WATER ISSUES IN ARKANSAS

A COMPANION REPORT TO
WATER ISSUES IN ARKANSAS – AN UNFINISHED STORY
SUMMARY REPORT

WINTHROP ROCKEFELLER FOUNDATION
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All conclusions, interpretations, and tools discussed or identified in the report are those of the authors, and not of the Winthrop Rockefeller Foundation.

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SUMMARY REPORT

A Study Conducted for the
Winthrop Rockefeller Foundation

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EXECUTIVE SUMMARY

Arkansas – a state with rich supplies of surface water in rivers, streams, lakes, reservoirs, and wetlands in addition to large amounts of sub-surface groundwater. These water resources have propelled the state's economy through recreation, navigation, power generation, manufacturing, and agriculture.

Water will continue to be essential for a robust economy, public health, and quality of life in Arkansas. But Arkansas is at a critical juncture in water management. Decisions we make now can move us toward crisis or sustainability.

This report highlights trends, desirable goals, policy options, and tools that will help Arkansans make informed choices. Our conclusions and proposals are based on documented facts about the state's water resources, a survey of 400 Arkansans, and interviews with more than 75 representatives of public, business, agricultural, nonprofit, and academic organizations.

Facts and Trends

From 1980 to 2005, these trends emerged:

- Water quality problems are increasingly caused by nonpoint source pollution, including storm runoff from communities, construction sites, agriculture, and dirt roads; and pollution from malfunctioning septic systems;
- Climate change is contributing to changes in the occurrence of droughts and floods;
- Groundwater levels are dropping. This is the water below the surface that flows through layers of soil and rock and emerges in springs, streams, lakes, or wells;
- Use of groundwater and surface water for irrigation and public water supplies has increased;
- Litigation, rather than collaboration, has become the most common approach to resolving water issues;
- Poorly planned development is contributing to flooding and inadequate water supply; and
- Water infrastructure needs repair and replacement.

High-Priority Issues

Public officials, government employees, educators, commercial and agribusiness representatives, and private citizens overwhelmingly agree that water is vital to the state's long-term growth and prosperity and yet there is a widespread lack of knowledge or understanding about our water resources.

These high priority issues were identified during our surveys and interviews:

- Lack of Understanding about Water Resources;
- Water Pollution;
- Groundwater Depletion;
- Flooding;
- Water Shortages;
- Inadequate Water Distribution;
- Lack of Stewardship;
- Inadequate Laws and Regulations;
- Inadequate Funding;
- Inadequate Planning;
- Ineffective Leadership; and
- Ineffective Management.

Desired Outcomes

We believe most Arkansans would support the need to work toward specific goals or outcomes that:

- Maintain an adequate supply of safe drinking water;
- Provide enough good-quality water to support the state economy and sustain a healthy environment;
- Protect life and property from damage caused by flooding;
- Recognize the value of water and its contribution to the overall quality of life in Arkansas;

- Provide good stewardship of water, protecting the rights of all Arkansans to use water resources;
- Manage water comprehensively to sustain groundwater and surface water for future generations; and
- Manage water resources efficiently through a participatory process.

Can Anything Be Done?

Citizens and leaders in Arkansas must be proactive and collaborative in identifying and implementing water management strategies. This report offers examples of policy options within eight broad water policy areas that could be used to help assure a sustainable, safe and abundant water supply.

- Economic Incentives and Markets
  - Determine the true value or cost of water, taking into account government subsidies, unintended consequences and alternative uses.
  - Create voluntary and economic incentives, such as tax credits for the installation of water conservation equipment by commercial or residential users.
  - Promote private-public alliances that enable public agencies to outsource certain activities to private companies for more efficient water management.
  - Review federal funding opportunities that are untapped because of failure to satisfy requirements for local matching funds.

- Integrated Surface/Groundwater Management
  - Manage groundwater and surface water quantity and quality through one agency with clear lines of authority.
  - Revisit water allocation in federal water projects, such as the amount of water stored in US Army Corps of Engineers reservoirs.
  - Develop regional water management districts based on surface water, groundwater, and precipitation patterns, rather than country boundaries.
  - Create and protect “soaking zones” where water can soak into the ground, and storage areas where surplus water can be captured during high-flow periods.
  - Enact enforceable water withdrawal regulations.

- Move water from where it is to where it is needed by revising criteria for setting water use priorities.
- Encourage water conservation, reuse, and recycling in the commercial, municipal, and household sectors.

- Integrated Point/Nonpoint Source Management
  - Manage water quality through one agency with authority over all types of water pollution.
  - Make water quality data readily available through a centralized public data storage system.
  - Spotlight water quality benefits by identifying and publicizing the monetary value of best management practices.
  - Authorize "pollutant trading practices" through which an industrial or municipal wastewater discharger pays for programs to reduce pollutant loads from other sources.

- Water Laws and Regulations
  - Establish a Vision 2025 Committee to develop a model for sustainable water resources by the year 2025 that could guide the development of a comprehensive water code or state water plan.
  - Establish a Comprehensive State Water Code Commission to determine the need for an integrated set of laws governing water.
  - Revise the existing Arkansas water plan to make it consistent with the 2025 vision for sustainable water resources.
  - Convene a Water Summit with broad, diverse participation to discuss laws and regulations, revisions to the Arkansas water plan, and water projects that integrate social, economic, and environmental goals.

- Participatory Process
  - Separate facts from perceptions by documenting the opinions of different population segments about water resource issues.

- Promote Water Watch or other voluntary programs to encourage public involvement, in the same way the Arkansas Game and Fish Commission assigns Stream Teams to promote stewardship of streams used for fishing.
- Work to build trust among stakeholders and community groups that may be polarized on water issues.

- Leaders and Champions
  - Provide water leadership training on socioeconomic and cultural approaches for watershed management.
  - Identify community leaders and champions and provide training/education on water resource issues.

- Public Awareness and Outreach
  - Provide a definitive source of public information about water in Arkansas.
  - Declare a "Decade of Water" in Arkansas.
  - Engage existing organizations in the effort to raise awareness of water resource issues (professional, trade, civic organizations).
  - Educate the kids with materials and lesson plans for primary, secondary, and post-secondary schools.
  - Promote an ethic of water stewardship.

- Adaptive Management
  - Improve water monitoring networks to develop an accurate picture of water availability in Arkansas.
  - Identify, track, and assess performance measures to determine if the state is moving toward sustainable water resources.
  - Supplement this monitoring information with data gathered through volunteer Water Watch programs.

A Call to Action

By raising awareness of issues and options for reaching solutions, this report seeks to encourage greater civic engagement to protect our water resources.

There are leaders and champions in our communities. Public interest and volunteerism are rapidly increasing. Everything is poised for success. When we address water issues, we also address social, economic, and other environmental issues. Sustainable management of water resources could also move Arkansas toward economic and social sustainability over the next 25 years. The question is which paths and options will Arkansans choose?

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

"When the well is dry, we learn the worth of water." Benjamin Franklin

Some say Arkansas is a water-rich state. Others say we will soon appreciate the value of water as groundwater in the Delta region is depleted and wells run dry. Arkansans are at a critical juncture in water management. Issues affecting the quantity and quality of water in Arkansas include:

- Lack of planning
- Uncontrolled growth and sprawl
- Lack of understanding
- Short-sighted use
- Poor stewardship
- Greed
- Piecemeal laws and regulations

Everyone contributes to the problems – business, industry, agriculture, government agencies, nonprofit organizations, and the public. Says who? Arkansans, that's who. More specifically, those we interviewed for this study and those who participated in a random telephone survey. The 1970s Pogo cartoon caption said it best, "We have met the enemy and he is us!"

Water is essential for life, so there is virtually no regulation, practice, activity, or community that does not directly or indirectly affect water. It is essential for social equity and economic development and contributes to the quality of life experienced by every population and business sector in Arkansas.

1.1 Purpose

Water has often proved a contentious issue in Arkansas. Some of the conflicts have endured for decades (groundwater depletion in the Delta), while others have recently emerged (the Lake Maumelle and Illinois River watershed disputes). Why do these conflicts surface? Is

water really that important? What factors contribute to these problems? What can we do to solve or resolve them? The purpose of this study is to answer such questions.

Throughout its 34-year history, the Winthrop Rockefeller Foundation (WRF) has maintained an awareness of the importance of a safe and abundant water supply in Arkansas. In 1982, WRF published the results from a study on the status of water resources in Arkansas. In 2006, WRF underwrote this project to identify and frame the issues related to water throughout Arkansas. This project also strove to identify the underlying rationale and mental models (beliefs) of various Arkansas agencies, organizations, institutions, and population sectors related to these water issues. This project focused primarily on the period from 1985 through 2005. This period was selected because in the early 1980s, a Water Code Study Commission conducted a comprehensive evaluation of water law and management for the state of Arkansas.

This report describes the insights into water resources issues in Arkansas gained during this project, along with various tools and policy options to help assure a safe, abundant supply of water for future generations while recognizing current needs for water use. This report reflects WRF's interest in gaining a comprehensive perspective on water issues in Arkansas from myriad sectors – government, corporations, agriculture, academia, institutions, and private citizens. Water directly affects the state's economic development. Industry and agriculture can exist only with the assurance of adequate water quantity and quality. Access to a safe and abundant water supply is critical to ensuring our public health and quality of life.

1.2 Background

The drought of 1980–1981 raised concerns about water shortages in Arkansas, including the impact on crop irrigation (Looney, 1984). By 1981, groundwater levels in the agriculture-dependent Delta counties had dropped from 20 to 30 feet below the surface to over 40 to 50 feet deep (Arkansas Farm Bureau Federation [AFBF], 1981). Depletion of the Alluvial Aquifer in the Delta had been occurring, and documented, since the 1920s (AFBF, 1981), but during the early 1980s, some farmers' wells were drying up because the groundwater level had been lowered below the depth to which many wells had been drilled (AFBF, 1981).

Also in 1981, the Arkansas Legislature established a Water Code Study Commission to review the adequacy of the piecemeal laws and regulations governing water management related to agriculture, industry, communities, and the environment. The commission worked through 1982 to develop a proposal for a comprehensive state water code encompassing an integrated set of laws and regulations governing water use rights (Looney, 1990). The 1983 legislature rejected the proposal and referred the question of water law revision to an interim committee for study. Although WRF proposals were submitted to the 1985 legislature, no comprehensive bill was adopted (Looney, 1990). Concerns raised about the proposed water code included the inadequacy of statewide regulations to address local concerns, interference with property rights, and the lack of readily available alternative water sources if restrictions were applied to current supplies (Looney, 1990).

1.3 Method

The initial step in the project was to synthesize the literature available on Arkansas water resources issues, including pundits' analyses and discussions of why a comprehensive state water code has not been approved in Arkansas. Information gained during the literature review guided development of interview questions for a statewide telephone survey (conducted by the Survey/Business Research Group of the Institute for Economic Advancement at the University of Arkansas at Little Rock) and a series of personal interviews with representatives of a range of Arkansas government, business, and social sectors. Along with information about perceived water issues in Arkansas, the survey and interviews provided suggestions for tools and policies that could be used to solve some of these issues, and gave the study team insight into what Arkansans want from our state water resources.

1.4 Report Organization

The second chapter of this report is a primer on Arkansas water resources, including explanations of water resources management terms and information about how water is used in the state. The third chapter is a summary of the literature review. The fourth chapter is a comparison of Arkansas census information from 1990 and 2000 – looking at changes that are

occurring in each of the major river basins in the state. Chapter 5 summarizes the findings of the statewide telephone survey and personal interviews conducted as part of this study. Chapter 6 outlines fundamental truths about water, and Chapter 7 presents the study team's interpretation of what Arkansans want from our state water resources. Finally, Chapter 8 discusses tools and policy options that could be used to address Arkansas water issues.

2.0 ARKANSAS WATER RESOURCES

2.1 Surface Water

Arkansas' surface water includes streams, rivers, lakes, reservoirs, wetlands, and their associated watersheds – the land that drains to bodies of water. All land drains to some water body, so everyone lives and works in a watershed. A watershed for a large system of connected waterbodies is often called a basin.

There are five major rivers in Arkansas: White River, Arkansas River, Ouachita River, Red River, and the Mississippi River. The basins associated with the major river systems in Arkansas are shown in Figure 2.1 (the Delta is the Mississippi River Basin).

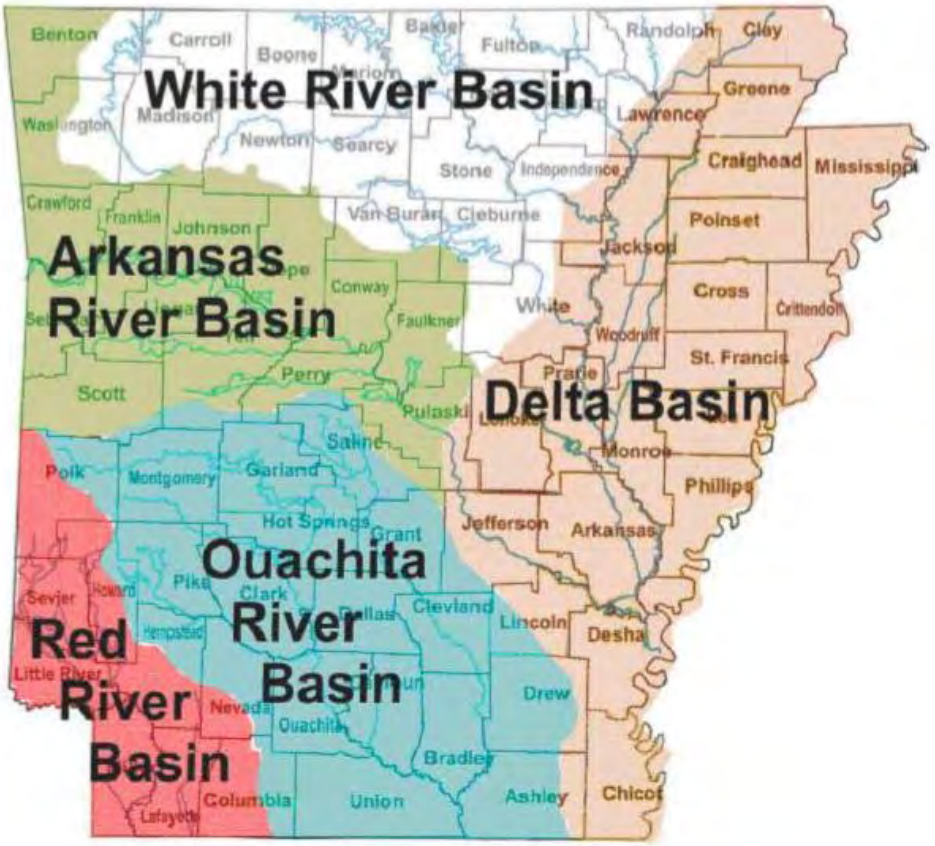

Figure 2.1. Major River Basins of Arkansas (Arkansas Soil and Water Conservation Commission [ASWCC], 1990).

It is estimated that approximately 280,000 million (280 billion) gallons of water flow through Arkansas rivers and streams every day. Reservoirs in Arkansas store over 4,890,000 million (5 trillion) gallons of water. A potential sustainable surface water use rate for Delta Basin streams has been estimated to be 96,000 million (96 billion) gallons per day (United States Geological Survey [USGS], 2005).

2.2 Groundwater

Arkansas also has important groundwater resources. Groundwater is water that has seeped into the earth. At some depth below the surface, water saturates soil or rock. The top of a saturated zone is called the water table (Figure 2.2). The level of the water table fluctuates depending on how much water seeps into the ground and how much flows out or is withdrawn. Factors affecting the water table include rainfall, how much ground is covered by impervious surfaces such as buildings and concrete, and how much the land is watered or irrigated. Water can also seep into the ground from streams, reservoirs, and lakes if the water table is deeper than the surface of the stream or lake.

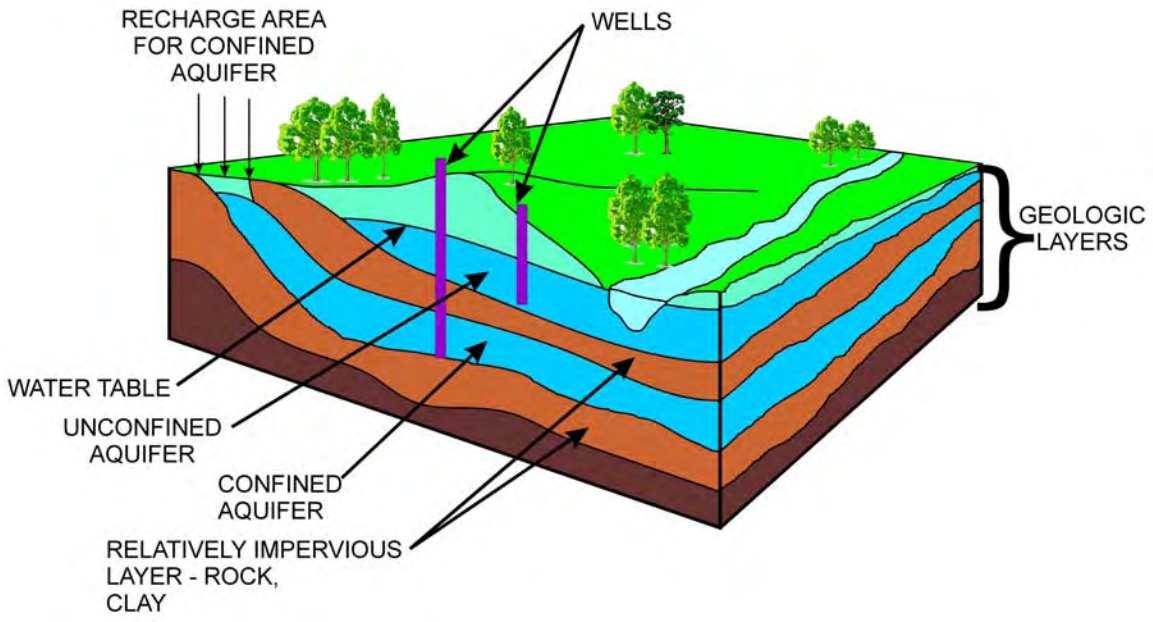

Figure 2.2. Groundwater Diagram.

Groundwater occupies the saturated zone below the water table. Groundwater flows through underground layers of soil and rock until it surfaces as a spring or as seepage into a stream or lake, or until it is pumped from a well. The elevation of the ground surface and how readily the underground geology conducts water affects the flow path of groundwater. Some geologic layers can act as barriers, while others allow groundwater to pass through easily.

Aquifers are water-saturated geologic layers of underground rock, sand, or gravel that conduct water easily enough for a well to remove useful quantities. Geologists characterize and name geologic layers, which is also the name applied to their associated aquifers. There are 12 major aquifers used for water supply in Arkansas (http://state.ar.us/agc/water.htm). Two of the largest and most often discussed are the Mississippi River Valley Alluvial Aquifer (Alluvial Aquifer) located in eastern Arkansas (the Delta), and the Sparta/Memphis Sand Aquifer (Sparta Aquifer) located in eastern and southern Arkansas. Several other major aquifers are also located in eastern and southern Arkansas. There are also several major aquifers in the northern part of the state (Ozark Plateau) and the Ouachita Mountains, and one along the Arkansas River.

Where an aquifer is sandwiched between two geologic layers that don't conduct water well (i.e., are relatively impervious), it is called a confined aquifer. The Sparta Aquifer is a confined aquifer in eastern Arkansas. Water in confined aquifers is usually under pressure, so when a well is drilled into a confined aquifer, the water level in the well ends up being higher than the upper boundary of the aquifer.

Where an aquifer is not overlain by an impervious geologic layer, it is called an unconfined aquifer. The water table is the upper boundary of an unconfined aquifer. Most of the Alluvial Aquifer in eastern Arkansas is an unconfined aquifer, and the Sparta Aquifer is an unconfined aquifer in central Arkansas. The unconfined portion of the Sparta Aquifer is where water seeps into the aquifer, and then, because of the slope of the geologic layers, it slowly seeps into the confined part of the aquifer (Figure 2.2).

Because the Sparta Aquifer receives water from a relatively small area, it does not replenish very quickly. The Alluvial Aquifer, because it receives water from a very large area (i.e., almost the entire land area under which it occurs), replenishes more quickly. When water is pumped out of an aquifer faster than it can be replenished, the water level in the aquifer declines,

or drops, becoming farther from the ground surface. In 1981, the groundwater level in Delta counties had declined from 20 to 30 feet below the surface to over 40 to 50 feet below the surface.

Computer modeling of the Alluvial and Sparta Aquifers has been completed to determine how much water those aquifers can supply while maintaining the water level in the Alluvial Aquifer above 50 percent of the original water depth, and in the Sparta Aquifer well above the top of the Sparta geologic layer. North of the Arkansas River, the Alluvial Aquifer can supply up to 2,690 million (2.7 billion) gallons per day. South of the Arkansas River, the Alluvial Aquifer can supply 525.8 million gallons per day, and the Sparta Aquifer can supply 89.0 million gallons per day (USGS, 2005). Determinations of similar "sustainable yields" have not been made for the other aquifers in Arkansas.

2.3 Rainfall

Ultimately, all water in Arkansas comes from rainfall. The long-term (1899–1999) average annual rainfall for Arkansas is 49.2 inches (National Climatic Data Center, 1999). An example of the variability in rainfall is shown for central Arkansas (Figure 2.3). The average annual rainfall for central Arkansas is 51 inches, but yearly averages range from 33 to 76 inches.

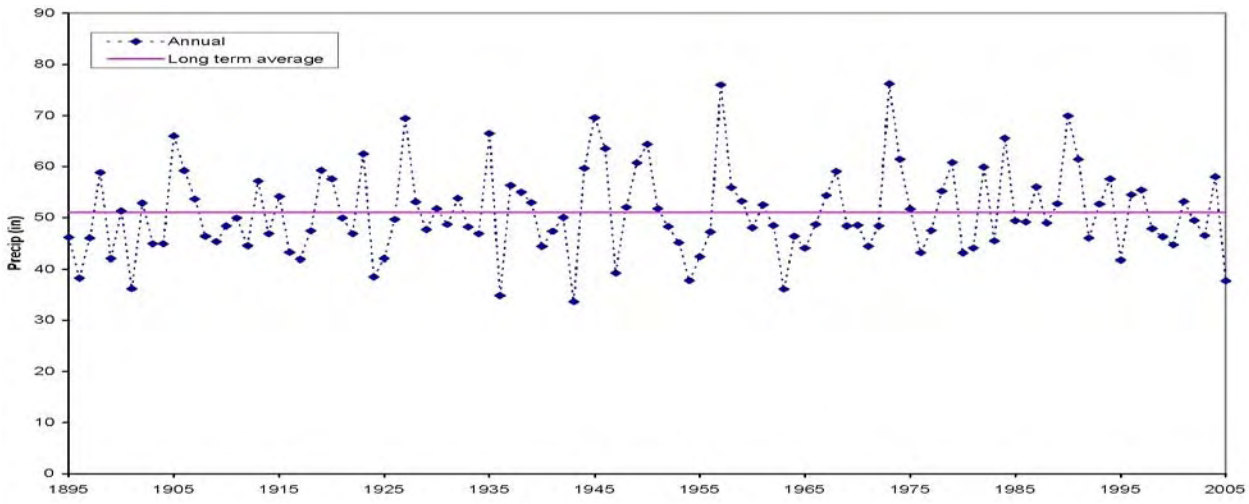

Figure 2.3. Long-Term Record (110 years) of Annual Rainfall Totals in Central Arkansas. Note the variability around the long-term average of 51 inches per year.

2.4 Water Use

In the years since the Water Code Study Commission developed its proposal, water usage and management in Arkansas have seen multiple changes. While water withdrawals in the U.S. have leveled off since about 1990 (Hutson et al., 2004), they continue to rise in Arkansas, affecting both surface water and groundwater (Figure 2.4). USGS did not report water withdrawals for 2000 by basin. Comparison of reported 1980 freshwater use (Holland and Ludwig, 1981) and estimated 1980 freshwater use by basin with estimated 2000 freshwater use by basin (Table 2.1) indicated that between 1980 and 2000:

- The greatest water use increases occurred in the White River Basin and the Delta Basin;
- Water use decreased slightly in the Red River Basin;
- Water use in the Ouachita River Basin did not change appreciably; and
- Water use in the Arkansas River Basin increased by about one third.

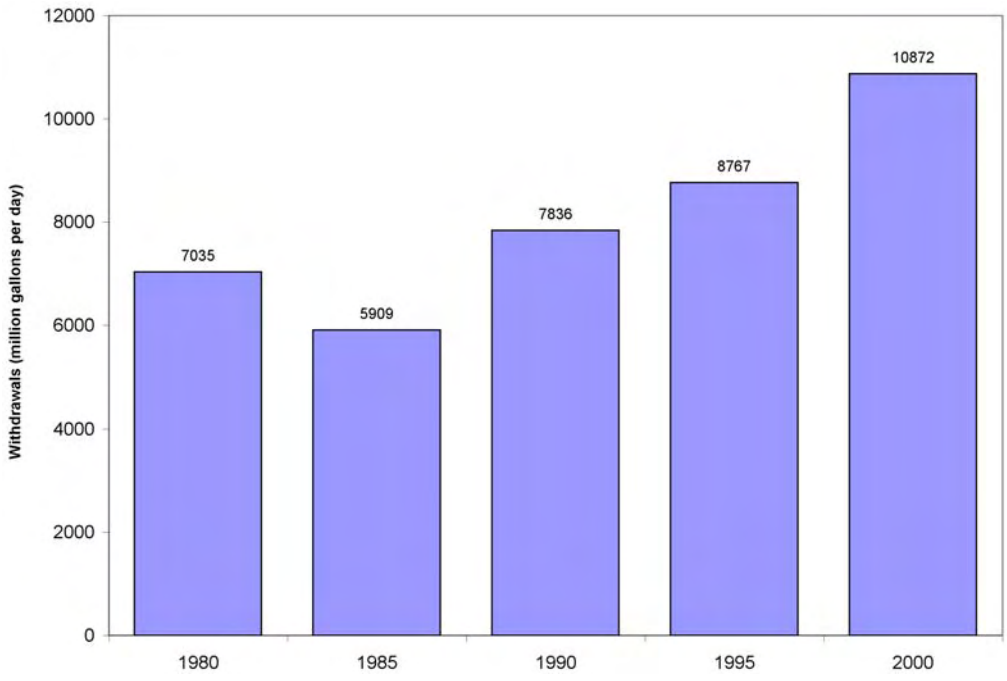

Figure 2.4. Changes in Arkansas Water Withdrawals Over the Last 20 Years (1980 data from Holland and Ludwig, 1981; data from all other years retrieved from http://water.usgs.gov/watuse/).

Table 2.1. Comparison of Historic Arkansas Water Withdrawals in Million Gallons Per Day (mgd) by Basin.

Data	Arkansas River Basin (mgd)	Delta Basin (mgd)	Ouachita River Basin (mgd)	Red River Basin (mgd)	White River Basin (mgd)	Total (mgd)
1980 reported	1,212	4,029	1,063	154	577	7,035
1980 estimated	1,212	3,855	1,135	152	682	7,035
2000 estimated	1,616	6,732	1,129	123	1,270	10,872
Percent change	33%	67 – 75%	-0.5 – 6%	-19.5%	86 – 120%	55%

While total water withdrawals in Arkansas increased between 1980 and 2000, water withdrawals for some use categories dropped during this period. Water withdrawals for industry and aquaculture decreased by almost half between 1980 and 2000 (Figure 2.5a), even though both experienced growth during this period. This was the result of changes in how water was used in industry and aquaculture (i.e., increased conservation).

The rise in Arkansas water withdrawals since 1980 is the result of increases in water withdrawals for public water supply, thermoelectric power generation, and irrigation (Figure 2.5a, b). Between 1980 and 2000, water withdrawals for irrigation doubled (Figure 2.5b). This is due to the fact that the amount of irrigated cropland, in both acreage and in percent, doubled during this period, increasing from about 2 million acres (20 percent of total cropland) in 1982 to about 4 million acres (43 percent of total cropland) in 2002 (United States Department of Agriculture [USDA], 1984, 2004). In 2000, 73 percent of Arkansas water withdrawals were used for irrigation (Figure 2.6). Information on water withdrawals for 2000 indicated that over 80 percent of the water used for irrigation in Arkansas was groundwater, and that over 95 percent of groundwater used for irrigation in Arkansas came from the Alluvial Aquifer (Maupin and Barber, 2005). Therefore, the majority of the increase in state water withdrawals between 1980 and 2000 resulted from increasing irrigation withdrawals from the Alluvial Aquifer.

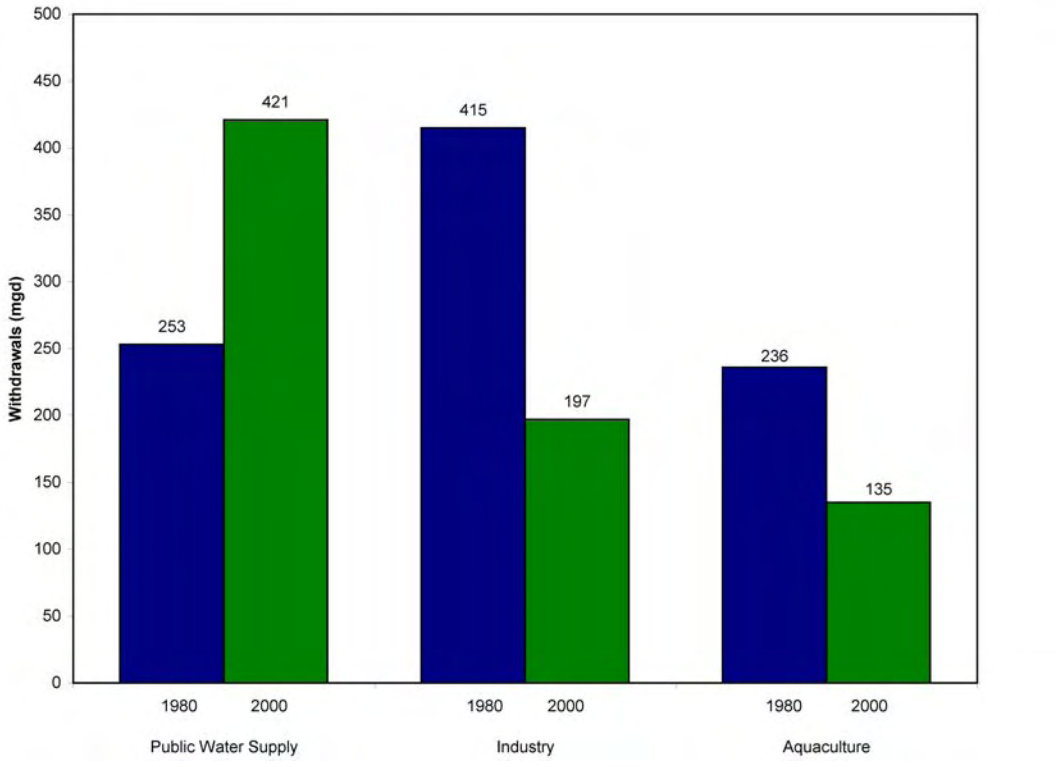

Figure 2.5a. Changes in Water Withdrawals from 1980 to 2000 for Public Water Supply, Industry, and Agriculture Use Categories.

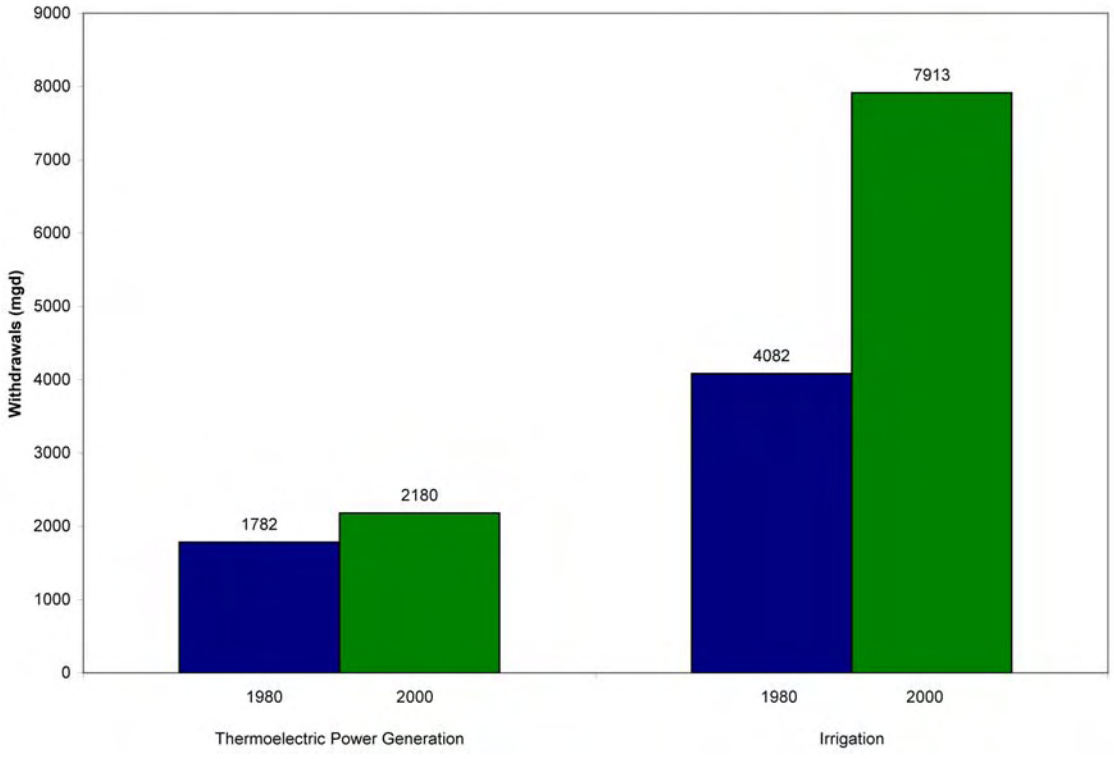

Figure 2.5b. Changes in Water Withdrawals from 1980 to 2000 for Thermoelectric Power Generation and Irrigation Use Categories.

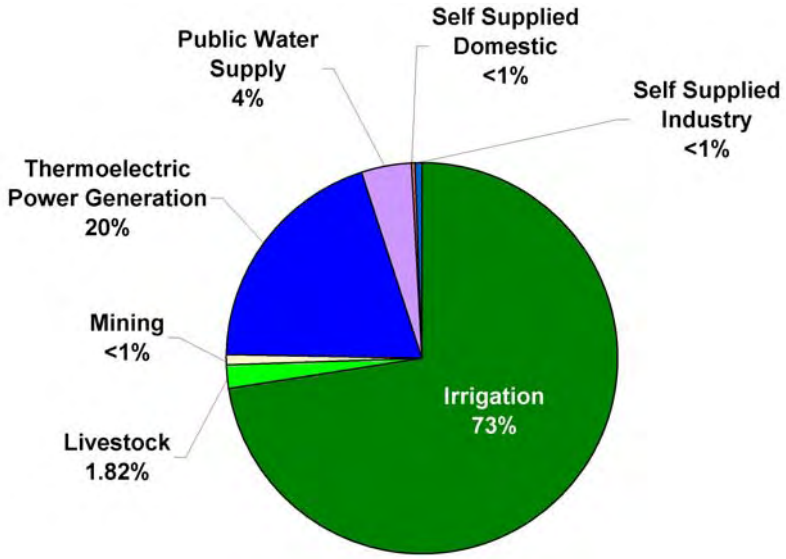

Figure 2.6. 2000 Arkansas Water Withdrawals.

Declining groundwater levels in both the Alluvial and Sparta aquifers have prompted growing concern. As groundwater levels drop, it becomes more expensive to pump the water, especially if deeper wells must be drilled. In addition, the ability of the aquifer to store and transmit water can be reduced, and underlying salt water can seep up and contaminate the aquifer. USGS studies of the Alluvial and Sparta Aquifers indicate that currently, water is being withdrawn from these aquifers faster than it can naturally be replaced (USGS, 2005). Scientific studies estimate that without a decrease in groundwater withdrawals, parts of the Alluvial Aquifer will be unable to supply good-quality water by 2015, and the Sparta Aquifer will be similarly affected by around 2030 (McGuire, 2003).

Water withdrawals in Arkansas for thermoelectric power generation (i.e., water withdrawn for use by gas, coal, and nuclear power plants) increased by about 400 mgd between 1980 and 2000, more than a 20 percent increase (Figure 2.5b). This increase reflects expansion of power generation capacity in Arkansas during this period.

In this 20-year span, withdrawals for public water supply increased by 66 percent, from 253 mgd to 421 mgd. The majority of public water supply withdrawals were taken from surface water (60 percent in 1980 and 70 percent in 2000) (http://www.census.gov), primarily reservoirs.

At least some of the increase in state public water supply withdrawals can be explained by the increase in Arkansas population that occurred during this period. Between 1980 and 2000, the population of Arkansas increased from about 2.3 million to over 2.6 million (http://www.census.gov). (The U.S. Census Bureau estimated Arkansas population for 2006 at just over 2.8 million – http://www.census.gov.) This is equivalent to an approximately 20 percent increase in population. But some Arkansans draw their water from private wells or similar systems, so a larger population does not entirely explain the higher withdrawals for public water supply.

It appears that between 1980 and 2000, there was also an increase in the amount of water individual Arkansans were using. Dividing the amount of water withdrawn for public water supply by the number of people served by public water services gives us per capita (per person) water use. Per capita use of public water supplies increased from 161 gallons per day in 1980 to 181 gallons per day in 2000. As a comparison, one estimate establishes 13 gallons per day as the minimum amount of water needed for personal use (Gleick, 1996). It is possible that increases in industrial water use supplied from public water supply may account for some of this increase.

Since 1980, the proportion of Arkansans getting their water from water supply utilities has changed. In 1980, about 74 percent of Arkansans received their drinking water from public or commercial companies, and 26 percent received their drinking water from private wells (http://www.census.gov). In 2000, about 85 percent of Arkansans received their drinking water from public or commercial companies (Figure 2.7). While many city wastewater utilities in the state upgraded their wastewater treatment systems between 1980 and 2000 (http://www.census.gov), the portion of the state population they serve has not changed much since 1980. The percentage of homes on septic systems remained about the same over this period (Figure 2.7).

Changes in water management in Arkansas are summarized in Chapter 3.

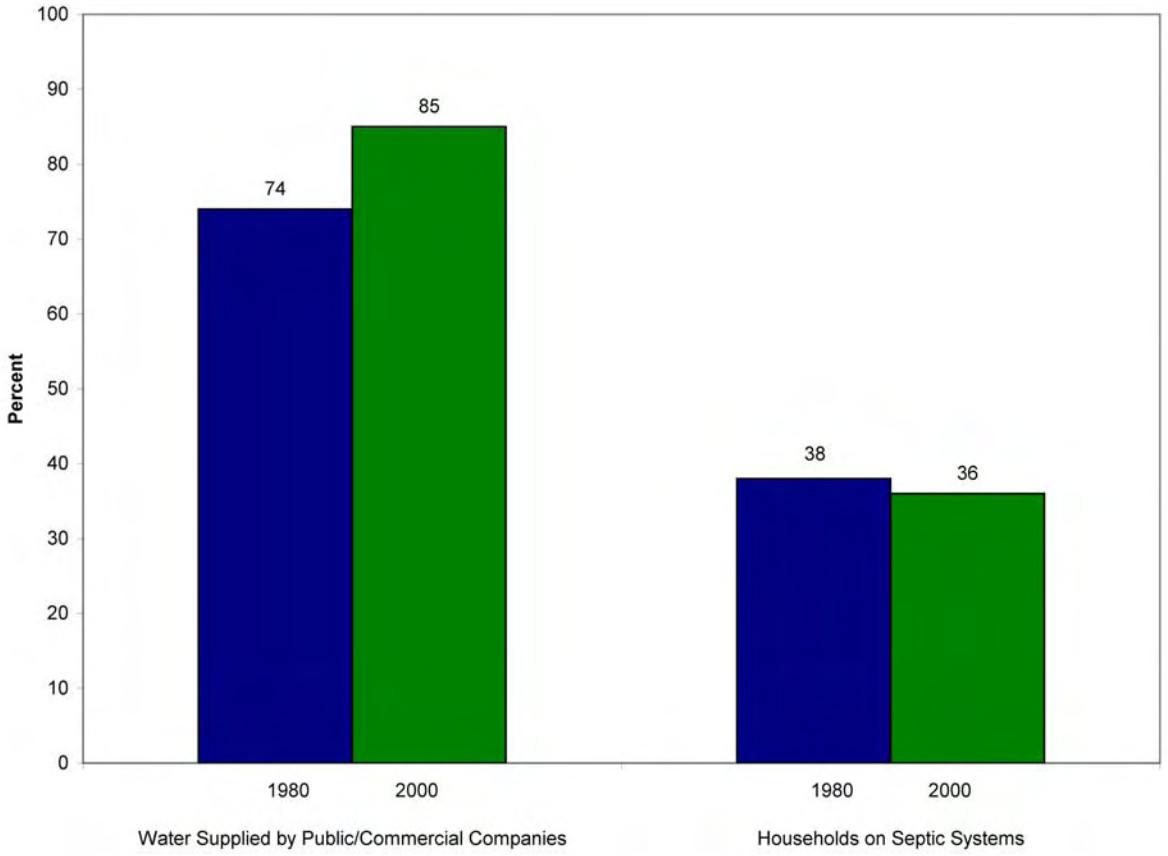

Figure 2.7. Water Supply and Septic System Changes Over the Past 25 Years.

3.0 ARKANSAS WATER ISSUES IN LITERATURE

In 1990, the Arkansas Natural Resources Commission (ANRC) (then the Arkansas Soil and Water Conservation Commission [ASWCC]) finalized the Arkansas State Water Plan. There were ten water issue themes in the State Water Plan Executive Summary (ASWCC, 1990) ranging from groundwater depletion to public awareness. The literature review for this project organized Arkansas water issues around these same ASWCC water issue themes. Table 3.1 is a summary of the issues identified during the literature review, organized by the major water basins used by ANRC (Figure 2.1). Spaces in Table 3.1 with "unknown" indicate that information related to the issue was not identified for that basin. Empty spaces indicate that information was available, but did not indicate the issue occurred in that basin. Brief descriptions of the water issue themes from the literature review are included below. A bibliography of the literature reviewed is included in Appendix A. Literature published between 1983 and 2005 was reviewed.

3.1 Surface Water Depletion

Critical surface water areas identified in the State Water Plan (ASWCC, 1990) are shown on Figure 3.1. These were areas judged to have significant water supply problems at that time. Bayou Meto, Bayou DeView, Plum Bayou, Bayou Bartholomew, Bayou Macon, and Boeuf River were identified as being impacted by irrigation withdrawals during summer months. Recent research indicates that water levels in Delta streams are also being impacted by lowering of the groundwater table in this region resulting from large volume groundwater withdrawals (Czarnecki et al., 2002).

No information was found during the literature review indicating that other areas of the state are experiencing surface water depletion. All surface waters in the state can be subject to allocation conflicts during drought periods, when the surface water supply is drastically reduced. General policies for allocation of surface waters during periods of reduced supply have been developed (ANRC Title III rules). In addition, ANRC is responsible for, and in the process of, developing basin-specific water allocation plans for periods of reduced surface water supply. A

Winthrop Rockefeller Foundation White River Allocation Plan has been completed and is currently under review (ASWCC, 2000; Perkins, 2002).

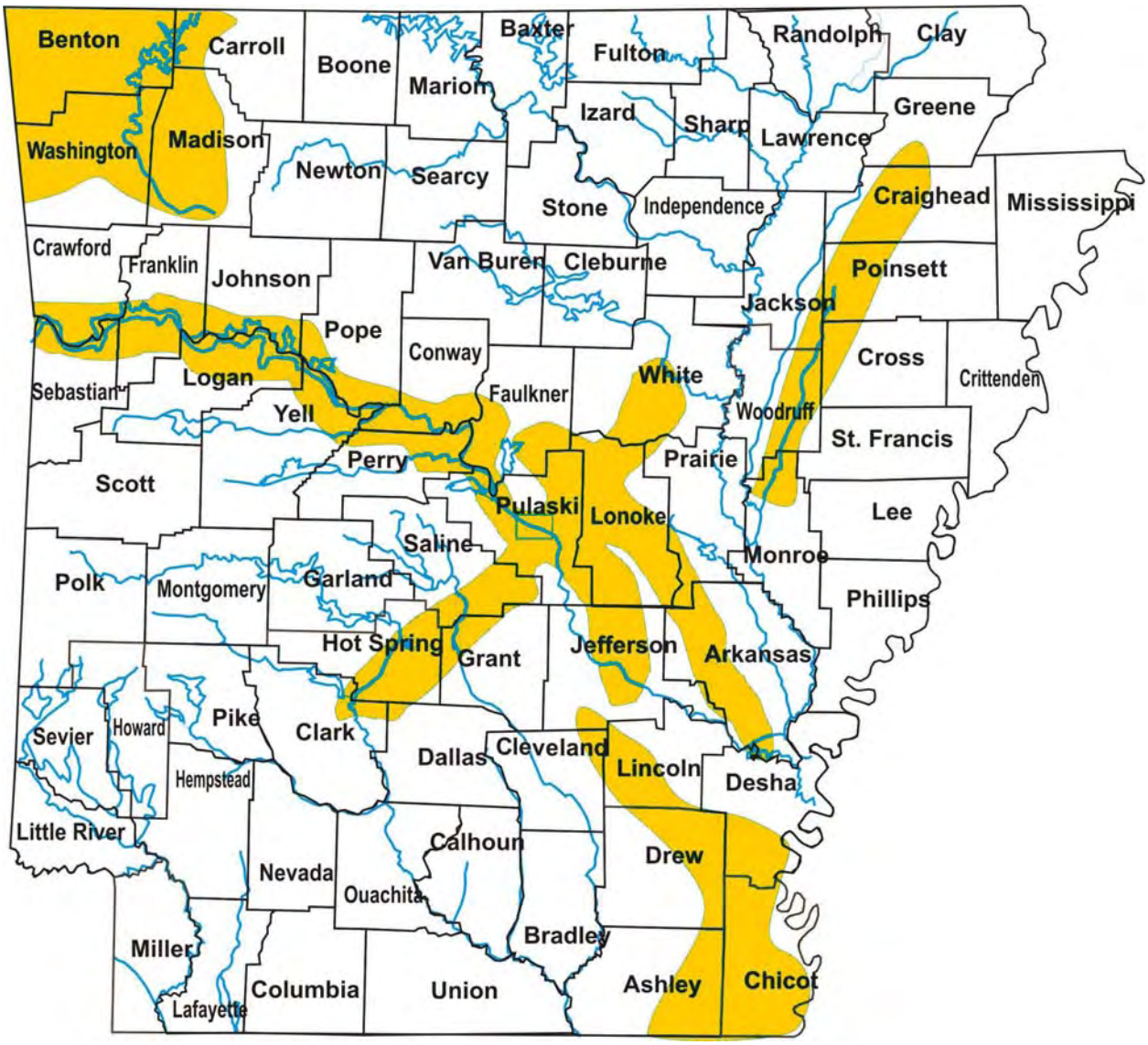

Figure 3.1. Critical Surface Water Areas Shown in Yellow (from ASWCC, 1990).

Table 3.1. Water Issues Summary by Major Arkansas River Basins (see Figure 2.1).

Issue Category	White River Basin	Ouachita River Basin	Red River Basin	Arkansas River Basin	Delta Basin
Surface Water Depletion	Drought only	Drought only	Drought only	Drought only	Due to groundwater withdrawals
Groundwater Depletion	Paleozoic Ozark Aquifer	Sparta Sand Aquifer critical groundwater areas	Tokio-Nacatoch Aquifer	Unknown	Alluvial and Sparta Aquifers critical groundwater areas
Drinking Water Supply Deficiency	Rural water suppliers	Sparta Aquifer	Unknown	Greenwood	Sparta Aquifer
Surface Water Quality	303(d) listings for copper, dissolved oxygen, pathogens, siltation and temperature; nutrient surplus areas, confined animal feeding operations, urbanization, gravel mining; high priority watersheds for restoration	303(d) listings for copper, zinc, siltation, and nitrate; resource extraction; high priority watersheds for restoration	303(d) listings for siltation, total dissolved solids, and nitrate; resource extraction	303(d) listings for siltation, total dissolved solids, and dissolved oxygen; nutrient surplus areas, confined animal feeding operations, natural gas extraction, urbanization; high priority watersheds for restoration	303(d) listings for siltation, organic enrichment, chloride, total dissolved solids, aluminum, copper, lead, and zinc; silver runoff, channelization
Groundwater Quality	Nitrate	Chlorides, high total dissolved solids/minerals			Chlorides, high total dissolved solids/minerals, pesticides, nitrate, arsenic
Health	Fish consumption advisories, bacteria exceedances	Fish consumption advisories, drinking water exceedances	Drinking water exceedances	Fish consumption advisories, drinking water exceedances	
Flooding	Yes	Yes	Yes	Yes	Yes
Water Quantity Management	Growth, allocation, climate change	Growth, allocation, groundwater depletion, climate change	Allocation, climate change	Growth, allocation, climate change	Irrigation supply, groundwater depletion, allocation, climate change
Environment	Minimum flow	Wetlands, minimum flow	Wetlands	Wetlands, zebra mussels	Wetlands, minimum flow, zebra mussels
Recreation	Water quality, rights conflicts	Rights conflicts	Unknown	Unknown	Water quantity
Financial	Aging infrastructure, expansion	Aging infrastructure, expansion	Aging infrastructure, expansion	Aging infrastructure, expansion	Aging infrastructure, expansion
Public Awareness	Water quality, environment, conservation	Water quality, environment, conservation	Water quality, environment, conservation	Water quality, environment, conservation	Water quality, environment, conservation
Social and Cultural	Unknown	Unknown	Unknown	Unknown	Agricultural lifestyle & water

3.2 Groundwater Depletion

Twelve major aquifers supply water in Arkansas (http://www.state.ar.us/agc/water.htm). Declining groundwater levels in the Alluvial and Sparta Aquifers located in eastern and southern Arkansas have been studied and reported on extensively. Arkansas legislation passed in 1991 designated a number of Arkansas counties that use groundwater from these aquifers as critical groundwater areas (Figure 3.2). With regard to other major aquifers in the state, water level declines were observed in five counties of the Paleozoic Ozark Aquifer (located in northern Arkansas) in 2004 (ASWCC, 2005). Declines and increases in groundwater levels in response to the amount of groundwater use are evident in the Tokio and Nacatoch Aquifers located in southwestern Arkansas (Schrader and Scheiderer, 2004), as well as in portions of the Cockfield Aquifer in southeastern Arkansas and the Wilcox Aquifer in northeastern Arkansas (Yeatts, 2004).

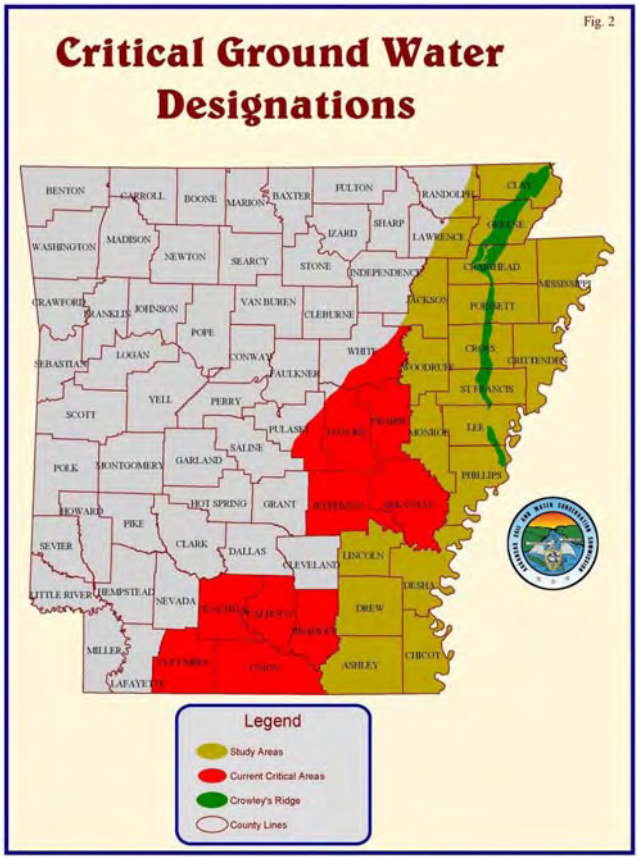

Figure 3.2. Arkansas Critical Groundwater Program Areas and Study Areas, in Grey Shading (ASWCC, 2005).

3.3 Drinking Water Supply Deficiency

The Arkansas Department of Health information on state community water suppliers includes details on the factors judged to be limiting the expansion of the supplier. Only about 50 Arkansas community water suppliers are classified as limited by the amount of available water. Over 90 percent of these are rural water suppliers, and approximately 70 percent are located in northern Arkansas counties. In the areas of the state where drinking water is supplied from the Sparta Aquifer, there is concern that drinking water supplies are threatened by declining water levels in that aquifer and the potential for increased withdrawals for irrigation as the Alluvial Aquifer is depleted.

There are Arkansas communities that have faced, or are facing, water quality-related drinking water supply deficiencies. There are a few Arkansas communities that have had to find alternative water supplies as a result of contamination of local groundwater wells by methyl-t-butyl ether (MTBE), a gasoline additive that probably leaked from underground gasoline storage tanks (http://www.healthyarkansas.com/eng/MTBE.htm). There are also localized occurrences of higher levels of dissolved minerals in the Sparta Aquifer in eastern and southern Arkansas where it is used as a drinking water supply. These high levels of dissolved minerals are believed to be a response to high-volume pumping from this aquifer, and have the potential to affect the usability of water from wells in these areas as a drinking water supply (Schrader, 2004).

3.4 Surface Water Quality

The Arkansas Department of Environmental Quality (ADEQ) listed 59 stream segments totaling 1,010 stream miles and 10 lakes totaling 5,530 acres on its 2004 303(d) list of impaired waterbodies (shown on Figure 3.3) (http://www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_public_notice.pdf). The most frequently listed causes of water quality impairments were silt (30 stream segments and one lake), total dissolved solids (11 stream segments), copper (nine stream segments), pathogens (eight stream segments), nutrients (six stream segments and six lakes), and chlorides (four stream segments and two lakes).

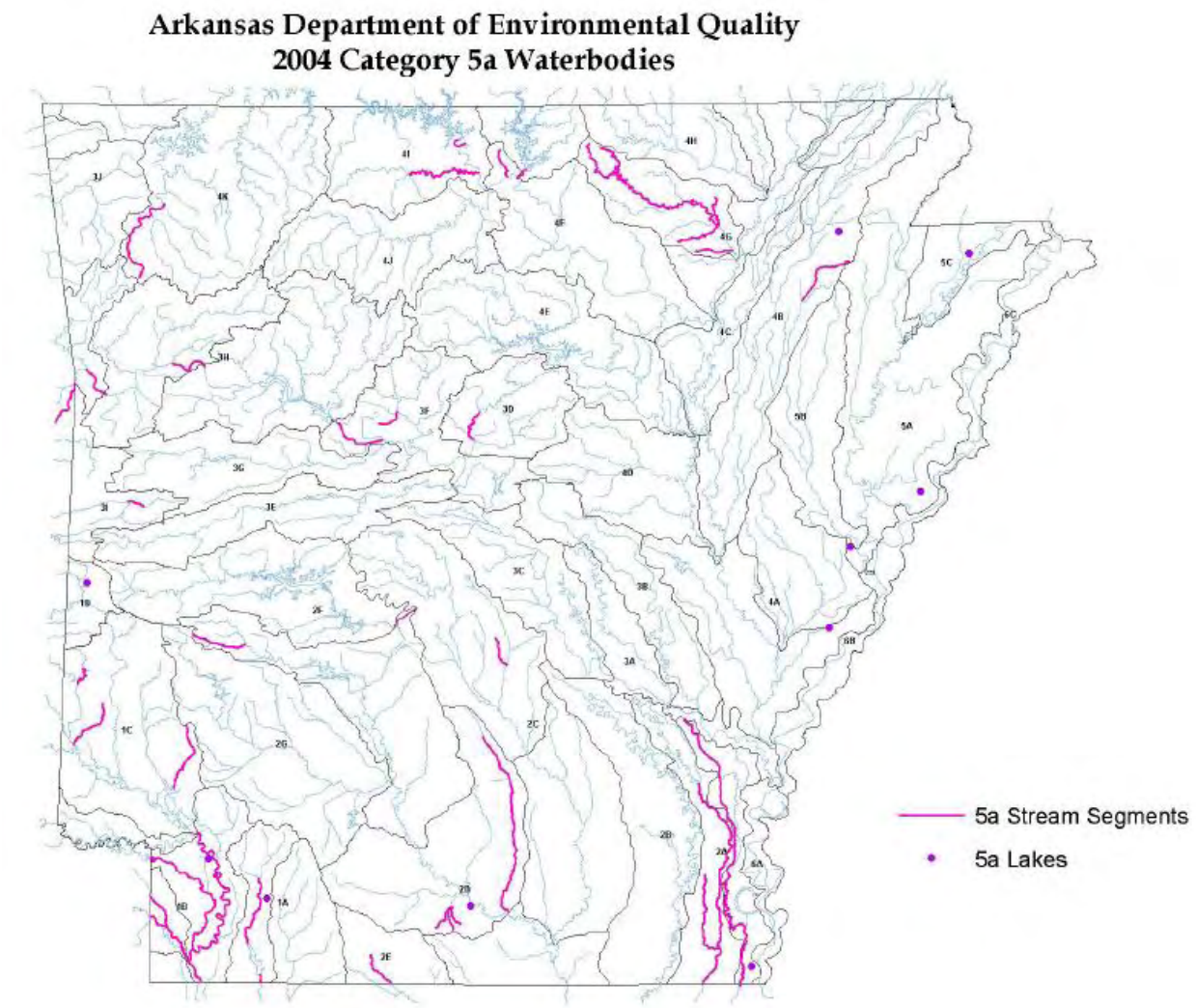

Figure 3.3. Arkansas 2004 303(d) Listed Waterbodies (5a classification indicates waterbody is impaired).

Nonpoint sources of pollution are generally more of a concern in Arkansas than point sources. Agriculture is often identified as a significant nonpoint source of pollutants of concern. In northern and western Arkansas, eight watersheds have been declared nutrient surplus areas by the state legislature (Figure 3.4). These areas are subject to state legislation requiring the use of agricultural practices that reduce the amount of nitrogen and phosphorus going into surface water (and groundwater) (Daniels et al., 2004; ADEQ, 2004; http://www.uaex.edu/Other_Areas/publications/HTML/FSA-29.asp). Other nonpoint source causes of water quality impacts that

have been identified by ADEQ (2002) include confined animal feeding operations; urbanization; gravel mining; extraction of resources such as oil, gas, and minerals; and channelization.

Figure 3.4. Designated Nutrient Surplus Areas in Arkansas.

Because there are water quality problems in the state, there are environmental groups and agencies that believe the existing water quality management framework is not adequate to protect Arkansas water resources. Some believe improvement is needed in how point sources of pollution are regulated or managed, or feel that the current system is not flexible enough to deal effectively with issues such as recently recognized water pollutants (e.g., medicines). Many believe nonpoint sources of pollution need to be managed better, and perhaps even formally regulated.

Twelve Arkansas watersheds have been identified through the ANRC Priority Watershed Program as priorities for development of Watershed Restoration Action Plans – locally led programs emphasizing voluntary implementation of conservation measures to reduce pollution from all land uses. They are the watersheds for Beaver Lake, Lower Little River, Illinois River, Strawberry River, Bayou Bartholomew, Little Red River, Cadron Creek, L'Anguille River, Poteau River, Smackover Creek, Buffalo River, and Big Piney Creek (ASWCC, 2003; http://www.aswcc.arkansas.gov/NPS_Webpage/NPS Priority Watersheds.htm).

3.5 Groundwater Quality

In general, groundwater quality in the state is very good (ADEQ, 2002). However, there are localized areas where groundwater quality is not good. In eastern Arkansas, there are localized occurrences of high iron and chloride concentrations in the Alluvial Aquifer (ADEQ, 2002; Schrader, 2004), and arsenic concentrations greater than the safe drinking water maximum contaminant level of 0.01 milligrams per liter. The arsenic appears to be naturally occurring (Kresse and Fazio, 2003). Pesticides also occur in the Alluvial Aquifer in measurable concentrations, although they are below safe drinking water levels (Kresse and Fazio, 2002; Kresse et al., 1997; http://www.adeq.state.ar.us/water/branch_planning/default.htm). Although the Alluvial Aquifer is generally not used for public water supply, many private wells used for drinking water do take water from the Alluvial Aquifer. Nitrate concentrations in the Springfield Plateau Aquifer in northern Arkansas are higher than the national median (Dixon et al., 2001); however, there are very few wells in Arkansas with nitrate levels that exceed the safe drinking water maximum contaminant level (ADEQ, 2002).

3.6 Health

Health-related water issues in Arkansas include water supply quality, bacteria, and fish consumption. In Arkansas, there are approximately 78 miles of streams designated for drinking water use that have water quality that does not meet drinking water standards. The nitrate drinking water standard is the one most often exceeded (ADEQ, 2002). There have also been incidences of groundwater nitrate concentrations above the drinking water standard in some wells (ADEQ, 2002). Eight Arkansas waterbodies were listed as impaired on the state 2004 303(d) list due to the presence of pathogens that could pose a health threat (http://www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_public_notice.pdf). Additional waterbodies are suspected to contain harmful pathogens, but the available data are inconclusive. ADEQ has recently adopted E. coli, rather than fecal coliforms, as the indicator of potential health threats from fecal contamination of water (ADEQ, 2005). As of 2000, there were active fish consumption advisories in 26 Arkansas waterbodies due to mercury, dioxin, and polychlorinated biphenyl (PCB) concentrations in fish (ADEQ, 2002). Mercury is the contaminant of concern most often cited in fish consumption advisories in the state; there are 20 state waterbodies with mercury-related fish consumption advisories (ADEQ, 2002). ADEQ noted in the 2002 305(b) report (ADEQ, 2002) that dioxin-related fish consumption advisories had decreased significantly between 1996 and 2000.

3.7 Flooding

The Federal Emergency Management Agency (FEMA) has determined that Arkansas is the fourth most flood-prone state in the nation (UALR, 1999). Eleven major riverine floods (floods caused by precipitation and runoff from a large watershed that crest in over 8 hours and result in flooding over large areas) and 129 flash floods (floods caused by heavy precipitation and runoff in smaller watersheds that crest in under eight hours and usually occur in hilly terrain) occurred in Arkansas between 1988 and 1998 (UALR, 1999). Between 1998 and 2005, there were five flood events in Arkansas that were declared major disasters (www.fema.gov/news/disasters_state.fema?id=5). In December 2004, the majority of Arkansas counties (57 out of 75) and approximately 243 Arkansas communities were participating in the

National Flood Insurance Program (http://www.fema.gov/business/nfip/statistics/pcstat.shtm). For the period of 1978 through 2004, FEMA reports that approximately $34 million in flood insurance payments were made to Arkansas (http://www.fema.gov/business/nfip/statistics/pcstat.shtm).

3.8 Water Quantity Management

Water resources in Arkansas must provide for multiple needs. The Arkansas River, for example, can provide transportation of goods, recreational opportunities, hydropower generation, wildlife habitat, commercial fishery, cooling water, drinking water, irrigation water, and aesthetic enjoyment. It can be difficult to manage a water resource like the Arkansas River to meet the needs of all of the desired and existing uses all of the time. Water use in Arkansas has exhibited an increasing trend historically (Figure 1.1), and as development and population continue to grow in the state and climate change affects water availability, allocation of water among agricultural, residential, industrial, transportation, power generation, and environmental needs will become more contentious. Particular water quantity management issues identified during the literature review include:

1. Irrigation water supply,
2. Water conservation,
3. Ambiguity of water management authority,
4. Interstate water transfer,
5. Water conflict resolution,
6. Allocation of water resources,
7. Integration of management decisions for all resources – water and otherwise,
8. Community growth and expansion of water and sewer utilities,
9. Privatization of water services, and
10. Climate change.

3.9 Environment

Water resources issues related to the environment that have been identified include in-stream habitat water quantity needs (ASWCC, 1990), wetlands loss (Arkansas Water Resources Center [AWRC], 1998, 1999; Arkansas Water Resources and Wetlands Task Force, 1994;

ADEQ, 2002), zebra mussels (AWRC, 1998), and climate change (Jacobs et al., 2000; United States Environmental Protection Agency (USEPA), 1998).

Arkansas is subject to conflicts between in-stream water needs (e.g., support of wildlife and maintenance of water quality) and human off-stream water needs (e.g., for municipalities, industry, agriculture) (ASWCC, 1990). This is an issue that has come up with surface water irrigation projects proposed in the Delta and with drinking water withdrawals in central Arkansas (Layher and Phillips, 2001; Evett et al., 2003). Environmental needs (in-stream flows for fish and wildlife, water quality, and aquifer recharge requirements) are considered in the ANRC procedures for evaluating excess water supply available for transfer (Title III). Under Acts 1051 of 1985 and 469 of 1989, ANRC is required to establish and enforce minimum stream flow requirements to protect in-stream water needs related to fish and wildlife support and water quality, as well as aquifer recharge, navigation, and interstate compact agreement requirements. ANRC has set site-specific minimum stream flows with input from ADEQ, the Arkansas Game and Fish Commission (AGFC), and the Arkansas Department of Parks and Tourism (Looney, 1990; ASWCC, 1990).

It has been estimated that by 1980, only 11 percent of Arkansas' historical wetlands remained (Dahl, 1990). The Arkansas Department of Parks and Tourism 1985 Statewide Comprehensive Outdoor Recreation Plan investigated wetland losses in the state and proposed a policy to abate wetland loss. The 1992 Statewide Comprehensive Outdoor Recreation Plan included the issue statement: "Arkansas must define and adopt a statewide no-net-loss wetland policy and take a proactive role to preserve, protect and restore our wetlands" (ADEQ, 2002). This concern exists even beyond national borders: the Ramsar Convention (an international agreement providing a framework for international cooperation for conservation of wetland habitats) designated the Cache/Lower White River as "Wetlands of International Importance" in 1989 (ADEQ, 2002; http://www.ramsar.org/sitelist.pdf, 2005). Several agencies have wetland restoration projects ongoing. As a result, National Resource Inventory data indicate that there was actually an increase in the acreage of wetlands in Arkansas between 1982 and 1992 (26,800 acres), the first increase in the history of the state (http://www.mawpt.org/wetlands/loss_gain.asp). Some sources believe that state wetland

resources are endangered by the fact that Arkansas has no wetland regulatory statutes or administrative rules beyond Section 404 of the Clean Water Act (http://www.aswm.org/swp/arkansas9.htm).

In 1997, AWRC identified zebra mussels as an environmental concern that could become a serious problem in the future (AWRC, 1998). Zebra mussels were discovered in the Arkansas and Lower White Rivers starting in 1992 (http://users.mo-net.com/flotilla6/zbra_msl.htm, http://midwest.fws.gov/endangered/clams/zebra.html). Zebra mussels can force out native mussel populations, change water body ecosystem processes, clog withdrawal and discharge pipes, and result in additional costs for their control and removal.

An additional water issue related to the environment that has recently been identified is the algae *Didymosphenia germinate* (Didymo). Blooms of this algae began occurring in Arkansas rivers downstream of reservoirs in 2005 (http://www.adeq.state.ar.us/water/didymo.htm). Didymo blooms have become fairly common in reservoir tailwater streams in the West, where they are blamed for declining trout fisheries. These algae aren't known to harm trout directly, but there is evidence that it interrupts the life cycle of crustaceans on which the trout feed. Didymo also out-competes other algae on which the crustaceans primarily feed. Currently, Didymo is known to occur in Arkansas in the White River below Bull Shoals Dam, in the Little Red River near Heber Springs, and in the North Fork River below Lake Norfork. In addition to potentially affecting fish populations, Didymo is known to clog water intakes.

3.10 Recreation

In the early 1980s, outdoor recreation contributed over $15 billion to the Arkansas economy (Wilson, 1986). Proposals to develop water resources often conflict with preservation and conservation efforts of significant streams that contribute to recreational opportunities in Arkansas (ASWCC, 1990). There have been several examples in Arkansas of conflicts between waterfront landowners and the public who desire to use waterbodies for recreation. These conflicts are usually decided based on the determination of whether the water body in question is navigable and thus a private or public water resource (Goodhart, 2002). Conflicts between

off-stream water uses, such as irrigation, and in-stream water uses, such as sport fisheries and waterfowl habitat, also exist (e.g., Grand Prairie Project).

There are occasions when reservoir operations affect recreation associated with the reservoirs. Fluctuating water levels can impact boaters, boat docks, fishing, and aesthetics of the reservoir. As population and development in the state increase, the demand for water-related recreation also increases. This situation requires careful management of water recreation areas to protect them from damage due to overuse (Tetra Tech, Inc., 2002). There can also be conflicts between different types of recreation on waterbodies, such as conflicts between fishermen, boaters, and Jet Skiers.

Water quality can also affect water recreation. Certain levels of water quality are required for a water body to be considered suitable for activities such as swimming. There are eight waterbodies on the Arkansas 2004 303(d) list of impaired waterbodies because the water quality makes them unsuitable for human contact (e.g., swimming) (ADEQ, 2005). Water quality can also affect the quality of sport fisheries. There are over 75 waterbodies on the Arkansas 2004 303(d) list for not being able to support their designated aquatic life use, which could have impaired sport fisheries (ADEQ, 2005).

3.11 Financial

The need for financial assistance for water development was identified as a water resources issue for Arkansas in the State Water Plan (ASWCC, 1990). Specifically, funding sources were deemed inadequate to meet existing needs for assistance in building water supply and wastewater projects, in terms of the monies available and in terms of the requirements associated with using the available funding sources (ASWCC, 1990). In 2001, the Governor's Water Resources and Wetlands Task Force recommended that 20 percent of the General Improvement Funds be allocated for critical water needs starting in 2003 (AWRC, 2001). Currently, the financial resources required to upgrade aging water systems are a national concern – $6 billion has been appropriated for the state revolving loan fund program, but nationally there are approximately $246 billion worth of needs (Wright et al., 2005). A recent survey reported that over 60 percent of mayors, representing 414 cities, identified aging drinking

water and wastewater facilities as their top priority (Saiyid, 2006). The American Society of Civil Engineers estimated that in 2005 Arkansas had $500 million in wastewater infrastructure needs, and that the drinking water infrastructure would need $1.5 billion in repairs over the next 20 years (http://www.asce.org/reportcard/2005/page.cfm?id=43).

3.12 Public Awareness

Several water resources education and outreach programs exist in the state. Examples include the education and outreach programs of ADEQ, Cooperative Extension, ANRC, AGFC, and Natural Resources Conservation Service (NRCS), as well as the Arkansas Multi-Agency Wetland Planning Team (MAWPT) wetland education projects (ADEQ, 2002). A recent survey of Jefferson County residents living in the Bayou Bartholomew watershed revealed that the residents were not knowledgeable about where their stormwater goes, or how their activities affect stormwater water quality (http://www.stormwaterauthority.org/library/view_article.aspx?id=221). Thus, the need still exists for continued education and outreach efforts.

Most existing educational efforts in the state focus on water quality and environmental issues. There is also a need for public education about water quantity needs and alternatives for supply. Education of farmers in more efficient irrigation methods, management, and equipment already occurs, but needs to be continued and expanded (Evett et al., 2003; Scott et al., 1998; Robinson et al., 2003).

3.13 Social and Cultural Impacts of Arkansas Water Resources

There is very little information currently available documenting the interaction of social issues and water issues in Arkansas. The one place where it is relatively easy to note intersections of social and water issues in the state is the Delta Basin. This region of Arkansas has the highest incidence of poverty in the state (http://argis.ualr.edu/2000census_pdf/socioecon/pctind.pdf), experiences the majority of flood damage in the state (ASWCC, 1990), and is experiencing significant groundwater supply depletion and groundwater quality issues (e.g., localized high levels of arsenic and atrazine in the Alluvial Aquifer). Also, the agricultural economy of the Delta Basin could be affected by reduced water availability or

usage (Evett et al., 2003). NRCS has identified a number of irrigation projects being considered for funding by the state legislature and Congress that invest significantly in maintaining the irrigated agriculture economy and agricultural lifestyle of this region. Some of these projects have raised objections from other sectors of the state about tax money being taken from them to fund these projects, and from other agencies regarding potential environmental effects of the projects. The Grand Prairie Irrigation Project is facing such opposition.

Water is an important part of the cultural identity of Arkansas. The official state nickname, "The Natural State," implies good-quality water resources. Arkansas water resources such as the Arkansas River and the thermal springs of Hot Springs are state landmarks that have figured significantly in the history, development, and culture of the state. These and other water resources, such as the Buffalo National River and 13 major lakes, attract people to Arkansas for recreation and to live. The major retirement communities in Arkansas are located on or near rivers or lakes. Arkansas water resources contribute to Arkansas' quality of life.

4.0 CENSUS DATA

Arkansas census data were examined to provide insight into Arkansas water issues. In particular, we were interested to see if there was any apparent intersection of water issues and socioeconomic conditions. The most recent information and changes were judged to be the most informative; therefore, state census data from 1990 and 2000 were examined. These census data were summarized by basin (see Figure 2.1) and county by the Census State Data Center at the University of Arkansas at Little Rock Institute for Economic Advancement.

4.1 Population Characteristics

Approximately one-third of the state population lived in the Arkansas River Basin (which covers 20 percent of the state land area) in 1990 and 2000 (Table 4.1). Around 25 percent lived in the Delta Basin (26 percent of the state land area), and almost 20 percent in both the Ouachita River (25 percent of state land area) and White River (22 percent of state land area) Basins, with the remaining 5 percent in the Red River Basin (8 percent of state land area). Between 1990 and 2000, the Arkansas River and White River Basins experienced the greatest increase in population (Arkansas River Basin increase of 151,824 people, approximately 20 percent; White River Basin increase of 87,189 people, approximately 23 percent). Population in the Red River Basin changed the least between 1990 and 2000 (5,742 people, four percent increase).

The Arkansas River Basin appears to be the most heavily populated basin in the state (33 percent of the population in 20 percent of the land area). In the 1990 State Water Plan, ANRC identified the Arkansas River corridor as a critical surface water area with limited local water resources. During the 2005 drought, there were communities in this basin that experienced difficulty meeting water supply demand (e.g., Perryville in Perry County). However, a number of the communities in central Arkansas (which includes portions of the Arkansas River Basin) have banded together to work on meeting their water supply needs through Central Arkansas Water. Central Arkansas Water was able to supply its customers without rationing during the 2005 drought. However, continued growth in this area of the state may eventually strain the available water supply, prompting attempts to expand the water supply or rationing.

Table 4.1. Arkansas Population and Race Characteristics by Major Basin.

Information	Year	Arkansas River Basin	Delta Basin	Ouachita River Basin	Red River Basin	White River Basin
Percent State Land Area		20%	26%	25%	8%	22%
Total Population	1990	766,994	621,896	449,042	129,780	383,014
	2000	918,818	652,477	496,397	135,504	470,204
Urban Population	1990	495,763	381,453	204,102	53,698	123,182
	2000	571,457	390,922	222,529	53,965	162,967
Rural Population	1990	271,230	240,443	244,940	76,082	259,832
	2000	347,361	261,555	273,868	81,539	307,237
White	1990	658,291	458,123	357,186	98,313	372,481
	2000	745,500	463,733	388,071	98,721	441,141
Black	1990	92,242	158,207	87,847	29,453	5,704
	2000	115,106	171,243	93,420	29,969	8,143
Other Race	1990	16,461	5,566	4,009	2,014	4,829
	2000	41,500	10,526	9,288	4,665	14,292
Hispanic	1990	7,594	4,363	3,370	1,679	2,580
	2000	40,773	12,331	10,233	6,174	16,065
Foreign-Born	1990	11,655	4,688	3,748	1,323	3,453
	2000	37,139	9,575	8,787	4,497	13,692
Not U.S. Citizen	1990	6,627	2,499	1,420	823	1,377
	2000	26,548	6,161	5,690	3,356	9,880

In 2000, around 60 percent of the population in the Arkansas River and Delta Basins were located in urban areas. Sixty percent or more of the population in the Red River and White River Basins were located in rural areas. In the Ouachita River Basin, the population was pretty evenly split between urban (45 percent) and rural (55 percent) areas. The population increase between 1990 and 2000 in the Arkansas River Basin was pretty evenly split between urban and rural areas. In the other basins, the majority of the population increase between 1990 and 2000 occurred in rural areas. Water in rural areas is mostly supplied by rural water utilities and private groundwater wells. The majority of the rural population in Arkansas was served by rural water

utilities in 2000 (see Section 1.2). The amount of water supplied from private wells actually decreased from 51 mgd in 1990 to 28 mgd in 2000 (http://www.usgs.gov/watuse).

With regard to race, the Arkansas River and Delta Basins had the largest numbers of people who classified themselves as "white" in 2000; however, the White River Basin had the largest percentage of population classified as white (94 percent), and the Delta Basin had the lowest percentage (71 percent). In 2000, approximately 35 percent of Arkansas' white population lived in the Arkansas River Basin; around 20 percent each in the Delta, Ouachita River, and White River Basins; and around five percent in the Red River Basin. In 2000, the Delta Basin had the largest number and percentage (26 percent) of people who classified themselves as "black." The Arkansas River Basin had the largest number and percentage (five percent) of people who classified their race as something other than white or black, and the largest number of people who classified themselves as Hispanic. The Red River Basin had the largest percentage of people who classified themselves as Hispanic (five percent).

In all of the basins, the Hispanic population showed the greatest percent increase between 1990 and 2000, ranging from a 182 percent increase in the Delta Basin to over a 500 percent increase in the White River Basin. In the Red River Basin, the increase in the numbers of Hispanics between 1990 and 2000 was greater than the increase in the numbers for any other race classification. In the Arkansas River, Ouachita River, and White River Basins, the increase in the number of Hispanics was second only to the increase in the number of whites. In the Delta Basin, the increase in the number of Hispanics was second only to the increase in the number of blacks.

The number of foreign-born residents in the state also increased dramatically between 1990 and 2000 (Table 4.1). In the basins, the increases ranged from doubling in the Delta Basin to quadrupling in the White River Basin. The number of residents who were not U.S. citizens increased even more dramatically between 1990 and 2000. In the Delta Basin, the number of residents who were not U.S. citizens increased by two and a half times; in the Ouachita River, Arkansas River, and Red River Basins, the number increased by four times, and in the White River Basin, the number increased by over seven times.

With regard to age, the age distributions in all of the basins are similar to the age distribution for the state as a whole (Figure 4.1).

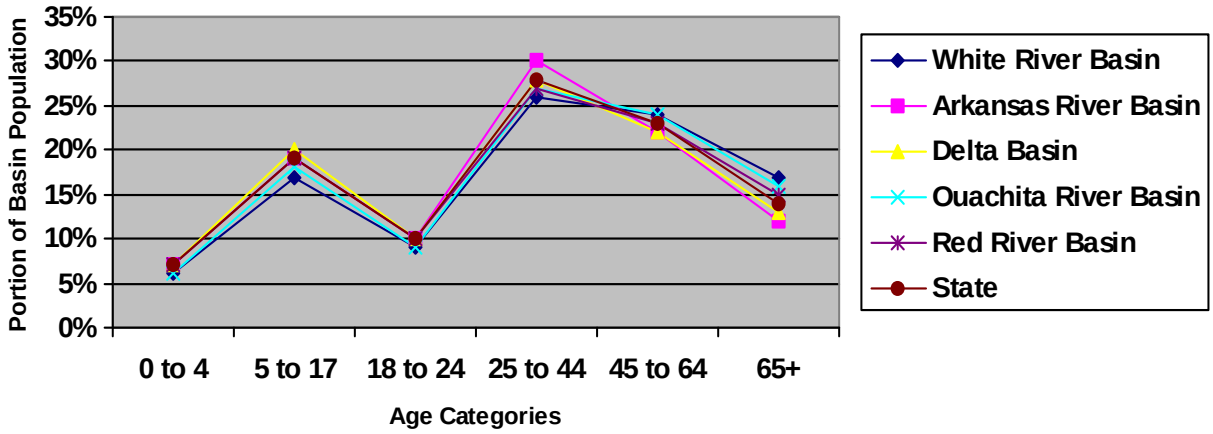

Figure 4.1. Comparison of Age Distributions Between Basin Populations and State Populations.

4.2 Income Characteristics

Median household income could not be calculated for the basins. Between 1990 and 2000 the median household income in Arkansas increased from $21,147 to $32,182. Median household income increased in all counties in Arkansas, with Lonoke County seeing the greatest increase (>$16,000). The counties in the Delta Basin had the lowest average median household income in 2000 ($27,524), and the counties in the Arkansas River Basin had the highest average median household income ($32,489) (Figure 4.2).

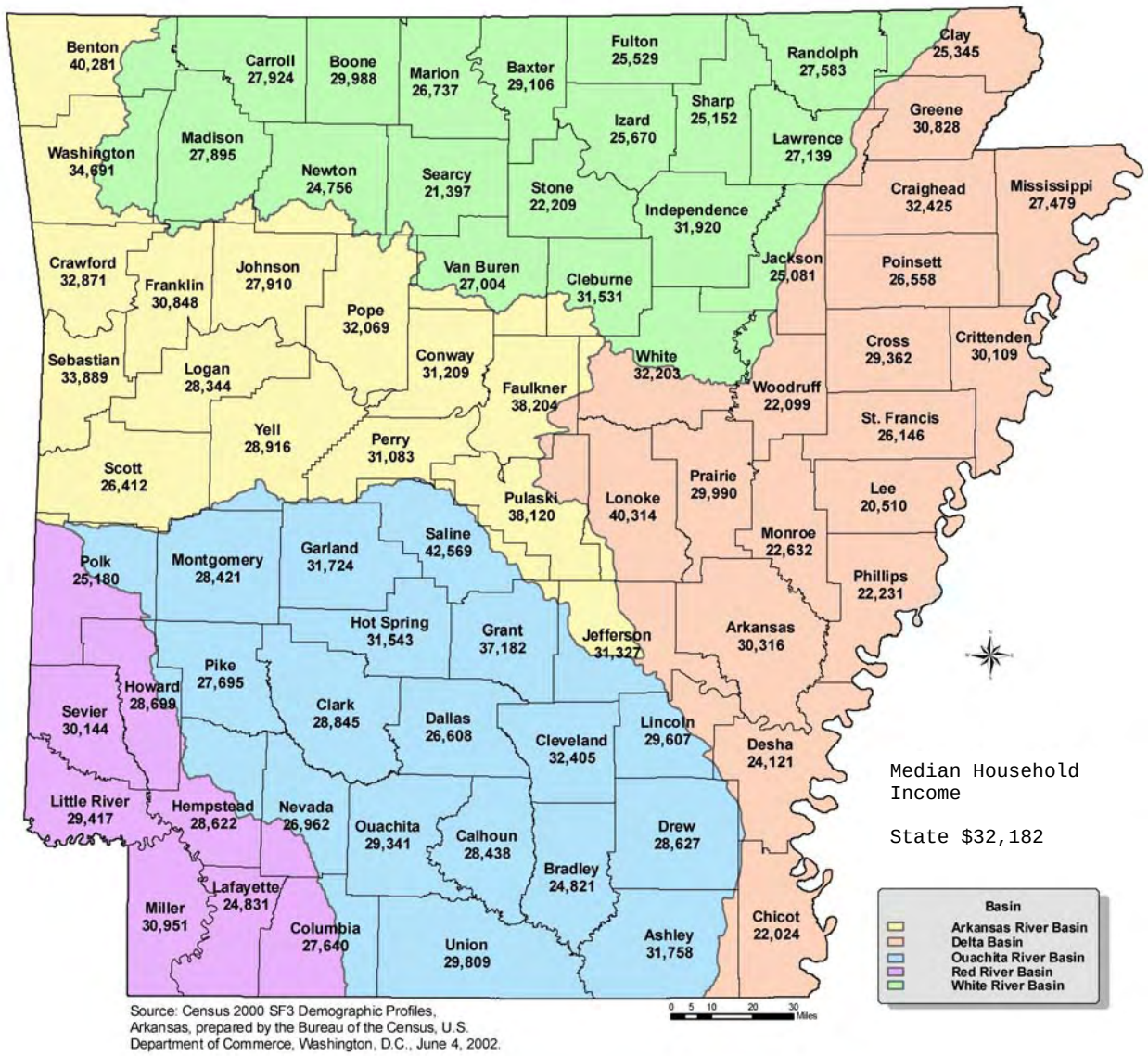

Figure 4.2. Arkansas Median Household Income in 2000 by County.

In 2000, the Arkansas River Basin had the highest number of persons below the poverty level. In 1990, the Delta Basin had the highest number of persons below the poverty level. Between 1990 and 2000, the number of persons below the poverty level decreased in all of the basins except the Arkansas River Basin, which actually saw an increase in the number of persons below the poverty level. Despite the high numbers of persons below the poverty level in the Arkansas River Basin, the percentage of people in this basin below the poverty level in 2000 was lower than the percentage for the whole state. The 2000 percentages for the White River and Ouachita River Basins were also below the state percentage. The 2000 percentage of persons below the poverty level was greater than the percentage for the whole state in the Delta and Red River Basins.

Persons on fixed income from Social Security or retirement plans tend to have an outlook that is based on managing their assets, whereas other people tend to have an outlook that is based on managing their revenue. Those on Social Security or retirement income are sensitive to activities that negatively affect their assets, such as tax increases. Increasing taxes is an option for raising funds to repair and/or upgrade water utility infrastructure, or for other aspects of water quality and/or quantity management in Arkansas. Therefore, we evaluated census information on the number of households in each basin receiving Social Security or retirement income.

The Arkansas River Basin had the highest number of households receiving earnings from Social Security and retirement income, both in 1990 and 2000 (Table 4.2). However, in both 1990 and 2000, the White River Basin had the greatest percentage of households receiving Social Security income, and the Ouachita River and White River Basins had the greatest percentage of households receiving retirement income. In both 1990 and 2000, the Arkansas River and Delta Basins had the lowest percentage of households receiving Social Security income, and the Delta Basin had the lowest percentage of households receiving retirement income. The number of households receiving Social Security and retirement income increased between 1990 and 2000 in all the basins. The percentage of households receiving retirement income also increased between 1990 and 2000 in all of the basins; however, the percentage of households receiving Social Security income decreased between 1990 and 2000 in all of the basins except the Ouachita River Basin, where the percentage stayed the same.

Table 4.2. Summary of Income Characteristics for Arkansas.

Information	Year	Arkansas River Basin	Delta Basin	Ouachita River Basin	Red River Basin	White River Basin	State
Persons Below Poverty Level	1990	110,837	144,634	83,660	28,157	69,801	437,089
	2000	122,738	119,769	75,629	25,237	68,404	411,777
Total Households	1990	289,876	230,329	169,599	48,365	153,496	891,665
	2000	353,177	249,961	194,636	52,441	192,593	1,042,807
Households with Social Security Income (number & percentage)	1990	83,254 (29%)	69,046 (30%)	57,988 (34%)	16,277 (34%)	56,762 (37%)	283,327 (32%)
	2000	97,169 (28%)	70,807 (28%)	65,307 (34%)	16,694 (32%)	66,721 (35%)	316,698 (30%)
Households with Retirement Income (number & percentage)	1990	43,062 (15%)	27,042 (12%)	27,042 (16%)	6,526 (13%)	25,126 (16%)	128,798 (14%)
	2000	55,218 (16%)	35,689 (14%)	36,205 (19%)	8,138 (16%)	34,290 (18%)	169,540 (16%)

4.3 Arkansas Housing Characteristics

Examining the number of housing units lacking complete plumbing and/or kitchen facilities may give an indication of where in the state people may not have access to safe water. In 2000, the largest number of housing units lacking complete plumbing facilities and complete kitchen facilities was in the Arkansas River Basin. The percentages of housing units lacking complete plumbing and kitchen facilities was low in all of the basins, one percent or less. The highest percentages of housing units lacking complete plumbing facilities and units lacking complete kitchen facilities were in the White River Basin (one percent and 0.8 percent, respectively). Between 1990 and 2000, the numbers of housing units lacking complete plumbing *and* kitchen facilities decreased in all of the basins. The greatest percent decreases occurred in the Red River Basin (around 66 percent decrease in both number of housing units lacking complete plumbing and number of housing units lacking complete kitchen facilities).

5.0 ARKANSAS WATER ISSUES

5.1 Statewide Telephone Survey

A statewide telephone survey to collect information about the views of Arkansas' adult population regarding water issues of importance across the state was designed and conducted by the Survey/Business Research Group of the Institute for Economic Advancement at the University of Arkansas at Little Rock. The telephone survey was conducted in May 2006. Four hundred seven random participants were interviewed from across the state. The interview results are reported in "Water Issues and Beliefs in Arkansas: A Statewide General Population Survey," a copy of which is included on the DVD. A short summary of some of the survey results is included below.

When asked about drinking water supplies, the majority of respondents reported that their household water supply was safe to drink, and average-priced. Over two-thirds of respondents used city-supplied water. When asked about wastewater, the majority of respondents reported that their community wastewater systems were adequate. Approximately half of the respondents were on city wastewater treatment systems, and approximately one-third used septic systems. Nearly all respondents viewed water as an important issue for Arkansas' long-term growth and prosperity. Water pollution was the water problem most frequently identified by respondents. Most respondents indicated that state and local governments bear primary responsibility for fixing water problems.

5.2 Personal Interviews – Targeted Organizations

Personal interviews were conducted with over 75 individuals from local, state, or federal government agencies, municipalities, counties, industry, agriculture, utilities, professional and trade organizations, watershed associations, nonprofit organizations, and academia. These individuals and their organizational affiliations are listed in Appendix B.

Ten open-ended questions were asked during each interview. These questions and a synopsis of the responses are discussed in this section. Specific responses to these questions are listed in Appendix C. Because many individuals had similar responses to each of the questions,

an attempt was made to list each response only once. In some instances, slightly different wording conveyed a slightly different meaning. In these cases, both responses are listed. While the individuals interviewed are listed in Appendix B, no responses are associated with specific individuals.

Question 1: Do you think water is an important issue for Arkansas' current and future prosperity? If so, how?

This question was answered with a resounding "Yes." No one stated that water was not important for Arkansas' current or future prosperity. In fact, several respondents indicated water should be the number one priority in the state because nothing – businesses, agriculture, cities, fish, wildlife, or individual citizens – can exist without water. Some respondents provided examples of the importance of water for tourism, recreation, agriculture, and growth of municipalities and industry in the state. Arkansas' image as The Natural State is dependent upon the abundance of high-quality water.

In responding to the second part of this question, many respondents began identifying water issues. These issues ranged from supplying water to municipalities and industries without damaging Extraordinary Resource Waters, to losing jobs to other states with reliable water sources, to the need to plan for a 50-year time horizon. Specific responses to this question are shown in Appendix C, Table C.1.

Question 2: Is your agency/company/organization actively involved in water management in Arkansas? If so, how? If not, what do you think you can contribute?

By defining water management broadly, every individual interviewed, from politician to water resources engineer, was involved in water resources management. Management activities identified included serving as a member of a watershed association, creating aquatic bird habitats, managing rural water districts, proposing legislation, enforcing regulations, planning future development (including future water projects), developing educational programs on water, implementing watershed best management practices, and managing regional water systems. Because water is an essential part of our lives, the range of activities associated with water resources management is staggering. Specific responses are listed in Appendix C, Table C.2.

Question 3: What do you consider to be the top priority water problem (issue) in our state, region (of the state), or a specific locality that needs to be addressed?

The most commonly stated problem related to water quantity was groundwater depletion, both of the Alluvial Aquifer and the Sparta Aquifer. The most common water quality problem stated was nonpoint source sediment and nutrient loads to waterbodies. Other water problems or issues included the Arkansas Pollution Control and Ecology Commission having state agency directors on it, property rights outweighing protection of water quality, outdated water allocation in federal reservoirs, poor drought contingency planning, an infectious diatom (a form of algae) below Bull Shoals Lake, and the need for increased funding for navigation projects. Specific responses are listed in Appendix C, Table C.3.

Question 4: In your view, what are the water problems (issues) in our state that have the most impact on the citizenry of Arkansas?

While issues similar to those in the previous question were raised, there were also other responses that provide additional insight into some of the water issues and problems perceived by respondents. These responses included the lack of groundwater standards, the increased cost of providing clean drinking water because of nonpoint source pollution, fish tissue contamination by toxic chemicals, the Oklahoma-Arkansas lawsuit over water quality in the Illinois River, impacts of global warming on water availability, the need to replace aging and failing infrastructure (water and sewerage distribution lines, treatment facilities, etc.) in many of our communities, growing rice instead of other crops that need less water, and lack of long-term agreements for water diversion. Within a given theme, such as regulation, there was a range of perspectives from inadequate enforcement of regulations for nonpoint source pollution to too-restrictive enforcement of regulations on building new impoundments for water supply. Specific responses are listed in Appendix C, Table C.4.

Question 5: What barriers exist to resolving these problems or issues listed in the two questions above?

The issue identified by every respondent as a barrier to resolving water problems or issues was ignorance. Ignorance was defined as: a lack of understanding about various water

issues by all constituents (agencies, organizations, elected officials, industry, agriculture, the public); lack of knowledge about the water cycle; lack of understanding about the effects of individual or community activities on water quantity or quality; lack of a comprehensive perspective on how water interacts with the environmental, economic, and social sectors; and lack of insight into the long-term consequences of our current activities.

Additional barriers identified by respondents included polarization among individuals and groups with no interest in seeking middle or common ground, citizen apathy about water issues, lack of funding to address issues, the complex nature of water issues, lack of agency and elected official leadership in addressing water issues, and water being taken for granted, assuming it would always be available. The lack, or eroding, of a stewardship ethic for water was in the background of many comments made by respondents. Specific responses are listed in Appendix C, Table C.5.

Question 6a: What are the water problems in our state, region (of the state), or a specific locality that affect your agency/organization the most?

While similar issues were raised as for the questions above, previous responses were typically broader in scope than just those issues important to their agency or organization. Agency or organizational issues included stream bank erosion during housing or commercial development, protection of Extraordinary Resource Waters, alternative water supply sources, river restoration in the Delta, lack of data on water uses, being able to triage wetlands that are not sustainable, and lack of coordinated and integrated approaches to water resources management. Additional responses are listed in Appendix C, Table C.6.

Question 6b: What potential strategies or options could be implemented to help mitigate these problems or issues?

Respondents not only identified water resources issues and problems, but also identified potential tools and policy options for the solution or resolution of these issues. Because a major issue or barrier was lack of understanding, education and outreach to all sectors were mentioned by interviewees. Tools or policy options were proposed for each issue or problem raised during the interview. For some issues, new approaches were proposed. Many solutions also called for

greater involvement of civil society institutions such as watershed associations in water resources management and public education and involvement. Most tools were not presented as the only solution, but rather as part of the solution to be integrated with other tools. Respondents recognized that with the current polarized situation on most societal issues, win-win solutions are needed to move forward toward sustainable water resources management in Arkansas. Strategies and tools identified by the respondents are listed in Appendix C, Table C.7.

Question 7: Do you believe appropriate resources are in place to properly address the water issues or problems you have identified? If not, can you provide an estimate (economic cost) of what is realistically needed to address these problems?

The consensus answer to this question was "no" – adequate resources are not available to solve water resources problems. Estimates were provided for specific issues, but there were no estimates of how much a comprehensive approach to sustainable water resources might cost. For example, one respondent indicated state education and outreach programs would need at least $500,000 annually. Another respondent indicated that over $1 billion would be needed to address groundwater depletion of the Alluvial Aquifer. Yet another respondent estimated that $10 to $15 million per year might be needed to manage the Beaver Lake watershed. Most respondents acknowledged that water is so heavily subsidized that the true cost of water and water resources management is unknown. Studies that quantified the cost and benefits of water resources management would allow for more informed decisions on priorities and approaches to water resources management. Additional responses are listed in Appendix C, Table C.8.

Question 8: In your view within the next 5 to 10 years, what do you see as emerging or potentially worsening water problems for the state, or region (of the state), or a specific locality?

Many respondents indicated the issues we currently face will not be resolved in the next 5 to 10 years and will continue to be with us. There were several additional issues identified, however, that respondents thought would become more important over the next 5 to 10 years. These included the effects on both surface and groundwater from developing the Fayetteville Shale Play. Other issues included the need for better understanding of the effects of

pharmaceuticals and agricultural chemicals (such as Round-Up and atrazine) on aquatic plants and animals, and the extent of contamination of drinking water sources by these chemicals. The continuing trend of rural development and increasing conflicts over private versus public rights to use water for multiple purposes was a concern mentioned by several respondents. Additional responses are listed in Appendix C, Table C.9.

Question 9: What are potential strategies or options that could be implemented to help mitigate these problems or issues raised in the previous question?

As with previous solutions, respondents emphasized the importance of education and outreach, particularly with emerging problems and issues. Preventing issues from developing is much more cost-effective than restoration or remediation efforts after problems have occurred. Some of the same solutions were suggested for emerging issues as were raised for existing issues, including developing comprehensive approaches for both policy and management of watersheds and waterbodies; conjunctive management of surface and groundwater quantity and quality; developing long-range plans for water resources management, including replacement of aging infrastructure and development of new water supplies; and identifying funding sources and opportunities for leveraging existing funds. Specific responses to this question are listed in Appendix C, Table C.10.

Question 10: Do you have any other comments or suggestions for solving water problems within Arkansas?

Many of the responses to this question reinforced the importance of a comprehensive, integrated approach to addressing water issues within the state. For a number of legitimate reasons, we have had a piecemeal approach to water resources management in the past. Nearly all respondents indicated this approach must change in the future if we are to move toward sustainable water resources in Arkansas. This includes a comprehensive approach to everything from education to source water protection; aquifer recharge to wetland restoration; conservation to cost-effective water treatment, reuse, and recycling; leveraging to leadership; and effectively using the talent and knowledge of all Arkansans to resolve water resources issues. Specific responses are listed in Appendix C, Table C.11.

5.3 Summary and Discussion

Is water important for Arkansas' long-term growth and prosperity? This is a fundamental question, and the answer affects how we think and act about water. Everyone interviewed in person, as well as more than 96 percent of the telephone survey respondents, agreed that water is vital to Arkansas' long-term growth and prosperity. The basic overarching reason was because water is necessary for life. Given that water is important, what issues have been raised with respect to water in Arkansas? A synopsis of the high-priority water resources issues identified by Arkansans is shown in Table 5.1.

Table 5.1. High-Priority Water Resources Issues for Arkansans.

High-Priority Water Resources Issues for Arkansans	
• Lack of Understanding about Water	• Lack of Stewardship
• Water Pollution	• Adequacy of Laws and Regulations
• Groundwater Depletion	• Inadequate Funding
• Flooding	• Inadequate Planning
• Inadequate Water Distribution	• Ineffective Leadership
• Water Shortages	• Ineffective Management

5.3.1 Lack of Understanding About Water Resources

The one issue that was identified during every personal interview, regardless of affiliation, was a lack of understanding about water resources. Both the telephone survey and personal interview respondents noted that water is such a multi-faceted subject that no one – public officials, government agencies, academics, commercial and agribusiness, or citizens – has sufficient knowledge to understand all facets of water resources issues.

Many raised concerns that were based on perception, rather than facts and science. Perceived problems are important, however, because they suggest people may make decisions about water issues without knowing the facts. Misperceptions will remain an issue as long as getting a clear grasp of all facets of water resources eludes us.

5.3.2 Water Pollution

Nearly all respondents identified water pollution as a priority issue. They mentioned point source pollution from municipal and industrial wastewater discharge, as well as nonpoint source pollution generated by agricultural runoff and stormwater runoff from commercial and industrial sites, real estate development, mining activities, and other land uses. Most respondents acknowledged the significant progress made in treating and controlling point source pollution over the past 25 years. They linked most current water quality issues to nonpoint pollution sources.

5.3.3 Groundwater Depletion

Likewise, a great majority of respondents cited groundwater depletion of both the Alluvial Aquifer and the Sparta Aquifer. Some said the depletion of these aquifers is already a crisis.

The depletion of the Alluvial Aquifer in the Delta has led to the drilling of irrigation wells into the Sparta Aquifer, which previously served primarily as a source of municipal water. Respondents raised concerns about pumping the Sparta Aquifer for agricultural irrigation, potentially jeopardizing the ability of municipalities to rely on this groundwater supply of drinking water for their citizens.

Drinking water versus irrigation illustrates one of many conflicts that are associated with water. These conflicts arise because for many water uses there are virtually no substitutes for water to satisfy these desired uses.

5.3.4 Flooding

The ebb and flow of water include cycles of flooding and drought. Respondents raised both flooding and water shortages as priority water issues for Arkansas. Many believed that commercial and residential development have contributed to both problems.

Increasing the number of buildings and amount of paved area in a watershed increases the likelihood of flooding because it prevents water from soaking into the ground. Rain runs off roads, parking lots, and rooftops too fast for streams to handle. They overflow and flood the area.

5.3.5 Inadequate Water Distribution

Floods and periods of drought both bring Arkansas' inadequate water distribution to the surface. We lack the storage capacity to capture the floodwaters for future use. In times of shortage, we lack the ability to transport water from where it might be available to where it is most needed.

5.3.6 Water Shortages

In addition to flooding, rapidly developing areas also are prone to water shortages. Respondents linked the cause of water shortages to an increased demand that exceeds the capacity of existing infrastructure (i.e., municipal water, mains and pipes) to deliver the water in some communities (e.g., the Bentonville and Rogers areas of northwest Arkansas).

5.3.7 Lack of Stewardship

Many respondents cited the need for a stewardship ethic as opposed to an ownership mentality they say is prevalent in Arkansas (i.e., "I own the land, I own the water.") In addition, many respondents said conflicts are increasing due in part to a polarity on water issues with an unwillingness to seek middle ground being the norm rather than the exception.

One respondent with 30 years of professional experience said polarization over water issues among individuals, groups, and organizations is more intense than ever. Those with disagreements seem to prefer turning these issues over to the courts rather than working toward a solution agreeable to both. In fact, several individuals declined to be interviewed for this study because of ongoing legal action, or fear of litigation, arising from water issues.

5.3.8 Adequacy of Laws and Regulations

Respondents had differing perspectives on this issue. Some maintained adequate laws exist but are insufficiently enforced, while others declared that existing statutes and regulations are clearly inadequate.

Although the adequacy of existing rules was in dispute, respondents generally agreed on the need for a review of existing laws and regulations and a more comprehensive water code.

Given polarized views, however, the respondents voiced skepticism about the possibility of enacting a comprehensive set of water laws.

5.3.9 Inadequate Funding

Respondents expressed nearly uniform agreement on the need for more money to address water issues. They listed numerous activities the required funding: replacing aging infrastructure such as drinking water and sewer lines in both urban and rural areas; building new treatment facilities; constructing additional water storage and/or distribution systems; monitoring water quantity and quality in lakes and streams; developing educational and instructional material on water issues; and restoring impaired waterbodies and watersheds. Most respondents said they had no idea how much money was needed, but there were estimates of up to $3 billion.

5.3.10 Inadequate Planning

Many respondents labeled the existing Arkansas Water Plan, which has not been updated since 1990, as inadequate and antiquated. Over the past 16 years, other states and agencies have enacted regulations and approaches that promoted more comprehensive management of water resources. Without a comprehensive set of laws (water codes that consider the entire water cycle and the effects on the environment, society, and economy in making decisions about water use), there can be no comprehensive water plan. Without a comprehensive plan, ineffective, inefficient, piecemeal approaches will continue to be used in addressing water issues.

5.3.11 Ineffective Leadership

Many personal interview respondents and more than half of the telephone-survey respondents indicated that either local or state government leaders have failed to place an appropriate emphasis on water in Arkansas, or that they (respondents) “don’t know” if government leaders are giving water issues enough emphasis. Sixty-two percent of the public random-survey respondents assigned the responsibility for fixing water problems to local and state governments.

Telephone-survey results also indicated a need for greater public education about various water resource initiatives and activities, both ongoing or in the planning stages.

5.3.12 Ineffective Management

Most respondents believed Arkansas lacks effective water management. They gave several examples: the management of surface water and groundwater as if they are two independent sources, disputes between municipalities and regional water authorities, and last-resort consideration (if considered at all) of conservation, reuse, and recycling. They also noted that conflicts arising among multiple uses (e.g., recreation, water supply, hydropower generation, fish and wildlife protection) occur in many waterbodies.

Respondents said litigation is usually the first choice for resolving water-use conflicts, rather than giving collaboration and cooperation a try. In addition, many respondents indicated there is no "champion" for water in Arkansas.

Management responsibilities for sustaining water quantity and water quality are distributed over multiple agencies, with fuzzy lines of authority and responsibility.

6.0 FUNDAMENTAL TRUTHS

We believe some fundamental truths apply as a starting point for discussing water in Arkansas. These principles represent our synthesis of survey- and interview-respondent comments, a review of articles and reports, and a framework and guidelines for sustainable water resources management. These fundamental truths are listed in Table 6.1 and briefly described below.

Table 6.1. Fundamental Truths About Arkansas Water Resources.

Fundamental Truths about Arkansas Water Resources
• Water is essential for life.
• Water is a renewable, but finite, resource.
• Surface water, groundwater, and precipitation are tightly linked.
• Water has no substitutes for most uses.
• Water runs downhill.
• No one owns the water in Arkansas.
• Water has social, economic, and environmental values, and touches every sector of our lives.

6.1 Water is Essential for Life

The human body consists of about 70 percent water. Plants and other animals obviously need water to live. In addition, their survival may depend on specific amounts of water at critical times of the year. Therefore, all life forms require consideration when resolving water issues. Humans are part of, not apart from, aquatic and terrestrial ecosystems.

6.2 Water is a Renewable, but Finite, Resource

Although a water-rich state, Arkansas does not have an infinite water supply. Fortunately, water is a renewable resource, meaning it can be withdrawn from our lakes, streams, and aquifers for use, treated, and eventually returned to a stream or reservoir for repeated withdrawal and reuse. Many water uses, for example, are considered non-consumptive (e.g., industrial cooling water, hydroelectric power generation, navigation, recreation), so water withdrawn for these uses

is returned to the stream or reservoir and is available to be withdrawn again to satisfy other uses. Some uses, however, are considered consumptive, such as incorporating water into industrial or manufactured products or agricultural crops, which are then sold. While this water may eventually be returned to the environment (as products are used or food is consumed), the return might not be within the state and might not occur for years. Water is renewable, but not an infinite resource.

6.3 Surface Water, Groundwater, and Precipitation are Tightly Linked

We tend to think about surface water, groundwater, and precipitation as independent of each other rather than interrelated parts of the hydrologic cycle. Precipitation (rain or snow) falls onto the land and either runs off the land into streams, rivers, lakes, and reservoirs to form surface water, or soaks into the ground to form and renew groundwater aquifers (Figure 6.1). In between rainstorms, groundwater serves as a primary source for surface water as it seeps out of the ground into stream channels or lakebeds. Some of the surface water evaporates and returns to the atmosphere. In addition, plants (trees, shrubs, grasses) pull water from the ground and transpire it back into the atmosphere from where it can again return in the form of precipitation. This illustrates the connection between surface water, groundwater, and precipitation. Affecting any one affects the other two.

6.4 Water Has No Substitutes for Most Uses

Unlike other resources, such as energy sources, water has no substitutes for most uses. We can generate electricity by burning coal, oil, or natural gas; by hydropower or wind generation, and by using solar energy or other sources. However, for many commercial, industrial, and agricultural uses, nothing can be used in place of water. Nothing can replace water in growing crops. The same is true for many other products and processes.

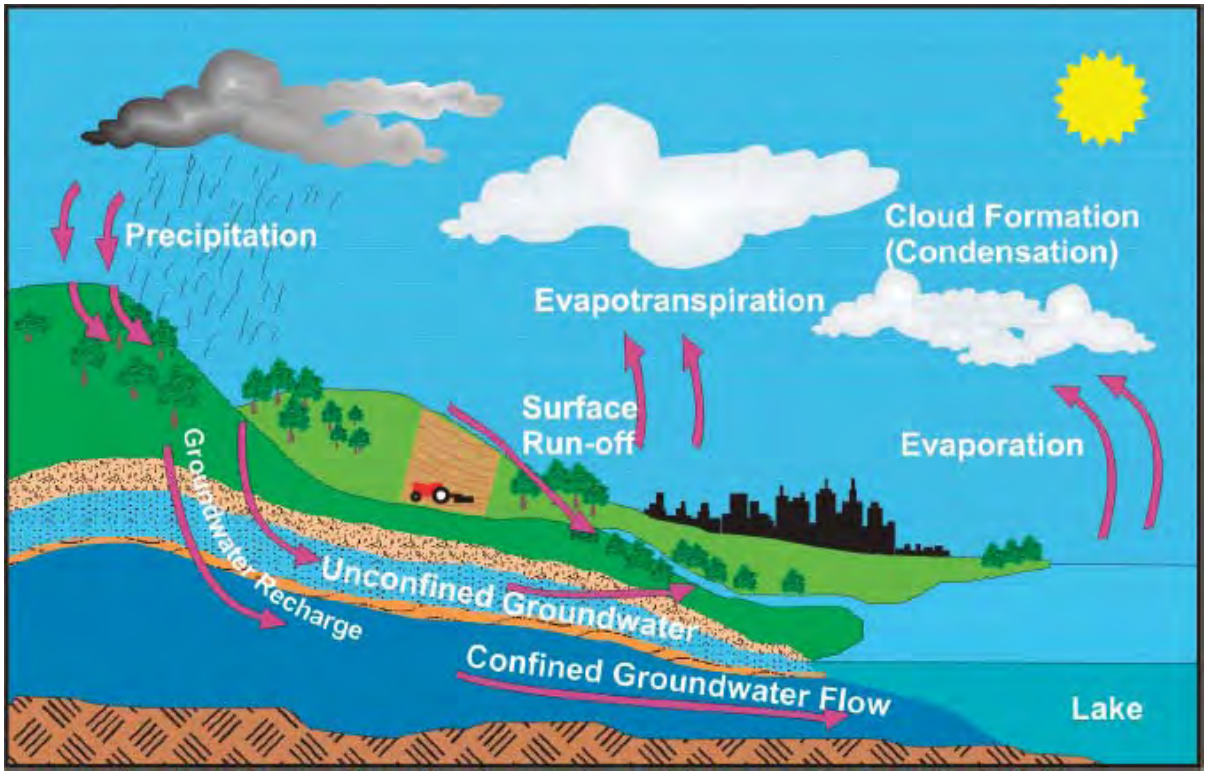

Figure 6.1. Hydrologic Cycle Links Precipitation, Surface Water, and Groundwater.

6.5 Water Runs Downhill

Water moves primarily with the force of gravity either pulling water into the ground, or channeling it downstream from a higher elevation to a lower elevation (Figure 6.1). Most people live downstream from someone else, and are affected by what happens upstream.

6.6 No One Owns the Water in Arkansas

Arkansas abides by a doctrine of reasonable riparian use similar to most Eastern states. This means that landowners (private, state, or federal) who own property next to a stream or lake, the ground under any surface water, or land over any groundwater have the right to reasonably use the water, but they do not own the water. This is not semantics. No one owns surface water, groundwater, or precipitation in Arkansas – only the right to use it under a set of specific conditions and circumstances.

6.7 Water Has Social, Economic, and Environmental Values, and Touches Every Sector of our Lives

Because water is essential for life, it affects every aspect of our social and economic fabric (Figure 6.2). Water is much more than a part of the physical environment. Many businesses, industries, and agricultural enterprises count on water for survival. We rely on water for recreational activities (boating, fishing, swimming) and social amenities (enjoying a sunset over a lake, hearing the roar of a waterfall, enjoying the serenity of a flowing stream). Resolving water issues therefore requires that we consider their environmental, economic, and social impact.

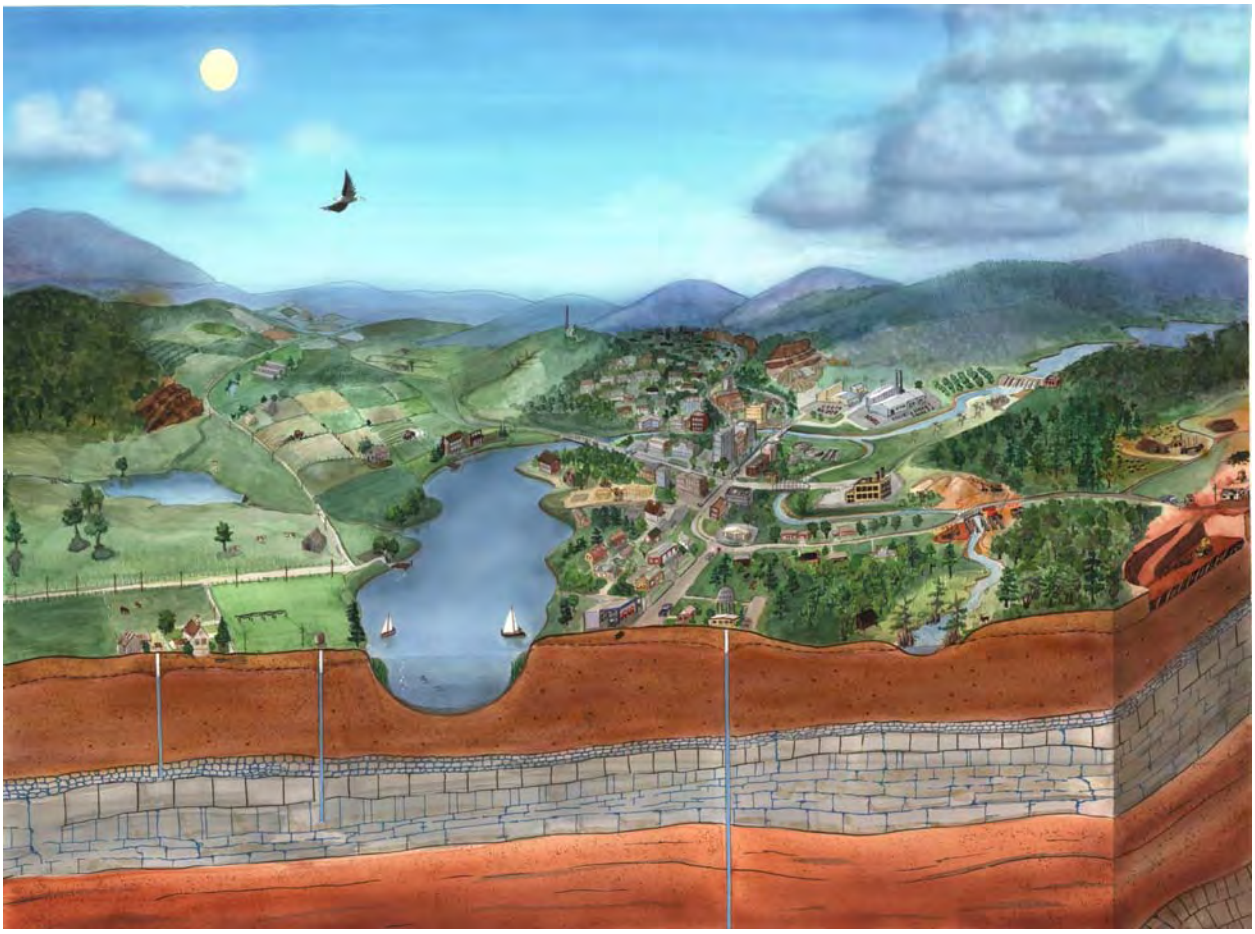

Figure 6.2. Multiple Uses of Surface Water and Groundwater.

7.0 DESIRED OUTCOMES

Now that we have a set of fundamental truths for use in evaluating our options, the next step might be to, as Stephen Covey states, "Begin with the end in mind." Responses to the telephone survey and personal interviews suggest a set of desired outcomes for water we believe that most Arkansans would support. These desired outcomes are listed in Table 7.1 and briefly described below.

Table 7.1. Proposed Desired Outcomes for Arkansas Water Resources.

Proposed Desired Outcomes for Arkansas Water Resources
• Maintain an adequate supply of safe, good-quality drinking water.
• Provide enough good-quality water to support the state economy and sustain a healthy environment.
• Protect life and property protected from damages caused by flooding.
• Recognize the value of water and its contribution to the overall quality of life in Arkansas.
• Serve as good stewards of water, protecting the rights of all Arkansans to use water resources.
• Manage water comprehensively to sustain groundwater and surface water for generations to come.
• Manage water resources efficiently with a participatory process.

7.1 Maintain an Adequate Supply of Good-Quality Drinking Water

Where water is available, every resident should enjoy a safe, good-quality supply for drinking. Some parts of the state lack adequate water, but in those areas where supplies are sufficient, water should be safe to drink.

7.2 Provide Enough Good-Quality Water to Support the State Economy and Sustain a Healthy Environment

Business, industry and agriculture require sufficient good-quality water to provide jobs and bolster the economy of Arkansas. Similarly, Arkansans need this resource for continued enjoyment of a healthy environment (fish, wildlife, forests, wetlands, etc.). As stated earlier in this report, our economic and social systems are part of, not apart from, ecological systems.

Therefore, ensuring enough safe, good-quality drinking water to support and sustain all living organisms is part of the formula for a successful state economy.

7.3 Protect Life and Property from Damages Caused by Flooding

Streams and rivers flood periodically, and Arkansans deserve protection from loss of life and property where such safeguards are environmentally and economically feasible. Some areas, however, must flood to preserve wetlands and habitat for fish and wildlife. Adequate protection does not imply that all areas will be secure from the effects of flooding.

7.4 Recognize the Value of Water and its Contribution to the Overall Quality of Life in Arkansas

Because state and federal subsidies cover parts of the cost of providing water, the market value (what people are willing to pay) for water is murky in most instances. Development of the bottled-water market has helped give us a better understanding of the economic value of water. In legislation for funding the McClellan-Kerr Arkansas Waterway Navigation System (completed in 1971), Senator Robert Kerr of Oklahoma declared that the day would come when a barrel of water would be worth more than a barrel of oil. Today, 20-ounce bottles of water frequently sell for at least $1. That is equivalent to more than $6 a gallon – more than the price you pay for a gallon of gas. However, water has more than a monetary value, because it is integral to our quality of life.

7.5 Serve as Good Stewards of Water, Protecting the Rights of All Arkansans to Use Water Resources

Because no one owns the water in Arkansas, we should all share the duty of good water stewardship. Virtually everyone lives downstream from someone else. What I do on my property will affect the quantity and/or quality of water for others downstream, for better or worse. While we have individual property rights, we also have collective stewardship obligations associated with those rights. Good stewardship is not optional; it is mandatory in a democratic society.

7.6 Manage Water Comprehensively to Sustain Groundwater and Surface Water for Generations to Come

As stated in the section titled "Fundamental Truths," surface water, groundwater, and precipitation are tightly linked. We can't manage one without affecting the other two. Managing surface water and groundwater together can ensure that neither resource is depleted and that both will be available in adequate supplies for future generations.

7.7 Manage Water Resources Efficiently with a Participatory Process

Economics focuses on the efficient allocation of scarce resources among alternative, competing ends. Water, as a finite resource, has become scarce in some areas of the state. Managing water calls for efficient approaches, perhaps using economic tools and instruments. Stakeholders who represent the competing uses for water in Arkansas should participate in the process so everyone has a say.

8.0 WHAT CAN BE DONE?

Respondents interviewed in person or by telephone for this report proposed many ideas for addressing water resources issues. Some suggested increasing the scope or extent of existing efforts. Others proposed tools that other states or settings utilize. These ideas, tools, and policy options were categorized into eight general themes, with some overlap and interaction among themes (Figure 8.1), and are described below. To address water issues in Arkansas, action is needed within each of these eight themes. As you consider the themes and options below, think of how all these might be integrated to address water resources issues in Arkansas.

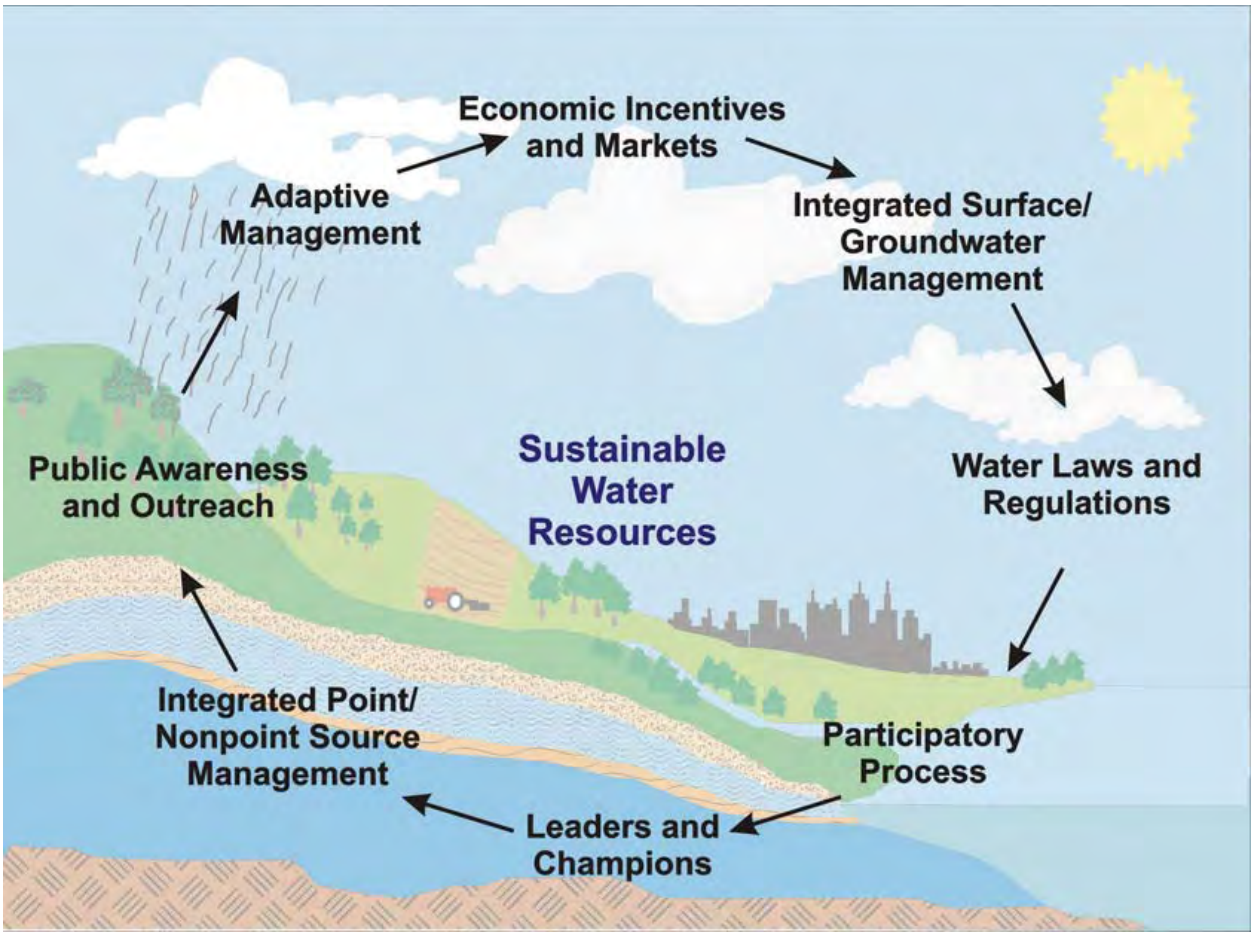

Figure 8.1. General Themes for Addressing Arkansas Water Issues.

8.1 Economic Incentives and Markets

Being able to identify sources of funds and assess economic feasibility are important considerations for many of the options discussed in this chapter. Many economic tools and instruments are available for use in water resources management, but may not be used by water resources managers because they aren't aware of or haven't considered the ideas in the context of water management. These and other economic tools are discussed below.

8.1.1 Determine the Value of Water

The price users pay for water reflects only part of the total cost associated with providing the water; government subsidies pay the rest. This makes it difficult to determine the actual value of water. A complete accounting must factor in the cost of unintended consequences and value of alternative uses. Understanding water's full cost and value would contribute to more effective and efficient use and to developing potential markets for water. Colorado, for example, has used water banks to facilitate municipality payments for rights to agricultural irrigation water (Taylor and Yound, 1995). The Global Water Partnership has developed guidance for determining the true value and cost of water supply (Rogers et al., 1998).

Pros	Cons
Water is a precious commodity that will be better appreciated when the full value of water is known.	Assessing the full value of water is difficult because it requires the use of non-market valuation approaches.
Understanding the full cost of water permits opportunity costs and benefits to be fully determined.	Changing behavior concerning water use is difficult, even with knowledge of the full value of water.
With a full understanding of the value of water, conservation becomes beneficial, not punitive.	

8.1.2 Create Voluntary and Economic Incentives

Economic incentives ideally decrease water use so additional sources don't need to be developed. For example, a number of states provide tax credits to residential or commercial users who install water conservation equipment, and several European countries have moved from fining polluters for polluting to paying potential sources of pollution (e.g., industry, agriculture)

not to pollute, as a cost-effective way to reduce nonpoint source pollution. One idea suggested during the interviews was a program to pay landowners to maintain riparian easements. Natural riparian areas can improve stream habitat and water quality.

Pros	Cons
Voluntary programs are received and perceived better than command and control regulations.	Voluntary programs don't work in many cases because the entity (business, industry, organization) that should participate does not participate.
Economic incentives permit the marketplace to work.	Voluntary programs are difficult to enforce and manage, and more prone to abuse.
Economic incentives have been shown to be as effective, if not more effective, than regulatory programs.	Most economic incentives require some form of cost-sharing or in-kind match, which might not be available.

8.1.3 Promote Private-Public Alliances

Public agencies can outsource activities to private sector companies for more effective and efficient outcomes. For example, some smaller public water utilities delegate billing, new construction or maintenance of water lines to private firms that can perform these tasks more cost-effectively. This approach could maintain the strengths of the public sector while shoring up weaknesses with private-sector assistance.

Pros	Cons
Privatization of public water utilities has been successful in some European countries.	Privatization of some European countries has failed, and they are returning to public administration.
Water costs have been reduced through public-private relationships.	Private companies typically emphasize profit, while public administration emphasizes public welfare.
Incentives can be used more effectively in the private, compared to the public, sector.	

8.1.4 Leverage and Legislate Needed Funds

Nearly all the tools discussed in this chapter require funds to implement. Most existing federal funding programs require matching funds from the organizations requesting these federal

funds. For example, USEPA's Section 319 fund for managing nonpoint pollution sources require a 40 percent match from non-federal sources to complete the projects, such as installing grassed buffer strips to control soil erosion. In many cases, the organizations that could use funds from federal programs cannot come up with matching funds, so the appropriated money in these federal programs cannot be fully used. A task force appointed for the purpose could review existing federal programs and their matching requirements and estimate the matching funds needed to fully use the appropriated federal dollars. Nonprofit and private-sector organizations could use this information to leverage existing funds and determine how much money Arkansas' legislature might appropriate to make the match.

Several funding ideas were suggested during the interviews, including impact fees to fund protection and management of critical resources, funding water infrastructure grants from the State General Improvement Fund and/or sales taxes, giving watershed districts taxation authority, using the State Landfill Post-Closure Trust Fund to monitor for leachate from old landfills, and developing an income source for the Port Priority Development Act and the Waterways Commission. Several interviewees suggested that there might be barriers to agencies working together to leverage funds that would need to be removed.

Pros	Cons
With matching funds, more money would be available from grants and cooperative agreements for water resources projects.	State funding legislation is difficult to pass and requires considerable effort by sponsors.
The return on investment can be anywhere from 2:1 to 4:1.	

8.1.5 Alternative Agricultural Crops

Alternative agricultural crops can contribute to water, soil, and energy conservation. For example, switch grass has greater potential as a biofuel source than corn and requires less water to grow and less energy to produce, harvest, and process. Timber has been promoted as a "second crop" for marginal lands. Timber not only uses less water, but also significantly reduces sediment, fertilizer, and pesticide loads to streams and lakes.

Pros	Cons
Alternative agriculture crops are an emerging market in Arkansas and other states.	Existing equipment might not be suitable for alternative crops and new equipment purchases might be required.
Alternative crops can contribute significantly to reduce groundwater usage, the amount of contaminant loading to waterbodies, and greenhouse gas emissions.	Markets for alternative crops might not be as profitable.
	Biofuel markets have not been fully developed and are uncertain.

8.1.6 Restoration Economy

In general, restoring waterbodies is much more costly than conserving and managing them. However, restoration also creates jobs and economic opportunities (e.g., heavy equipment operators, nurseries, laborers, engineers, designers). In addition, in 2006 there was over $11 billion in federal funds available for integrated ecological restoration.

Pros	Cons
Restoration of waterbodies can be a growth industry and provide jobs in areas with a skilled labor force.	While funds are available, in many cases, several grants from different agencies, with different procedures and processes, are needed to complete a project.
Restoration, by definition, improves both the quantity and quality of waterbodies.	Most funding opportunities require matching funds, which may not be available at the state or local level. Without matching funds, no funds are provided
Funds are available to pay for restoration activities.	Restoration markets are not well developed.

8.2 Integrated Surface/Groundwater Management

Survey respondents identified groundwater depletion as one of the highest-priority water issues for Arkansas. In addition, one of our fundamental truths declares that surface water, groundwater, and precipitation cannot be managed independently because these three elements are inseparably linked through the hydrologic cycle. For example, declining groundwater levels in eastern Arkansas have resulted in less surface water in streams, because groundwater seepage supplied a large part of the flow in these streams. Projects to capture rainwater for agricultural use can also reduce water available for eastern Arkansas streams. This theme deals primarily

with water quantity management. Read on for a discussion of proposed tools and policy options for moving toward integrated water resources management.

8.2.1 Implement Water Management Through One Agency

A single agency with unified authority over groundwater and surface water quantity and quality could have clear lines of authority and responsibility. Some respondents called for a "water czar" to ensure a comprehensive approach to water management coupled with the authority to make and enforce needed changes. Others voiced concern about a "water czar" wielding too much power without appropriate checks and balances.

Pros	Cons
Consolidation of water management activities within one agency can lead to efficiencies of scale and elimination of redundant functions among agencies.	A bureaucracy is a bureaucracy regardless of whether it is multiple agencies or a single large agency. A single agency is not necessarily more efficient.
Management decisions could be reached more rapidly and effectively through a direct chain of command.	Vesting authority for all water issues within a single agency can lead to abuse of power.

8.2.2 Revisit Water Allocation in Federal Water Projects

Only an act of Congress can change the allocation of water stored in Corps of Engineers reservoirs. The allocation of many of these reservoirs was established in the 1940s and 1950s. Revisiting these allocations given existing needs for water in Arkansas could prove necessary. Although the Arkansas River is used as a drinking water source by some communities, drinking water was not an authorized project purpose, so there is no storage allocated for drinking water. Subsequently, navigation or recreation, which are authorized project purposes, would supercede drinking water uses, even in drought conditions when drinking water might be in short supply. One suggestion made during the interviews was to revise water allocations every 20 to 25 years, similar to what occurs during Federal Energy Regulatory Commission (FERC) license reapplication on Lakes Hamilton and Catherine.

Pros	Cons
Reallocating water storage in federal projects based on current needs can ameliorate water shortages that were not anticipated 50 years ago.	Because Corps of Engineers projects are federal, congressional legislation must be passed reallocating storage for other uses, which is not a trivial activity.
In many instances, needed uses of water now are significantly different than desired uses of water identified years ago.	Changing water demands and uses might require reallocation again in the near future.

8.2.3 Develop Regional Water Management Districts

Water management regions can be redefined based on surface water, groundwater, and precipitation patterns, rather than county boundaries. These new regions wouldn't necessarily correspond to watersheds because groundwater does not follow watershed boundaries.

Pros	Cons
Current districts are based on political (county) or watershed boundaries, not contiguous surface water and groundwater boundaries. Regional water management districts would bring the management unit in line with the resource that needs to be managed.	Regional management units would include many different political units – municipalities, townships, and counties – and likely different regulations for managing water within these political units.
Decisions could be based on the effects of management practices on both surface and groundwater within the same management unit.	Regional management units would require a new management structure to administer.
Regional management units are large enough to include the effects of individual landowner decisions on both surface and groundwater.	This would add one more layer on top of existing water management layers.

8.2.4 Protect "Soaking Zones"

"Soaking zones" encompass areas where water can soak into the ground to replenish aquifers. Texas and other surrounding states have established protected soaking zones for aquifer maintenance.

Pros	Cons
Recharge areas are critical for sustaining groundwater and need to be protected.	Voluntary measures typically are not very effective in protecting critical resources.
Source water protection areas can already be designated within the state. Soaking zones could be included as part of the source water protection areas.	Restricting land use on these recharge areas could be considered a taking of individual property rights.
Economic incentives can be provided to landowners to encourage the protection of groundwater recharge or "soaking zones."	

8.2.5 Create Storage Areas

New major reservoir projects appear unlikely, but small, off-channel storage projects could capture surplus water during high-flow periods, and store it for use during low flow periods. Coordinated program support for the construction of on-farm reservoirs could help protect Delta groundwater resources.

Pros	Cons
Off-channel storage areas can be created with minimal effort and expense compared to tributary or main-stem reservoirs.	Current regulations can impede the creation of any storage areas in the riparian area or floodplain.
Off-channel storage can increase property value.	Off-channel storage areas might be filled with water taken from the stream, temporarily reducing downstream flows.
Economic incentives can be provided to create off-channel storage areas.	

8.2.6 Enact Enforceable Regulations

For the most part, water withdrawal regulations, particularly groundwater withdrawal rules, are voluntary and nearly unenforceable. Regulations with enforcement actions and penalties would be useful in effective water resources management. Management areas identified in the interviews as not currently being subject to enforceable regulations, and needing them, included groundwater withdrawals, water quality standards, and installation and maintenance of best management practices (in areas where nutrients and/or sediment are a significant problem). Management areas identified as needing better enforcement of existing regulations included

installation and maintenance of septic systems, municipal separate storm sewer systems, and drilling practices to prevent groundwater contamination when drilling in aquifer zones.

Pros	Cons
Enforceable regulations are more effective than voluntary measures for common, shared resources, because economic incentives to promote volunteer effort work only as long as funds are provided.	Command and control approaches have been shown to be ineffective in the long run because they do not promote stewardship.
	Enforceable regulations are expensive to institute and sustain.
Enforceable regulations are effective in controlling and reducing undesirable behaviors.	Regulations are negative, not positive, incentives to change behavior.

8.2.7 Move Water from Where It Is to Where It Is Needed

Arkansas could move toward the efficient transfer of water from areas with a surplus to areas with a shortage by adopting new or revised criteria for prioritizing water use and transfer. The new criteria could include use of economic tools such as water trading and water markets to encourage cost-effective redistribution of water. An example of water trading would be where a municipal wastewater utility contributes money to develop a grey water distribution system to reduce wastewater volume instead of investing a larger amount of money to expand the treatment facility. Water markets have been successfully introduced in other states. For example, a local water district operating under a pre-established agreement with the U.S. Army Corps of Engineers can purchase water from a Corps reservoir, and then sell the water to another district that needs water, but lacks a contractual relationship with the Corps.

Pros	Cons
Moving water from where it is to where it is needed can be cost-effective and environmentally sound. Consider the recent effort to pipe water from Bull Shoals Lake to small communities south of Bull Shoals, such as Marshall, that desperately need the water.	Removing water from any resource can lead to scarcity both in the stream or lake from which the water is taken, and increased demand in the area to which the water is transferred.
Moving surplus water reduces the need for new reservoirs and the environmental impacts associated with these reservoirs.	Defining surplus water is a dynamic process and can change dramatically from year to year. Forecasting how much water might be available in any given year is highly uncertain.
This approach can also be used to manage demand as much as supply.	

8.2.8 Encourage Water Conservation, Reuse, and Recycling

Farmers irrigating crops, catfish farmers and various industries employ conservation practices to reduce water use. More can follow their example by practicing conservation, recycling, and reuse across the board at the commercial, municipal and household level. Practices suggested during the interviews included irrigation tailwater recovery (collecting and reusing irrigation runoff), water conservation in industrial processes, and use of treated effluent for watering public spaces such as golf courses and parks. Water conservation programs work! Seattle, Washington reduced their per capita water use from 160 gallons per person per day to 100 gallons per person per day from 1975 to 2005 with a target of a 1 percent reduction in water usage per person per year. In addition, the earned revenues for 2006 in the U.S. water recycling and reuse market were $676 million and are projected to reach $1.3 billion in 2013 (http://www.landscapeonline.com/research/article/9477).

Pros	Cons
Water conservation saves money and scarce resources.	Water conservation is viewed by many people as a forced hardship.
There are already several programs that are available and proven in reducing water use, such as the USEPA WaterSense Program, and the Water – Use It Wisely Program.	Conservation is generally considered to entail losing options, rather than gaining benefits.
	Water conservation requires changing human behavior, which is difficult to do.

8.2.9 Promote Green Infrastructure

"Green" infrastructure is gaining momentum in the U.S. and has a strong foothold in Europe as a way to reduce water use and energy consumption. Stormwater control practices that reduce stormwater runoff and increase groundwater recharge are being designed as part of the green infrastructure movement.

Pros	Cons
Green infrastructure practices reduce water loss and promote infiltration of stormwater so it is not lost through rapid stream flow, but continues to recharge streams over time.	Green infrastructure practices are not as well established as traditional engineering practices, so practitioners are not as readily available.
Green infrastructure can improve the aesthetic settings of buildings and grounds, contributing to an increased quality of life.	Green infrastructure can be more expensive to install than traditional infrastructure.
Green infrastructure can be more cost-effective over time than traditional infrastructure.	

8.3 Water Laws and Regulations

Many Arkansans believe the development and adoption of a comprehensive set of laws and regulations governing surface water and groundwater use would benefit Arkansas' water resources. Piecemeal approaches got us where we are. A comprehensive, integrated approach could resolve water issues. Tools that could be used to develop a more integrated water policy are described below.

8.3.1 Vision 2025

Without a vision of what sustainable water resources are in Arkansas, it is difficult to develop a comprehensive set of water laws or a water plan. The governor could establish a Vision 2025 Committee to develop a model for sustainable water resources in the year 2025. This, in turn, could guide the development of a comprehensive water code or state water plan.

Pros	Cons
Vision statements help eliminate ambiguity about what is desired for the future and can create mental pictures of what is attainable.	Public participation is essential in preparing vision statements, but participation is based on trust among organizations and agencies, which may not be present.
"Without a vision, the people perish," because there is no compelling force of a greater good to help resolve conflicts and issues.	Developing useful vision statements requires buy-in from all parties, which may not be attainable.
Vision statements provide direction and purpose.	Preparing a good vision statement is a time-consuming, difficult process.
Vision statements provide a common rallying point for public participation and action.	Poor vision statements can be more damaging than no vision statement.

8.3.2 Comprehensive State Water Code Commission

The governor could appoint a Comprehensive State Water Code Commission, similar to the one created in 1981, to research and determine the need for an integrated set of laws governing water issues. Laws serve valid public purposes in regulating competition for limited resources and in providing procedures for resolving disputes (Henrie, 2007). Laws also generally lag behind reality (Henrie, 2007). It has been over 20 years since water laws have received a comprehensive review, and much of that previous review was not enacted into legislation. The American Society of Civil Engineers (ASCE) prepared a model water code for a regulated riparian system of water law. This model water code is considered a complete, comprehensive, and well-integrated statutory scheme for creating or refining a regulated riparian system of water law that is capable of dealing with water management issues in the 21st century (ASCE, 2004). This model code could serve as a starting point for Arkansas code revision.

Pros	Cons
A comprehensive set of water laws could streamline management and minimize litigation.	Forming a Commission does not mean changes will occur.
Separate groundwater and surface water laws contribute to the current water issues in Arkansas. Conjunctive water codes are needed to resolve these issues.	It is easy to bias the Commission membership so that certain special interest groups and organizations are represented.
A State Water Code Commission can be formed so that multiple stakeholder groups, organizations, and agencies can provide input and be represented.	There is disagreement as to whether any changes or additions in water laws are needed.
The reality is that Arkansas does not have a comprehensive approach for managing surface and groundwater, and a comprehensive approach can only be developed through a Comprehensive State Water Code Commission.	Forming this Commission requires either legislation, an executive order, or both.
	Reaching consensus through a Commission can be time-consuming and difficult.

8.3.3 Plan 2025

In conjunction with a Comprehensive State Water Code Commission, ANRC could partner with other agencies and institutions to revise the existing Arkansas water plan and make it consistent with the vision for 2025 and any legislatively enacted water code. The water plan revision was recommended by the 2001 Governor's Water Resource Task Force. Plans must be

revised frequently to reflect societal, economic, and environmental changes that are continually occurring. The state of Oklahoma has entered into a five-year effort to update its Comprehensive Water Plan. A Phase I report will document water demand projections by county through forecast year 2060, as well as a comprehensive inventory and analysis of the state's water supplies. Phase II of the updated Water Plan will identify local and regional problems and issues along with opportunities related to the use of water for public water supply, agricultural, industrial, recreational, and environmental uses. Phase III will involve the implementation of planning initiatives and tools derived from the issues, problems, and needs identified in Phase II. This five-year planning effort will focus on development of system-level plans, for the first time, to provide the most water to the most Oklahomans (Oklahoma Water Resources Board, 2005).

Pros	Cons
Updating the Arkansas Water Plan keeps it current with emerging technology and emerging problems.	Planning is time-consuming and can be costly.
Planning permits emerging issues or problems to be addressed before they reach crisis situations.	Plans without subsequent action are not worth the effort.
President Eisenhower stated "Plans are nothing, planning is everything." Updating the Water Plan ensures the planning process of thinking through problems and issues, and options and alternatives, and deciding on a course of action has occurred.	Plans can become the end in themselves rather than a process to solve problems and resolve issues.

8.3.4 Conduct a Water Summit

Representatives from all sectors could gather to brainstorm, discuss, and debate the appropriate format for and elements of a comprehensive set of laws and regulations pertaining to water, and of revisions to the Arkansas water plan. A water summit could show participants how water can integrate social, economic, and environmental concerns, provide multiple benefits, and improve the overall quality of life in Arkansas. A water summit could be held at the University of Arkansas Systems' Winthrop Rockefeller Institute on Petit Jean Mountain. A Summit addressing water issues in Arkansas would be fully consistent with what Winthrop Rockefeller once said: "Every citizen has the duty to be informed, to be thoughtfully concerned, and to participate in the search for solutions."

Pros	Cons
The water summit can provide information to initiate and contribute to each of the three activities listed above: vision, comprehensive state water code, and a revised Arkansas water plan.	Many of these summits simply produce reports documenting problems with possible solutions, but, if there is no follow-up, the summit simply represents one to two lost days.
The primary theme would be to document the role water plays in every element of society, economy, and quality of life.	
A water summit can initiate dialogue among many of the stakeholder groups, organizations, and agencies whose input is essential for sustainable water resources management in Arkansas.	Many people come to promote their own agenda and are not open to other viewpoints. The summit might serve to further polarize individuals, rather than to create compromise on issues.
Breakout discussion groups could focus on specific issues of interest, with the intent of laying all the cards on the table for review.	

8.3.5 Comparative Regulatory and Policy Review

A comparative regulatory and policy review should accompany, or be directed by, the Comprehensive State Water Code Commission. Regulations and policies are established based on enabling legislation and translate laws into management actions and practices in managing surface and groundwater.

Pros	Cons
A comprehensive water code or set of laws could result in a corresponding comprehensive set of regulations and policies for managing water.	Reviewing all the regulations related directly or indirectly to water among multiple state and federal agencies could be an almost intractable task.
Enforceable regulations, rather than voluntary practices, could result from a comprehensive review of existing regulations and policies.	The review will need to include not just the regulations, but also the common interpretation of these regulations. In some instances, the intent of the regulation and the implementation of the regulation could be in conflict.
Conjunctive approaches for managing surface water and groundwater could emerge from a comprehensive review of existing regulations.	Enforceable regulations, rather than voluntary practices, could result from a comprehensive review of existing regulations and policies.

8.4 Participatory Process

Nearly all of the telephone-survey respondents indicated an interest in water and water resources and expressed their opinions on myriad issues. The desire among respondents to participate in making decisions about water issues affecting them emerged as an underlying theme during the survey.

8.4.1 Document Community Beliefs

We make decisions based on what we think is true through a set of mental models. But sometimes, what we believe isn't true. Instead, it is perception. However, until we actually review what we think is true and compare it with the facts, we will find it difficult to change our beliefs and actions. A project that identifies what different population segments believe is true about various water resources issues could be useful in separating perceptions from facts.

Pros	Cons
Informed decisions require factual information. The first step is determining what people perceive to be true.	Documenting mental models is a time-consuming and difficult process.
Changing people's behavior about water can occur if they are provided factual information and tools to help change their perception.	Specialists are needed to formulate these models, and these specialists are not readily available.
Communities and cultures also have mental models, not just individuals, so it is critical that these mental models also be identified.	

8.4.2 Promote Water Watch or Similar Public Participation Programs

There are a number of volunteer organizations in Arkansas that deal with water resources issues. Examples include AGFC Stream Teams and local watershed groups. The Water Watch programs in Alabama and Kentucky are similar volunteer programs that could also be implemented in Arkansas. These types of volunteer organizations form as a result of stakeholder interest. They are most often funded by member dues and contributions. On their own, these organizations do not have any kind of regulatory authority. However, they work to accomplish their goals using the existing regulatory framework, most often through increasing public awareness and legislative lobbying. Interviewees suggested supporting and strengthening

volunteer organizations that deal with water resources issues by educating them about potential funding sources, creating additional funding sources, and/or encouraging local institutions of higher education to partner with them to provide expertise.

Pros	Cons
Volunteer efforts are invaluable in protecting and restoring waterbodies.	Volunteer programs require significant effort to make them effective.
Participation in a water program makes believers out of people because they see the results with their own eyes.	These programs need continuous oversight to ensure they continue to move toward the goals, objectives, and vision of the program.

8.4.3 Build Trust

Another word for trust is social capital. Just like economic capital, social capital can be used to "purchase" the participation of others in resolving water issues. People work and participate with those whom they trust. Building trust helps achieve consensus when contentious issues arise. Determining how trust is built among different groups and organizations could help community leaders and others understand the current lack of trust and polarization among community groups on water issues and begin building the trust (social capital) needed to resolve their differences.

Pros	Cons
Trust is the glue that holds groups together.	Trust requires anywhere from two to five years to build and strengthen.
Acceptance of factual information and changing behavior are facilitated by trust in the messenger.	Trust is very fragile and can be easily damaged, so it needs continual reinforcement.

8.4.4 Alternative Futures

For nearly all of us, seeing a picture of what could be helps us understand what is proposed. Alternative futures is a process for helping to create a picture or vision of what could be for water resources within a community or region.

Pros	Cons
The process for developing alternative futures is well-established and successful.	The process is time-consuming and requires extensive stakeholder input to be successful.
Alternative futures helps limit the number of options that realistically need to be considered.	Alternative futures requires the use of specially trained facilitators.

8.4.5 Civil Society Institutions

"Anything that happens in the 21st century will happen through civil society institutions." This was a statement by Peter Drucker, an internationally renowned management expert. Civil society institutions include churches, professional societies, clubs, civic organizations such as the Rotary or Kiwanis, or special interest groups. Water management agencies and utilities might partner with civil society institutions to implement and promote economic incentives and conservation programs.

Pros	Cons
Civil society institutions have extensive educational networks so it is easy to get information to their membership.	Many civil society institutions have a vested interest in the outcomes of various activities or projects, which might be at variance with the facts.
These institutions already have established trust among members because of shared common interests.	Conflicts among different institutions can result in conflicts in moving water resources projects or efforts forward, not because of the project, but because of politics.
These institutions know how to communicate with their membership so that the information is understood.	

8.5 Leaders and Champions

A national study on water resources management identified three factors that have to be in place before most water issues are addressed. They are crisis, leadership, and money – and in that order. Unfortunately, many water resources issues reach the crisis stage before they are addressed. Leaders come forward in times of crisis. By this time, though, it is too late to implement many potentially viable solutions, though their long-term benefits significantly

outweigh short-term costs. Good leadership can sometimes avert crises and provide the time needed to put more cost-effective, benefit-rich solutions to work.

8.5.1 Identify Community Leaders and Champions

Arkansas' communities offer programs to identify leaders and champions and provide them with educational training. Their training could cover information about water resources, infusing new leaders and champions throughout Arkansas with knowledge and understanding about the relationship between water issues and the long-term growth and prosperity of their communities. A Watershed Leadership Forum could be planned to help organizations raise leaders and champions from within their local communities to help improve water in Arkansas.

Pros	Cons
Programs already exist to identify community leaders and champions, so this effort is very cost-effective.	Existing programs may not be interested in expanding to accommodate other issues.
A Watershed Leadership Forum would specifically identify individuals interested in water issues.	Focusing on multiple topics dilutes the attention to any one topic.

8.5.2 Provide Water Leadership Training

There are several institutions within Arkansas that are working with watershed organizations to provide training on technical approaches for implementing watershed management plans. Watershed management, however, is fundamentally a social activity – involving interactions with people to get things done in the watershed.

Pros	Cons
Programs already exist on leadership training that can be supplemented with training on water issues.	Focusing on multiple topics dilutes the attention to any one topic.
Emphasizing non-technical aspects of management (meeting organization and management, group dynamics, etc.) completes the skill set needed for leading organizations.	Many technical people are neither interested, nor good, at managing social organizations.

8.5.3 Let Young People Lead

The Do Something League is a national organization established to encourage community activism and develop leadership skills among young people. Leaders can, and do, emerge at any age. Young people can be encouraged to lead efforts to address water issues.

Pros	Cons
An organization already exists to elevate leaders among young people and develop their leadership skills. Water is an excellent theme for community development.	Water issues can be trivialized if immature approaches are taken to address them.
Young people have enthusiasm and energy to tackle difficult issues.	It is difficult to get some adults to take young people seriously.

8.5.4 Civil Society Institutions

Numerous civil society institutions already exist and are active (see Section 8.4.5). Educating their leaders about water and water issues can help resolve water issues in Arkansas.

Pros	Cons
These leaders are already active and recognized within the community.	Leaders are already overwhelmed with information, so adding more information on water may not be effective.
These leaders have already established networks and developed trust with other organizations.	Specific, tailored information needs to be provided related to their organization's mission. This takes time and effort.

8.6 Integrated Point/Nonpoint Source Management

Survey respondents also ranked water pollution as a high-priority issue for water in Arkansas. Current management of point source industrial and municipal wastewater differs from methods applied to nonpoint sources of pollution, even though their combined loads affect water resources. Permit systems typically regulate point source and municipal storm water discharges while education and voluntary practices help control nonpoint sources, such as agricultural runoff.

8.6.1 Implement Water Management Through One Agency

As suggested in Section 8.2.1, integrated management of water quality issues may be improved by placing responsibility for management of all aspects of state water (e.g., surface water and groundwater, quantity and quality) under a single agency. This agency would need a broad perspective to ensure all facets of water were addressed. The pros and cons identified for water quantity (Section 8.2.1) are also applicable for water quality.

Pros	Cons
Consolidation of point and nonpoint source management activities within one agency can lead to efficiencies of scale and elimination of redundant functions among agencies.	A bureaucracy is a bureaucracy regardless of whether it is multiple agencies or a single, large agency. A single agency is not necessarily more efficient.
Management decisions could be reached more rapidly and effectively through a direct chain of command.	Vesting authority for all water issues within a single agency can lead to abuse of power.

8.6.2 Make Water Quality Data Readily Available

Several agencies and groups collect data on the quality of surface water and groundwater, but the state lacks a central repository for this information. Organizations, agencies, and groups that need this information would benefit from a centralized public data storage and retrieval system.

Pros	Cons
One-stop location makes gaining access to water quality information easy and efficient.	Compiling all the information in one central location is time-consuming and can be expensive.
For many statistical analyses, multiple constituents need to be compared. Having all this information in one place permits these comparisons to be made.	The file needs to be continually updated for it to be useful.
	Many agencies use different formats or parameter codes, which makes compiling compatible and comparable information difficult.

8.6.3 Spotlight Water Quality Benefits

We have a good idea of what it costs to treat water to meet water quality standards, but we rarely hear about the monetary value of best management practices, water treatment and water quality management (e.g., improved human health, not having to restore water quality). Understanding benefits and costs not only help with decision-making, but also help win public acceptance of those decisions.

Pros	Cons
Benefits estimation makes it easier for decision makers, stakeholders, and the public to determine the worth of various water resources projects.	Value estimation for water is difficult because, in many instances, it does not have market value.
Better and more realistic economic comparisons of water resources projects can be made if the benefits and costs are known and understood.	Non-market valuation techniques typically have a number of assumptions that are difficult for decision makers and the public to understand.

8.6.4 Pollutant Trading

The 1990 Clean Air Act Amendment authorized trading of air-pollution credits as a management tool. Some states have adopted a similar system of water-pollution trading as a way to establish economic markets that improve water quality. Under such a system, an industrial or municipal wastewater discharger would pay for programs to reduce pollutant loads from other sources (point or nonpoint) in the watershed in lieu of modifying its treatment process. This approach achieves the goal of reducing total pollutant loads, usually at a lower price than modifying the paying discharger's treatment process.

Pros	Cons
Water quality trading programs have already been developed within several states, so the technology and procedures are available.	The water quality trading program requires not only administrative costs, but also oversight costs.
Trading can be cost-effective for both point source and nonpoint source contributors.	Trading can only occur within a watershed.
Trading is a voluntary program for reducing total contaminant loadings to waterbodies.	Pollutant trading is in its infancy, and not all the kinks have been worked out of the process.

8.6.5 Green Infrastructure

As discussed in Section 8.2.9, "green" infrastructure is gaining momentum in the U.S. and has a strong foothold in Europe. Green infrastructure also reduces water pollution. Stormwater control practices being designed as part of the green infrastructure movement reduce pollutant loading from stormwater to receiving systems.

Pros	Cons
Green infrastructure reduces water pollution by trapping and retaining pollutants.	Green infrastructure can be more expensive to install than traditional infrastructure.
Green infrastructure can improve the aesthetic settings of buildings and grounds, contributing to an increased quality of life.	The fate and effect of trapped or retained pollutants within the watershed are not entirely understood.
Green infrastructure can be more cost-effective over time than traditional infrastructure and can significantly reduce the potential for future legacy pollutants in receiving waterbodies.	Green infrastructure practices are not as well-established as traditional engineering practices, so practitioners are not as readily available.

8.6.6 New Technology

Encourage development and use of new technologies that protect water quality. Specific areas where new technologies are needed that were identified during the interviews included wastewater treatment and disposal of problem materials, like toxic substances (i.e., technology to turn problem materials into useful commodities).

Pros	Cons
New technology can provide opportunities for jobs and economic growth.	Development of new technologies can be a slow, unpredictable, unreliable process.
	New technologies can have unforeseen negative effects.

8.7 Public Awareness and Outreach

Almost all survey respondents and people interviewed agreed that all sectors of society – elected officials, government officials, private business, industrial and agricultural interests, institutions, academics, and private citizens – lacked sufficient awareness and understanding of water resources issues. Little effort has been made to provide the information they need about

water in Arkansas. Most Arkansans are not aware that a near-crisis situation exists for several water resources issues, including groundwater depletion. The respondents identified tools to improve public awareness and outreach as discussed below.

8.7.1 Targeted Public Awareness Campaign

Public awareness and outreach campaigns are the first step in helping Arkansans understand water resources issues. Awareness precedes change. Without an awareness of various issues, there is no reason to assume anything needs to change.

Pros	Cons
Public awareness campaigns work, when properly developed and implemented.	Public awareness campaigns can be expensive.
The public usually responds once they recognize there is a problem or issue.	General purpose campaigns are usually ineffective. Public awareness campaigns must be targeted at specific audiences. This requires extensive research and time.

8.7.2 Declare a "Decade of Water" in Arkansas

The governor could designate the next 10 years as the "Decade of Water" in Arkansas. Activities could include the development and distribution by state agencies of promotional material on the importance of water to economic and community development, to human and ecological health, to recreation and tourism, and to the aesthetic beauty of The Natural State. An Office of Water Information could cultivate public awareness and ensure promotional messages delivered by state agencies are coordinated, collaborative, and consistent.

Pros	Cons
A Decade of Water could be the initiation of a public awareness campaign on water issues in Arkansas, and keep us focused on water for 10 years.	Often, people's interest in any issue rarely lasts more than a few days to weeks, let alone 10 years.
A public declaration by the governor that we are going to address water issues in Arkansas would not only increase awareness, but would also begin the process of solving these problems.	Programs come and go, and there is no long-term continuity in any branch of government.
	State agencies don't work together. They have their own agendas and missions.

8.7.3 Engage Existing Organizations

Trade, professional, and other civil society institutions and organizations could use their existing educational and communication networks to raise awareness of water resources issues among their constituencies. Government agencies can only do so much, and are often hindered by procedural requirements and funding restrictions. Civil society institutions are seen by some as the way to get things done in the 21st century (Drucker, 1999). Right now in Arkansas, there are watershed associations and environmental groups that are able to bring together elements of federal, state, and local government with concerned citizens to address local water issues.

Pros	Cons
Organizations know how to communicate effectively with their members, so there is no need to research how best to communicate to these people.	The audience is limited somewhat – not all Arkansans belong to civil society organizations.
Organizations have communication networks in place, so there is no need to develop new networks.	
People generally have a high level of trust for civil society organizations – usually a higher level of trust than they have for government organizations.	
People who belong to organizations are likely to be willing to change or work for change – they are likely to be receptive.	

8.7.4 Educate the Kids

Primary, secondary, and post-secondary educational institutions need educational material, lesson plans and other information related to Arkansas water resources issues.

Pros	Cons
Children can be a strong force for change – influencing their parents and, sometimes, their communities.	Water and water issues education may not fit into existing curriculum.
Children who are aware of water issues can grow up to become adults who are aware of water issues and will work to address them.	Teachers are already overburdened with recordkeeping and federal and state requirements.

8.7.5 Promote Stewardship

The ethics of water stewardship could become part of the educational information, materials, and programs provided not only to the public, but also to private business, industry, agriculture, and government agencies. Stewardship is defined as the responsible management of resources that are not owned, but held in trust.

Pros	Cons
People with stewardship mentalities may be more willing to make changes needed to address water issues.	There will always be people who have an ownership mentality toward water.

8.7.6 Provide Definitive Information Source on Water in Arkansas

As mentioned in Section 8.6.2, currently there is no one place where non-technical individuals can find information on the multiple facets of water in Arkansas. An engaging, comprehensive, electronic encyclopedia on water and its various facets in Arkansas could serve as the basic reference for the development of educational material for different target audiences.

Pros	Cons
Having information all in one place makes it more accessible, and potentially more useable and more used.	Just because data are all in one place doesn't mean that they will all be able to be used together. Data collected by different groups are not always compatible or fit to be used for the same purpose.
	New data are constantly being generated by existing and new groups. Keeping up with all of the data would not be a small matter.
Having information all in one place could highlight, and help reduce, redundant efforts, and highlight opportunities for groups to combine/leverage information collection efforts.	It may be necessary to change procedures or implement requirements of agencies and institutions collecting data to ensure that new data are provided to the information portal.
	Information available from the information portal may end up being not as up-to-date as is available from the original source.
	Having information more available for use could mean that it will be more likely that information will be used incorrectly, even if annotation of the limitations of the information is provided.

8.7.7 Social Marketing

Social marketing is the use of advertising techniques, normally used to market commercial products, to elicit changes in social behavior. Examples of social marketing campaigns include ad campaigns to reduce smoking, increase use of seatbelts, reduce drunk driving, and reduce littering. These techniques have been used successfully by several states to increase awareness of both water quality and water quantity issues, and promote behavior changes to address them.

Pros	Cons
Social marketing can be very effective.	To be effective, social marketing requires a lot of work researching the audience; developing a simple, targeted message; and tracking results. All of this takes time and money.
There is currently a store of information on social marketing for environmental issues readily available through USEPA, including guidance and examples from successful programs.	Social marketing can be tricky, and what works well one place may not work well others. Developing a social marketing campaign that gets the desired result can be a trial and error process.

8.8 Adaptive Management

The water resources issues facing Arkansas faces did not surface overnight, nor will they be resolved quickly. Change is the only constant in our lives. As the physical, social, and economic environment changes, some solutions to and resolutions of current issues will no longer be appropriate. Mid-course corrections, or new approaches, will be needed. Adaptive management is a continuous cycle of: monitor => assess => evaluate => adapt, if needed => monitor => assess…. Several tools that promote adaptive management are described below.

8.8.1 Improve Water Monitoring Networks

An adage in business is, “What matters gets measured.” We currently cannot develop an accurate picture of water availability and use for Arkansas because all of the needed data do not exist. Designing, implementing, and funding an effective water-quantity and water quality-monitoring network could help provide information needed for effective

water-management decisions. Some interviewees suggested developing a real-time monitoring network linked to models to more closely track water quantity or quality. Increased monitoring of best management practices installation and maintenance in areas with significant nutrient and sediment water quality issues was also suggested, along with closer monitoring of wastewater disposal and drinking water quality.

Pros	Cons
The right data can make it possible to effectively track trends and identify changes in water quality and quantity.	Monitoring takes money and manpower, one or both of which are already fully committed in most government agencies. Additional funding and personnel may be required to improve water monitoring in the state.
The right data can make it possible to more effectively manage water resources, providing feedback on how water resources are responding to management activities.	Most groups have their own sampling and analysis protocols, which may not be compatible. Some groups may need to make changes to sampling and/or analysis protocols before their data can be combined with data from other sources to create a complete picture of the status of Arkansas water resources. There may be some resistance that will need to be overcome before such changes could be made.
It may be possible for government agencies to team with each other and other organizations to extend monitoring efforts. This may include leveraging of funding sources, personnel, and/or expertise.	

8.8.2 Identify, Track, and Assess Performance Measures

A revised and comprehensive water plan could identify explicit goals and strategies, socioeconomic indicators, and water indicators to determine if the state is moving toward sustainability of water resources. Other states have developed indicators that possibly could be modified and adapted for Arkansas. Some interviewees suggested real-time monitoring linked to models or some other real-time decision support tool as a way to effectively track water quality or quantity.

Pros	Cons
Being able to track performance makes it possible to identify what is working when addressing water resources issues, and what needs to be changed.	It can be difficult to identify an appropriate indicator that can be monitored.
Being able to show results from specific water resources management activities improves support for those activities, including funding.	It may be expensive or time-consuming to monitor an appropriate indicator, or require expertise not currently available in Arkansas.
Indicators can be chosen to show the full impact of water resources management – impacts to the economy, the environment, and quality of life.	

8.8.3 Use Water Watch Data

The volunteer programs discussed in Section 8.4.2 could supplement the fixed monitoring network supported by government agencies. Judicious location of additional sites could significantly increase the data available for assessing the performance of management and regulatory practices and raise public participation in water resources management within Arkansas.

Pros	Cons
Volunteer monitoring can be a source of data to supplement other existing water monitoring programs.	There may be difficulty keeping volunteer monitoring programs going – finding people willing to make a commitment to the training, following procedures, and conducting the monitoring when and where it is needed.
Volunteers can be very committed to providing good-quality information about their local water resources.	Some data gathering procedures may be too complicated for volunteer programs.
	Volunteers require training in correct sampling and analysis techniques to ensure the resulting data have compatible quality assurance/quality control.

8.8.4 State of Water in Arkansas Assessment

There are several routine assessments of Arkansas water resources that already occur. Every 2 years, ADEQ prepares an assessment of statewide surface and groundwater quality. ANRC prepares an annual assessment of Arkansas aquifer levels. ANRC and USGS also compile annual water use data for irrigation, livestock, public supply, commercial, industrial,

mining, and power generation uses. Every 5 years, USGS prepares a national assessment of water use. There is, however, no routine assessment of trends in surface water availability. Preparation of a comprehensive (water quality and quantity, surface water, and groundwater) assessment of Arkansas water resources every 5 years or so, using information already being collected, would be useful for identifying and documenting problems and response to management activities. County and/or basin-level assessment would be useful.

Pros	Cons
Can be used to identify and document problems.	Personnel and funding needed to perform assessment.
Can be used to track progress of management.	May not be possible to complete assessment quickly enough for the results to be useful to managers.
A lot of necessary information is already being collected.	

9.0 CONCLUSIONS

Arkansas is at a critical juncture in water management (Figure 9.1). This companion report supports the summary report by identifying some of the changes in water resources that have occurred over the past 25 years; describing the water issues identified by leaders in municipal, county, state, and federal government, and industry, utilities, agriculture, nonprofit organizations and institutions, academia, and the public; developing fundamental truths for Arkansas water that help put the water issues into perspective; proposing the desired outcomes we assume most Arkansans would support; and describing some of the tools and policy options to address various Arkansas water issues. The critical question, however, is what will happen now? How will this information help shape the future of water in Arkansas over the next 25 years?

Most of the knowledge needed to address issues identified by the respondents interviewed for this study already exists. There are leaders and champions in each of our communities. Public interest and volunteerism are rapidly increasing. Everything is poised for success. Water integrates environmental, economic, and social concerns. When we address water issues, we also address social, economic, and other environmental issues. Sustainable management of water resources could also move Arkansas toward economic and social sustainability over the next 25 years. The question is, which paths and tools will Arkansans choose?

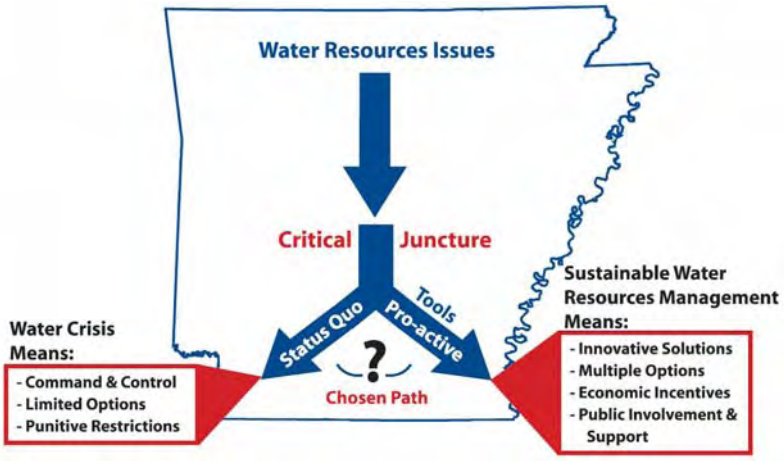

Figure 9.1. Arkansas Citizens are at a Critical Juncture in Water Resources Management.

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APPENDIX A

Literature Review Bibliography

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APPENDIX B

Individuals Interviewed

Table B.1. Individuals interviewed on water issues in Arkansas.

Individual	Entity
FEDERAL AGENCIES	
David Johnson	Corps of Engineers – Vicksburg District
Dr. Reed Green	US Geological Survey
Tony Stevenson	USDA Natural Resource Conservation Service
STATE AGENCIES	
Katie Teague	University of Arkansas Cooperative Extension Service
Marcus Devine	AR Department of Environmental Quality
Mary Leath	AR Department of Environmental Quality
Martin Maner	AR Department of Environmental Quality
Dr. John Harris	AR Highway and Transportation Department
Karen Smith	AR Department of Natural Heritage
Richard Davies	AR Department of Parks and Tourism
Randy Young	AR Natural Resources Commission
Earl Smith	AR Natural Resources Commission
Edward Swain	AR Natural Resources Commission
Robert Hart	AR Department of Health and Human Services
Harold Seifert	AR Department of Health and Human Services
Alan McVey	AR Department of Economic Development
Scott Henderson	AR Game and Fish Commission
Dennis Eagle	AR Forestry Commission
Keith Garrison	AR Waterways Commission
CHAMBERS OF COMMERCE	
Kenneth Hall	State Chamber of Commerce
Raymond Burns	Rogers Chamber of Commerce
Mike Dumas	Southwest AR PDD
Fonda Hawthorne	Little River Chamber of Commerce
Jon Chadwell	Newport Economic Development Commission
Don Wales	El Dorado Chamber of Commerce

Table B.1. Continued.

INDUSTRIAL/AGRICULTURAL ORGANIZATION/CORPORATION	
Greg Yielding	Arkansas Rice Growers Association
Evan Teague	Arkansas Farm Bureau
Randy Thurman	Arkansas Environmental Federation
Paul Beckehimer	McKee Foods Corporation
Robert Langston	Langston Companies
Jamie Burr	Tyson Foods, Inc.
Jacob Adcock	Potlatch Corporation
Uvalde Lindsey	Ozark International Consultants, Inc.
Randy Wilkerson	Martin Marietta
Allan Gates	Mitchell, Selig, Williams, Gates & Woodyard, PLLC
Charles Summerford	Summerford Engineers
UTILITIES	
Alan Fortenberry	Beaver Water District
Bob Morgan	Beaver Water District
Jim Harvey	Central Arkansas Water
Steve Morgan	Central Arkansas Water
Roger Moren	Saline Watershed Alliance
Steve Wear	Conway County Regional Water
Dennis Sternberg	Arkansas Rural Water Association
Sarah DeVries	Arkansas Rural Water Association
Curtis Warner	Arkansas Electric Cooperative Commission
Stephen Cain	Arkansas Electric Cooperative Commission
Gene Sullivan	Bayou Meto Water Management District
MUNICIPALITIES AND COUNTIES	
Don Zimmerman	Municipal League
David Morris	Association of County Judges
Mayor Robert Reynolds	City of Harrison
Mayor Tab Townsell	City of Conway
City Manager Charles Nickerson	City of Texarkana
City Manager Kent Myers	City of Hot Springs
Deputy City Administrator Ray Gosack	City of Fort Smith
County Judge Larry Williams	Garland County

Table B.1. Continued.

County Judge Bobby Edmonds	Union County
County Judge Steve McGuire	Mississippi County
Honorable Jake Looney	Polk County Circuit Court
CIVIL SOCIETY INSTITUTIONS AND ORGANIZATIONS	
Floyd Watson	Lake Fayetteville Environmental Study Center
Alice Andrews	The Ozark Society
Stewart Noland	The Ozark Society
Ken Smith	Audubon Arkansas
Kevin Pearson	Audubon Arkansas
Jay Hale	Illinois River Watershed Partnership
Jennifer Michaels	Lake Fayetteville Watershed Partnership
Luanne Diffin	Illinois River Watershed Partnership
Colene Gaston	Illinois River Watershed Partnership
Gene Pharr	Illinois River Watershed Partnership
Sherri Herron	Illinois River Watershed Partnership
Dr. William Layher	Bayou Bartholomew Watershed Alliance
Mike Malone	Northwest Arkansas Council
Scott Simon	The Nature Conservancy
Tim Snell	The Nature Conservancy
ACADEMIA	
Dr. Joel Anderson	University of Arkansas at Little Rock
Kenneth Gould	University of Arkansas at Little Rock School of Law
Dr. Ralph Davis	University of Arkansas Water Resources Research Center
Dr. Ashvin Vibhakar	University of Arkansas at Little Rock Institute for Economic Advancement
Mark McManus	University of Arkansas at Little Rock Institute for Economic Advancement
Dr. Jerry Ferris	Arkansas State University

APPENDIX C

Interview Question Responses

Table C.1. Responses to questions, "Do you think water is an important problem for Arkansas' current and future prosperity? If so, how?"

It should be the No. 1 priority in the state. Nothing exists without sufficient water resources and infrastructure.
Water is the key for everyone and every sector.
Water is at the top of the priority list because it is tied to public health and economic sectors such as agriculture, commerce, energy, etc.
Water is important, but it cycles in and out of public perception based on drought or flood.
Sustainable supply of clean water is needed by everyone.
Water is a quality of life component that is very important, as well as an economic issue.
Growth is dependent upon adequate water (quantity and quality).
Water resources don't exist without water.
Water is extremely important as a habitat for many aquatic species.
Water affects tourism. Thirty percent of tourists visit the state for the fish and wildlife.
Arkansas is a water-rich state. However, the water is often not where it is most needed.
The recreation and tourism industry is dependent on water. This is a $4.5 billion per year industry in Arkansas.
A major issue will be assuring sufficient quantity and quality of water for all uses.
A sustainable approach will consider the environment, financial and social dimensions of the debate.
Growth is outstripping available water infrastructure capabilities.
Planning horizons often conflict. Potable water supply planners look 25-50 years out while local elected officials are looking 2-4 years out. Rather than long-range planning, there is a tendency to react to emergencies, which is always more expensive.
Arkansas' "image" as the Natural State is dependent upon an abundance of high-quality water.
The demand for water is outstripping available low-cost supplies.
If industries face curtailed supplies in Arkansas, they will seek other, more reliable locations and take their jobs and investments with them.
The availability of quality water is the problem, considering the competing demands for the resource. Adaptive management is needed to optimize sustainability.
We need to be looking forward 10-20 years.
There is no real statewide plan. There is also no central state agency who is really taking a leadership role on this issue.
Water is a basic issue in the attraction of new industrial jobs and the maintenance of existing jobs.
There is insufficient coordination among utilities/Corps of Engineers/power companies/Congress on the allocation of storage in water resources.
Extremely tight environmental concerns and existing power pool contracts on our major dams threaten expansion of existing supplies.
Distribution issues regarding rural water services and surrounding expanding cities freeze the expansion of certain city services, such as sewers, that are needed for future economic expansion.
Provision of water without sewer encourages sprawl at very low densities, challenging other infrastructures such as streets, and also expands the threat of water quality degradation by expanding the footprint of development unnecessarily.

Table C.2. Responses to questions, "Is your agency/company/organization actively involved in water management in Arkansas? If so, how? If not, what do you think you can contribute?"

Involvement in:
WQS, NPDES Permits, and land application regulations.
Short-term education of general public and economic agencies.
Water management, operator training, and decision making.
Advocacy on water issues.
Public education on watershed dynamics and pollution prevention.
Working to ensure water quality is considered in approving large development projects.
Improvement of Illinois River watershed.
Consulting in water resources management.
Educating water industry and public officials on importance of water.
Education, outreach, and urban stream restoration.
Aquatic bird habitat protection and restoration.
Managing federal water resources projects in Arkansas.
Leadership, foresight and future planning, technical expertise in drinking water and environmental quality, monitoring, research, funding for purchasing easements and important water-related causes, education, public information, and facilitation.
Assisting landowners with water management issues.
Protecting clean groundwater and source water protection.
Attempting to reduce sediment and nutrient pollution to water bodies.
Providing education and support for Best Management Practices.
Restoring rivers in the Delta region.
Conversion of ditches to streams.
Fisheries management.
Oversight of public drinking water utilities in the state; delineation of watershed areas of drinking water sources and potential sources of contamination in those watersheds; source water protection, promotion of watershed management, and conservation programs to water utilities.
Development and implementation of the state water plan.
Issuing permits for use of excess surface water, establishing minimum stream flows, and allocating water resources during shortage conditions.
Monitoring surface water quantity and groundwater levels.
Planning in Ft. Smith, with Arkansas River Navigation and with the Yellow Bend Intermodal facility.

Table C.2. Continued

Management training and resource management.
Outreach to industrial sector users.
Providing scientific expertise.
Political support.
Securing federal funding for construction and maintenance of river navigation systems which often create reservoirs used for water supply and recreation.
Writing and administering grants for communities and small water associations.
Coordinating research for helping to solve water problems in Arkansas.
Stormwater Plans/permits; water reuse.
Management of a water supply lake and a back-up water supply lake.
Management of a water distribution system.
Development of a Master Water Plan.
Enforcement of MS-4 federal regulations.
Wholesale and retail distribution of treated water to customers.

Table C.3. Responses to the question, "What do you consider to be the top priority water problem (issue) in our state, region (of the state), or a specific locality that needs to be addressed?"

State	Region
Sediment impairment.	NWA – Sediment/Nutrients.
No statewide plan for water.	Infectious diatom below Bull Shoals.
Clean drinking water.	East Arkansas – Sediment.
People assume if own the land, own the water	Water supply and groundwater depletion.
Ensuring water is where it is needed.	NWA – Phosphorus management.
Water management.	Stream bank stabilization.
Groundwater depletion.	Impacts of urbanization on runoff/infiltration.
State Water Plan inadequate.	Flooding.
NRC isn't functioning to meet water needs and demands.	Lack of ordinances in Benton and Washington County to protect Beaver Lake and its watershed and Illinois River and its watershed.
Lack of political will and legislative understanding of water issues.	Protection of Beaver Lake, Illinois River and White River.
Coordination among state agencies.	Continued depletion of the Sparta Aquifer.
Protection of the groundwater and upgrades of existing water systems.	Water quality in Beaver Lake and the ability to meet its designated uses.
Authorized water uses antiquated – doesn't match current needs.	Nutrients and sediment from agriculture and development (Hot Springs Village and Northwest Arkansas).
Lack of integration or coordination of water policy and land use.	NWA – The issue is water quality. Groundwater in the Delta especially as related to the allocation of surface water quantity.
Better indicators and monitoring to protect water quality.	The challenges with Oklahoma threaten entire industries and sectors of Arkansas' economy if not addressed. Guarding against degradation of the quality of the water in Beaver Lake also is a critical water priority for NWA.
Water is a public resource.	Northwest Arkansas infrastructure.
Property rights outweigh water quality protection.	Aquifers in east and southeast Arkansas.
NPS pollution from agriculture and development.	Nutrient loading in NW Arkansas.
Lack of planning from legislature on down to the local communities.	Residential development around large reservoirs.
No real water plan and no oversight.	Clean water supply in Central Arkansas.
Riparian rights to water, and withdrawing more than runoff.	In NW Arkansas this might be for cave recharge, in the Grand Prairie the issue might be for plants that are compatible with the area.
Simultaneously managing for water supply and flood control.	In central Arkansas the Mid-Arkansas Water Alliance needs to be maintained and strengthened.
PC&E Commission has state agency directors on it.	Sparta Aquifer.

Table C.3. Continued

State	Region
Impact of residential development including handling of wastes.	Groundwater supplies getting scare in SW Arkansas but little data on these systems. Same true in North Central Arkansas.
Visibility of small water and wastewater systems in meeting the increasing number and complexity of federal regulations.	For North and Northwest Arkansas the issue is the availability of adequate water for domestic use and the related treatment of the resulting wastewater. In the Arkansas Delta the issue seems to be aquifer depletion.
ERW issue – Where do we get water for growth?	
Impact of stormwater runoff.	
Maintaining or improving the water quality in existing streams and reservoirs.	
Proper disposal of poultry wastes.	
Most critical need is to address the groundwater overdraft problem in the delta.	
Develop a watershed management strategy to manage the resource.	
The need for responsible planning and development giving consideration to bio-diversity values.	
Preserving high quality of Arkansas' groundwater and surface water supplies.	
High quality drinking water is important for food manufacturing operations and for the public's health.	
Cooperative efforts aimed at water resource management.	
Aquifer depletion.	
Adequate funding of river navigation/flood control projects.	
Poor drought contingency planning.	
Lack of good data on water systems in some parts of state.	
Education; Regulation if education is not successful.	
Water quantity and quality.	
Protection and preservation practices are needed to assure the quality of the resource.	
Watershed management and specific issues of threat of water diversion.	
Ensuring that we have the long term capacity to serve our future water customers.	
If environmental concerns limit the future construction of water supply impoundment to the existing stock the entire state has major issues.	

Table C.4. Responses to the question, “In your view, what are the water problems (issues) in our state that have the most impact on the citizenry of Arkansas?”

No groundwater standards.
Aquifer depletion.
Sediment loading--drinking water and recreation (development & agriculture).
Water supply--drought has exposed weaknesses in keeping up with demand.
Loss/decrease in water supply; NPS pollution increasing treatment costs.
Clean drinking water.
Wetland protection.
Fish tissue contamination.
Short-term: groundwater depletion.
Long-term: water quality degradation.
Increased impervious surface area & limited riparian areas.
Shifting surface/groundwater supplies.
Interbasin transfer of water withdrawal of drinking water in one watershed, but wastewater discharge into another watershed.
No unified or comprehensive approach to water law, water policy or water management.
Distribution of water among basins.
Declining drinking water quality and water quality of scenic rivers.
Oklahoma/Arkansas lawsuit over poultry litter.
Groundwater depletion for rice production.
Continued degradation of water.
Water shortages that occurred throughout the State in 2005 and 2006.
Limited water supply capacity.
Rights of citizens to withdraw riparian water.
Impact of global warming on water availability.
Lack of planning leading to wrong decisions.
Lack of public understanding of wetland issues.
Conversion from groundwater to surface water for agriculture.
Sewer and water infrastructure.
Lack of cooperation in solving municipal water supply problems.
Water quality and its safety; ensuring it is safe to drink, safe in which to swim, safe for multiple uses from agriculture to industry.
Accurate and realistic estimates of the economics of water are not available.
Lack of national policy and funding to de3velop surface3 water sources.
Economic impact of adding nutrients to lakes such as Beaver Lake.

Table C.4. Continued

Lack of accountability in dealing with water issues.
Organized approach to get water to fast growth areas.
No one seems to really “know” water law.
Lack of water policy and no plan to get there. This results in difficult in making decisions about allocation of water.
Likelihood that citizens are going to have to pay more each month for their drinking water and wastewater service as the result of infrastructure replacement and upgrading.
Increasingly stringent federal regulations.
Source water development and protection.
Groundwater overdraft in east and southeast Arkansas.
The need for more surface water development for potable water in west Arkansas, which may affect ERW streams.
Water quality issues particularly those related to nutrients and sediment.
Need for navigation on the Red River in southwest Arkansas.
Lack of wastewater treatment systems to serve the development around large reservoirs – Beaver, Bull Shoals, Greers Ferry, etc.
Lack of surface storage for potable water supply.
Nutrient levels in streams and lakes.
Availability of water to sustain the growth in N.W.A.
Populations growth is creating higher demand on water quantity.
Drought conditions.
Maintaining pristine streams and clean lakes.
Competition for resources.
Singling out one use without giving consideration to the whole basin.
Having enough water, particularly during peak demands in the summertime.
Protecting the quality of Arkansas’ drinking water sources from pollution.
Distribution is a major issue. There is plenty of water, but it is not always where it is needed for either potable supply or for irrigation.
Aquifer usage far exceeds sustainability.
Water quality impacts from runoff.
The potential degradation and loss of our extraordinary resource waters is, in an esoteric way, a loss to all of us, whether or not we ever dip a toe in those waters. They are our treasures, our last “wild” places, and they simply cannot be restored without a commitment of significant resources that most Arkansans are unwilling to expend. Best to protect them on the front end.
Lack of state funding of river port infrastructure.
Lack of and Adequate water supply for existing water systems and growth of economy.
Low quality of drinking water in rural areas.

Table C.4. Continued

Making sure that agriculture in east Arkansas has enough water. We are growing a crop there which probably should not be grown in that area but is already such an important part of the economy, we cannot stop it.
Nutrient enrichment of water supplies in NW Arkansas.
Groundwater resource of NW Arkansas may not continue to provide supplies.
Even with proposed surface water diversion, there will not be enough water to sustain rice production in the Grand Prairie region of the state.
Shortage; compliance with request for conservation; capacity of water systems.
The availability of quality drinking water.
Forestry; Agriculture
Practices to protect water quantity and quality have started to impact landowner (the citizenry) rights.
Easing the approval process to provide more surface impoundments.
Redistribution of the pool allocations at our major federal impoundments from power to water supply. Thee are other options for power, water options are finite.
Working through the Mid Arkansas Water Alliance to gain capacity from Lake Ouachita.
Long term agreements governing diversion issues.
Stronger protection measures for watershed.
We need a state agency that has a central focus on future water issues. This is currently not a state priority since the perception is that Arkansas will always have an abundance of quality water to serve future generations.
Reassess how the state is carved up in terms of rural water districts. Some of these districts are simply unable to serve areas that are now experiencing rapid growth.
Drinking water shortages.
Potential and real contamination of groundwater.
Watershed deterioration.
Deterioration of surface water quality.
Finite surface impoundment.
Conflicting and competing rural water associations.
Flood damage.
Developers need to pay more for the infrastructure that serves them.
Loss of wetlands.
Lack of access to lakes and streams for boating, fishing and other recreational uses.
Better priority and geographic assignment by the state agencies (i.e., Planning and Development, Soil Conservation, Department of Health).

Table C.5. Responses to the question, "What barriers exist to resolving these problems or issues listed in the two questions above?"

Misinformation; ill-informed public.
Narrow perspective and time horizon (next quarter) for public officials and citizens.
Highly charged political issues.
Lack of education and outreach.
Lack of funds for monitoring/inspection/enforcement.
Bureaucracy for new water supplies (primarily surface water impoundments).
Environmental groups create obstacles.
Citizens not taking responsibility for their impacts on water.
No elementary or secondary school education on the importance of water.
Decrease in local citizens/decision makers volunteering to support environmental efforts.
Competing uses.
Lack of ANRC leadership.
Lack of public awareness and understanding of the hydrologic cycle.
No sense of public ownership and responsibility.
Lack of effective communication of BMPs and collective impact of individual activities.
Uninformed state leaders on water issues.
Tremendous lack of public understanding about water resource issues.
ADEQ funding.
Case by case resolution of water issues through the legal system; no comprehensive water code.
No comprehensive, long-term perspective on water law or water policy – cobbled together through case law.
No single entity that addresses all aspects of water.
Lack of public understanding of magnitude and extent of water problems.
Jurisdictional barriers among federal, state, and local agencies.
Different laws/policies for surface water versus groundwater – distribution and land use.
Vested interests and special interest groups.
No interest in water conservation because can mine water for use with impunity.
Inadequate agency funding and limited effectiveness.
Ignorance, obstinacy on part of the polluters and water miners.
Political barriers between private property owners and water quality protection.
Insufficient regulations.
Lack of funding on state and federal level.
Agreement among agencies that there is a long-term problem and working toward solutions.
Water quantity and quality taken for granted.

Table C.5. Continued

Lack of authority to control use of water – both groundwater and surface water. No permit system.
EPA/FWS position on farmed wetlands.
Lack of political leadership and will.
Lack of tax incentives which could help solve water issues.
Citizen apathy.
Inadequacy of regulations.
Considerable ignorance and lack of knowledge about water issues.
Difficult to get public attention unless there is a crisis.
Lack of national policy, lack of funding.
Communities not cooperating on water supplies.
Lack of leadership.
Water issues are very complicated.
Water quality agency (ADEQ) is politically “shy” and has little public support.
NW Arkansas has focused on Beaver Lake but most people do not really understand what impacts water quality.
Issues are new to citizens, so don’t understand.
Focus on local issues and failure to see the entire water picture.
Political environment is often a barrier.
Lack of trust between the various interest groups/users.
Perception among citizens that an abundant volume of clean water has been and always should be cheap.
Lack of definition of the role of the state in watershed protection.
Local governments not taking ‘ownership’ of water resources management.
Poor coordination among, and poorly defined regulations within, the many state and federal agencies involved in water resources management.
Finding methods to educate all parties as to what is happening with water and how each use impacts other uses.
Lack of general understanding by the public that we’re facing a water quality crisis.
The lack of immediate technological and economically feasible alternatives for managing domestic waste, poultry litter, and other livestock manure is a barrier to finding “outside the box” solutions for water treatment.
Economic development when it conflicts with quality of life.
Lack of financial capability for infrastructure on the local level.
Lack of an open forum providing for discussions of all system uses.
Lack of funds for system-wide studies.
Environmental barriers and political opposition hindering the development of new supplies.

Table C.5. Continued

Land development pressures on water supply lakes and aquifers will threaten the quality of drinking water used for human consumption and for manufacturing.
Strategies and long-range planning for water supply needs and preserving land use controls around sources of water supply.
The “me” society – short sightedness.
Lack of scientific data that accurately illustrates agriculture’s actual impact rather than its “perceived” impact to water quality.
Lack of public funding for conservation.
Dearth of political will to restrict land and water usage.
Too few viable economic incentives for private property owners to set aside resources for future generations…too little knowledge and understanding of the ones that are available now.
State spending priorities.
A unified plan for Arkansas water utilization…several agencies regulate competing uses-seems to be some duplication of effort and funding.
Lack of adequate funds and lack of education on the part of the public to understand the water supply problems.
Lack of money and resources to control vegetation and sedimentation.
Finding comprehensive solutions that benefit everyone.
No long range planning to resolve growing rice in Eastern Arkansas, thus creates continuing demand for agricultural water.
Continuing conflict between urban and agricultural uses of water.
Lack of knowledge on how to deal with state agencies.
Knowledge--what are our resources, what are our uses, what is the rate at which the sources are replenished. Data to date is more short-term than long-term.
Lack of funding for wastewater treatment, especially for nutrient removal; need more funding for rural water systems.
Priorities; time.
Education. The public needs to be better educated and involved to become better stewards of the resource.
Territorial fears that a larger system will absorb a smaller one’s area of responsibility.
Lack of concern.
Lack of cooperation, lack of a coordinated effort to address sustainability issues.

Table C.6. Responses to the question, "What are the water problems in our state, region (of the state), or a specific locality that affect your agency/company/organization the most?"

El Dorado wastewater discharge and pipeline.
NPS voluntary measures.
Stream bank erosion from land cleaning/development
Loss of riparian area.
Agriculture versus domestic supply competition.
NPS pollution.
Water quantity and water quality.
No water conservation.
ERW protection.
Buffalo River management.
Lack of integrated approach to water planning.
Lack of holistic approach to water problems.
Toothless groundwater legislation with very limited authority.
Overlapping authority among agencies.
Nutrient management.
Sediment runoff.
Conflict management.
Public policy education.
Water policies formulated through compromise and piece-wise solutions.
No well-thought out public policy on water.
Lack of an integrated approach to land use and water.
Lack of enforcement of stormwater regulations.
Land development in Lake Fayetteville Watershed and erosion/sedimentation
Illinois River water quality.
Protection of Beaver Lake, Illinois and White River watersheds.
Better enforcement of ADEQ regulations.
Competition between local communities needing drinking water from Sparta Aquifer and agricultural needs for same water.
Lack of alternative water sources.
Triage on existing wetlands, which are not sustainable.
Keeping water safe and having its quality acceptable to the public has become increasing difficult.
Increased deterioration of the physical condition of streams and changing geomorphology because of land use change.
Cost-share incentives to assist landowners in addressing these problems on their properties.
Limited assistance in the development of irrigation projects.
Protection of clean groundwater.
Attempt to reduce sediment and nutrients.

Table C.6. Continued

Education and support of BMPs.
Restoring rivers in the Delta region.
Conversion of ditches to streams.
Minimum flow for trout fisheries in the White and Norfork Rivers.
Viability of small water and wastewater systems to meet state and federal regulations.
Conflicts between property rights and watershed protection.
Formation of watershed councils to involve all users in one place – create an understanding of the needs of all users and strike a balance that will optimize the resource.
Watershed protection.
Need for data related to water by local governments.
Recharge zones above caves in NW Arkansas.
Restoration projects along riparian areas.
Including biodiversity values I all development designs and planning.
Nutrients (N&P) from non-point sources and agriculture's actual contribution.
Participation in watershed organizations.
Options or strategies: • Decrease fish populations and accessibility to areas of the lake because of vegetation and sediment in Millwood Lake, which has decreased tourism and tourism dollars. • Need for advance treatment systems that will accommodate single-family and cluster residences. • Management/conservation of water • Watershed deterioration • Loss of wetlands • Mosquitoes • Conflicting and competing rural water associates.
Flood damage
Lack of financial resources to expand the water infrastructure to handle the increasing growth and replace older parts of the water system.

Table C.7. Responses to the question, "What potential strategies or options could be implemented to help mitigate these problems or issues?"

Participation in watershed organizations.
The El Dorado consortium of energy, industry and local governments that developed a river water pipeline to divert usage from the aquifer.
Improved wastewater discharge by upgrading joint facilities. Implementing water conservation measures in industrial process.
Funding for projects and encouraging local water systems to look at reducing operating cost.
Developing a strategy to make groundwater regulations stronger than voluntary in East Arkansas.
Develop and implement advance treatment systems that will accommodate single-family and cluster residences.
Require impact fees from developers.
Enforce MS4 permits.
Engage local governments in water management program/enforcement activities.
Support upper Illinois River watershed pilot program for NPS control.
Strengthen WQS for nutrients and sediment.
Promote mediation practices to develop common ground.
Implement real-time monitoring and modeling to forecast and diagnose problems.
Revise water allocations for water projects every 25-50 years. Lakes Hamilton/Catherine example with FERC reapplication.
Focus on user groups; utopian to think you can educate the public.
Improve education and facilitation.
Carefully craft groundwater legislation.
Encourage cities to enforce stormwater requirements (MS4).
Attend and participate in City council and Planning Commission meetings.
NGO advocacy for improved water quality and interaction among interstate agencies.
NGO partnerships to change public attitude and move toward action.
Provide training and technical assistance to water utilities.
Install sediment runoff control through flashboard risers and dropped inlets in fields.
Implement irrigation tail water recovery projects.
Protect aquatic habitat.
Protect stream corridor integrity.
Have agencies solicit additional advisory and educational input on water issues.
Formulate riparian easements for water quality protection.
Form Watershed Districts with taxation authority.

Table C.7. Continued

Develop a statewide plan to show how drinking water will be provided in all areas of the State for the next 10-20 years.
Create a state agency that will monitor ground and surface water supplies, as well as allocate water resources, in the future.
Develop new drinking water supplies.
Adopt water conservation measures and policies.
Create more public awareness about water supply issues.
Explore ways to use treated effluent for certain water uses such as for golf courses, agriculture, city parks, etc.
Effectively inform the entire population of the need to address this issue and garner input from a broad area of concerns as well as simply insure that the citizenry is aware of the vast importance of maintaining our water assets.
More closely monitor drinking water and wastewater disposal.
Strictly enforce state health department regulations on septic systems.
DEQ, Oil and Gas Commission and other regulatory authorities should exercise control over any drilling into drinking water supplies to ensure proper care is taken to avoid pollution of our water supply.
Develop new surface water sources.
Require groundwater users to switch to surface water when available.
Ease restrictions on future new water impoundments.
Reallocate power storage at the major impoundment for drinking water.
Groundwater preservation: 1) Adopt a no net loss policy for groundwater depletion (prevent the increase in salinity from encroachment from lower aquifers), 2) Require use of surface water when possible, 3) Increase surface impoundments dedicated to agriculture.
Develop mediation and resolution techniques to reduce conflicts between cities and rural water.
Allocate water resources statewide in a fair reasonable fashion to prevent water purveyors from hoarding water resources that they will never need or use.
Strengthen WQS.
Make optimal use of current staff.
Increase public education efforts.
Education – Education – Education.
Develop better water quality indicators.
Promote greater enforcement of leaking septic systems.
Develop a state database for all septic systems.
Bring people together, public officials and stake holders to discuss water issues in their community.
Improve pricing of water based on actual value.

Table C.7. Continued

Slow down planning/approval process to work out kinks in septic systems before create problems.
Coronate a water czar.
Develop state mechanisms to address complex, multifaceted issues over the long-term.
Create a Water Policy or Water Law Institute to contribute to long-range planning.
Formulate balanced, objective approaches that don't brand individuals as wacko.
Educate the legislature on water issues.
Promulgate integrated water policy and land use policies.
Identify appropriate institutions for management – one public agency, water districts, local entities.
Develop integrated, comprehensive, long-term approaches to land and water policy and management.
Public education on water issues must drive the process.
Use critical designated areas for groundwater to impose regulations in these areas.
Hold developers accountable for impacts.
Consider holistic watershed plans.
Continue outreach and educational programs on water issues.
Protect and maintain riparian zone and wetland.
Use impact fees to provide revenue for protection and management of critical resources.
Sell elected officials and general public on political and economic upside of implementing better management practices and controls to protect water quality.
Educate elected officials and the public on the need for adequate water supplies to satisfy all Arkansans needs.
Develop collaborative agreements on the problem and working together for a solution.
Follow the Union County example of getting off groundwater.
Implement BMPs for sediment runoff.
Find a state leader to champion water issue.
Governors need to make more effective appointments to commissions.
Facilitate agencies working together.
Implement smart growth development practices with consistent application across the region.
Educate stakeholders.
Develop better approaches for source water protection, and managing development.
Formulate realistic policies and regulations for environmental management.
Promote a national and sate water development initiative with adequate funding and necessary policy changes.
Develop a strategy to help communities get needed water.
Make better use of EPA's model on vulnerability of water in karst areas.
Use planning so we can prioritization water needs models.
Increase capacity to monitor and enforce BMPs in area of sediment and nutrients.

Table C.7. Continued

Increase outreach and education concerning water resources.
Model the G & F stream teams.
Use State General Improvement Funds for water and wastewater infrastructure grants.
Earmark sales tax revenue from water and wastewater sales for infrastructure grants.
Bring all users in watersheds to the table to look at all uses.
Build water storage facilities to store excess water.
Look for alternative uses.
Promote CREP.
Adjust the percentage of Beaver Lake water used for electricity generation and drinking water.
Prepare strategic plan for water in the state.
Find middle ground to protect the quantity of water in Arkansas.
Educate residents on actions that positively influence the quality of the water bodies in the State.
Develop regional, integrated approaches to address water and wastewater needs.
Provide outreach/education with regard to conservation and optimizing the use of water.
Develop approaches for different users to come together to address need and reach good compromises.
Conduct comprehensive water planning at the state level.
Encourage stronger local planning functions, or even a centralized state planning and development function. Educate developers on best practices.
Strengthen Watershed protection groups through additional sate funding and partnerships with local institutions of higher education.
Develop a “conservation handbook” for landowners.
Spend the ADEQ’s Land Fill Post Closure Trust Fund on monitoring of old landfills and seek Legislative approval to immediately replace the $10 million transferred from that fund in 2003 that went to pay for local and statewidc General Improvements Projects.
Develop a dedicated income stream to fund the Port Priority Development Act and the Waterways Commission.
Unify regulatory missions for agencies.
Follow the model created by Union County Water Conservation Board.
Start programs to help educate the public and stakeholders about water issues.
Better treatment of wastewater, expansion of rural water systems, new and better technologies to address development around water bodies and improvement of municipal wastewater treatment plants.
Formulate adaptive management strategies using real-time decision-support systems to optimize sustainable resource functions and to assess present and forecast future conditions.
Ease restrictions on future new water impoundments.
Plan for growth of water supplies.

Table C.7. Continued

Reallocate the power pool storage at the major impoundment for drinking water.
Adopt conservation measures and policies.
Create more public awareness about water supply issues.
Explore ways to use treated effluent for certain water uses such as golf courses, agriculture, city parks, etc.
Adopt a no net loss policy for groundwater depletion (prevent the increase in salinity from encroachment from lower aquifers.
Require use of surface water when possible.
Increase surface impoundments dedicated to agriculture.
Convince researchers of the need for improved use of our water resource so they will develop means by which efficiency is enhanced.
Define the specific roles for local, sate and federal agencies.
Engage every sector, every individual, every organization to address this problem.
Modernize water management methods.
Continue to link watershed stakeholders to better understand each other's challenges/perspectives and interests to move toward comprehensive management strategies.
Consolidate state agencies and commissions into single agency dealing with water.
Link farming practices with their associated effects.
Invest in the infrastructure to conserve, store, and transport out water resources.
Document water issues are quality of life issues.
Invest in studies and/or technology to turn problem materials into useful commodities.
Develop a state strategy to project needs, identify needed infrastructure and a means to provide that infrastructure in growth areas.
Eliminate duplication or at least competition among agencies with water management missions.
Develop regional approaches. Northwest and northeast Arkansas don't necessarily need the same regulations as southern Arkansas and vice versa.

Table C.8. Responses to the questions, “Do you believe appropriate resources are in place to properly address the water issues or problems that you have identified? If not, can you provide an estimate (economic costs) of what is realistically needed to address these problems?”

Overwhelming response of almost all respondents was “no.”
ADEQ needs minimum of $1 mil/yr just for sedimentation, construction inspection teams, and outreach/education.
Won’t ever be enough, but will be even more expensive in a crisis.
Eliminate matching funds for grants and fund on merit.
Yes, but not being used efficiently.
Until have some idea of what the long-term plan is, can’t provide an estimate.
Don’t have good estimates of what water is worth; heavily subsidized by agencies.
A minimum of $5-10 mil/yr would likely be needed just for the Beaver Lake watershed.
$10-15 mil/yr for inter-county activities, coordination, management.
The Fox River, MN, for example, has spent about $120 million for restoration.
Target high priority watershed that need additional funding to minimize degradation, as well as target watersheds that require minimal funding because there is a low risk change.
Much of the money being spent through the Farm Bill is a waste.
The cost for tail water improvements on the two streams is $14-15 million for trout fishing.
The overdraft issue alone is estimated to need $1 billion.
The state could use $500 annually for education and outreach.
Resources are adequate if people will talk to each other and focus on issues.
Funding of state agencies is primarily through federal flow-through money; this needs to be corrected.

Table C.9. Responses to the question, “In your view, within the next five to ten years, what do you see as emerging or potentially worsening water problems for the state, region (of the state), or a specific locality?”

For many respondents, the response was to see the issues already identified for previous questions. The issues aren’t going away. Emerging issues included:
Fayetteville Shale Play - issuing timely permits for land application and environmental protection.
Bioaccumulation of pharmaceuticals and agricultural chemicals.
More water-efficient agriculture.
Increasing pressure on water quantity and quality through development, recreation, and tourism; desire for protection and preservation.
Land development, stormwater runoff, sediment and nutrient pollution.
Water rights and availability.
Development pressure leading to wetland destruction, forest removal, riparian zone destruction.
Continuation of groundwater aquifer depletion and permanent damage to the aquifer.
Water supply – in some areas, municipalities will pay power companies more for water than revenue gained through hydropower electricity generation.
Urban runoff and changes from rural to urban environments.
What I don’t know about the future is always a concern.
Complete destruction of the Alluvial Aquifer, increased of the Sparta Aquifer.
Legislation to limit or eliminate the use of the Sparta Aquifer for agricultural use, devastating economic losses to the agriculture industry in eastern Arkansas.
Extremists will continue to “keep things stirred up.”
Continued purchases of acreages to “live in the country” which creates the desire for good quality and quantity of water in streams, with increased property rights issues.
Continued land development around large impoundments.
Competition for funds.
Competition for water resources.
Growth that outstrips resources in certain areas.
Greater pressure on small communities, which are not capable of planning.
Development of the gas reserves in the Fayetteville shale.
Assignment of water rights; inability of rural water utilities to provide adequate service in rapidly growing areas.
Nutrients will continue to be an issue.
Bacteria and possibly pharmaceuticals will become larger issues. Water quantity may surpass all quality issues.
Uncontrolled development that decimates buffers, adds runoff and depletes public funds.

Table C.9. Continued

As long as it is less costly … in terms of both outright development costs and regulatory compliance…. for builder to use a green site rather than redevelop an existing site, we will continue to be one of the most "sprawled" states in the nation, with the accompanying cost of inefficient use of public services and cost to the environment.
The old, potentially leaky, pre-Subpart D landfills scattered throughout the state.
Continued lack of funding of river navigation infrastructure on the White, Red, Ouachita, Arkansas, and Mississippi Rivers.
The continued draw down of the aquifers and the lack of funds to develop surface water sources.
Southern and central part of the state will have to deal with availability issues. Northwestern part of the state will have to deal with quality; northeastern part of the state will have to deal with increasing regulatory issues.
Taste and odor problems will increase in northwest Arkansas.
Relationships with surrounding states is likely to become even more of a problem than it is now.

Table C.10. Responses to the question, "What are potential strategies or options that could be implemented to help mitigate the problems or issues identified in the previous question?"

Many of the responses provided to an earlier question on strategies and options are relevant here. Additional responses included:
Develop a statewide plan to show how drinking water will be provided in all areas of the state for next 10-20 years.
Create a state agency that will monitor ground and surface water supplies, as well as allocate water resources, in the future.
Optimal use of current staff in agencies.
Improve the pricing of water.

Table C.11. Responses to the question, "Do you have any other comments or suggestions for solving water problems within Arkansas?"

There must be a collective, collaborative effort of state, local, federal – each with appropriately defined roles.
People must understand there is a problem.
Every sector, every individual, every organization needs to be engaged to address this problem.
Existing regulations are dated.
We need to modernize water management methods.
We must continue to link watershed stakeholders to better understand each other's challenges/perspectives and interest to move toward comprehensive management strategies.
Water Code Study of 1981-83 came out of 1980 drought. Water interest cycles in and out, but is reaching crisis proportions.
Groundwater laws were grandfathered, so ineffective at managing groundwater.
There are many, many, many hidden features of water that typically aren't considered when looking only at water use.
Consolidate state agencies and commissions into single agency dealing with water.
Education, Education, Education! We can't say it enough. It has to become part of our DNA.
Takes vision, partnerships and powerful champions to make sustainable water resources a reality, but can be done.
No integrated approach to helping individuals understand that their cumulative actions do have an effect on water.
Invest in the infrastructure to conserve, store, and transport out water resources.
Water issues are quality of life issues.
There is a need for source water protection legislation and watershed protection planning. Regulations are needed to cover development in source watersheds.
Invest in studies and/or technology to turn problems into materials that are useful commodities.
We must work together and avoid the "us against them" mentality to develop equitable and fair solutions for all.
Now is the time!