ARKANSAS WATER SCIENCE CENTER

SCIENCE, WORKFORCE, & COMMUNICATION PLANS

2010

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Arkansas Water Science Center
Science, Workforce, and Communication Plans
March 2010

Dissemination of Plans

The Arkansas Water Science Center (WSC) Science, Workforce, and Communications Plans are made available to all employees of the Arkansas WSC via our internal web page which can be accessed from http://ar.water.usgs.gov/internal.html. The plan is an unapproved, strategic document intended for use by the WSC staff and other USGS personnel. The Plan contains assumptions and information about cooperators' and partners needs, plans, or activities and will be updated frequently. This Plan describes the WSC's strengths, weaknesses, and roles in the natural resources community that we believe agrees with our cooperators' perceptions and is consistent with the Bureau’s “Strategic Science Directions” as defined in USGS Circular 1309 and, is in alignment with the South Central Area’s Science Priorities. The Arkansas WSC Planning document is posted on the WSC internal web page and is shared both internally and externally for input and feedback.

ARKANSAS WATER SCIENCE CENTER SCIENCE PLAN

Introduction

The purpose of this science plan is to characterize current and emerging natural resource issues in Arkansas and to develop a dynamic planning process so that program development strategies are well focused over the next 5 years. This plan addresses the specific actions that are necessary for the Arkansas WSC to enhance its technical viability within the scientific community and to enhance the quality of the hydrologic science, data, and reports resulting from projects conducted in cooperation with a variety of partners. We hope that, by promulgating this plan, we will be better able to communicate our vision to the other Disciplines within the USGS and thereby involve them at the planning stages of many of the science opportunities that may present themselves within the State of Arkansas.

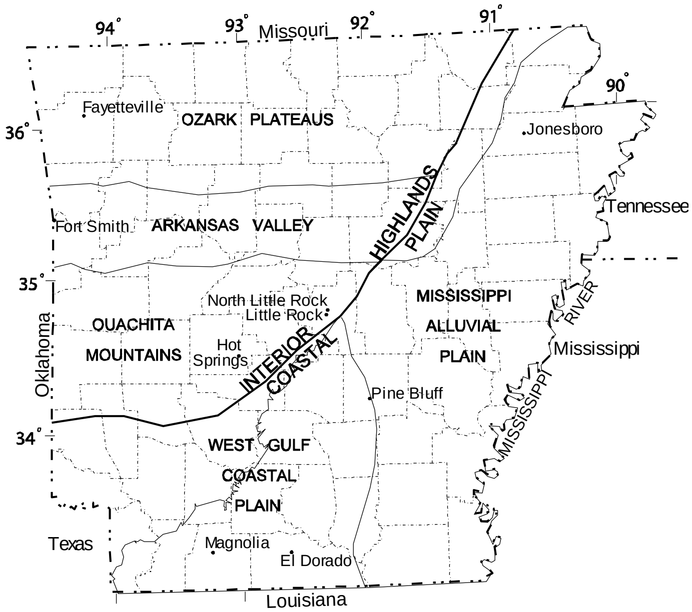
The current budget climate necessitates using existing resources more effectively and efficiently to face the challenges of providing credible, impartial scientific information to those charged with making public policy. The Arkansas WSC (like other Federal, State, and local agencies) must adapt to these budget constraints by leveraging the combined resources available to contribute to the scientific understanding important to the State and Nation. Investments in people, equipment, and technology and improvements in business practices demand our attention now to shape the future role of the USGS in Arkansas in this dynamic environment.

State and Hydrologic Setting

Arkansas, known as the "Natural State," has some 514,000 acres of lakes, over 28,000 miles of perennial streams, and approximately 17 million acres of forest that offer countless opportunities for camping, hiking, fishing, hunting, and canoeing. The 53,200 square mile State also has 48 State parks, 3 national forests, and 5 national park sites. The scenic beauty of the Natural State appeals to travelers from all over the country with annual visitation exceeding 17.4 million travelers.

Arkansas' population increased from 2.83 million in July 2007 to 2.85 million in July 2008 - an increase of more than 24,000 people. Population centers are in Little Rock-North Little Rock (approximately 350,000) and Fort Smith, Pine Bluff, and Jonesboro. The towns of Fayetteville, Springdale, Rogers, and Bentonville form a complex of development (anchored by companies such as Wal-Mart and Tyson) in the northwestern corner of the State.

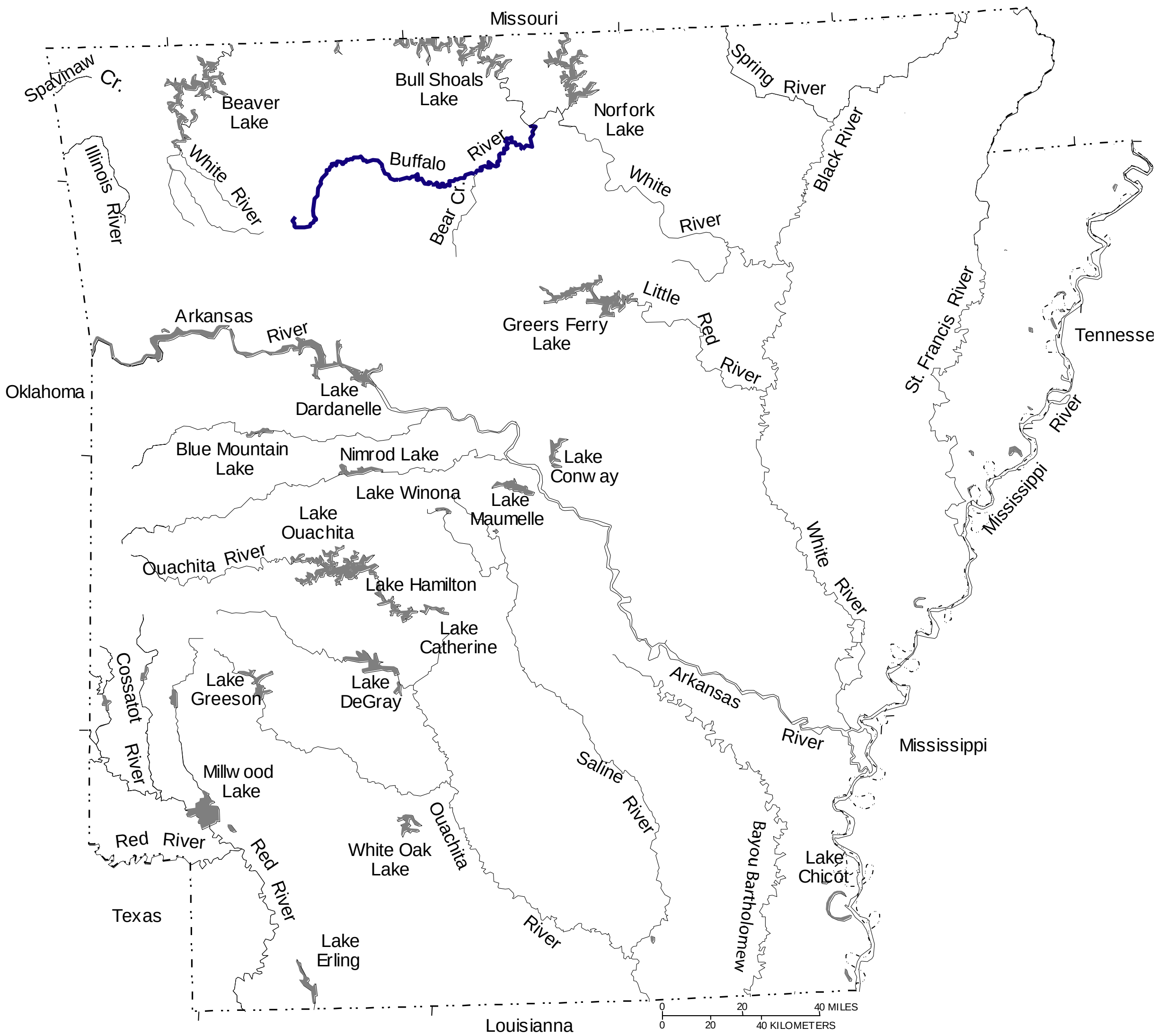
The State is about equally divided between lowlands and highlands, with the Gulf Coastal Plain on the south, the Mississippi River Alluvial Plain (Delta) on the east, and the Interior Highlands on the west and north. The highlands are divided into two areas—the Ozark Plateaus to the north and the Ouachita Mountains to the southwest with the Arkansas River flowing between the two. Elevations range from 54 feet above sea level in the south to 2,753 feet above sea level in the west. The dominating soils and/or surficial geologic features of Arkansas are the sandy loam of the Coastal Plain, alluvial sands and clays of the Delta, shale and sandstone of the Arkansas Valley and Ouachita Mountains, and limestone and dolomite of the Ozarks.



Major resources of the State include water, forests, minerals, and agricultural products. The Ozarks are noted for their many springs and caverns and the Buffalo National River was the country's first National River. More than-750,000 gallons of water flow daily (average temperatures 143 degrees Fahrenheit) from Hot Springs National Park. Arkansas is the home of the only diamond mine open to the public in North America. Arkansas leads the Nation in production of bauxite from which aluminum is made. Petroleum, natural gas, and bromine are the top three minerals produced in the State. Arkansas leads the nation in rice production. Arkansas farmers produce about 80 million hundredweight (cwt) of rice annually, which is 40 percent of the U.S. crop. The farm gate value of Arkansas-grown rice is about $700 million. An estimated 30,000 Arkansas jobs are associated with rice production and distribution. There are an estimated 3,000 rice farms in the state. The estimated economic impact of the rice industry in Arkansas is $2.5 billion. The poultry industry is big business in Arkansas. According to the National Agriculture Statistics Services of the U.S Department of Agriculture, in 2007 Arkansas ranked second nationwide in broiler production; third nationwide in turkey production; and eighth nationwide in egg production. Arkansas is the only state nationwide ranked in the top 10 of all 3 categories of broiler, turkey, and egg production.

Arkansas is ranked number three in the Nation in catfish raised. However, Arkansas catfish production during 2007, was down 10 percent from 2006 and, as of January 1, 2008, the water surface acres being used for catfish production totaled 29,900 acres, down 2 percent from a year earlier. The number of Arkansas catfish operations decreased from 137 on January 1, 2007, to 128 on January 1, 2008. These changes make significant differences in water use and water demand.

Arkansas is rich in surface water. Large rivers in the State include the Mississippi, Arkansas, White, St. Francis, Red, and Ouachita which drain to the south and southeast. Arkansas has 13 major lakes or reservoirs constructed primarily for hydropower or flood control; 10 of these exceed 10,000 acres.



Ground-water problems in eastern and southern Arkansas have progressed to the point that the State has passed legislation authorizing the responsible State agency, the Arkansas Natural Resources Commission (ANRC) to establish Critical Ground-Water Areas under certain well defined circumstances. Using USGS data and reports, ANRC has defined areas of the Mississippi River Valley alluvial (alluvial aquifer) and Sparta aquifers as critical ground-water areas. The initial phase after critical area designation is to educate the water users and, through voluntary compliance, have reduced withdrawals from the aquifers in question and more reliance on alternative sources of water. If voluntary compliance fails, ANRC has the authority to enforce regulation.

The major aquifers in the State are experiencing serious water-level declines due to over pumping. The alluvial aquifer in eastern Arkansas supplied about 96 percent of the nearly 7.5 billion gallons per day of ground water used in 2005. As a result of the large withdrawals, cones of depression have developed in the potentiometric surface causing reversals in the natural flow direction. The Sparta aquifer in southern and east-central Arkansas provides water for municipal and industrial supply near Pine Bluff, El Dorado, and Magnolia, and water for agricultural irrigation in the Grand Prairie area. Heavy withdrawal from the Sparta aquifer has resulted in large cones of depression. The aquifer has also experienced dewatering effects—converting the aquifer from artesian to water table conditions in some places.

As a result of head reductions in major aquifers and long-term farming practices some quality problems are emerging in the State's aquifers. Saline water migration is a potential problem in both the alluvial and Sparta aquifers. Evidence of pesticide contamination in the shallow ground-water system in eastern Arkansas is being increasingly recognized as more data are accrued.

There are two main karst aquifers in the Ozark Plateaus composed of mainly carbonate rocks—the Springfield Plateau and Ozark aquifers. Poultry, cattle, and swine farming are commonly practiced in the Ozarks; the potential for nutrient and bacteria contamination is very high. Results of the Ozark Plateaus NAWQA indicate considerable ground-water/surface-water interactions and springs appear to be more susceptible to surface contamination than is well water. Further, the occurrence of high concentrations of radon also is widespread in both aquifers, but the processes affecting the distribution of radon are poorly understood.

In southwestern Arkansas, minor aquifers of Tertiary and Cretaceous age, which occur at either very shallow depths or as outcropping units, yield moderate amounts of ground water. These aquifers also are susceptible to surface contamination and other human influences.

Present and future water-quality problems in Arkansas predominately are related to land use, confined animal feeding operations, and agriculture nonpoint source runoff. Water quality in the Delta region of eastern and southeastern Arkansas significantly is influenced by nonpoint source runoff from areas of intensive row-crop agriculture (rice, cotton, soybeans). Many of the surface-water systems within this region have been modified into extensive networks of channeled streams and ditches. Elevated turbidity, nutrients, and pesticides are the major water-quality issues in the Delta. Confined animal feeding operations have increased within recent years and are impacting receiving streams and shallow ground water with elevated nutrients and pathogens. Water-quality problems are related to the conversion of forestland to pasture, expansion of confined animal feeding operations, and even-aged timber management. The Ozark Plateaus contains fractured limestone geology that allows direct linkage from surface waters to ground waters. Some of the highest animal production rates in the United States occur in this area. A large percentage of streams in this region are designated by the State as extraordinary resources.

Additional water-quality problems in Arkansas are related to impacted waters leaving the State, fisheries and wildlife benefits, and wetland functions. Two of the stream systems in northwestern Arkansas enter Oklahoma. One stream, the Illinois River, is designated by Oklahoma as a scenic river and is on the 303-D list as requiring a TMDL and the other stream, Spavinaw Creek, is the city of Tulsa's water supply.

In March 2002, the State of Oklahoma set a nutrient limit of 0.037 mg/L for phosphorus in all "Scenic Rivers" in Oklahoma. Currently, representative concentrations of phosphorus in the Illinois are 0.40 mg/L–ten times the limit. The 0.037 mg/L is a value representative of undisturbed streams. There is much contention and threatened litigation between Arkansas and Oklahoma. The USGS was asked for a written opinion on the plausibility of the 0.037 mg/L limit and the suggested methodology for monitoring. This document was generated in the summer of 2002 jointly by the USGS in Arkansas and Oklahoma. In June of 2005, Oklahoma attorney general, Drew Edmonson, filed suit on behalf of the state against 14 separate poultry companies for litter applied in the region, a move that angered several farm groups and even resulted in legislation to restrict the attorney general's power. Despite such opposition, Attorney General Edmonson has remained steadfast in his pursuit of the lawsuit. Law firms representing Oklahoma in this lawsuit against poultry companies have spent about $25 million (as of January, 2009), and that amount will increase unless the case is settled. As of October 2009 EPA has embarked on an effort to model the Illinois River basin in Arkansas and Oklahoma with the intent of creating total daily maximum loads (TMDLs) for nutrients in the Illinois River watershed. Their contractor in this effort is AquaTerra Engineering.

The tail waters of five White River reservoirs in northern Arkansas and southern Missouri support a trout fishery of major economic proportion. A State natural resources agency is requiring sustained minimum flows from these dam projects and needing information to determine if proposed increases in minimum flow will provide temperature and dissolved oxygen qualities necessary to sustain the downstream fishery.

Proposed dredging and irrigation projects on the lower White River will have significant functional impacts on the U.S. Fish and Wildlife Service's (USFWS) White River National Wildlife Refuge. The White River Refuge contains one of the largest remaining bottomland hardwood forests in the Mississippi River Valley and includes over 300 oxbow lakes vitally linked to the river. Detailed information is needed related to the hydrologic and water-quality impacts of the proposed channelization and irrigation projects. USFWS is particularly concerned with insuring that “environmental flows” are maintained and that planned COE irrigation projects to provide supplemental irrigation water for rice farming do not have detrimental impacts on the necessary frequency and duration of flooding of bottomland hardwoods.

Priority Science Issues

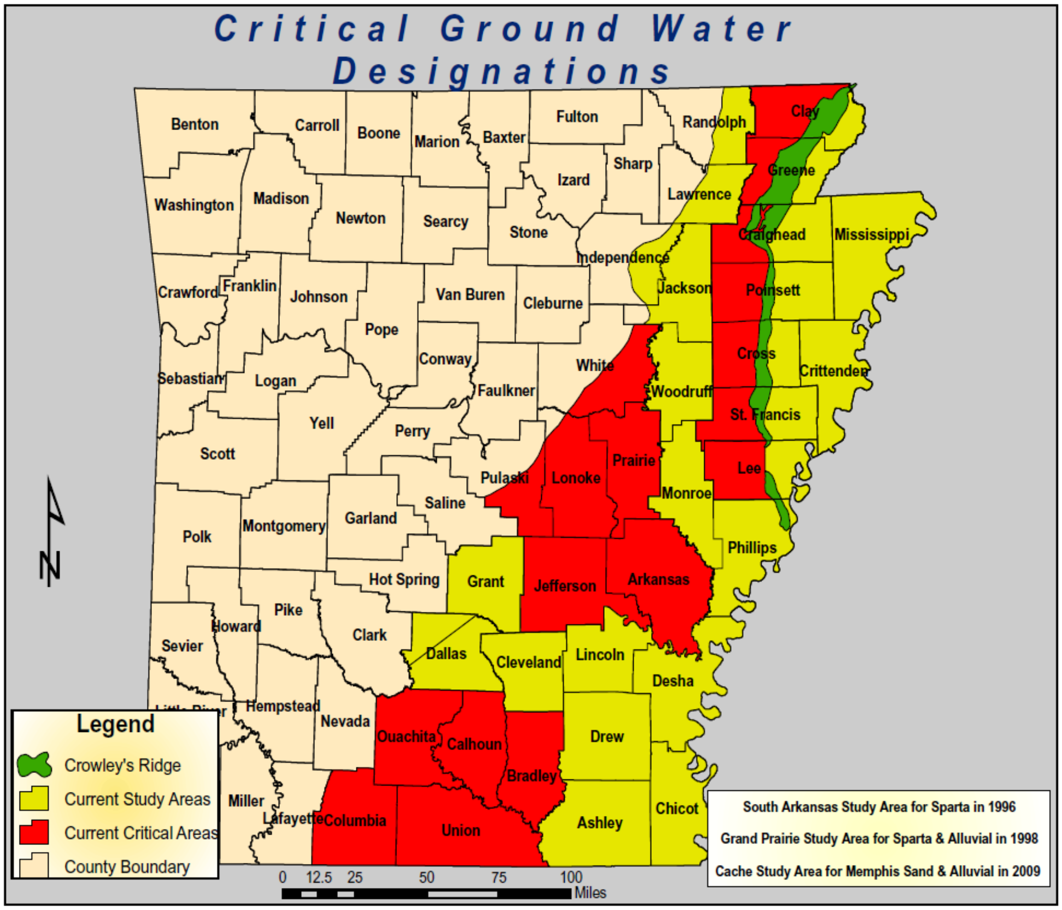
Priority science issues in the State of Arkansas, with respect to natural resources and the environment, align well with the "strategic directions" outlined in USGS Circular 1309. Multiple topical and spatial priorities identified by the USGS Central Region South Central Area (SCA) are being addressed in Arkansas – in several cases by interdisciplinary teams within the USGS working in collaboration with other Federal and State agencies across interstate project areas.

There are many water-resource issues confronting the State that are consistent with, and/or are an integral part of, topical or spatial priorities defined by the SCA. Clearly, if these State priorities are consistent with the SCA priorities then they align with the Bureau's Strategic Science Directions. Federal agencies within the State, State agencies, local government entities, and the private sector are all involved in identifying and defining these priority issues. That's extremely important because approximately 70% of the AR WSC budget is reimbursable money which comes from USGS partnerships with this same group of entities. As we strive to follow the directions outlined in Circular 1309 it is imperative that those directions align well with the priorities of our reimbursable funding partners. These issues generally fall into the four main categories we have addressed in this science plan: 1) water supply and availability, 2) human health, 3) natural resource protection/restoration, and 4) water quality and biological impacts from nonpoint sources. For each of these categories, one to four priority water resource issues are identified and discussed in this section. While all of these issues offer technical opportunities to advance the hydrologic science for the State, we have prioritized the major current water resources issues in table 1 of the summary. These are the issues that are important to the State and local water agencies, politicians, and the public which offer the highest opportunity to be funded. We believe they are also consistent with Circular 1309 directions and SCA priorities.

ISSUE - WATER SUPPLY AND AVAILABILITY

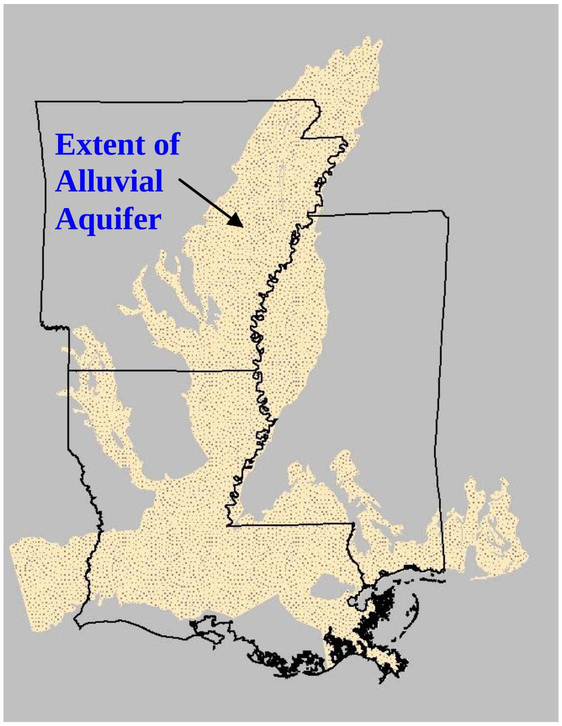
(1) Declining Ground-Water Levels in the Sparta and Alluvial Aquifers

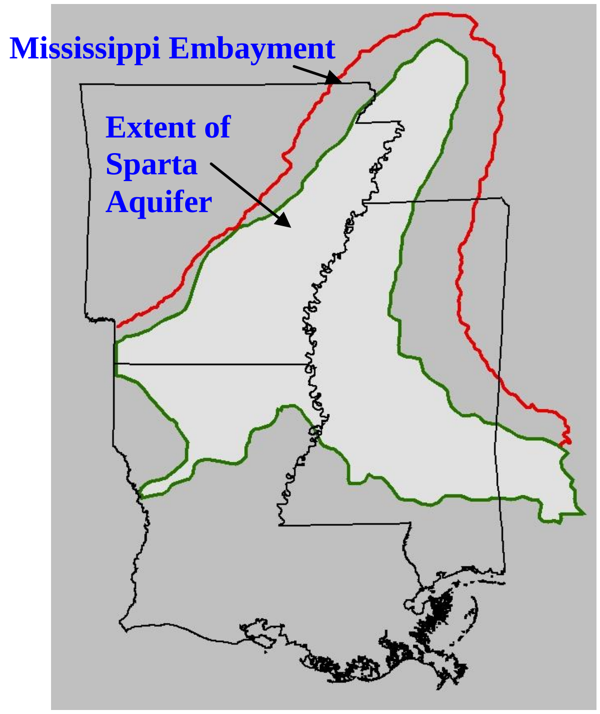
BACKGROUND - The Sparta aquifer in southeastern Arkansas and north-central Louisiana is a major water resource for municipal, industrial, and agricultural uses. In recent years, the demand for water in some areas has resulted in withdrawals from the Sparta that significantly exceed recharge to the aquifer. Considerable drawdown has occurred in the potentiometric surface, and water users and managers alike have begun to question the ability of the aquifer to supply water for the long term. ANRC established Arkansas' first Critical Ground-Water Area based on Sparta aquifer conditions in 1996; this law mandates maintaining aquifer conditions within specific, water-level based limits. Large cones of depression are centered beneath the Grand Prairie area and the cities of Pine Bluff and El Dorado, Arkansas. Water levels in the aquifer have declined at rates greater than 1 foot per year for more than a decade in much of southern Arkansas and northern Louisiana and are now below the top of the formation in parts of Union and Columbia Counties, Arkansas. Problems related to overdraft from the aquifer include increased drilling and pumping costs, loss of yield, saltwater intrusion, and decrease in water quality in areas of large drawdown.



The Mississippi River Valley alluvial aquifer (hereafter referred to as the alluvial aquifer), located in eastern Arkansas, and parts of Missouri, Kentucky, Tennessee, Mississippi, and Louisiana, supplies nearly 7 billion gallons of water per day in Arkansas (2000 data). Historically, the aquifer has been an important water resource driving agriculture, business, and community growth in eastern Arkansas by providing abundant water of good quality. However, in recent years demand has outstripped recharge, and water-use management has become a critical issue for the aquifer. In July 1998, Arkansas' second Critical Ground-Water Area was established by law through the work of ANRC. Withdrawals from the aquifer have caused considerable drawdown in the water-table surface. For example, in some areas the saturated thickness of the alluvial aquifer has been reduced to less than 20 ft from original total saturated thickness greater than 200 ft. The effects of current ground-water withdrawals and potential future withdrawals on water availability are major concerns of water managers and users as well as the general public; a full understanding of the behavior of the aquifer under various water-use scenarios is critical to development of viable water-management and alternative source plans.

On December 8, 2009 the Arkansas Natural Resources Commission adopted staff recommendations to create the State’s third Critical Groundwater Area covering parts of 7 counties just west of Crowley’s Ridge (shown in red in the illustration above). This designation is for the Mississippi River Alluvial aquifer and the Memphis Sand aquifer (an extension of the Sparta aquifer and equivalent to the Claiborne Group).





CURRENT (ONGOING) PROGRAM - The Sparta and alluvial models are regional scale, digital ground-water flow models first developed and calibrated by the USGS and ANRC in the mid-1980's and early 1990’s. Three ground-water flow and conjunctive-use optimization models (two alluvial and one Sparta), funded by the Corps of Engineers and ANRC, have been updated and published in reports in 2004. The flow models were used to evaluate the impact of projected water demands upon the alluvial aquifer through the year 2049 and the Sparta aquifer through 2027. Each of the optimization models provides estimates of “sustainable yield” based on constraints that are consistent with criteria used by the ANRC. ANRC is extremely interested in the results of all three of these modeling studies and is funding a continuing “modeling technical assistance” project that will assist ANRC personnel at public meetings, prepare and conduct presentations, publish fact sheets, and run additional scenarios. The models have helped ANRC understand how redefining certain constraints may affect sustainable yield from the aquifer and rivers, aerial distribution of withdrawals contributing to sustainable yield, and/or total maximum conjunctive withdrawals. To date (February 2009) multiple projects using these models have been completed and reports published. The North Alluvial Flow model has recently been updated with appropriate data through 2005 and validated very successfully.

Scenarios simulated with an early version of the Sparta Model helped residents in Union County, Arkansas better understand how much they would have to reduce their pumpage from the Sparta to see water levels rebound to the top of the formation. This information provided incentive for much local collaboration, the formation of the Union County Water Conservation Board, and, ultimately, a very successful conservation project that has provided supplemental Ouachita River water to major industries in the El Dorado area. Consequently, there has been about 60 feet of rebound in Sparta water levels. We know that because we now have an ongoing Coop project with the Union County Water Conservation Board – The Sparta Recovery Project. This initiative (series of projects) was a recipient of the 2008 DOI Cooperative Conservation Award presented in April of 2008 to multiple government and private entities and individuals that have been involved in the initiative.

Ground-water modeling results for the Sparta and alluvial aquifers incorporate data from and complement other, long-term USGS ground-water data collection programs in Arkansas. In alternating years, over 300 ground-water levels in the Sparta and alluvial aquifers are measured by USGS to produce potentiometric maps. Another critical component is water-use data, which is available from the statewide, site-specific water-use database managed by the USGS and funded jointly by the USGS and ANRC (see item 2 under this category).

INITIAL VISION (continuing) - Following the development of these models for the Sparta and alluvial aquifers our vision was to have them become a part of a large-scale undertaking to develop and refine calibrated ground-water flow and conjunctive-use optimization models for the Sparta aquifer in eastern and southern Arkansas and the northern and the southern extents of the alluvial aquifer in eastern Arkansas. These three separate, calibrated models would be consolidated into a single, unified model to simulate the gross Sparta/alluvial aquifer system in eastern and southern Arkansas. This model—the unified model—was envisioned to be extended into neighboring states into which these aquifers or their equivalents extend. This extended unified model would be developed with the assistance of USGS offices in Louisiana, Mississippi, and Tennessee.

CURRENT (ONGOING) PROGRAM (continued) – In January 2006 opportunity was provided to begin building the "unified model" at a breadth and depth of scale that was even beyond our initial vision. A proposal to build a ground-water flow model of the entire Mississippi Embayment was selected for funding by the USGS Office of Ground Water Resources Program to simulate these complex systems and to evaluate various scenarios related to water availability. The project is scheduled to be completed September 30, 2009.

The focus of the Mississippi Embayment Regional Aquifer Study (MERAS) is ground-water availability (water census) and the effects of climate change on the ground-water system in the Mississippi Embayment area of Arkansas, Louisiana, Mississippi, and Tennessee. The primary tool used to answer questions about ground-water availability is a ground-water flow model constructed using existing data and input information from each state in the area.

A major part of the project includes refinement of the hydrogeologic framework used in previous models in the area, incorporating water-use data from each respective state from predevelopment to present, and calibrating the model with available ground-water-level and stream-flow information. Information from surficial geology maps, structure maps, and geophysical logs of selected borings and wells in the area are compiled. From these data, a refined hydrogeologic framework and conceptual model form the basis of the new digital ground-water flow model.

The ground-water flow model utilizes MODFLOW 2005 and ArcGIS as the dominant pre- and post-processing tool. USGS scientists in each prospective state provide hydrogeologic data and modeling concepts for use in the model construction, with an emphasis placed on framework, water-use, and water-level data. The Mississippi, Arkansas, Tennessee Regional Aquifer Study (MATRAS) Sub-Regional Model (SRM) initiative consists of focused work in and around the Memphis area. This support results in data used in the MERAS work and provides detailed information to be used in a more-finely discretized flow model of the Memphis area that will be developed using the MERAS model. The MERAS flow model consists of 13 layers to simulate the various aquifers and confining beds within the embayment, with an active model area of approximately 78,000 mi^2 comprising cells of one mi^2 each.

The study culminates in multiple Scientific Investigation Reports and a Professional Paper describing the construction and results of simulations using the ground-water flow model. These simulations are designed to answer four main objectives:

- Assess the ground-water availability (status and trends) of the Mississippi embayment aquifer system
- Develop a better understanding of the freshwater bearing deposits of the Mississippi embayment aquifers
- Systematically estimate water budget components for the ground water flow system in areas dominated by irrigated agriculture or public supply withdrawals
- Evaluate the existing water-level monitoring and recommend improvements in monitoring network design and understanding of hydrologic factors crucial to the assessment of ground-water availability.

The objectives of the ground-water availability assessment are designed to contribute to a water census of the United States. The development of the tool (the ground-water flow model) to quantify available ground-water in the study area also produces opportunities to examine scenarios that examine the effects of climate change on the ground-water system. In this respect, a climate change analysis of precipitation, water use, ground-water levels, and tree rings have helped to define the climate forcings that drive the water system in the Mississippi embayment. The climate change analysis allows projections of precipitation based on the cyclical nature of the climate forcings, which are translated to the ground-water flow model. Simulations that utilize the climate analysis aid in quantifying the effect of climate change on the ground-water system.

As of March 2010 we are in the final stages of completing the MERAS Professional Paper.

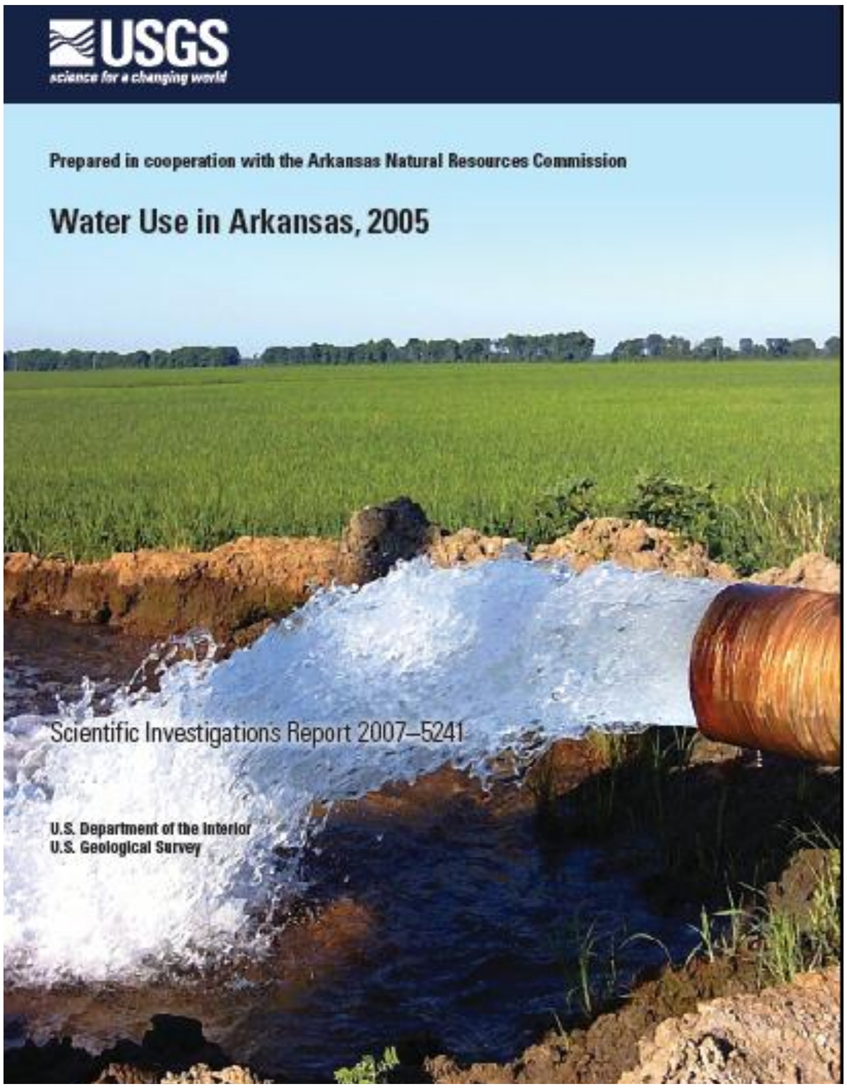
CURRENT VISION (continuing)- Our vision beyond the completion of the MERAS effort is that there will be opportunity at both the embayment scale and the more local scale to work with partners and stakeholders to investigate optimization scenarios that integrate interstate, agreed upon, strategies for water resource protection that can be defined as constraints in the model(s) to help better understand, on an interstate basis, the concept of sustainable yield and how that relates to current and possible future demands for water. The flow model could/should be used to simulate additional scenarios related to system response to various changing stresses.

As of March 2010 MERAS spin-off, local scale models or evaluation of scenarios with the regional model have been, or are being, developed in Tennessee and Mississippi and one is under discussion for Arkansas for the State FY2011 fiscal year.

(2) Water-Use Data Program

BACKGROUND - In 1985, ANRC and the USGS began a water-use program that provides for the collection, storage, and dissemination of accurate water-use information for Arkansas within a consistent national framework. The ANRC conducts an annual inventory of the ground- and surface-water withdrawals in Arkansas in cooperation with USGS. Data collected during this inventory are shared by State and Federal agencies to document the State's total water use and to facilitate planning the most effective use of Arkansas' water resources for the economic and social well being of the people of Arkansas and the Nation.

CURRENT (ONGOING) PROGRAM - The nationally recognized cooperative water-use project has evolved from data compilation and entry in the early 1980's to a state-of-the-art remote web based, data entry and storage system in 2008. Site-specific water-use data are collected and compiled annually. Water users that withdraw 1 acre-foot or more of surface water per year or wells with the capability of pumping 50,000 gallons per day or more of ground water are required by Arkansas law to report their withdrawals to the appropriate reporting agency. Data for the irrigation, livestock, aquaculture, and duck (hunting) clubs categories are reported and remotely entered through the Conservation District offices in 29 eastern Arkansas counties. Water-use data for each of the other categories are reported directly to the ANRC. Site-specific water-use data for irrigation, livestock, duck (hunting) clubs, public supply, commercial, industrial, mining, and power generation are stored in the Arkansas Water-Use Data Base (WUDBS) maintained by USGS.

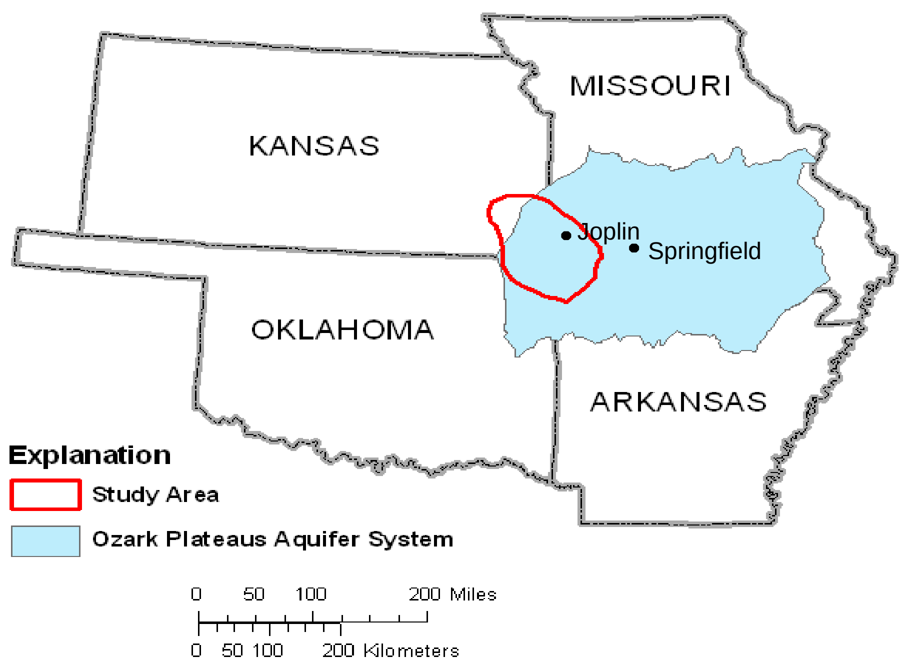


CURRENT VISION (continuing)- Continue this long-term cooperative effort with ANRC to collect, store, and make available comprehensive site-specific water-use information for the State of Arkansas and to provide the necessary stress data for digital models of water-resource systems. In addition, continue to respond to other States that would like to pattern their own systems after this successful Arkansas product.

(3) <u>Ground-Water Flow Model in Tri-State Area of Kansas, Missouri, and Oklahoma</u>

BACKGROUND - The tri-state area of Kansas, Missouri, and Oklahoma is experiencing substantial population growth and corresponding increases in municipal, industrial, and rural residential use of water. Most water supplied to city residents for drinking and household use comes from municipal ground-water wells. Water for industrial use primarily comes from wells drilled and owned by small businesses and larger corporations. Many new municipal wells have been drilled in the last decade to keep pace with the expanding population. Rural residents living near towns have been forced to deepen their domestic wells and lower pumps because of declining water levels.

CURRENT (ONGOING) PROGRAM - To assess the effect that increased water use is having on the long term availability of ground water in the tri-state area, USGS, in cooperation with the Kansas Water Office, developed and applied a ground-water flow model to a study area covering a part of the Ozark Plateaus aquifer system in northwestern Arkansas, southeastern Kansas, southwestern Missouri, and northeastern Oklahoma. All municipal and industrial wells, and some residential wells, in the study area are open to the Ozark aquifer, which is 250 feet to more than 1,000 feet beneath the land surface. A confining unit varying in thickness from 0 to about 100 feet overlies the Ozark aquifer and impedes ground-water flow between the surficial Springfield Plateau aquifer and the Ozark aquifer in most places. The Springfield Plateau aquifer yields sufficient water for residential use, and was used as a source of water to many older domestic wells. Most new wells are cased through the Springfield Plateau aquifer to protect against contamination from surface sources and to utilize the greater yield of the deeper Ozark aquifer. One concern in this area is that many older abandoned wells are open to the Springfield Plateau aquifer and the Ozark aquifer. These wells can be conduits for the transport of contaminated water from the surface (which was mined for lead and zinc in some parts of the study area) and the shallow aquifer into the deep aquifer.



This study provides increased knowledge of ground-water flow directions in the vicinity of municipal and industrial wells in the study area, and a better understanding of the areas contributing water to the wells. Water managers will be better able to assess the availability of ground-water in their area, better determine the effect of pumping on ground-water levels, and better assess the potential for possible future contamination of wells.

This study, as originally scoped and funded, is complete and reports published.

CURRENT VISION (continuing) – Follow-up with assistance to the USGS offices in this tri-state area as well as State agencies as requested to simulate additional scenarios and/or to assist in the development of a conjunctive-use optimization tool to evaluate sustainable yield strategies.

We are currently in discussion with Missouri DNR on additional funded work to further improve model calibration and/or evaluate additional scenarios.

(4) Reservoir Modeling

BACKGROUND – Water supply for a large portion of the population comes from reservoirs. The availability of sufficient quantities of good quality water from these reservoirs is imperative for human health and economic stability. Two dimensional hydrodynamic and/or water quality models of several Arkansas reservoirs have been developed by the AR WSC in partnership with State agencies and other Federal agencies. A number of reports have resulted from these efforts and work is ongoing to provide real-time updating of selected models and links between a reservoir model and a model of the associated watershed.

Recent advances in sensor technology and data telemetry allow a range of surface meteorological and vertical water-column data to be collected simultaneously, in real time, for lakes and reservoirs. With recent advancements in computer technology, three-dimensional lake and reservoir models can be run in much shorter time frames, allowing for real-time simulations of hydrodynamics and water quality. Together, these advances allow for the development of quasi-real-time decision-support systems for water-quality management of individual lakes and reservoir systems. Using real-time instrumentation, the models can “learn” from the data and continuously check their predictive capabilities. Real-time model simulations will provide necessary information for “data-driven” monitoring schemes designed to examine current physical, chemical, and biological conditions that impair the water quality of a lake or reservoir, like algal blooms. For example, real-time model simulations and resultant animations of algal patch development (functional groups like nitrogen-fixing cyanobacteria or even species like Microcystis aeruginosa), which may be responsible for taste and odor or toxin problems in drinking water, will provide up-to-date information that can be used by monitoring teams to cost-effectively target data-collection to specific locations in the lake or reservoir and collect data throughout the growth phase and subsequent crash of the algal population. Until recently, recognition of an algal bloom in a lake or reservoir did not happen until after the bloom peaked or crashed, and then too late to collect information about the conditions that propagated the bloom. Understanding the processes that lead to an algal bloom and water-quality impairment will aid in the design of in-lake or landscape engineering or management solutions to reduce or eliminate future impairments. The Arkansas WSC is currently working on three projects using these technologies, Beaver Lake, an impounded mountain valley reservoir in the Ozarks of northwestern Arkansas; Lake Houston, an impounded flood-plain reservoir near the Gulf Coast of Texas; and the South Arm of the Great Salt Lake in Utah.

CURRENT VISION (continuing) – To continue to collaborate with partners to develop these 2- and 3-dimensional real-time reservoir models, linked when appropriate with other models (watershed and/or ground-water models). These models will evolve into adaptive management tools that will be extremely useful to resource managers who must deal with issues related to sustained water availability and quality.

FUTURE PROGRAM OPPORTUNITIES -

- continue to use the smaller scale ground-water models where appropriate to help cooperators and stakeholders understand issues related to system stressors.
- as a spin-off of MERAS, work toward the development of interstate optimization models.
- keep communication lines open and integrate multiple USGS disciplines in studies when appropriate

- evolve the flow and optimization models to include water-quality transport modules
- expansion of existing water level, specific conductance, and chloride-sampling network of wells in the Sparta and alluvial aquifers
- respond to the needs of and develop program with National Guard Bases in Arkansas
- development of a comprehensive data management plan will open the door to more opportunities for quality assurance work on our site-specific water-use database
- continue to upgrade and enhance the internet based Water-Use Database System (WUDBS) to offer better quality control input information and improved GIS/map based interfaces
- involve the Geologic Division to better define the geology of the Sparta and alluvial aquifers
- continue discussions with the Pine Bluff Arsenal and develop program to assist them with water resources studies
- continue to develop potential with EPA regarding characterization of old industrial areas in Arkansas
- continue to cooperate with those in the tri-state area of Oklahoma, Kansas, and Missouri to evaluate remedial strategies and public water supply issues with ground-water and surface-water models
- continue to develop two dimensional hydrodynamic and/or water quality models of Arkansas reservoirs and advance the development of quasi-real-time decision-support systems for water-quality management of individual lakes and reservoir systems.
- Continue to work in Arkansas, and other states as requested, on development of 3-dimensional reservoir models running in real time that constitute adaptive management, self-learning management systems

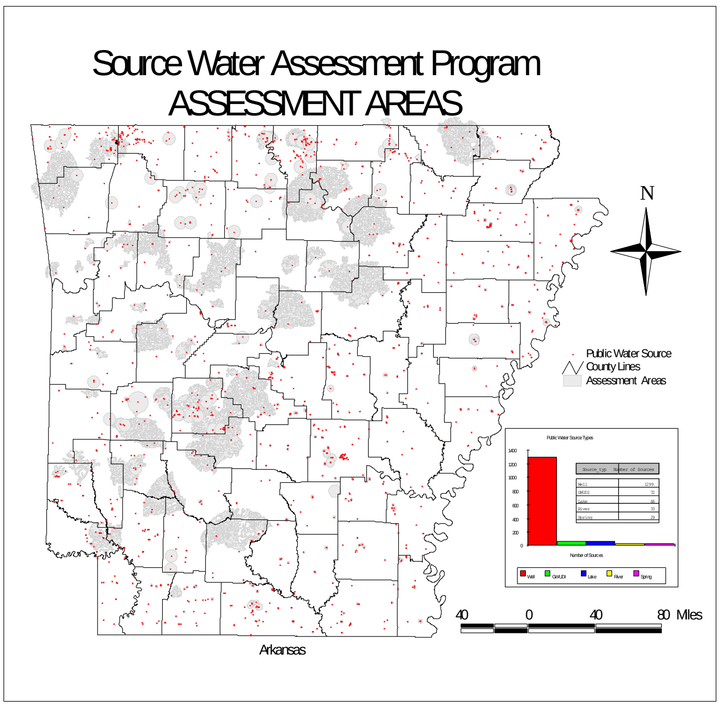
SPECIFIC STEPS AND CHALLENGES -

- maintain a high level of quality assurance in our NWIS and water-use databases
- expand a populate existing borehole geophysics database in conjunction with new and ongoing ground-water data-collection projects
- working with the University of Arkansas concerning water-quality issues in northwestern Arkansas
- finding adequate fundingfor reservoir modeling – federal and cooperator funding
- develop a method to better estimate recharge rates for the major aquifers in the State
- competing demands on important aquifers in the State, the establishment by the State of Critical Ground-Water Areas, the keen interest of the public and the State Legislature in declining water levels, and the news media's portrayal of dissenting opinions on solutions to the problems are causing many questions and requests for information to be directed our way which makes it difficult to stay on target with the timelines of ongoing projects.

ISSUE - HUMAN HEALTH

1) <u>Source Water Assessment of Public Drinking Water Supplies</u>

BACKGROUND - The 1996 Amendments to the Safe Drinking-Water Act required that each state prepare a source-water assessment for all public water supplies. States are required to determine the sources of drinking water, to identify potential sources of contamination (PSOC), and the susceptibility of the water supplies to these potential sources of contamination. The State of Arkansas has approximately 1,500 individual public drinking-water sources. Included in this total are 205 surface sources (69 impoundments, 32 rivers/streams, 31 springs, and 73 wells directly influenced by surface water) and 1,315 ground-water systems. Each of these sources was assessed in 2001-02 to determine their vulnerability to contamination. The Arkansas Source Water Assessment Program (SWAP) was a program to establish a methodology to perform vulnerability assessments in an effort to provide information/data to water systems, customers, and government agencies. The information/data will be pertinent to promoting drinking-water source-protection programs. The vulnerability assessment is a multi-step process consisting of source location, delineation of source water assessment areas, potential contaminant identification, and a susceptibility analysis. The culmination of the vulnerability assessment resulted in a designation of low, medium, or high source susceptibility.



CURRENT PROGRAMS - A 4-year Phase 1 Assessment project which spanned the period 1998 to 2002 was conducted by the USGS under the direction of the Arkansas Department of Health (ADH). Various activities were outsourced to the Department of Geology, University of Arkansas and the Center for Advanced Spatial Technology (CAST). The Department of Geology performed the assessment of public drinking-water supplies in four counties (Benton, Carroll, Madison, and Washington) in northwestern Arkansas. CAST developed and supplied data layers for GIS to assist in the assessment of the drinking-water supplies in the State, and develop methodologies for assessment using GIS. All the data, maps, and susceptibility analysis were compiled and summarized. An information summary was generated and sent to each public water system for dissemination to their customers. Two Phase II efforts, consistent with our earlier vision, are complete. One is an assessment of the concentration for four springs in northwest Arkansas that are used for public water supply and the other is a statewide refinement of regional time-of-travel equations for streams, first developed by Harvey Jobson.

VISION - Further Phase 2 assessments are a refinement of the initial assessments on a continuing basis utilizing more detailed site specific geohydrologic information gained through new investigations. Program activities will be refined and continue to evolve past the statutory deadline as USGS and ADH assist communities and water systems to develop local watershed and wellhead protection programs. The assessment process should provide information needed by local groups or agencies to develop local source water protection plans that focus their resources to the areas of greatest need. Each local plan may be customized to the particular area and the hazards, both actual and potential, contained therein.

FUTURE PROGRAM OPPORTUNITIES - Additional Phase 2 Assessments would utilize the priority ranking system developed by Phase 1 as well as requests for assistance from water systems. These assessments may include any or all of the following:

- there is still opportunity in this arena but progress continues to slow with the likely cooperator
- assessment of the entire watershed for rivers and impoundments
- delineations of recharge basins for springs and ground-water-under-the-influence wells
- contaminant pathogen sampling of highest priority (population served) ground-water-under-the-influence wells or in water supplies, generally
- enhancement of the assessment area utilizing more detailed site specific geohydrologic data
- on-site contaminant inventories to include accurate siting with GPS
- evaluation of individual PSOCs to determine the likelihood of contaminant release and its actual public health significance
- re-evaluation and updating of the data used to determine the source's intrinsic susceptibility
- incorporation of any other new information obtained
- consideration of emerging contaminants along with their respective new sampling and analytical techniques.

SPECIFIC STEPS AND CHALLENGES -

- develop and prioritize Phase 2 studies with ADH to bring needed science to public health issues within USGS mission
- keeping Phase 2 study costs within ADH budget constraints
- having sufficient coop money available to fund Phase 2 studies.

2) <u>Drinking-Water Quality Studies of Arkansas</u>

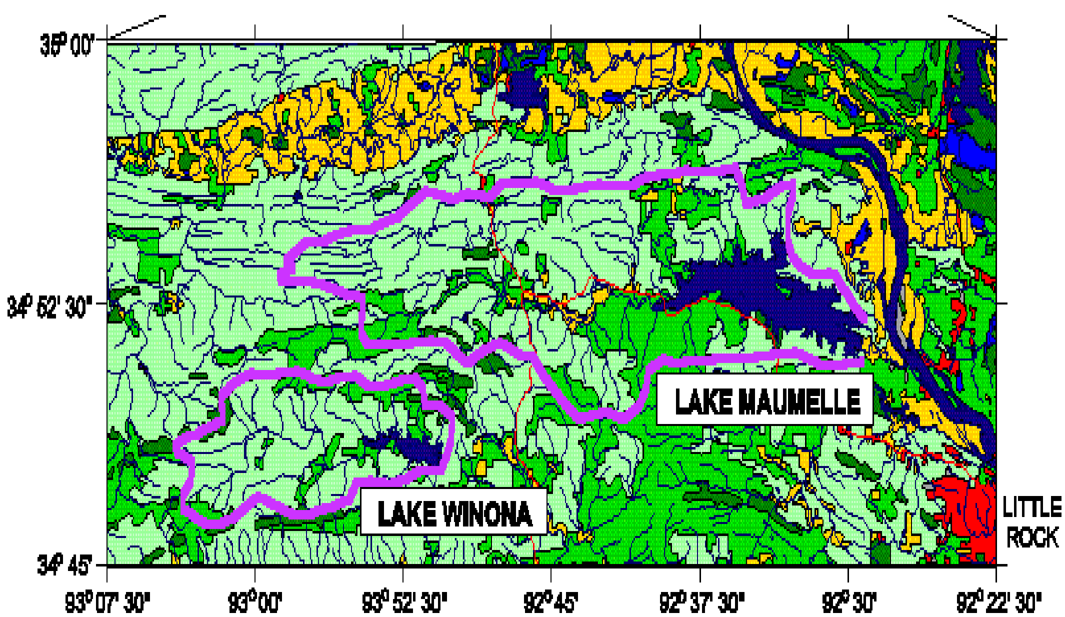
BACKGROUND - The Arkansas WSC and Central Arkansas Water (CAW) have worked cooperatively since 1989 monitoring the quantity and quality of the drinking water supply for central Arkansas (Lakes Maumelle and Winona). Lakes Maumelle and Winona supply water for the Little Rock and North Little Rock metropolitan areas in central Arkansas. In addition to water supply, the reservoirs are used for recreation and fish and wildlife habitat. As the urban and agricultural development of the basins has increased in the last 20 years, concerns about the sustainability of the quantity and quality of the water supply also have increased. Monitoring changes in the hydrology and water quality of the basin as the land use changes is critical to managing the resource.

CURRENT PROGRAM - A long-term water-quality database is important to accurately assess present water-quality conditions, trends, and sensitivity to change. Hydrologic and water-quality data have been collected on Lakes Maumelle and Winona and their inflows from 1989 to present by USGS in cooperation with CAW, the utility that owns and operates the two water-supply reservoirs. Water samples are being collected four times annually at several sites in each lake along with vertical profiles for field parameters. Water-quality samples are collected six times annually plus during three storm events at all streamflow-monitoring sites. In addition, automatic samplers are operating at three tributary sites to collect multiple samples during storm runoff events.

A 2-dimensional CE-QUALW2 model is currently being updated and re-calibrated along with an HSPF Model of the watershed. The two models will be linked and configured to run in “real time” mode.

Photo of USGS gage at Lake Maumelle.

With residential development encroaching the eastern area of the basin, along with proposed development and existing and intensified forest activities, sod farms, and residential growth in the remaining basin, more comprehensive hydrologic information and an adaptive management tool is needed to make sound management decisions.



As of March 2010 an Environmental Sensing Platform (ESP), formerly called a Lake Diagnostic Station (LDS) has been procured by our Central Arkansas Water (CAW) partner and the AR WSC will install, operate, and maintain the instrument. Data will be transmitted to a computer in our office and processed and stored in NWIS. This instrument is a forerunner and critical to the future development of real-time models of Lake Maumelle and it's watershed.

BACKGROUND - Beaver Lake, completed in 1963, is located in northwestern Arkansas and receives a majority of its water from three tributaries of the White River (White River, Middle Fork White River, and West Fork White River), Richland Creek, and War Eagle Creek. The drainage area of Beaver Lake is 3,087 km^2; with a lake surface area of 11,420 hectares, and contains $2.04x10^9$ m^3 of water at normal pool elevation. The Beaver Lake watershed was selected as the number one priority watershed in Arkansas' Unified Watershed Assessments and Restoration Priorities report. This watershed was selected as the number one priority because it contains a state extraordinary water resource, an imperiled aquatic species, supplies drinking water to a population of more than 250,000, is a state impaired water body, and is an interstate "waters of concern". Beaver Lake serves as the source-water supply for over 281,000 customers in northwestern Arkansas. Beaver Lake supplies drinking water to much of northwestern Arkansas and has been monitored by USGS since 2001. Early data collected on tributary inflows and lake water quality have been used to develop a model of reservoir hydrodynamics and water-quality.

Map of Beaver Lake watershed

CURRENT PROGRAM - A water-quality monitoring program at numerous tributary inflows and lake sites has been ongoing to construct a data record for further water-quality assessment, trend analysis, and water-quality modeling of Beaver Lake. Water-quality samples are collected at stream sites on three tributaries to Beaver Lake: White River east of Fayetteville; Richland Creek near Goshen; and War Eagle Creek near Hindsville. Samples also are collected at six lake sites along the downstream gradient in Beaver Lake: White River at Goshen; Beaver Lake near Sonora; Beaver Lake near Lowell; Beaver Lake near Rogers; Beaver Lake near Eureka Springs, White River Upstream from War Eagle Creek near Springdale and below Beaver Lake Dam near Eureka Springs. Water-quality sampling frequencies vary from approximately monthly, bi-monthly, and during selected high-flow storm events at the tributary sites. Water samples are analyzed for concentrations or levels of pathogenic bacterial indicators, turbidity, alkalinity, nutrients, major ions, total iron and manganese, and suspended sediment. Lake water-column profiles of field parameters (water temperature, dissolved-oxygen concentration, pH, and specific conductance) in addition to Secchi disc transparency, phytoplankton and algal biomass as chlorophyll a are also conducted. The USGS operates streamflow gages in cooperation with U.S. Army Corps of Engineers, ANRC, and Beaver Water District on the three tributaries and on the White River below Beaver Lake Dam. A previously calibrated two-dimensional, laterally averaged model of hydrodynamics and water quality was used for the evaluation of changes in input nutrient and sediment concentrations on the water quality of the reservoir for the period of April 2001 to April 2003. This model is currently being updated and validated as a precursor to development of a 3-dimensional model.

VISION - Decision support systems are being developed for Beaver Lake and planned for Lake Maumelle. These systems will integrate real-time monitoring programs and continuous updated databases, 3-dimensional numerical models, and visualization tools to help resource managers develop short-term strategies and long-term management objectives within the framework of sustaining reservoir function through adaptive management applications. The purpose of these separate studies is to develop a real-time decision-support systems for sustainable and adaptive management of Beaver Lake and Lake Maumelle.

The decision support systems will consist of four broad components:

1. Lake diagnostic systems to measure environmental reservoir response,
2. Models to predict the response to environmental forcing of the physical, chemical, and biological system, in real-time;
3. Optimization methodology that considers the constraints on the system in order to maximize the short- (management) and long-term (planning) sustainability; and
4. A decision support system to automate and adaptively manage the process.

Development of self-learning decision-support systems for managing reservoir functions to this point has focused on ensuring that each component is built on the best available scientific knowledge. The vision for this project is to combine these components in such a way as to take full advantage of the synergies existing between the various components, and to develop a revolutionary methodology of managing Beaver Lake.

FUTURE PROGRAM OPPORTUNITIES -

- maintain and adjust as necessary the streamgaging and water-quality sampling of Beaver Lake and Lake Maumelle and associated tributaries
- redevelop the disinfection byproduct program with CAW and perhaps Beaver Water District
- develop disinfection byproduct and water-quality monitoring programs with other major water utilities
- projects could serve as a model program for other activities involving drinking water issues in other WSCs
- continue to assist with reservoir monitoring/modeling activities in other Science Centers as needed.

SPECIFIC STEPS AND CHALLENGES -

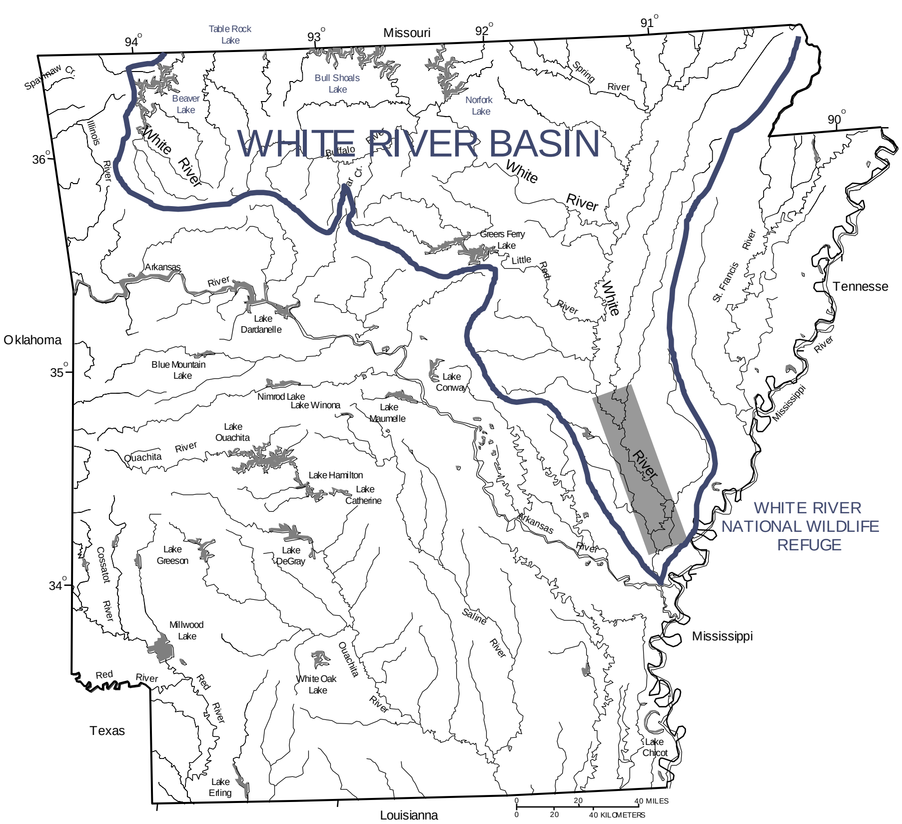
- funding challenges to maintain adequate data collection networks for lakes and associated watersheds

- develop proposals with other water utilities to identify DBP precursors in raw and finished water
- develop proposals with other water utilities to monitor water quantity and quality (Greers Ferry Lake for example)
- educate other large surface-water supply utilities and ADH about opportunities in identifying and characterizing precursors to DBP's and water-quality monitoring programs
- look for Federal funding opportunities to help initiate new and further develop existing studies.

ISSUE - NATURAL RESOURCE PROTECTION/RESTORATION

1) <u>White River Basin Streamflow, Water Quality, and Aquatic Biology</u>

BACKGROUND - The White River National Wildlife Refuge, established in 1935, contains over 156,000 acres of prime bottomland hardwood habitat located in the floodplain of the lower White River. There are over 300 lakes or isolated water bodies within the refuge. Upstream management of streamflow for flood control and hydroelectric operations has affected the ecological connectivity between the stream channel and the floodplain and therefore impaired the natural processes and functions within the refuge. Historically, the White River received base flow from the underlying alluvial aquifer. Due to substantial ground-water withdrawals for agricultural irrigation and industrial uses, the White River presently loses water to the aquifer. Multiple demands on the White River for navigation, irrigation, hydroelectric, and flood control has limited the ability of the White River and surrounding floodplain to support fish and wildlife. Natural resource managers are looking for information to comprehensively assess the environmental consequences resulting from all the existing and planned demands for water and the channel modifications required to support navigation interests. Using this information, water and natural resource managers will be able to better manage the White River for all competing demands.



CURRENT PROGRAMS - The Arkansas WSC and Ozark Plateaus NAWQA currently monitor streamflow and water quality at various locations within the White River Basin. In the upper White River Basin, hydrodynamic and thermodynamic models of four reservoirs were developed on Beaver, Table Rock, Bull Shoals, and Norfork Lakes. These studies were conducted in response to recently authorized minimum flow adjustments. Downstream, at the lower end of the basin, the Mississippi Embayment NAWQA has collected surface and ground water and biological samples in and around the White River National Wildlife Refuge. The Corps of Engineers, Memphis District, are project managers for the White River Comprehensive study covering the entire White River Basin in Missouri and Arkansas. Five million dollars of Federal money is authorized requiring a 25/75 match with State and local partners—25 percent Federal cash and 75 percent local sponsor in kind. The Arkansas WSC received water-quality modeling funding for Beaver Reservoir funded in 2003 when the comprehensive study match was 50/50, 50% Federal cash and local sponsor 25% cash, 25% in kind..

VISION - The Arkansas WSC would like to see increased monitoring efforts in both streamflow and water quality within the White River Basin and to use this information for developing a basinwide set of connected hydrologic and water-quality modeling tools. Surface-water models could be linked with ground-water models to assess the effects the demands for water and channel modifications have on the fish and wildlife in the streams, bottomland hardwoods, and associated lakes within the floodplain. Scenarios then could be tested to provide the best management strategies.

FUTURE PROGRAM OPPORTUNITIES -

- there could still be some opportunity through the White River Comprehensive Study for water-quality data collection on Table Rock, Bull Shoals, and Norfork reservoirs and development water-quality models
- develop the infrastructure to gather streamflow, water-quality, and biological data necessary to develop simulation tools for use in assessing the comprehensive environmental impact of all the demands for water and channel modifications in the White River
- USFWS and multiple USGS Disciplines (BRD and WRD) are likely candidates to be involved in the development of these tools
- In the confluence area of the White River, Arkansas River, and Mississippi River—locally often called the “Containment Area” or the “Big Island Area”—natural conditions and man-made enhancements and containment structures are “seriously out of balance.” Major “head cutting” and bank degradation are occurring causing great concerns among Federal and State agencies and local citizens. There is the distinct possibility of the Arkansas River cutting through old channel lakes and intersecting the White River. This would cause major problems with navigation in both rivers and would be a catastrophe for the Fish and Wildlife operated wildlife refuge. This needs investigation.
- renew efforts to collaborate with the Arkansas Highway and Transportation Department on interpreting work after successful completion of 2D modeling in the White River Basin.

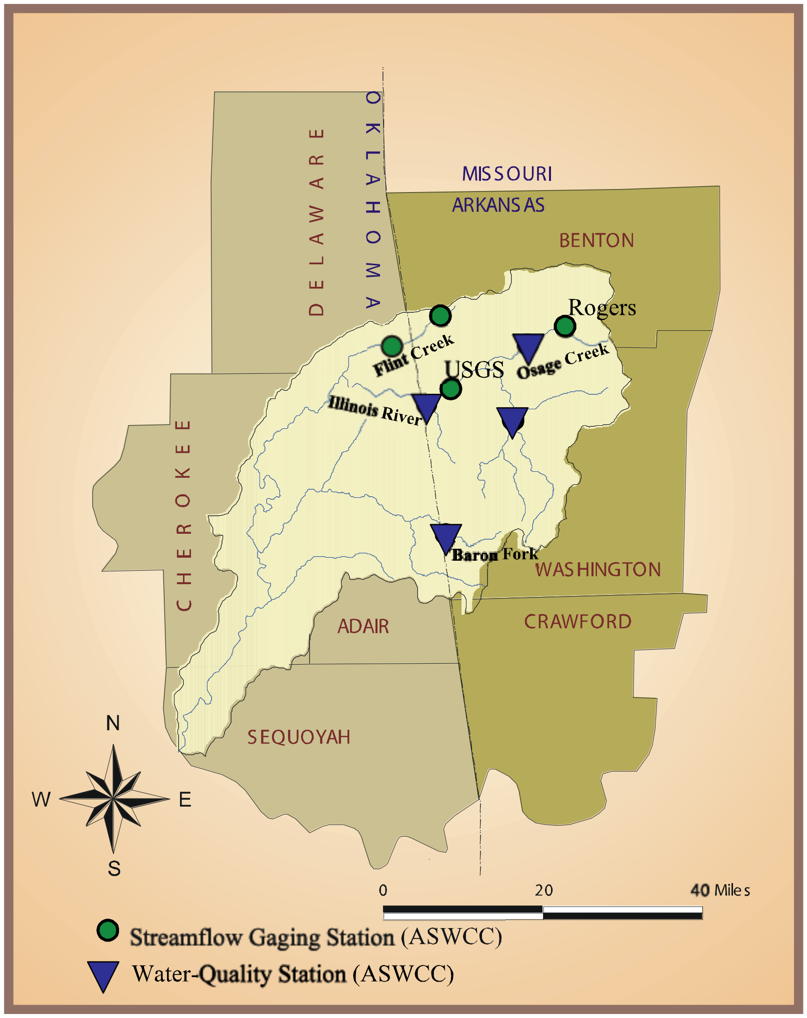
SPECIFIC STEPS AND CHALLENGES -

- look for opportunities for inter-discipline collaboration with other stakeholders
- continue to educate potential cooperators about USGS expertise and capabilities in surface-/ground-water monitoring, modeling, and biological investigations
- determine other agencies needs and begin to obtain funding to start developing a data collection network
- gather information about appropriate modeling software
- design a monitoring network to provide data for use in model calibration and verification

- increase awareness of White River issues with the Corps and USEPA who could/should be major funding partners
- dealing with certain groups of cooperators when multiple potential funding partners have interest in the same study is always more challenging than one-to-one relationships. When the group includes avid environmentalists and those who have regulatory authority, the challenge is even greater. That's the situation we find ourselves in concerning discussions of a comprehensive study of the White River System. We have suggested a phased, modular approach beginning with the reservoir models and the dissolved-oxygen and temperature monitoring that we are doing in the headwaters and the models of the alluvial aquifer for which the White River provides recharge
- continue interaction with Arkansas and Missouri agencies that are potential funding partners in the White River Comprehensive study.

2) Illinois River Basin Streamflow, Water Quality, and Nutrient Dynamics

BACKGROUND - The Illinois River Basin in northwestern Arkansas and eastern Oklahoma is a complex system that is influenced by both accelerated population growth and agricultural expansion. Land use in the Illinois River Basin has changed significantly over the past few decades and as a result, nutrient enrichment within the streamflow network and accelerated eutrophication in the receiving reservoir, Tenkiller Ferry Lake, has lead to deteriorating water-quality conditions. Comprehensive information is needed to assess the water-quality impacts from both point and nonpoint sources in order to obtain a proper understanding of nutrient dynamics (fate and transport) in the streamflow network.



CURRENT PROGRAMS - The USGS has been involved at various levels in the discussion of water-quality and nutrient loading issues in the Illinois River Basin for the past 10 years. Other entities and stakeholders participating in these discussions, in addition to the USGS, are the ANRC, the Arkansas Department of Environmental Quality (ADEQ), Oklahoma Department of Natural Resources, Oklahoma Scenic Rivers Commission, the Arkansas/Oklahoma Arkansas River Compact Commission, the University of Arkansas, Oklahoma State University, and USEPA. Fifteen streamflow gaging stations currently exist and are operated by the USGS in the Illinois River Basin in Arkansas and Oklahoma and some nutrient sampling has been done on both sides of the border. However, for various reasons, no comprehensive basinwide monitoring plan has been implemented so that ultimately needed nutrient fate and transport modeling can be done.

VISION - The USGS would like to develop and conduct an intensive water-quantity and -quality monitoring network throughout the Illinois River Basin (including the receiving reservoir - Tenkiller Ferry Lake) to provide comprehensive information to assess the water-quality impacts from both point and nonpoint sources and provide a better understanding of nutrient fate and transport in the streamflow network of the Illinois River Basin.

FUTURE PROGRAM OPPORTUNITIES -

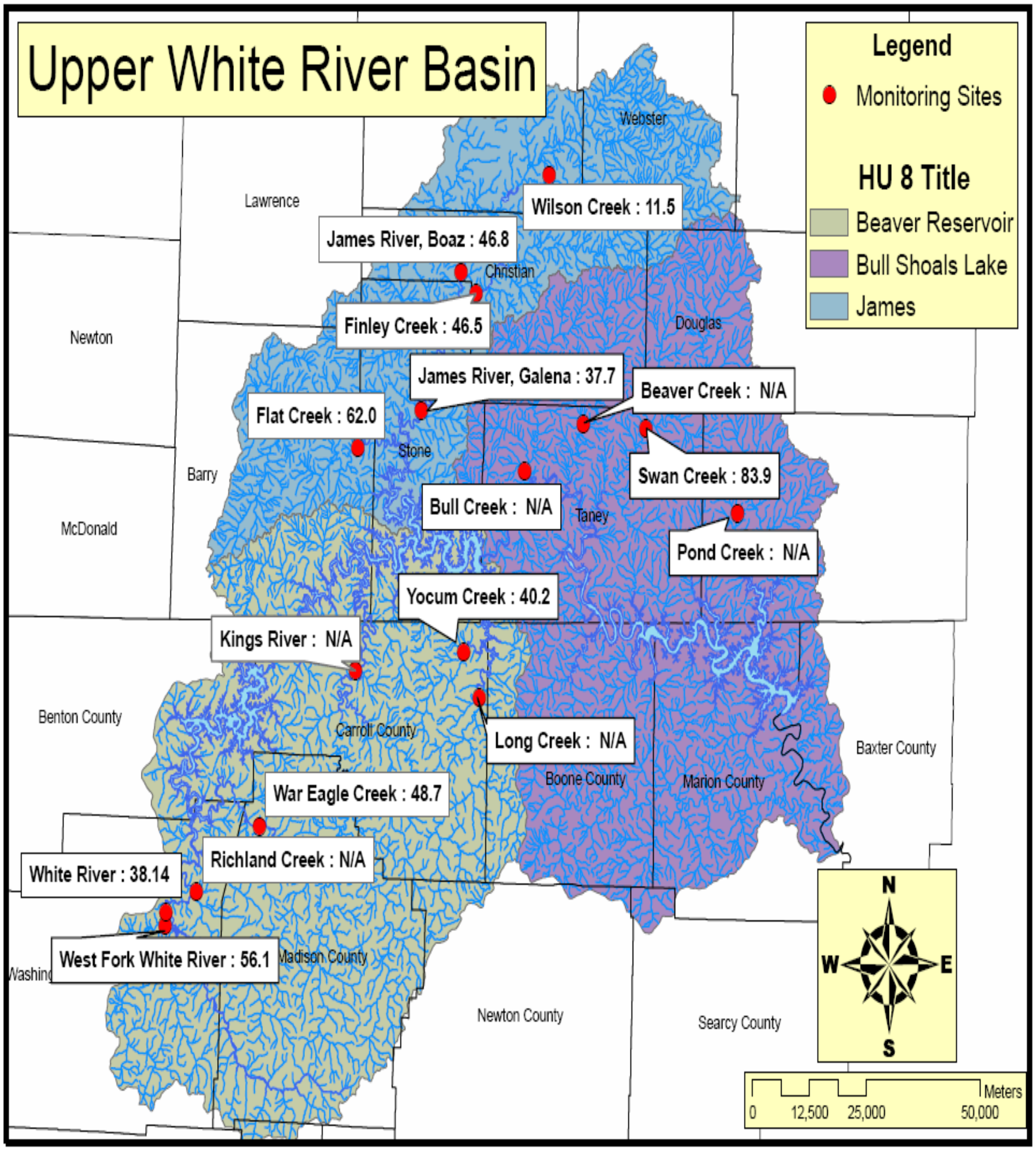
- additional flow and water-quality sampling is needed in Arkansas and Oklahoma
- local watershed interest groups have formed that may be potential funding partners (for example, The Illinois River Partnership).

SPECIFIC STEPS AND CHALLENGES -

- high cost of monitoring and modeling - appropriated funding seems only hope
- animosity between the states
- getting "agreement" between all stakeholders so that work can be conducted to better understand and ultimately manage the nutrient loading problem.

3) <u>Multi-State Monitoring in Partnership With the Upper White River Basin Foundation</u>

BACKGROUND - The Upper White River Basin Foundation (the "Foundation") is a not-for-profit watershed organization with offices in Branson, Missouri. Its mission is to promote water quality in the upper White River watershed through bi-state collaboration on research, education, public policy and action projects in Arkansas and Missouri. Established in 2001, the Foundation was



formed to address threats to the beautiful rivers, lakes and streams which have supported economic development in the region and contributed to the attractive lifestyle of the Ozarks. Through the support of its board of trustees and several water quality grants, the Foundation has undertaken a variety of projects to fulfill its mission.

CURRENT PROGRAMS – The Foundation's mission is to develop an assessment which would fulfill four general objectives:

1. To communicate information to the public in an annual report on the status of water quality in the basin watershed;
2. To understand the natural seasonal and/or annual variation in the water quality being measured;
3. To identify locations of concern to focus additional targeted monitoring programs or watershed education and management; and
4. To identify areas of high ecological quality that can inform future watershed protection efforts and serve as a reference for comparison to other sites.

To help meet these objectives, the Foundation has partnered with the USGS. The Arkansas WSC and the Missouri WSC are monitoring sites in their respective States as indicated in the map above. Most of the sixteen sites being sampled across the basin have been in operation for some time and historical data are available. The Foundation recognizes that these data represent the most consistently reliable and credible profile of the physical, chemical and biological characteristics of the water being sampled.

VISION - The data resulting from this effort will be extremely valuable, not only to the Foundation, be to all who seek to preserve the Ozark ecosystems as well as provide for availability of good quality water for the various uses required by the ever expanding human population.

FUTURE PROGRAM OPPORTUNITIES -
- development of surrogate relationships
- calibration of watershed models
- long-term monitoring
- similar work in adjoining basins.

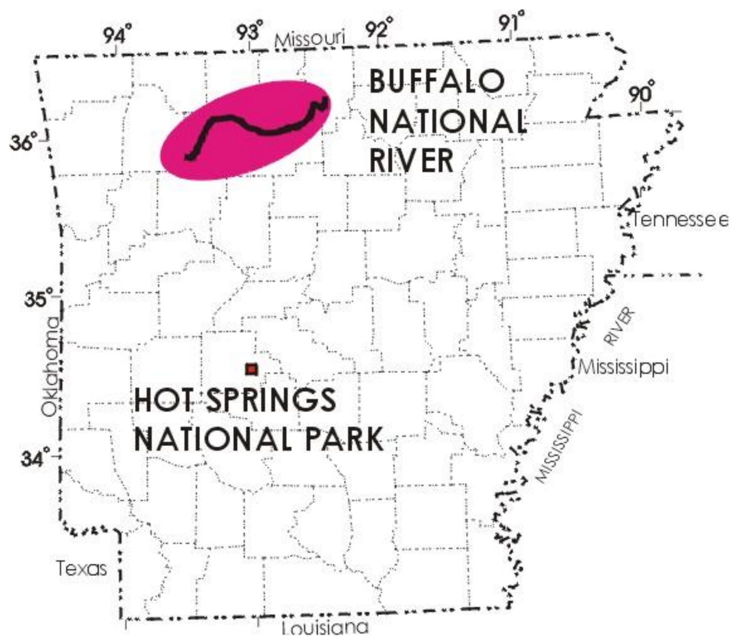
SPECIFIC STEPS AND CHALLENGES -
- competing demands and interests in the area
- seeking cooperation and collaboration of multiple "special interest" natural resource groups that are "springing up" in the Ozarks
- finding adequate funding to do the science that is needed.

4) <u>Impacts of Human Activities on Water Resources of National Parks</u>

BACKGROUND - The two largest and most visited national parks in Arkansas are the Buffalo National River and Hot Springs National Park. Water resource issues are of utmost concern to these water related parks and advancing the understanding of the hydrology is a priority.

Buffalo National River is a 150-mile long, free-flowing stream in northern Arkansas, famous for its scenic beauty, as well as, canoeing, fishing, and other recreational opportunities. The National Park Service's (NPS) jurisdictional boundary includes a continuous 132-mile river corridor from near the headwaters to the confluence with the White River. Eleven percent of the watershed is within Park Service boundaries. The remaining land cover within the watershed is a mix of public and private ownership: Ozark National Forest, 26 percent; Arkansas Game and Fish Commission, 3 percent; and private, 60 percent. Most land-use activities are related to agriculture including logging, beef, dairy, swine, and poultry operations. Consequently, the middle portion of the river has been designated by the State as impaired for water-based recreational use due to non-point source pollution. The middle portion of the basin is being cleared and converted to pasture at the highest rate of any area within the basin. Current agricultural use, increased forest clearing for pasture, and poor land management practices, occurring in an area of karst terrain are resulting in the degradation of the river. Streamflow and water-quality information is needed to relate land-use practices with water quality in order for NPS to develop water and natural resource management strategies.

Hot Springs National Park (HSNP) is the oldest property currently in the National Park System; it was established as Hot Springs Reservation on April 10, 1832, and became known as HSNP in 1921. The Park includes part of the urban-suburban area of the city of Hot Springs, Arkansas (population 33,000). About 45 hot springs issue from the mountain. Combined flow from the springs typically exceeds 750,000 gallons per day and water temperature is about 143 degrees Fahrenheit. People have used the hot spring water in therapeutic baths for more than 200 years to treat rheumatism and other ailments. The area eventually developed into a well-known resort. Today the Park protects eight historic bathhouses with the former luxurious Fordyce Bathhouse housing the park visitor center. The entire "Bathhouse Row" area is a National Historic Landmark District that contains the grandest collection of bathhouses of its kind in North America. Water from the springs continues to be used for bathing and drinking. The primary potential threats to the water resources of HSNP are related to increasing urbanization and suburbanization in the area surrounding HSNP and the degree of surface-water and ground-water interactions.



CURRENT PROGRAMS - A water-quality project on the Buffalo National River as part of the NPS-USGS Water-Quality Assessment and Monitoring Partnership Program was completed on Bear Creek and a report written. A 2-year streamflow gain and loss synoptic study funded by the Park Service (NPS-WRD) evaluated the ground-water and surface-water interactions and assessing base-flow water quality and quantity within the Buffalo River from the upstream park boundary to the confluence with the White River. The USGS Ozark Plateaus NAWQA study unit discontinued collecting water-quality data at a site on the Buffalo in FY05. The Federal-State cooperative program is participating in the operation of two stream-gaging stations and one water-quality site on the Buffalo River.

In HSNP, the delineation of the recharge area for the cold-water component of flow in the thermal springs of the park was determined in a 2-year study funded by the USGS/NPS Water-Quality Assessment and Monitoring Partnership Program. Flow from the thermal water springs follows a long, deeply plunging flow path, attaining its high temperature; flow from the cold-water component of the springs follows a shorter, shallow flow path representing local recharge and is susceptible to contamination from urban land-use activities. This project defined the approximate boundaries of the cold-water recharge area and the approximate times of travel from different points within the recharge area.

In HSNP, a previous study sampled several springs and monitored temperature in nine springs to determine the local, cold-water recharge contribution to the hot springs. Funding shortfalls have required the discontinuation of this temperature monitoring network. Funding from the NPS Heartland Network Inventory and Monitoring Program in FY03-04 enabled fish inventory surveys to be accomplished at Buffalo National River, Hot Springs National Park, Pea Ridge National Military Park, Wilson's Creek National Battlefield (Missouri), and George Washington Carver National Monument (Missouri). The study documents the fish species using backpack, tote-barge, or boat electrofishing equipment, and kick seining of riffles at each of the five NPS units. A separate report for each park is being prepared describing the study area, sampling program and methods, and includes a summary of the fish assemblage data.

Currently the Arkansas WSC operates an early flood warning information system for the City of Hot Springs. The HSNP is a collaborator in that one of the gaging stations is on Park Service property.

VISION - The Arkansas WSC would like to see more investigations in the Buffalo National River and HSNP. There are many opportunities to use and relate science in water and natural resource management. The foundation for cooperative programs has already been established in the USGS/NPS partnership program and DOI match. Better understanding of the relations between land use and water quality will provide for more sound management of the water and natural resources.

FUTURE PROGRAM OPPORTUNITIES -

- develop additional water-quality programs within the Buffalo National River and HSNP
- additional studies will be proposed for future USGS/NPS partnership programs
- other studies could be funded with a consortium of DOI match and 319 funding from ANRC and ADEQ
- current collaboration with the parks should lead to continuation and expansion of existing USGS activities at Buffalo National River and HSNP.

SPECIFIC STEPS AND CHALLENGES -

- four proposals were submitted to the USGS/NPS partnership program in FY09
- one intensive study and one fixed-station proposal may get funded
- Buffalo National River has a hydrologist who actively seeks assistance from the USGS and funding from regional Park Service office, HSNP does not
- work with the new HSNP park superintendent for the need for hydrologic information to better assess the spring resource which was the original sole purpose for the park
- work with HSNP superintendent to champion the seeking of funds through the parks regional office for additional studies
- develop new proposals to meet both parks natural resource needs

ISSUE - WATER QUALITY AND BIOLOGICAL IMPACTS FROM NONPOINT SOURCES

BACKGROUND - Present and future water-quality problems in Arkansas are predominately related to land use and nonpoint-source runoff; many biological problems have similar causes. Potential effects related to land use and nonpoint-source concentrations runoff include elevated sediment, nutrients, and pesticides; lowered dissolved oxygen minimums; streambed sedimentation; loss of riparian corridors; streambank erosion; and changes in algal, macroinvertebrate, mussel, and fish communities.

Water quality in the Delta region of eastern and southeastern Arkansas is significantly influenced by nonpoint-source runoff from areas of intensive row-crop agriculture (rice, cotton, soybeans). Many of the surface-water systems within this region have been modified into extensive networks of channeled streams and ditches. Elevated turbidity, nutrients, and pesticides are the major water-quality issues in the Delta. Preliminary results from the Mississippi Embayment NAWQA indicate Delta streams contain high concentrations of DDT and toxaphene in fish tissue. Pesticide related fish kills are common.

Water-quality problems and many biological problems in the Ouachita Mountains, Arkansas Valley, and Ozark Plateaus primarily are related to conversion of forestland to pasture, expansion of CAFOs, road construction and even-aged timber management. Many of the streams in these areas are State-designated extraordinary resource waters. Nutrients, pathogens, and turbidity effects on surface water and shallow ground water are the major water-quality issues within these areas. Particularly in the Ouachita Mountains and Ozark Plateaus, a large number of endemic (found nowhere else in the world) species of fish, crayfish, and mussels exist. Concerns for these endemic and other sensitive species have grown as land-use changes have accelerated.

Additional water-quality problems in Arkansas are related to impacted waters leaving the State, fisheries and wildlife benefits, and wetland functions. Two of the stream systems in northwestern Arkansas enter Oklahoma. One stream, the Illinois River, is designated by Oklahoma as a scenic river and is on the 303-D list as requiring a TMDL. Spavinaw Creek, another stream originating in Arkansas, flows into Oklahoma where it is one source of water for the city of Tulsa. Detailed information is needed related to identifying sources and fate of contaminants entering these streams on both sides of the State line. The downstream tail waters of five White River reservoirs in northern

Arkansas/southern Missouri support a trout fishery of major economic proportion. A State natural resources agency has been given authorization to require sustained minimum flows from these dam projects to support fishery habitat. Information is needed to determine if proposed increases in minimum flow will provide temperature and dissolved-oxygen qualities necessary to sustain the downstream fishery.

CURRENT PROGRAM - The Arkansas WSC is involved in a number of Federal and Coop projects related to water-quality issues from point, nonpoint, CAFO's, and other sources. The USGS monitors water quality at about 70 surface-water sites in Arkansas. These and other data are used to:

- describe ambient conditions
- analyze for trends
- estimate sediment and nutrient load and yield, for
  - base flow
  - surface runoff
  - total discharge
- model calibration
- relate water-quality and habitat conditions to biologic communities

As interpretive reports are produced from the Mississippi Embayment NAWQA, more will be known about the water quality and aquatic resources of the Delta. Both the Ozark Plateaus and the Mississippi Embayment NAWQA were restarted in 2005.

VISION - The Arkansas WSC would like to develop more interpretive studies associated with its water quality and biological monitoring programs. Much of the collected data (streamflow and water quality) is used to estimate constituent mass flux or load and could be used in the Total Maximum Daily Load (TMDL) process. Load estimation and TMDL determinations require large amounts of data. The Arkansas WSC would like to conduct studies to develop guidelines and technologies for the use of automatic samplers to monitor and calculate loads. If automatic samplers are used, what information is needed to ensure the accuracy of the automatic sampler results, determine the frequency of sample collection, and the number of high- flow storm-event samples. Hydrograph separation techniques also could be used to independently estimate base-flow and surface-runoff loads.

Nonpoint source runoff investigations in the intensive row-crop agricultural Delta area need to be developed. Elevated turbidity, nutrients and pesticides in water, and pesticides in fish are common issues that need further data collection efforts to quantify cause and effects.

Better quantification and source identification of indicator bacteria and pathogens in surface water and ground water (particularly in areas where human and confined animal populations are growing) would be helpful to water-quality managers and regulators in Arkansas. Use of bacterial source-tracking methods, virus and coli phage sampling methods, and analysis for wastewater compounds and antibiotics widely used by humans (such as caffeine and some pharmaceuticals) could be employed to begin to quantify the relative contribution of humans and other animals to elevated fecal coliform concentrations.

The Arkansas WSC also would like to develop more interpretive studies to investigate relations between hydrologic characteristics (water quality, streamflow, etc.) and biological endpoints such as community structure, presence/absence of key species, tissue concentrations of pesticides and trace elements, and gonadal condition/endocrinology of fish in response to "gender bender" compounds.

FUTURE PROGRAM OPPORTUNITIES -

- the University of Arkansas Water Resources Center (AWRC) operates a number of automatic samplers at various size streams to collect nutrients, pathogens, and suspended solids. USGS

periodically collects depth integrated cross sectional composite samples at these sites and shares the sample with AWRC to develop autosampler cross-section coefficients
- develop a joint proposal with AWRC to compare results from empirical derived load estimates to that of integrated load estimates
- ANRC is very interested in nonpoint source water-quality studies for use in monitoring 319 programs
- develop more projects/data collection with ADEQ since USGS approval of ADEQ water-quality laboratory
- develop a partnership with a number of agencies (ANRC, ADEQ, AG&FC, USFS, USFWS, USEPA, National Resources Conservation Service (NRCS), USGS-BRD) to address water-quality and biology concerns for the Delta, Ouachita, and Ozarks area.

SPECIFIC STEPS AND CHALLENGES -
- continue to educate ADEQ about USGS TMDL experiences and opportunities to develop TMDL program
- develop load estimation and comparison study with ANRC and AWRC to identify optimum monitoring strategies for load determinations
- develop program to provide protocol and guidance for use of automatic samplers with ANRC and AWRC
- develop more biological programs, especially in the White River Basin, with USGS-BRD and agencies such as the AG&FC and the USFWS
- continue to apply expertise and knowledge for the sampling and analysis of emerging contaminants such as bacteria source tracking, virus and coli phage, pathogens, wastewater compounds, antibiotics, and pharmaceuticals – as we have already begun in the Ozarks.

Equipment and Technology Needs

It is always a challenge to have optimal equipment and technologies available so that Arkansas WSC staff can to do their jobs in the most efficient manner possible. The following are our needs at the current time.

Equipment
- more transducers for ground-water level monitoring and aquifer tests
- surface geophysics equipment possibly in consortium with Missouri, Louisiana, and Texas
- the WSC is working towards eliminating paper notes and hand calculations of discharge measurements and could use more ADCPs for boat measurements, acoustic flow trackers for wading measurements, and Sutron DMXs for wading and bridge measurements
- need water-quality profilers for reservoir monitoring and modeling work.

Technologies
- train additional personnel to use of Lake Diagnostic Systems (LDS)
- continue development geophysical log data base
- watershed modeling using Gen Scn (GENeration and analysis of model simulation SCeNarios) for use in fate and transport diagnostics (loading) and forecasting, TMDL determinations
- continue incorporating state-of-the-art modeling tools for water-resource systems

Improvements in Business Practices

- Continue to work with Area staff to broaden our cooperator base through interactions at the Regional and National level
- Strive to integrate Strategic Science Directions in our Science Center programs and still remain responsive to our funding partners priorities
- As of March 2009 we are on the threshold of learning a new financial management system that will require the continued use of Basis + for project budgeting. Hopefully, this will not prove to be a stumbling block in our business model. Continue to develop and maintain close relationship with all USGS Disciplines and cooperators. If multiple Disciplines deal with the same cooperator, be consistent in our approach.
- Continue to be sensitive to each cooperator's priorities and propose projects that meet those needs.
- Plan ahead to ensure that the technologies and skills necessary address the Bureau’s Science Directions and to meet cooperator's needs are available.
- Look for opportunities to coordinate with other USGS Disciplines in project development.
- Be careful not to overload key employees who are always ready to help with proposals and program development. Their contributions are essential to the fiscal and financial health of the WSC. If needed, additional staff should be provided to ensure that the time spent in program development does not negatively impact progress on ongoing projects.
- Project people need more time for details: proposal review, procedure, methods, approach review and evaluation, maintaining files and archiving, database management, interacting more with cooperators and other USGS people involved in similar work.
- Adopt a system of mentoring, having a young hydrologist or two around who can be provided experience and can provide some additional work capacity when unanticipated short-term tasks arise, and to step into positions requiring more experience as personnel turnover occurs. This will allow us to continue our work and provide timely service to our cooperators without interruption.
- Continue to maintain a high level of QA in our databases, GWSI, ADAPS, Water Use, and QWDATA. This takes time and will have to be paid for either by including adequate funding in projects.
- Develop a traveling road show to introduce USGS information and capabilities across the State, providing for education and program development.
- Continue to develop, redesign, and update the Arkansas WSC web page to market our programmatic and technical expertise.

Summary

The Arkansas WSC Science Plan contains many elements to help focus program development strategies and improve the science of the WSC. Tables 1 and 2 summarize the major current priority water-resource issues and specific action items to address each issue.

Table 1. Major current priority water-resource science issues for Arkansas

Priority Issue 1: Declining ground-water levels in the Sparta and alluvial aquifers
The Sparta aquifer in southeastern Arkansas and north-central Louisiana and the alluvial aquifer of eastern Arkansas is a major water resource for municipal, industrial, and agricultural uses. In recent years, the demand for water in some areas has resulted in withdrawals from the Sparta and alluvial aquifers that significantly exceeds recharge to the aquifer. Considerable drawdown has occurred in the potentiometric surface, and water users and managers alike have begun to question the ability of the aquifers to supply water for the long term. A portion of the Sparta aquifer was established as Arkansas' first Critical Ground-Water Area in 1996 and a portion of the alluvial aquifer was designated in 1998.

Priority Issue 2: Illinois River Basin Streamflow, Water Quality, and Nutrient Dynamics
The Illinois River Basin in northwestern Arkansas and eastern Oklahoma is a complex system that is influenced by both accelerated population growth and agricultural expansion. Land use in the Illinois River Basin has changed significantly over the past few decades and as a result, nutrient enrichment within the streamflow network and accelerated eutrophication in the receiving reservoir, Tenkiller Ferry Lake, has lead to deteriorating water-quality conditions. Comprehensive information is needed to assess the water-quality impacts from both point and nonpoint sources in order to obtain a proper understanding of nutrient dynamics (fate and transport) in the streamflow network.

Priority Issue 3: Water Quality and Biological Impacts from Nonpoint Sources
Present and future water-quality problems in Arkansas are predominately related to land use and nonpoint-source runoff; many biological problems have similar causes. Potential effects related to land use and nonpoint-source concentrations runoff include elevated sediment, nutrients, and pesticides; lowered dissolved oxygen minima; streambed sedimentation; loss of riparian corridors; stream bank erosion; and changes in algal, macroinvertebrate, mussel, and fish communities.

Priority Issue 4: White River Basin Streamflow, Water Quality, and Aquatic Biology
The White River National Wildlife Refuge contains over 156,000 acres of prime bottomland hardwood habitat located in the floodplain of the lower White River. Multiple demands of the White River for navigation, irrigation, hydroelectric, and flood control, has limited the White River and surrounding floodplain in supporting fish and wildlife. Natural resource managers are looking for information to comprehensively assess the environmental consequences resulting from all the existing and planned demands for water and the channel modifications required to support navigation interests. Increased monitoring efforts are needed in both streamflow and water quality within the White River Basin in order to use this information for developing a basinwide hydrologic and water-quality modeling tool.

Priority Issue 5: Source-Water Assessments of Public Drinking Water Supplies
The 1996 Amendments to the Safe Drinking-Water act require that each state prepare a source-water assessment for all public water supplies. States are required to determine the sources of drinking water, to identify potential sources of contamination, and the susceptibility of the water supplies to these potential sources of contamination. The State of Arkansas has approximately 1,519 individual public drinking-water sources. Phase 2 assessment studies will be a refinement of the initial assessment on a continuing basis utilizing more detailed site-specific hydrologic information.

Priority Issue 6: Impacts of Human Activities on Water Resources of the National Parks
The two largest and most visited national parks in Arkansas are the Buffalo National River and Hot Springs National Park. Water resource issues are of utmost concern to these water related parks and advancing the understanding of the hydrology is a priority. In the Buffalo National River, current agricultural use, increased forest clearing for pasture, and poor land management practices occurring in a area of karst terrain are resulting in the degradation of the river. The primary potential threats to the water resources of Hot Springs National Park are related to increasing urbanization and suburbanization in the area surrounding the hot springs.

Priority Issue 7: Drinking-Water Quality Studies of Arkansas
The Arkansas WSC and Central Arkansas Water (CAW) have worked cooperatively since 1989 monitoring the quantity and quality of the drinking-water supply for central Arkansas (Lakes Maumelle and Winona). In 1994, samples were collected and analyzed to identify characteristics and sources of precursors to disinfection byproducts (DBP) in the finished water. A side-looking acoustic doppler sonar-gaging instrument was installed and a Web accessible streamflow and water-quality database retrieval system was developed in 2002. Five streamflow and reservoir elevation discharge stations are continuing to be operated. The Arkansas WSC would like to see this water-quality monitoring used further to assist CAW and other water utilities to better manage their water supply. Monitoring and modeling of Beaver Lake is ongoing. The Fort Smith metropolitan area and much of western Arkansas receive their water from surface-water reservoirs. Better understanding of the characteristics and sources of water-quantity and quality by these major utilities will provide safer drinking water to a major proportion of the population in Arkansas.

Priority Issue 8:-The Ozark Highlands – A Nationally Treasured Region

A unified approach through multiple projects to address Ozark issues will help insure the continued viability of this nationally treasured region. The interaction of unique and high-quality biological and hydrologic resources and the effects of stresses from human activities can be evaluated best by using a multidisciplinary approach that USGS can provide. Information varying from defining baseline resource conditions to developing simulation models will help resource managers and users understand the human impact on resource sustainability. Varied expertise and experience in biological and water-resources activities across the entire Highlands makes the USGS a valued collaborator in studies of Ozark ecosystems, streams, reservoirs, and ground water. A large part of future success will depend on the involvement and active participation of key partners.

Table 2. Specific action items the Arkansas WSC will pursue to address each priority science issue

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Priority Issue 1. Our vision beyond the completion of the MERAS effort is that there will be opportunity at both the embayment scale and the more local scale to work with partners and stakeholders to investigate optimization scenarios that integrate interstate, agreed upon, strategies for water resource protection that can be defined as constraints in the model(s) to help better understand, on an interstate basis, the concept of sustainable yield and how that relates to current and possible future demands for water. The flow model could/should be used to simulate additional scenarios related to system response to various changing stresses.

ACTION 1—Coordinate with USGS offices in Arkansas, Louisiana, Mississippi, and Tennessee to develop the model proposal that satisfies multiple objectives

ACTION 2—Develop the participation of cooperators and potential Congressional appropriations for funding for regional ground-water modeling studies for the Sparta and alluvial aquifer to ultimately determine the sustainable yield for important aquifers in the Delta

ACTION 3—Plan and coordinate with USGS offices to collect and compile various model input parameters and maintain a high level of quality assurance in our NWIS and water-use databases

Priority Issue 2. Develop strategies that will provide a better understanding of nutrient fate and transport in the streamflow network of the Illinois River Basin.

ACTION 1— Get agreement between all stakeholders so that work can be conducted to better understand and ultimately manage the nutrient loading problem

ACTION 2— Morph the strategy into a proposal

ACTION 3—Seek funding for such study

Priority Issue 3. The Arkansas WSC would like to develop more interpretive studies associated with its water quality and biological monitoring programs. Much of the collected data are used to estimate constituent mass flux or load and could be used in the TMDL process. Guidelines and technologies are needed for the use of automatic samplers to monitor and calculate loads. Nonpoint-source runoff investigations in the intensive row-crop agricultural Delta area need to be developed. Better quantification and source identification of indicator bacteria and pathogens in surface water and ground water would be helpful to water-quality managers and regulators. More interpretive studies are needed to investigate relations between hydrologic characteristics and biological endpoints.

ACTION 1—Develop load estimation and comparison study with ANRC and AWRC to identify optimum monitoring strategies for load determinations and provide protocol and guidance for use of automatic samplers

ACTION 2—Collaborate with BRD to develop partnerships with a number of agencies to address water-quality and biology concerns for the Delta, Ouachita, and Ozarks

ACTION 3—Continue to apply the expertise and knowledge for the sampling and analysis of emerging contaminants as we have been doing in the Ozarks

Priority Issue 4. The Arkansas WSC would like to increase monitoring efforts in both streamflow and water quality within the White River Basin in order to use this information for developing a basinwide hydrologic and water-quality modeling tool. We will continue to work with the Upper White River Basin Foundation and other entities to address priority science issues in this important Ozark river basin.

ACTION 1—Continue to educate potential cooperators about USGS expertise and capabilities in surface-/ground-water monitoring and modeling

ACTION 2—Determine other agencies and private entities needs and begin to obtain funding to further develop and expand data collection networks

ACTION 3—Increase awareness of White River issues with the Corps and USEPA who could/should be major funding partners

Priority Issue 5. Phase 2 source-water assessments could refine further the initial assessment by conducting new site-specific geohydrologic investigations to assist ADH and water systems to develop local watershed and wellhead protection programs.

ACTION 1—Identify the "good science" that grew from the early study to foster meaningful Phase 2 studies

ACTION 2—Prioritize Phase 2 studies with ADH to bring needed science to public health issues within USGS mission

ACTION 3—Keep Phase 2 study costs within budget constraints and redirect sufficient coop money to fund Phase 2 studies if available

Priority Issue 6. The Arkansas WSC would like to see more investigations in the Buffalo National River and Hot Springs National Park. Better understanding of the relations between land use and water quality will provide for more sound management of the water and natural resources.

ACTION 1—Submit at least two proposals for each park to the USGS/NPS partnership program each year

ACTION 2—Work with the HSNP park superintendent to obtain hydrologic information to better assess the spring resource and seek funds through the parks regional office for additional studies

ACTION 3—Develop new proposals in the future to meet both parks natural resource needs

Priority Issue 7. The Arkansas WSC would like to see disinfection byproduct technologies and additional water-quality monitoring studies conducted to further assist CAW, Beaver Water District, and other water utilities to better manage their water supply. A better understanding of the characteristics and sources for disinfection byproducts and water quantity and quality by these major utilities will provide safer drinking water to a major proportion of the population in Arkansas. Monitoring and modeling studies should continue, directed toward adaptive management systems to help insure the long term protection of the resource.

ACTION 1—Develop new proposals with CAW, Beaver Water District, and other water utilities to identify DBP precursors in raw and finished water and additional water-quality monitoring

ACTION 2—Continue and expand monitoring and modeling efforts

ACTION 3—Educate other large surface-water supply utilities and ADH about opportunities in identifying and characterizing precursors to DBP's and water-quality monitoring

Priority Issue 8. Continue to collaborate and partner with fellow USGS Disciplines, state agencies, local government, and the private sector that share the general goal of maintaining or increasing the quality of natural resources in the Ozark Highlands while maintaining a viable economy. Each of these agencies and organizations has unique perspectives and capabilities. The USGS is well suited for providing the scientific leadership necessary to address this goal because of its physical presence in each State, broad multidisciplinary expertise, and non-regulatory/non-management mandate. USGS and partners will identify common regional goals and objectives, threats and emerging issues, and informational gaps; coordinate the collection of baseline data to provide a starting point for all assessment efforts as well as regular and continual monitoring and assessment activities; develop simulation tools to help stakeholders with resource adaptive management and sustainability; and disseminate information to resource managers, researchers, legislative bodies, and the lay public.

ACTION 1— Seek agreement on how research and monitoring should be done on Ozark Highlands natural resources in a way that meets current and future sustainable management objectives

ACTION 2— Seek to understand how global climate change will affect the ability to sustainably manage resources in the Ozarks

ACTION 3—Seek to understand how USGS science can help stimulate optimum natural resource management action for a particular site or area, given local conditions, short- and long-term goals, and social issues

Arkansas Water Science Center Workforce Plan

WORKFORCE PLAN

We strive for a balanced, well integrated, diverse workforce well able to meet the challenges of today and those anticipated for the future. We plan tactically for 1-3 years in the future and strategically try to envision 5-6 years ahead. On a continuum we strive for the following goals.

GOALS

- To nurture and maintain a management staff that has a vision of science excellence; is empathetic to the challenges and needs of local science partners; is a catalyst for good internal and external communication; is sensitive to opportunities to work with other USGS disciplines; encourages, challenges, holds accountable, and rewards staff at all levels; and works well together in a seamless fashion regardless of section and unit boundaries.
- To nurture and maintain an administrative staff that understands that science excellence is our business; is knowledgeable and resourceful in administrative and financial management issues; provides needed services, instruction, and/or help to project staff on such issues so as not to have them negatively impact the science; and works with management to ascertain the fiscal "well being" of the WSC.
- To nurture and maintain a sufficient staff of Hydrologic Technicians that understands that science excellence starts with, and cannot be done without, excellent data; is well trained in appropriate field techniques and methodologies; is aware of required safety protocol in all types of field and laboratory situations and adheres stringently to those protocol; and is able to work well together in teams in all types of stressful and difficult situations.
- To nurture and maintain a sufficient staff of Hydrologists at the project chief and project member level that understands that excellent science can only be done by excellent scientists; that stays abreast of "cutting edge" issues in appropriate fields of expertise; that communicate well with their supervisors, their peers in and outside the WSC, Regional Specialists, and stakeholders and funding partners; and that is insightful in the development of proposals and able to complete funded projects in a timely and cost effective fashion.
- To nurture and maintain a sufficient support staff of Information Technology Specialists who provide excellence in Computer Systems Administration; needed software and hardware support for science projects; networking capabilities that provide required speed and bandwidth for effective sharing of digital tools, data, and products.
- To nurture and maintain sufficient additional support staff including Receptionist, Clerk, and Students—excellent in their respective fields and committed to providing quality services vital to the science efforts and crucial to the completion and delivery of required communications and scientific reports.
- Nurture the good relationship between the Arkansas WSC and the Enterprise Publication Network (EPN) and continue to provide excellent report products that help us disseminate our science results to cooperators, stakeholders, and the general public.

PERSONNEL CHANGES

It is a continual challenge to keep our staff balanced with respect to technical expertise needed and diversity. In recent years, we have nurtured along state-of-the-art simulation studies in both ground water and surface water to help better understand the hydrologic systems and to meet the needs of the State. Current staffing in the WSC is stable based on our ongoing, expected near future, and long-range Science Plan. Our current FTE level is 49.03.

Staffing Changes Since February 2008

- Filled Supervisory Hydro Tech position in the Northwest Arkansas Field Service Unit.
- Hired approximately 6 SCEP/STEP students.
- Hired new office automation clerk to perform front office duties.
- Filled Supervisory Hydrologist position to supervise Hydrologic Information Management and Software Development Program.
- Moved Hydrologist and Hydro Tech to Hydrologic Information Management and Software Development Program from the Hydrologic Investigations Program.
- Created Hydrologic Reservoir Science and Northwest Arkansas Programs and plan to fill Supervisory Hydrologist position.
- Moved experienced Hydologist and another Hydrologist from the Hydrologic Investigations Program to the Hydrologic Reservoir Science and Northwest Arkansas Programs.
- Water-Quality Specialist transfered to North Dakota, and filled the position with an existing, well qualified Hydrologist.
- Hired IT Specialist for new NWIS position.

CURRENT STAFF

Type	Permanent, full-time	Permanent, part-time	Term	Student	Contract
Number	41	1	1	10	0

Retirement Eligible by Series (excluding SCEPS/STEPS)

Occupation	Currently Eligible	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15+
Hydrologist	1	1				1	13
Supv Hydrologist	1		1				1
Hydrologic Tech	1		1				9
Supv HydroTech							2
Admin Officer							1
Admin Ops Asst					1		1
Off Aut Clerk					1		1
IT Specialist							4
Supv IT Special							1
Biologist							1
Budget Analyst				1			1
TOTAL	3	1	2	1	2	1	34

NEW HIRES

We currently looking to add a couple of additional students and possibly one additional full-time Hydrologic Technician to our roles.

TRAINING

Workforce planning training occurred in June 2004.

Tactically, we are in “good shape” from a workforce perspective, to meet the expected challenges as defined in our science plan for the next 1-3 years.

As priorities within the Bureau change and as State government reorganization and budgetary adjustments stabilize, we will continually reevaluate science goals and plan for necessary strategic changes in our workforce.

ARKANSAS WATER SCIENCE CENTER ORGANIZATION CHART
February 10, 2010

OFFICE OF THE DIRECTOR
J. E. Terry, Director-15

Hydrologic Investigations Program
D.A. Freiwald, SupvHyd-14, Supv and Associate Director
J.B. Czarnecki, Hyd-13[1]
B.G. Justus, Bio-12
T.M. Kresse, Hyd-12[3]
A.L. Pugh, Hyd-12
T.P. Schrader,Hyd-12[11]
R.F. Montanus, HydTech-9
J.A. Gillip, Hyd-9
J.E. Wallace, HydTech-7
D.A. Westerman-StuTrn-5
J.M. Blackstock, HydTech-3

Administrative Services Program
S.R. Dolls, AdminOff-12, Supv.
S. Abernathy, BudAnalyst-9
R.K. Childers, AdmOpsAsst-7[8]
R.F. Bowling, OffAutClk-3

Hydrologic Reservoir Science and Northwest Arkansas Programs
W.R. Green, SupvHyd-13[13] Supv and Assistant Director
P.D. Hays, Hyd-13[13]
J.C. Petersen, Hyd-13[5,10,12]
S.E. Bolyard, Hyd-9
J.L. De Lanois, Hyd-9[7]
Vacant, Hyd-9

Hydrologic Surveillance & Analysis Program
J.E. Funkhouser, SupvHyd-13[2] and Assistant Director
W.E. Baldwin, ActSupvHydTech-11
T.H. Brossett, HydTech-12
D.A. Evans, HydTech-12
R.A. Blanchard, Hyd--9
J.M. Clark, HydTech-4 (SCEP)-4

Hydrologic Information Management and Software Development Program
B.R. Clark, SupvHyd-13[9]
J.R. Cole, ITSpec-12[6]
D.S. Davidson, ITSpec-12[14]
T.W. Holland,HydTech-12[4]
B.T. Jackson, ITSpec-11
R.M. Scheiderer, Hyd-11
M.P. Smith, ITSpec-7
C.C. Martin, CompClerk (STEP)-4
G.A. Beasley, CompClerk (STEP)-3

Northwest Arkansas Field Service Unit
K.M. Hubbs, SupvHydTech-12
D.M. Wagner-Hyd-7
W.F. Killion-HydTech-6
B.K. Breaker-HydTech (SCEP)-4
C.B. Reinhardt-HydTech (STEP)-4
L.M. Schenk, HydTech (STEP)-4
Vacant, SCEP

Little Rock Field Service Unit
W.E. Baldwin, ActSupvHydTech-11
R.J. Freret,HydTech-11
J.A. Heavener,HydTech-11
W.E. Baldwin, HydTech-9
M.L. Gipson,HydTech-9
A.D. Lasker,HydTech-9
P.L. Stephens,HydTech-9
E.A. Beavers, HydTech-8
K.W. Davis, HydTech-7
S.B. Franks, HydTech-6
B.K. Martin, HydTech-6
L.M. Schenk, HydTech (STEP)-4
J.T. Mays, HydTech (STEP)-3

USGS Geospatial Liaison NSDI Partnership Office
W.D. Sneed, Cartographer-13

National Water Information System
M.L. Farmer, ITSpec(SysAnalysis)-13[15]
M.R. Bryant, ITSpec-12

Lafayette Publishing Service Center
B.L. Louthian,Writer-Editor-9

1 – Ground-Water Specialist
2 – Surface-Water Specialist
3 – Acting Water-Quality Specialist
4 – Water Use Specialist
5 – Ozark Plateau NAWQA Chief
6 – Computer System Admin
7 – Safety Officer
8 – Training Officer
9 – GIS Specialist
10 – Report Specialist
11 – Hazardous Waste Coordinator
12 – Outreach Coordinator
13 - UofA Adjunct Professor
14 – Part-time NWIS Support
15 – NWIS ADAPS Team Lead

Arkansas Water Science Center Communication Plan

Goals:

1. Improve communication within the WSC and with Area, Regional, Headquarters, and other USGS offices and the Department of Interior about WSC activities and issues.

2. Improve external communications by developing an information delivery system for USGS reports, information, and activities to:

- Increase USGS profile in the technical and scientific community and with potential cooperators and customers
- Inform and increase USGS profile with elected officials of scientific issues and relevance of USGS work to address issues
- Increase USGS profile with the public to develop a constituency of citizens and organizations
- Continue to increase media coverage of USGS activities and products
- Encourage, foster, and promote scientific education and scientific career choices.

Goal 1 - Activities:

- Participate in monthly all-hands WSC meetings.
- Communicate Regional and Headquarters activities and changes to the WSC staff.
- Engage and share development and implementations of Arkansas WSC Science Plan.
- Communicate status and results of current WSC projects and activities.
- Share and summarize training and conference information with WSC staff at “brown bag” seminars or short, informal presentations.
- Increase use of internal web page for exchanging ideas and information.
- Condense newsworthy Area, CR Water Directors, and WRD Senior Staff meeting notes and forward to WSC staff.
- Forward WSC senior staff meeting notes to WSC staff as appropriate.
- Forward the “USGS Weekly Highlights”, “The Communicator”, and the “USGS in the News” email of news clips.
- Improve communications with the USGS Office of Communications and Regional Public Affairs Specialist by
  - Submitting items to USGS Weekly Highlights
  - Submitting items to SCA Highlights
  - Submitting news releases to Regional and Headquarters communication staff in electronic format
  - Alerting Regional and Headquarters communications staff to “HOT” issues to discuss strategies
  - Alerting Regional and Headquarters communications staff when interviewed by the news media
- Develop, share, update, and organize exhibit material within the WSC.
- Document events, field and project activities, and training with photos.
- Utilize “Cyber Seminar” technology to communicate with Regional, Headquarters, and other USGS offices about issues of Regional, National, or multidisciplinary interest.
- Invite USGS employees from other Disciplines to make presentations to WSC personnel.
- Include and invite USGS Regional, Headquarters, and other Disciplines in technical/managerial meetings and workshops where possible.
- Engage USGS technical offices in review of development of projects and review of reports as appropriate.

Goal 2 - Activities:

- Develop and maintain a customer information management process by:
  - Defining the audience and identify targeted customers for USGS reports, information, and activities,
  - Commit the necessary resources to develop and maintain a process, rather than a one-time distribution effort,
  - Periodically evaluate the success of the established communication process,
  - Adjusting the customer information management system as feedback is received, and
  - Reviewing the customer information management system during quarterly project reviews.
- Develop a WSC media communication plan and strategy that identifies the target audience and appropriate media outlets for WSC activities and information.
- Give presentations and poster sessions at State and National conferences and meetings.
- Encourage active participation in professional organizations and societies.
- Distribute selected USGS reports and fact sheets, visit, make presentations or provide briefings, and supply information for newsletters to:
  - U.S. Congressional members and staff,
  - Gubernatorial and State legislative members and staff,
  - County and city officials,
  - Key members of technical and scientific community,
  - University seminars
  - Local citizen groups and local chapters of national organizations involved in environmental and recreational activities.

  A 2-3 person team will be established and will schedule monthly visits to the above-mentioned entities for the purpose of outreach and information dissemination.
- Increase participation in stakeholder groups.
- Invite elected officials on field trips to USGS research, project, and data collection sites.
- Inform U.S. Congressional members and staff when USGS projects or activities are conducted in their WSCs and invite members to share in the announcements of USGS scientific results through joint news releases, joint media events, and in the Members' newsletters.
- Attend training and meetings offered by the USGS Office of Communications or other Federal agencies
  - Congressional Training class
  - News media training class
  - Annual USGS outreach conference.
- Maintain a professional, informative, and current WSC web page that describes projects, real-time data, and selected on-line publications.
- Look for opportunities to develop and post USGS information near USGS project or activity sites.
- Prepare and distribute news releases announcing selected publications and WSC activities.
- Participate in activities at:
  - Community or event fairs and festivals
  - Career/job fairs
  - Science fairs.

The Arkansas WSC is committed to improving both internal and external communications. We acknowledge that by taking the above actions, we will more effectively fulfill the mission of the U.S. Geological Survey.