

Dissolved solids in major aquifers and rivers of the Southwest

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INTRODUCTION

The Southwestern United States is an arid environment where the location and extent of economic and cultural activities are dependent in part on the availability and quality of water. In many areas of the Southwest, there is little or no surplus water to flush salts from the environment and as a result, high concentrations of dissolved solids degrade the water's suitability for certain uses. Concentrations exceed the U.S. Environmental Protection Agency's Secondary Maximum Contaminant Level for drinking water (500 mg/L) or state maximum contaminant levels for irrigation in some areas. In response to this water-quality issue, the U.S. Geological Survey (USGS) National Water-Quality Assessment program began a regional study in 2004 to characterize dissolved solids in the major aquifers and rivers in the Southwest (figs 1 and 2).

STUDY OBJECTIVES

This study of dissolved solids in the major aquifers and rivers of the Southwest has three objectives. The first is to describe the spatial distribution of (1) dissolved-solids concentrations in major aquifers and (2) dissolved-solids concentrations, loads, and yields for major rivers and their tributaries. The second objective is to describe the natural and human sources, transport processes, and sinks for dissolved solids in major aquifers and rivers at site, basin, and regional scales throughout the Southwest. The third objective is to describe the interannual trends of dissolved-solids concentrations in major aquifers and rivers, and where possible, relate the trends to natural and human causes.

APPROACH

This investigation will rely on existing data and use distinct approaches to meet each objective. The spatial distribution of dissolved-solids concentrations in major aquifers will be characterized by synthesizing information from the many maps and reports prepared by previous investigators. Where data gaps exist, concentration conditions will be determined on the basis of sample data that were collected as part of many USGS ground-water sampling programs and stored in the NWIS database. The spatial distribution of dissolved-solids concentrations, loads, and yields in major rivers will be characterized on the basis of chemical, specific-conductance, and discharge data that were collected at 420 sites. These data were collected as part of many USGS surface-water quality and discharge monitoring programs and were stored in the National Water Information System (NWIS) database.

The natural and human sources, transport processes, and sinks affecting dissolved-solids concentrations in water at site and basin scales will be described for 12 selected basins in the Southwest. The selected basins differ in physiographic, climatic, hydrologic, and cultural

conditions, and represent the diverse conditions in the Southwest. For each basin, information about the sources, transport processes, and sinks of dissolved solids will be determined by synthesizing results from previous studies and new analysis of existing data.

The natural and human factors affecting dissolved-solids concentrations in water will also be determined at basin and regional scales by using a mass-balance approach. In this analysis, the Southwest will be divided into about 300 basins. The spatially referenced regressions of contaminant transport on watershed attributes (SPARROW; Smith and others, 1997) model will be used to estimate (1) source loadings—the annual mass of dissolved solids contributed from natural and human sources within a basin to a river, (2) transport losses—the annual mass of dissolved solids removed from the river owing to diversions and infiltration, and (3) basin exports—the annual mass of dissolved solids exported out of the basin through the river or major trans-basin diversions. Results from the SPARROW model will be used to identify which natural and human sources are most significant in each basin. In addition, basins will be categorized as source areas or sink areas for dissolved solids in the Southwest on the basis of the net mass balance of (1) annual source loadings within the basin, (2) annual stream loads importing dissolved solids from upstream basins, (3) annual transport losses within the basin, and (4) annual exports of dissolved solids to downstream basins. Spatial patterns of source-type basins and sink-type basins will be used to identify regions that are major sources and sinks of dissolved solids in the Southwest.

Interannual trends of dissolved-solids concentrations in selected basins of major aquifers will be determined from ground-water sample data stored in the NWIS database. Interannual trends of dissolved-solids concentrations and loads in select rivers will be determined for a subset of the sites from the spatial analysis described above. Trends in both major aquifers and major rivers will be attributed to natural and human causative factors where possible.

USE OF RESULTS

Data compilation and analysis are underway, and the study results will provide water-resource managers with information that will be useful for addressing water-resources development, protection, and quality-improvement issues. For example, knowledge of the spatial distribution of dissolved-solids conditions in aquifers and streams is fundamental for water providers that are seeking new water supplies. In addition, an understanding of the major sources and transport of dissolved solids allows for strategic selection of salinity-control projects that seek to mitigate salt loading to major rivers.

REFERENCES

Smith, R.A., Schwarz, G.E., and Alexander, R.B., 1997. Regional interpretation of water-quality monitoring data. *Water Resources Research* 33(12): 2781-2798.