Arkansas Water Plan 2014 Update

Appendix J
Statewide Demography, Economy, Social Setting, and Environmental Issues Report

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water resources / environmental consultants

Arkansas WATERplan
Essential For Life

ARKANSAS WATER PLAN UPDATE
TASK 5: SOCIOECONOMIC CHARACTERISTICS AND WATER RESOURCES ISSUES

APRIL 18, 2014

ARKANSAS WATER PLAN UPDATE
TASK 5: SOCIOECONOMIC CHARACTERISTICS AND WATER RESOURCES ISSUES

Prepared for

Arkansas Natural Resources Commission
101 East Capitol Avenue, Suite 350
Little Rock, AR 72201-3813

Prepared by

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

FTN No. 03015-0003-001

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ACRONYMS

ADEM	Arkansas Department of Emergency Management
ADEQ	Arkansas Department of Environmental Quality
ADH	Arkansas Department of Health
ADPCE	Arkansas Department of Pollution Control and Ecology
ANRC	Arkansas Natural Resources Commission
ASPB	Arkansas State Plant Board
AWP	Arkansas Water Plan
CBSA	Core Based Statistical Area
CEC	Contaminant of emerging concern
E. coli	Escherichia coli
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GDP	Gross domestic product
MCL	Maximum contaminant level
Mgd	Million gallons per day
n.d.	No date
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
OMB	United States Office of Management and Budget
PCB	Polychlorinated biphenyl
SDWA	Safe Drinking Water Act
TDS	Total dissolved solids
TMDL	Total maximum daily load
TOC	Total organic carbon
TSS	Total suspended solids
U of A	University of Arkansas at Fayetteville
US	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1.0 INTRODUCTION

The Arkansas Natural Resources Commission (ANRC) is responsible for preparing and periodically updating a statewide water resources planning document. The previous Arkansas Water Plan (AWP) was completed in 1990. In 2012, ANRC initiated an update of the 1990 AWP to be completed in 2014.

This document was prepared as part of the 2014 update of the AWP (Project Task 5). It provides a description of the socioeconomic characteristics and water resources issues in Arkansas. The objective is to present an overview of the state economy and demography, along with a summary of the values and concerns of various user groups with respect to water use and development and environmental issues. The following sections present general descriptions of state demographics and economic drivers and how they relate to water use and demand, as well as water resources issues in the state.

2.0 DEMOGRAPHICS

Demographic information for Arkansas from the 2010 United States (US) census is presented below. Demographic data presented include population totals and the percentages of people living in urban and rural areas, above or below selected ages, and of different races. The information from the 2010 census is compared to information from the 1990 census to identify population changes that have occurred since the 1990 AWP. Although the 1990 AWP reported population data from the 1980 census, the 1990 census better represents conditions at the time of the 1990 AWP. Population changes affect the need and demand for water resources, not just for drinking water, but also for recreation, food supply, irrigation, and aesthetics. Population demographics also affect the potential tax base to pay for water infrastructure upgrades, expansion, and repairs.

2.1 Current Population

Arkansas demographic data from the 2010 census are summarized in Table 2.1. Figure 2.1 shows the distribution of the state population. The Office of Management and Budget (OMB) has defined several categories for use in classifying population density across each state. The classifications are for statistical purposes and are not intended to be utilized for determining whether an area is "urban" or "rural" for federal program funding. The US Census Bureau utilizes the categories defined by OMB to delineate geographic areas of the state as urban clusters, urbanized areas, and metropolitan statistical areas. The OMB definitions for these categories are as follows (OMB 2010):

- Urban cluster: a statistical geographic entity delineated by the Census Bureau that consists of densely settled census tracts and blocks and adjacent densely settled territory, which together contain at least 2,500 people. Only urban clusters of 10,000 or more population are considered for purposes of delineating Core Based Statistical Areas (CBSA).
- Urbanized area: a statistical geographic entity delineated by the Census Bureau that consists of densely settled census tracts and blocks and adjacent densely settled territory, which together contain at least 50,000 people.

- Metropolitan statistical area: a CBSA associated with at least one urbanized area that has a population of at least 50,000 people. The metropolitan statistical area comprises the central county (or counties) containing the core as well as adjacent outlying counties that have a high degree of social and economic integration with the central county/counties (measured through commuting).
- Large metropolitan statistical area: a CBSA associated with at least one urbanized area that has a population of at least 250,000 people. The metropolitan statistical area comprises the central county (or counties) containing the core as well as adjacent outlying counties that have a high degree of social and economic integration with the central county/counties (measured through commuting).

Table 2.1. Arkansas demographics in 1990 and 2010 (US Census Bureau 1992, 2012a, 2013).

Demographic	1990	2010	Percent Change
Total Population	2,350,725	2,915,918	24.0%
Female	51.8% (1,217,649)	50.9% (1,484,281)	21.9%
Male	48.2% (1,133,076)	49.1% (1,431,637)	26.3%
Urban	52.0% (1,223,495)	56.2% (1,637,589)	33.8%
Rural	48.0% (1,127,230)	43.8% (1,278,329)	13.4%
AGE			
Under 5	7.0% (164,667)	6.7% (197,689)	20.1%
Under 18	26.4% (621,131)	24.4% (711,475)	14.5%
Over 65	14.9% (350,058)	14.4% (419,981)	20.0%
RACE			
White non-Hispanic	82.7% (1,944,744)	77.0% (2,245,229)	15.5%
African American	15.9% (373,912)	15.4% (449,895)	20.3%
Hispanic or Latino	0.8% (19,876)	6.4% (186,050)	836%
Asian	0.5% (12,125)	1.2% (36,102)	198%
American Indian	0.5% (12,773)	0.8% (22,248)	74.2%
Pacific Islander	0.02% (405)	0.2% (5,863)	1,348%
Other	0.3% (6766)	3.4% (99,571)	1,372%

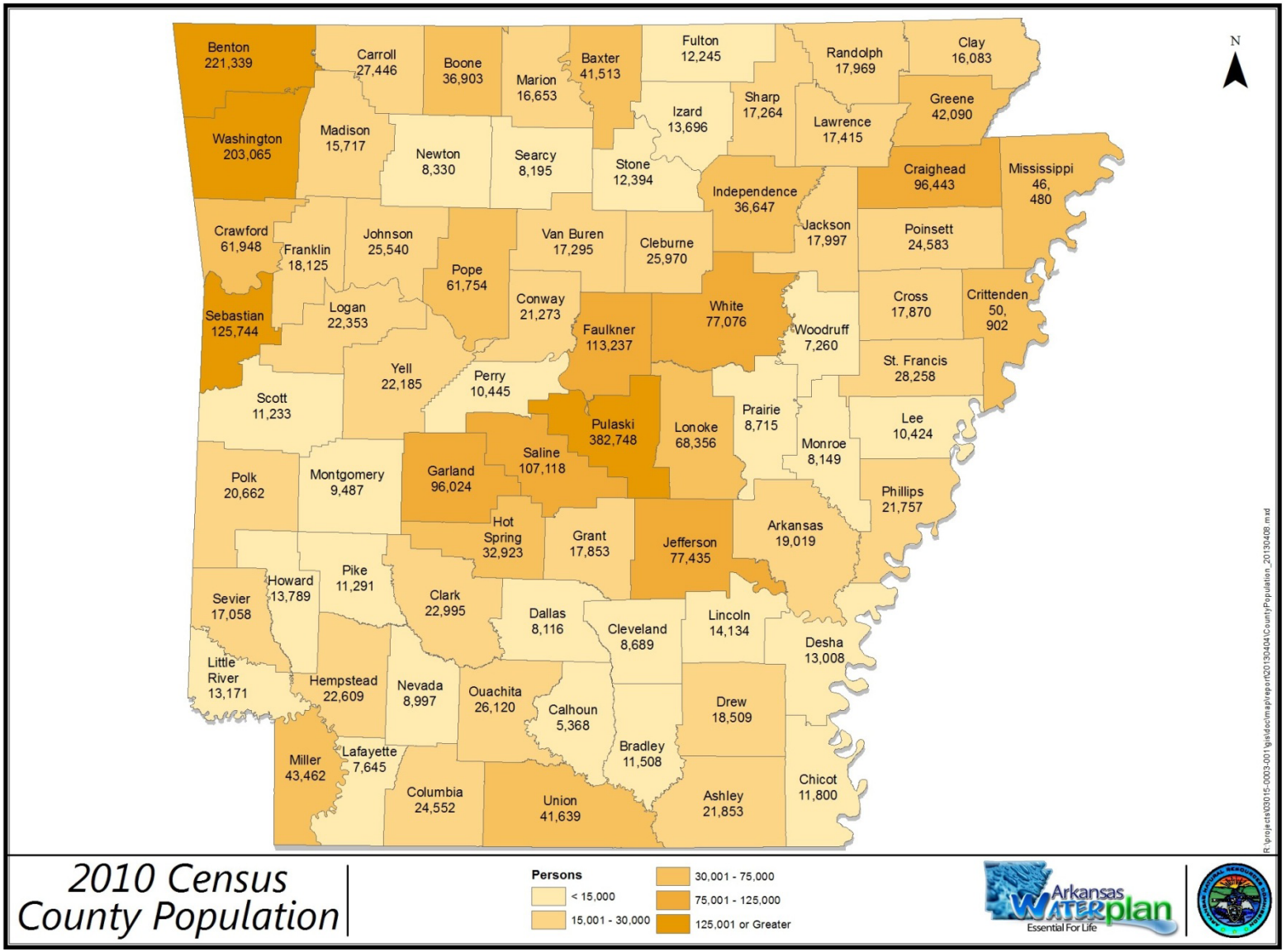

Figure 2.1. 2010 population by county (US Census Bureau 2012c).

There are four large metropolitan statistical areas in Arkansas (although two overlap into adjacent states): (1) Little Rock-North Little Rock-Conway; (2) Fort Smith, Arkansas-Oklahoma; (3) Fayetteville-Springdale-Rogers; and (4) Memphis, Tennessee-Mississippi-Arkansas (Figure 2.2) (US Census Bureau 2012b). The 2010 census also identified 9 urban areas and over 60 urban clusters (Figure 2.2). In 2010, approximately 56% of Arkansans lived in urban areas (US Census Bureau 2012a).

2.2 Changes Since 1990

The state population increased approximately 24% between the 1990 and 2010 census (Table 2.1). No significant change has occurred since 1990 in the ratios of men and women or in the age profile of the state. Data show that minorities (with the exception of African-Americans and Native Americans) have experienced a nearly ten-fold increase in population. In addition, 4.2% more of the population was living in urban areas in 2010 than in 1990.

Portions of central and northwest Arkansas experienced significant population increases between 1990 and 2010 (Figure 2.3). Increased development and increased demands on water utilities accompanied these population increases. In central Arkansas, the Faulkner County population increased by almost 90%, and the populations in Lonoke County and Saline County increased by over 79% and 66%, respectively. Faulkner, Lonoke, and Saline counties are expanding bedroom communities for the Little Rock-North Little Rock-Conway large metropolitan statistical area (Landreth 2012, McGraw 2013). In northwest Arkansas, the population of Benton County increased by almost 130%, and the population in Washington County increased by 79%. These increases are related to the expansion of businesses based in Arkansas that serve national and international markets. However, the majority of the counties in eastern Arkansas experienced population declines during this period (US Census Bureau 2012a).

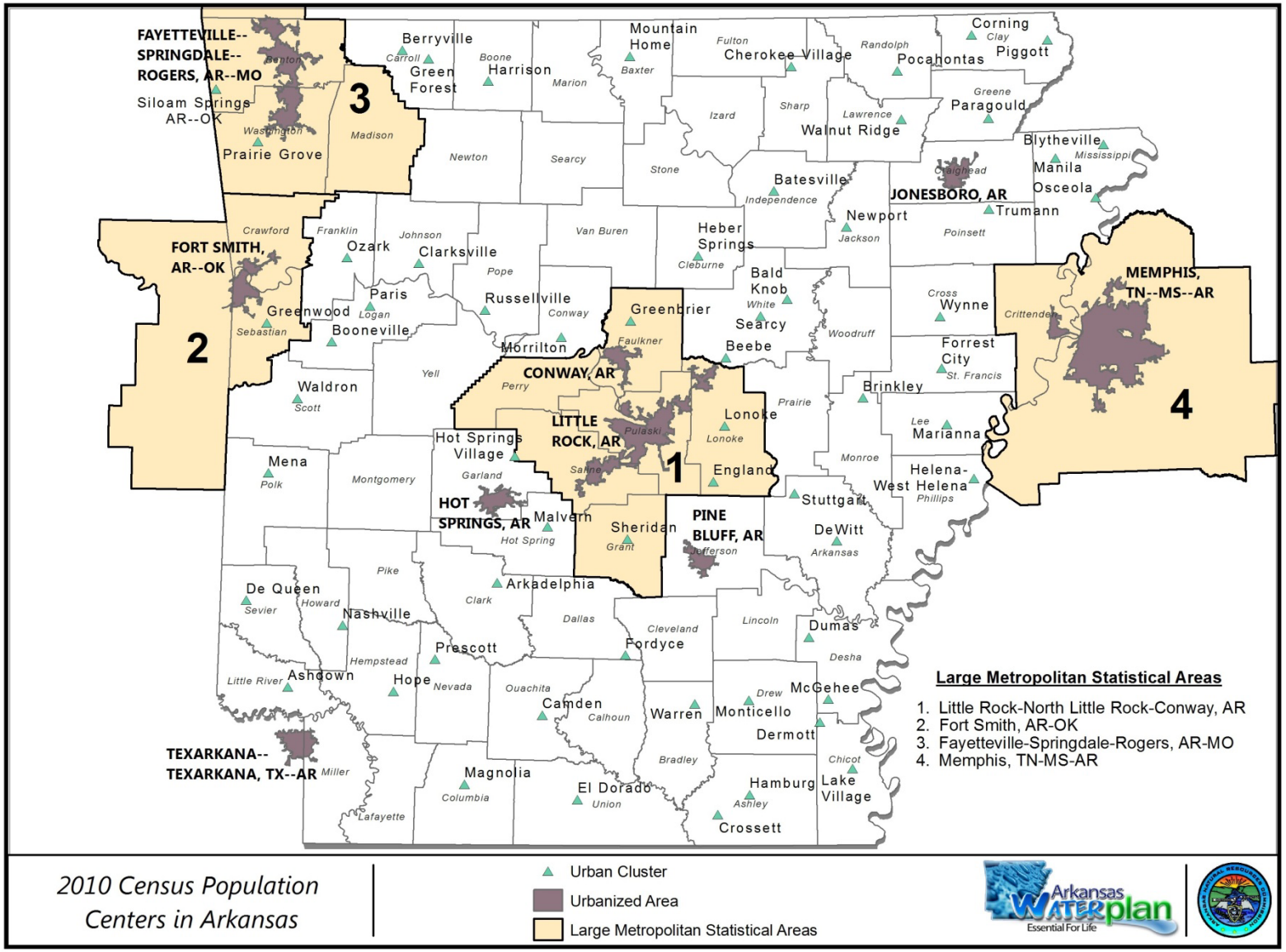

Figure 2.2. State population centers, 2010 (US Census Bureau 2012c).

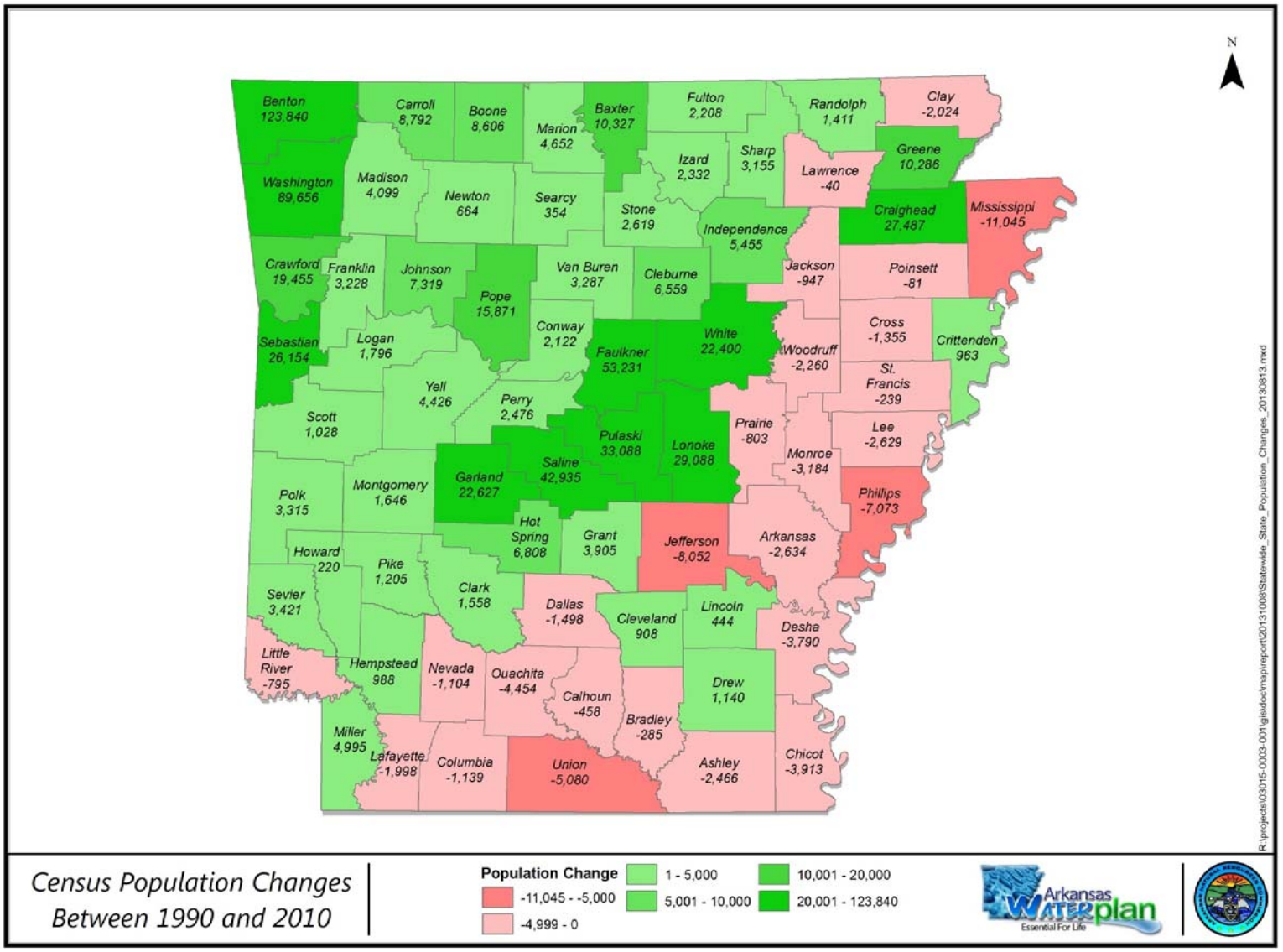

Figure 2.3. Population change 1990 to 2010 by county (US Census Bureau 1992, 2012a).

3.0 SOCIOECONOMICS

The economy influences the demand for water resources in numerous ways. For example, certain types of industry require more water to operate than others. Changes in population that result from economic growth or decline affect the demand for water and wastewater treatment. Increased development driven by economic change can negatively impact water quality in a region. Industries and communities produce waste that must be properly managed to prevent pollution of water resources. Higher incomes can increase the demand for recreation and aesthetics that involve water resources.

The socioeconomic characteristics of Arkansas are examined by reviewing information on income, the industries that support the state's economy, and waste management. Recent information is compared to information from the early 1990s, at the time of the previous AWP, to identify how things have changed since then. Understanding these changes provides insight into changes in the demand for water resources in Arkansas.

3.1 Income and Employment

Income and employment data are available for Arkansas by county from the US Census. Data from 2007 to 2011 are presented below to characterize the current income and employment levels within the state and how they vary across the state. Data from 1990 are also presented for comparison, to provide insight into any changes that have occurred in income and employment levels in Arkansas since the 1990 AWP.

3.1.1 Current Income and Employment Levels

The median household income in Arkansas in 2011 was $41,302 (US Census Bureau 2012c) (see Table 3.1). Figure 3.1 shows the distribution of median household income levels in the state. There are 15 counties where the 2007 through 2011 median household income was greater than $40,000: Benton, Baxter, Craighead, Crawford, Faulkner, Grant, Lonoke, Miller, Perry, Pope, Pulaski, Saline, Sebastian, Washington, and White (US Census Bureau n.d.). The

county with the highest median household income from 2007 through 2011 was Saline County, where the median household income was $52,982 (US Census Bureau n.d.).

Table 3.1. Summary of income information for Arkansas from 1990 and 2011 (US Census Bureau n.d., 2012c; Census State Data Center 2002).

Category	1990	2007-2011	Percent Change	Change in Percentage
Median household income[1,2]	$22,786	$41,302	81%	--
Families with income below the poverty level	14.8%[3]	13.8%[4]	--	-1.0%
Population supported by income below the poverty level	19.1%[3]	18.4%[4]	--	-0.7%
Unemployment	6.8%[3]	8.4%[4]	--	1.6%

Notes: 1. For the years 1990 and 2011, taken from US Census Bureau 2012c.
2. Equivalent in 2012 US dollars.
3. From Census State Data Center 2002.
4. From US Census Bureau n.d.

The proportion of Arkansas families that had an income below the poverty level in 2007 through 2011 was 13.8%, accounting for 18.4% of the state population (Table 3.1). Unemployment in the state during the same time period was 8.4%, higher than the national average of 5.6% (US Census Bureau n.d.).

3.1.2 Changes Since 1990

The median household income in Arkansas during the period from 2007 to 2011 was over 80% higher than it was in 1990 (comparison made in 2012 dollars[1]) and unemployment is 1.6% higher than it was in 1990 (Table 3.1). In 1990, as in the period from 2007 through 2011, Saline County had the highest median household income (US Census Bureau n.d., 1992).

[1]The purchasing power of the dollar differs between years due to inflation, so the data were adjusted by the Bureau of Labor Statistics (BLS) using an index called CPI-U-RS, or the "Consumer Price Index Using Current Methods, 1978-1998." Adjusting income values using CPI-U-RS allows more realistic comparisons to be made between the 1990 and 2011 median household income values.

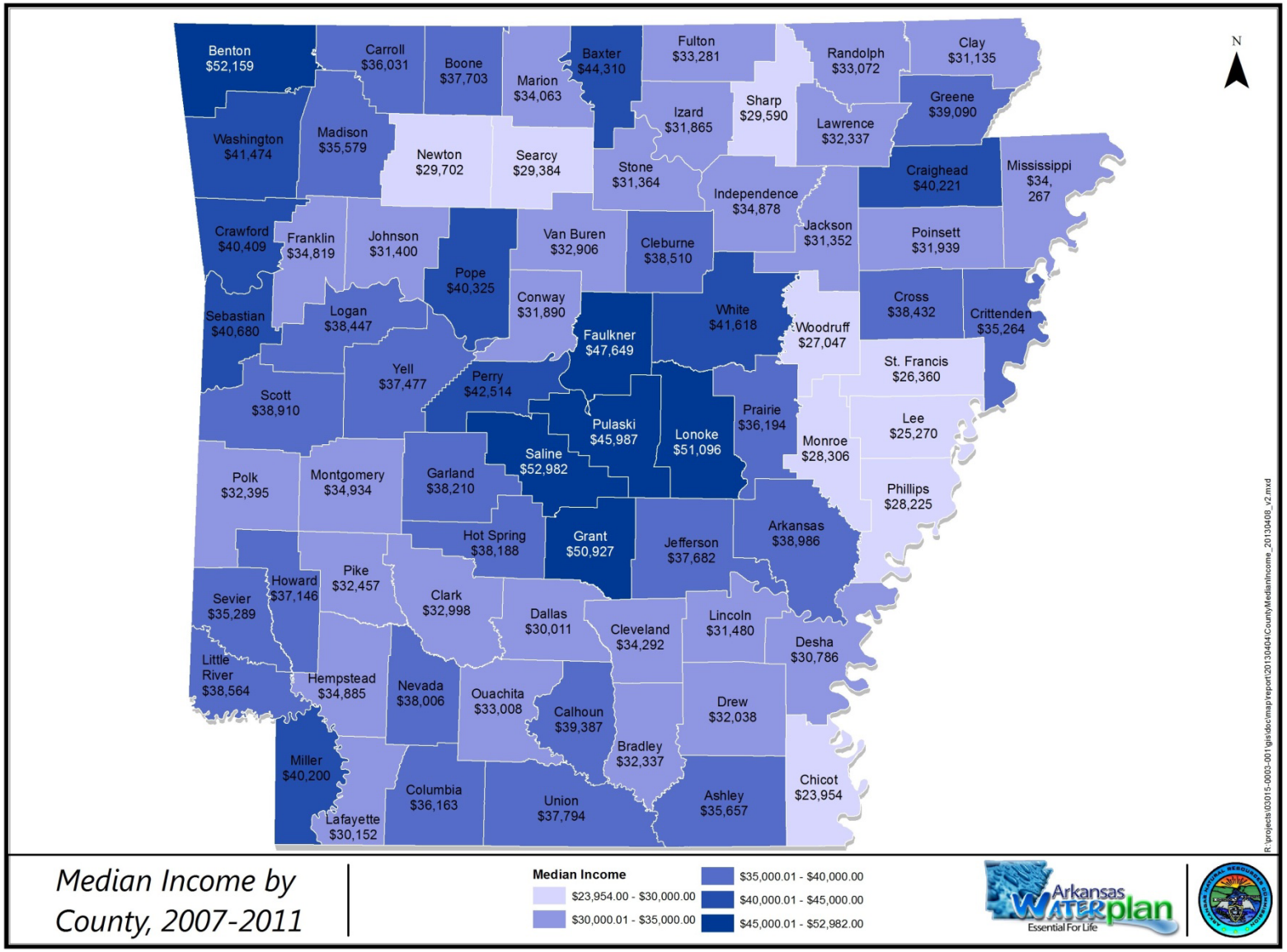

Figure 3.1. Median household income by county, 2007 through 2011 (US Census Bureau n.d.).

3.2 Economic Drivers

There are a variety of industries active in Arkansas's economy. These industries vary in their demands on the state water resources. Currently, service industries are the largest contributors to the state economy. This was not the case at the time of the 1990 AWP. This change in the state economy has influenced the demands on the state water resources.

3.2.1 Current Arkansas Economic Profile

In 2010, the state Gross Domestic Product value (GDP) was over $102 billion (US Bureau of Economic Analysis 2010). The percent contribution to the state GDP by various economic sectors is summarized on Figure 3.2. The service industry (i.e., health care, accommodations, education, administration, information, and other services) contributes the most to the state GDP. This industry does not utilize large volumes of water. The economic sectors that employed the most people in the state in 2011 included education/health/social assistance, manufacturing, and retail (Table 3.2) (US Census Bureau n.d.).

Fortune magazine annually publishes a list of the 500 US corporations with the highest gross revenue (adjusted for excise taxes). Four of these Fortune 500 companies are based in Arkansas: Dillard's, Murphy Oil, Tyson Foods, and Wal-Mart. In 2012, Wal-Mart ranked second in the nation. Tyson Foods and Murphy Oil ranked in the top 100 companies. Dillard's is the fourth 2012 Fortune 500 Company based in Arkansas. A number of Fortune 500 companies have operations in the state, including International Paper, Verizon Communications, Whirlpool, and Weyerhaeuser (Fortune 2012a). Stephens Inc., in Little Rock, is one of the largest off-Wall Street investment firms in the country (Nelson 2012).

The two largest industries in Arkansas are agriculture and tourism. Both of these industries rely on Arkansas water resources. Another important Arkansas industry that affects the state water resources is resource extraction, i.e., mining and oil and natural gas production. These industries and their contributions to the state economy are discussed below.

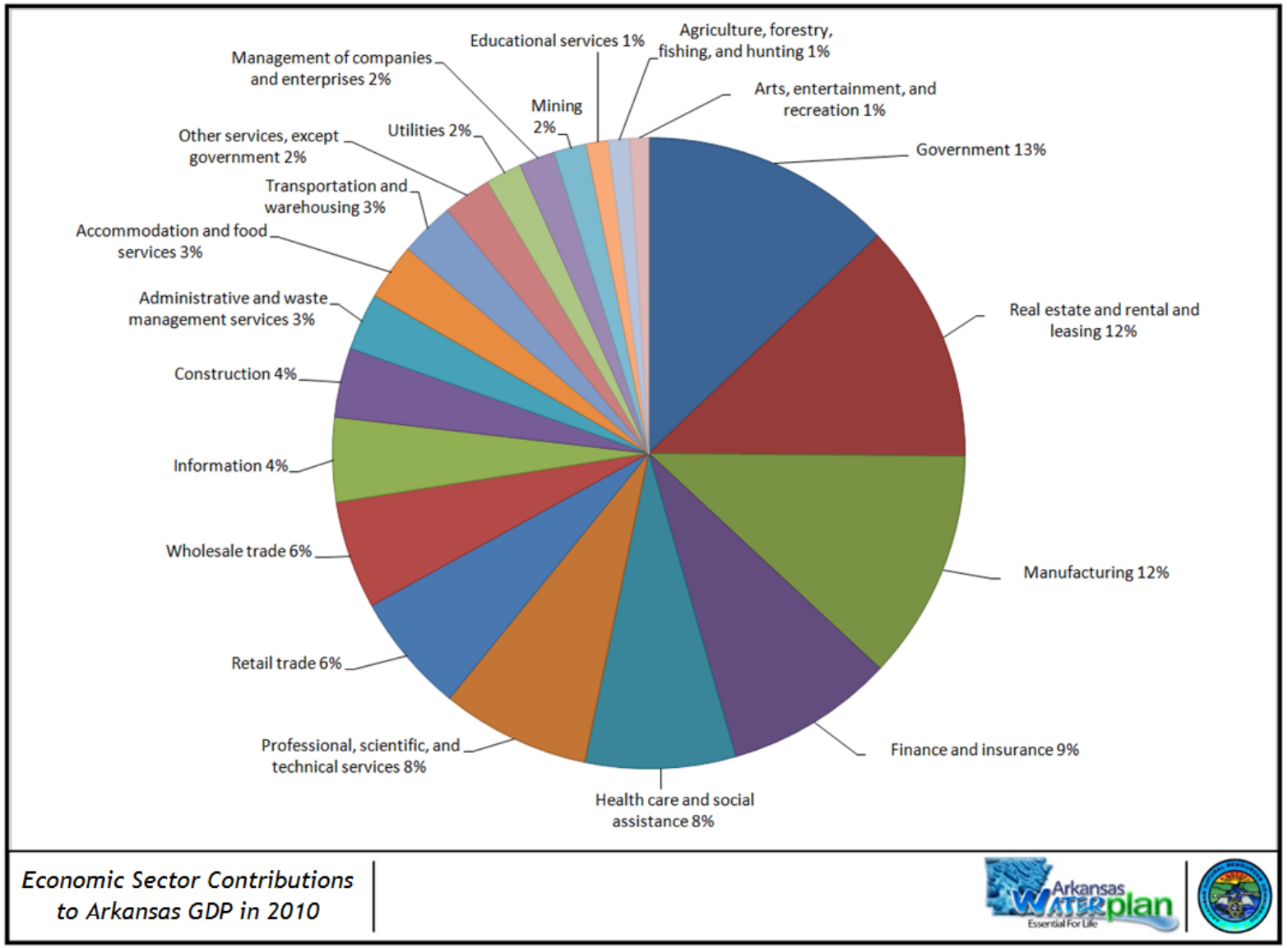

Figure 3.2. Economic sector contributions to Arkansas GDP in 2010 (US Bureau of Economic Analysis 2010, Arkansas Institute for Economic Advancement 2013).

Table 3.2. Summary of employment in 1990 and 2011, by economic sector (US Census Bureau 2013, Census State Data Center 2013).

Economic Sector	1990	2007-2011
Total employed population	994,289	1,252,276
Mining	4,010 (<1%)	(included in agriculture)
Agriculture, forestry, fisheries	48,384 (4.9%)	42,482 (3.4%)
Construction	60,414 (6.0%)	88,500 (7.1%)
Manufacturing	223,375 (22.5%)	179,702 (14.4%)
Transportation	45,771 (4.6%)	70,516 (5.6%)
Communications	26,424 (2.6%)	Not reported
Information	Not reported	21,520 (1.7%)
Utilities	(included in communications)	(included in transportation)
Wholesale trade	38,425 (3.9%)	33,829 (2.7%)
Retail trade	173,468 (17.4%)	166,616 (13.3%)
Health services	83,378 (8.4%)	287,708 (23.0%)
Educational services	81,182 (8.2%)	(included in health services)
Professional, scientific, management, administrative, waste management	(included in other services)	84,970 (6.8%)
Business and repair services	37,097 (3.7%)	Not reported
Entertainment, recreation	8,578 (1%)	95,196 (7.6%)*
Other services	48,096 (4.8%)	59,983 (4.8%)
Finance, insurance, real estate	46,785 (4.7%)	63,414 (5.1%)
Public administration	39,293 (4.0%)	57,840 (4.6%)
Personal services	29,609 (3.0%)	Not reported

3.2.1.1 Agriculture

Agriculture (including forestry and timber) is Arkansas's largest industry. In 2010, Arkansas was ranked 14th in the nation in the value of agricultural products sold (McGraw, Popp and Miller 2012). The state's agricultural outputs include poultry and eggs, soybeans, rice, hay, cotton, corn, wheat, oats, sorghum, cattle, hogs, and milk. Crop agriculture is the largest water user in the state. For the period 2007 to 2011, Arkansas was the nation's largest producer of rice and ranked in the top three for cotton, broiler chickens, pullets, turkeys, and aquaculture (catfish). Arkansas ranks fourth nationally and first in the South in

softwood lumber production (US Department of Agriculture [USDA] National Agricultural Statistics Service 2007; McGraw, Popp and Miller 2012).

In addition to the agriculture economic sector, Arkansas's agriculture and timber industries generate revenue in the manufacturing, real estate, wholesale trade, and transportation and warehousing economic sectors. In 2010, agriculture (including production and processing of crops, forestry products, livestock, and poultry) directly and indirectly contributed just over $16 billion (just over 10%) to the state GDP. This is a relatively high percentage compared to neighboring states and the southeast region (University of Arkansas Divison of Agriculture 2012). The timber industry contributes, directly and indirectly, over $3.2 billion to the state GDP (McGraw, Popp and Miller 2012). Agriculture and forestry generate jobs in Arkansas in all 20 of the economic sectors shown in Figure 3.2 (University of Arkansas Divison of Agriculture 2012).

3.2.1.2 Tourism

Tourism is Arkansas's second largest industry. The quality of state water resources contributes significantly to this industry. Tourism in Arkansas includes water-related recreation such as boating (including power-boating, canoeing, kayaking, and personal watercraft), fishing, swimming (including water-skiing and scuba diving), waterfowl hunting, and wildlife watching. These activities take place at over 600,000 acres of public lakes, including 13 US Army Corps of Engineers (USACE) reservoirs and 130 square miles of Extraordinary Resource Waters; 9,700 miles of streams, including the Buffalo National River, over 400 miles of state and federally designated wild and scenic rivers, and over 2,200 miles of state designated Extraordinary Resource Waters; thousands of acres of wildlife refuges and wildlife management areas; 52 state parks, and national parks, including Hot Springs National Park. Arkansas tourism contributes to the state economy in a majority of the economic sectors identified in Figure 3.2, including recreation, accommodation and food services, retail trade, and real estate.

Hunting, fishing, and wildlife watching contribute significantly to the state economy. In 2011, Arkansas ranked seventh in the nation in hunting-related sales, and more mallard ducks were harvested in Arkansas than any other state (Arkansas Game and Fish Commission 2013). Table 3.3 lists economic value associated with several of these activities.

Table 3.3. Contributions to Arkansas economy from tourism and water-related recreation.

	Consumer spending	Direct jobs	Wages	State & local tax revenue	Federal tax revenue	Value added
Outdoor recreation (2011-2012)[1]	$10 billion	126,000	$2.9 billion	$696 million	Not reported	Not reported
Visitation to USACE lakes (2012)[2]	$807 million	8,719	$201 million	Included in value added	Not reported	$332 million
Tourism (2012)[3]	$5.8 billion	58,452	$1.1 billion	$411 million	Not reported	Not reported
Fishing (2011)[4]	$508 million	7,549	Not reported	$49.4 million	$49.8 million	Not reported
Waterfowl hunting (2011)[4]	$236.7 million	4,706	Not reported	$29.1 million	$23.9 million	Not reported
Wildlife watching (2011)[5]	$216 million	Not reported	Not reported	Not reported	Not reported	Not reported

1 (Outdoor Industry Association 2013)
2 (US Army Corps of Engineers 2011)
3 (Arkansas Department of Parks and Tourism 2012)
4 (Arkansas Game and Fish Commission 2013)
5 (US Department of the Interior Fish and Wildlife Service; US Department of Commerce Census Bureau 2013)

3.2.1.3 Resource Extraction

A number of materials are mined or extracted commercially in Arkansas, including bauxite, chalk, clay, coal, crushed stone, diamonds, gravel, gypsum, iron, natural gas, novaculite, oil, quartz crystals, sand, stone, and tripoli. In 2009, production of non-fuel minerals in Arkansas was valued at $636 million, ranking 30th in the nation. The non-fuel mineral that accounted for the largest proportion of this value was crushed stone, one-third. Bromine, Portland cement, sand and gravel, and lime together accounted for over 60% of the non-fuel mineral value. Arkansas is the only state that produces bromine, and accounts for 40% of global bromine production. Gypsum mined in Arkansas supplies the world's largest wallboard plant, which is located in the state (Howard 2011, US Geological Survey 2013).

The oil and gas industry contributes significantly to Arkansas's economy, primarily from natural gas production in the Fayetteville Shale Play (University of Arkansas Sam Walton

College of Business 2009). In 2011, natural gas production contributed $8.9 billion to the Arkansas economy, and Arkansas was ranked as one of the top ten marketers of natural gas in the US in 2011 (Brown 2012, University of Arkansas Sam M. Walton School of Business Center for Business and Economic Research 2012).

For the most part, water quality impacts are the primary water resources concerns associated with resource extraction in the state. However, because natural gas in Arkansas is extracted using the hydrofracking process, development of the Fayetteville Shale Play has resulted in increased use of surface water in that part of the state.

3.2.2 Changes in Economic Profile Since 1990

The nature of the Arkansas economy, and its water use, has changed since the 1990 AWP. Table 3.4 lists the state GDP for 1990 and 2010, and values for selected economic sectors. Different methods were used to classify economic sectors in 1990 and 2010, so a direct comparison of GDP by economic sector is not possible. However, some general comparisons can be made. First, the state GDP has almost tripled since 1990. Second, in 1990, manufacturing contributed the largest percentage to the state GDP, while services contributed the largest percentage in 2010 (Das and Rainey 2006). Only two Arkansas companies were in the Fortune 500 in 1990, Murphy Oil and Tyson Foods, and neither of them were in the top 100 (Fortune 2013b).

Table 3.2 lists employment numbers from the most recent 5-year estimates from the Community Survey and the 1990 census, by economic sector. Different methods were used to classify economic sectors in the 1990 census and the Community Survey. As a result, it is not possible to directly compare employment numbers from these sources for all of the industrial sectors. There are a few economic sectors where the number, and percentage, of employees is lower in 2011 than in 1990, including manufacturing and wholesale and retail trade. Employment in education and health services appears to have increased since 1990.

Table 3.4. Summary of economic information for Arkansas and selected economic sectors from 2010 and 1990 (US Bureau of Economic Analysis 2010).

Economic Sector	$ Million (% of GDP)	
	1990	2010
Arkansas GDP	$38,680	$103,170
Agriculture, Forestry, Fishing	$1,689 (4%)	$2,668 (2%)
Mining	$408 (1%)	$2,151 (2%)
Construction	$1,399 (4%)	$4,217 (4%)
Manufacturing	$9,520 (25%)	$14,383 (14%)
Transportation & warehousing	$1,701 (4%)	$7,260 (7%)
Wholesale trade	$2,253 (6%)	$7,074 (7%)
Retail trade	$3,701 (10%)	$7,535 (7%)
Government	$5,100 (13%)	$15,044 (14%)
Legal services	$271 (1%)	$677 (1%)
Educational services	$107 (<1%)	$550 (1%)
Health & social services	$2,430 (6%)	$8,422 (8%)
Real estate	$3,018 (8%)	$11,368 (11%)
Finance & insurance	$1,581 (4%)	$4,863 (5%)

3.2.2.1 Agriculture

In 1990, the agriculture and forestry industries accounted for a greater percentage of the state GDP than in 2010 (US Bureau of Economic Analysis 2010). In 1992, Arkansas ranked 13th in the nation for the value of agricultural products sold, was first in the nation for broiler chickens and rice production, fourth for turkey and cotton production, and seventh for soybean production (US Department of Commerce 1994). In 1990, Arkansas was second in the nation for catfish production (USDA National Agricultural Statistics Service 1990). Rice, soybeans, and wheat accounted for the majority of harvested acres of major crops grown in Arkansas in 1992, and in 2012 rice, soybeans, and hay accounted for the majority of the harvested acres. However, the proportion of corn, rice, and hay acres is greater in 2012 than it was in 1990 (Figure 3.3) (USDA National Agricultural Statistics Service 2013).

In the 1990s, forestry was an important economic driver, contributing over $4 billion annually to the state economy (Gray 1993). Lumber and wood products companies dominated the manufacturing sector of the state economy during this period (Advameg, Inc. 2010; Gray 1993). Timber production in Arkansas has expanded since the 1990s and continues to be an important economic driver for the state (Mehmood and Pelkki 2005, Pelkki 2005).

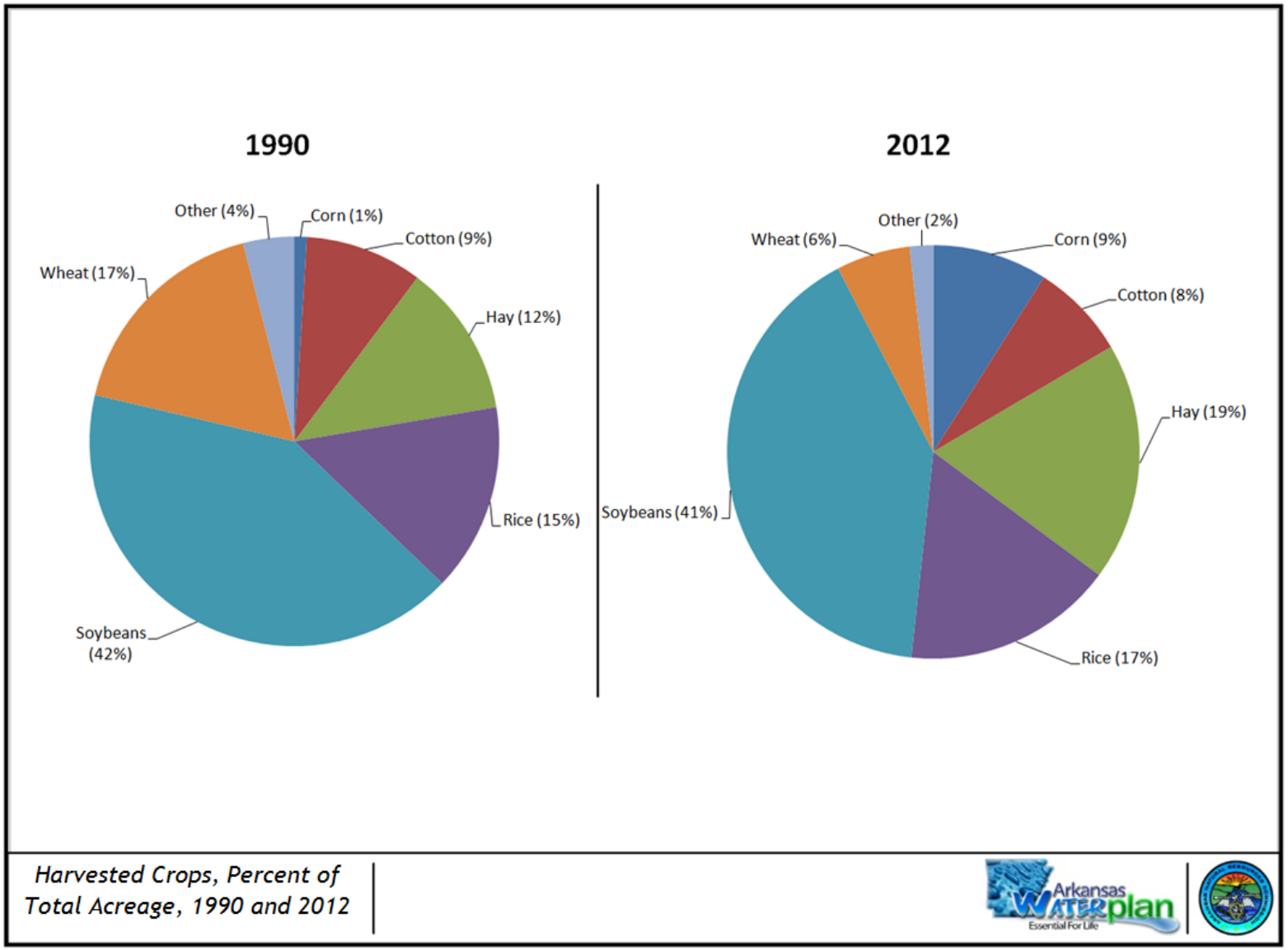

Figure 3.3. Acres harvested in Arkansas for selected crops in 1990 and 2012 (USDA National Agricultural Statistics Service 2013).

3.2.2.2 Tourism

There is not quite as much information about the contribution of tourism to the state economy in 1990 as there is about current conditions (Table3.5). Overall, the value of tourism to the Arkansas economy has increased since 1990 (Arkansas Department of Parks and Tourism 2012). Hunting and fishing did not bring as much money into the state in 1990 as they did in 2011. However, the economic benefit from recreation at USACE reservoirs appears to have been greater in 1994 than it was in 2010.

Table 3.5. Economics of recreation and tourism around the time of the 1990 AWP update.

	Consumer spending ($ million)	Direct jobs	Wages ($ million)	State tax revenue ($ million)	Local tax revenue ($ million)
Visitation to USACE lakes (1994)[1]	$1,218	16,000	$193	Not reported	Not reported
Tourism (1990)[2]	$2,288	47,600	$414.1	$107.5	$27.4
Fishing (1991)[3]	$216.9	Not reported	Not reported	Not reported	Not reported
Hunting (includes waterfowl)(1991)[3]	$85.0	Not reported	Not reported	Not reported	Not reported

1 (Jackson, et al. 1996)
2 (Arkansas Department of Parks and Tourism 2012)
3 (US Department of the Interior Fish and Wildlife Service; US Department of Commerce Bureau of the Census 1993)

3.2.2.3 Resource Extraction

In 1990, production of non-fuel minerals in Arkansas was valued at $302 million, about half of the current value. At that time, bromine production accounted for the largest proportion of the value, one-third, followed by crushed stone and sand and gravel, which together accounted for another third of the production value (White and Bush 1990). Aluminum and vanadium were still being mined in Arkansas in 1990. Mining of these metals ceased in Arkansas in 1991 (Howard 2011). In 1990, oil production was on the decline, and the Fayetteville Shale Play was not yet developed (Bridges 2011, Taylor 2013). As a result, the oil and gas industry contributed much less to the state economy at that time than it does presently.

3.3 Waste Generation and Disposal

Industries and communities produce wastes that must be properly managed to protect water quality, which contributes to water availability for the water users of the state. The Arkansas Department of Environmental Quality (ADEQ) is the state agency responsible for regulating waste (both solid waste and wastewater). Solid waste and wastewater are managed through separate permitting programs overseen by the US Environmental Protection Agency (EPA). Waste management in Arkansas is quantified below, along with changes in waste management that have occurred since the 1990 AWP.

3.3.1 Solid Waste

Solid waste in Arkansas is managed primarily through 18 Regional Solid Waste Management Districts. In 2012, over 5.9 million tons of the solid waste that was generated in the state was disposed of in the state. A little over 3.5 million tons of the waste was disposed of in state landfills and around 2.4 million tons of the waste was recycled (ADEQ 2012a). Some Arkansas communities near the borders transport solid waste to landfills outside of the state. Approximately 390 illegal dump sites located in Arkansas were reported in 2012 (ADEQ 2013a).

There have been significant changes in the solid waste arena since 1990, driven by the need to protect water quality. In 1991, federal regulations changed, requiring improvements in the way landfills were constructed in order to protect groundwater quality. In addition, the new regulations required monitoring of groundwater quality around landfills (EPA 2012a, ADEQ 2011a). At the same time, state regulations set up programs to fund cleanup of groundwater contamination from landfills, and for collection and recycling of batteries and waste oil, both of which pose risks to surface and groundwater quality when disposed of improperly. Around 1995, the Arkansas General Assembly established a policy to eliminate illegal dumping, another threat to surface and groundwater quality. State legislation to implement this policy was passed in 1997. In 2005, state legislation was passed that resulted in the development and implementation of a comprehensive mercury minimization program for the state. Mercury is a surface water quality issue throughout the state (ADEQ 2011a). State programs initiated since

1990 for the collection and recycling of electronics, and collection of household hazardous wastes also protect water quality.

3.3.2 Hazardous Waste

There are 4,858 permitted hazardous waste generators in Arkansas. One hundred seventy-six of the facilities are classified as large quantity generators, meaning they generate at least 1,000 kilograms of hazardous waste per month. Three hundred thirty-three of the facilities are classified as small quantity generators, meaning they generate between 100 and 1,000 kilograms of hazardous waste per month (ADEQ 2012b). In addition, there are 16 hazardous waste treatment/storage/disposal facilities located in Arkansas (ADEQ 2011b).

Hazardous waste generation data is compiled annually, but this program was not implemented by the Arkansas Department of Pollution Control and Ecology (ADPC&E, now ADEQ) until after 1990. Information from 1990 on the number of hazardous waste generators is also not readily available. Therefore, a comparison with 1990 conditions is not made in this document.

3.3.3 Wastewater and Stormwater

There are over 8,600 individual point sources permitted to discharge wastewater to Arkansas surface waters (Table 3.6). These discharges are permitted by ADEQ through the federal National Pollutant Discharge Elimination System (NPDES). Industrial, municipal, and domestic wastewater discharges are permitted through NPDES as well as discharges of stormwater and runoff associated with industrial sites, municipalities (MS4s), and temporary construction sites. Of the permitted point sources in Arkansas, 157 are classified as major discharges, designed to discharge over 1 million gallons per day (mgd) (ADEQ 2013b). See Task 4 report for more details on wastewater regulations and permitting in Arkansas.

Table 3.6. Arkansas active NPDES permits (ADEQ 1990, 2013c).

Permit type		1990	2013	Change
Industrial		132	918	786
Municipal		344	368	24
Domestic		237	654	417
Cooling water		24	14	-10
Filter backwash		13	125	112
Process water		3	65	62
Agricultural		2	6	4
Major		NA	157	NA
Large Municipal Separate Storm Sewer System (MS4)		NA	2	NA
Stormwater	Construction stormwater[1]	NA	1,100	NA
	Industrial stormwater[2]	NA	3,353	NA
	Small MS4[3]	NA	56	NA
	Confined animal feeding operations	NA	1	NA
Total		**776**	**8,672**	

Note: NA = not available
1 ADEQ 2013d
2 ADEQ 2013e
3 ADEQ 1013f

Approximately 690 surface waterbodies in the state receive wastewater discharges. Several state waterbodies receive wastewater discharges from more than one point source. The Arkansas River receives effluent from 38 point sources within the state, making it the surface waterbody receiving the greatest number of point source wastewater discharges (ADEQ 2011a).

Wastewater that is disposed of through land application, e.g., septic systems, or underground injection also has the potential to impact surface water and groundwater quality. Therefore, this wastewater is also regulated and permitted. A summary of the individual permits for no-discharge wastewater disposal is included in Table 3.7.

Table 3.7. Arkansas active no-discharge wastewater permits (ADEQ 2013b).

Permit Type	Number Active Individual Permits
Underground injection	6
Agriculture	265
Brine	453
Domestic	6
Drip irrigation	23
Industrial	255
Land applied drilling fluids	4
Municipal	52
Reserve pits	403
Total	**1,467**

In 1990, there were 776 point sources permitted to release wastewater in Arkansas (Table 3.6); therefore, the number of permitted wastewater point source discharges has increased by nearly 600% since the 1990 AWP. The majority of the increase in the number of individual permits is due to enactment of the NPDES stormwater permitting program. In late 1990, the NPDES permitting program was expanded to better protect surface water quality through regulation of the water quality of stormwater runoff. At that time, industries, large municipalities, and construction sites were required to obtain NPDES permits describing acceptable water quality for stormwater runoff. The first industrial sites and smaller municipalities were added to the program in late 1999. The first industrial and construction stormwater runoff NPDES permits were issued by ADEQ in 1992 (ADEQ 2013d,e). ADEQ first issued permits for small municipal stormwater runoff in 2004 (ADEQ 2013f).

4.0 WATER RESOURCES ISSUES

Water resources issues in Arkansas include concerns about the amount of water that is available, how the water is used, and the chemical and biological quality of state water resources. In addition, there are concerns in the state about how water is managed in terms of flood control, water supply infrastructure, and wastewater treatment infrastructure. These issues are discussed and, to some extent, quantified below. Changes in state water resources issues since the 1990 AWP are also discussed.

4.1 Flooding

Flooding was identified as a state water resources issue in the 1990 AWP update and is still considered an issue. Flooding has occurred, and will continue to occur, throughout Arkansas. The Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) has identified approximately 7,944 square miles of special flood hazard areas within the State of Arkansas as of April 30, 2013. Arkansas has approximately 1,700 miles of flood protection levees (American Society of Civil Engineers 2013).

Various factors affect the types and severity of flooding that occurs in the state. Flash floods are more common in the western half of the state, where the topography, geology, and rainfall characteristics of the Ozark Mountains, Ouachita Mountains, and West Gulf Coastal Plain contribute to rapid runoff. River backwater flooding is the more common cause of flooding in the Arkansas River Valley and Mississippi Embayment regions. The state averages over 100 flooding events every year, with approximately one major event each year (ADEM 2010).

According to the National Weather Service (NWS), there is no one agency in the US that collects and details flood loss information; however, NWS can provide loss estimates through their many field offices and each year provides an Annual Flood Loss Summary Report to USACE. The 30-year average of direct flood damages collected by the NWS for the period of 1981 through 2010 is $7.82 billion (adjusted to 2011 dollars for inflation). In Arkansas in 2011, the direct damages measured by NWS were over $296 million (NWS 2013). ANRC, the

state agency responsible for administering the NFIP, has access to the detailed loss and claims data processed through FEMA.

4.2 Water Supply

Arkansas water law allows for designation of critical surface water and groundwater areas in the state. For surface water, critical areas are areas where existing or projected water use, or water quality degradation, has caused, or will cause, a shortage of useful water within a relatively short time frame (ANRC 2009). In the 1990 AWP, areas in eastern and northwest Arkansas and along the Arkansas River were identified as critical surface water areas (Arkansas Soil and Water Conservation Commission 1990). However, there are no critical surface water areas designated in the state regulations (ANRC 2009).

Critical groundwater areas are areas where ANRC determines that there has been significant groundwater depletion or degradation (ANRC 2005). In the 1990 AWP, areas experiencing significant groundwater level declines were identified, but were not designated as critical groundwater areas (Arkansas Soil and Water Conservation Commission 1990). There are currently three critical groundwater areas designated in the state. These areas include all or part of 18 counties (Figure 4.1). In some of these areas, lowered groundwater levels are causing lower flows in surface water streams.

The critical surface water and groundwater designations are primarily driven by human needs for water. There are also concerns about the amount of water available to maintain quality fisheries and habitat for other aquatic and amphibious wildlife. Minimum stream flow requirements for support of fisheries (i.e., fish and wildlife flows) have been estimated for a number of streams in the state. Standards for minimum stream flow in parts of the White River are included in state regulations (ANRC 2009).

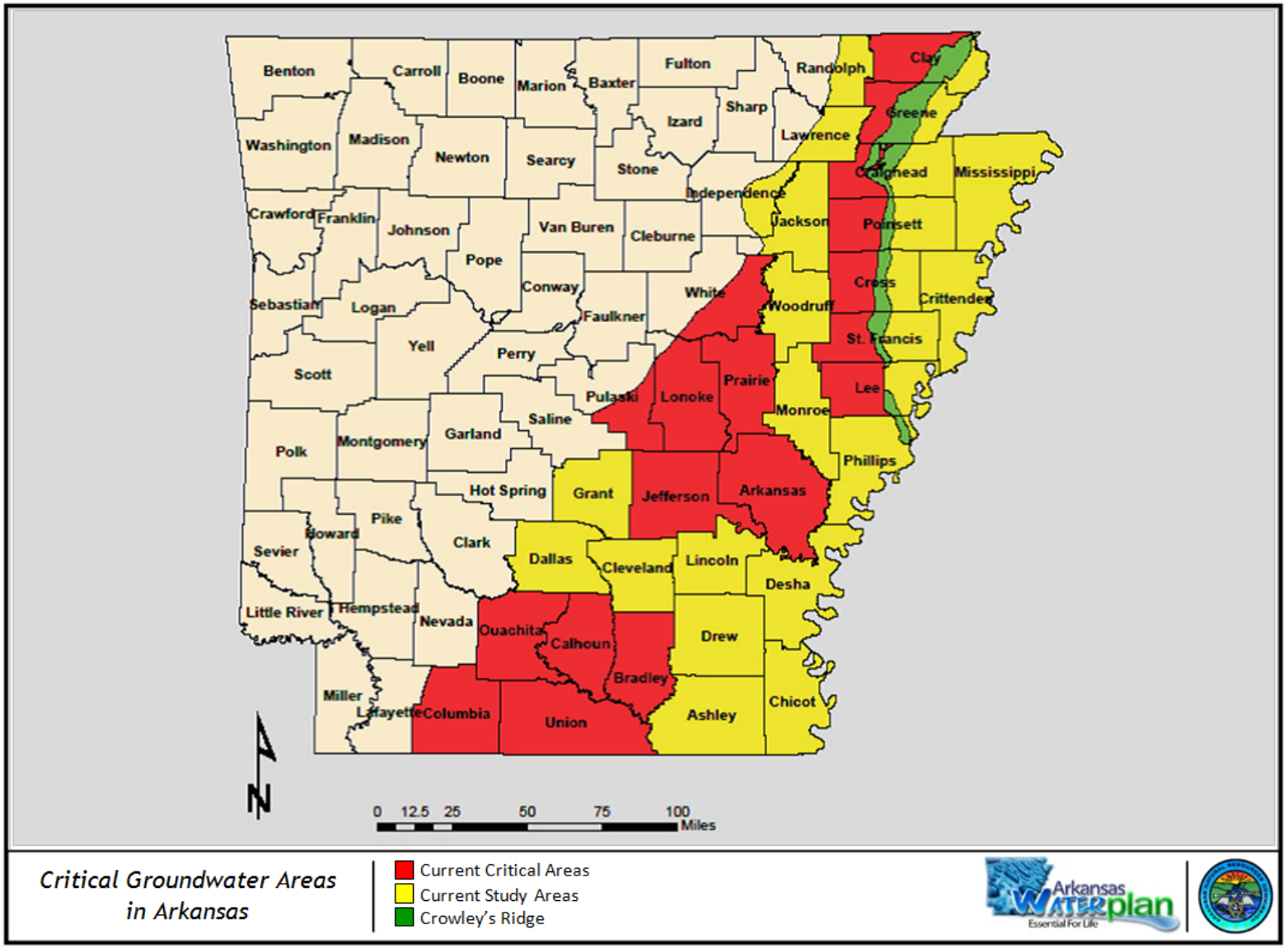

Figure 4.1. Arkansas critical groundwater areas (Arkansas Natural Resources Commission 2010).

4.3 Water Infrastructure

The need for upgrade and/or repair of aging water infrastructure is an issue across the United States. In Arkansas, drinking water infrastructure needs for the next 20 years have been estimated at $5.3 billion, and wastewater infrastructure needs total $470 million (American Society of Civil Engineers 2013). A summary of allocations from federal and state infrastructure funding programs is provided in Table 4.1.

Table 4.1. Funding programs for infrastructure in Arkansas (ANRC, personal communication).

Funding Program	Agency	Annual Amount ($ million)	Infrastructure
Clean Water Revolving Loan Fund	EPA/ANRC	$16	Sewer
Community Development Block Grants	Housing and Urban Development/ANRC	$7	Sewer and water supply
Drinking Water State Revolving Fund	EPA/ANRC	$20	Water supply
General Obligation Bond Program	ANRC	$30	Sewer and water supply
Water Development Fund	ANRC	$1-$2	Water supply
Water, Sewer, Solid Waste Fund	ANRC	$1-$2	Sewer and water supply
Water and Environment Program	USDA Rural Development	$25	Sewer and water supply

4.4 Water Quality

Federal law requires states to assess the water quality of the waters of the state (both surface water and groundwater) and prepare a comprehensive report documenting the water quality, which is to be submitted to EPA every 2 years. ADEQ is the agency in Arkansas responsible for enforcing the water quality standards and preparing the comprehensive report for submittal to EPA. This section discusses surface water and groundwater quality issues that have been identified in the state. These issues include non-attainment of surface water quality standards, non-attainment of drinking water standards and water quality guidelines in groundwater, fish consumption advisories, nonpoint source pollution of surface water and groundwater, and contaminants of emerging concern.

4.4.1 Monitoring

To assess water quality, it is necessary to collect water quality data through monitoring programs. Monitoring of water quality in Arkansas occurs under a range of programs, including routine ambient, special project, and research-oriented monitoring. Multiple agencies are responsible for the various water quality monitoring programs, and numerous entities assist with monitoring activities. Surface water and groundwater monitoring programs in Arkansas are outlined below.

4.4.1.1 Surface Water

ADEQ monitors water quality of surface waters through several programs. The ambient water quality monitoring network includes 150 sites on rivers and streams that are sampled monthly for chemical analysis. The roving water quality monitoring network includes over 200 stream sites, divided into four regional groups. Each group of sites is sampled for chemical and bacterial analysis on a rotating basis, bimonthly over a 2-year period, every 6 years. Bacterial analysis is also performed on samples from the ambient water quality monitoring network within the active region of the roving water quality monitoring network. In addition, ADEQ conducts water quality monitoring during "intensive surveys." These surveys can involve water sampling for chemical and bacterial analysis, as well as biological sampling to evaluate water quality. Intensive surveys are conducted for a variety of purposes, including determination of total maximum daily loads (TMDLs), and to augment water quality information from the routine water quality monitoring networks for more accurate assessment of designated use support. ADEQ also routinely monitors water quality in 78 significant publicly owned lakes. Significant publicly owned lakes in Arkansas are those lakes approximately 100 acres or greater where there is access designed to enhance public use (ADPCE 1990, ADEQ 2012c).

Through its nonpoint source management program, ANRC oversees water quality monitoring programs in 10 nonpoint source priority watersheds. These programs involve universities, contractors, and nonprofit organizations. Parameters monitored by these programs typically include nutrients and sediment, turbidity, and/or total suspended solids.

The monitoring and reporting requirements for surface water used for human consumption are authorized by both federal and state regulations. The Arkansas Department of Health (ADH) is primarily responsible for water quality monitoring of drinking water. A summary of these requirements can be found in Chapter 5 of *Arkansas Public Water System Compliance Summary*, "Microbial Disinfection By-Products Rules" (ADH 2012). There are over 170 public water supply systems in the state that use surface water (ADH n.d.). Depending on the treatment methods used and the number of customers served by the public water supply utilizing surface water, the monitoring requirements for the raw surface water, or source water, will vary and may include turbidity, *Escherichia coli* (*E. coli*), cryptosporidium, total organic carbon (TOC), and alkalinity.

The US Geological Survey (USGS) also routinely monitors surface water quality data in Arkansas. Data from USGS monitoring stations may also be used in the biennial assessment. There are over 90 active USGS water quality monitoring stations on streams and lakes in Arkansas. Samples are collected at these stations monthly, bi-weekly, or quarterly (USGS 2013).

4.4.1.2 Groundwater

Divisions of ADEQ administer mandated groundwater monitoring programs at sites around the state that are regulated by state and federal programs. The purpose of this monitoring is to evaluate potential and actual impacts to groundwater resulting from human activities and natural phenomenon (ADEQ 2012c). Examples include Superfund sites, properties in the State's Brownfields program that are currently being evaluated, sites on the State Priority List, sites in the Elective Cleanup program, Class I solid waste landfills, and hazardous waste sites and leaking underground storage tank sites that are being evaluated or monitored through other regulatory mechanisms.

ADEQ monitors groundwater quality in the state as part of its Ambient Groundwater Monitoring Program. In this program, 195 groundwater monitoring stations are sampled approximately once every 3 years on a rotating basis and are distributed across 12 monitoring areas; Athens Plateau, Brinkley, Chicot, El Dorado, Frontal Ouachitas, Hardy, Jonesboro, Lonoke, North Central, Omaha, Pine Bluff, and Ouachita. The monitoring stations serve to

document groundwater quality over time, determine whether contaminated areas are expanding, and assist with water quality planning (ADEQ 2012c, ANRC 2011).

The ADH is the primary agency for implementing the Safe Drinking Water Act (SDWA) and is responsible for monitoring public water-supply wells. ADH maintains a statewide database that consists of 1300 wells (Kresse, et al. 2013). Every three years, these wells are sampled for inorganic, organic (including pesticides, herbicides, synthetic organic compounds, and volatile organic compounds), and radiochemical contaminants. The Total Coliform Rule of the SDWA requires sampling on a monthly basis, where the number of samples required is dependent upon the population size. Nitrate monitoring is performed on a yearly basis unless a sample greater than or equal to 50% of the maximum contaminant level (MCL) is detected and prompts the need for increased frequency. Additionally, the Disinfection Byproduct Rule of the SDWA requires monitoring of trihalomethanes and haloacetic acids (byproducts of chlorine and other disinfectants used to treat drinking water) on a quarterly or annual basis. While all of the programs above collect samples from treated drinking water, ADH also collects samples from untreated water sources (surface and groundwater) that include bacteria, particulates, algae, organics, pathogens, total organic carbon on a weekly or monthly basis as required by the SDWA (ADEQ 2012c).

The Arkansas State Plant Board (ASPB) monitors groundwater throughout the state to detect pollution by agricultural chemicals, such as pesticides. This groundwater monitoring program is voluntary for farmers. Since the program initiated in 2004, ASPB has sampled 271 wells in 30 counties. Results of sampling activities are included in annual reports and posted on the Plant Board web site (Kresse, et al. 2013)

Several ambient groundwater quality monitoring programs exist that involve cooperative efforts among the USGS, ANRC, and ADEQ. These ambient groundwater-quality monitoring activities are primarily funded by EPA grants under Sections 106 and 319 of the Clean Water Act. The USGS and ANRC monitor 25 “master” wells and springs in 14 aquifers across the state. ANRC also monitors water quality in a network of 51 monitoring wells across the state (ANRC 2011). The University of Arkansas (U of A) has conducted a significant amount of

groundwater research that has resulted in scientific data and information necessary to understand, manage, and protect water resources within the state (Kresse, et al. 2013).

4.4.2 Non-attainment of Surface Water Quality Standards

In 2008, almost 10,000 miles of streams and 78 lakes with a total area of over 350,000 acres were assessed for water quality in Arkansas (Table 4.2).[2] Sixty-three percent of the stream miles assessed and 44 of the 78 lakes were determined to be meeting surface state water quality standards. Water quality standards consist of numeric criteria for selected chemicals and pollutants, narrative criteria for other chemicals and pollutants, and a listing of uses waterbodies are expected to have adequate water quality to support. In over half of the stream miles identified as not attaining water quality standards, the aquatic life designated use was not supported. Metals, dissolved minerals, organic enrichment/low dissolved oxygen, and sediment/siltation were the primary causes of impaired water quality in the majority of the stream miles assessed (Table 4.1) (ADEQ 2009a). For over 75% of the lake acres identified as not attaining water quality standards, the drinking water designated use was not supported. However, changes in water quality criteria have resulted in the majority of these lakes being reclassified as attaining the drinking water use. Pollutants identified as causing impairment of lake designated uses included nutrients, sediment/siltation and/or turbidity, and metals (Table 4.1) (ADEQ 2009b).

It should be noted that while a stream reach may be impaired due to sediment, there is no numeric water quality standard for sediment/siltation. Arkansas does have a numeric water quality standard for turbidity; thus turbidity is the chemical parameter that is assessed to determine if a sediment impairment exists. There is currently no other method that is consistently used by EPA or ADEQ to measure sediment or siltation in water.

[2] ADEQ has completed water quality assessments for 2010 and 2012 and submitted them to EPA for review. However, the lists of non-attaining waterbodies from 2010 and 2012 have not been finalized as of October 2013. Therefore, the most recent finalized list, from 2008, is utilized in this water quality discussion.

Table 4.2. Causes of impairment for waterbodies not meeting water quality standards (ADPCE 1990, ADEQ 2009a).

Cause of Impairment	Size of Assessed Waters with Listed Causes of Impairment			
	Rivers and Streams (miles)		Lakes, Reservoirs, and Ponds (acres)	
	1990	2008	1990	2008
Ammonia	26.0	11.5	0	0
Dioxins/Priority Organics	45.7	44.8	0	0
Mercury	NA	440.6	0	>23,637.0
Metals (other than mercury)	NA	1,672.5	0	97,440.0
Nutrients	32.0	96.3	0	4,625.0
Organic Enrichment/ Oxygen Depletion	321.9	1,190.9	0	0
Pathogens	2,331.4	236.9	0	0
pH/Acidity/Caustic	33.5	121.7	0	0
Salinity/Dissolved Minerals*	32.4	1,234.4	0	0
Sediment/Siltation	648.7	1,151.1	0	4,735.0
Temperature	14.8	114.8	0	0
Total waters assessed	**11,310.2**	**9,849.7**	**355,063**	**357,896**

Note: NA=not assessed.
*Dissolved minerals include TDS, chlorides, and sulfates.

In the 1990 state water quality inventory, pathogens, sediment, and organic enrichment affected the majority of the river miles assessed (Table 4.2). The majority of the significant publicly owned lakes were first assessed for water quality for the 1990 state water quality inventory, and all were classified as achieving their designated uses (ADPCE 1990). Comparing the size of the waterbodies listed as impaired in 1990 and 2008 does not provide any insight into changes or trends in water quality in Arkansas. Development of new water quality criteria or revision of existing criteria can change the impairment status of a waterbody, as can changes in assessment methodology (e.g., changing the percentage of observed data that can exceed the water quality criterion without resulting in an impairment from 25% to 10%). It appears that, for most of the pollutants listed in Table 4.2, the change in the amount of Arkansas waterbodies listed as impaired is primarily the result of changes in assessment methodology over time.

In cases where exceedances of water quality criteria are preventing the attainment of a designated use, a TMDL must be developed. A TMDL is the maximum amount of a pollutant

that a waterbody can assimilate without exceeding the established water quality standard for that pollutant, resulting in the waterbody being listed as impaired. A TMDL allows for the allocation of pollutant loads between point sources and nonpoint sources discharging to the waterbody, as well as a margin of safety.

Around 115 TMDLs have been completed for Arkansas waterbodies since 2000 (ADEQ 2012d). The exact number of completed TMDLs in Arkansas is difficult to determine due to the fact that a TMDL report may propose TMDLs for one pollutant or for multiple pollutants and in one reach of one waterbody, in multiple reaches of one waterbody, or in multiple waterbodies and reaches. EPA records indicate that 271 TMDLs have been completed for Arkansas waterbodies since 1995 (EPA 2013). A summary of the pollutants addressed by these TMDLs is provided in Table 4.3. Sediment-related impairments (total suspended solids [TSS], turbidity, siltation) were the most frequently addressed parameters in Arkansas TMDLs.

Table 4.3. Completed Arkansas TMDLs since 1995 (EPA 2013).

Pollutant	Number of TMDLs
TSS/Turbidity/Sediment/Siltation	6
Bacteria	6
TDS/Sulfate/Chloride	3
Mercury in Fish	3
Metals	2
Nutrients/Nitrogen/Phosphorus	2
pH	9
Dissolved Oxygen/Oxygen Demand	4
TOTAL	**27**

4.4.3 Non-attainment of Drinking Water Quality Standards and Water Quality Guidelines of Groundwater

Groundwater used as a drinking water source in Arkansas is required to meet state and federal drinking water standards (see Task 4 report). Other groundwater water users, such as farmers and industries, have developed guidelines that they use to determine if groundwater quality is suitable for their uses. Even though no groundwater quality standards have currently

been set by state agencies in Arkansas, groundwater quality standards have been developed by ANRC in accordance with the Ground Water Protection and Management Act, ʃArk. Code Ann. 15-22-901 et seq. These standards are currently in review by senior staff at ANRC, and when finalized, they will serve as a critical component to the groundwater protection program in Arkansas, and provide many benefits to citizens, businesses, and government agencies.

Most of the aquifers in the state are considered by ADEQ to have good to very good water quality (ADEQ 2009a). However, areas of poor water quality have been identified. In some areas, poor groundwater quality is a natural phenomenon (i.e., basic rock-water interactions, natural chemical reactions, or upwelling of high salinity water from underlying formations). Throughout the state, human activities have caused contamination of the groundwater, typically occurring in the shallow aquifers.

Groundwater quality issues resulting from natural phenomena occur primarily in two of the aquifers in the state, the Ozark aquifer in north Arkansas, and the Mississippi River Valley alluvial aquifer in eastern and southern Arkansas. In the Ozark aquifer, which is a deep aquifer, there are areas where the natural radon and fluoride levels in the groundwater exceed drinking water standards. Groundwater in the Mississippi River Valley alluvial aquifer tends to have high levels of hardness, iron, and manganese, which often exceed secondary drinking water standards and require treatment for industrial and municipal water supply purposes. As previously mentioned, groundwater concentrations of naturally occurring arsenic exceed drinking water standards in some areas of this aquifer (Kresse and Fazio 2003), which limits its use as a drinking water supply, but not for irrigation, which is its primary use. There are also localized areas where chloride levels in the groundwater can affect soybeans and rice when the water is used for irrigation (ADEQ 2009a, Renken 1998). Many of the other Coastal Plain aquifers are characterized by good quality near their outcrop areas, but basic rock-water interactions along the groundwater flow path may cause a higher salinity water quality in the down dip direction of flow.

Groundwater throughout the State that occurs at shallow depths close to the ground surface is more vulnerable to contamination from human activities. There are over 100 specific sources of groundwater contamination (e.g. landfills, etc) that are being monitored by ADEQ or

consultants under the oversight of ADEQ. In the Interior Highlands, soils are often thin in the mountainous regions and groundwater travels through rock fractures and bedding planes in the subsurface. As a result, there is little chance for contaminants to be filtered or removed from the groundwater, and any contaminants on the land or in the soil, easily transported to the aquifer. Nitrates and fecal coliforms from septic systems and animal production operations are the contaminants that most often exceed drinking water standards in the Ozark Mountains (Adamski 1997, ADEQ 2009a, Todd et al. 2009). Insecticides and herbicides have been detected in groundwater in the Ozark Mountains, but not at levels that pose a health risk (Adamski 1997). Groundwater nitrate concentrations that exceed the drinking water standard have also been found in some areas of the Ouachita Mountains (ADEQ 2009a, Todd et al. 2009). There is concern that natural gas extraction in the state could affect groundwater quality. However, a recent study in an area of the Fayetteville Shale Play did not find evidence of groundwater contamination associated with natural gas extraction (Warner et al. 2013, Kresse et al. 2012).

The unconsolidated, porous strata of the Gulf Coastal Plain provide filtering of surface water as it recharges into the groundwater system. However some quality issues are associated with groundwater in this region. Nitrate concentrations above the drinking water standard have been found in the Ouachita River alluvial aquifer, particularly in Calhoun and Bradley Counties, and are probably associated with septic systems (USGS personal communication, June 5, 2013). Row crop agriculture is the dominant landuse in eastern Arkansas, thus the use of pesticides and nitrogen fertilizers is the most prevalent threat to groundwater quality in the Mississippi River Valley alluvial aquifer. Pesticides have been identified in groundwater here, but concentrations were below drinking water standards and federal health advisory limits (Kresse and Fazzio 2002); nitrates levels above the drinking water standard are localized in shallow portions of this aquifer (Steele, Davis and Kresse 2003). In southeastern Arkansas, a large area of high chloride concentrations in the groundwater of the Mississippi River Valley alluvial aquifer has been attributed to saltwater intrusion caused partially by over-pumping from the aquifer (ADEQ 2009b), but Kresse and Clark (2008) have suggested a natural source of chloride related to the deposition environment for the aquifer in this area. In southern Arkansas, localized areas of brine contamination have been identified, associated with the existing and historical oil and brine

extraction activities in the area (ADEQ 2009a). Saltwater intrusion due to over-pumping is also an issue in the Sparta aquifer in southern Arkansas.

Specific sources of groundwater contamination exist in urban, rural, and industrial settings (e.g., underground storage tanks, landfills, hazardous waste sites, feedlots, spills, etc.).These are typically not major sources of groundwater contamination on a large spatial scale. In 2013 there were well over 100 sites in Arkansas being investigated or remediated for organic and inorganic chemical contamination. Most cleanups are overseen by a Division of the ADEQ. Hazardous waste sites posing threats to human health and the environment, known as Superfund sites, are places on the National Priority List (NPL).

4.4.4 Fish Consumption Advisories

There are fish consumption advisories due to mercury for 343 miles of streams and 11 significant publicly owned lakes in the state. In addition, there are 48 miles of stream and one lake subject to a fish consumption advisory due to dioxin, and 2 miles of stream closed to fishing due to polychlorinated biphenyl (PCB) contamination (ADEQ 2009a). In 1990, there were only three active fish consumption advisories, one due to dioxin and the others due to PCBs (ADPCE 1990). Between 1990 and 1992, one PCB fish consumption advisory was ended and three dioxin fish consumption advisories were added (ADPCE 1992). Between 1992 and 1994, two dioxin fish consumption advisories were removed and one was added, and 17 mercury fish consumption advisories were added. One mercury fish consumption advisory was removed in 2011 (Arkansas Department of Health, Arkansas Game and Fish Commission, Arkansas Department of Environmental Quality 2011).

4.4.5 Nonpoint Source Pollution

Nonpoint source pollution was identified as a water resources issue in the 1990 AWP (Arkansas Soil and Water Conservation Commission 1990). Nonpoint source pollution still contributes significantly to surface water and groundwater quality issues in Arkansas; it is the most frequently cited source of pollutants causing non-attainment of surface water quality

standards (ADEQ 2012c). Several nonpoint sources of groundwater pollution were discussed in Section 4.4.3. Nonpoint source pollutants and sources that are of concern in Arkansas include:

- Sediment from construction sites, crop and forest lands, and eroding stream banks;
- Fertilizers and other chemicals from agricultural lands, and urban and residential areas;
- Bacteria and nutrients from livestock, animal waste, and septic systems; and
- Modification of stream channels and flow regimes (ANRC 2011).

As part of the state nonpoint source management program, the ANRC has identified 10 nonpoint source priority watersheds and developed and updated state nonpoint source pollution management plans. Outside of the nonpoint source priority watersheds, nonpoint source pollution is addressed through ANRC statewide nonpoint source management programs, as well as federal programs, and some local programs (see Task 4 report for more information on these programs). State guidelines have been developed for management practices to reduce nonpoint source pollution for several potential sources including resource extraction, silviculture, and natural gas exploration in the Fayetteville Shale Play (ANRC 2011).

4.4.6 Contaminants of Emerging Concern

There is growing interest, nationally and in Arkansas, in the occurrence of a group of chemicals called contaminants of emerging concern (CECs), which include pharmaceuticals, personal care products (e.g., soap and shampoo), natural and synthetic hormones, surfactants, pesticides, fire retardants, and plasticizers primarily in surface waters, but also starting to be measured in groundwater across the nation. The risks to human health and the environment from the majority of these chemicals are unknown, which is why they are referred to as "contaminants of emerging concern." In 2004, USGS, with several partners, collected water samples from 17 sites upstream and downstream of municipal wastewater treatment plants on seven streams in northwest Arkansas, and one site on North Sylamore Creek. The samples were analyzed for selected antibiotics, disinfectants, fire retardants, plasticizers, insect repellents, fragrances,

detergents, flavorings, fuels, solvents, polycyclic aromatic hydrocarbons, and over-the-counter medications; a total of 108 chemicals. Of the 108 chemicals tested, 42 were detected in the water samples. Caffeine was one of the most frequently detected chemicals. There was only one "background" site where none of these chemicals were detected. At all of the rest of the sites, at least one of these chemicals was present (Galloway, et al. 2005). Detection, however, does not indicate there is an effect.

4.5 Loss of Aquatic Biodiversity

In a 2002 report, NatureServe ranked Arkansas 13th in the nation for the level of reportedly extinct species (NatureServe 2002). In 2005, 369 animal species of greatest conservation need were identified for Arkansas by a team of specialists. These species of greatest conservation need (SGCN) include over 250 species associated with aquatic and semi-aquatic habitats (Anderson 2006). Figure 4.2 summarizes the numbers and classes of SGCN in Arkansas. In addition, there are 185 species of rare aquatic and semi-aquatic plants in Arkansas that have been identified by the Arkansas Natural Heritage Commission (ANHC 2013). Figure 4.2 shows the numbers of crayfish, fish, and mussel SGCN present in watersheds throughout the state. Twenty-two Arkansas aquatic and semi-aquatic species are on the federal list of threatened and endangered species (Table 4.4). Twenty-three semi-aquatic plant species present in Arkansas are on the state threatened and endangered plant species list (13 threatened, 10 endangered) (Arkansas Natural Heritage Commission 2013). Many of these species of concern, particularly species of mussels, crayfish, and plants, are affected by water quality, water levels, flow rates, and/or seasonal changes in water levels or flow.

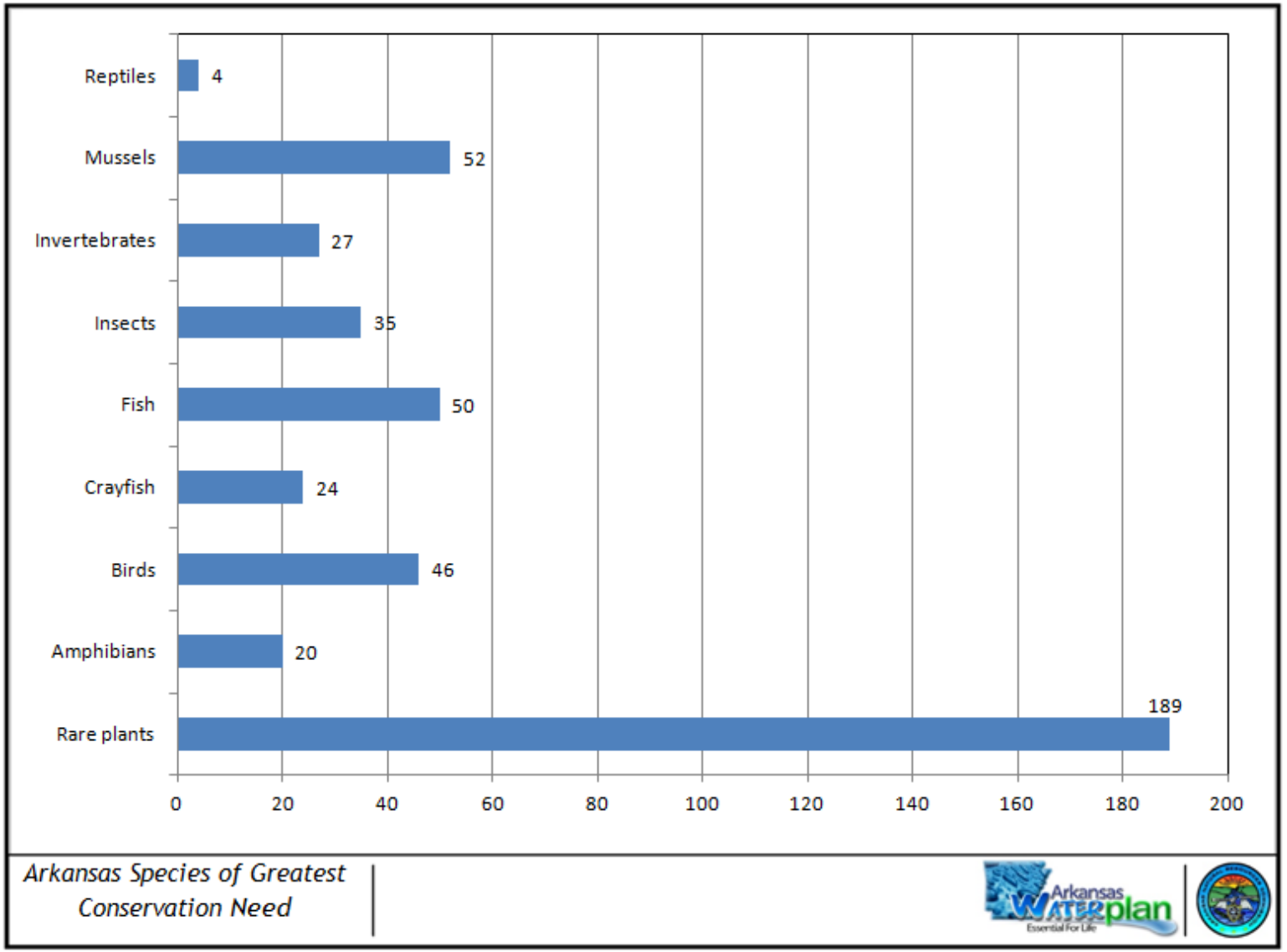

Figure 4.2 Summary of classes of SGCN for Arkansas.

Table 4.4. Federally listed threatened and endangered species occurring in Arkansas's aquatic and semi-aquatic habitats (Arkansas Natural Heritage Commission 2013, NatureServe 2013).

Common Name	Species Name	Status	Habitat
Pallid Sturgeon	Scaphirhynchus albus	Endangered	Large, turbid rivers in strong current
Ozark Cavefish	Amblyopsis rosae	Threatened	Dark cave streams and pools, clear water
Leopard Darter	Percina pantherina	Threatened	Clear, upland small to medium rivers in pools with rocky substrate
Arkansas River Shiner	Notropis girardi	Threatened	Turbid creeks to large rivers in shallow water with shifting silt and sand substrate
Yellowcheek Darter	Etheostoma moorei	Endangered	High gradient small to medium clear rivers in riffles with rocky substrate
Arkansas Fatmucket	Lampsilis powellii	Threatened	Deep pools, backwaters, with sandy substrates
Curtis Pearlymussel	Epioblasma florentina curtisi	Endangered	Creeks with good water quality in slow current
Scaleshell	Leptodea leptodon	Endangered	Riffles of creeks to big rivers, mud to boulder substrates
Fat Pocketbook	Potamilus capax	Endangered	Large to medium rivers in slow water on fine substrates, including man-made ditches
Ouachita Rock Pocketbook	Arkansia wheeleri	Endangered	Pools, backwaters, side channels of rivers and large streams in the Ouachita Mountains
Pink Mucket	Lampsilis abrupta	Endangered	Large rivers, usually in strong currents on rocky substrate
Speckled Pocketbook	Lampsilis streckeri	Endangered	Riffles of clear perennial streams on sandy substrate
Turgid Blossom	Epioblasma turgidula	Endangered	Clear, unpolluted, shallow, fast-flowing streams in sand and gravel substrates
Winged Mapleleaf	Quadrula fragosa	Endangered	Large to medium rivers, mud bottoms and riffles
Ozark Hellbender	Crytpobranchus	Endangered	Cool, rocky, clear creeks

Table 4.4. Threatened and endangered species occurring in Arkansas's aquatic and semi-aquatic habitats (continued).

Common Name	Species Name	Status	Habitat
	alleganiensis bishop		
Unnamed Crayfish	Cambarus aculabrum	Endangered	Cave streams and pools
Unnamed Crayfish	Cambarus zophonastes	Endangered	Cave pools and streams
Ivory-billed Woodpecker	Campephilus principalis	Endangered	Mississippi alluvial plain bottomland depression, lower Mississippi River high bottomland forest, lower Mississippi River low bottomland forest
Interior Least Tern	Sterna antillarum athalassos	Endangered	Mud flats, ponds, lakes
Piping Plover	Charadrius melodus	Threatened	Mud flats
Harperella	Ptilimnium nodosum	Endangered	Clear swift streams with rocky substrate, edges of intermittent pineland ponds or wet savannah meadows, granite outcrop seeps
Pondberry	Lindera melissifolia	Endangered	Usually in shade in seasonally flooded wetlands, around ponds, sinkholes, and bogs

In some cases, the presence of non-native aquatic species is believed to affect aquatic biodiversity. There are 66 aquatic animal species known to occur in Arkansas that are not native to the state (USGS 2013). The majority of the nonindigenous fish species present in Arkansas are sportfish species that have been introduced purposely and are regularly stocked. The impact of many of these species on native species is unknown. Some species, such as carp, are suspected to affect native species as a result of modifying aquatic habitats, e.g., removing vegetative cover and increasing turbidity. Other species, such as non-native sportfish and exotic clams, are suspected to affect native species by competing with them for food and/or habitat (USGS 2013). There are also 14 species of invasive aquatic plants known to occur in Arkansas (University of Georgia Center for Invasive Species and Ecosystem Health 2013).

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