



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Estimation of Groundwater Recharge Using Environmental Tracers and Comparison of Results to Other Estimation Methodologies

Focus: Groundwater Recharge

Keywords: groundwater, recharge, tracers

Duration: 3/99 to 5/01

Federal Funds: \$23,257

Non-Federal Funds: \$47,495

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Congressional District: 1

Statement of Critical Regional or State Water Problems

Nevada and other areas of the desert southwest United States rely heavily on groundwater resources for municipal, domestic, and industrial needs. Available water resources may become the limiting factor for economic development, especially in rural areas, which tend to depend more heavily on groundwater. Therefore, an accurate estimate of the available groundwater resources, determined using the best available tools and methodologies, is essential to planning community growth and development. In Nevada, a state-wide assessment of water resources was undertaken during the 1960s and early 1970s (Shamberger, 1962 and 1991). The results, published as the NDWR water-Resources Reconnaissance Series reports continue to provide the basic information for planning and development decisions faced by resource managers at both local and state levels despite their design as reconnaissance level efforts. Since completion of the Reconnaissance Series technological developments and the introduction of new investigation tools give opportunity for more accurate assessments of available resources. Application of these tools have often indicated that significantly more water is available than previously believed in central Nevada (Nichols, 1994) and in southern Nevada (Russell and Minor, in prep.). In order to effectively utilize the available resources for the maximum benefit of local communities and the state, it is, therefore, important to further illustrate the usefulness of these new tools for enhancing estimations of available water resources.

Statement of Results or Benefits

The proposed effort will produce several direct results. First, groundwater recharge in Steptoe Valley of eastern Nevada will be evaluated. This recharge estimate will be based on measurement of the concentration of environmental tracers directly associated with the recharging waters and indicative of their movement through the geologic section (Russell and Minor, in prep.).

Second, a comparison of three recharge estimation efforts will be made. The recharge estimate developed in this study will be compared to that developed during the 1967 reconnaissance investigation of Steptoe Valley (Eakin and others, 1967) and with the recently completed discharge-based estimate of recharge prepared by the USGS (D. Maurer, personal communication, 1998). Such a comparison will indicate the general validity of the estimated recharge values. As different approaches to estimation of recharge converge on the same value confidence is gained in the accuracy of the estimates. Alternatively, differences between the results obtained for different investigation methodologies will spur explanation for the differences; thus, enhancing understanding of the water resource system and again adding confidence to estimation of recharge. Just as significant, though somewhat less quantitative, will be the added insight and understanding of the Steptoe Valley groundwater system developed through this activity.

In addition to the direct results envisioned for the proposed work, other benefits may be realized. Application of the environmental tracer technique in Steptoe Valley will validate the methodology outside of southern Nevada. Comparison of the various recharge estimates should illustrate the value of applying the new resource assessment tools and enhance understanding of the assumptions and point to preconceptions underlying each. Finally, a future benefit of the work may be to encourage state-wide efforts to apply modern technologies to assessment of Nevada water resources.

Nature, Scope and Objectives of Research

During the 1960s and early 1970s, the Office of the State Engineer and the Nevada office of the U.S. Geological Survey Water Resources Division (USGS) worked cooperatively, under funding from the Nevada Legislature, to produce a reconnaissance appraisal of the water resource potential of virtually every topographic basin in Nevada (Shamberger, 1962; Shamberger, 1991). Results of these investigations have been documented in the Water-Resources Reconnaissance Series publications of the Nevada Division of Water Resources. The reconnaissance investigations provided valuable preliminary estimates of water availability, including recharge estimates. However, the studies were never intended to provide definitive groundwater budgets for the areas studied.

During the last two decades, developments in methods and technology for assessment of water resources have been significant. These advances have developed along two tracts. In one case, the discharged-based recharge estimation procedures have been enhanced by improved estimates of plant transpiration and technological capability for determining the

landscape coverage of various plant communities. Within the state of Nevada the USGS has demonstrated the viability and value of the advances in the discharge-based recharge estimations in a number of hydrographic basins. Applying the advanced technologies to 16 basins of eastern Nevada, the USGS (Nichols, 1994) has determined that the estimated recharge to groundwater throughout the region is approximately twice the amount estimated during the reconnaissance series studies of the 1960s and 1970s. The estimated recharge was determined to be higher in some basins and lower in other basins within the region. In the second case, understanding of the behavior of stable isotopes and dissolved constituents have permitted investigators to use the concentrations of these environmental tracers to develop estimates of groundwater recharge. Russell and Minor (1998) have applied environmental tracer studies to the estimation of groundwater recharge in south central Nevada. Their results have also indicated that new estimates of groundwater recharge are generally greater than those reported in the reconnaissance series publications.

Application of the two methods to the same hydrographic basin would provide a particularly powerful test of the methodologies. Comparable results from application of the two methods to the same hydrographic basin would give water resource managers greater confidence in the quantity of the resource available for beneficial use. Therefore, the principal objective of this proposed effort to apply the environmental tracer methods for estimating groundwater recharge to a single hydrographic basin in which the USGS has already applied the discharge-based estimation techniques. Specifically, the proposed effort will utilize stable isotope and chloride concentration data for water gathered from springs to estimate the annual groundwater recharge in Steptoe Valley of eastern Nevada. Secondly, the results based on the environmental tracer methodologies will be compared to the discharge-based recharge estimates obtained by the USGS and to the results published in the reconnaissance report for the valley (Eakin and others, 1967)