

Kansas Water Research and Data Needs, 1995-2000

Council of Water Research Directors:

Kansas Geological Survey (KU)
Kansas Water Resources Research Institute (KSU)
Water Resources Center (KU)
Kansas Agricultural Experiment Station (KSU)
Kansas Biological Survey (KU)

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Preface:

At their meeting in Manhattan on March 1, 1995, the Council of Directors of the Kansas State Water Research Agencies agreed that it was appropriate to review and assess developments in the area of water research and data needed by the state. The group agreed to produce a "white paper" summarizing and organizing the views of the Directors and research staff of the agencies. The stated objective was to provide a comprehensive, up-to-date basis for interactions with water-related policy-makers, planners, managers, and funding agencies at all levels of government.

Input was solicited from the staff and Directors of all the participating agencies by circulating a list of issues and topics. The responses received were assembled into a draft report which was then sent for review to each of the Directors in April; after their comments and suggestions were incorporated, a second draft was sent in May to both the Directors and the major state and local water agencies for final review.

Based on suggestions and discussions received, the final version contained in this report was completed in June, 1995. I hope that it will serve as a useful basis for developing and coordinating the water research needed by the state as it prepares for the coming century.

The contributing Directors were:

Lee Gerhard, KGS
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Because many suggestions were routed through the agency Directors, I can not identify all contributors. However, I wish to acknowledge both the personal and institutional contributions of the Directors and their staffs, and in addition, those of: J. Koelliker; the research staff of the KGS Geohydrology Section; R. Angelo (KDHE); T. Stiles, G. Hargadine, and K. Wedel (KWO); and W. Anderson, D. Lambley, and M. Scherer (DWR).

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Over the past five to ten years, circumstances surrounding water use and its management in Kansas have undergone a profound change. The final turning point in this transition came with the establishment of a DWR regulation requiring all new appropriations to meet standards for long-term sustainable use -- with sustainability defined as including consideration of both groundwater and surface water effects. With this rule in place, many areas in Kansas have, in the words of the Chief Engineer, "essentially no new water." Increased demand will have to be met from water rights already appropriated, through conservation and/or increased efficiency, or through market-based change in use.

Most of the state's water management, research, and monitoring programs now in place, however, were formulated at times when resource limitations and their implications were not as clearly perceived. The base of information and knowledge, and in some cases the nature of the programs, are inadequate to deal with the problems and opportunities that will arise in a market-oriented environment driven by increasing scarcity. In particular, increased research and programmatic attention needs to be devoted to the interactions between water quantity and water quality issues.

The Kansas Water Research Agencies have prepared this summary of research and data needed to permit the state to plan for, manage, and address today's water issues. The focus is on unmet needs and new issues, and the paper should not be taken as implying that existing programs are obsolete or unnecessary -- many should continue, but may need to be supplemented or modified as discussed below. The list of issues below is arranged by topical groupings, and the order does not represent any particular priority or sequence for the necessary work.

Water Quantity-Quality Interactions

Water quality is determined by the concentrations of dissolved and suspended material. Consumptive use of water -- that is, evaporation and transpiration -- increases these concentrations. In addition, human alteration of groundwater and surface water flow rates and residence times (e.g., by storage in reservoirs) alters the natural processes influencing water quality. Such alteration affects the hydrologic system's ability to dilute and transport both natural contaminants and the wastes and

byproducts of municipal, agricultural, or industrial activities. While these aspects of water use diminish the quantity of good-quality water, a more positive aspect of the issue is that Kansas has large quantities of marginal-quality water that may be used selectively or purified economically under circumstances of high water-demand and limited supply. Examples of issues that should be addressed under this category include:

Diminished stream flow and groundwater declines -- Surface water impoundments, land use and conservation practices, and groundwater pumping all modify the total volume, rates, and temporal patterns of stream flow and groundwater recharge.

- What effects do diminished streamflow and groundwater declines have on primary water quality and quantity of streams, of hydraulically connected alluvial aquifers, and of large regional aquifers?
- How are stream capacities to accept discharged waste and anthropogenic contaminants affected?
- What are the consequences of these changes for long-term sustainable yield, and for water-rights and aquifer management strategies?
- What management strategies and models are best suited to cope with these changes?
- What are the consequences of combined quality and flow changes for stream ecosystems and in-stream uses?

Direct land-use impacts -- Water quality is affected by land uses and may change with changing life-styles, technologies, and economic conditions.

- What are the effects and constraints of land application of sewage sludge?
- What management practices can reduce contaminant levels in urban storm-water flows?
- Can acceptance and utilization of water-quality best management practices in agricultural production be enhanced?

Marginal-quality water inventory and assessment -- Water that does not naturally meet primary drinking-water quality standards may be useful for a variety of domestic, agricultural, and industrial applications, replacing or extending limited supplies of potable water.

- For what applications is marginal-quality water presently or potentially usable?

- What is the inventory, distribution, and sustainable yield of such water resources?
- What programs or technology can be developed to expand use of these resources, and how should the resources be managed?
- Are present potable water quality standards appropriate?

Agricultural salinization -- Irrigation and the use of nutrients and other agricultural chemicals can contribute to salt build-up, in soils and in ground- or surface-water that receives return flows.

- What are the water-quality, irrigation system, water management, and best management practice constraints on sustainability of irrigation?
- How do these constraints relate to climatic regimes and unsaturated-zone characteristics?
- What management practices can minimize water quality effects?
- Are there salt-tolerant crops or strains that are suitable for continued productivity in areas of increasing salinization or naturally poor water quality?
- What are the long-term effects on soil quality of fostering the use of salt-tolerant crops?

Water-Use Efficiency

The traditional approaches to water-use efficiency focus on questions such as how to maintain crop yields with less water per acre, or the same quality of urban life with less water consumption per capita. With a limited water supply and growing demand, these questions take on even greater importance; however, a new suite of issues must be considered. Improvements in overall efficiency will need to include consideration of qualitatively appropriate use (e.g., opportunities to use poorer quality water to conserve good water for critical applications), and the potential impacts of water-quantity conservation measures on long-term water-quality trends.

Agricultural use efficiency -- Increased use efficiency needs to integrate quality preservation with reduced consumption, with the goal of maintaining or increasing net income with reduced impact on the water resources.

- How can improved irrigation technology and management be combined with programs to reduce the impacts of waste and agricultural chemicals on water quality?

- What combination of irrigation scheduling, water and chemical application, and drainage management systems can minimize water-quality impacts and maximize water-use efficiency?
- Can plant breeding and management develop both dry land and irrigated crops that have enhanced productivity per unit of water and are more drought- and/or salt-tolerant?
- Are there levels of conservation treatment on dry land production systems that can adequately protect the soil and also yield more usable water resources to other users?
- What are the projected future economic and tax impacts of highly efficient irrigation systems, zero-depletion or planned-depletion strategies, and conversion from irrigated to dryland farming?
- Can decision-support software systems be developed for specific irrigated areas to provide irrigators and water resource professionals with information on water use, soil water drainage, crop yield, costs, and returns?
- What will be the impacts of federal farm programs on agricultural use efficiency?

Municipal use efficiency -- Demands for municipal water supplies, rural water supplies, and for domestic supplies in unincorporated suburban areas are steadily growing, and are accompanied by increasing volumes of wastewater discharge.

- Are technologies available to meet increased water demand by treatment of lower-quality water that is presently unused, or by treatment and recycling of waste water, and are there adequate mechanisms to encourage adoption of existing or new technologies?
- What are the hydrologic and environmental effects of long-distance water transfers and/or changes in use?
- How can wastewater impacts on water quality be reduced if discharges increase?
- What are the effects on water quantity and quality if discharges decrease because of changes to non-discharging wastewater treatment processes?
- Can improved water-quality and water-quantity conservation strategies be devised to enhance household, industrial, and landscape water use efficiency, and can acceptance and utilization of new or existing strategies be improved?

- What are the potential roles of interconnected systems, integrated treatment facilities, and water-use charges in reducing water system risk and increasing reliability?

The Hydrologic and Environmental System as a Resource

The introduction of sustainability as a criterion for permitting water use focuses attention on the controlling role of nature, since the natural hydrologic system determines the limits of "sustainability," however humans define that term. At the same time, the market system has no inherent mechanism for valuing such factors as the maintenance of the "natural infrastructure" of the hydrologic system, or costs and benefits to third parties as a result of the environmental effects of changes in water use.

Sustainability of consumptive uses -- Consumptive use means that water is removed from the ground- and surface-water bodies of the natural hydrologic system; large-scale sustained consumptive use causes a permanent reduction of reserves and a shift in the dynamic equilibrium of the natural system.

- What are useful definitions or assessments of sustainability or "safe yield" that address both quantity and quality of water?
- What do these definitions imply about the future of water resources in Kansas, and about appropriate management of those resources?
- Can interactions between natural processes and regulated use be balanced in a rational management strategy, and if so, how?

The hydrologic system as natural infrastructure -- Streams, bank storage, and aquifers provide a natural water transport and storage system that is a vital component of society's water use.

- What groundwater levels and stream flows must be sustained in order for the hydrologic system to function as a base system from which a sustainable yield fraction can be harvested?
- What is the system's sensitivity to extreme wet or dry periods, climate change, or land-use changes, and what risks are associated with depletion?
- How may the critical components of the natural infrastructure be maintained and managed?

Nonconsumptive and ecosystem uses -- Valuation of the uses and benefits of water that is not consumed by human activities remains a major political and economic challenge.

- How will recreational and environmental water use be affected by changing use patterns and trends in water quality?
- What is the role of wetlands and riparian areas in the natural system?
- How can the contributions of natural systems to the hydrologic infrastructure be assessed and valued in the context of sustainability (example: corridors of riparian vegetation reduce bank erosion and help purify local runoff, but at the cost of some additional water lost to evapotranspiration)?

Information, Communication, and Education

Communication -- Technical capabilities for the storage, exchange, and application of data and information have rapidly outpaced implementation by Kansas water research, management, and regulatory agencies.

- What kind of electronic networking system can be rapidly deployed to permit the hydrologic community to share data and information efficiently at all levels?
- What should be the priorities for establishing data management and access protocols, and for bringing existing information on line?

Information -- It is often difficult for individuals or agencies focused on one water use or issue to appreciate the interactive complexity of the hydrologic system; this difficulty will increase with efforts to consider the relationship between quantity and quality issues.

- What general reference, strategy, or explanatory documents or programs can be developed to achieve a common frame of reference at the technical level, and to help in coordinating state and local regulation and planning?

Education -- Reliance on a renewable natural resource involves both uncertainty and risk, topics which are difficult to incorporate into governmental planning and management.

- What educational or explanatory materials should be developed to help water users, decision makers, and the lay public understand and attain sustainable water resource use and management?