USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

1. Title: *A Multi–Level Approach to Modeling Ground– and Surface Water Exchange in Agriculturally–Dominated Settings*

2. Focus Category: NC

3. Keywords: *surface–groundwater relationships, subsurface drainage, water quality modeling, groundwater modeling, irrigation, algae*

4. Duration: September 1, 1998 to August 31, 2001

5. Federal funds requested: $229,696

6. Non–federal funds pledged: $512,266

7. Principal Investigators:

- W. Alan McKay, Desert Research Institute, University and Community College System of Nevada
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- Eric V. McDonald, Desert Research Institute, University and Community College System of Nevada
- John J. Warwick, University of Nevada, Reno
- Gary Vinyard, University of Nevada, Reno

8. Congressional district where research will be conducted: Nevada 02

9. Statement of Critical Regional Water Problem

Conversion of agricultural water rights to other "higher–valued" uses in the western U.S. (e.g., Nevada, New Mexico, California, Arizona) is often initiated under the assumption that improved water quality will be one of the benefits realized from this change in land and water use. In western Nevada for example, one by–product of the Truckee River Water Quality Settlement is a plan by Washoe County, the Cities of Reno and Sparks, and the U.S. Department of Interior to purchase up to 24,000 acre–feet (af) of Fernley

Bench agricultural water rights. The proposed purchase would serve the dual purpose of: 1) augmenting Truckee River flows to meet water quality objectives; and, 2) potentially reducing non–point source (NPS) groundwater return flows (and associated solutes) from irrigated agriculture in the lower river basin. A probable outgrowth of this initiative will be a pollution swapping request by the Cities that would include a relaxation of the TDS standards in their NPDES discharge permit at the regional wastewater treatment facility. The outcome of this request will rely, to a large degree, on the ability of the Cities and County (see attached letter, M. Widmer, Washoe County) to demonstrate that NPS pollution in the lower river will be reduced as a result of the change in land use.

The relationship between lower Truckee basin agricultural activities and groundwater return flow is poorly understood. Previous investigators (Cockrum, et al, 1995; Hoffman, 1990; Bratberg, et al, 1982; Sinclair and Loeltz, 1963) have noted water quality changes in the lower Truckee River, which are only partially explained by surface returns from agricultural operations. In virtually every study, investigators have opined that groundwater discharge may account for some, if not all, of the unexplained increases in many constituents downstream of the Reno/Sparks metropolitan area. However, in each instance a detailed investigation of ground– and surface water interaction (and the associated impacts on instream water quality) was beyond the scope of the particular study. It is therefore within the dual context of applied research and policy–driven inquiry that we propose the following study.

10. Statement of Results or Benefits

The results and benefits generated from the proposed study will be significant in several respects. First, our multi–level approach to model development and parameter estimation will provide a template for modeling complex ground– and surface water systems in other areas; especially those dominated by irrigated agriculture. By combining simple mixing–cell models, environmental isotopes and vadose zone modeling with airborne geophysics and on–the–ground field testing, we expect to constrain model error and uncertainty in a manner that will raise confidence in groundwater and solute transport model results.

Second, the proposed drilling and sampling program will yield useful information regarding the chemistry of sediments and associated groundwater in the lower Truckee River Basin. Long speculated as a potential source of groundwater solutes in the lower river, this study will, for the first time, help quantify the physical and chemical nature of the Pleistocene soils and stratigraphy that comprise the shallow aquifers in the region. Third, by integrating the results of this effort with ongoing surface–water studies by the investigators in the lower Truckee, we will acquire critical information regarding the nature of groundwater solute discharge to the river, and the associated impacts on instream water quality. This is significant in that current surface water quality programs do not model the hydrobiological processes associated with solute exchange at the ground– surface water interface. In lotic systems dominated by attached periphyton (i.e., Truckee River), this may be a particularly important process.

Lastly, the results of the study will provide critical information to planners, regulators and other basin stakeholders as they attempt to assess the impacts of large–scale changes in land–use activities on the hydrology and chemistry of the lower Truckee River; and provide a blueprint for addressing similar problems in other states within the Region, including New Mexico (e.g., the Rio Grande in Mesilla Valley; the Pecos River in the Carlsbad–Roswell area; and the San Juan River in San Juan County).