

# Draft

March 25, 1999

Mr. Ken Bonesteel  
Kern Water Bank Authority  
33141 Lerdo Highway  
Bakersfield, CA 93308

Re: KWBA Amount of Recharge Possible

Dear Ken:

Pursuant to your request, I have re-evaluated the amount of water that can be recharged once the groundwater levels are shallow enough to control infiltration rates from the KWBA recharge ponds. Also, I have revisited the "maximum storage capacity" for the project that was evaluated in our report of November 24, 1997. I reviewed and used two primary sources of information for this evaluation. The first source was water-level elevations and the direction of groundwater flow for the shallow groundwater condition. The second source was infiltration rates for late 1998.

When our previous evaluation was done, I hypothesized the water-level elevations and groundwater flow that would be present under the shallow groundwater condition. Fall 1998 water-level elevations are now available for the area, which indicate this

condition. We prepared a Fall 1998 water-level elevation map of the KWBA area and added flowlines to indicate the direction of groundwater flow. We then recalculated the amounts of groundwater flow away from the recharge ponds, using the same transmissivities as were used in our previous evaluation.

#### Results of Previous Evaluation

Infiltration rates (feet per day) for the KWBA ponds are not exactly known because all ponds aren't totally full at all times, and thus the area of each pond bottom covered by water is not exactly known at such times. Our previous evaluation estimated that about 720,000 acre-feet of water could be recharged prior to the water levels becoming so shallow that infiltration rates would decrease. Estimated infiltration rates for the KWBA ponds in 1998 indicate that this happened sometime after August and prior to October. The total KWBA recharge (deducting the estimated evaporation loss) from early 1995 through August 1998 was about 740,000 acre-feet, in very close agreement to our previous estimate. Our previous evaluation estimated that a total of 920,000 acre-feet per year of water could be recharged over a five-year period. This was based on being able to recharge about 100,000 acre-feet annually after the groundwater levels became the

controlling factor on pond infiltration rates. This amount was determined by calculating the projected groundwater flows away from the recharge ponds for the shallow groundwater condition. Then 55,000 acre-feet per year was deducted to account for other sources of recharge (2,800-acre area and river Kern River recharge).

#### Fall 1998 Groundwater Flows

The calculated groundwater flow away from the KWBA ponds located north of the Kern River was about 91,000 acre-feet per year in Fall 1998. This was less than our previous estimate of 128,000 acre-feet per year, primarily because of lower water-level slopes than were estimated previously. This was due to higher than anticipated water levels to the north and downgradient of the recharge ponds. The calculated groundwater flow away from the KWBA ponds located south of the Kern River was about 67,000 acre-feet per year in Fall 1998. This was much greater than the previous estimate of 27,000 acre-feet per year, because of much greater water-level slopes and a longer flow width than previously estimated. This was due to lower than anticipated water levels to the south and downgradient of the ponds. The estimated total groundwater flow away from the north and south KCWA pond areas was 158,000 acre-feet per year as of Fall 1998, almost exactly equal to

the previous estimate of 155,000 acre-feet per year. Deducting the estimated 55,000 acre-feet per year contribution from other recharge sources, the groundwater flow from recharge in the KWBA ponds would be about 105,000 acre-feet per year, or essentially the same as for our previous evaluation.

#### Infiltration Rates

Rates of pond drop were measured in the KWBA ponds in late 1998, and indicate estimated average infiltration rates were about 0.10 foot per day. If the KWBA ponds were kept full and this infiltration rate was maintained for one year (without any drying periods), about 160,000 acre-feet of water could be recharged. However, this is considered unlikely due to pond clogging and hydrogeologic controls.

Overall infiltration rates were also estimated from the total water delivered to the ponds on a monthly basis during the last half of 1998, and correcting for evaporation losses. These calculations involve some uncertainty, because the bottoms of all ponds aren't covered with water at some times. In July 1998, the estimated infiltration rate averaged about 0.17 foot per day. Shallow groundwater levels were apparently not limiting the infiltration rates beneath most of the KWBA ponds at that time. In

October 1998, the estimated infiltration rate averaged about 0.11 foot per day, and in December 1998, the estimated infiltration rate averaged about 0.08 foot per day. Water-level measurements and these latter two rates indicate that groundwater levels beneath most of the ponds were limiting infiltration rates in October and December, 1998.

Infiltration rates often decline exponentially with time. The estimated rates for the KWBA ponds in late 1998 were plotted on a semi-log plot versus time. From this, it was projected that the estimated average infiltration rates would decline to about 0.04 foot per day after one year. Thus an estimated average infiltration rate of about 0.06 foot per day could apparently be maintained for the first year after groundwater levels become the controlling factor on infiltration rate. This estimated average rate indicates that over a year, about 110,000 acre-feet of water could be recharged in the KWBA ponds. This estimate agrees almost exactly with that determined independently from the groundwater flow estimates. My opinion is that for the following year (the second year after the shallow groundwater condition is the controlling factor), the average infiltration rate would probably range from about 0.03 to 0.04 foot per year. Thus, about 65,000 acre-feet could be recharged during the following year.

Conclusions

This evaluation is based on estimated infiltration rates. Rates in feet per day aren't precise because of periodic changes in the area of ponds covered by water. However, this evaluation verified that the recharge rate after the groundwater levels become shallow is about 105,000 to 110,000 acre-feet for the first year. It should be noted that greater recharge rates could be possible in the absence of COB and river recharge in the area. If these were not occurring under the shallow groundwater condition, the KWBA recharge could be increased to about 160,000 acre-feet per year. Our original estimate of the recharge capacity in a five-year period of recharge in the KWBA ponds was 920,000 acre-feet. If enough recharge is practiced in 1999, this total amount would have been recharged between early 1995 and the end of 1999. The total recharge capacity would be about 985,000 acre-feet assuming two years of recharge after the onset of the shallow groundwater condition. Please call me if you have any questions.

Sincerely yours,

Kenneth D. Schmidt

KDS/bbs