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**REPUBLICAN RIVER BASIN MODELING, GROUND-  
WATER/SURFACE-WATER INTERACTION AND WATER-  
QUALITY PROJECT**

OCT 10 2001

DEPARTMENT OF  
NATURAL RESOURCES**October 4, 2001****Modeling**

Substantial progress towards completing the study was made in the last quarter but it is expected that modeling and report drafts will not be completed until December.

Calibration of the ground-water model for the development period (1950-1997) is proceeding. Input data sets for recharge and pumping were regenerated after error checks revealed some problems with the data. The current data sets have passed through extensive quality assurance. Some problems with numerical stability of the model were encountered during the development period simulations due to the rapid changes in water storage, particularly in areas with low saturated thickness, due to greater pumping and recharge than during the predevelopment period. Recharge and aquifer specific yield (an aquifer storage parameter) are the main model parameters being adjusted to calibrate the model to changes in water levels and base flows.

The reports that will document the study methods and results are being written and figures and tables prepared. The following reports are being prepared:

Base flow and runoff components of streamflow and base-flow gain/loss in part of the Republican River Basin Nebraska, Kansas, and Colorado, USGS Water-Resources Investigations Report, by Matthew Landon, Virginia McGuire, Michaela Johnson, Jennifer Stanton, and James Cornwall, (Interpretative technical report describing the results of base-flow separation analysis and statistical analysis of trends in streamflow, runoff, base flow, and precipitation), approximately 30 pages, 11 figures, 5 tables.

Description of hydrogeologic system and simulation of ground-water flow and ground-water/surface-water interaction in part of the Republican River Basin Nebraska, Kansas, and Colorado, USGS Water-Resources Investigations Report, by Matthew Landon, Michaela Johnson, and James Cornwall, (Interpretative technical report describing the hydrogeologic system, the methods and results of simulations with a soil-water balance model used to estimate recharge and pumping, and the methods and results of a ground-water flow model used to simulate ground-water flow and ground-water/surface-water interaction in the basin), approximately 120 pages, 31 figures, 34 tables.

Ground-water flow and ground-water/surface-water interaction in part of the Republican River Basin, Nebraska, Kansas, and Colorado, USGS Fact Sheet, by Matthew Landon and Michaela Johnson, (Report written for a non-technical audience summarizing the major results of the study), 4 pages.

A talk summarizing study results to date was prepared for presentation at the Annual Meeting of American Institute of Hydrology in Minneapolis on October 16. The U.S. Department of Justice also requested that this talk be given to representatives of the lawsuit parties on October 19 in Lincoln.

In the next quarter, simulations to calibrate the development period ground-water model will be completed. The results will be analyzed to evaluate the effects of ground-water pumping on ground-water flow and base flow, and the sensitivity of model results to model parameters. The effects of selected hypothetical future scenarios on ground-

water flow and base flow will be simulated using the calibrated model. Reports documenting the methods and results of the study will start into review.

It is projected that first drafts of reports will go into USGS supervisory review in December and will be available for review by the USGS project review team and cooperators in January. With this schedule it is expected that the reports would be approved for publication in late February and printed copies available in April.

#### **Ground-Water/Surface-Water Interaction**

The component of the study involving field investigations of ground-water/surface-water interactions has been completed. The results of the study were published in USGS Water-Resources Investigations Report 99-4200, "Interaction of streams and ground water in selected tributaries of the Republican River, Nebraska, 1998-99," by Gregory V. Steele.

#### **Ground-Water Quality**

The component of the study involving investigations of areal ground-water quality in the Nebraska part of the Republican River Basin has been completed. The results of the study were published in USGS Water Resources Investigations Report 00-4056, "Distribution of nitrate in ground water in the Republican River Basin, Southwest Nebraska, 1996-98" by Jennifer S. Stanton.

For additional information, please contact Matt Landon (Hydrologist), Bob Joseph (Hydrologic Investigations Chief), or Mike Slifer (District Chief) at the USGS Lincoln, Nebraska office (Tele: 402-437-5082).

07/09/01

Roger  
Jennifer  
Jeff  
Ann (last)

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July 10, 2001

JUL 17 2001

DEPARTMENT OF  
NATURAL RESOURCES

## Modeling

Calibration of the predevelopment (prior to extensive ground-water development for irrigation, not pre-settlement) ground-water flow model was completed. The model was satisfactorily calibrated to: (1) pre-1964 ground-water levels, (2) pre-1964 long-term average base flows (ground-water discharge to streams) determined from base flow separation analysis at gaging stations, (3) base-flow gain/loss measurements during the 1970s, 1980s, and 1998 indicating relative proportions of tributary inflow and main stem base-flow gain, (4) the location of the headwaters of perennial streams. The principal model parameters that were adjusted to calibrate the model were: recharge (long-term average prior to extensive irrigation), hydraulic conductivity of the Ogallala Formation and the paleoalluvial deposits outside of the modern stream valleys in the eastern part of the study area, ground-water evapotranspiration in riparian areas along streams (adjusted to account for historical changes in woodland area), and streambed conductance (a term that describes how much water can be transmitted through streambeds, depends on streambed hydraulic conductivity and area).

Calibration of the ground-water model for the development period (1950-1997) is proceeding. The output from the predevelopment ground-water model is being used as the initial condition for the development period model. The development period model has two stress periods per year, a summer (irrigation season) stress period from May – September and a winter (non-irrigation) stress period from October – April. There are a total of 95 stress periods during the development simulation period beginning in May 1950 and ending in September 1997. Rates of recharge, pumping, and ground-water evapotranspiration from riparian areas change every stress period.

Writing, figure preparation, and table preparation are proceeding on the reports that will document the methods and results of the study. The reports that are being prepared are:

Base flow and runoff components of streamflow and base-flow gain/loss in part of the Republican River Basin Nebraska, Kansas, and Colorado, USGS Water-Resources Investigations Report, by Matthew Landon, Virginia McGuire, Michaela Johnson, Jennifer Stanton, and James Cornwall, (Interpretative technical report describing the results of base-flow separation analysis and statistical analysis of trends in streamflow, runoff, base flow, and precipitation), approximately 30 pages.

Description of hydrogeologic system and simulation of ground-water flow and ground-water/surface-water interaction in part of the Republican River Basin Nebraska, Kansas, and Colorado, USGS Water-Resources Investigations Report, by Matthew Landon, Michaela Johnson, and James Cornwall, (Interpretative technical report describing the hydrogeologic system, the methods and results of simulations with a soil-water balance model used to estimate recharge and pumping, and the methods and results of a ground-water flow model used to simulate ground-water flow and ground-water/surface-water interaction in the basin), approximately 100 pages.

Ground-water flow and ground-water/surface-water interaction in part of the Republican River Basin, Nebraska, Kansas, and Colorado, USGS Fact Sheet, by Matthew Landon and Michaela Johnson, (Report written for a non-technical audience summarizing the major results of the study), 4 pages.

In the next quarter, additional model simulations will be conducted to calibrate the development period ground-water model to changes in ground-water level and base flow during 1950-97. The calibrated simulation results will be analyzed to evaluate the effects of ground-water pumping on ground-water flow and base flow, and the sensitivity of model results to model parameters. The effects of selected hypothetical future scenarios on ground-water flow and base flow will be simulated using the calibrated model. Writing of the reports documenting the methods and results of the study will continue.

The study is behind the schedule anticipated earlier in the year due to difficulty with model calibration. It is expected that ~~drafts of reports will be ready for review in September.~~ With an expedited review schedule using the team review process, it is expected that reports should be approved for publication by USGS in October and printed ~~copies available by November.~~

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