Workplan to develop a regional ground-water flow model of the Upper and Middle Verde River Watersheds, and adjoining areas and to continue hydrologic data collection in support of the numerical model

Introduction

A numerical ground-water flow model simulating the ground-water system of the upper and middle Verde River Watersheds, Coconino Plateau, and Mogollon Highlands is currently being developed by the U.S. Geological Survey (USGS) in cooperation with the Arizona Department of Water Resources (ADWR) under the Rural Watershed Initiative (RWI) and Yavapai County. The numerical model will enable examination of development scenarios, and identification of potential attendant effects on surface-water resources.

In addition to the construction of the numerical model, selected ongoing basic data collection activities will continue that will assist in parameterizing and improving the accuracy of the ground-water model. The data collection tasks include operation of the Williamson Valley stream-flow gaging station and precipitation gage, continued operation of continuous water level altitude stations, and collection of precipitation and surface-water stable isotopes from the Verde River and its tributaries.

Numerical modeling

Development of a numerical model entails translation of the conceptual models of a geohydrologic system into a mathematical representation. This translation entails simplifications and approximations of complex flow systems to yield a representation that can be reasonably supported by the available data and can be used to support resource-management decisions.

A current version of the USGS ground-water modeling package, MODFLOW2000, has been used to create a multi-layer steady-state model. During this fiscal year and current workplan, parameter estimation techniques will be applied to determine the sensitivity of the model to the distributions and magnitudes of the inputs, parameters, and to test the validity of the conceptual model. The results of these efforts will describe the extent to which the simulation represents the natural system. As a

subsequent task, the model will be forced using 'transient' data sets that represent sequentially more recent time intervals, up to the most recent data. The final model that evolves from these transient steps will be analyzed using the same parameter-estimation techniques used earlier to quantify and qualify its sensitivities. The sensitivity analyses performed will enable confidence intervals to be established for model simulations. Results of the sensitivity analysis are useful for assessing potential needs for additional geohydrologic information, and for identifying what information should be collected on a long-term basis to both verify model performance and update it to reflect increased understanding of how the hydrologic system works.

Williamson Valley Stream-Flow Gaging Station and Precipitation Gage

Long-term monitoring of streamflow is critical to the understanding of ground-water recharge and discharge. The value of data increases with length of record; longer records allow evaluation of trends caused by climate variability, vegetations changes, land use changes, or changes in ground-water withdrawals. The USGS stream gage at Williamson Valley Wash was re-activated in FY2001 to record surface water that flows toward the Big Chino Valley and infiltrate into the subsurface, often before they reach this destination. While Big Chino Wash, the major drainage in Big Chino Valley, is dry most of the year, flows from some of the perennial tributaries end at the valley margin, indicating that tributaries contribute a portion of the total recharge to the valley aquifer system. Operation and maintenance of the gaging station and periodic discharge measurements will be conducted through this task. The integrity of the data will be verified and the data populated into the USGS database.

Continuous Ground-Water Level Monitoring

Wells currently instrumented for continuous water-level altitude monitoring will be maintained and continue serving real-time water level data to the web. These monitoring wells (currently 7 total) have been recording since March 2000 and have begun a long-term record of seasonal and annual water-level fluctuations; these data will complement information collected by staff of the Prescott AMA. These wells, as well as other monitoring wells that have long-term water-level records will be used as calibration

targets of the regional ground-water flow model. Operation and maintenance of the stations and periodic calibration measurements will be conducted through this task. The integrity of the data will be verified and the data populated into the USGS database.

Precipitation and Surface Water Stable Isotope Monitoring

Beginning in 2003 stable isotopes of precipitation have been measured and compared to synoptic measurements of surface and ground-water to determine recharge locations and ground-water travel paths. This task would continue the collection of stable isotopes at precipitation sites and start collecting repeat stable isotope measurements on a quarterly basis from the Verde River main stem and its tributaries. The repeat measurements will provide a temporal record of changes in the system caused by seasonal and land use influences that should be incorporated into the ground-water model. The integrity of the data will be verified and the data populated into the USGS database.

Budget

The costs associated with project tasks are included in Tables 1. Personnel needed include three hydrologists, and additional support staff.

Table 1. Project costs for continued regional ground-water flow model development and monitoring. This budget is presented on the USGS Fiscal Year (Oct 1 to Sep 30).

[Values in thousands of dollars]

Item	FY08
Williamson Valley Stream and Precipitation Gage	15
Continuous Water Level Monitoring and Precipitation Gages	19.5
Stable Isotope (Precipitation and Surface Water)	15.5
Ground-Water Model Development	40
TOTAL	**90**
Yavapai County Share	50
USGS Share	40