# Kansas Geological Survey

## Kansas Geological Survey and U.S. Fish and Wildlife Service Study of the Quivira National Wildlife Refuge: A review of progress and work ahead

by

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Many regions of western and central Kansas have experienced significant ground-water and streamflow declines, especially during the last two decades. Fish and wildlife resources in and along several central Kansas streams and wetlands have been significantly affected because of loss of baseflows. There is also concern that the quality of ground and surface waters in central Kansas is deteriorating, mainly as a result of increased natural nonpoint mineral intrusion from underlying geologic formations; this increased mineral intrusion is a consequence of freshwater declines in the Quaternary alluvial aquifers of central Kansas.

The purpose of this project is to determine the impacts to the Quivira National Wildlife Refuge of continued irrigation pumping or of possible future increases in pumping. For this purpose a computer model is needed to predict stream base flows and mineral intrusion from underlying geologic formations under various pumping scenarios and to predict the impacts of irrigation pumping on the Quivira NWR; in addition, a computer model is needed for use in managing the water supply to the refuge from the Rattlesnake Creek.

To carry out such a research endeavor, one needs a compilation of available data and an evaluation of the adequacy and gaps in data that somehow need to be bridged. All these data need to be integrated into a comprehensive predictive and management model for stream-aquifer interactions and mineral intrusion in the lower Rattlesnake basin. The following list is an outline of our progress in addressing these tasks to date.

1. All available bedrock and predevelopment water levels in the area from numerous published and unpublished sources were compiled, evaluated and synthesized into a comprehensive

data base and contour maps on a scale of 1/4 inch to a mile. This completed work phase was reported to the US Fish and Wildlife Service in June 1990.

2. A geophysical logging survey of a limited (because of financial and personnel constraints) number of existing wells in the region was conducted in April and May 1990 using a rented US Geological Survey logging vehicle. The purpose of this survey was to locate the saltwater interface underlying the freshwater Great Bend aquifer and to pinpoint locations for detailed study. Despite equipment deficiencies, which resulted in a logging survey of a qualitative nature only, the results were helpful in locating the approximate extent of the saltwater interface.

3. Two locations near the Quivira marsh were selected for drilling monitoring wells to track the location and temporal variations of the saltwater interface. After securing land owner permission and other clearances, two 5-inch fully screened wells down to bedrock were drilled, installed, developed, lithologged and gamma-logged by the Kansas Geological Survey during May and June 1990.

4. Two conductivity recording probes, one with an electronic data acquisition system (Hydrolab's Datasonde III) and the other with a recording chart, were selected and purchased by the KGS. These probes were checked, adapted to our field situation by rewiring some circuits for extended battery operation, calibrated, and installed in the field in August 1990. Periodic field maintenance and instrumentation adjustment is still being conducted by the KGS.

5. Two preliminary water quality surveys of the waters entering and leaving the Quivira marsh, and of the Little and Big Salt marshes were conducted in August 1990. One survey was specifically conducted for trace element analysis.

6. All official water rights in the area as of 1990 were obtained on tape from the Division of Water Resources/Kansas State Board of Agriculture and were processed and displayed on a map at a scale of 1/4 inch to a mile. The boundaries of the Rattlesnake Creek watershed are also displayed on the map.

7. All streamflow data in the region were also obtained electronically from U.S. Geologcial Survey data bases, and the results were processed and displayed as stream hydrographs on an annual and monthly basis for the entire period of record. The data were also displayed as streamflow differences between gaging stations.

8. A two-dimensional areal model involving a combination of stream-pond-aquifer interaction and freshwater-saltwater sharp interface routines with distributed ground-water modeling has been developed for this study. Initial testing and verification tests of this model were conducted, and a comprehensive documentation, testing, and verification report was sent to the US Fish and Wildlife Service in November 1990.

9. A square-mile finite-difference grid has been constructed for the entire lower Rattlesnake Creek basin encompassing the Quivira NWR, and all required data for implementing the stream-pond-aquifer modules of the previously mentioned model were grid-formatted as input to that model. Currently the study area boundaries extend from west of the Macksville stream gaging station to the confluence with the Arkansas River.

10. Preliminary implementation and calibration runs of the model for the predevelopment (steady-state) conditions are under way.

11. The advantage of colateral studies in the area in cooperation with the Groundwater Management District No. 5 cannot be overemphasized. Results and data from these studies are providing feedback for this study.

Several further tasks need to be undertaken to fully address the objectives of this study:

1. A comprehensive water conductivity survey is needed to map the spatial extent of the underlying saltwater interface; this survey needs to be repeated at least once (initially at least twice) a year. Such data are required input for the freshwater-saltwater interface module of the developed computer model for the area;

2. More electronic conductivity probes are needed per monitoring site (at least three) to trace the position, salinity level and movement of the saltwater interface,

3. More monitoring wells (at least four more) are needed close to the marsh to study the spatial and temporal variations of the saltwater interface,

4. Quarterly water quality surveys of both surface and ground waters in and around the marsh are needed to study the function of the marsh and its chemical mass balance,

5. A detailed ground-water-level survey of the area surrounding the marsh is needed to study current water levels in detail,

6. A stream survey of the Rattlesnake Creek within the study area may be needed to obtain streambottom sediment properties and stream geometry features,

7. A more detailed grid (and thus more detailed data matrices) needs to be developed for the study area closest to the Quivira NWR,

8. Once the steady-state calibration has been completed, detailed transient calibration needs to be initiated (such calibration runs, including sensitivity analysis, are time-consuming iterative procedures),

9. Hydrologic water budgeting models with climate-generation routines need to be interfaced with the developed model to run plausible predictive runs of expected future conditions in the area,

10. Several management scenarios need to be evaluated using the completed, calibrated transient model, including drought and flood conditions, current, increased or decreased appropriations, and reduced pumping stream corridors.