

Water Transfer Effect on Sacramento Valley Groundwater

Nick Reid, May 2014

Introduction

Water transfers are the selling of surface water normally used for crop irrigation to districts in high-drought impact areas. Typically farmers will sell (transfer) their surface water rights and pump groundwater for crops. This has the potential to significantly impact an aquifer. Water transfers occurred between the northern and southern regions of California in the early 1990's during drought years.

- MODFLOW used with the Central Valley Hydrologic Model to model the effect of pumping 600,000 ac-ft in three months of the summer of 1990 from a one mile by one mile location
- No pumping from 1991 through 1999 to observe recovery
- Several pumping rates were modeled, but only the maximum rate is displayed on the maps

Data and Methods

- MODFLOW used to model the effect of additional groundwater pumping due to water transfers.
- Pumping only occurs in 1990 in the model, and recovery through 1999
- Drawdown overlaid on landuse data based on farmland which uses groundwater or mixed ground/surface water for irrigation

Groundwater Head Drawdown

600,000 ac-ft pumped in 1990, natural recovery through 1999

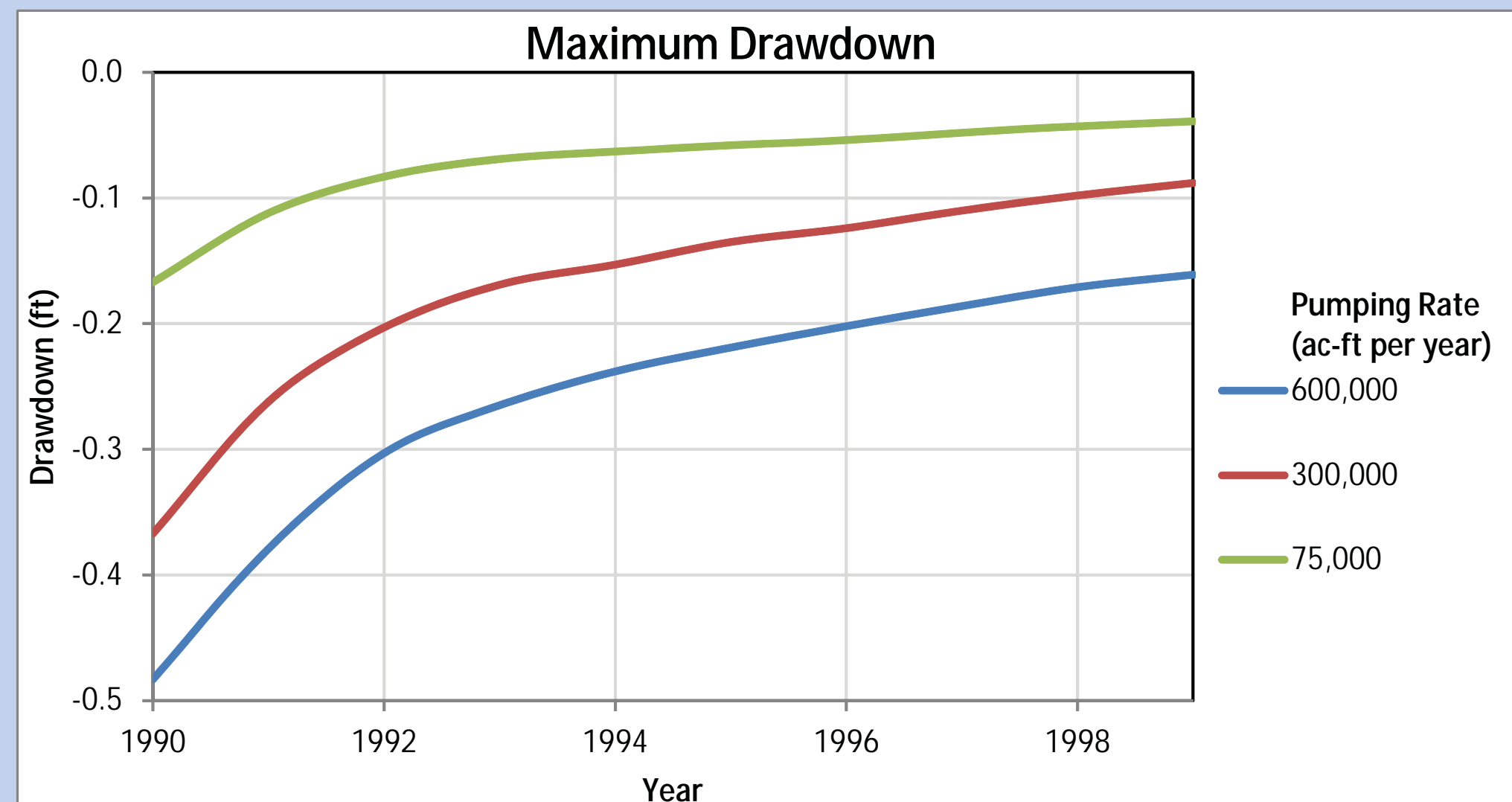
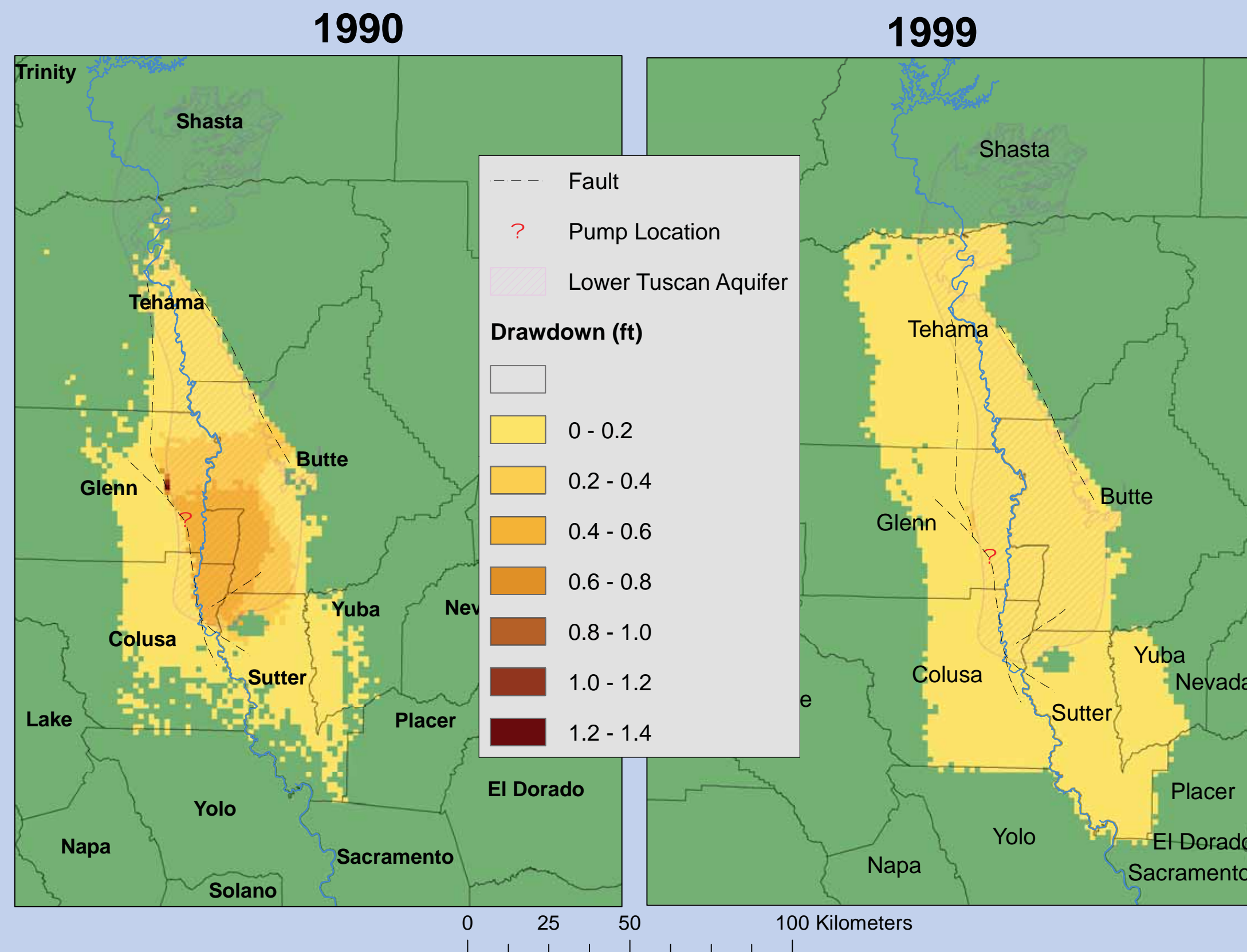
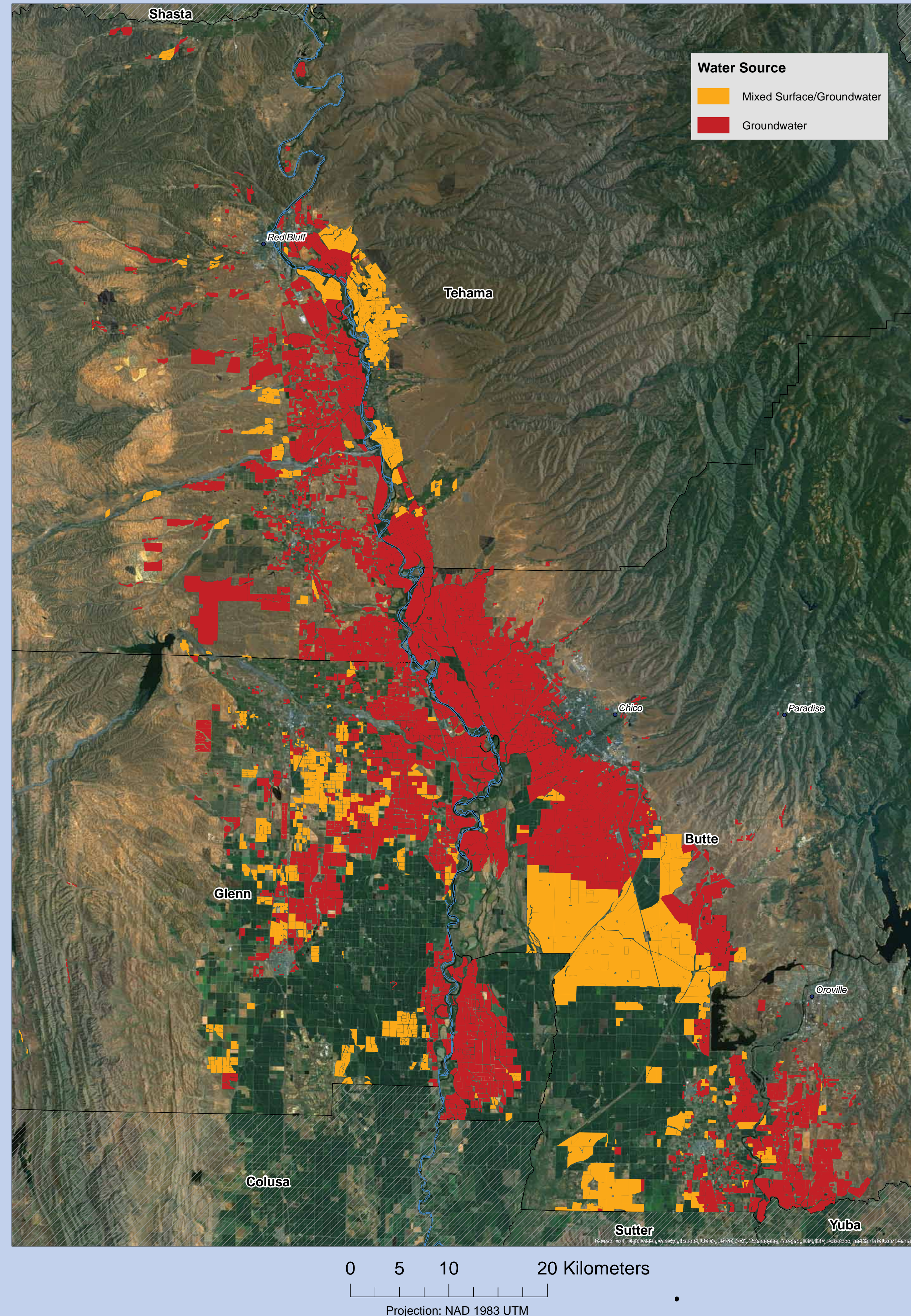


Figure A: Maximum drawdown at various pumping rates.

Affected Farmland in Butte, Tehama, and Glenn Counties, 1990



Results

- Over 120,000 acres of farmland affected by drawdown
- For the heavily impacted area: nearly 0.5' head loss initially, over 0.1' head loss after 10 years of recovery
- 0.07% budget discrepancy (discrepancy between total inflows and total outflows).

Discussion

- Unexplained drawdowns due to "numerical slop" in MODFLOW (significantly impacts small-scale drawdowns)
- Land use data is approximate
- Further investigation is required to determine the cause of anomalies within the model.

Conclusion

This model suggests that water transfers would have a distinct and drawn-out impact on the groundwater of the Sacramento Valley. The significance of the impact is debatable (is 0.1' head loss significant? 0.5?); this would require further studies to determine.

The finite difference method is not mathematically exact. Rather, it is a numerical ("guess-and-check") method which resolves differential equations within an acceptable range of error. This may account for some of the "numerical slop" observed in the output.

References

- Morgado, Kyle. "Effects Of Groundwater Pumping For Water Transfers On Groundwater Elevations In The Sacramento Valley And Modeling Stream/Aquifer Interactions Compared To Analytical Solutions." CSU Chico, 2013.
- Harbaugh, Banta, Hill, and McDonald. "Modflow-2000, The U.S. Geological Survey Modular Ground-Water Model—User Guide To Modularization Concepts And The Ground-Water Flow Process." U.S. Geological Survey, 2000. Open-File Report 00-92.