
FINAL ENVIRONMENTAL ASSESSMENT (12-061)

Subsidence Data and Groundwater Pumping Estimates

Appendix B

January 2013

Proposed Action

To assess the potential for incurring new subsidence as a result of the groundwater pumping of the Proposed Action, it is appropriate to review the available data on groundwater pumping and subsidence measurements. Correlations between historical pumping and subsidence can be compared to the proposed magnitudes of pumping to assess the likelihood that new subsidence will be incurred. The most recent and relevant subsidence data that is available is contained in a soon to be released report by the USGS (Sneed et al., in review). Groundwater pumping is not recorded in California and, thus, it is necessary to use estimates of actual pumping in a historical analysis. Such estimates are available in the soon to be released revision (Faunt et al., in review) of the USGS's Central Valley Hydrologic model (Faunt, 2009). Evaluation of the Proposed Action is based on the subsidence data in Sneed et al. (in review) as well as the groundwater pumping estimates in Faunt et al. (in review).

Continuous GPS monitoring data of land subsidence are available from six stations along the DMC and neighboring the seven water districts participating in the Proposed Action (Figure 1-1). Figures 1-2 through 1-7 display the data for these six stations from late 2005 through 2010 (Note that these figures give the recorded vertical displacements in millimeters. The blue lines are the raw data and the red lines are the 31-day averages). It can be seen that only one of these stations exhibits significant inelastic subsidence: station P303, which is located a few miles north of the southern end of the DMC. However, stations P259 and P301 also exhibit minor trend suggesting inelastic subsidence superimposed on the elastic subsidence.

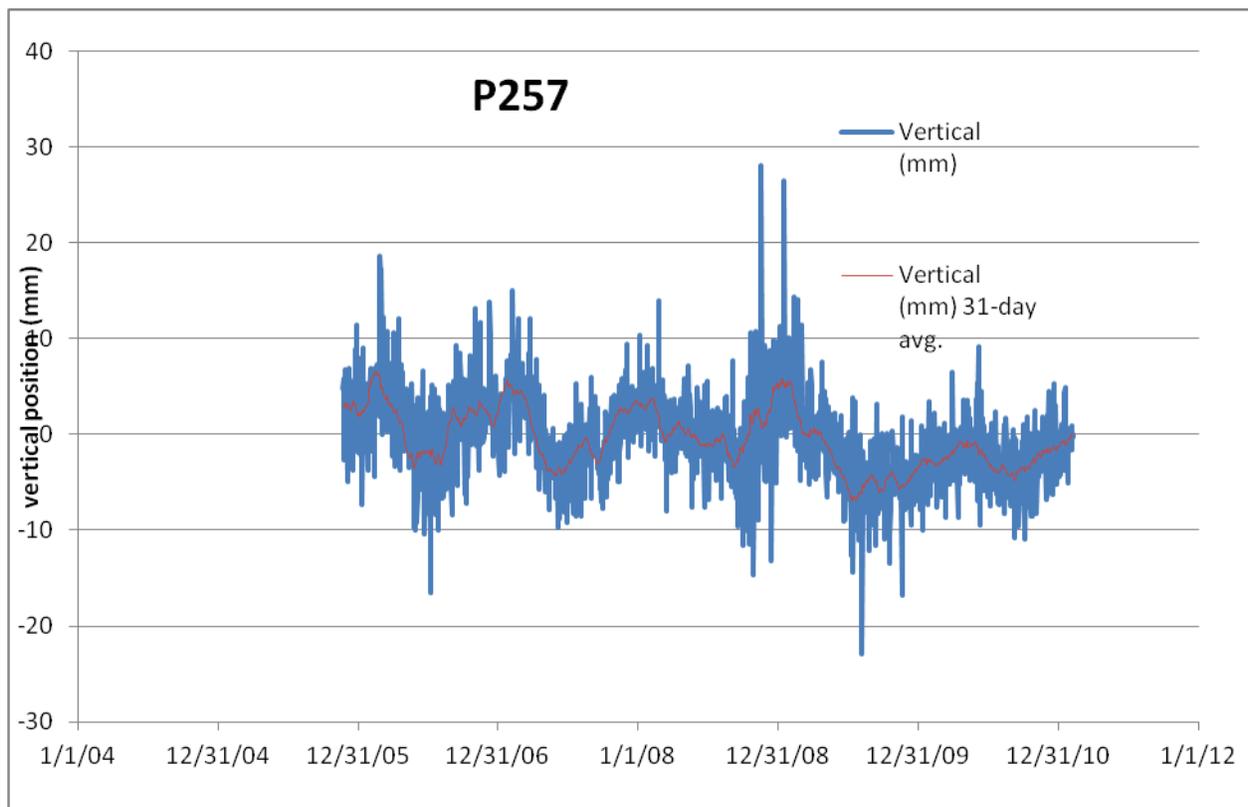


Figure 1-2

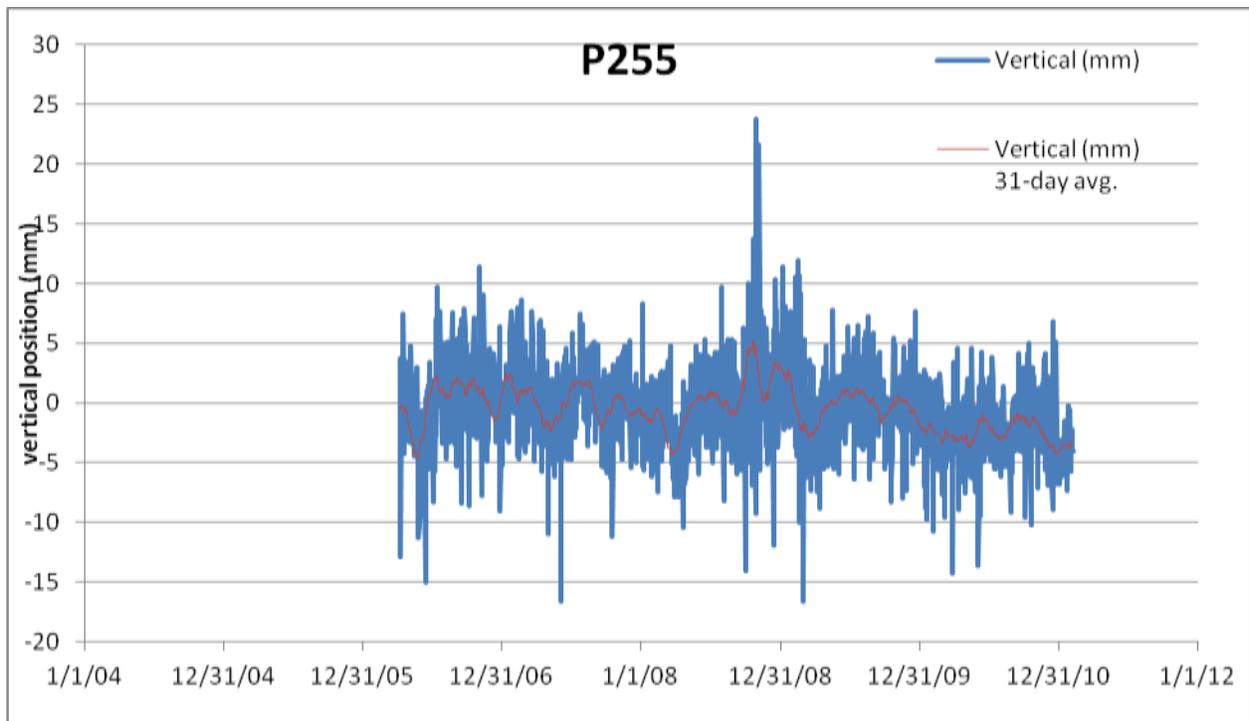


Figure 1-3

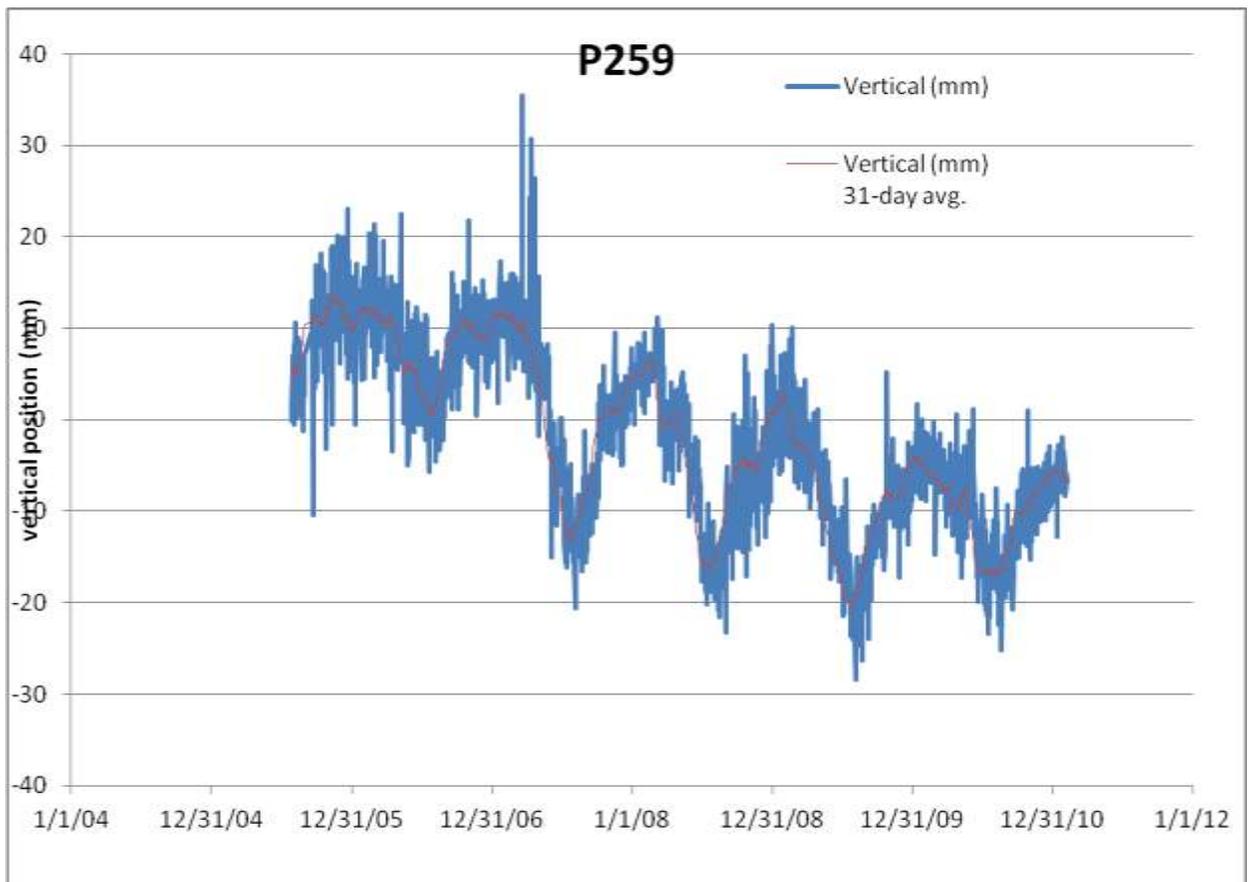


Figure 1-4

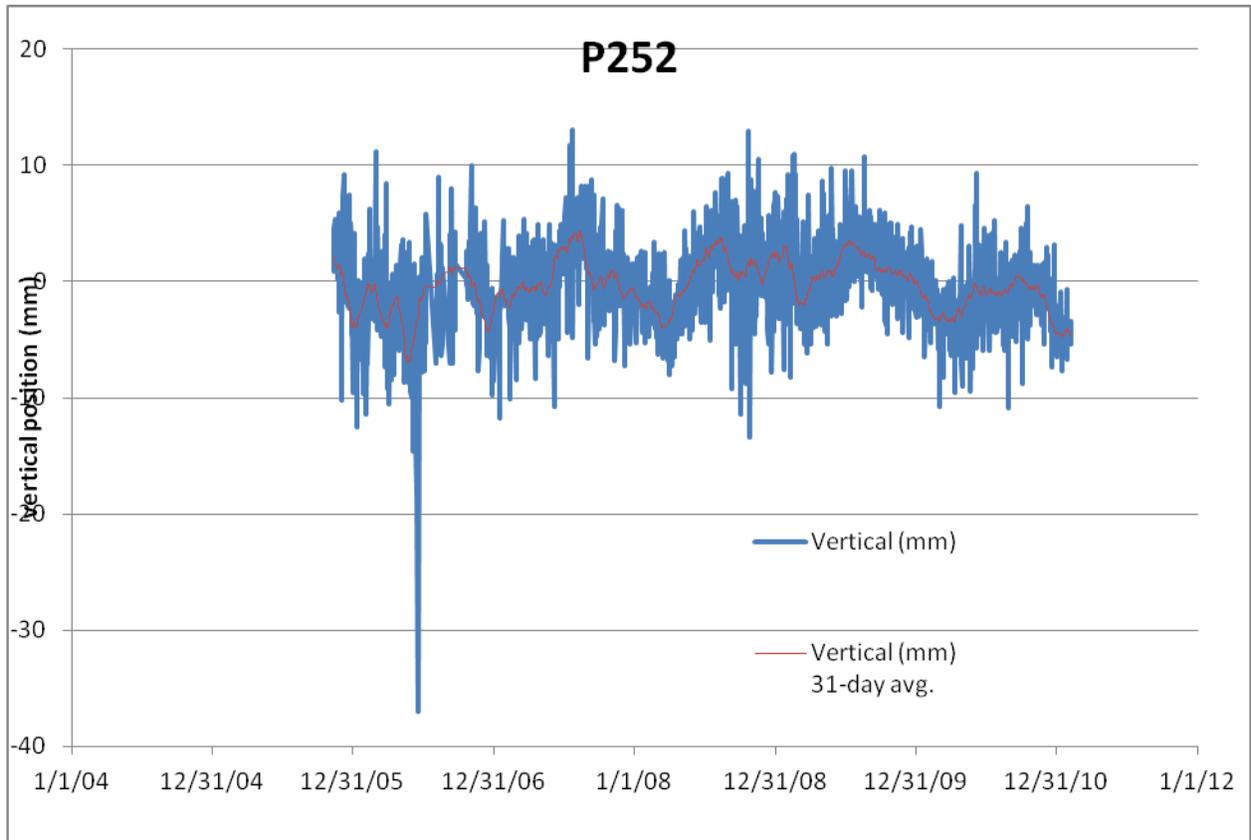


Figure 1-5

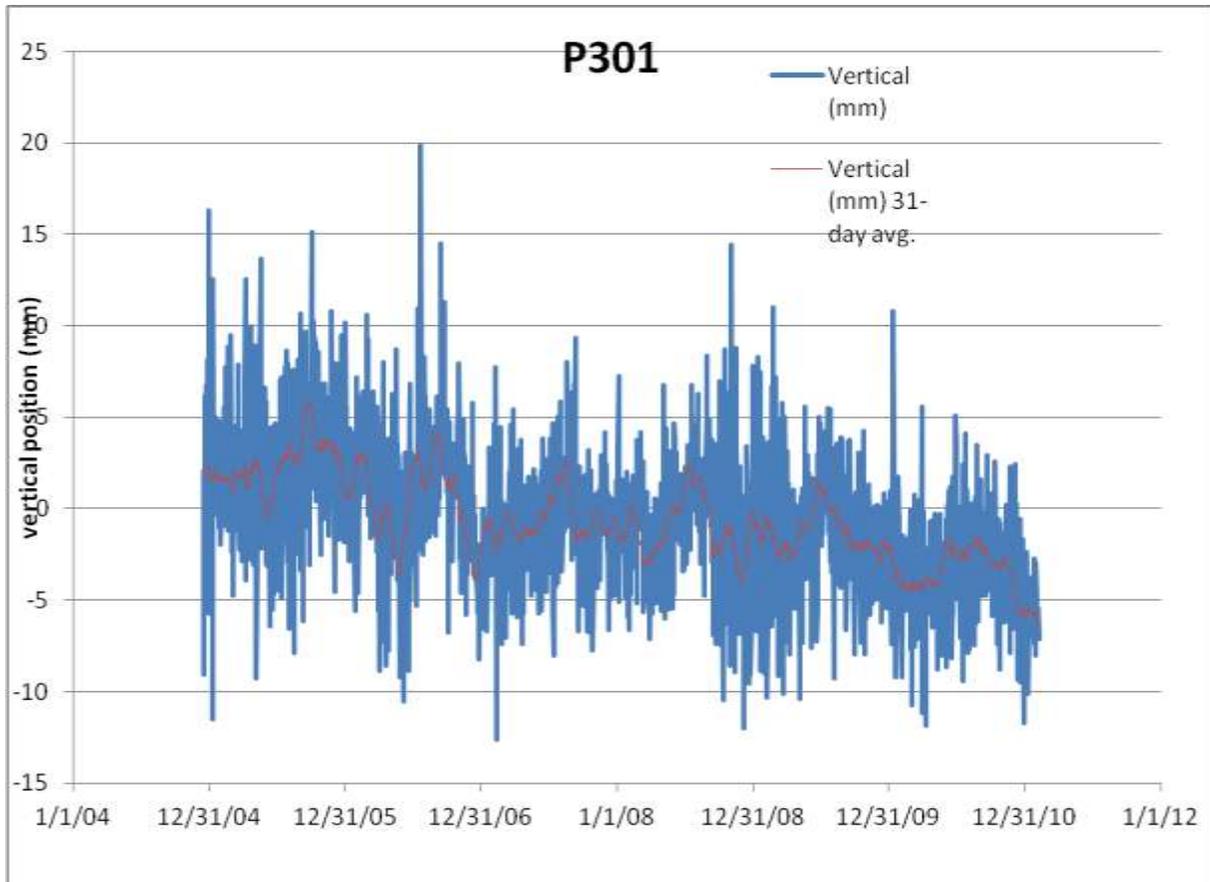


Figure 1-6

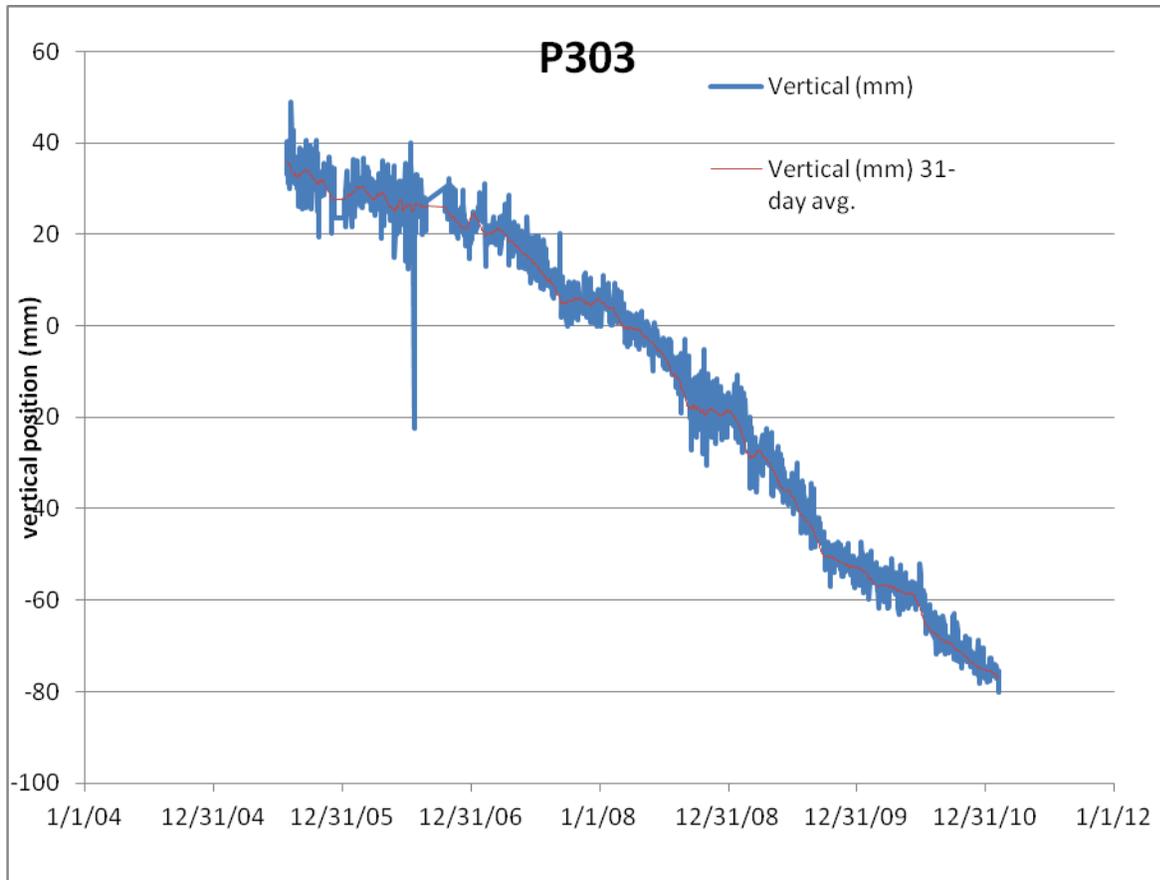


Figure 1-7

The subsidence data presented in Figures 1-2 through 1-7 suggest that the major area of concern with regard to subsidence potential is in the southern portion of the DMC, with possibly a minor area of concern in the more central portion of the DMC. The southern area of concern has possible implications for pumping from the Panoche, Pacheco, Mercy Springs, and San Luis Water Districts. The central area of concern has possible implications for pumping for the San Luis and Del Puerto Water Districts.

To attempt to correlate the observed subsidence measurements to district pumping, groundwater pumping estimates were extracted from the revised CVHM model (Faunt et al., in review). The new refinements of agricultural input data in this model allowed direct accounting for pumping from five of the Water Districts in the Proposed Action: Banta-Carbona, West Stanislaus, Del Puerto, San Luis, and Panoche. The CVHM model estimates agricultural groundwater pumping via a mass balance approach in which recorded surface water deliveries are subtracted from irrigation demands estimated based on land use data; the remainder is assumed to be satisfied by groundwater pumping. Urban pumping is also incorporated via available records compiled by DWR. Figures 1-8 through 1-12 display these groundwater pumping estimates. Also, the dashed red lines on these figures gives the historical pumping for the post 1980's period plus the proposed pumping. With the exception of Del Puerto, it can be seen that the proposed pumping is a small fraction (within one standard deviation) of the historical post-1980's pumping. This

strongly suggests that the additional groundwater pumping in Banta-Carbona and West Stanislaus will not incur inelastic subsidence. It is also reasonable to expect that the proposed pumping in San Luis and Panoche will not result in inelastic subsidence due to the small fraction of overall pumping that it represents, as well as the fact that the P303 station is not immediately adjacent to these districts. Nonetheless, there is a possibility that this pumping in San Luis and Panoche Water Districts could bring the aquifer below the threshold for inelastic subsidence (preconsolidation head) and lead to inelastic subsidence. Although there are not explicit groundwater pumping estimates for Mercy Springs and Panoche Water Districts, it is believed that they would fall into the same category of risk as San Luis and Panoche.

With regard to Del Puerto Water District, the substantial increase in groundwater pumping relative to post-1980's historical pumping estimates coupled with the subsidence observations at the north end of the district imply a significant risk of additional subsidence incurred by the proposed pumping. This risk is tempered, however, by the fact that the post-1980's pumping of Del Puerto are very small. Put another way, there is a large degree of uncertainty in interpreting the available data in the vicinity of Del Puerto. Nonetheless, the risk of some subsidence is considered significant.

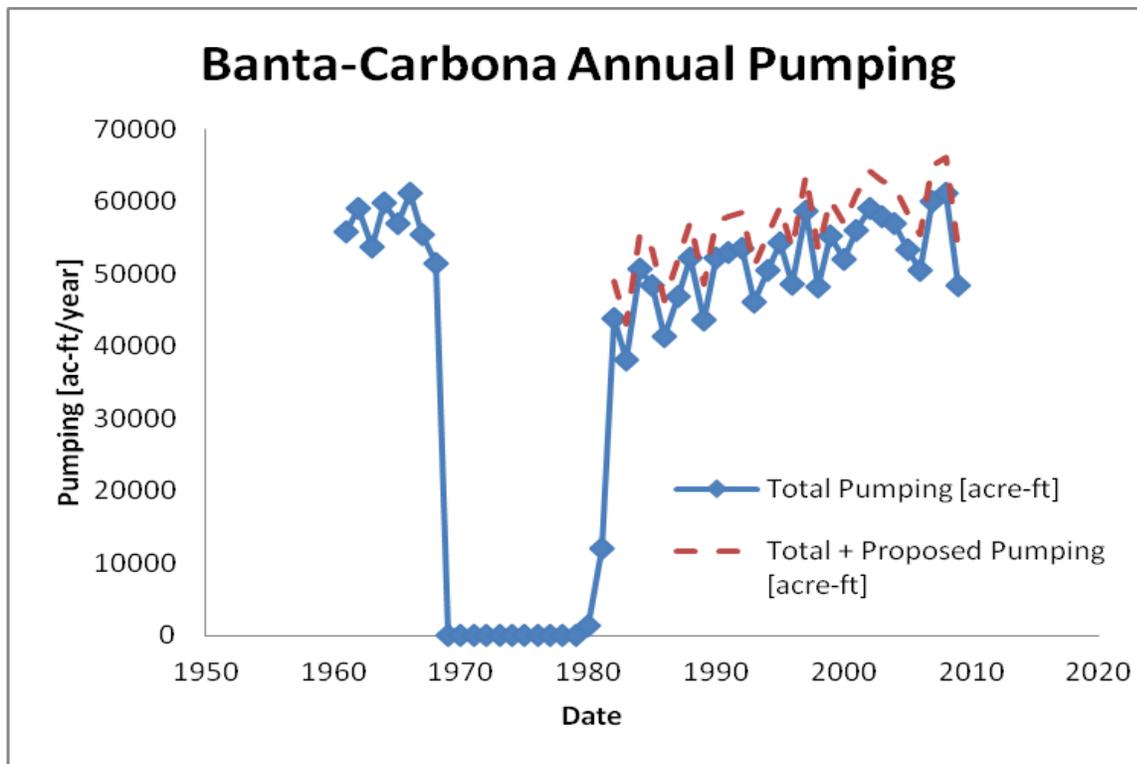


Figure 1-8

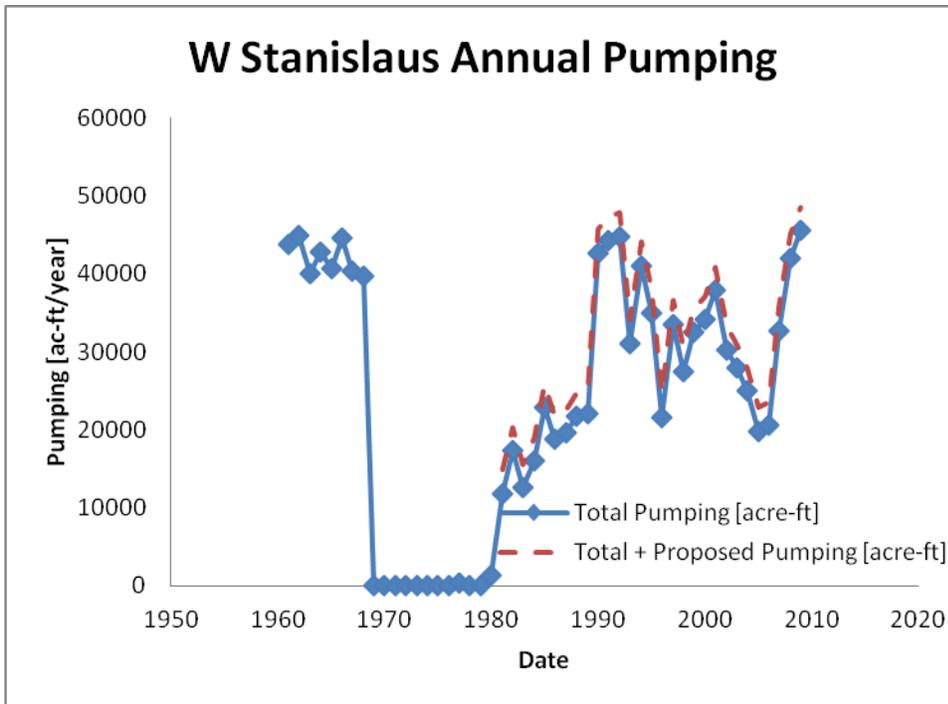


Figure 1-9

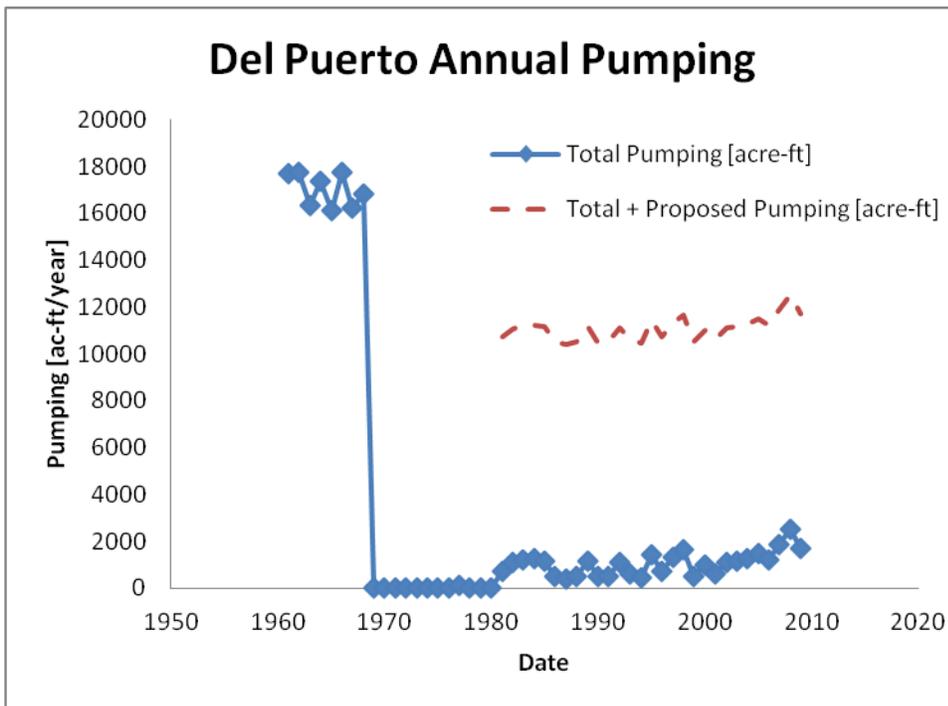


Figure 1-10

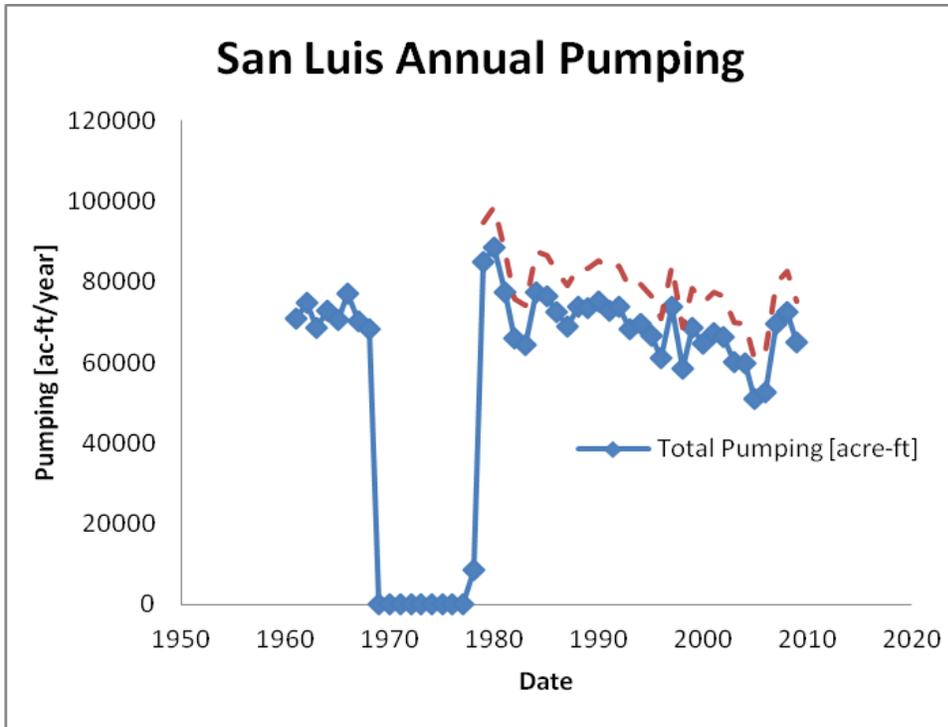


Figure 1-11

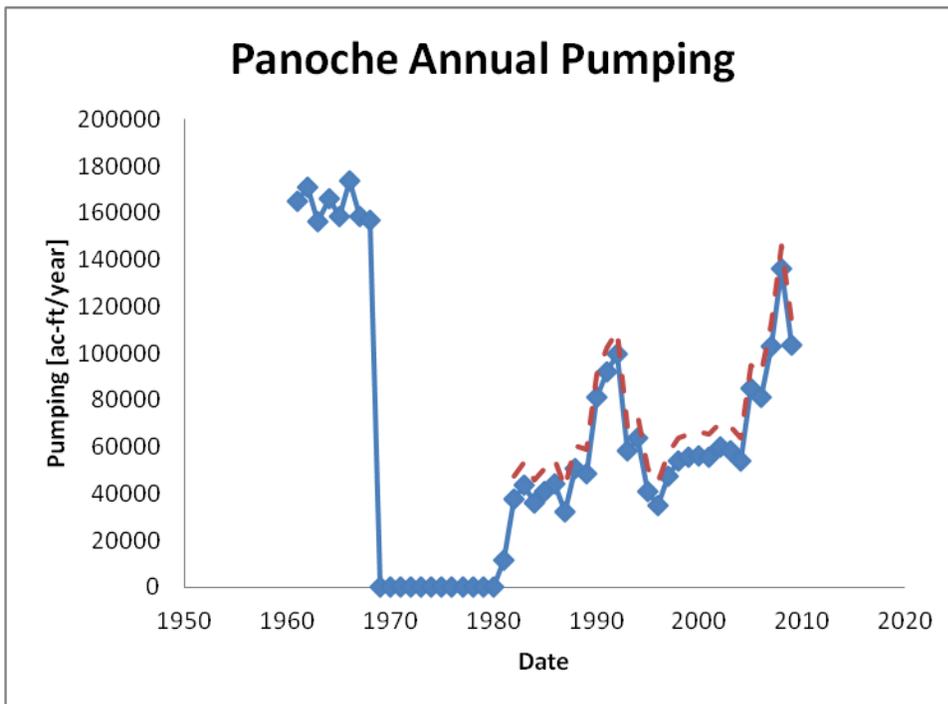


Figure 1-12