to support all the water needs for the SMRSPP including construction (compaction, dust control), plant operations, and personnel – including both construction and permanent workers.
h. Combining e, f and g, and using the equation above, we can now estimate the areal extent of the SW aquifer as:
   - Aquifer Area = Baseline water volume pumped / Sy / baseline annual water table decline
   - Aquifer Area = 1769 afy / 0.1 / 2 ft/yr = 8,845 acres.
i. 8,845 acres*43,560 square feet / acre = 385.3 million (M) square feet (sf) or M sf.
j. Now back to item d, how much water is used by SM personnel?
   - 204.4 afy = 204.4 afy*43,560 sf / acre = 8,903,664 cubic feet (cf) water per year.
k. How much water is that averaged over the size of the aquifer calculated from h?
   - 8.903 M cfy by 385.3 M sf = 0.0231 fty.
l. How much groundwater drawdown is that equivalent to?
   - 0.0231 fty / S_y = 0.0231 fty / 0.1 = 2.77 inches per year.

This calculation process was ported into a spreadsheet that in turn was used to compute the cumulative impact of water withdrawal from construction and subsequent operation of the plant. The results of this spreadsheet calculation are shown in the following figures. Using SM's estimate of 1,500 af total construction water, 170 afy for construction workers for 28 months, and 204.4 afy for operations and plant workers, the total cumulative construction and operational water table decline is over 9-feet after 30-years, shown as the red line attached to the right axis in Figure 1.

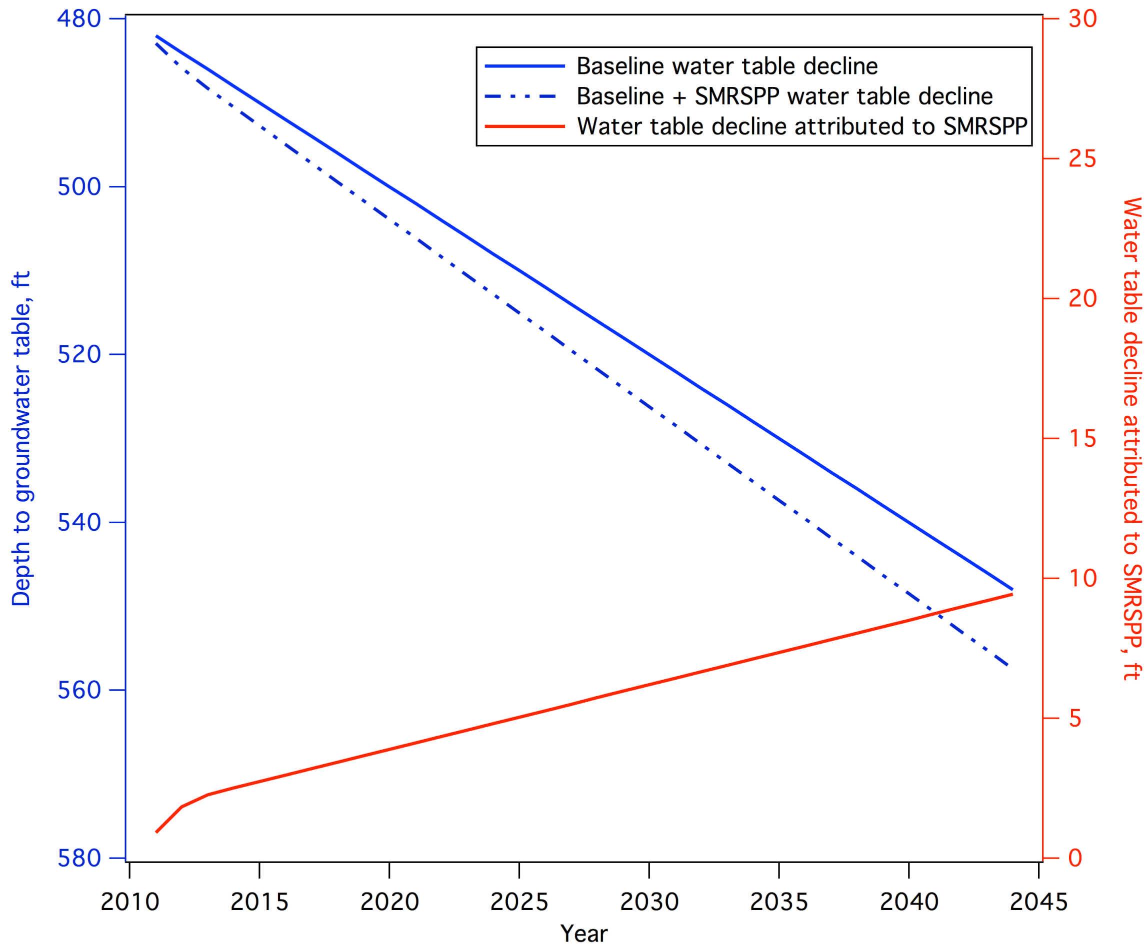

Figure 1: Projected groundwater table decline following a cumulative calculation of construction and operational water consumption. Construction water consumption 1,500 af total, 170 afy for construction workers for 28 months, and 204.4 afy for plant operations and plant workers per SM SA/DEIS. The right axis and the red line illustrates the estimated water loss resulting from the SMRSPP being constructed and operated for 30 years. There is clearly an impact, contrary to the claim made by SM in Section 5.17 of the SA/DEIS.

Now at the other end of the construction water use estimate is the 8,000 afy estimated by CEC staff[4] that results in a very significant amount of water lost to the existing water users of the IWV with a total water table decline of almost 29-feet as shown in Figure 2.

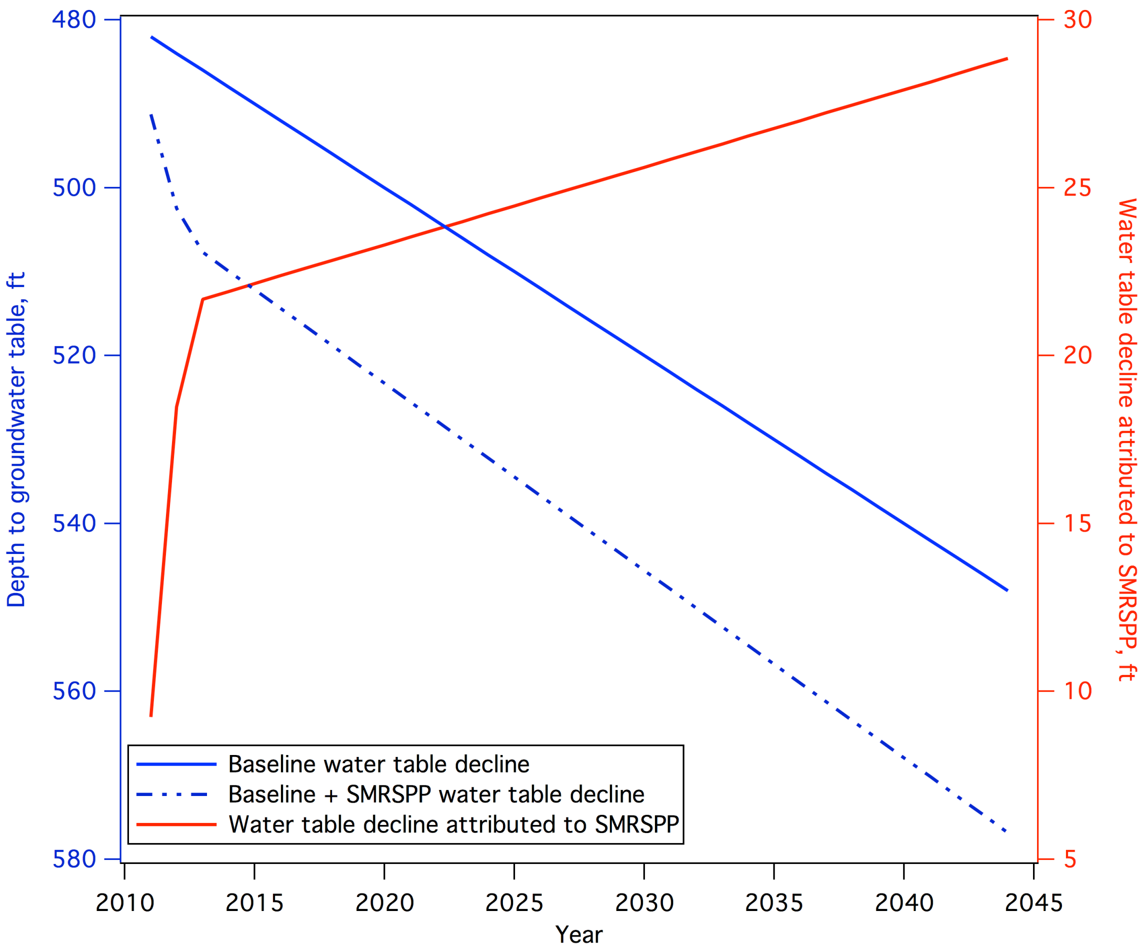

Figure 2: Projected groundwater table decline following a cumulative calculation of construction and operational water consumption. Construction water consumption 8,000 afy, 170 afy for construction workers for 28 months, and 204.4 afy for plant operations and plant workers per CEC.[4] The right axis and the red line illustrates the estimated water loss resulting from the SMRSPP being constructed and operated for 30 years. There is clearly an impact, contrary to the claim made by SM in Section 5.17 of the SA/DEIS.

The separation between the baseline water table drop and the SM project water table drop curves is a result of the large initial water extraction and consumption to support construction of the plant. The change in slope between the two projections is the additional water needed to support plant operations and the 85 plant workers. The two effects combined result in an obvious, quantifiable impact of many feet of permanent (and irreversible with the present lack of imported water to the IWV hydrographic basin) water table decline which is shown as the red line in both figures.

[4] http://www.energy.ca.gov/sitingcases/solar_millennium_ridgecrest/documents/2009-12-28_Issues_Identification_Report_TN-54597%20.pdf

'BUT WHAT DOES THIS REALLY MEAN?'

Using this simple and straightforward first principles calculation method, the SM impact to IWV groundwater table decline will be between 9 and 30 feet after 30-years of plant operation depending on which construction water estimate one believes. As a civil engineer, I intuit that the construction water needs may well *exceed* 8,000 afy.

- The construction contractor must apply enough water to the cut/fill portions of the project to reach proctor density – the density of fill needed to prevent subsequent settling.
    - Any settling of the earthen fill will result in misalignment problems with the mirror frames – and if left unchecked could result in HTF leaks or worse.
- Enough water must be applied to prevent dust transport – a subject of concern addressed elsewhere in the SA/DEIS.
    - This produces a circular impact conundrum – don't apply enough water to minimize impacts to groundwater but then risk dust transport and subsequent construction shutdown – apply enough water to stop dust, and risk impacts to groundwater.

Yet SM claims 'no impact' in Section 5.17 of their SA/DEIS document using a sophisticated and non-layman accessible numerical groundwater model. How can this be? The first sentence of Chapter 1 of Wang and Anderson's book "Introduction to Groundwater Modeling" says 'A model is a tool designed to represent a simplified version of reality'.[5] Thus, both models attempt to articulate an estimate of what is actually happening – so is one model really better/worse than the other? Here are a few observations that may explain the differences.

- SM did not run their version of the Brown and Caldwell model to calculate the cumulative impacts of construction PLUS operations – they only looked at these individually. This is a significant error on SM's part – one that is to SM's advantage – and must be addressed in a revised analysis. What is the impact of making this correction? The very steep initial decline in Figure 1 and especially Figure 2 is a result of construction water withdrawal, followed then by a shallower slope resulting from operational water removal and use. The construction water withdrawal 'kicks' the groundwater table decline sharply, and is reflected in both figures to varying extent. But the operational water use follows at the same slope in both plots, but starts only after the conclusion of construction – so one adds to the other.
- The Brown and Caldwell model overall appears to be a professional quality product, although I did not conduct a thorough review of it. However, I note that the transient model calibration for the area around Well 18 falls far short of portraying the actual historical drawdown in this area – historical drawdown measured from 1985 – 2006 is about 40 feet, whereas the Brown and Caldwell transient model results show only 20 feet of drawdown during this time – thus the B&C model is off by a factor of 100% – a fact that SM choose to not address in their model, even though they invested the effort to conduct a grid refinement in the area of Well 18 and vicinity. Using a model that portrays a baseline groundwater table decline half of that actually measured certainly significantly contributes to the modeling results that seemingly support a 'no impact' finding provided by SM in 5.17 of the SA/DEIS – again a result to SM's advantage.
- The graphical presentation of SM's model results does not support a 'no impact' finding, Figures 5.17-14 and 5.17-16. Their claim of 'no impact' is made based on a visual examination of a course scale map with thick lines representing the 5' drawdown contours. To the casual lay observer the contours more/less plot on top of each other, and thus it looks like there is no difference – hence 'no impact'. However, I can see there is a difference because I'm a professional hydrogeologist. Furthermore, any engineer or scientist knows that to portray the difference between two large numbers, one must do the math, compute the difference, and plot that difference value. The SM figures are 'unclear' at best, and are certainly misleading to the advantage of SM.

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[5] H.F. Wang and M.P. Anderson, Introduction to Groundwater Modeling, 1982. ISBN 0716713039

So it is quite possible that if SM ran their model after addressing the points raised above, their model may provide essentially the same estimates as what has been given to you here.

Why didn't SM do a better job with their modeling effort? Who knows, but surely they wouldn't try to fool the CEC staff and the lay public …

In conclusion, the SM computations of groundwater withdrawal impacts from their project significantly underestimate the impact to groundwater resources, and the graphical presentation and subsequent interpretation of their model results are both misleading. There is in fact a significant impact to the IWV groundwater resources as clearly shown by this analysis. A sophisticated numerical model is not necessary to compute this impact.

The SM SA/DEIS 'no impact' assessment of groundwater impact must be re-examined carefully by CEC staff, and if my analysis given here is confirmed by CEC staff, should be changed to 'significant negative impact'.

Finally, this week the National Academy of Sciences (NAS) announced the release of their latest series of reports regarding the impacts of Global Climate Change. The desert southwest is specifically mentioned with regard to an estimated 20% decline in precipitation and surface water runoff for California, Nevada and Utah in their entirety.[6] In a rare move, the NAS further underscores this conclusion by assigning a high degree of confidence to it. The meager power production and carbon savings from the SMRSPP will do nothing to offset any loss in recharge to the IWV groundwater aquifer resulting from global climate change as predicted by the National Academy of Sciences. The IWV baseline water condition is already in overdraft – meaning that the long-term prognosis for the IWV is grim without massive intervention. If this project is approved, a 20% decline in recharge on top of the significant water use by the SMRSPP simply dooms the IWV to ghost-town status even faster – and quite possibly within the 30-year lifetime of the project. As a matter of fact, if I was an SM investor, I'd be seriously considering whether or not the proposed plant could actually make it to it's engineered life expectancy or not based on both decline in water table and subsequent decline in water quality - salt content increases with depth as discussed in the SA/DEIS.

Please conclude 'no project' based on a significant and sustained deleterious groundwater impact.

Sincerely,

D. Decker

Dave Decker

Cc: Hector_Villalobos@ca.blm.gov, RFO

[6] http://www.nap.edu/openbook.php?record_id=12783&page=34