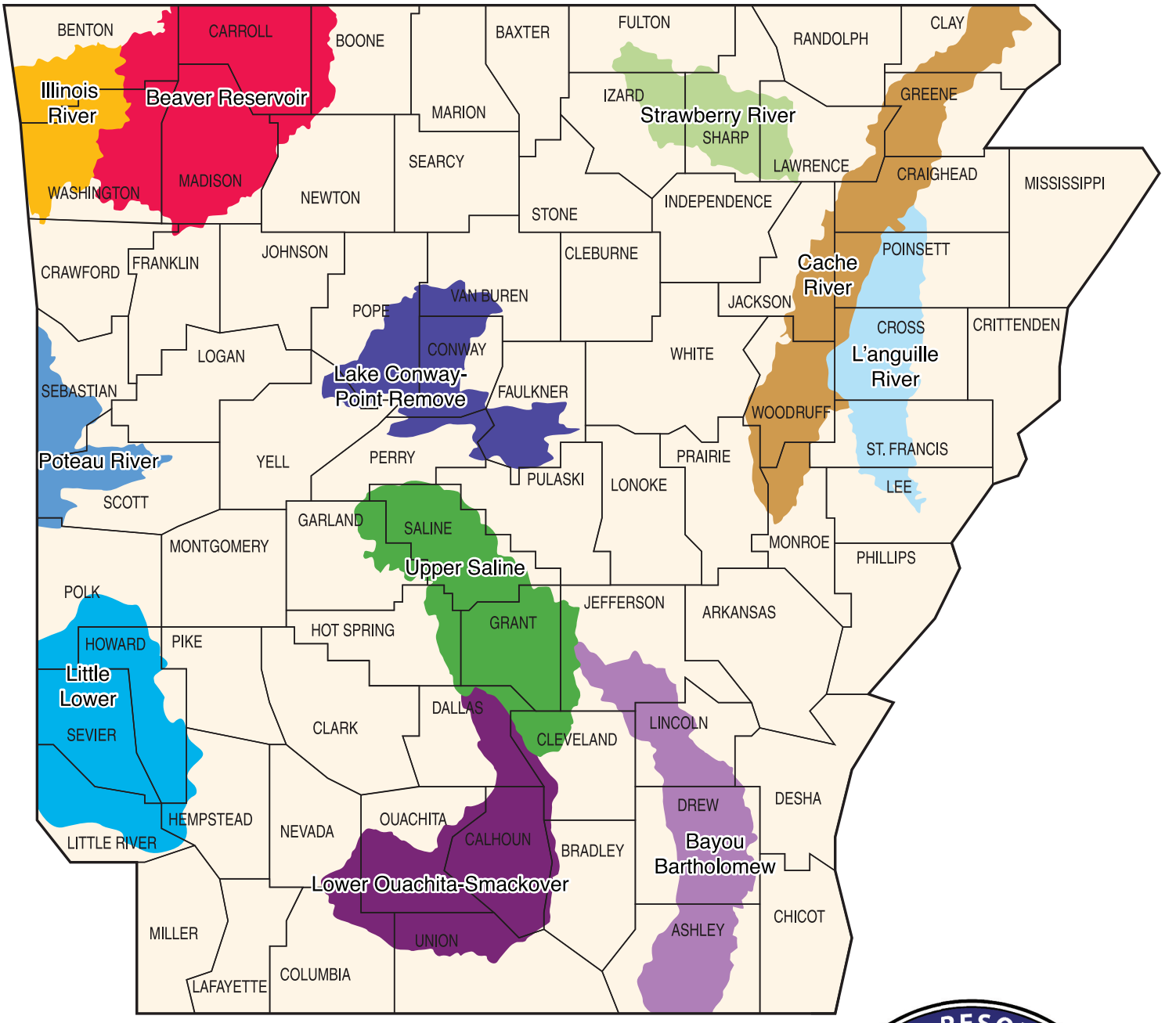
Arkansas Natural Resources Commission



2018-2023 Nonpoint Source Pollution Management Plan

Arkansas Natural Resources Commission

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The 2018-2023 Nonpoint Source Pollution Management Plan was created in cooperation with the University of Arkansas System Division of Agriculture's Public Policy Center and Crop, Soil and Environmental Science staff.

For additional information on Arkansas' NPS Pollution Management Plan and other water issues, visit www.arkansaswater.org

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Introduction

2018-2023 NPS Management Plan

The purpose of this document is twofold. First, it provides a historical perspective of the Arkansas Nonpoint Source Pollution Management Program's beginning, development process, function, purpose, management processes, objectives and overall goals. Secondly, it serves as a resource to state and federal agencies, stakeholders and those interested in Nonpoint Source (NPS) Management.

The reader may interpret this document as the NPS Management Program or the NPS Management Plan and both, or either, would be correct. The document (Plan) describes the process of how the NPS Program will be managed from 2018-2023. It is important to understand how some facets and functions of the Plan are basic elements of the Program. The Plan, Program and its administrative development and function are subject to federal, state, agency or commission codes, rules, regulations and laws, and are incorporated into this document.

In January of 1990, in a letter to the U.S. Environmental Protection Agency (EPA), Gov. Bill Clinton designated the Arkansas Soil and Water Conservation Commission (ASWCC) as the lead agency for agriculture nonpoint source pollution management in the state. This designation was for a period of three years. Prior to the governor's designation, the Arkansas Department of Pollution Control and Ecology (ADPC&E) was beginning to develop a NPS Management Program. Due to constraints in the capability of auditing local in-kind and generating the match required to secure Clean Water Act 319 funding, the ADPC&E asked ASWCC (what is now the Arkansas Natural Resources Commission) to be designated the lead agency for agricultural NPS management.

Subsequently, after the governor's designation, ASWCC and EPA developed a work plan for grant funding under Section 319 of the Clean Water Act. This grant allowed ASWCC to prepare and implement an agricultural NPS Management Program.

In 1993, the state re-evaluated the NPS Management Program. Gov. Jim Guy Tucker extended ASWCC's responsibility for agriculture NPS Management another three years. In 1996, Tucker ultimately designated Arkansas Natural Resources Commission, ASWCC's successor, as the lead agency for agriculture NPS Management in the state after evaluation and determining substantial progress in implementing the NPS Management Program had been made.

In September 1996, the Arkansas Natural Resources Commission (ANRC) submitted a holistic draft of a NPS Management Program. Upon concurrence with the EPA, Gov. Mike Huckabee gave ANRC the responsibility of coordinating the NPS Management Program for all categories of NPS pollution.

ANRC developed a holistic NPS Management Program, using the same management process as used with agriculture: a non-regulatory voluntary approach. Activities, programs and initiatives that require a permit or are regulated by a state or federal agency are not under the purview of the NPS Management Program. Some specific exceptions are made that include the following examples.

Examples of exceptions include but are not limited to:

- U.S. Army Corps of Engineers 404 permits for streambank stabilization or restoration
- Arkansas Department of Environmental Quality Short-Term Authorization permits
- Nutrient Management Plans in Nutrients Surplus Areas

Therefore, activities, programs and initiatives that are regulated by state or federal agencies are not eligible for CWA 319 grant funding or the Arkansas Natural Resources Commission Title X Agricultural Cost Share Program through the NPS Management Program.

The Arkansas 2018-2023 Nonpoint Source Management Plan is intended to serve as a statewide reference. The NPS Pollution Management Plan is to be used in conjunction with the most current List of Impaired Waterbodies (303(d) report) and Water Quality Assessment Report (305(b) report) prepared every other year by the Arkansas Department of Environmental Quality (ADEQ). The plan's purpose is to provide an over-arching guide to develop, coordinate and implement Watershed Management Plans, programs and projects, to reduce, manage, control or abate NPS pollution. This NPS Plan provides a focal point for public agencies, nonprofit organizations, interest groups and citizens to discuss and address NPS pollution together. The plan provides the basis (a decision support matrix) that allows stakeholders to periodically evaluate, add to and rank risk factors influencing the potential outcome of alternative NPS management and investment strategies. The product is a consensus-built, science-based priority ranking of watersheds in which investment and decision strategies

developed hold the greatest promise for results. The process is agile and reactive to the changing circumstance of available resources, demonstrated need, capacity to deliver and measures of new knowledge.

The planning process builds on the most current version of the plan and continues the concept of addressing changing conditions in the state and adapting the plan to best serve identified needs. Examples of changing circumstances range from the creation of new watershed-based organizations and partnerships to the implementation of new federal and state initiatives.

The plan's core components and stakeholder involvement methodologies are strategic in their design. They provide for a systematic analysis of program objectives and the scientific basis for prioritizing limited resources. Stakeholders participate in the priority-setting process and anticipate the management plan will continue to evolve as nonpoint source effects occur on the changing landscape.

Arkansas' current method of the NPS Planning process began in 2005 and covered the period 2006 through 2011. An amendment was prepared in 2002 that provided interim guidance for 2003-2004. The Arkansas Natural Resources Commission undertook a major review and update of the NPS Plan. This update occurred after reviewing the significant changes in policy, process, technology and needs that developed after the initial 1997 plan, as well as changes in state and regional perceptions of NPS issues. That review and the subsequent creation of a direct stakeholder participation process and a watershed prioritization matrix resulted in the current and continuing adaptive management plan.

Significant policy and regulatory changes occurred during the 2006-2010 and the 2011-2016 plan such as:

- EPA accelerated implementation of the total maximum daily load (TMDL) program nationwide.
- The presence of USDA-Natural Resources Conservation Service's Mississippi River Basin Initiative, National Water Quality Initiative and the Regional Conservation Partnership Program.
- The Arkansas General Assembly's modified statutory language enabling ANRC to create Nutrient Surplus Area designations in the state, register poultry production operations, require nutrient management planning in Nutrient Surplus Areas and train nutrient management planners and nutrient applicators. Figure 10.1 shows areas designated as nutrient surplus areas.
- Arkansas combined several agencies – the Arkansas State Plant Board, the Arkansas Forestry Commission, the Arkansas Livestock and Poultry Commission, the Arkansas Aquaculture Division and the Arkansas State Land Surveyor – to form the Arkansas Agriculture Department during the 2005 legislative session.
- The update of the Arkansas State Water Plan.

In addition to regulatory changes, a wide range of programs have been implemented to promote voluntary use of Best Management Practices (BMPs).

- The Arkansas Forestry Commission (AFC) has developed guidelines for silviculture BMPs. AFC monitors and reports implementation of these BMPs every other year. Implementation has remained positive and steadily defensible since monitoring began.
- The University of Arkansas Center for Advanced Spatial Technologies' (CAST) and the Arkansas Geographic Information Office's (AGIO) support in the development and use of Geographic Information System (GIS) data has aided in both watershed delineation and the certification of new watershed data sets for Arkansas.
- Expansion of the Arkansas Discovery Farm network.

Arkansas' landscape, through land use, land cover conversion and dominant usage, has undergone significant changes since the current plan was last updated. Some NPS management measures and BMPs have improved as well, especially those related to soil health and Low Impact Development. Taken together, these changes point to a need to review and update Arkansas' NPS Pollution Management Plan.

The Changing Landscape

Arkansas' NPS pollution landscape is changing rapidly.

- Land use evolves with changing population and economic conditions. Figure 1.1 shows land uses in 2011.
- Population continues to grow rapidly in Northwest Arkansas while declining in the Delta and many other rural counties of the state. Figure 1.2 shows population change from 2010-2016.
- Construction continues to be strong in Northwest Arkansas (Arvest, 2017).
- Figure 4.1b shows row crop agriculture areas of Arkansas as of 2011.
- Marginal croplands in the Mississippi Alluvial Plain are being placed in conservation programs and easements at an increasing pace.

- The number of Arkansas farms raising all types of poultry declined from 6,089 in 2007 to 5,895, according to the 2012 Agriculture Census, which was conducted before an increase in poultry operations in northeast Arkansas. The state still ranked third in the nation in the number of broilers produced (National Agricultural Statistics Service, 2016). Census data showed that Benton County had the largest one-day broiler inventory with 17.8 million birds, followed by Washington County with 14.7 million birds. Figure 4.1a shows the distribution and concentration of poultry production by watershed, while Figure 4.1c shows similar information about cattle.
- Some industrial forests are being sold to investor groups and private landowners, creating growing land fragmentation. Figure 1.3 shows public lands in Arkansas.

A series of maps provide a snapshot of the changing landscape in which NPS pollution management plan will be implemented.

Figure 1.1
Arkansas Land Use, 2011

Source: 2011 National Land Cover
Data Source: Multi-Resolution Land Characteristic Consortium

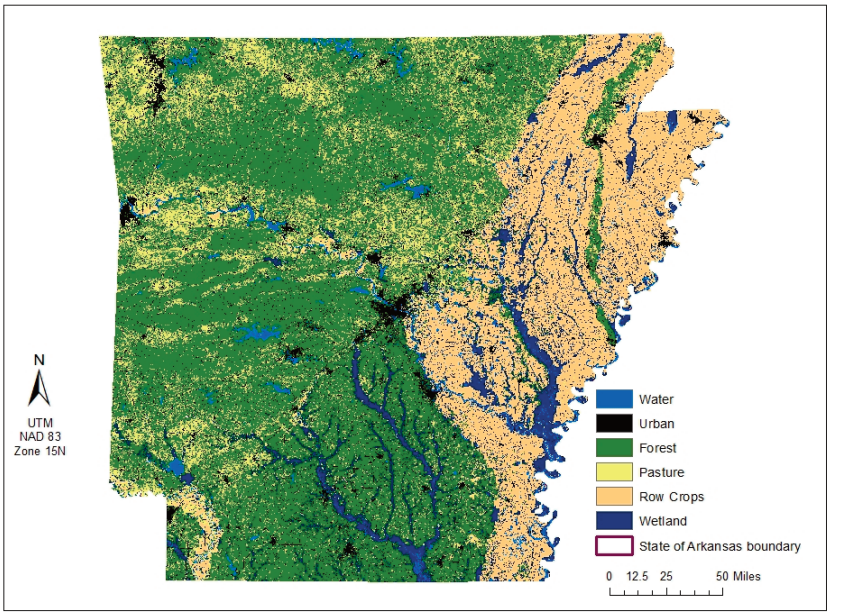


Figure 1.2
Population Change 2010-2016, Arkansas

Source: United States Census Bureau
Map Created: June 2017

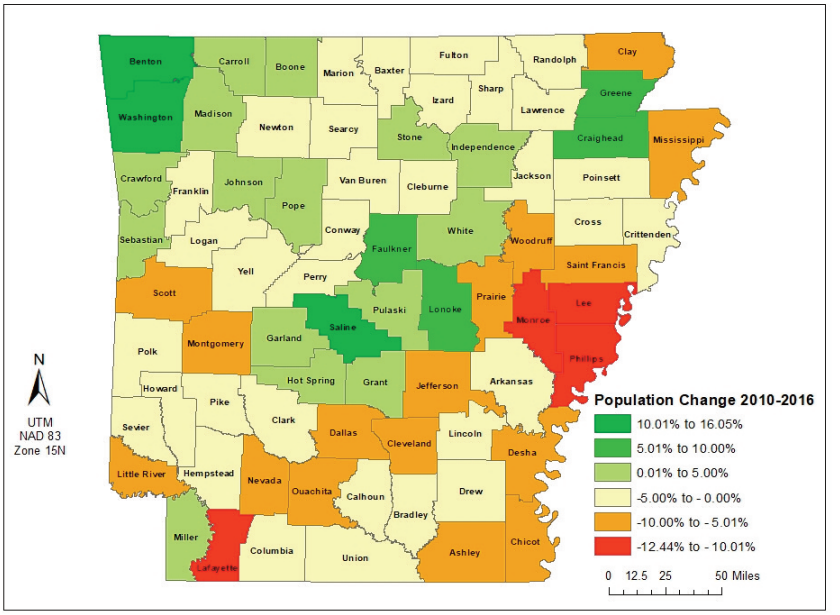
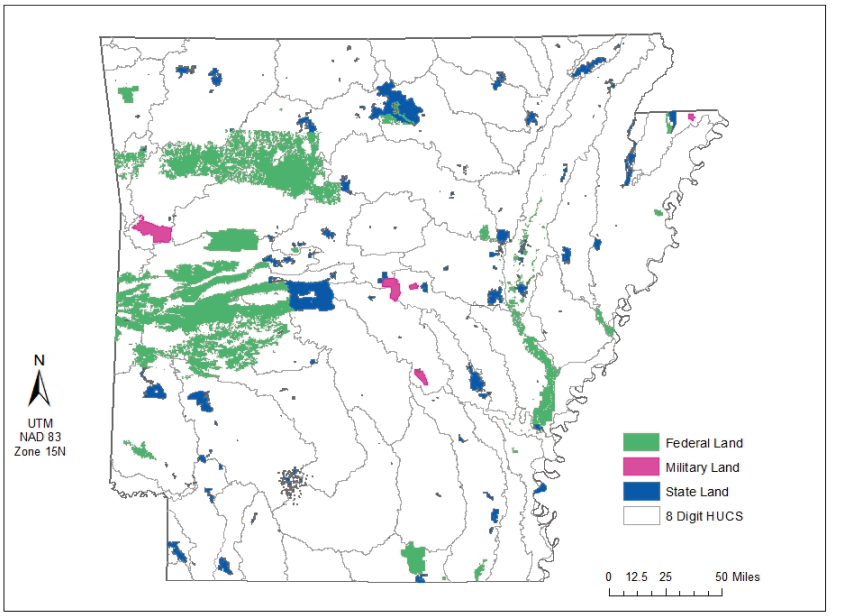


Figure 1.3
Public Lands in Arkansas

Source: Arkansas Highway and Transportation Department
Data Source: GeoStor
Map Created: April 2017



Surface and Groundwater Management in Arkansas

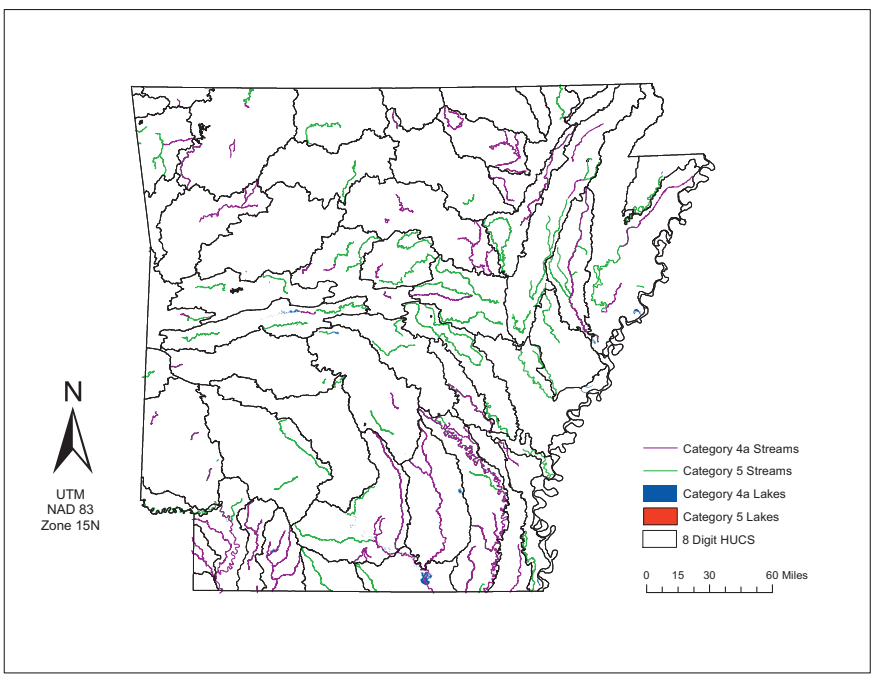
The 2018-2023 NPS Management Plan is closely aligned with Arkansas' List of Impaired Waterbodies, Water Quality and the 305(b) report. ANRC is responsible for the NPS Management Plan, and ADEQ is responsible for developing water quality standards, monitoring water quality, and developing the biennial List of Impaired Waterbodies.

Section 303(d) of the Clean Water Act (CWA) requires states to identify waters that do not meet or are not expected to meet applicable water quality standards. These waterbodies are compiled in even-numbered years into a document known as the List of Impaired Waterbodies prepared pursuant to Sections 305(b) and 303(d) of the Federal Water Pollution Control Act. The regulation (40 CFR 130.7) requires that each 303(d) list be prioritized and identify waters targeted for TMDL development. Figure 1.4 shows streams identified as impaired in the 2016 List of Impaired Waterbodies.

The 2016 List of Impaired Waterbodies can be accessed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

Figure 1.4
Arkansas' 303(d) Waterbodies, 2016

Source: Arkansas Department of Environmental Quality, 2016
Data Source: GeoStor
Map Created: November 2017



Arkansas Designated Uses

State Designated Uses

1. **Extraordinary Resource Waters:** Some 16 percent of Arkansas' total stream miles have been designated as Extraordinary Resource Waters (ERW). ERW are characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential and intangible social values. The ERW designation gives ADEQ the responsibility of providing extra protection to those waters. Figure 1.5 shows ERW waters.
2. **Ecologically Sensitive Waterbodies:** Ecologically Sensitive Waters (ESW) include segments known to provide habitat within the existing range of threatened, endangered, or endemic species of aquatic or semi-aquatic life forms. Figure 1.6 shows streams designated as ESW.
3. **Natural and Scenic Waterways:** Arkansas has designated parts of five rivers as Natural and Scenic Rivers – Cossatot River, Little Missouri River, Saline River, and the Strawberry River in addition to the federally designated Natural and Scenic Rivers, which include Big Piney Creek, Buffalo River, Cossatot River, Hurricane Creek, Little Missouri River, Mulberry River, North Sylamore Creek and Richland Creek. Figure. 1.7 shows Natural and Scenic Waterways.

Federally Designated Uses

4. **Primary Contact Recreation:** Suitable for swimming.
5. **Secondary Contact Recreation:** Suitable for wading.
6. **Fisheries:** Suitable for fishing.
7. **Domestic Water Supply**
8. **Industrial Water Supply**
9. **Agricultural Water Supply**

Figure 1.5
Extraordinary Resource Waters

Source: Arkansas Department of Environmental Quality
Data Source: GeoStor
Map Created: April 2017

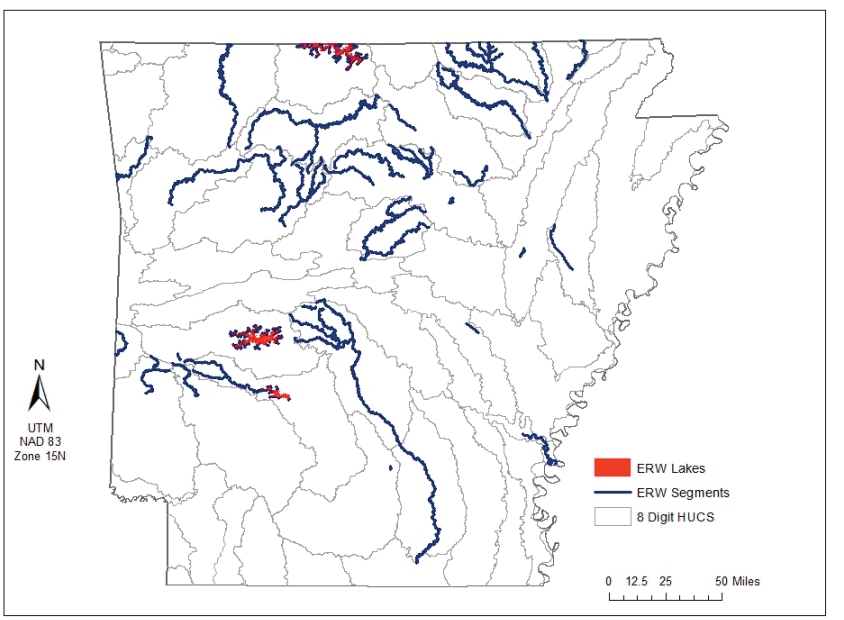


Figure 1.6
Ecologically Sensitive Waters

Source: Arkansas Department of Environmental Quality
Data Source: GeoStor
Map Created: April 2017

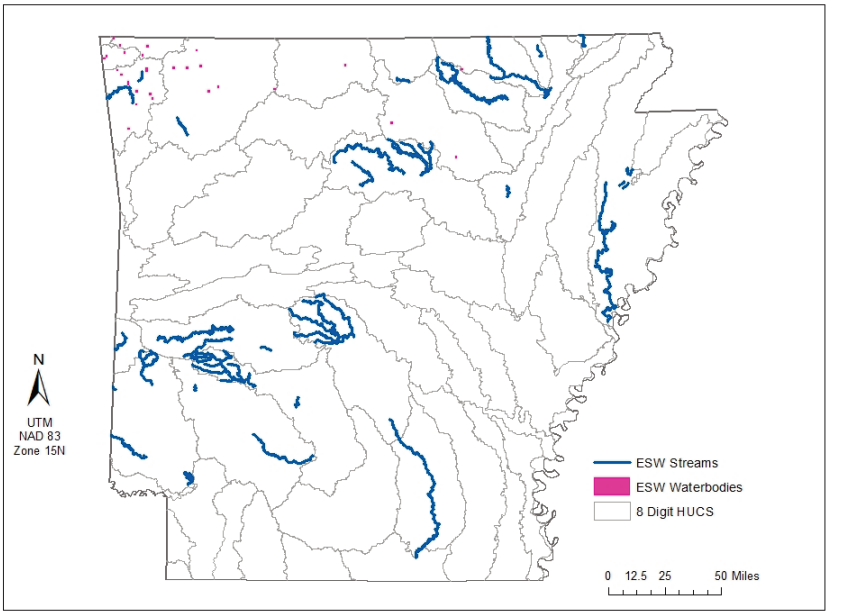
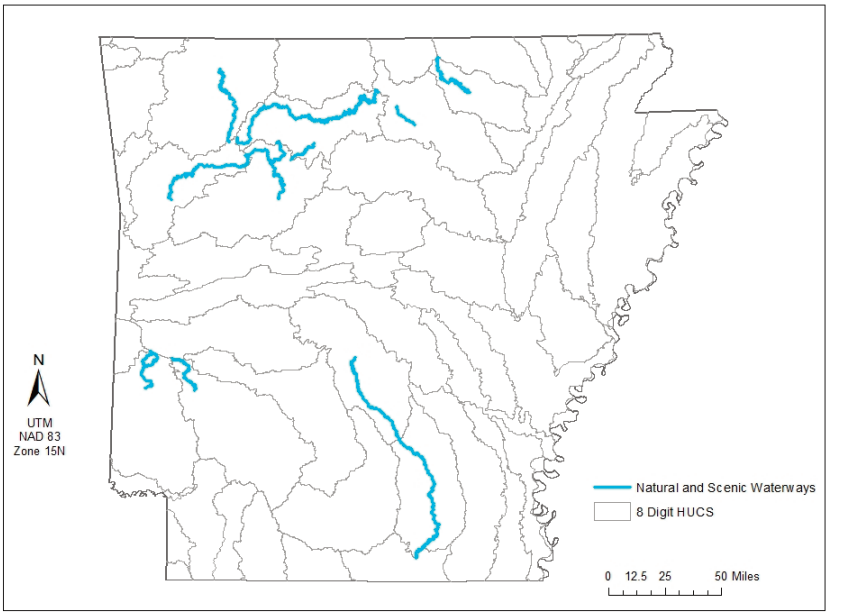


Figure 1.7
Natural and Scenic Waterways

Source: Arkansas Department of Environmental Quality
Data Source: GeoStor
Map Created: April 2017



Arkansas' surface waters are managed through Regulation 2 – Arkansas' Surface Water Quality Standards. The standards include designation of uses for all waters of the state, narrative or numeric criteria designed to prevent impairment of those designated uses, and a policy to prohibit degradation of waters of the state (anti-degradation policy). The water quality standards are ecoregion-based; waters within each of the six ecoregions of the state have standards that were developed from data from least-disturbed streams within each ecoregion. The data was developed during an intensive, statewide study of the physical, chemical and biological characteristics of least-disturbed streams during 1983-1986.

Designations 4 through 9 are federally mandated designations. Virtually all of the waters of the state are designated for uses 4 through 9. Waterways in categories 1 through 3 are considered worthy of the highest level of protection by the state because of their beauty, value or beneficial use.

Arkansas' groundwater quality programs are administered by ADEQ's Ground Water Protection Program. The responsibilities of the program include budgeting and grant administration, groundwater quality planning, water quality monitoring and addressing gaps in groundwater protection through the development of guidelines and regulations. The Ground Water Protection Program conducts water quality monitoring, including ambient and research-oriented monitoring.

The ambient groundwater monitoring program was developed in order to document existing groundwater quality in various aquifers throughout the state on a three-year rotating schedule. Because each area of the state is sampled every three years, the data is used to document trends and changes in water quality over time. Ambient groundwater monitoring in Arkansas has traditionally been performed by four organizations – the United States Geological Survey (USGS), ADEQ, the Arkansas Department of Health (ADH) and ANRC.

In cooperation with ANRC, USGS monitors 25 master wells (or springs) in 14 aquifers throughout the state. These wells are monitored for a variety of constituents, including nutrients, metals, radioactivity, organics, and selected primary and secondary drinking water constituents. Specific conductance analysis is also performed in certain years for the alluvial and Sparta aquifers. ANRC also monitors ambient water-quality conditions from a network of springs and 51 dedicated monitoring wells. These wells are monitored based on available funding.

ADEQ maintains the Arkansas Ambient Ground Water Quality Program, which was initiated in 1986. The monitoring program currently consists of 195 well and spring sites in nine different monitoring areas within the state. A full suite of inorganic parameters is analyzed for the samples, including all major cations and anions and trace metals. In addition, in areas where industry, landfills and other facilities that store, manufacture or dispose of organic chemicals, semi-volatile and volatile organic analyses are performed on the samples. Areas with row crop agriculture commonly include pesticide analyses. ADH monitors public water supply wells (treated water only) in Arkansas. Analyses by ADH include bacteriological, nitrate and other basic water quality parameters. Published reports for each area of the state are produced following each sampling event.

Examples of targeted research-oriented monitoring include the investigation of pesticides in groundwater in eastern Arkansas, nutrient and bacteria transport in shallow aquifer systems in northwestern Arkansas and salt-water intrusion into shallow aquifers in southeastern Arkansas. Nonpoint sources of pollutants, although regional in scope, generally result in low level contamination below established health standards. Point source or site-specific sources result in higher levels of contamination but are restricted to smaller areas (commonly onsite boundaries). Program personnel work together with other ADEQ divisions and other agencies in crafting guidelines and regulations to address both point-source and nonpoint sources of pollution. Although the state does not have a formal set of groundwater standards, ADEQ's Water Division uses federal standards and health advisory limits to establish cleanup levels at contaminated sites.

Arkansas' NPS Approach to Addressing EPA's Nine Key Elements

Congress amended the Clean Water Act in 1987 to focus greater national efforts on nonpoint sources. Congress enacted Section 319 of CWA, establishing a national program to control nonpoint sources of water pollution. Under Section 319, states address NPS pollution by assessing NPS pollution problems and causes within the state, adopting management programs and strategies to control the NPS pollution, and implementing those identified. Section 319 (h) directs states to develop NPS management programs. It also authorizes the EPA to issue grants to states to assist them in implementing those management programs and strategies approved by the EPA.

The EPA issued guidance for Section 319(h) in May 1996. Arkansas developed the NPS Pollution Management Plan based on that guidance. In October 2003, the EPA published an updated guidance for implementing Section 319(h). That guidance provided direction for NPS management plans, which must address Nine Key Elements. In April 2013, the guidance was again updated (U.S. Environmental Protection Agency, 2013). Some of the key changes in the 2013 guidance included:

- A limited amount of 319(h) funding can be used to develop watershed-based plans
- A limited amount of funding can be used to protect unimpaired, high-quality waters when protection is cited in the state's NPS Management Program
- States should update their NPS Management Programs every five years
- Increased coordination with USDA Farm Bill programs
- Revised the amount of program funds that could be used for monitoring

- Revised funding language from "Base funds" to "NPS Program funds" and "Incremental funds" to "Watershed Project funds"

Other recommendations included:

- NPS Management Program evaluation by the regional office using nationwide uniform process
- Annual satisfactory progress determination by the regional office
- Submission of success stories with an average of one accepted per year

The elements that are required to be addressed in an EPA-accepted Watershed Management Plan are discussed below.

Element 1

Explicit short- and long-term goals, objectives and strategies to protect surface and groundwater.

The ultimate long-term goal of the NPS Management Plan is to restore designated uses to waterbodies identified as impaired by ADEQ and to prevent waterbodies that are threatened due to changing or intensifying land uses from becoming impaired.

Arkansas has made substantial progress to protect water quality. Many point sources have been or are being addressed. However, NPS pollution remains a special concern because it is often difficult and expensive to determine specific sources and causes, management measures are voluntary and funding and other resources are insufficient to address problems holistically.

A. Program Strategies

1. **Pollution Prevention and Source Reduction:**
   NPS pollution is a contributor to the impairment of Arkansas' waterbodies. It represents the dominant fraction of surface water pollution to lakes, streams, and rivers. Reducing NPS pollution is complex and involves a large number of stakeholders representing important sectors of the economy taking voluntary, coordinated action to implement BMPs over a sustained period of time. Moreover, the amount and distribution of NPS pollution are also highly variable in both time and space as land use patterns and shifts in population result in increasing and changing nonpoint source pollution stressors upon limited natural resources and land.

   As a result, Arkansas' NPS management measures and programs will focus primarily on pollution prevention or source reduction. Regardless of the pollution source (e.g., agriculture, silviculture, surface erosion or urban runoff) or the cause (e.g., sediment, nutrients, pathogens, pesticides, etc.), the Arkansas NPS Management Plan will focus on cost-effective and environmentally protective management practices that efficiently address the targeted NPS pollutant.

2. **Watershed-Based Implementation:**
   Limited funds make it impossible to effectively manage all causes of NPS pollution from all sources in all watersheds of the state. Arkansas will focus on priority 8-digit hydrologic unit code (HUC) watersheds where there are known impairments or significant threats to water quality from present and future activities and have an EPA-accepted Nine Element Plan. A watershed's HUC designation is a unique identification code describing where that watershed is in relation to other watersheds. The longer the HUC, the more a specific location is being identified (e.g. 8-digit versus 12-digit).

   Only watersheds selected as priority watersheds with EPA-accepted Nine Element Watershed Management Plans will be eligible for Section 319(h) funding from EPA "watershed project funds." In addition, ANRC will encourage other state agencies to target their efforts toward these same watersheds. To further focus limited resources to achieve measurable results, Arkansas may give preference to implementation projects that focus on sub-watersheds within identified priority watersheds.

3. **A Voluntary Plan:**
   Arkansas' NPS Management Plan promotes voluntary action to improve water quality. Unlike point source pollution, which may be relatively easily identified, collected and treated, Arkansas primarily addresses NPS pollution through citizen education and outreach coupled with voluntary adoption of practical and cost-effective BMPs. BMPs are generally designed to allow for the continuation of everyday activities while reducing or preventing NPS pollution.

   Alternatives, optional management strategies and BMPs are often found as lists of choices and management options as part of the voluntary NPS menu available to land and water managers. However, they are constantly changing. New technologies, understanding, science, etc. informs a changing road map of strategies. Attention to these changes and new opportunities and a willingness to adapt is now a basic component of Arkansas' plan.

4. **Building Local Capacity to Address Local Concerns:**
   Since the program's inception, local watershed groups, organizations, conservation districts and other stakeholders have been the greatest asset to

watershed management. These entities' motivation, concern and willingness to be watershed stewards generate action. They are typically the most motivated to develop and implement watershed management plans, resolve issues and cooperatively collaborate to improve watershed conditions and water quality.

The NPS Management Program recognizes the assets of stakeholders. Through the NPS Program, ANRC works cooperatively with state and federal agencies, academic institutions, conservation districts, groups and organizations to promote watershed stewardship, specifically in relationship to water quality.

Since NPS pollution is primarily a "people problem," the NPS Management Program advocates building local capacity to effect changes by providing many and varied opportunities for volunteer involvement at the local level. When NPS pollution problems do occur, it is generally because of a lack of knowledge or a perception problem. Although it is difficult at times to measure or quantify management program implementation "successes," especially in the short-term (1 to 5 years), citizen education, outreach and involvement are and continue to be primary tools for NPS Management in Arkansas.

B. Program-wide Short-term Objectives

The short-term objectives below apply to the overall NPS Management Plan.

- As resources allow, continue to make available competitive grants on an annual basis for statewide programs and watershed-based implementation projects, giving emphasis to priority watersheds that are consistent with goals and objectives in this plan.
- Give preference to implementation projects that defensibly target sub-watersheds, thus improving the opportunity to achieve measurable improvements in the timeframe of this plan.
- Continue to focus on increasing implementation of BMPs and other related behavioral changes that have the cumulative effect of improving water quality.
- Continue to improve mechanisms for tracking, measuring, and reporting implementation of BMPs.
- Continue to strengthen education, outreach and involvement activities to move individuals and businesses from awareness to advocacy.
- Update the Qualitative Risk Assessment Matrix as appropriate or within six months after ADEQ publishes a draft List of Impaired Waterbodies.
- Continue to review ADEQ's draft List of Impaired Waterbodies to determine the potential to develop EPA success stories.
- Continue to develop local capacity of watershed groups to effect behavioral change, giving emphasis to priority watersheds.
- Continue to promote the development of Watershed Management Plans and update and refine existing ones as appropriate.
- Strengthen existing and develop new working partnerships among cooperating entities in order to better leverage limited resources available to improve water quality.
- Foster improved sharing of data, GIS layers, assessments, research and other analytic tools that will enable improved targeting of NPS resources by all cooperating entities.
- Promote and support strengthened cooperation at the state and local levels to more effectively and efficiently target and coordinate resources to improve water quality.
- Work within the framework of the Arkansas Water Plan to enhance the NPS Management Program and seek to obtain increased nonfederal funding.

Element 2

A balanced approach that emphasizes both statewide NPS programs and on-the-ground management of individual watersheds where waters are impaired and threatened.

Watershed-based implementation has been a goal of the nation's NPS Pollution Management Plan from its inception. Section 319 of CWA mandates that "A state shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis…" In 1997, EPA increased its commitment to watershed implementation with publication of Picking up the Pace, which established policy to target risk by enhancing the TMDL program and improving identification of water impaired by nonpoint sources. Supplemental program guidance encourages states to use a balanced approach that emphasizes both statewide NPS programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

To achieve this, the guidance places top priority on implementing on-the-ground measures and practices that will reduce pollutant loads and contribute to the restoration of impaired waters. The approaches described below strive to balance between statewide programs and watershed-based implementation projects. They also address CWA objectives by directing the

use of Section 319 watershed project funds for the development and implementation of EPA-accepted Nine Element Watershed Management Plans. These plans are designed to restore waters that ADEQ lists as impaired under Section 303(d) of CWA or maintain water quality and promote water quality in unimpaired watersheds.

Statewide Programs

Arkansas' 2018-2023 NPS Pollution Management Plan balances statewide programs focused on specific land uses with watershed-based projects that seek to restore designated uses or prevent waters from becoming impaired. Table 1.1 lists activities most commonly associated with nonpoint source pollution and identifies the section in this document where the activity description can be found.

Table 1.1: 2018-2023 NPS Plan Chapters

Section	Activities Commonly Associated With NPS
4	Agriculture
5	Silviculture
6	Surface Erosion
7	Urban Runoff

Statewide programs have been redefined for the 2018-2023 NPS Management Plan in discussion with ADEQ, the Arkansas Department of Health and AFC to more effectively integrate program responsibilities between the lead agencies. Table 1.2 identifies the lead agencies for each statewide program.

Table 1.2: Lead Agencies with Primary Responsibility for Statewide Programs

	Agriculture	Silviculture	Surface Erosion	Urban Runoff
Arkansas Natural Resources Commission	Lead		Lead	
Arkansas Department of Environmental Quality				Co-Lead
Arkansas Forestry Commission		Lead		
Arkansas Department of Health				Co-Lead

Priority Watershed Programs

Arkansas has emphasized watershed-based management in its NPS Management Plan since 1998.

Arkansas will continue, as appropriate, to treat all watersheds with NPS TMDLs, excluding phosphorus from unknown sources and mercury only TMDLs, as priority waters for 319(h) funding.

A list of TMDL's can be found on the Arkansas Department of Environmental Quality's website at www.adeq.state.ar.us/water/planning/integrated/tmdl/.

To identify additional priority watersheds for the 2018-2023 plan, the NPS Management Program continues to update and employ a qualitative risk assessment matrix to select 8-digit watersheds eligible for watershed project funds. While the analysis includes all watersheds in the state, watersheds with reaches on the state's 303(d) List of Impaired Waterbodies are given the most weight. Over time, stakeholders have identified 13 parameters to be considered and a scoring system for each parameter. Based on the resulting scores, watersheds were grouped into quintiles. Appendix A describes the qualitative risk assessment matrix in more detail.

In 2017, ANRC designated 11 priority 8-digit HUC watersheds from the top quintile. The selected watersheds are listed below. Table 1.3 lists the priority watersheds. Figure 1.8a and 1.8b shows the location of priority watersheds.

Table 1.3: Priority Watersheds, 2017

Section	Priority Watersheds Planning Segment
11	Bayou Bartholomew (2B)
12	Beaver Reservoir (Upper White River) (4K)
13	Cache River (4B)
14	Illinois River (3J)
15	Lake Conway-Point Remove (3F)
16	L'Anguille River (5B)
17	Lower Little River (1C)
18	Lower Ouachita-Smackover (2D)
19	Poteau River (3I)
20	Strawberry River (4G)
21	Upper Saline River (2C)

Figure 1.8a
Location of Priority Watersheds

Source: Arkansas Natural Resources Commission
Data Source: USDA NRCS Geospatial Data Gateway
Map Created: April 2017

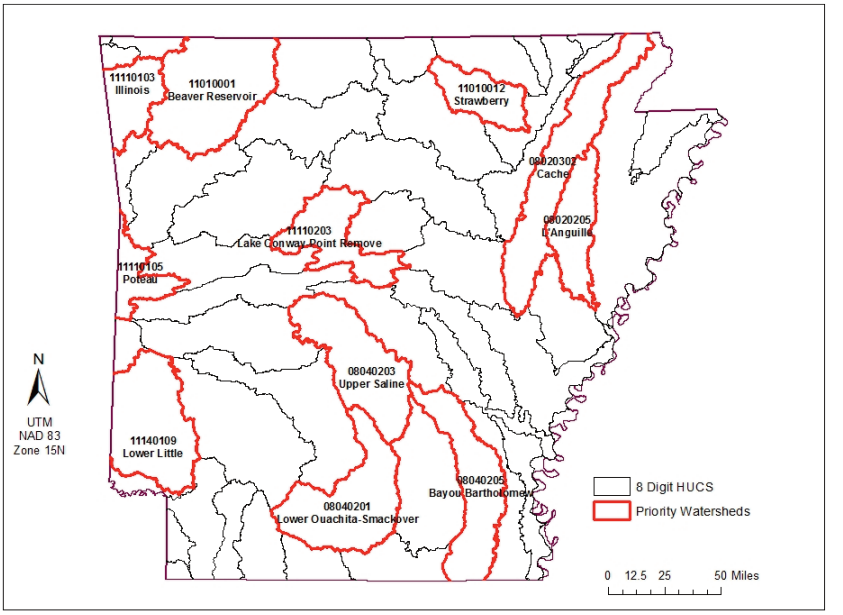
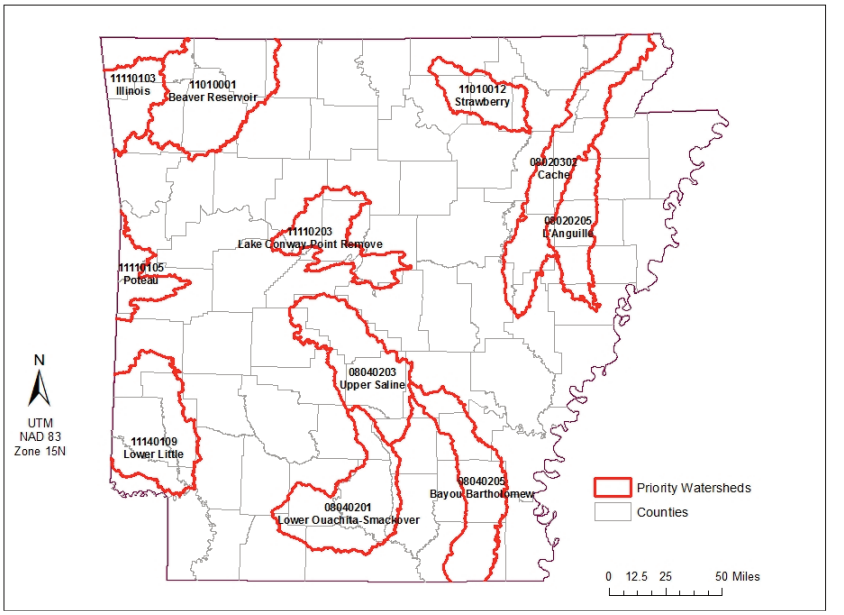


Figure 1.8b
Location of Priority Watersheds by County

Source: Arkansas Natural Resources Commission
Data Source: USDA NRCS Geospatial Data Gateway
Map Created: April 2017



Targeted Implementation

Water quality protection efforts can be better targeted using inclusive stakeholder-developed plans and strategies to achieve shared goals and objectives. However, development and adoption of well-designed watershed management plans continue to be challenging tasks in state and local efforts to protect water quality. Limited availability of staff and other resources are program constraints. Substantial efforts and resources will be expended to develop and implement Nine Element Plans for these priority watersheds with clearly stated, achievable and measurable goals and objectives. Table 2.1 in the program description shows the status of development of Nine Element Plans.

Funding through EPA and other programs is not likely to be sufficient to fully treat any 8-digit HUC watershed. As appropriate, as watershed resources are available and as groups have the capacity, the state will target its efforts toward sub-watersheds within identified priority 8-digit HUC watersheds with EPA-accepted nine element plans. Only those watersheds

will be eligible for Section 319(h) funding from EPA watershed project funds. In addition, ANRC will encourage other state and federal agencies and nonprofit environmental interest groups to target their efforts towards these same watersheds.

Implementation projects that focus on sub-watersheds where there is demonstrated potential for measurable results in the short run may be given preference for watershed implementation grants. The program description in Section Two includes a detailed description of how sub-watershed priorities will be reviewed.

Watersheds not designated as priority watersheds are not excluded from funding under the 319(h) grant program. They will continue to compete for NPS Program funds. However, those watersheds listed as NPS priorities will be given the first consideration. Watersheds having EPA-accepted Nine Element Plans will have second consideration. As funds allow, other watersheds may receive consideration.

Element 3

Strong working partnerships with appropriate state, tribal, regional, and local entities, private sector groups, citizens groups and federal agencies.

ANRC has been the lead agency responsible for Arkansas' NPS Management Plan since 1990. The agency has made it a priority to develop strong working partnerships with appropriate state and federal agencies, regional and local entities, nonprofit organizations and watershed groups. In addition, ANRC works closely with industry associations and other private sector groups to promote implementation of voluntary BMPs.

State, federal and local agencies along with state, regional and local associations, nonprofit organizations and watershed groups will cooperate to provide education, outreach, technical assistance, cost-share, and other programs targeted to one or more sources or pollutants. More than 100 cooperating entities have some responsibility for addressing NPS pollution in Arkansas.

The process of preparing this 2018-2023 NPS Pollution Management Plan reflects a continued commitment to cooperation and substantive planning and implementation involvement by NPS stakeholders. The plan provides a mechanism for regular review and updates. Two examples of this stakeholder review should be noted.

Stakeholders attending the annual NPS meeting in 2014 approved studying how endangered species should be included as a category in the watershed prioritization risk matrix. Following several committee meetings, stakeholders at the annual 2015 NPS meeting approved adding the 13th category, with it to take effect in the 2018-2023 NPS Plan. The updated watershed prioritization risk matrix identified the Lower Little River as a new priority watershed for the 2018-2023 NPS Plan.

Stakeholders also served on committees to review the language of the 2011-2016 NPS Plan for potential updates. In 2016, ANRC and the Public Policy Center at the University of Arkansas System Division of Agriculture invited stakeholders attending the 2016 NPS meeting to participate in the review. The invitation was also shared at other water-related meetings, with signup sheets posted for people to volunteer.

A total of 45 people signed up to participate in the update of the six chapters. Cooperative Extension Service and ANRC staff also identified an extensive list of other stakeholders who should be contacted and asked if they were interested in participating in chapter updates when they were ready. A total of 131 stakeholders were identified. The six committees reviewed these chapters: Agriculture, Silviculture, Resource Extraction, Surface Erosion, Road Construction and Maintenance, and Urban Runoff.

Committee members provided suggestions on potential updates, and their suggestions were reviewed by Cooperative Extension Service and ANRC staff. (During the next editing stage, ANRC staff recommended removing several chapters that included activities that were already regulated and not under their purview.) This cooperative process continues to build the participation network. Data sharing, project planning and cooperative project development are all examples of the stronger collaborative basis for NPS efforts.

New initiatives ranging from Regional Conservation Project Partnership, National Water Quality Initiative project proposals, Discovery Farm investments to the Arkansas Soil Health Alliance and cover crop use, promotion and management projects are examples of the growing network. The GeoStor data resource and cooperation with the state's Geographic Information Office provide opportunities to explore new modeling and mapping efforts, with a goal of improved targeting of resources. The challenge for resource agencies, policy makers and citizens is to cooperatively implement NPS management tools and techniques with measurable success. At the same time this cooperative effort must find ways to integrate new, unique or emerging needs into the update and employ the most effective and efficient tools.

Section Three, Cooperating Entities, describes entities that are working together to manage NPS

pollution in Arkansas. Appendix C describes in more detail how the NPS Management Plan Stakeholder Group was created and its role in the planning process. The adaptive management discussion below describes how the NPS Management Plan Stakeholder Group will be used for review and update of this plan.

Element 4

The state plan (a) abates water quality impairments from existing sources and (b) prevents significant threats to water quality from present and future activities.

ADEQ is responsible for monitoring and assessing water quality. The Arkansas NPS Pollution Management Plan administered by ANRC utilizes the 305(b) report and List of Impaired Waterbodies (303(d)) as the basis for information to determine if waterbodies are affected by NPS pollution. Both evaluative and monitored data have historically been utilized to assist in making this determination.

The NPS Management Plan is directed at abatement of known water quality problems as identified in the section 305(b) report and List of Impaired Waterbodies and significant threats to water quality from present and future activities. Statewide programs are developed to prevent and address the different causes of impairment and their sources for abatement activities. The state NPS Management Plan is reviewed periodically by the NPS Management Plan Stakeholder Group and can be modified to address new problems as they arise.

Element 5

An identification of waters and watersheds impaired or threatened by NPS pollution and a process to progressively address these waters.

ADEQ's List of Impaired Waterbodies includes waters not supporting all designated uses and identifies the most likely source of pollution and causes for the impairment. The inventory is based on monitoring and evaluative data collected by ADEQ as well as data from other sources if the data meets EPA specifications. The state's NPS Management Plan uses this assessment report as a guide in developing action plans for statewide programs and for identifying priority watersheds for special assistance.

Once a watershed is identified as a priority watershed for the purposes of the NPS Management Plan, it is identified for further assessment work and development of a Nine Element Plan involving local watershed groups with support from state and federal agencies and other cooperating entities. As appropriate, SWAT modeling or other watershed analysis of nonpoint sources is initiated and action plans are developed for addressing water quality conservation needs of the watershed. BMP implementation in priority watersheds will be monitored to the extent possible given confidentiality requirements enacted by Congress in the Farm Bill. Best Management Practice monitoring, together with ongoing water quality and environmental monitoring, can be used to determine the effectiveness of the watershed plans. Evaluation and revision of the plans will be conducted by local planning and technical support partners on a regular basis.

Element 6

The state reviews, upgrades, and implements all program components required by Section 319 of the Clean Water Act, and establishes flexible, targeted, iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The state programs include: (a) a mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water; and (b) a mix of regulatory, non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.

Arkansas' NPS Management Plan utilizes a voluntary approach to achieve and maintain designated uses. To promote voluntary effort, the NPS Pollution Management Plan makes available competitive grants to eligible public agencies, universities, and nonprofit organizations on an annual basis for statewide programs and watershed-based implementation projects. The grants program is described in Section Two of this plan.

As the lead agency, ANRC prepares an annual report that documents the state's implementation of the NPS Management Plan. The annual reporting process is described in Section Two of this plan. In addition to meeting CWA reporting requirements, the annual report is used to communicate program status to the NPS Management Plan Stakeholder Group, thus enabling them to participate in evaluating programs and recommending mid-course corrections to the NPS Management Plan on an ongoing basis.

Arkansas will continue to employ an adaptive management approach to keep the NPS Management Plan current. The role of the NPS Management Plan Stakeholder Group in the adaptive management process is described in Section 2. For all statewide and priority watershed programs, the overall program strategy is to promote voluntary BMPs using a cooperative process whereby federal and state programs cooperate

in priority areas of the state where water quality problems have been identified. As long as voluntary implementation of BMPs and cooperative processes result in the incremental reduction of nonpoint source pollutant loads, it will be viewed as successful. However, if the voluntary, cooperative process does not result in the incremental reduction of NPS pollution and/or water quality improvements, then state and local entities will need to investigate additional cost-effective steps needed to enable waterbodies to meet their designated uses over the long term.

Element 7

Efficient and effective management and implementation of the state's NPS plan, including necessary financial management.

Efficiency and effectiveness are achieved in the following ways:

- The NPS Management Plan Stakeholder Group will review the plan periodically. Through review of the program, progress toward achieving milestones reported in annual reports, ANRC will provide assurance that NPS Management Plan funds are used effectively, are targeted toward state priorities, and truly address NPS issues affecting the waters of Arkansas.
- Many agencies represented in the Stakeholder Group are also represented on various other state and federal committees and task forces, such as the NRCS State Technical Committee or the Multi-Agency Wetlands Planning Team. This cross representation promotes greater coordination and leveraging of limited funds to more adequately meet the needs of the NPS Management Plan.
- ANRC provides technical assistance to the agency, university, or nonprofit organization that submits a proposal to develop a detailed work plan that meets the needs of the proposing entity, the NPS Pollution Management Plan and the requirements set by the CWA. This process helps shape projects so they are more likely to achieve the intended results efficiently and effectively.
- ANRC follows Generally Accepted Accounting Principles (GAAP) guidelines issued by the Governmental Accounting Standards Board and undergoes an annual audit consistent with government audit standards laid out in various Office of Management and Budget and Government Accountability Office guidance. Entities that expend Section 319(h) funds are subject to audit requirements that assure compliance with state and federal laws and regulations. This financial oversight provides both EPA and the public with confidence in the integrity of ANRC's financial management.

Element 8

Identification of federal lands and objectives, which are not managed consistently with state program objectives.

A list of federal lands in the state is included in the update along with the agency responsible. ANRC will provide copies of this 2018-2023 Arkansas NPS Management Plan to the director of each federal agency. The U.S. Forest Service (USFS) manages more federal lands in Arkansas than any other federal agency. AFC monitors and reports implementation of BMPs on USFS lands through a biennial survey.

Element 9

A feedback loop whereby the state reviews, evaluates, and revises its NPS assessment and its management plan at least every five years.

Arkansas' NPS Management Plan was developed in 1998 and updated in 2002, 2005 and 2011. Experience has shown that the plan needs to be updated on a regular basis in order to integrate new, unique or emerging needs and programs. The NPS Management Plan Stakeholder Group was formed to develop the 2006-2011 NPS Pollution Management Plan and the 2011-2016 plan, and stakeholders continue to provide input on the development of the 2018-2023 plan. The continuing goal is an incrementally updated plan, adapting to the changing opportunity, knowledge and needs of the state. This adaptive management process acts as a scoping mechanism that keeps the plan relevant and open to the state's changing NPS pollution circumstance. It also helps avoid the need for major updates that are time-consuming and disruptive to ongoing effort.

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Section Two

Program Description

2018-2023 NPS Management Plan

Introduction

The Arkansas Natural Resource Commission (ANRC) is the lead agency responsible for Arkansas' Nonpoint Source Pollution Management Program. This plan provides a broad framework and aspirational objectives and is updated every five years.

Program Structure

Arkansas' NPS Pollution Management Program includes two major components: a statewide program consisting of statewide issues of concern and a select group of priority watersheds identified by a matrix created with input from stakeholders.

Statewide programs focus prevention and, to a lesser extent, abatement activities on a particular land use or group of land and water uses. Typical activities may include identification and/or development of appropriate Best Management Practices (BMPs), BMP monitoring, water quality monitoring, demonstration projects, training, and outreach.

The priority watershed program focuses on priority 8-digit hydrologic unit code (HUC) watersheds where there are known impairments or significant threats to water quality from present and potential future activities. Waterbodies with an approved total maximum daily load (TMDL) may be considered a priority watershed, except in cases in which the TMDL does not have an NPS component or the source cannot be identified (e.g., TMDLs for phosphorus or mercury only).

Typical priority watershed program activities may include assessments to identify target sub-watersheds, development of a Nine Element Plan and implementation projects. ANRC will give preference to implementation of NPS program projects that target sub-watersheds where measurable water quality improvements can be expected in a specified time-frame. Arkansas' NPS Program recognizes that water quality improvements most often occur where there are active and effective local watershed groups involved.

Table 2.1 shows the status of local institutional capacity and planning in each of the identified priority watersheds as well where in this plan they are described.

Table 2.1 Status of Priority Watersheds, 2017

Section	Priority Watershed	Active Watershed Groups	Nine Element Plan
11	Bayou Bartholomew		Yes
12	Beaver Reservoir	Association for Beaver Lake Environment (ABLE) Beaver Watershed Alliance Ozarks Water Watch Kings River Watershed Partnership	Yes
13	Cache River		Yes
14	Illinois River	Illinois River Watershed Partnership	Yes
15	Lake Conway-Point Remove		Incomplete Draft
16	L'Anguille River		Yes
17	Lower Little River		Yes
18	Lower Ouachita-Smackover		No
19	Poteau River		No
20	Strawberry River		Yes
21	Upper Saline River		Yes

Watershed Projects and Funding

Watershed projects promote understanding of the full range of stressors in a watershed – physical, chemical, and biological – that may be affecting aquatic life and human health. When all significant sources and stressors are understood, the program and subsequent projects are better able to focus on those controls that are more likely to produce measurable improvements in ecosystem health.

Administratively, watershed projects are highly efficient. They encourage local and statewide cooperating entities to focus staff and financial resources on prioritized geographic locations and facilitate coordination of resources among interested parties. Also, they provide local agencies with an opportunity to take leadership roles in ecosystem protection. Individual watershed projects provide a statewide proving ground for innovative approaches as new models are developed and new watershed-level management approaches are tried.

Finally, watershed projects encourage local agencies and citizen groups to get involved either by participating in state or federal projects or by starting their own watershed projects. Projects create a sense of ownership within the project area and engender enthusiasm that will carry forward to new initiatives.

The elements of an effective watershed project are:

- **Building a Project Team and Public Support:** Developing effective institutional arrangements and ownership of the project by stakeholders.
- **Defining the Problem:** Developing an inventory of the watershed and its problems and conducting baseline monitoring.
- **Setting Goals and Identifying Solutions:** Developing project goals, a list of management measures and a detailed plan for their implementation.
- **Implementing Controls:** Obtaining funding, securing commitments and installing controls.
- **Measuring Success and Making Adjustments:** Documenting success in meeting goals, monitoring, changing management measures as needed, and ensuring project continuity.

Program Administration and Funding

The Arkansas Natural Resources Commission (ANRC) receives funding through an Assistance Agreement from the Environmental Protection Agency (EPA) for the purpose of enacting and maintaining the Nonpoint Source Pollution Management Program (NPS Program). Funds are received from EPA yearly, and the EPA allocation varies but is generally between $2 to $3 million. EPA funding is contingent upon ANRC providing or securing a 40 percent match.

The NPS Program and associated staff are funded through the Assistance Agreement with the exception of one staff position. In an effort to secure the non-federal match requirement, a minimum surcharge of three percent is added to the match requirement for projects. Additional non-federal match may be secured through state funds or state-funded programs or activities directly associated with NPS pollution abatement, reduction or control. Examples of state-funded programs may include, but are not limited to:

- **Water Quality Technician (WQT) Program:** WQTs are funded for multiple county conservation districts using state dollars for the purpose of developing Nutrient Management or Conservation Plans.
- **State Revolving Fund (SRF) Agriculture Loan Program:** Individuals may borrow up to $250,000 for agriculture equipment or services for the implicit and expressed purpose to abate, reduce or control NPS pollution. Payments made by the borrower may be counted as non-federal match.
- **NPS Implementation Projects:** NPS projects totally funded with non-federal dollars by other state agencies, groups or organizations. Fiscal expenditure tracking and verification is documented and submitted to ANRC and dedicated to the NPS Program solely.

In an effort to secure and maintain staff and the consistency of the NPS Program, once every four to five years, the total annual funding allocation from EPA is dedicated to the administrative function of the program. The periodic funding ensures adequate staffing, ongoing program enhancements and updates and overall program consistency and efficiency.

Program Project Funding

As described further in this chapter, Arkansas will focus watershed NPS Project funding on the priority 8-digit HUC watershed scale where impairments or significant threats to water quality exist due to NPS activities and where certain criteria are met. When applicable, ANRC will encourage other state agencies to target their efforts in watersheds where NPS Program projects are taking place.

The annual EPA allocation and subsequent Assistance Agreement award to ANRC is divided equally between the two funding "pools" and is a competitive process. NPS projects are selected based on watershed location and other criteria (i.e., being designated an NPS priority watershed and having an EPA-accepted Nine Element Plan). The two pools of funding are:

- **Watershed Project Funds**
  Priority watersheds identified through the use of the Risk Matrix Tool that have an EPA-accepted Nine Element Plan are eligible for Section 319(h) funding from the EPA Watershed Project Funds. In the event that these funds are exhausted, projects meeting the criteria for Watershed Project Funds may be paid for by NPS Program Funds.

- **NPS Program Funds**
  Non-priority watersheds are only eligible for NPS Program Funds. These funds can be used to address a proactive approach to protect water quality, non-priority watershed projects or projects in watersheds without an EPA-accepted Nine Element Plan.

To further focus limited resources to achieve measurable results, Arkansas will give preference to implementation projects that focus defensibly on sub-watersheds within identified priority watersheds and effectively leverage limited available resources. Implementation projects are defined as projects with activities that primarily include installing or implementing "on the ground" best management practices (BMPs) that directly abate, reduce or control NPS pollution.

Sub-Watershed (12-digit HUC) Projects

Project proposals for implementation of sub-watershed projects will adhere to the same criteria as 8-digit HUC watersheds but will include a description of the data and the analytic methodology used to prioritize the sub-watershed(s). The prioritization methodology will be reviewed by ANRC's NPS staff on a number of criteria including, but not limited to:

- What data were used (quantitative analyses will be given preference, analyses that provide comparative rankings of sub-watersheds will be given preference).
- Methodology used to analyze the data (e.g., land use change from Geographic Information System (GIS), Soil Water Assessment Tool (SWAT) models, Water Erosion Prediction Project (WEPP), etc.
- Validation methodology and assumptions used in setting modeling parameters.
- How the data were collected (rigorous methods of data collection will be given preference).
- How complete and up-to-date the data used are.
- Whether there is meta-data (GIS) or a data dictionary (databases) that enable the data to be shared with other analysts/researchers (data that can be shared will be given preference).
- Degree to which the data/analysis has been or can be verified through analytic methods or through other objective means.

ANRC will review the prioritization methodology used before a proposal is accepted for consideration. If the prioritization methodology is determined to be inadequate, the proposal will not receive further consideration from ANRC.

Cost-Sharing as a Project Component

Recognizing that agriculture is consistently listed as the most frequent nonpoint source of impairment to Arkansas waterbodies on the state's 303(d) List of Impaired Waterbodies, watershed-based implementation projects may include cost-sharing to encourage agricultural producers to implement and maintain specific BMPs as one component of a project proposal.

Proposals that include cost-sharing for other types of entities will not be considered. BMPs eligible for cost-sharing are selected and approved by the NPS Staff on a project-by-project basis.

ANRC works with cooperating entities to identify appropriate and economical BMPs that producers will be able and willing to implement. Projects that include cost sharing are targeted at a single watershed.

Where practical, U.S. Department of Agriculture-Natural Resources Conservation Service (NRCS) initiatives and programs such as the Environmental Quality Incentive Program (EQIP), the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program (CREP), the Wildlife Habitat Improvement Program (WHIP), the Wetland Reserve Program (WRP), Mississippi River Basin Initiative (MRBI), National Water Quality Initiative (NWQI) and other state and local cost-share are coordinated with ANRC's Title X Rules Governing Agriculture Cost Share and can be a component of an NPS Program project. However, many of the NRCS programs do not operate on the watershed level but rather the county level. Only initiatives within the NPS Program project area may be used to augment the project.

Proposal Review and Selection Process

Projects are selected through a competitive process. ANRC issues a Call for Work Plans in November or early December. Eligible entities are invited to submit proposals to ANRC's NPS Management Program. Proposals are reviewed through a structured process, and projects are selected for funding as appropriate and as funds allow. NPS Program staff work with potential grantees on a continuous basis to encourage a pool of proposals that address the most critical needs of the NPS Pollution Management Program, as identified by ANRC. The following is a narrative description of the competitive grant process.

Eligibility:

Entities eligible to receive Section 319(h) grants include state and local government agencies, 501(c)(3) nonprofit organizations, and universities. Other entities are not eligible. ANRC may at its discretion waive eligibility requirements on a case-by-case basis when it is in the best interests of the Arkansas NPS Pollution Management Program.

Call for Work Plans:

NPS Program staff issue a call for work plans on an annual basis. Staff maintain an active list of interested stakeholders (both entities and individuals are included). Any eligible entity may request to be added to the email distribution list to receive the Call for Work Plans. The Call for Work Plans provides a format for proposal submission and a due date for proposals. ANRC may at its discretion solicit additional project work plans during the course of the year or accept unsolicited project work plans for consideration if it is in the best interests of the Arkansas NPS Pollution Management Program.

Work Plan Review and Project Selection:

Work plans must pass through a multi-stage review. ANRC staff review submitted work plans for eligibility and completeness. Staff may return incomplete work plans for additional work or reject incomplete work plans. Rejected work plans may or may not receive further consideration based on the merits of the work plan and the needs of the NPS Program.

Completed work plans are forwarded to a peer review team for evaluation. However, the peer review process may not be used when not enough work plans have been submitted to utilize the total annual allocation.

When the peer review process is used, the team includes representatives of current or past Section 319 grant recipients selected by ANRC. No grant recipient may have more than one representative on the peer review team. Members of the peer review team independently rank all proposals as high, medium or low priority. NPS Program staff also independently review and rank work plans.

After all rankings are submitted, the peer review team and NPS Program staff meet as a group to discuss the strengths and weaknesses of work plans relative to the NPS Management Program objectives. This group may recommend changes to the project design in order to strengthen project outcomes.

The NPS Program staff then reviews all rankings as well as other input to make funding recommendations to ANRC management. ANRC management staff review recommendations and assist in making the final determination for project funding.

Work Plan Development:

Entities with projects selected for funding will be notified and asked to develop a detailed work plan if applicable. ANRC may at its discretion ask for project modifications in order to strengthen project outcomes.

Project Reporting

Project leaders (also known as project investigators or PIs) are required to submit quarterly reports that describe the project's progress, task activities, task

completion, expenditures and match generated. They also submit annual reports that provide implementation data to estimate load reduction as well as a discussion of successes and failures and mid-course adjustments to the scope of work. All projects are required to submit a final report.

To provide input into the adaptive management process, sponsors of active projects participate in the annual Nonpoint Source Pollution Stakeholder and Project Review Meeting as appropriate or requested. Project leaders present information and respond to questions about their project from peers and NPS Program staff. In addition, all participants in the peer review process work together to identify lessons learned or potential adaptations that would strengthen the project or similar projects in the future.

Program-Level Annual Reporting

As the lead agency, ANRC prepares an annual report that documents the state's implementation of the NPS Management Plan. The Clean Water Act details the requirements for the Annual Report. Specifically:

> *Section 319(h) (11) Reporting and Other Requirements. Each State shall report to the Administrator on an annual basis concerning:*
>
> *a. Its progress in meeting the schedule of milestones submitted pursuant to subsection (b)(2)(C) of this section; and*
>
> *b. To the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality for those navigable waters or watersheds within the State which were identified pursuant to subsection (a)(1)(A) of this section resulting from the implementation of the management program.*

In Arkansas, responsibility for (a) and (b) above are divided between two state agencies.

a. ANRC administers the NPS Management Plan and reports on progress toward meeting the schedule of milestones; and
b. The Arkansas Department of Environmental Quality (ADEQ) is responsible for monitoring and assessing the waters of the state "to the extent that appropriate information is available." ADEQ issues two major reports on a roughly biennial basis: the Water Quality Inventory Report (also called the 305(b) report) and the List of Impaired Waterbodies (also called the 303(d) report). ADEQ has responsibility for assessing the waters of the state.

In addition to ADEQ's monitoring activities, ANRC maintains a limited long-term supplemental monitoring program that is included in the annual report. ANRC's long-term monitoring stations supplement but do not duplicate ADEQ monitoring.

On the project level, ANRC estimates load reductions utilizing the Region 5, STEPL and RUSLE models, which are entered into the Grants Reporting and Tracking System (GRTS). When project monitoring is included as a component of a funded project, it is typically done for the purpose of BMP demonstration efficiency. These data are only useful and available at the completion of the project.

Adaptive Management Approach

The 2018-2023 NPS Management Plan will continue to use an adaptive management approach as appropriate. The NPS Management Plan Stakeholder Group will meet when necessary to review the NPS Management Plan for needed updates, information, upcoming activities and trends, and to suggest potential changes to the NPS Management Program. Stakeholders include individuals and organizations that have an interest in identifying and solving nonpoint source water quality problems and in monitoring the effectiveness of these solutions over time. Entities represented in the Stakeholder Group in the past include but are not limited to:

- Alliance for an Improved Middle Fork
- Arkansas Association of Conservation District Employees
- Arkansas Association of Conservation Districts
- Arkansas Canoe Club
- Arkansas Department of Environmental Quality
- Arkansas Department of Health
- Arkansas Department of Heritage
- Arkansas Department of Parks and Tourism
- Arkansas Department of Transportation
- Arkansas Environmental Federation
- Arkansas Farm Bureau
- Arkansas Forestry Association
- Arkansas Forestry Commission
- Arkansas Game and Fish Commission
- Arkansas Homebuyers Association
- Arkansas Livestock and Poultry Association
- Arkansas Municipal League

- Arkansas Natural Heritage Commission
- Arkansas Natural Resources Commission
- Arkansas Office of the Governor
- Arkansas Oil and Gas Commission
- Arkansas Pork Producers Association
- Arkansas Poultry Federation
- Arkansas Public Policy Panel
- Arkansas River Valley RC&D Council
- Arkansas Rural Water Association
- Arkansas State Plant Board
- Arkansas State University
- Arkansas Tech University
- Arkansas Water Resources Center
- Associated General Contractors of Arkansas
- Association of Arkansas Counties
- Audubon Arkansas
- Baxter County Conservation District
- Bayou Bartholomew Alliance
- Beaver Watershed Alliance
- Beaver Water District
- Boone County Conservation District
- Buffalo River Watershed Alliance
- Cattails Environmental, LLC
- Central Arkansas Water
- City of Fort Smith
- City of Little Rock
- Crooked Creek Conservation District
- Cross County Conservation District
- East Arkansas Planning and Development District
- Equilibrium
- Friends of North Fork/White River
- Friends of Fourche Creek
- Friends of the Ouachita Trail
- FTN Associates
- Fulton County Conservation District
- GBMc & Associates
- Illinois River Watershed Partnership
- Kings River Watershed Group
- Lake Conway Homeowners Association
- Lake Conway Point Remove Watershed Alliance
- Lake Fayetteville Watershed Partnership
- L'Anguille River Keepers
- L'Anguille River Watershed Coalition
- Leatherwood Creek Watershed
- League of Women Voters of Arkansas
- Little Red River Action Team
- Lower Little River Watershed Coalition
- McGeorge Construction
- National Park Service
- National Weather Service
- Northwest Arkansas RC&D Council
- Ouachita Watch League
- Ozark Foothills RC&D Council
- Ozarks Water Watch
- Plum Creek Timber Company
- Scott County Organization to Protect the Environment
- Southwest Arkansas Planning and Development District
- Southwest Arkansas RC&D Council
- Springdale Water Utilities
- St. Francis County Conservation District
- Streamworks Mitigation Services
- The Agricultural Council of Arkansas
- The Nature Conservancy
- The Ozark Society
- University of Arkansas
- University of Arkansas at Little Rock
- University of Arkansas at Monticello
- University of Arkansas at Pine Bluff
- University of Arkansas for Medical Sciences
- University of Arkansas System Division of Agriculture Cooperative Extension Service
- University of Arkansas System Division of Agriculture Public Policy Center
- University of Arkansas System Division of Agriculture Research Stations
- University of Arkansas Watershed Research and Education Center
- University of Central Arkansas
- Upper White River Basin Foundation
- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Farm Service Agency
- U.S. Department of Agriculture, Forest Service
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- Watershed Conservation Resource Center
- West Center Arkansas Planning and Development District
- West Fork-White River Watershed
- Western Arkansas Planning and Development District
- White County Conservation District
- White River Planning and Development District

Section Three

Cooperating Entities

2018-2023 NPS Management Plan

Introduction

The Arkansas Nonpoint Source (NPS) Pollution Management Plan is implemented through working partnerships with state and federal agencies, educational institutions, municipalities, counties, conservation districts, regional planning commissions, nonprofit organizations and others. These partners are invited to participate in an annual NPS Pollution Stakeholder and Project Review meeting to discuss current issues impacting nonpoint source pollution, share information about efforts to address nonpoint source pollution, and provide input to the Arkansas Natural Resources Commission (ANRC) regarding the Management Plan and its implementation.

ANRC works collaboratively with several agencies that provide leadership for statewide programs included in this plan. Table 3.1 indicates the lead agencies for each statewide program.

Table 3.1: Lead Agencies for Statewide Programs

Statewide Program	Lead Agency
Agriculture	Arkansas Natural Resources Commission
Silviculture	Arkansas Forestry Commission
Surface Erosion	Arkansas Natural Resources Commission
Urban Runoff	Arkansas Department of Environmental Quality and the Arkansas Department of Health

This section summarizes major efforts of these partners as well as other cooperating entities that contribute directly or indirectly to Arkansas' NPS Management Plan. Table 3.2 (end of this section) identifies the statewide programs to which the cooperating entities may contribute directly or indirectly over the course of the 2018-2023 NPS Pollution Management Plan.

Arkansas Natural Resources Commission (ANRC)

ANRC manages and protects water and land resources for the health, safety and economic benefit of the State of Arkansas. A nine-member commission appointed by the governor provides direction for ANRC. The governor also appoints the ANRC executive director. ANRC is divided into three operating divisions: the Conservation Division, the Water Management Division and the Water Development Division.

Since 1990, ANRC has been the lead agency for planning, coordinating and implementing the NPS Pollution Management Plan, including the development and maintenance of the plan's updates, submitted to the U.S. Environmental Protection Agency (EPA) for approval every five years. In addition, ANRC manages wide-ranging programs that address NPS pollution both directly and indirectly across its three divisions. A few of those programs are highlighted.

Nonpoint Source Pollution Grants Program

ANRC offers competitive grants, funded through Section 319(h) of the Clean Water Act (CWA), to support statewide programs and implementation projects on an annual cycle. Special emphasis is given to watersheds prioritized by the NPS Pollution Management Plan Stakeholder Group. ANRC provides assistance to eligible entities on preparation of grant applications, including conceptual project design, development of a work plan, and budget preparation. ANRC accepts work plans for projects to manage, reduce, or abate NPS pollution. Projects are funded for one to four years.

Support for Conservation Districts

ANRC provides significant support for Arkansas' 75 conservation districts in collaboration with the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). The purpose of the Arkansas Association of Conservation Districts is to help conservation districts increase their capacity to effectively and efficiently conserve soil and water. Conservation districts are political subdivisions of the

State of Arkansas. They are a creation by popular vote of resident landowners for the purpose of conserving land and water resources as authorized by Act No. 197 of the Arkansas General Assembly of 1937, the nation's first conservation district law. ANRC appoints two members of each local conservation district while three members are elected locally.

ANRC, the Arkansas Department of Environmental Quality (ADEQ), the Arkansas Forestry Commission (AFC), the Arkansas Game and Fish Commission (AGFC), NRCS and other entities may provide technical assistance to conservation districts through their staffs of professional engineers, geologists, and/or biologists in the design and implementation of Best Management Practices (BMPs) for the purpose of improving or maintaining water quality.

ANRC provides state funding to some local conservation districts for water quality technicians. The technicians provide assistance to landowners in the implementation of farm management plans and in the implementation of water quality and conservation plans. ANRC, in cooperation with NRCS, oversees ongoing training of technicians on management techniques and practices. NRCS provides daily supervision for conservation district technicians.

Poultry Registration

Poultry feeding operations, in which 2,500 or more poultry are housed or confined on any given day, must register annually in accordance with the Arkansas Poultry Feeding Operations Registration Act.

While confined animal feeding operations (CAFO) regulations at a national level are being developed, in Arkansas, CAFOs under the General Permit No. ARG590000 that have no discharge other than stormwater and which does not propose to discharge are not required to seek permit coverage.

Along with Poultry Registration, ANRC became responsible for other programs authorized by the Arkansas General Assembly in 2003. Implementation began in 2005, and with amendments continued through 2010. They are:

- **Nutrient Management Planner Certification Program**
  These rules govern ANRC's Nutrient Management Planner Certification Program for individuals who prepare nutrient management plans. Planners prepare nutrient management plans to indicate how nutrients should be applied to fields and other land for crop production while protecting groundwater and surface water from excessive nutrient enrichment. Plans contain operating procedures based on expected crop type, existing nutrient levels in the soil, organic residuals, optimum timing and placement of nutrients, environmental resource protection, and agronomic practices such as liming, tillage and crop rotation. ANRC certifies the competence of individuals to prepare these plans, and determines information to be contained in nutrient management plans.

- **Nutrient Management Applicator Certification Program**
  These rules govern ANRC's Nutrient Management Applicator Certification Program for individuals who apply nutrients to land. ANRC certifies the competence of individuals to apply nutrients and provides training relating to nutrient application. The training must, at a minimum, meet the NRCS conservation practice standards for Arkansas. To maintain certification, nutrient planners must develop plans consistent with certified nutrient planner training. ANRC may issue distinct classifications of certification. Persons making nutrient application to Nutrient Surplus Areas (NSAs) on or after the effective date of Title 22, Rules Governing the Arkansas Soil Nutrient and Poultry Litter Application and Management Program, must become certified. Persons making nutrient application outside NSAs are not required to become certified.

- **Soil Nutrient and Poultry Litter Application and Management Program**
  This program encourages prudent practices regarding the application and management of soil nutrients and poultry litter to protect and enhance the state's surface water quality while allowing for optimum soil fertility and proper plant growth. The program's primary goal is to maintain the benefits derived from the wise use of poultry litter, commercial fertilizers, and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters within the state. To further this goal, the program provides requirements applicable to NSAs, nutrient management plans, and poultry litter management plans.

Wetland and Riparian Zones Tax Credit Program

This program, created by the Arkansas Private Wetland Riparian Zone Creation and Restoration Incentive Act of 1995, allows a credit against the tax

imposed by the Arkansas Income Tax Act for any taxpayer engaged in the development or restoration of wetlands and riparian zones. The program is designed to encourage private landowners to restore and enhance existing wetlands and riparian zones and, when possible, create new wetlands and riparian zones because the state continues to experience significant loss of wetlands and most lands suitable for wetlands are privately owned. This program benefits the landowners through tax credits and the state by increasing wetlands and riparian zones, which provide flood control, water quality enhancement, fish and wildlife habitat, recreation, and groundwater recharge.

Wetland Mitigation Bank Program

The Arkansas Wetland Mitigation Bank Program is a state-sponsored initiative to re-establish wetland hydrology and vegetation with compensatory funds from Section 404 permit recipients for impacts of approved wetland projects in selected areas that meet program criteria. Within these areas, site selection takes into consideration current and potential contributions to groundwater quality and other factors.

Ground Water Protection Program

ANRC is responsible for state level planning, management and protection of groundwater resources. This is accomplished through monitoring aquifer water levels and NPS-related water quality concerns, implementation of BMPs, conservation, enforcement of the proper construction of water wells and education. These goals are accomplished through a strong working relationship with the public and with other agencies. ANRC works closely with other state and federal agencies to monitor a water well network of more than 1,200 sites for water level and water quality information. Pursuant to the Arkansas Ground Water Protection and Management Act of 1991, ANRC produces an annual groundwater report on the condition of the state's groundwater resources, makes recommendations on critical areas, participates in the Arkansas Conservation Partnership and enforces Water Well Construction Commission rules and regulations.

Arkansas Water Plan

In 1969, the Arkansas General Assembly passed Act 217 making ANRC responsible for water planning at the state level and the development of the first Arkansas Water Plan. Since its completion and publication in 1975, the plan has served as a guide for efficient development of land and water resources. In 1985, the Arkansas General Assembly enacted Act 1051 directing ANRC to update the plan so it will remain a valid and reliable document addressing current issues. The most recent data and research provide the basis for meeting planning objectives and finding potential solutions. The Arkansas Water Plan, in accordance with Acts 217 of 1969 and 1051 of 1985, consists of 12 basin reports. Each basin report includes a land resource inventory (land use and soil resources), identifies quantity and quality problems for surface and groundwater and provides solutions and recommendations.

Arkansas Act 469 of 1989, A.C.A. 15-22-503(e)(1) provides that water development projects in Arkansas are implemented consistent with the Arkansas Water Plan. The statute states: "No political subdivision or agency of the state shall spend any state funds on or engage in any water development project…until a preliminary survey and report therefore which sets forth the purpose of the project, the benefits to be expected, the general nature of the works of improvement, the geographic area to be served by the project, the necessity, feasibility, and the estimated cost thereof is filed with the commission and is approved by the commission to be in compliance with the plan." ANRC provides the structure for which water plan compliance can be achieved.

Arkansas currently operates under the 2014 Arkansas Water Plan Update that became effective on Feb. 1, 2016.

Additional Financial Assistance Programs

The Arkansas General Assembly authorized ANRC to create seven financial assistance programs that use the state's bonding authority to assist local units of government to finance water-related facilities and projects including the:

- Water Development Fund
- Water, Sewer and Solid Waste Fund
- Water Resources Cost-share Revolving Fund
- Safe Drinking Water Revolving Fund
- Water, Waste Disposal and Pollution Abatement Facilities General Obligation Bond Program
- Water Plan Compliance
- Clean Water Revolving Loan Fund Program

Arkansas Department of Environmental Quality (ADEQ)

ADEQ's mission statement states its goal is to "protect, enhance, and restore the natural environment for the well-being of all Arkansans." A 13-member

commission provides oversight. The governor appoints seven of the members and six agencies are represented by their director or a designee. The agencies are the:

- Arkansas Department of Health (ADH)
- Arkansas Game and Fish Commission (AGFC)
- Arkansas Forestry Commission
- Arkansas Natural Resources Commission
- Arkansas Oil and Gas Commission (AOGC)
- Arkansas Geology Survey (AGS)

The governor appoints the ADEQ director who oversees five operating Offices. Two Offices are particularly related to the NPS Pollution Management Plan: the Office of Water Quality and Office of Land Resources-Mining Program and Land Resources Administration. ADEQ develops, monitors, and determines both long- and short-term impacts of land use management practices on water quality standards for surface and groundwater, and also develops waste load allocations. Among other responsibilities, ADEQ is charged with:

- Protecting, enhancing and restoring the natural environment for the well-being of all Arkansans;
- Maintaining a network of ambient water quality monitoring stations, roving monitoring sites and a program for biological monitoring;
- Producing special studies and mandated reports, including the 303(d) List of Impaired Waterbodies and the 305(b) Integrated Water Quality Monitoring and Assessment Report;
- Issuing permits under the National Pollution Discharge Elimination System (NPDES) including pretreatment, individual and stormwater permits for water discharge of any sort within the state of Arkansas;
- Issuing permits relating to "no-discharge" waste disposal systems (those that do not discharge directly in to waters of the state), and saltwater disposal systems including industrial septic tank systems and animal waste facilities such as hog farms and chicken operations with wet waste disposal systems;
- Managing the Underground Injection Control (UIC) Program;
- Issuing 401 Water Quality Certifications for any water project requiring a federal permit or license;
- Enforcing compliance with permits described above through district field office inspectors and supervisors including:
    - Conducting permit compliance evaluation inspections for NPDES facilities permitted for surface water discharges, primarily municipal wastewater treatment plants and industrial discharges for process wastewater and for subsurface or no discharge facilities, including industrial septic tank systems, animal waste facilities such as hog farms and chicken operations with wet waste disposal systems, and oil- and gas-related inspections that address deep well injection of brine from oil production;
    - Conducting stormwater inspections which address stormwater runoff from construction and industrial sites;
    - Investigating citizen complaints against municipalities, industries, other citizens, or agricultural facilities;
    - Responding to spills of materials from industries, transportations, and municipalities to assure protection of the environment;
    - Investigating fish kills related to environmental causes; and collecting routine water samples from a network of sampling stations to monitor ambient water quality of waters of Arkansas; and
- Regulating surface mining and reclamation, which includes two programs.
    - *Non-Coal Program:* Act 827 of 1991, as amended, deals with the reclamation of land affected by the mining of non-coal minerals such as bauxite, clay, sand, and gravel using open cut mining methods. An amendment to the law, passed in 1995, authorized the regulation of the practice of removing sand and gravel from the beds of streams within Arkansas. A 1999 amendment authorized the regulation of soil and shale pits with some exemptions based on the size of the pit and the distance from adjacent property lines. Regulation 15, the Arkansas Open Cut Mining and Land Reclamation, set performance standards that must be followed during mining and during the process of reclaiming land to a beneficial use. Act 1166 of 1997 provided a regulatory framework for the operation, reclamation and safe closure of new stone quarries and any land purchased or leased for a quarry.
    - *Coal Program:* Active coal mines must comply with Rule 20, the Arkansas Surface Coal Mining and Reclamation Code (ASCMRC). Active coal mining sites are inspected on a monthly basis for compliance.
- Providing technical, administrative and professional assistance to citizen groups and state and federal agencies.

Arkansas Forestry Commission (AFC)

AFC promotes forest resource health, conservation, and stewardship of forests. The governor appoints the nine-member AFC Board of Commissioners and also selects the state forester, who oversees day-to-day operations. The following is a partial list of AFC programs that relate to silvicultural NPS pollution management.

BMPs

AFC develops and maintains BMPs, a set of voluntary techniques and practices that forest managers can use to control nonpoint sources of pollution at a given site.

BMP Monitoring

AFC collects and analyzes survey data on the implementation of recommended forestry BMPs in Arkansas' nonpoint water source silvicultural program. AFC collaborates with forest industry associations and the University of Arkansas Division of Agriculture, Cooperative Extension Service to provide training and technical assistance to help loggers, landowners and forest managers implement recommended silvicultural BMPs to control nonpoint sources of pollution.

Pollution Abatement

Through a Memorandum of Understanding, ADEQ refers citizen complaints about pollution from silvicultural activities to AFC for investigation and voluntary resolution before taking enforcement action.

Forest Management Incentives

AFC helps landowners apply for federal cost-share assistance for improving management of their forestland, including the Environmental Quality Incentives Program (EQIP), the Conservation Reserve Program (CRP), and other related programs administered by NRCS and the Farm Service Agency (FSA).

The Forest Stewardship Program (FSP)

The stewardship program recognizes and rewards landowners who are managing their forestlands according to a multiple-use concept. Landowners have access to resource professionals who assist them in obtaining a written forest management plan addressing multiple-use management.

Forest Legacy Program (FLP)

The legacy program uses conservation easements and fee-simple acquisitions to protect environmentally important, privately owned forest areas that are threatened by conversion to non-forest uses.

Forest Inventory and Analysis

AFC, in cooperation with the USDA Forest Service Southern Research Station, is responsible for collecting scientific data from permanently established plots located all over the state. The plots, each representing 5,937 acres, are strategically located on a three-mile by three-mile grid. Natural resource managers use the data to make management decisions. The inventory plots have been generating data since they were established in the 1950s. The forest survey allows resource managers to monitor Arkansas' natural resource trends through time.

Urban and Community Forestry Program

AFC provides technical assistance and grants for urban forestry through a cooperative agreement with the USDA Forest Service. Communities, non-federal government agencies, educational institutions and 501(c)3 nonprofit organizations may apply for these competitive grants.

Arkansas Department of Health (ADH)

As it relates to NPS pollution, ADH protects the health of all Arkansas citizens by providing technical assistance, analytical services, training, regulation, and public education related to public and private water, waste disposal and other systems. The 22-member Board of Health provides policy oversight and is appointed by the governor. The governor also appoints the director of the Department of Health.

Public Water Systems Regulation and Enforcement

ADH regulates and provides oversight of public water systems throughout the state. This program consists of plan review of new water system facility construction, inspection of water system facilities, troubleshooting water treatment and distribution problems, investigating complaints and collecting and analyzing samples to determine water quality. ADH also performs related

functions such as review of new sewer system construction plans, inspection of proposed cemetery sites, and provision of water system operator training and certification. ADH promulgates rules to ensure public water systems adhere to EPA regulations.

Wellhead Protection (WHPP) Program

This program is a pollution prevention and management program used to protect underground sources of drinking water. The federal Safe Drinking Water Act (SDWA) Amendments of 1986 specified that certain program activities, such as delineation, contaminant source inventory, and source management, be incorporated into state Wellhead Protection Programs, which are approved by EPA prior to implementation.

Source Water Assessment Program (SWAP)

The Safe Drinking Water Act (SDWA) Amendments of 1996 required states to develop and implement Source Water Assessment Programs (SWAP) to analyze existing and potential threats to the quality of the public drinking water sources throughout the state. States were given considerable flexibility in the design of their programs. A state SWAP includes delineating the source water assessment areas, conducting contaminant source inventories, determining the susceptibility of each public water supply source to contamination from the inventoried sources and releasing the results of the assessments to the public.

Individual Sewage Disposal Systems

ADH approves and inspects individual disposal systems including alternate and experimental sewage system applications and subdivisions. ADH also issues annual licenses for septic tank manufacturers, installers and pumpers and provides training for professional staff and industry personnel as well as education materials for rural homeowners.

Subdivisions

ADH consults with developers on proper sewage disposal plans for proposed subdivisions, provides information on soil suitability determinations, which may determine lot size and the number of lots, and reviews plans for drinking water supply and sewage disposal.

Septic Tank Cleaning

Septic tank cleaners are required to pass a test and pay an annual fee for each vehicle in order to be licensed. ADH conducts an annual inspection of all pumping vehicles and monitors documentation of the legal sites where tank cleaners dispose of septage waste.

Outdoor Bathing Places and Swimming Beaches

ADH consults with the U.S. Army Corps of Engineers, the U.S. Forest Service, the Arkansas Department of Parks and Tourism and private individuals concerning the development and operation of swim beaches. ADH monitors bacteriological water quality throughout the swimming season. ADH administers regulations in compliance with EPA recommendations.

Environmental Complaints

ADH responds to environmental complaints involving vectors, marine sanitation, garbage, sewage and other basic sanitation regulations.

Arkansas Department of Transportation (ARDOT)

Through its Environmental Division, ARDOT provides multidisciplinary review and analysis of project development and operations to ensure compliance with environmental laws, regulations and policies. Federal environmental legislation includes the National Environmental Policy Act (NEPA), CWA, the Endangered Species Act, the National Historic Preservation Act and others. ARDOT is committed to environmental stewardship and mitigation of environmental and cultural impacts. The partial list of programs below describes how ARDOT participates directly and indirectly in the NPS Pollution Management Plan.

National Environmental Policy Act Project Review

The 1969 environmental legislation established procedures that all federal agencies are required to implement to make environmental consideration a necessary part of their decision-making processes including approval and construction of federally funded highway projects. To this end, ARDOT produces environmental documentation for all federally funded construction projects for the Federal Highway Administration's review and approval. Full disclosure of environmental issues includes scoping with resource agencies and a public engagement process that consists of early public involvement

meetings and public hearings. NPS-related activities routinely undertaken include geographic information systems analysis, wetland impact assessments and stormwater permitting. In addition, the Environmental Division monitors water quality and implements wetland mitigation property management strategies.

Stormwater Management

ARDOT has a statewide Small Municipal Separate Storm Sewer System (MS4) NPDES permit. The agency works under a Stormwater Management Plan that addresses minimum control measures including public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control and pollution prevention/good housekeeping. The Environmental Division provides training to ARDOT personnel on stormwater management and permit requirements. In February 2010, ARDOT instituted an erosion and sediment control training and certification course through the University of Arkansas Center for Training Transportation Professionals (CTTP) to train and certify construction and maintenance personnel. This certified training program has been offered to ARDOT contractors on a voluntary basis but will be required beginning in October 2018.

Resource Agency Permit Facilitation

ARDOT obtains all required environmental permits for state and federally funded highway projects including filing Notices of Intent, preparing permit applications and obtaining permits.

Highway Construction BMPs

ARDOT maintains an Erosion and Sediment Control manual of BMPs for construction stormwater management and provides training to its contractors and staff on BMPs. The CTTP training program is provided to ARDOT construction and maintenance personnel and will be required of ARDOT contractors beginning in October 2018.

Technology Transfer Program (T2)

This program is responsible for assisting cities and counties with obtaining information and training on transportation-related technology. While the program focuses on construction and maintenance, materials, administration and computer programs, cities and counties have also benefited from training on stormwater BMPs. The Arkansas Technology Transfer Program is a cooperative effort of ARDOT, the Federal Highway Administration's Local Technical Assistance Program (LTAP) and the University of Arkansas at Fayetteville.

Arkansas Game and Fish Commission (AGFC)

AGFC controls, manages, restores, conserves and regulates bird, fish, game and wildlife resources of the state, including acquiring and establishing hatcheries, sanctuaries, refuges, reservations and all property now owned or used for these purposes under the auspices of a seven-member commission appointed by the governor for seven-year terms. Some of the AGFC programs related directly and indirectly to the NPS Pollution Management Program are listed.

Water Development Projects

AGFC coordinates with federal, state, and other interests to protect fish and wildlife resources on private and public lands associated with federal water development activities including:

- reviewing and evaluating federally permitted projects such as Section 404 Permits (CWA) and Section 10 Permits (Rivers and Harbors Act) administered by the U. S. Army Corps of Engineers;
- identifying and recommending opportunities for fish and wildlife restoration and enhancement features associated with planning of federal and state water development projects; and
- coordinating with federal assistance programs (Section 1135, Section 206 and Section 22 programs) administered by the U. S. Army Corps of Engineers.

Stream Teams are voluntary groups of citizens interested in working on water conservation efforts sponsored by a coalition of agencies and private groups, including the AGFC, Keep Arkansas Beautiful, ADEQ, Audubon Arkansas, NRCS, the Arkansas Bass Association, ANRC, the Arkansas Cattlemen's Association, the Arkansas Department of Parks and Tourism, the Arkansas Chapter of the Sierra Club and approximately two dozen other agencies and groups. Stream Teams help control litter, work on streambank stabilization projects, improve fish habitat and monitor water quality. Approximately 500 Stream Teams are active in Arkansas.

Threatened and Endangered Species Conservation

In cooperation with U.S. Fish and Wildlife Service (USFWS), AGFC has developed and maintains conservation programs for resident federally listed threatened and endangered species.

Wildlife Conservation State Grants Program

AGFC offers competitive grants to public agencies, universities and nonprofit organizations to conserve non-game species of concern and their habitats including aquatic species and habitats.

Nature Centers

The Governor Mike Huckabee Delta Rivers Nature Center located in Pine Bluff opened in 2001, followed by the Forrest L. Wood Crowley's Ridge Nature Center in Jonesboro. The Janet Huckabee Arkansas River Valley Nature Center opened in Fort Smith in 2005. The final center, the Witt Stephens Jr. Central Arkansas Nature Center, is located in Little Rock and opened in 2008. A new nature center to be built in Springdale is expected to be completed in 2020. These nature centers offer an opportunity to expand water quality education for the general public; for example, the Pine Bluff center focuses on wetlands education.

Lakes and Wildlife Management Areas

AGFC manages more than 100 lakes and wildlife management areas spanning thousands of acres in Arkansas.

Arkansas State Plant Board (ASPB)

ASPB is primarily responsible for regulating pesticides and other agricultural chemicals used in Arkansas. ASPB has primacy under the federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the authority to regulate the proper labeling, distribution, storage, transportation, use, application and disposal of pesticides within the state. Some of the ASPB programs that directly or indirectly relate to the NPS Pollution Management Plan, particularly the agricultural statewide program, are listed.

Groundwater Monitoring and Protection

The goal of the Arkansas State Plant Board"s groundwater monitoring program is to prevent the state's groundwater from being polluted by agricultural chemicals and, if pollution is found, to respond appropriately. The Plant Board monitors groundwater in areas that may be considered vulnerable to agricultural pesticide contamination based on area use patterns and the concentration of agricultural production land in the vicinity. The Plant Board has been monitoring groundwater since 2004 using an EPA-approved Pesticide Management Plan, which allows the agency to work with the Arkansas Department of Health to determine actions to be taken in the event pesticide contamination is confirmed. The groundwater program is a voluntary program that offers quality lab testing of groundwater samples from agricultural wells to help ensure that producers and applicators are safely using pesticides in accordance with label directions to protect and preserve groundwater. The Plant Board's groundwater monitoring program targets both point source and nonpoint source contamination by investigating possible causes of contamination when a pesticide is detected in a groundwater sample. The best way to avoid groundwater contamination is to implement best management practices for pesticide use. This does not guarantee that contamination will not occur, but taking these steps is a preventative method to protect the groundwater resources of Arkansas.

Pesticide Registration

Before a pesticide can be sold in Arkansas, it must first be registered with ASPB in accordance with the Arkansas Pesticide Control Act and Regulations. This allows ASPB to confirm that the product meets all state and federal requirements to provide for both human and environmental protection. Each year ASPB registers approximately 10,000 pesticides for use in the state.

Dealer Licensing

Dealers who wish to sell or distribute pesticides designated by EPA as restricted use pesticides must first obtain a license from ASPB to do so in accordance with the Arkansas Pesticide Use Regulations. ASPB processes more than 400 dealer applications annually.

User and Applicator Training/Certification

Both users and applicators of restricted use pesticides must be trained in the proper handling of such pesticides and then licensed by ASPB in accordance with the Arkansas Pesticide Use and Application Act and Regulations. Those applicators who will apply pesticides commercially must also be tested before a license can be issued. Each year ASPB issues approximately 15,000 private applicator licenses, 900 commercial applicator licenses, 2,000 non-commercial applicator licenses, 500 commercial firm licenses (ground and air) and 250 custom applicator licenses.

Enforcement

ASPB is also responsible for taking enforcement action against persons and businesses who fail to comply with pesticide laws and regulations. Penalties can range from a warning letter to a monetary assessment of up to $1,000 and license revocation.

Worker Protection

The ASPB Pesticide Division is responsible for enforcement of the worker protection standard in Arkansas as it applies to the use of pesticides.

Arkansas Livestock and Poultry Commission (ALPC)

ALPC was created by Act 87 of 1963 and has authority for the control, suppression and eradication of livestock and poultry diseases and pests, and supervision of sanitation related to livestock and poultry production. In addition, ALPC is responsible for promoting development of Arkansas livestock and poultry industries and administering regulations pertaining to livestock and poultry production. With respect to the NPS Pollution Management Plan, ALPC is responsible for regulation of carcass disposal. ALPC regulates carcass disposal under two sets of regulations: Carcass Disposal – Poultry (Act 87 of 1963, Act 150 of 1985, Act 168 of 1985, and Act 20 of 1989) and Regulation for the Disposal of Large Animal Carcasses, Excluding Dogs and Cats (Act 87 of 1963 – Arkansas Code Annotated 2-33-101 and Act 150 of 1985 – Arkansas Code Annotated 19-6-448).

Arkansas Geological Survey (AGS)

Dating back to 1857, the AGS mission is to develop and provide knowledge of the geology and hydrogeology of the state, to stimulate orderly development, and to encourage effective management and utilization of the state's mineral, fossil-fuel and water resources, while protecting the environment. This is accomplished through services that include consultation on water well and septic tank inquiries and water well construction records. AGS has on file more than 152,800 water well construction records dating from the early 1970s filed by county and township/range.

Other services include geologic mapping on areas of the state where the State Mapping Advisory Committee determines need. AGS also provides topographic maps and interpretation as well as many publications. Mineral occurrences are developed to the benefit of the state and nation while keeping economic development to the benefit of Arkansas' citizens. Service is provided to mineral and fossil fuel companies through geologic interpretation of the state. Natural hazards are identified and noted where protection can be developed and instituted. Access to the Arkansas Geological Survey's information can be found on the agency website at geology.arkansas.gov.

Arkansas Oil and Gas Commission (AOGC)

AOGC's mission is the regulation of the Arkansas oil, gas and brine industries to prevent waste, encourage conservation and protect the correlative rights of mineral ownership associated with the production of oil, natural gas, brine and associated products. AOGC has issued more than 38,000 permits to drill oil, gas and brine wells since its creation in 1939. AOGC maintains well-specific permitting, drilling, plugging and abandonment, and production records for these wells. A nine-member commission appointed by the governor provides oversight.

Arkansas Department of Parks and Tourism (ADPT)

As indicated in its mission statement, ADPT is committed to enhancing the quality of life for all citizens by providing facilities and skilled leadership for the development and safeguarding of natural

resources. Conservation of valuable state resources through ADPT policy plays an indirect role in the management of NPS pollution in the following ways.

Arkansas State Parks

The planning and development (P&D) section of Arkansas State Parks designs and reviews designs of professional architectural/engineering consultants for renovations and new construction within the state park system. P&D also cooperates with regulatory agencies (i.e., ADEQ, ADH, the Arkansas Building Authority, the International Building Council and others) for compliance with environmental laws, rule, and regulations. Some of the regulations considered are the National Environmental Policy Act of 1969, the Clean Air Act, CWA, Executive Order 115114, Protection and Enhancement of Environmental Quality, Executive Order 11288 Concerning Prevention, Control and Abatement of Water Pollution, the Wild and Scenic Rivers Act of 1968, Executive Order 11990, Protection of Wetlands and the Fish and Wildlife Coordination Act.

SCORP

The Outdoor Recreation Grants section of ADPT prepares the Statewide Comprehensive Outdoor Recreation Plan (SCORP) that identifies outdoor recreation concerns and goals. ADPT seeks the input of all interested federal and state agencies when updating the SCORP. A section of the plan is dedicated to the conservation of natural and cultural resources. Special consideration is given to wetlands, consistent with the Emergency Wetlands Resources Act of 1986, Section 303. The Arkansas Multi-Agency Wetland Planning Team (MAWPT) has contributed valuable wetland information for publication in the SCORP. Applicants seeking grant monies to assist in the development of parks and trails address SCORP issues.

Grant Applications

Staff members of the Outdoor Recreation Grants Program (ORGP) administer grants for the development of local parks and trails. ORGP coordinates grant projects with the statewide clearing house by requiring Matching Grant Applicants to submit an environmental review with their applications. Any proposed park or trail development project near a lake, stream or other water resource must contact the AGFC's Stream Team for environmental examination before consideration for a grant award.

Environmental Review

Throughout the state, projects subject to environmental review are examined by ADPT for consideration and commentary. Projects impacting parks, streams and wetlands raise concern. Onsite visits are conducted when concerns warrant them. Comments and recommendations are sent to project applicants and the Arkansas Technical Review Committee.

University of Arkansas System Division of Agriculture

The University of Arkansas System Division of Agriculture consists of two units: the Cooperative Extension Service and the Agricultural Research Station. The Cooperative Extension Service develops research-based education and training programs and delivers programs through county faculty located in every county of the state. The Agricultural Research Station supports research, including highly applied demonstration projects with direct application to NPS pollution management.

Faculty members are located on five university campuses, seven research stations, five research and extension centers and 81 county extension offices around the state. Many faculty with joint Research and Extension responsibilities contribute to the NPS Pollution Management Plan. Working closely with ANRC and the Arkansas Conservation Partnership (ACP), the University of Arkansas System Division of Agriculture conducts applied research on new and innovative agricultural BMPs, provides soil testing services to the state's land users and works with state agencies in the development of effective policy for the management of agricultural NPS pollution.

Specific to the 2018-2023 NPS Management Plan Statewide Agricultural Program, the University of Arkansas System Division of Agriculture, Cooperative Extension Service is the primary agency for development and delivery of agricultural education and training programs, including NPS management. With respect to the NPS Management Plan, some of the University of Arkansas System Division of Agriculture, Cooperative Extension Service's education and training programs include:

- In-service training for multi-agency personnel;
- Program planning and leadership for community and natural resource leaders;

- Water quality awareness curriculum for school children;
- Training on BMPs, regulatory frameworks and the relationship between production/biological processes that impact water quality for agricultural producers;
- Farm*A*Syst, Urban*A*Syst and Home*A*Syst programs help agricultural producers as well as urban and rural dwellers identify and reduce sources of NPS pollution in their environments;
- Urban stormwater management education;
- Certification programs for pesticide applicators, nutrient applicators, etc.;
- Regulatory requirements and required training mandated in regulation (e.g., Regulation Five requires training for permitted liquid animal waste management systems);
- Sources of cost-share and other financial assistance;
- BMP training for landowner and logger education for private non-industrial forestlands; and
- Discovery Farm and Farm Production Verification Program Demonstrations as on-farm examples of BMP implementation and results.

Extension also maintains an extensive library of research-based fact sheets, applied research publications and BMP manuals and guidelines. Content of these educational materials is carefully coordinated with ANRC, NRCS AFC and other members of ACP.

The University of Arkansas System Division of Agriculture's Research Stations maintain research and demonstration farms in all the major agricultural areas of the state, where farmers learn about the most recent information available to them on production and environmental methods. Arkansas' NPS Pollution Management Program works with the University of Arkansas System Division of Agriculture to utilize these research and demonstration farms to evaluate the effectiveness of BMPs and to educate farmers and landowners about how BMPs can be beneficial in reducing the loss of sediment, nutrients and organic material from their farms.

In addition, faculty is involved in modeling watersheds, evaluating alternative products and markets to utilize poultry litter, designing streambank restoration projects, geomorphological assessment, evaluating technologies to improve stormwater management and other critical projects.

Arkansas Water Resources Center (AWRC)

AWRC, part of the University of Arkansas System, is one of 54 water research institutes in the United States established through the Water Resources Research Act of 1964. The AWRC's mission is to:

- Plan and conduct water resource research, cooperating closely with colleges, universities and other institutes in Arkansas to address the state's water and land-related problems;
- Promote the dissemination and application of research results;
- Provide for the training of scientists in water resources;
- Formulate a research program that is responsive to state water issues; and
- Work closely with state and federal agencies.

For more information about the water center – see http://arkansas-water-center.uark.edu/index.php.

AWRC has contributed substantially to Arkansas' water resources via research and educational outreach activities through established partnerships with federal, state and local entities. The AWRC also provides one of the primary mechanisms in the state for information transfer, including publishing technical reports, making available raw water-quality data on the web, archiving information in a digital library, maintaining an active social media presence and hosting an annual water research conference. Please see http://arkansas-water-center.uark.edu/publications/index.php.

The AWRC manages a federal grant program, which uses its funding through the U.S. Geological Survey (i.e., USGS 104 Base Program) to address water issues specific to Arkansas. The program funds university faculty, research and students, and the funded projects are selected in consultation with a technical advisory committee. This committee is composed of state and federal agencies, university faculty specializing in water resources, non-governmental organizations and municipalities. The committee is broad in nature and expertise to ensure that the funded research addresses Arkansas' needs.

The AWRC has trained a large pool of students who eventually move into the workforce that targets water resource concerns throughout Arkansas. These training efforts come in two forms; that is, direct internships with the water center and student-sponsored research through the USGS 104B Base Program. The center

helps students get experience in various aspects from communication to social sciences and even complex engineering design.

AWRC's Water Quality Lab provides analytical, field and technical support to the water quality community, which includes university researchers, state agencies, federal agencies and private groups or individuals. The Water Quality Lab is accredited for analysis of water samples by the Arkansas Department of Environmental Quality. The certification includes general physico-chemical parameters, nutrients, sediment, trace elements and bacteria – see http://arkansas-water-center.uark.edu/water-quality-lab.php. This lab is available for use by anyone in the state of Arkansas.

Through these collaborative partnerships, AWRC provides effective coordination between the university research community and watershed-based implementation projects by providing technical assistance that is delivered throughout the state, especially within priority watersheds.

Other Universities

Faculty at nearly every public and private university in Arkansas are involved in activities that directly and indirectly improve the results of the NPS Pollution Management Plan, including education and training of professionals, applied research, project design and management and public outreach. Universities that are represented on the NPS Management Plan Stakeholder Group include:

- Arkansas Tech University
- University of Arkansas at Monticello
- Arkansas State University
- University of Arkansas at Little Rock
- University of Central Arkansas
- University of Arkansas at Pine Bluff
- Southern Arkansas University

U.S. Department of Agriculture Natural Resources Conservation Service (NRCS)

NRCS helps landowners and communities conserve, maintain and improve the state's natural resources and environment. NRCS coordinates with its partners through the State Technical Committee. The State Technical Committee is composed of individuals who represent a variety of natural resource sciences and occupations, including soil, water, plants, wetlands and wildlife. NRCS employees provide information and technical assistance to private landowners and land users. In addition, NRCS provides financial assistance to landowners to implement conservation measures on agricultural lands and non-industrial private forestland through the following programs authorized in the Agricultural Act of 2014, also known as the 2014 Farm Bill, or via congressional appropriations.

Conservation Stewardship Program (CSP)

CSP is a voluntary program that provides financial and technical assistance to producers who maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resource concerns. The program provides financial and technical assistance to conserve and enhance soil, water, air, energy, plant and animal life and other conservation purposes on private agricultural and forest lands. Participants earn CSP payments for conservation performance; the higher the performance, the higher the payment. In fiscal year (FY) 2016, 719 new contracts were developed enrolling 679,889.9 acres. These contracts will provide more than $17 million in financial assistance to participants over the five-year contract agreements. Total CSP payments for existing contracts in Arkansas were more than $75.1 million.

Environmental Quality Incentives Program (EQIP)

EQIP is a voluntary program that provides financial and technical assistance to eligible agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and nonindustrial private forestland. EQIP may also help producers meet federal, state, tribal and local environmental regulations. Financial assistance payments through EQIP are made to eligible producers to implement approved conservation practices on eligible or to help producers develop Conservation Activity Plans to address specific land use issues. Historically underserved producers (limited resource farmers/ranchers, beginning farmers/ranchers, socially disadvantaged producers, Native American tribes and veteran farmers/ranchers) who self-certify that they meet the required criteria are eligible for a higher practice payment rate to support implementation of contracted conservation practices and activities. EQIP also includes the National Water Quality Initiative (NWQI). Through this initiative, NRCS offers financial and technical assistance to farmers, ranchers and forest

landowners interested in improving water quality and aquatic habitats in priority watersheds with impaired streams. Currently, the priority watersheds are Cousart Bayou-Little Cypress Bayou, Upper Deep Bayou and Lower Deep Bayou located in Jefferson and Lincoln counties. Through the NWQI Edge of Field Water Quality Monitoring funding, NRCS provides financial assistance to help install edge-of-field stations that monitor water quality as it leaves their fields, providing data to evaluate the success of various conservation efforts. In order to measure the water quality outcome of given conservation practices, NRCS works with partners like universities and nongovernmental organizations to monitor the amount of nutrients and sediment in water leaving two similar fields after rain or irrigation. NWQI Edge of Field Monitoring occurs on eligible agricultural land located in priority watersheds throughout the state.

Agricultural Conservation Easement Program (ACEP)

This voluntary program provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. ACEP includes the following two easement components: Wetlands Reserve Easements (WRE) and Agricultural Land Easements (ALE), which are described.

- **Wetlands Reserve Easements (WRE)**
  This program, formerly known as the Wetland Reserve Program (WRP), helps to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement that include the following enrollment options on eligible land: a permanent easement; a 30-year easement that expires after 30 years; and a term easement that are for the maximum duration allowed under applicable state laws. An additional enrollment option of a 30-year contract is only available to enroll acreage owned by Indian tribes. NRCS pays 100 percent of the easement value for the purchase of the easement and 75 to 100 percent of the restoration costs for permanent easements. For the other easement enrollment options, NRCS pays 50 to 70 percent of the easement value for the purchase of the easement and 50 to 75 percent of the restoration costs. Eligible land includes farmed or converted wetlands that can be successfully and cost-effectively restored. Arkansas is ranked third nationwide in enrolled WREs; there are 655 easements totaling 250,842 acres. In FY 2016, Arkansas enrolled 18 easements totaling 4,827.2 acres of wetlands for $11.4 million. In FY 2017, 27 easements have been selected for acquisition totaling 11,820 acres for $33.7 million.
- **Agricultural Land Easements (ALE)**
  This program, formerly known as the Grassland Reserve Program (GRP), protects long-term viability of the nation's food supply by preventing conversion of productive working lands to non-agricultural uses. NRCS provides financial assistance to eligible partners for purchasing ALEs that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland, and shrubland. Eligible partners include Indian tribes, state and local governments and nongovernmental organizations that have farmland or grassland protection programs. NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. NRCS may contribute up to 75 percent of the fair market values of the agricultural land easement for grasslands that NRCS has determined are of special environmental significance that will be protected.
- **Healthy Forests Reserve Program (HFRP)**
  This program helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Land enrolled in HFRP easements must promote the recovery of endangered or threatened species, improve plant and animal biodiversity, and enhance carbon sequestration.
- **Watershed Protection and Flood Prevention Program (PL 83-566)**
  The objective of this program is for NRCS to cooperate with state and local agencies to carry out works of improvement for soil conservation and other purposes, including flood prevention, conservation, development, rehabilitation of existing structures, utilization and disposal of water, and conservation and proper utilization of the land.

- **Emergency Watershed Protection (EWP)**
  This program, which is funded through congressional appropriations, is a recovery effort aimed at relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. All projects must have a project sponsor except for the purchase of floodplain easements (see next item). Through EWP, NRCS provides funding to project sponsors for work such as clearing debris from clogged waterways, restoring vegetation, and stabilizing river banks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. NRCS provides up to 75 percent of the construction cost of emergency measures; the funding is up to 90 percent within limited resource areas as identified by the US Census data. The remaining costs must come from local sources and can be provided by cash or in-kind services.

- **Emergency Watershed Protection-Floodplain Easement Program**
  This program, which is part of EWP, includes the purchase of floodplain easements. The goal of this program is to reduce the recurring cost of flood damage in areas prone to flooding while restoring or protecting fish and wildlife habitat, especially wetland habitat. The program accomplishes this by acquiring perpetual easements from interested landowners and, where necessary, restoring the hydrology and vegetation of the floodplain.

- **Mississippi River Basin Initiative (MRBI)**
  NRCS and partners work with producers and landowners to implement conservation practices that improve water quality, restore wetlands, enhance wildlife habitat and sustain agricultural profitability in the Mississippi River basin. This 13-state initiative builds on the cooperative work of NRCS and its conservation partners in the basin and offers agricultural producers in priority watersheds the opportunity for voluntary technical and financial assistance. Currently, there are 7 active MRBI projects including Willow Ditch and Podo Creek-Cache River, Middle Strawberry River, Tupelo Bayou-Beaverdam Creek, Upper Bayou Macon, Caney Creek, Strawberry River, and the Upper Cache River.

- **Regional Conservation Partnership Program (RCPP)**
  Through this program, NRCS and its partners help producers install and maintain conservation activities in selected project areas to increase the restoration and sustainable use of soil, water, wildlife and related natural resources on regional or watershed scales. NRCS provides assistance through partnership agreements and Farm Bill programs. Eligible partners include agricultural or silvicultural producer associations, farmer cooperatives or other groups of producers, state or local governments, Native American tribes, municipal water and irrigation districts, conservation-driven nongovernmental organizations, and institutions of higher education. Partners are responsible for contributing to the cost of the project, conducting outreach and education to eligible producers for potential participation in the project and for conducting an assessment of the project's effects. Eligible participants include eligible producers and landowners of agricultural land and non-industrial private forestland. Since 2015, Arkansas has entered into partnership agreements for ten RCPP project areas.

U.S. Department of Agriculture Farm Service Agency (FSA)

FSA is dedicated to achieving an economically and environmentally sound future for American agriculture. In the 1930s, Congress set up a unique system under which federal farm programs are administered locally. Farmers eligible to participate elect a three- to five-person county committee, which reviews county office operations and makes decisions on how to apply the programs. This grassroots approach gives farmers a say in how federal actions affect their communities and their individual operations. After more than 60 years, it remains a cornerstone of FSA's efforts to preserve and promote American agriculture. FSA administers four conservation programs authorized in the Agricultural Act of 2014, also known as the 2014 Farm Bill.

Conservation Reserve Program (CRP)

This is a voluntary program for agricultural landowners. Through CRP, producers can receive annual rental payments and cost-share assistance to establish long-term, resource-conserving land cover on eligible farmland. CRP is administered by the Commodity Credit Corporation (CCC) through FSA. Program support is provided by NRCS, the University of Arkansas Division of Agriculture Cooperative Extension Service, state forestry agencies, and local conservation districts.

Conservation Reserve Enhancement Program (CREP)

FSA and Arkansas launched a $10 million CREP program to improve water quality of the Bayou Meto watershed and wildlife habitat in five central Arkansas counties in 2001. Producers enrolled in CREP remove lands from agricultural production and plant native grasses, trees and other vegetation to improve water quality, soil and wildlife habitat under voluntary 10 to 15-year contracts. The Arkansas CREP is targeting 4,700 acres to establish tree buffers around streams and rivers in the Bayou Meto watershed.

Emergency Conservation Program (ECP)

This program provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters.

Emergency Forest Restoration Program (EFRP)

The Emergency Forest Restoration Program (EFRP) provides payments to eligible owners of nonindustrial private forest (NIPF) land in order to carry out emergency measures to restore land and trees damaged by a natural disaster. Available funding for EFRP is determined annually by Congress.

U.S. Department of Agriculture Forest Service (USFS)

The mission of USFS is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. In addition to managing national forests and grasslands, USFS is also among the largest forestry research organizations in the world, and provides technical and financial assistance to state and private forestry agencies.

The Ouachita National Forest covers 1.8 million acres in central Arkansas and southeastern Oklahoma. The Ouachita National Forest includes land in three priority watersheds for the 2018-2023 NPS Management Program, including the Poteau River watershed, the Upper Saline River watershed and the Lower Little watershed.

The Ozark-St. Francis National Forest is actually two distinct forests. The Ozark National Forest covers 1.2 million acres, mostly in the Ozark Mountains of northern Arkansas. This National Forest has land in the Lake Conway-Point Remove, the Beaver Reservoir, and the Illinois River watersheds, which are both 2018-2023 NPS Management Program priority watersheds. The St. Francis National Forest covers 22,600 acres in eastern Arkansas, one of the smallest and most diverse forests in the country. Some of the USFS programs are listed.

Forest Planning

Each forest in the National Forest System operates under a Forest Plan. The Revised Land and Resource Management Plan for the Ouachita National Forest was signed in September 2005. The current plan for the Ozark-St. Francis National Forests was signed in September 2005. These plans are typically updated every 10-15 years and include participation from a variety of local, state, and federal groups to encourage consistency.

Forest Service Research and Development (R&D

Scientists carry out basic and applied research to study biological, physical and social sciences related to diverse forests and rangelands. USFS research promotes ecologically sound management of national forest lands as well as private forest lands. Examples of relevant research products include:

- Forest inventory and analysis reports on status and trends in forest area and location. The program is managed in cooperation with state and private forestry and National Forest System.
- Fish and water research that enhances understanding of organisms, populations, ecosystems, and ecological processes that are essential for managing forests and rangelands to sustain water quality and biological diversity. This research is crucial to the agency's ability to comply with requirements of key environmental statutes, including CWA.
- Ozark-Ouachita Highlands Assessment of Aquatic Conditions provides an inter-disciplinary comparative assessment of 73 watersheds in portions of three states that make up the Ozark-Ouachita Highlands.

U.S. Geological Survey (USGS)

USGS is the principal federal agency for generating hydrologic information and appraising the nation's water resources. The water resources of Arkansas

consist of numerous streams, springs, lakes and aquifer systems. USGS collects stream flow, groundwater levels, and water quality data throughout the state. These hydrologic data and other data are used in research and hydrologic studies to describe the quantity, quality, and location of Arkansas' water resources. The collection, analysis, and interpretation of these data are done in cooperation with other federal, state, and local agencies, universities, and research centers. The USGS Little Rock and Fayetteville offices of the Lower Mississippi Gulf Water Science Center's website at www.usgs.gov/centers/lmg-water/ provides a wealth of data and links to research publications.

U.S. Fish and Wildlife Service (USFWS)

USFWS's mission is to conserve, protect and enhance fish and wildlife and their habitats through consultation, cooperation, and communication for the continuing benefit of the American people. In partnership with the state, USFWS provides a range of environmental services programs to protect endangered and threatened species, conserve habitat and reduce environmental contaminants. In cooperation with USFWS, AGFC has developed and maintains conservation programs for resident federally-listed threatened and endangered species.

Endangered Species Act (ESA)

This act requires all federal agencies to conserve threatened and endangered species. While managing federal lands or engaging in other federal business that could affect listed species, agencies must first consult with USFWS to ensure that their actions will not harm a listed species or damage or destroy its habitat. These actions include the issuing of federal permits, licenses granting approval to certain private activities, or federally funded actions. In the relatively few cases where USFWS determines a proposed action will harm a species, the agency suggests ways for landowners to modify their proposals to conserve listed species. USFWS also works with agencies to minimize potential harm to protected species, allowing projects to continue. Private landowners who develop and implement an approved habitat conservation plan providing for conservation of threatened or endangered species can receive an "incidental take permit" that allows the development project to go forward.

Habitat Conservation and Environmental Contaminants Programs

These programs are responsible for providing information and consultative services for the protection and conservation of fish and wildlife species and their habitats to a widely diverse audience including federal, state, and local governments, businesses and private individuals. Consultations include:

- Mapping of wetlands
- Habitat restoration and management
- Contaminant risk assessment, restoration, and remediation
- Public outreach and education

The programs provide USFWS with internal and external review to ensure compliance with a variety of federal environmental and resource laws.

Federal Permits and Projects

USFWS evaluates federally constructed, licensed or permitted water resource development projects and provides recommendations to reduce impacts to fish and wildlife resources. Under the provisions of the Fish and Wildlife Coordination Act, CWA, and other legislation, federal agencies permitting or constructing these projects must consult with USFWS during the planning of projects. USFWS provides technical support to the agencies in the planning process, providing fish and wildlife resources information and analyses while recommending measures to mitigate impacts.

National Wetlands Inventory (NWI)

The NWI prepares and distributes maps showing the location and types of wetlands found throughout the region. It also provides technical assistance in wetland delineation, wetland soils, wetland plants, wetland hydrology, wetland trends, and wetland values to individuals, other USFWS programs, and other federal and state agencies.

Partners for Fish and Wildlife Program

This program provides financial and technical assistance to restore, improve, and protect fish and wildlife habitat on private lands through partnerships with private landowners and other organizations while leaving the land in private ownership.

Land Management

USFWS manages 10 national wildlife refuges, three national fish hatcheries, two ecological service offices, a law enforcement office and a migratory bird field station in Arkansas.

U.S. Army Corps of Engineers (USACE)

The mission of USACE is to provide quality, responsive engineering services to the nation for planning, designing, building, and operating water resources and other civil works projects for navigation, flood control, environmental protection, and disaster response as well as providing engineering support for the armed forces and federal agencies. Its workforce includes biologists, engineers, geologists, hydrologists, natural resource managers and other professionals. Through its centers of expertise, USACE provides environmental consulting services to federal, state, local, and private entities. In granting or denying permits to developers, USACE strives to prevent environmental damage. Evaluating public interest, regulatory experts balance the need of economic development with environmental considerations. USACE forms numerous partnerships with other agencies, state and federal governments, environmental groups and private citizens to help solve ecological problems. The following are a few of USACE programs that relate to the NPS Pollution Management Plan.

Wetlands and Waterways Regulation and Permitting

Passage of CWA in 1972 greatly broadened this role by giving USACE authority over filling and dredging in the waters of the United States, including many wetlands. A major aspect of the regulatory program is determining which areas qualify for protection as wetlands. In reaching these decisions, USACE uses its 1987 Wetland Delineation Manual. Working toward a national goal of no net loss of wetlands, the Civil Works program is undertaking projects to restore existing wetlands or to create new ones.

Ecosystem Restoration

Since passage of the National Environmental Policy Act in 1969, environmental protection has been an important component of the civil works planning process. Legislation passed in 1990 established environmental protection as one of the primary missions of water resources projects along with navigation and flood control. Over the last 10 years, small ecosystem restoration projects have grown increasingly popular throughout the country. This new direction has allowed USACE to expand its traditional environmental activities and enhance or restore natural resources as part of USACE projects.

Environmental Stewardship

USACE carries out environmental and natural resource management programs through its projects, managing forest and wildlife habitat, monitoring water quality at its dams and operating fish hatcheries in cooperation with AGFC.

Nonprofit Organizations

Statewide, regional and local nonprofit organizations are key partners in the 2018-2023 NPS Pollution Management Plan. Examples of these organizations include, but are not limited to:

The Nature Conservancy (TNC)

The mission of TNC is to preserve the plants, animals and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. The Arkansas Chapter of TNC has field offices in Northwest and east Arkansas. This chapter has been actively providing assistance to the NPS Pollution Management Plan by providing training to local professionals in stream geomorphology assessment and restoration practices. The Nature Conservancy works collaboratively with state, federal, and local agencies to achieve its mission and is providing staff support for planning and implementation of NPS management assessments, Nine Element Plans and projects in the Upper Saline River, the Strawberry River, the Spring River, and other rivers. Priority rivers include the Strawberry River, the Kings River, the Mulberry River, the Little Red River, Spavinaw Creek, the Buffalo River, the Eleven Point River, and the Spring River.

Audubon Arkansas

Audubon's national mission is "to conserve and restore natural ecosystems, focusing on birds, other wildlife and their habitats for the benefit of humanity and the earth's biological diversity." Audubon Arkansas' vision is "to inspire and lead environmental education, resource management, habitat restoration, bird conservation, and enlightened advocacy."

Audubon Arkansas is providing staff leadership for planning and implementation of NPS pollution management programs in two watersheds – the West Fork of the White River in Northwest Arkansas and the Fourche River in and around Little Rock.

Watershed Organizations

Nonprofit watershed organizations exist in some watersheds. Those that exist are in different stages of development and maturation. New groups form even as existing groups cease to exist. The NPS Pollution Management Plan will support the development of effective and sustainable watershed groups where there is local leadership and potential for effective implementation of Nine Element Plans in priority watersheds. The following is a partial list of watershed groups. Groups working in priority watersheds are noted with an asterisk.

- Association for Beaver Lake Environment*
- Bayou Bartholomew Alliance*
- Beaver Watershed Alliance*
- Cache River Watershed Partnership*
- Alliance for an Improved Middle Fork*
- Friends of the North Fork and White River*
- Friends of Fourche Creek
- Kings River Watershed Partnership*
- L'Anguille River Watershed Coalition*
- Lake Conway-Point Remove Watershed Alliance*
- Lake Fayetteville Watershed Partnership*
- Leatherwood Creek Watershed Group
- Little Red River Action Team
- Lower Little River Watershed Coalition*
- Lower Mississippi River Conservation Committee
- Lower White River Watershed Group
- Ozarks Water Watch*
- Strawberry River Watershed Group*
- Save Our Spring River
- Upper White River Basin Foundation*
- West Fork of the White River Watershed*
- Illinois River Watershed Partnership*

Local Government and the Entities That Serve Them

Local government including municipalities, counties and conservation districts as well as the entities that serve them are key partners in the 2018-2023 NPS Pollution Management Plan. Examples of local government partners include, but are not limited to:

Municipalities and Counties

Phase I Municipal Stormwater Program and municipal NPDES permits cover and regulate municipalities with populations over 100,000 people, drainage systems interconnected with these municipalities' systems or municipalities determined to be significant contributors of pollutants. In Arkansas, Little Rock was the only "large" MS4 permitted under Phase I. Phase II of the Stormwater Program regulates municipalities with populations less than 100,000 people, including urbanized areas (typically areas with a population of 10,000 or greater and density greater than 1,000 people per square mile), cities and county areas designated by the state based on site-specific criteria, and various state and federal facilities (e.g., universities, state highway system, Pine Bluff Arsenal, etc). Municipalities work together to develop education programs, model ordinances, and obtain technical assistance through the Arkansas Municipal League. Counties work together in a similar fashion through membership in the Association of Arkansas Counties.

Regional Planning Commissions

Local government and other facilities required to obtain permits for municipal separate storm sewer systems (MS4) are finding it beneficial to work together in collaborative efforts in order to reduce the cost and increase the effectiveness of their education and outreach programs. Regional planning commissions, working in cooperation with the University of Arkansas System Division of Agriculture Cooperative Extension Service, are at the forefront of pulling together these innovative partnerships.

- **Northwest Arkansas Regional Planning Commission**
  This commission coordinates a regional education effort among the 19 small MS4s in Benton and Washington counties affected by EPA Phase II Stormwater regulations. By contracting with the University of Arkansas System Division of Agriculture Cooperative Extension Service to develop and conduct stormwater public education and involvement efforts, the Northwest Arkansas partnership benefits from a comprehensive, cost-effective outreach program that will improve water quality on a watershed-scale. Cooperating entities include, among others, the cities of Bentonville, Bethel Heights, Elkins, Elm Springs, Farmington, Fayetteville, Greenland, Johnson, Little Flock, Lowell, Springdale and Rogers along with Benton and Washington counties and the University of Arkansas.

- **Southeast Arkansas Regional Planning Commission**
  With initial leadership and coordination from the Southeast Arkansas Regional Planning Commission, the University of Arkansas Division of Agriculture Cooperative Extension Service has entered into an agreement with Pine Bluff, White Hall, the University of Arkansas at Pine Bluff and a portion of Jefferson County that have been identified as small municipal separate storm sewer systems (MS4s) under the EPA Phase II stormwater regulations. The University of Arkansas System Division of Agriculture, Cooperative Extension Service provides public education and outreach, encourages public involvement and participation and trains municipal employees in pollution prevention and good housekeeping.

Conservation Districts

Conservation districts are the front line for technical assistance to agricultural producers when it comes to implementation of BMPs on their farms. They are political subdivisions of the State of Arkansas, created by a popular vote of resident landowners for the purpose of conserving land and water resources as authorized by Act 197 of the Arkansas General Assembly of 1937; The act was the nation's first conservation district law. A five-person board of directors governs each district. ANRC appoints two directors while resident landowners elect three directors. Arkansas' 75 conservation districts establish natural resource priorities at the local level and provide support and input into how soil and water conservation programs are implemented at the local level, working cooperatively with landowners and federal and state government agencies. Conservation districts coordinate at the state level through membership in the Association of Arkansas Conservation Districts. Conservation district employees coordinate at the state level through involvement in the Arkansas Association of Conservation District Employees.

Other Entities That Serve Local Government

Municipalities and counties also rely on other organizations for education, information and technical assistance, including but not limited to:

- Planning and development districts
- Arkansas Municipal League
- Association of Arkansas Counties
- Association of Conservation Districts
- Association of Conservation District Employees

Membership Associations and Organizations

Industry associations and farm groups can be important partners in the 2018-2023 NPS Management Plan. These associations and organizations are in a unique position to pull together audiences of their members, help deliver education and training programs through their meetings, newsletters and websites; participate in the development of BMPs where appropriate; promote increased implementation of BMPs and assist in the monitoring of BMP implementation and evaluation of BMP effectiveness.

Examples of associations and organizations that have been involved in the NPS Management Plan development process include:

- Arkansas Farm Bureau
- Arkansas Poultry Federation
- Arkansas Environmental Federation
- Arkansas Homebuilders Association
- Arkansas General Contractors
- Arkansas Forestry Association
- Arkansas Pork Producers Association

Water Districts and Associations

Water districts and associations are also partners in implementing the 2018-2023 NPS Pollution Management Plan. Examples of their involvement include but are not limited to:

Arkansas Rural Water Association

The Arkansas Rural Water Association is working with a watershed organization in the Upper Saline Watershed to develop strategies to reduce sedimentation.

Beaver Water District

The water district provides, treats and sells drinking water to five municipal customers. The district has a director of environmental quality and a director of public affairs, who provides education and works with land users in the watersheds of Beaver Reservoir to improve water quality.

Central Arkansas Water (CAW)

The water district is a regional water supplier for 400,000 people in the central Arkansas region. The district has taken a comprehensive approach to protecting Lake Maumelle, one of its sources of drinking water. The utility adopted a comprehensive Watershed

Management Plan in 2007. The intent of the plan is to protect the lake from increased pollution that results from development and other land disturbances, provide for the equitable sharing of costs and benefits associated with the protection, and minimize land-use restrictions on long-time land owners surrounding the water source.

Fort Smith Water Utility

The utility is a regional water supplier for 200,000 people in western Arkansas and eastern Oklahoma. The utility has an extensive watershed monitoring program and partners with multiple entities to research water quality related topics. The utility's watershed management efforts are key components of assuring the effective and long-term protection of important drinking water sources. Watershed management activities include land purchases, resource management, watershed easements, water education programs and shoreline cleanup events for the protection of water quality in the Frog Bayou and Lee Creek watersheds.

Southwest Arkansas Water District

Southwest Arkansas Water District's mission is to provide up to 256 million gallons per day of high-quality raw water at reasonable prices to municipal, rural, agricultural, commercial and industrial customers in a five-county area (Little River, Miller, Hempstead, Lafayette and Columbia) from the lower Little River Basin through Millwood Lake.

Inter-Agency Cooperation

There are a number of inter-agency teams and work groups that bring together not only different agencies but also teams of scientists and practitioners from different disciplines.

Efforts will be made to develop effective working partnerships among these groups to gain efficiencies. For example, the Multi-Agency Wetland Planning Team (MAWPT) is in the process of posting critical wetlands data to the Internet and making it available to the public. Much of this geographically referenced data would also be useful to watershed groups.

The Comprehensive Wildlife Strategy Steering Committee is assessing habitat threats to non-game species of concern. There may be mutual benefit in sharing data. Coordination can be strengthened between the NRCS Technical Committee and the NPS Pollution Management Plan Stakeholder Group (e.g., meetings could be held back-to-back and agendas coordinated). Six examples of groups created to promote interagency cooperation are briefly described.

NPS Pollution Management Plan Stakeholder Group

The NPS Pollution Management Plan Stakeholder Group expands and builds on previous collaborative planning. Organized in July 2004, the group met four times in preparation of the 2011-2016 NPS Pollution Management Plan. Since that time, stakeholders have met annually to review progress, assess and discuss possible changes to the plan and identify ways to improve coordination of implementation activities within statewide programs and between priority watersheds and statewide programs. In preparing the 2018-2023 NPS Pollution Management Plan, additional email and phone communications between subsets of the group have been utilized to make revisions to the previous plan.

NRCS Technical Committee

NRCS coordinates with its partners through the State Technical Committee. The State Technical Committee is composed of individuals who represent a variety of natural resource sciences and occupations, including soil, water, plants, wetlands and wildlife. The State Technical Committee includes representatives of federal, state and local agencies as well as nonprofit organizations and others.

Arkansas Conservation Partnership (ACP)

A formal relationship known as the ACP was formed in 1992 between key local partners and state and federal agencies with a statewide focus. The ACP includes ANRC, the Arkansas Association of Conservation Districts (AACD), the Arkansas Association of Conservation District Employees (AACDE), NRCS, the University of Arkansas System Division of Agriculture Cooperative Extension Service, the University of Arkansas at Pine Bluff, AFC and the Arkansas Resource Conservation and Development Council, Inc.

The partnership is committed to locally-led conservation of natural resources by providing a unique combination of coordinated educational, financial and technical assistance to landowners. While each partner offers unique services, the partnership is committed to teamwork, consensus, joint decision-making and sharing of successes and failures. The partnership strives to break down interagency barriers, eliminate duplication of effort and improve communication so

that landowners are better served. Partners in the ACP also work closely with ADEQ, ARWC and other entities within the University of Arkansas System Division of Agriculture (e.g., the research station at Arkansas State University).

Multi-Agency Wetland Planning Team (MAWPT)

The Arkansas MAWPT is comprised of state agency representatives promoting wetland conservation through implementation of goals and objectives contained in the Arkansas Wetland Strategy. The Arkansas MAWPT, formed through the governor's office, has developed statewide and watershed-level strategies that encourage voluntary, incentive-based conservation initiatives and consistent planning efforts. The hydrogeomorphic classification and assessment of wetlands, Geographical Information Systems (GIS) watershed analyses, restoration and protection of unique wetlands and educational outreach are key components to successful conservation and management of the wetland resources of Arkansas.

Comprehensive Wildlife Strategy Steering Committee

An interagency, multidisciplinary team of professionals representing public agencies and private organizations are contributing to the development of a strategy for conserving Arkansas non-game wildlife. The interagency team will identify species of concern; identify the habitats where these species are located; assess habitat conditions; and identify management practices and financial assistance programs to protect those species and habitats, including aquatic life and habitats. Guidance for developing the strategy is provided by USFWS. This interagency team includes biologists, hydrologists, land use managers and others. Agencies represented include AGFC, USFS, USFWS, Arkansas Natural Heritage Commission (ANHC), Audubon Arkansas and TNC.

Stream Teams

These teams are made up of voluntary groups of citizens interested in working on water conservation efforts sponsored by a coalition of agencies and private groups, including AGFC, Keep Arkansas Beautiful, ADEQ, Audubon Arkansas, NRCS, the Arkansas Bass Association, ANRC, the Arkansas Cattlemen's Association, ADPT, the Arkansas Chapter of the Sierra Club and approximately two dozen other agencies and groups. Stream teams help control litter, work on streambank stabilization projects, improve fish habitat and monitor water quality. Approximately 500 stream teams are active in Arkansas.

Table 3.2: Cooperating Entities Contributing Directly or Indirectly to Statewide NPS Management Program

	Agriculture	Silviculture	Surface Erosion	Urban Run-off
State Agencies				
Arkansas Natural Resources Commission (ANRC)	×	×	×	×
Arkansas Department of Environmental Quality (ADEQ)	×		×	
Arkansas Forestry Commission (AFC)	×	×	×	×
Arkansas Department of Health	×	×	×	×
Arkansas Department of Transportation		×	×	×
Arkansas Game and Fish Commission (AGFC)	×	×	×	
Arkansas State Plant Board	×	×		
Arkansas Livestock Commission	×			×
Arkansas Geological Commission			×	
Arkansas Oil and Gas Commission			×	
Arkansas Department of Parks and Tourism	×	×	×	

Table 3.2: Cooperating Entities Contributing Directly or Indirectly to Statewide NPS Management Program (continued)

	Agriculture	Silviculture	Surface Erosion	Urban Run-off
Universities				
University of Arkansas System Division of Agriculture Research and Extension	×	×	×	×
University of Arkansas - Arkansas Water Resources Center	×	×	×	×
Other public and private universities (e.g., Arkansas Tech, UCA, Ouachita Baptist)	×	×	×	
Federal Agencies				
USDA Natural Resources Conservation Service (NRCS)	×	×	×	
USDA Farm Service Agency (FSA)	×	×	×	
USDA Forest Service	×	×	×	
U.S. Geological Survey (USGS)	×		×	
U.S. Fish and Wildlife Service (USFWS)	×	×	×	
U.S. Corps of Engineers			×	×
Local Governments and Entities That Serve Them				
Municipalities			×	×
Counties			×	×
Conservation Districts and related associations	×	×	×	×
Regional Planning Commissions			×	
Planning and Development Districts			×	×
Associations (e.g., Municipal League, Association of Counties)	×	×	×	×
Others (e.g., Arkansas Chapter, American Public Works Association)	×	×	×	
Organizations (IRS 501(c)(3) Tax Exempt Status)				
Statewide (e.g., The Nature Conservancy, Audubon Arkansas)	×	×	×	
Watershed groups	×	×	×	×
Resource Conservation and Development Councils (RC&D)	×	×	×	×
Membership Associations and Organizations				
Arkansas Farm Bureau	×	×	×	×
Arkansas Poultry Federation	×		×	×
Arkansas Environmental Federation			×	
Arkansas Homebuilders Association			×	
Arkansas General Contractors			×	×
Arkansas Forestry Association		×	×	
Arkansas Pork Producers Association	×		×	
Water Districts and Related Associations				
Water Districts	×	×	×	×
Arkansas Rural Water Association	×	×	×	×
Others (e.g., professional organizations)	×	×	×	×
Interagency Coordination Teams				
NPS Management Program Task Force	×	×	×	×
NRCS State Technical Committee	×	×	×	
Arkansas Conservation Partnership	×	×	×	×
ADEQ Watershed Outreach	×	×	×	×
Multiagency Wetlands Planning Team	×	×	×	
Comprehensive Wildlife Conservation Steering Committee	×	×	×	

Section
Four

Agriculture

2018-2023 NPS Management Plan
Statewide Programs

Introduction

Aggregate agriculture, including crop, animal, and forestry production and processing and industries supporting those sectors, is a major industry in Arkansas. Collectively, aggregate agriculture accounts for $20.1 billion of value added to the Arkansas economy in 2012 (English, Popp and Miller, 2014). There are 43,000 farm operations cultivating 13.7 million acres throughout the state (United States Department of Agriculture-National Agricultural Statistics Service, 2016). Arkansas farmers provide jobs and produce food and fiber for domestic and international markets. In addition, agricultural lands provide environmental benefits of value to wildlife and all citizens of the state.

Agricultural activities can also result in polluted runoff entering waterbodies. Potential nonpoint source pollutants include sediment, nutrients, oxygen-demanding organic matter and pesticides. Figures 4.1a-4.1c demonstrate the estimated distribution and concentration of poultry, row crop agriculture and cattle across the state.

Arkansas' most current List of Impaired Waterbodies, also known as the 303(d) List, identifies streams in which agriculture is identified as a source of pollution (Arkansas Department of Environmental Quality, 2016). Agriculture is one of five potential sources specifically identified on the 303(d) list. The list shows agriculture as a source of impairment for 96 stream segments. These specific segments are characterized as Category 5 Waters, which indicates the waterbody is impaired for one or more water quality standards.

Another 57 stream segments not meeting standards due to agricultural sources are characterized as Category 4a Waters. The Category 4a Waters label indicates water quality standards are not attained for one or more designated uses and a Total Maximum Daily Load (TMDL) calculation has been completed.

Water Quality Program Goals

In its 2016 List of Impaired Waterbodies, the Arkansas Department of Environmental Quality (ADEQ) identified waters of the state that are not fully supporting of designated uses and in which the major source of the pollutant causing the impairment to the use is agriculture (Arkansas Department of Environmental Quality, 2016).

Figure 4.1a
Estimated Distribution and Concentration of Poultry Production by Watershed

Source: Arkansas Natural Resources Commission, 2016

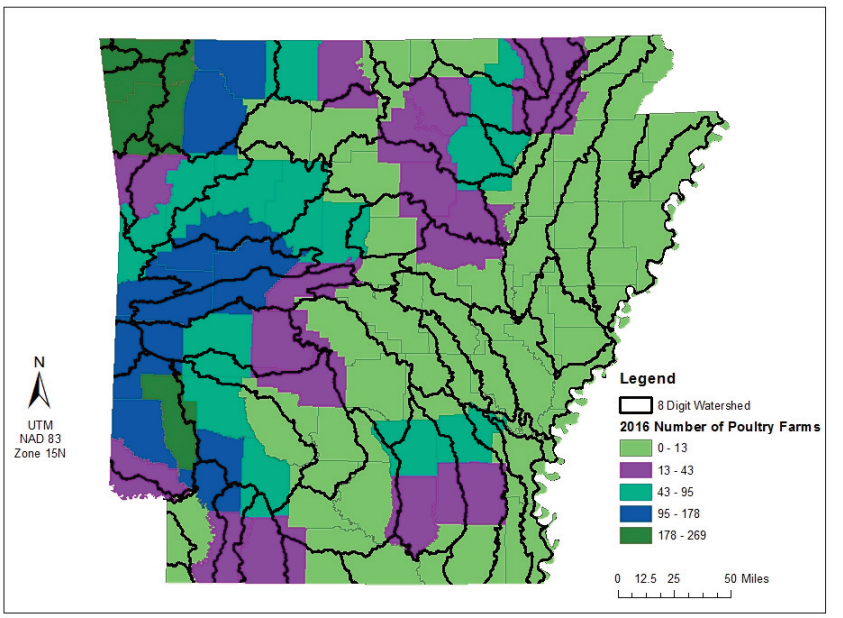


Figure 4.1b
Distribution of Row Crops, 2011

Source: 2011 National Land Cover
Data Source: Multi-Resolution Land Characteristics Consortium

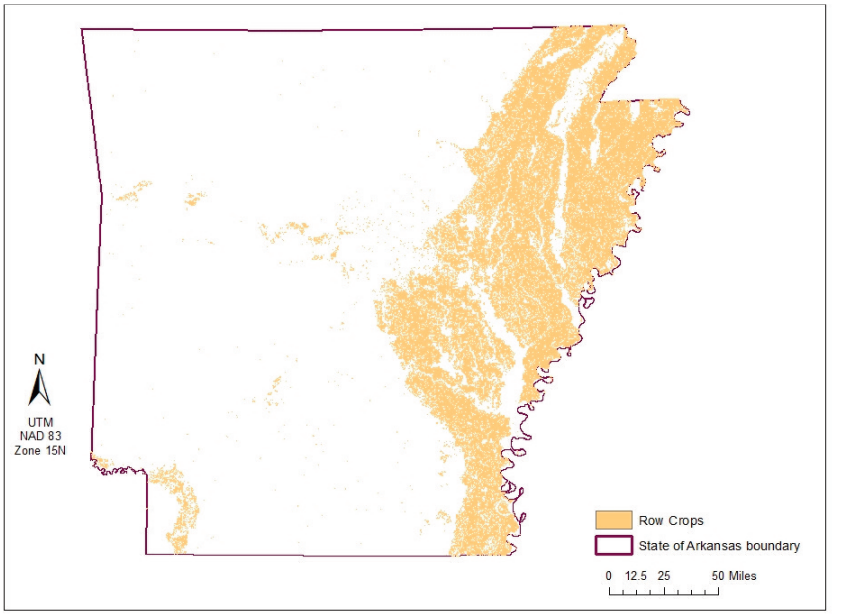
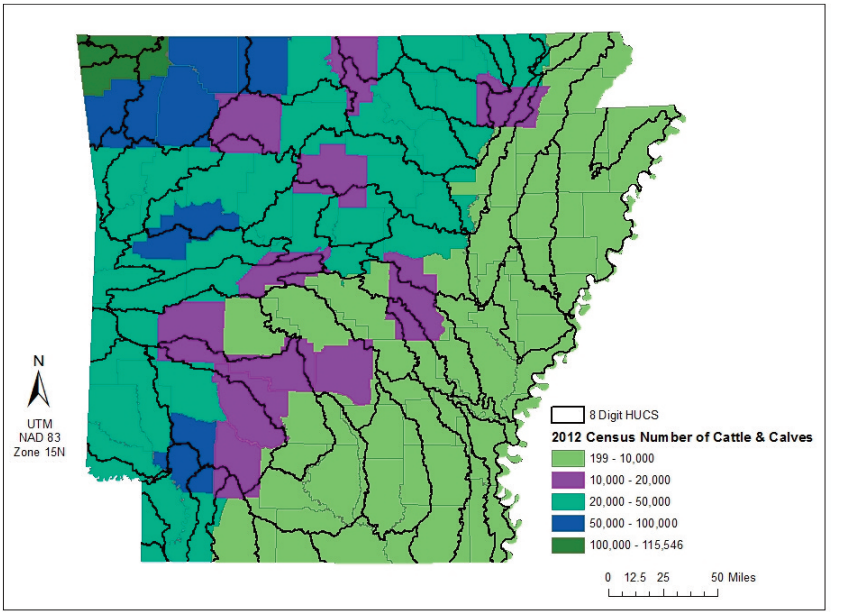


Figure 4.1c
Concentration of Cattle in Arkansas by Watershed, 2012

Source: National Agricultural Statistics Service (NASS), 2012
Data Source: National Agricultural Statistics Service (NASS), 2012



The ultimate long-term goal of the agriculture statewide program is for agriculture not to be identified as contributing to impairment of Arkansas waters. This can be achieved through targeted awareness, BMP training and implementation, monitoring and other voluntary programs.

More specifically, long-term goals that can be achieved within 15 to 20 years include:

- Managing animal wastes applications in floodplains.
- Managing aerial application of chemicals in floodplains, riparian areas and on-farm storage reservoirs.
- Agriculture will not contribute sediment, nutrients or other pollutants to streams in such amounts as to cause impairment of the waters of the state.
- Pesticides will not be found in the waters of the state in concentrations that cause impairment to the designated use of the waters. This can be continued through effective application of pesticide training and certification programs and continued development of BMPs for pesticide management.

- Pesticides, including herbicides and fungicides, will not be detected in groundwater in concentrations higher than those set by the EPA as MCLs and HALs.

Short-term measurable goals for the next five years include:

- Utilize U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) land management practices on highly erodible land.
- Have 90 percent of poultry and livestock growers operate within the conditions of a nutrient management plan (NMP) prepared by a certified nutrient planner.
- Establish a detectable trend toward reduced nutrient loading for selected streams within NSAs as a result of implementation of NMPs.
- Develop effective BMPs for management of identified chemical-resistant weeds or pests and the use of chemicals for control.
- Promote soil health and cover crops in animal and row crop agriculture.

Objectives

ANRC is the lead agency for implementation of the agriculture statewide program. The overall program strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in nonpoint source pollutant loads, it will be viewed as successful. If the cooperative process does not result in nonpoint source reductions and water quality improvements, state and local entities will investigate additional steps. These steps will be developed using an adaptive management approach described in the introduction to this section to ensure waterbodies meet their designated uses.

Specific ongoing objectives for Agriculture include:

4.1. Continue to encourage and provide technical assistance for the development of conservation plans, nutrient management plans and comprehensive nutrient management plans and implementation of BMPs through wide-ranging education and outreach programs. Continue to recruit and train more technical service providers in an effort to meet the demand for technical assistance and to develop conservation plans, nutrient management plans and comprehensive nutrient management plans.

4.2. Identify measures and analyze factors that influence behavior change to effectively target education and outreach programs as well as other incentives.

4.3. Develop tools that enable measurement of the combined effects of implementing multiple water quality BMPs in farming systems and assess their effectiveness at a watershed or sub-watershed level.

4.4. Utilize and potentially expand on the USDA assessment tool for use by agricultural producers for decision making on management systems related to water quality protection.

4.5. Identify additional sources of funding for projects that demonstrate systematic approaches that enable farmers to achieve multiple goals (e.g., conserve water supply and protect water quality while achieving profitability goals).

4.6. Improve the availability and access to information on land uses at the watershed and sub-watershed levels to better identify areas for potential implementation projects. While maintaining mandated confidentiality, make available information on the types, extent and distribution of land uses, BMPs in use, riparian buffers, and total acres enrolled in conservation programs.

4.7. Seek additional sources of funding to increase and improve the effectiveness of technical assistance for planning resource management and for the implementation of BMPs, with emphasis on NSAs.

4.8. Coordinate conservation planning to take full advantage of financial incentives, incentives or assistance programs from state, federal and private entities. Examples include riparian habitat improvement, Agricultural Conservation Easement Program's Wetlands Reserve Easement Program, Conservation Reserve Program (CRP), Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

4.9. Continue to focus on BMP implementation to improve conservation practices for erosion control, sediment retention, irrigation management, and nutrient management on agriculture lands and farm forests. As appropriate, direct technical assistance to landowners, giving emphasis to developing new conservation plans and riparian areas, especially those that connect, enhance or expand established riparian corridors.

4.10. Continue to provide and improve outreach, education and training promoting BMP implementation through the use of demonstrations, workshops, conferences, on-site visits and one-on-one consultations as appropriate and resources allow.

4.11. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved Section 319(h) implementation projects.

4.12. Work with major integrators and farm workers as well as landowners to encourage input from and cooperation with nutrient management planning and implementation.

4.13. Promote nutrient planning for farms that are below the threshold for classification as a Confined Animal Feeding Operation with dry manure.

4.14. Expand education for poultry producers with a special focus on the role that the producer plays in the big picture of NPS pollution management (e.g., the relationship between biological processes and agricultural production processes as they relate to water quality).

4.15. Provide educational and technical assistance to support full implementation of nutrient application rules promulgated by ANRC.

4.16. Continue to promote positive relationships between state and federal agencies and agricultural producers in order to cultivate open communication and an environment of trust.

Program Tracking and Evaluation

The agricultural nonpoint source management plan can be tracked and evaluated on three levels: short-term inputs, intermediate processes and long-term outcomes. Tracking and evaluation will be based upon program activities, behavioral change and delisting of streams from the ADEQ List of Impaired Waterbodies.

The first measure of the program is tracking program activities (e.g., what activities are implemented, how many farmers participated, how many fact sheets were developed, how many newspaper articles were published, how many dollars were expended to address a particular issue, etc.). These input measures track effort expended, which is a first and necessary step toward effecting change.

The second measure of the program focuses on whether program activities result in behavioral changes. To assist in identifying changes in behavior, BMP implementation data must be collected. Historically, data on BMP implementation has been compiled into Arkansas' NPS Pollution Management Annual Report published by ANRC. Congressionally-mandated confidentiality requirements can make it difficult to obtain the data needed to analyze and report BMP implementation. Strategies will need to be identified and developed in order to comply with these requirements while tracking and reporting BMP implementation.

The ultimate measure of the program is whether streams impacted by pollutants from agricultural sources are improved to the point that they can be removed from Arkansas' 303(d) List of Impaired Waterbodies. Sources of data for tracking interim water quality improvements are ADEQ's ambient monitoring network and synoptic surveys, United States Geological Survey (USGS) monitoring sites, Arkansas Water Resources Center (AWRC) dedicated monitoring sites, and research by the University of Arkansas and others. Ultimately, this data is compiled into the state's 305(b) report, which is published by ADEQ every other year.

Brief Summary of Institutional Context

The 2018-2023 NPS Pollution Management Plan will support voluntary efforts by wide-ranging partners. Partners include federal, state, and local agencies, which provide funding through cost-share assistance, expertise through technical assistance, and education through outreach programs to farmers as well as state regulatory agencies through administration of existing and proposed rules and regulations. Commodity groups, farm organizations, and nonprofit organizations also participate in the planning and targeting of this statewide agricultural program through participation in the NPS Pollution Management Plan Stakeholder Group and also through participation and support for local NPS implementation projects.

Key partners for implementation of this statewide agricultural program include local agencies such as conservation districts, University of Arkansas System Division of Agriculture faculty and local nonprofit organizations. These key local players provide a coordinated and organized process for disseminating outreach, education and technical assistance related to implementing BMPs to reduce erosion and manage pesticides and fertilizer use on agricultural lands. These partners reside in the watershed where farmers and landowners live. They have both the expertise and

experience that is crucial to give farmers sound advice and technical assistance related to land management decisions. The trust built over the past 50 years between these partners and landowners is the foundation that makes the implementation process work smoothly. They provide day-to-day advice on conservation tillage practices, pesticide and fertilizer management, record-keeping and animal waste management plans.

A formal relationship known as the Arkansas Conservation Partnership (ACP) has been formed among these key local partners and state and federal agencies with a statewide focus. The ACP includes ANRC, the Arkansas Association of Conservation Districts (AACD), AACD Employees (AACDE), NRCS, the University of Arkansas System Division of Agriculture Cooperative Extension Service, the University of Arkansas at Pine Bluff and the Arkansas Forestry Commission. The partnership is committed to locally-led conservation of natural resources by providing a unique combination of coordinated educational, financial and technical assistance to landowners. While each partner offers unique services, the partnership is committed to teamwork, consensus, joint decision-making and sharing of successes and failures. The partnership strives to break down interagency barriers, eliminate duplication of efforts and improve communication so that landowners are better served.

Partners in ACP also work closely with ADEQ, Arkansas Game and Fish Commission (AGFC), AWRC and other entities within the University of Arkansas System Division of Agriculture, such as the research station at Arkansas State University.

Some examples of conservation partnership programs are discussed below.

Arkansas Discovery Farm

The Arkansas Discovery Farm (ADF) program uses a unique approach based on agriculture producers, scientists, and natural resource managers working jointly to identify issues and potential solutions. It strives to collect economic and environmental data to better define sustainability issues and find solutions that promote agricultural profitability and natural resource protection. The University of Arkansas System Division of Agriculture provides leadership and expertise to ensure that data is collected in a scientifically rigorous and valid manner. The program is led by the ADF Stakeholder Committee. The committee consists of members of agricultural, nongovernmental and rural entities within Arkansas. It is supported by the Technical Advisory Committee, which is comprised of members of state and federal organizations and agencies involved with agriculture in Arkansas. More information about Discovery Farms can be found at http://discoveryfarms.uark.edu/index.htm.

The Discovery Farm program uses extensive state-of-the-art water quality monitoring systems equipment and protocol installed on real, working farms to document environmental and natural resource impact and to investigate solutions to reduce off-farm impacts. The overall goal of the program is to document sustainable and viable farming systems that remain cost-effective and environmentally sound. The following objectives are applied to each farm:

- Assess the need for and effectiveness of adopting appropriate Best Management Practices to reduce nutrient and sediment loss and conserve water for major agricultural systems.
- Provide on-farm verification of nutrient and sediment loss reductions and water conservation.
- Mitigate nutrient and sediment losses that may prevent state waters from attaining designated uses.
- Deliver outreach programs to producers in achieving production and environmental goals.
- Provide information in support of the Arkansas State Water Plan.

This program and its partnerships have the potential to affect millions of agricultural acres across the state. In 2016, the program consisted of 11 farms spread across the state targeting dominant farming systems (Figure 4.2). The following is a brief description of those locations.

1. **Elkins - Poultry-Beef Operation (Washington County)**
   This farm is a poultry and beef grazing operation in the Beaver Lake-Upper White River Watershed. There are 10 poultry houses, with 1,200 acres of pasture and about 1,000 acres of woodland. This effort focuses on monitoring nutrient runoff from four poultry houses that flow into a three-acre pond and from two poultry houses where runoff flows through a pasture into an ephemeral creek connected to the White River. Monitoring stations will quantify nutrient and sediment loadings captured by the pond and pasture before reaching the creek. The data will be used to determine quantities of nutrients and sediment that may be lost from around the

poultry houses and to quantify the nutrient and sediment trapping efficiencies of the pond and pasture.

2. **Wedington – Beef Operation (Washington County)**
   This farm is a beef rotational grazing operation in the Illinois River Watershed, where they are assessing the benefits of rotational grazing on soil health and the effect of reestablishing a riparian corridor along a stream on the farm to mitigate nutrient transport. Costs of BMP implementation will be estimated and evaluated in terms of economic feasibility and efficiency.

3. **Lincoln – Poultry Operation (Washington County)**
   This is a poultry farm that is increasing the number of poultry houses on the farm located in the Illinois River Watershed. The effort focuses on developing four new houses with a reduced environmental footprint compared to traditional house structure and operation. The program seeks to use a low nutrient footprint and install BMPs such as house gutters, retention pond, grassed waterways, larger concrete pads at the house entrance, and drains backfilled with by-product materials that will sorb large amounts of phosphorus. Monitoring and a cost analysis of each BMP will allow for a determination of the effectiveness of each practice, in term of dollars per pound of nutrient decrease.

4. **Gentry – Dairy Operation (Benton County)**
   This is a newly constructed dairy operation in the Lower Neosho Watershed on 240 acres, which also includes beef cows. On this farm, the focus is working with the farmer to establish legumes into the pastures in an attempt to decrease nitrogen fertilizer needs. The plan is to divide pastures into 11 paddocks and rotationally graze them. A grassed walkway will be established through the middle of the pastures to decrease the distance cows will have to walk to get to the milking parlor. There will be monitoring of soil nutrient status and soil health over a period of five years to determine the long-term benefits of rotational grazing on soil productivity. Additionally, there will be passive monitoring of nutrient flows in the leach field that treats liquid waste material from the milking parlor.

5. **Atkins – Corn-Soybean Row Crop Farm (Pope County)**
   This 940-acre row-crop farm is in the MRBI-focus watershed of Lake Conway-Point Remove. There are approximately 200 acres of wheat, 240 acres of rice, 200 acres of corn and 400 acres of soybean. This project focuses on assessing the benefits of a winter cover crop to nutrient and sediment runoff reduction. Monitoring focuses on runoff from three fields that have management ranging from cover crop, no cover crop, conservation tillage, and conventional tillage under a rotation of corn and soybean.

6. **Cherry Valley – Soybean-Rice Rotation (Cross County)**
   This farm consists of 2,700 acres of rice and soybean with conservation tillage. Situated near the L'Anguille River, this farm is in a Critical Groundwater Area. A 120-acre field was divided in half where irrigation water was applied to soybeans by furrow with poly pipe. Each irrigation system was designed by Pipe Planner software. Irrigation to the eastern half of the field utilized a surge valve to alternate between furrows to demonstrate the effect on runoff volume and nutrient losses.

7. **Stuttgart – Rice –Soybean-Corn Rotation (Arkansas County)**
   This 1,500-acre farm in the Bayou Meto Watershed has been in a Critical Groundwater Area for more than a decade. The farm no longer has active irrigation wells in the shallow alluvial aquifer. It does have one well in the deeper (> 600 ft) Sparta aquifer but pumping costs render it for emergency-use only. The entire farm is irrigated using an onsite reservoir, and all water draining from the leveled farm is captured via tail-water recovery systems and returned to the reservoir. This farm represents a unique opportunity to highlight reuse of water, an issue of national prominence across all sectors of society across the nation. The focus of this project is water conservation, harvesting and crop rotations to assess water use efficiency, while at the same time decreasing nutrient and sediment runoff.

8. **Dumas – Cotton-Soybean-Corn Row Crop Farm (Desha County)**
   This farm is a 1,500-acre row-crop operation in the Bayou Macon Watershed concentrating on cotton and corn. This project focuses on evaluating the benefits of conservation tillage on nutrient and sediment runoff.

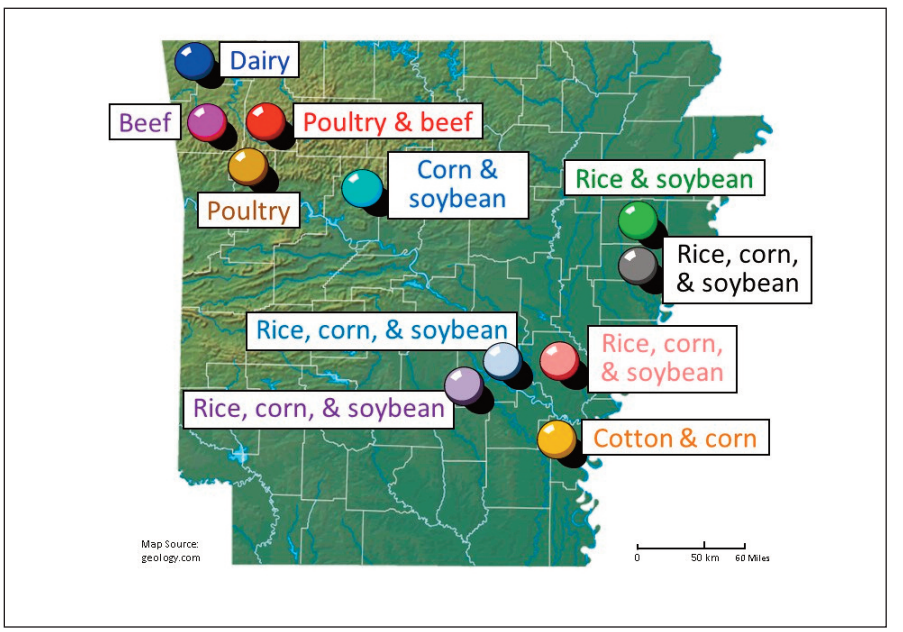
9. **Pine Bluff – Rice-Corn-Soybean With Cover Crop Rotation (Jefferson County)**
   This row crop operation with rice, corn and soybeans will be implementing cover crops in the rotation on the farm in the Bayou Bartholomew Watershed to see what effect cover crops have on water quality. Three subwatersheds are in the National Water Quality Initiative project area. Two water monitoring stations have been set up on opposite sides of the field where the water drains off the field. This will allow the water leaving the field to be collected and analyzed for sediment and nutrient concentrations. Approximately 40 acres of the field will be planted in cover crops. The rest will serve as a control by not having any cover crops planted.

10. **Pine Bluff – Rice-Corn-Soybean With Cover Crop Rotation (Jefferson County)**
    This row crop operation in the Bayou Bartholomew Watershed concentrates on rice, corn and soybean rotations with cover crops. The farm is located within the National Water Quality Initiative project area. A 12-acre field will be treated with cover crops and the 18-acre field across the road will be used as a control without cover crops. Both of these fields have water monitoring stations where the water drains off the fields. The results will be used to evaluate the effect that cover crops have on water quality.

11. **Forrest City – Rice-Corn-Soybean With Cover Crop Rotation (St. Francis County)**
    This row crop operation in the L'Anguille River Watershed concentrates on rice, corn and soybean rotation with cover crops. The leveled field is in the Mississippi River Basin Healthy Watersheds Initiative project area. Approximately 80 acres are being managed with cover crops planted on half of the field and no cover crops as a control on the other half. The field has two drainage pipes and associated sampling sites: one for each half of the field. This allows for a comparison of sediment and nutrient runoff between two sections, with and without cover crops.

Figure 4.2
Location of Arkansas Discovery Farms

Source: Dr. Michael Daniels, University of Arkansas System Division of Agriculture



The Mississippi River Basin Initiative (MRBI)

To improve the health of the Mississippi River Basin, including water quality and wildlife habitat, NRCS has launched the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through the MRBI program, NRCS provides assistance to producers in developing conservation plans to meet producer's objectives and implement a suite of practices that will reduce the impacts of nutrients and sediment leaving agricultural fields. Key conservation practices include nutrient management, conservation crop rotation and residue and tillage management. Farmers and landowners can use other conservation practices such as restoring wetlands, planting trees along streams to filter nutrients out of water draining off the farm, and water management. Financial assistance is also available to install edge-of-field monitoring systems in specific locations within the selected watersheds.

The initiative builds on the past efforts of producers, NRCS, partners, and other state and federal agencies in the 12-state initiative area, including Arkansas, to address nutrient loading in the Mississippi River Basin. Nutrient loading contributes to both local water quality problems and the hypoxic zone in the Gulf of Mexico. The MRBI will be implemented by NRCS through various programs.

In 2015, NRCS invested $10 million in 27 high-priority watersheds in Arkansas and 13 existing projects to improve water quality and strengthen agricultural operations. The investment is part of a $100 million commitment over four years to address water quality concerns, according to USDA NRCS.

Arkansas' active MRBI projects provide financial and technical assistance to agricultural producers for addressing water quality concerns. The projects include:

Bayou Meto

This program area includes Lower Crocked Creek, King Bayou-Bayou Meto, Upper Mill Bayou, King Bayou, Hurricane Bayou, Kaney Bayou-Bayou Meto, Middle Mill Bayou, Rodgers-Bayou Meto, Lower Mill Bayou, Bayou Meto Outlet and Bills Bayou. This project covers 238,106 acres in Arkansas, Jefferson and Lonoke counties. Goals are to improve water quality, reduce sediment and nutrient loads entering the watershed, enhance wetlands, improve fish and wildlife habitat benefits and improve the biological health of the streams. Water quality and water quantity will be enhanced through conservation practices in the project area to improve water quality and reduce ground water mining of the aquifer.

Bayou Meto Middle

This program area includes White Oak Branch-Bayou Two Prairie, Skinners Branch-Bayou Two Prairie, Upper Big Ditch-Bayou Meto, Bayou Two Prairie Outlet, Middle Big Ditch-Bayou Meto and Lower Big Ditch-Bayou Meto. Funding is available for landowners in portions of Arkansas, Jefferson, Lonoke and Prairie counties. The project area covers 249,349 acres. The goals of the project are to improve water quality by reducing nitrogen, phosphorous, and sediment levels in the watershed; enhance wetlands; improve fish and wildlife habitat benefits; and maintain agricultural productivity by utilizing a combination of conservation practices. Water quality and water quantity will be enhanced through conservation practices in the project area to improve water quality and reduce ground water mining of the aquifer.

Big Watershed

This project addresses water quality concerns in the Big Watershed that includes Coffee Creek, North Creek-Big Creek, Outlet Lick Creek, Hurricane Ditch, Beaver Bayou and Johnson Bayou Ditch-Big Creek. Funding is available for landowners in a portion of Phillips County. The project area covers 125,846 acres. The goals of the project are to improve water quality, reduce sediment and nutrient loads entering the Big Watershed, enhance wetlands, improve fish and wild-life habitat benefits, and maintain agricultural productivity by utilizing a combination of conservation practices.

Caney Creek Watershed

This program area involves Caney Creek-L'Anguille River Watershed in a portion of Cross County. The project area covers 22,231 acres. The project seeks to reduce soil loss in the watershed in a segment of the L'Anguille River, voluntarily implement conservations practices to reduce nutrient and sediment, and work with Arkansas State University to document improved soil organic matter through BMPs.

East Arkansas Enterprise Community Inc., L'Anguille River

The L'Anguille River has been designated as an impaired watershed by EPA due to excessive siltation and turbidity from agricultural sources. The project area covers 90,301 acres and funding is available for

landowners in portions of Cross and St. Francis counties. The voluntary program provides financial and technical assistance to agricultural producers for addressing water quality concerns in the L'Anguille River that includes Lick Creek, Big Tellico Creek, Spybuck Creek, Unnamed Creek and Coffee Creek.

Grand Prairie

Funding is available for landowners in portions of Arkansas, Lonoke, Prairie and Monroe counties. The project area covers 174,564 acres. The goals of the project are to improve water quality by reducing nitrogen, phosphorous, and sediment levels in the watershed; enhance wetlands; improve fish and wildlife habitat benefits; and maintain agricultural productivity by utilizing a combination of conservation practices. Water quality and water quantity will be enhanced through conservation practices in the project area to improve water quality and reduce ground water mining of the aquifer.

Lower Arkansas Upper Watershed

This program addresses water quality concerns in the Lower Arkansas (Upper) River Watersheds that includes Snow Brake-Upper Indian Bayou, Bakers Bayou-Upper Indian Bayou, Upper Indian Bayou, Caney Creek-Salt Bayou and Mile Branch-Salt Bayou. Funding is available for landowners in portions of Jefferson, Lonoke and Pulaski counties. The project area covers 131,522 acres. The goals of the project are to improve water quality by reducing nitrogen, phosphorous and sediment levels in the watershed by utilizing a combination of conservation practices; enhance wetlands; improve fish and wildlife habitat benefits; and maintain agricultural productivity. Water quality and water quantity will be enhanced through conservation practices in the project area to improve water quality and reduce ground water mining of the aquifer.

Middle Cache River Watershed

This program addresses water quality concerns in the Middle Cache River Watershed that includes Skillet Ditch-Overcup Ditch, Browns Creek-Overcup Ditch, Cyprus Creek-Overcup Ditch, Overcup Slough-Overcup Ditch and Town of Gourd-Overcup Ditch. Funding is available for landowners in portions of Craighead, Jackson, Poinsett and Woodruff counties. The project area covers 121,583 acres. The goals of the project are to improve water quality, reduce sediment and nutrient loads entering the watershed and the Cache River National Wildlife Refuge, enhance wetlands, improve fish and wildlife habitat benefits. Water quantity will be enhanced through conservation practices in the project area and reduce ground water mining of the aquifer.

Strawberry River Watershed

This program provides assistance in the Little Strawberry River and Philadelphia Creek-Piney Fork watersheds in portions of Fulton and Izard counties. The project area covers 43,821 acres. The project seeks to reduce sediment loss within the watersheds, increase public interest in water quality and soil health by conducting educational workshops and field days, and develop a demonstration farm to promote soil health practices that reduce soil erosion and sedimentation in the river.

Tyronza River Watershed

Funding is available for landowners in portions of Mississippi and Poinsett counties. The project area covers 228,611 acres. The goals of the project are to improve water quality, reduce sediment and nutrient loads entering the Tyronza watershed, enhance wetlands, and improve fish and wildlife habitat benefits. Water quantity and instream water quality will be enhanced through implementation of the approved conservation practices listed.

Upper Cache River Watershed

This program provides financial and technical assistance to agricultural producers for addressing water quality concerns in the Petersburg Ditch-Cache River watersheds in portions of Clay, Greene and Lawrence counties. The project covers 54,025 acres and seeks to reduce soil loss in the watershed, voluntarily implement conservation practices to reduce nutrient and sediment, and document water savings for basic irrigation water management practices.

Wapanocca Lake Watershed

The Wapanocca Lake Watershed includes Bell Hammer Slough and Ditch No. 9-Fifteen Mile Bayou. Funding is available for landowners in a portion of Crittenden County in the Wapanocca Lake Watershed. The project area covers 51,012 acres. The goals of the project are to improve water quality by reducing nitrogen, phosphorous and sediment loads entering the Wapanocca Lake Watershed. Water quality will be enhanced through conservation practices in the project area.

Conservation Reserve Enhancement Program (CREP)

This is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat and safeguard ground and surface water. Farmers and ranchers are paid an annual rental rate along with other federal and state incentives in exchange for removing environmentally sensitive land from production and establishing permanent "resource conserving" plant species, according to the program's website.

The program is a partnership among producers, tribal, state, and federal governments and, in some cases, private groups. CREP is a part of the country's largest private-lands environmental improvement program – the Conservation Reserve Program (CRP) – and is administered by USDA's Farm Service Agency.

CREP addresses high-priority conservation issues of both local and national significance, such as impacts to water supplies, loss of critical habitat for threatened and endangered wildlife species, soil erosion and reduced habitat for fish populations such as salmon. CREP is a community-based, results-oriented effort centered around local participation and leadership.

In 2017, Arkansas has CREP projects in the Bayou Meto, Cache River/Bayou DeView and Illinois River watersheds.

SPARROW Modeling

SPARROW is a watershed modeling technique developed by USGS for relating water-quality measurements made at a series of monitoring stations to attributes of the watersheds, such as contaminant sources and environmental factors that affect rates of delivery to streams and in-stream processing.

SPARROW stands for **SPA**tially **R**eferenced **R**egressions **O**n **W**atershed. As stated on the USGS website describing SPARROW, the core of the model consists of a nonlinear regression equation describing the non-conservative transport of contaminants from point and nonpoint (or "diffuse") sources on land to rivers and through the stream and river network.

USGS scientists developed SPARROW to do the following:

- Utilize monitoring data and watershed information to better explain the factors that affect water quality.
- Examine the statistical significance of contaminant sources, environmental factors and transport processes in explaining predicted contaminant loads.
- Provide a statistical basis for estimating stream loads in unmonitored locations.

The model builds on actual stream monitoring by using comprehensive geospatial data in a calibrated SPARROW model to predict water quality conditions at unmonitored stream locations. The geospatial data sets describe fertilizer and manure applications, atmospheric deposition to the land surface and urban sources.

There are several geospatial data sets used to develop explanatory variables in SPARROW models.

Contaminant Source Data Sets
Agriculture, National Agricultural Statistics Service, Permit Compliance System, Sewered Population, Atmospheric Deposition, National Resources Inventory, Census, Land area.

Contaminant Delivery Data Sets
SSURGO, State Soil Geographic or STATSCO, National Soil Survey, PRISM, National Climatic Data Center.

For more information about SPARROW and the parameters included in the model, visit https://water.usgs.gov/nawqa/sparrow.

Arkansas Soil Health Alliance

While the science and measurement of soil health will eventually emerge and advance, early-adopter farmers in Arkansas are not waiting on the science be fully developed before they implement conservation practices that promote soil health. In 2017, a group of early-adopter row-crop farmers approached the Arkansas Conservation Partnership about helping them form a Soil Health Network and to help them promote the benefits of soil health in addressing climate change and water resources. The Arkansas Association of Conservation Districts was able to obtain a State NRCS Conservation Innovation Grant to help organize a group of farmers into the Arkansas Soil Health Alliance.

The Alliance has elected a Board of Directors and officers, is developing bylaws and seeking nonprofit status. This network is farmer-led and is actively documenting and promoting the benefits of soil health practices and experiences so that it can lead other farmers to adopt and protect soil health. The AACD, ANRC, NRCS and the University of Arkansas Division

of Agriculture is supporting their effort with education, outreach and technical assistance. The alliance held their first annual field day on March 31, 2017, in Cotton Plant, Arkansas, which was attended by 180 farmers and consultants.

Partnering and Planning

At the federal level, the Water Quality Information Center is a USDA working group on water resources. It is composed of representatives from USDA agencies involved with various water issues. The group fosters communication and collaboration among USDA agencies and other organizations on water-related topics. Offices at the federal level communicate and work with state, regional and county offices to plan and implement water quality projects and programs throughout the United States. In Arkansas, USDA agencies, state agencies, educational institutions, private groups, organizations and foundations work together to implement water quality programs in the state.

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Section
Five

Silviculture

2018-2023 NPS Management Plan
Statewide Programs

Introduction

More than 56 percent of Arkansas' land area is forested, according to the Arkansas Forestry Commission (AFC). Private landowners, including farmers, ranchers and other individuals, own more than 69 percent of the forest land in the state and many actively manage their forest lands. National forests account for 13 percent of Arkansas' total forested acreage. Forest resource companies own or lease 12 percent of the state's forest land. The remaining 6 percent is classified as "other public" in the 2015 Forest Survey (Arkansas Forestry Commission, 2015).

Arkansas Department of Environmental Quality's (ADEQ) 2016 List of Impaired Waterbodies does not identify silviculture as a primary or secondary source of impairment for any Arkansas waterbodies. However, silviculture is included in Arkansas' Nonpoint Source Pollution Management Plan because forestry operations have the potential to degrade several water quality characteristics in waterbodies receiving drainage from forestlands when voluntary Best Management Practices (BMPs) are not followed.

Timber is a major resource harvested in the Gulf Coastal Ecoregion of southern Arkansas, according to ADEQ's 2016 305(b) report, but no large-scale impairments from silviculture activities have been identified in this region.

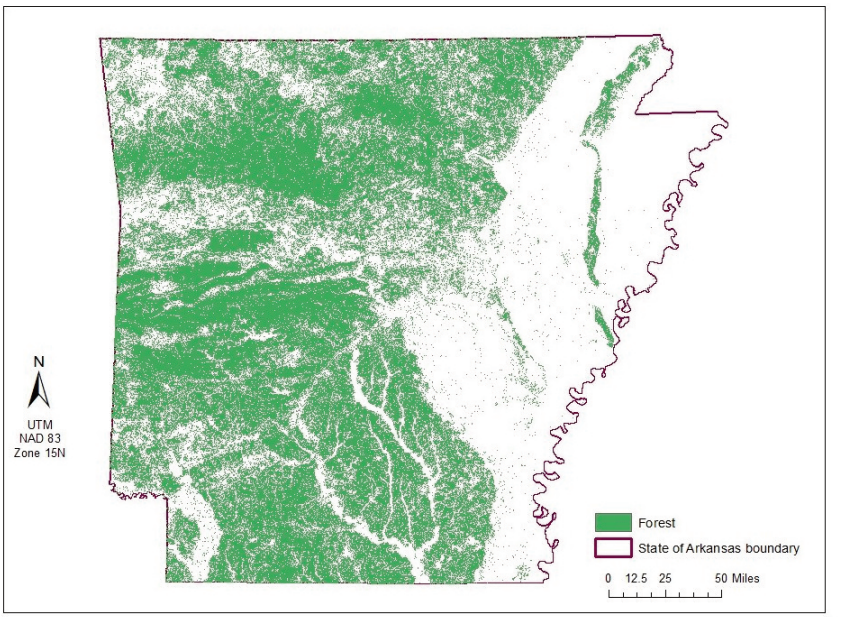
In the Ouachita Mountain Ecoregion, the predominant land use is silviculture, both in private timber companies and National Forest holdings. Concerns have been voiced by various groups and organizations regarding potential erosion and siltation as a result of management practices used in timber harvest. Periodic water quality monitoring data have not indicated significant impairments to the streams within this region. Occasional elevated turbidity values have been observed during periods of significant rainfall.

In the Boston Mountain Ecoregion, the dominant land use is silviculture and much of the region is located within the Ozark National Forest. One of the major concerns about potential water quality degradation is even-aged timber management. Current monitoring data from within this region continue to reflect high quality water. Periodic elevated levels of turbidity are noted in some waters in this region. One of the contributors of turbidity problems is secondary and tertiary road construction and maintenance.

Impacts to aquatic habitats, biota and water quality by silviculture in southeastern United States streams,

Figure 5.1
Distribution of Forestland in Arkansas, 2011

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



including Arkansas, have been itemized and described in an *American Fisheries Society* publication (Filipek, 1993).

The AFC, which is the lead agency for implementing silviculture programs in the state, offers guidelines for silvicultural Best Management Practices in the publication *Best Management Practices for Water Quality Protection* (Arkansas Forestry Commission, 2002).

Although the use of silvicultural BMPs is voluntary in Arkansas, AFC performs a biennial statewide assessment of the implementation of BMPs. Direct comparison between the latest survey and those done prior to 2005 is not possible because of changes in the monitoring instrument and protocol since BMP implementation surveys began in 1998. In 2002, a new survey instrument was adopted to conform to the updated BMP guidelines. Likewise, in 2005, aerial reconnaissance was adopted as the new method for identifying potential tracts to be included in the survey.

The most recent survey was published in 2011, with the statewide BMP implementation rate being 89 percent, 3 percentage points higher than the rate determined in the 2008 survey (Arkansas Forestry Commission, 2011). Private non-industrial forestlands averaged 83 percent, a significantly lower implementation rate than any other ownership group. Federal lands averaged 97 percent BMP implementation, while state lands scored 87 percent and industrial lands scored 95 percent. The 2011 survey grouped silviculture BMPs into four major categories:

- Harvesting (95 percent)
- Regeneration (95 percent)
- Roads (86 percent)
- Streamside Management Zones or SMZ (82 percent)

By physiographic region, the Delta scored 86 percent; the Ozark region scored 89 percent; the Ouachita region scored 90 percent, and the Southwest region or Gulf Costal Plain scored 86 percent for BMP implementation.

The 2011 Implementation Survey noted common deficiencies in BMP implementation, including

- Absence of an effective Streamside Management Zones
- Mechanical site preparation in ephemeral stream channels
- Lack of water bars on skid trails, fire lanes and inactive roads
- Inadequate stabilization of stream crossings (road and skid trail)
- Poor utilization of seeding and mulch to stabilize loose soil

Water Quality Program Goals

Arkansas' 2016 List of Impaired Waterbodies, also known as the 303(d) List, notes that the state does not fully support all designated uses (Arkansas Department of Environmental Quality, 2016). Siltation/turbidity of reservoirs and streams has been identified as the largest source of NPS pollution. While silviculture is not currently identified as a source of these pollutants in the waters of the state, activities associated with silviculture may contribute to sediment and other pollutant loads, particularly in small, high-quality headwater streams.

The ultimate goal of the silviculture statewide program is that through targeted awareness, BMP training, monitoring and other voluntary programs, silviculture will never be identified as contributing to impairment of the waters of the state.

The AFC is the lead agency for implementation of the silviculture statewide program. For silviculture, the overall strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in NPS pollutant loads, it will be viewed as successful.

Objectives

5.1. Continue to strengthen outreach and training programs in BMP implementation for landowners and loggers by:

- Developing additional mechanisms for delivering BMP implementation training targeted at private non-industrial landowners (e.g., educational workshops, expanded local partnerships in areas where there are high concentrations of private non-industrial landowners and increasing emphasis on woodland management in farm planning).
- Placing BMP outreach and training programs aimed at private non-industrial forestland owners in the broader economic context on the assumption that landowners will better manage a resource they value.

5.2. Continue to partner with the Arkansas Forestry Association and its Forest Practices Committee as well as the Arkansas Timber Producers Association to deliver and evaluate the effectiveness of BMP training to effect behavioral change as measured by BMP implementation, trainings and technologies.

5.3. Continue to promote incentives for landowners and/or loggers to increase voluntary BMP implementation. Review options to increase landowner incentives to adopt BMPs.

5.4. Continue to improve the quality of BMP implementation monitoring (e.g., increasing the sample size to improve the validity of subgroup results, identifying sites in riparian areas, and investigating alternatives to better identify the universe of harvest sites).

5.5. Continue assessing the effectiveness of silviculture BMPs to protect Arkansas water quality (e.g., reduce sedimentation), building on ongoing evaluation and recognizing that such assessment is a long-term, ongoing process. Consider conducting special assessments of high-quality headwater streams using synoptic surveys or other methods as resources allow.

5.6. Continue to review new research as it becomes available to re-evaluate AFC silviculture BMP guidelines, involving both scientists and stakeholders in the dialogue, and update BMP guidelines as appropriate.

5.7. The state will participate in and support regional forest conferences, workshops or outreach trainings when appropriate.

5.8. Provide or support specialized technical assistance, outreach, supplies and equipment when needed to address NPS issues related to silvicultural activities and deemed appropriate by AFC and ANRC. Request for "specialized" services or equipment will be evaluated by AFC and ANRC on a case-by-case basis.

5.9. During or after catastrophic events, appropriate assessment will be conducted as to how water quality has been affected. BMP implementation(s) will be prioritized when appropriate to maintain water quality.

Program Tracking and Evaluation

The statewide silviculture program can be tracked and evaluated on three levels.

Agencies and organizations involved in implementing objectives will track program activities (e.g., how many landowners, loggers, foresters or purchasers participated in education and training programs; how many fact sheets were developed; how many newspaper articles were published, etc.). These input measures track effort expended, which is a first and necessary step toward effecting change. As part of training programs, it is important to incorporate surveys and tests in workshops for forestry professionals and landowners to assess participants' efforts to prevent silviculture from contributing to the pollution of waterbodies.

The second level of program tracking and evaluation focuses on whether program activities result in behavioral changes (i.e., BMP implementation). AFC will continue to monitor BMP implementation and is taking steps to improve the effectiveness of its monitoring. Results are published in a biennial report available on the AFC website.

The final level of evaluation is to measure whether streams are removed from the 303(d) List of Impaired Waters. The state's 303d list needs to be continually reviewed, and trends of BMP implementation should be analyzed. The most current List of Impaired Waterbodies did not identify silviculture as a primary or secondary source contributing to impairment (Arkansas Department of Environmental Quality, 2016). The desired evaluation outcome is that silviculture will not be listed as a primary or secondary contributing source in future List of Impaired Waterbodies.

Brief Summary of Institutional Context

The Arkansas Forestry Commission is the lead agency for the implementation of the statewide silviculture program in the NPS Pollution Management Plan. The commission seeks to reduce sediment concentrations and loading in priority watersheds and statewide through proper and consistent voluntary implementation of silvicultural BMPs on private and public forest lands.

AFC began providing a BMP training and education program for non-industrial forestland owners in 1998-99, with training continuing. The Arkansas Timber Producers Association and the Best Management Practices Committee of the Arkansas Forestry Association launched a logger BMP education program in 1995. Training continues to be made available to logging contractor employees and procurement foresters through these organizations.

In 1996, AFC adopted a BMP implementation monitoring framework protocol as recommended by the BMP Monitoring Task Force for the Southern Group of State Foresters. Additional modifications to the survey were made in 2002 and 2005; in 2002 the survey instrument was amended to comply with updated AFC BMP guidelines, and in 2005, aerial reconnaissance became the method of selecting tracts for the survey. The AFC monitors and reports silviculture BMP implementation every two to three years.

AFC completed the first survey in May 1998. Additional surveys were completed in July 1999, 2001/02, 2004, 2005/06 and 2007/08. The most recent published survey was in 2011. The eighth survey began in October 2015 and is expected to be completed by September 2018. Survey results can be found on the AFC BMP Program website at http://www.aad.arkansas.gov/best-management-practices-water-quality.

Through a Memorandum of Understanding, ADEQ refers citizen complaints about pollution from silvicultural activities to AFC for investigation and voluntary resolution before taking enforcement action.

In addition, AFC assists landowners in obtaining financial assistance through several programs, including the Environmental Quality Incentives Program (EQIP), the Conservation Reserve Program (CRP) and the Wildlife Habitat Incentives Program (WHIP) for managing their forest land. The Forest Stewardship Program recognizes and rewards landowners who manage their forest lands for multiple uses and provides professionals to assist them in obtaining a written forest management plan. The Forest Legacy Program (FLP) uses conservation easements and fee-simple acquisitions to protect environmentally important privately owned forest lands that are threatened by conversion to non-forest uses.

AFC published its *Arkansas Forestry Best Management Practices for Water Quality Protection* in March 2002 after two years of reviewing the available research and discussion among wide-ranging stakeholders. The guide can be found at http://www.aad.arkansas.gov/Websites/aad/files/Content/5944986/BMPs.pdf.

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Section Six

Surface Erosion

2018-2023 NPS Management Plan
Statewide Programs

Introduction

Surface erosion is one of the categories for sources of pollution used by the Arkansas Department of Environmental Quality (ADEQ) to identify waterbodies that are not meeting water quality turbidity criteria. This category includes erosion from agriculture activities, construction activities, unpaved road surfaces and instream erosion mainly from unstable streambanks.

Surface erosion resulting from agricultural and silvicultural practices is addressed in Sections 4 and 5 of this update. This section addresses some issues associated with paved and unpaved roads including forestry roads; construction at sites that do not require a National Pollution Discharge Elimination System (NPDES) permit, such as construction sites of less than one acre and not part of a common plan; and hydromodification. Additional components may be added as the need arises.

Arkansas' 2016 List of Impaired Waterbodies, also known as the 303(d) list, identifies 28 stream segments totaling 458 miles and 2 waterbodies covering 4,410 acres that are impaired because of siltation/turbidity where surface erosion is identified as the source. There are 24 stream segments listed in Category 5 and 56 stream segment listed in Category 4a as not attaining the turbidity (silt) water quality criteria.

The source of the turbidity, in most cases, is identified as either surface erosion or agricultural activities. In addition, there are two lakes listed in Category 5 and one lake listed in Category 4a as not attaining the turbidity water quality criteria.

Category 5 streams are those that are not attaining one or more water quality standards. Category 4a streams are those that are not attaining one or more water quality standards and have a total maximum daily load established. Note that under the "Causes" descriptions on the List of Impaired Waterbodies, waters impaired by siltation/turbidity are designated by "Tb," and under the "Sources" description surface erosion is listed as "SE" or "AG" agriculture (Arkansas Department of Environmental Quality, 2016).

Sources of Surface Erosion

Paved and Unpaved Roads

Roads, highways and bridges are sources of significant contributions of pollutants to our nation's waters. Contaminants from vehicles and activities associated with road construction and maintenance are washed from roads and roadsides when it rains or snow melts. Because of this, road construction, road maintenance, recreational vehicle road and trail use and heavy equipment use of rural roads have been identified as potential threats to water quality.

The ADEQ 2016 List of Impaired Waterbodies does not indicate any stream segments or waters identified with road construction as the cause. However, there were several segments of waterways listed with turbidity as the cause or impairment with the source being unknown.

The local impact of sediment on water quality from timber harvesting and unregulated road construction can be significant when Best Management Practices (BMPs) are not followed, especially in smaller headwater streams. Gravel, dirt and other types of roads are considered to be the major source of erosion from forested lands, contributing up to 90 percent of the total sediment production from forestry operations, according to studies (Rothwell, 1983; Appelboom, et al., 2002).

These effects are of greatest concern where forestry activity occurs in high-quality watershed areas that provide municipal water supplies or support fisheries. Use of rural roads by heavy trucks involved in resource extraction take a toll on roadway integrity, resulting in significant potential for erosion and sediment impacts on receiving streams. Roads constructed and maintained without use of recommended BMPs, especially those with steep gradients, deep cut-and-fill sections, poor drainage, erodible soils and poorly or improperly constructed road-stream crossings, contribute to most of this sediment load with roads with stream crossings being the most direct source of erosion and sediment.

Improperly installed or undersized culverts increase energy in stormwater delivered to receiving

streams and may result in increased headcutting and streambank destabilization. This adds significant sediment loads, especially in flashy upland headwater stream circumstances.

Road construction and maintenance activities that are not required to follow or do not adequately follow appropriate design standards, BMPs or NPDES permitting requirements may cause a further substantial discharge of pollutants into waterbodies.

On Aug. 7, 2012, the Federal Highway Administration (FHWA) issued a memorandum to all states requiring them, beginning on June 15, 2014, to develop an inventory of all public roads (paved and unpaved) through a Linear Referencing System (LRS) (Federal Highway Administration, 2014). The FHWA aimed to stop the use of multiple sources and different formats of road data in an effort to create one nationwide LRS to serve assessment and planning needs. The responsibility to complete this requirement belongs to each state's Department of Transportation.

While Arkansas already had an LRS that covered the state highway system, the Arkansas LRS did not include all public roads (Arkansas Geographic Information System, 2017). In 2014, what was then called the Arkansas Highway and Transportation Department entered into an agreement with the Arkansas Geographic Information System (AGIS) Office to accomplish the FHWA requirement by combining the current 911 centerline file with the Arkansas state highway system LRS data. The end product will meet and exceed the FHWA requirement and serves as a resource for surface erosion assessment. This project is known as the All Road Network of Linear Referenced Data (ARNOLD). The ARNOLD project is well underway with a projected completion date for all counties in 2017.

The work to complete the data for each county started with communicating with local authorities about their current road network. This included explaining the requirement and detailing needed attributes such as dual carriageway (two centerlines for divided routes), a paved/unpaved attribute, ownership information (federal, state, county, city, levee, etc.) and road design (dual carriageway, ramp, frontage, traffic circle, etc.). From there, each county's road data was worked on individually by AGIS and what is now called the Arkansas Department of Transportation (ARDOT) to meet the requirements. The roads data is then delivered to the county so that everyone will be working from the same information. Once complete, the maintenance of each county's information for new roads or other changes will be communicated and completed similarly.

Paved Roads

Arkansas' highway system totals 16,418 miles (Arkansas Department of Transportation, 2015). Paved county and municipal roads are currently being inventoried through the ARNOLD project and affect large areas. The U.S. Environmental Protection Agency (EPA) stated that nonpoint source (NPS) pollution problems are increased in urban and suburban areas because paved surfaces cause runoff to occur at higher velocities and in greater quantities (U.S. Environmental Protection Agency, 2015). Paved roads and highways, bridges and other transportation infrastructure can be sources of heavy metals, oils, other toxins and debris. In addition, they alter hydrologic regimes by increasing the area of impervious surfaces and modified drainage structures. Finally, pesticides and fertilizers used along road rights-of-way can pollute surface waters through runoff, application drift or attachment to soil that is then blown into surface waters.

Table 6.1: Typical Pollutants Found in Runoff From Roads and Highways

	Pollutant	Source
Sedimentation	Particulates	Pavement wear, vehicles, not being maintained, atmosphere and maintenance activities
Nutrients	Nitrogen and phosphorus	Atmosphere, sediment adsorption and fertilizer application
Heavy Metals	Lead	Leaded gasoline from auto exhausts and tire wear, lead wheel weights
	Zinc	Tire wear, motor oil and grease, individual galvanized highway fixtures
	Iron	Auto body rust, steel highway structures such as bridges and guardrails, and moving engine parts

Table 6.1: Typical Pollutants Found in Runoff From Roads and Highways (continued)

	Pollutant	Source
Heavy Metals (cont.)	Copper	Metal plating, bearing and brushing wear, moving engine parts, brake lining wear, fungicides and insecticides
	Cadmium	Tire wear and insecticide application
	Chromium	Metal plating, moving engine parts and brake lining wear
	Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, bushing wear, brake lining wear and asphalt paving
	Manganese	Moving engine parts
	Cyanide	Anti-caking compounds used to keep de-icing salt granular
	Sodium, calcium and chloride	De-icing salts
	Sulphates	Roadway beds, fuel and de-icing salts
Hydrocarbons	Petroleum	Spills, leaks, antifreeze and hydraulic fluids and asphalt surface leachate

Source: U.S. Environmental Protection Agency, 1995

Unpaved Roads

The EPA defines unpaved roads as any road, equipment path or driveway that is not paved, and which is open to public access and owned or operated by any federal, state, county, municipal or other governmental or quasi-governmental agencies (U.S. Environmental Protection Agency, 1995). In Arkansas, approximately 85 percent of rural roads are unpaved (The Nature Conservancy, 2014). The main pollutant associated with unpaved roads is sediment. Sedimentation can originate from both maintenance activities and the lack thereof; however, BMPs, including water diversion and retention devices, can reduce the sediment load entering our streams, rivers and lakes.

The majority of unpaved roads in the state are managed by county judges, whose road foremen are responsible for implementation of maintenance activities. They are in a particularly critical position to positively affect water quality. Typical unpaved road maintenance involves using a road grader to smooth out the road, which makes for a smoother ride, but it also serves to disaggregate the road surface into unconsolidated material that has a higher potential to be carried into our waterways. The resultant sedimentation from this necessary maintenance can be limited by the inclusion of low-cost BMPs – broad-based dips, wing-ditches, proper culvert installation, sediment retention basins and other BMPs used to divert and retain runoff. Implementation of these practices ultimately improves water quality. Water velocity is the most critical factor when considering runoff on unpaved roads. Fast-moving water has the potential to scour surfaces and carry more sediment than relatively slower-moving water. Implementation of these BMPs generally serves to decrease water velocity, which allows sediment to fall out before it reaches our waterways. The Arkansas Forestry Commission's Best Management Practices for Water Quality Protection details these practices at www.aad.arkansas.gov /Websites/aad/files/Content/5944986/BMPs.pdf.

Stream crossings can also cause alterations to stream hydrology and habitat. In a study of the West Fork White River, unpaved roads accounted for an estimated 4,500 tons per year of sediment from a 124 square mile area, making it the second highest source of sediment after streambank erosion (Formica et al., 2004). This area has an average density of unpaved roads when compared to other parts of the state.

In early 2013, the Arkansas Association of Counties, The Nature Conservancy, various state agencies and many public and private partner organizations worked to establish the Arkansas Unpaved Roads Program. The program aimed to create an incentive-based unpaved roads management program to encourage the utilization of best management practices on rural, unpaved roads to reduce erosion, improve water quality and support county finances.

In 2015, the Arkansas Legislature created Act 898, the Arkansas Unpaved Roads Program Fund. The

program will use a public-private partnership arrangement to assist counties in funding unpaved road projects such as demonstrations, training, promotion and use of best management practices in construction and maintenance of roads that may directly impact lakes, rivers or streams. Public entities that own and maintain public roads in Arkansas that are open to public vehicle travel at least eight consecutive weeks a year are eligible to apply for grants. Starting in fiscal year 2017, counties are eligible for program funding after completing a training program and submitting an application.

Erosion can come from many sources on an unpaved road including, but not limited to, construction activity and routine maintenance of road surface, ditches, culverts and bank slopes. In addition, unpaved shoulders and informal conveyances such as skid trails, utilities easements, horse trails, all-terrain vehicle (ATV) trails and fire lanes can be sources of sediments. These surfaces may be very similar to unpaved roads, except they are often not planned in the traditional engineering sense and are, more than likely, immediately adjacent to the stream.

Hydromodification

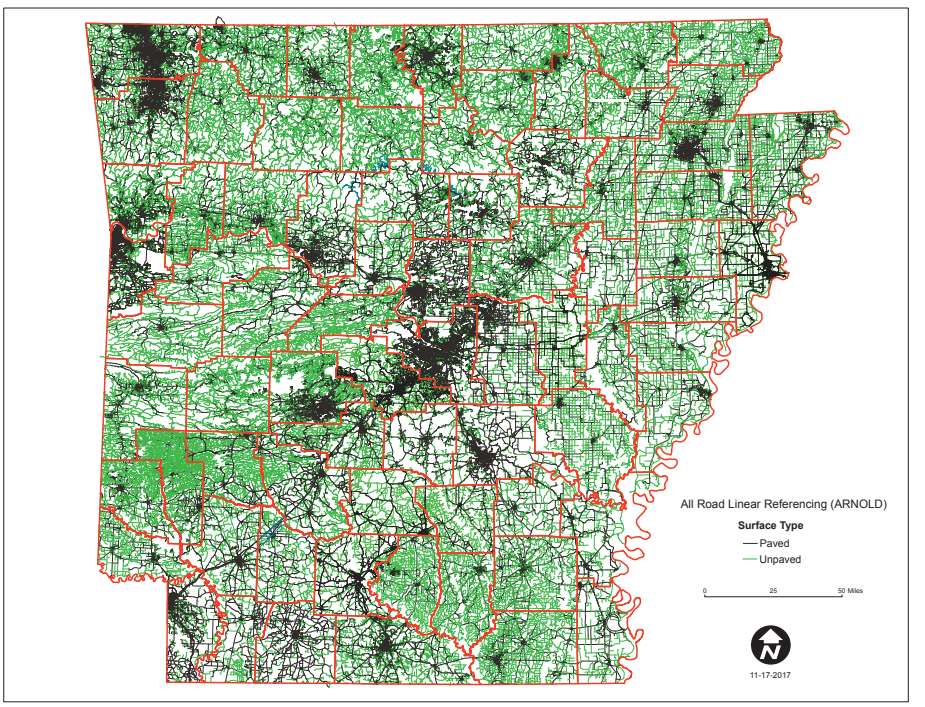
Instream erosion of streambanks or beds results from structures, activities and land uses that affect natural stream flow. These activities may be designed and planned or can be unintended, as a result of various land-use activities. Direct hydromodifications that affect stream flow include channel alterations, high-flow cutoff devices, instream construction, water withdrawal, dredging, instream mining, locks and dams, levees, spillways, bridges and culverts, impoundments and other water control structures. Indirect hydromodification is often associated with land use changes in a watershed, such as resource extraction, urbanization and some silvicultural practices. For example, conversion of mixed deciduous forests to pine through clear cutting and reseeding has the potential to decrease stream flow and groundwater recharge in the affected watershed due to higher evapotranspiration rates of pines (Swank and Douglass, 1974). Infilling of the floodplain for development and other purposes can alter the hydrology of a system dramatically as well.

Accelerated lateral erosion of streambanks from introduced river channel instability results in excessive amounts of sediment entering the system and loss of riparian zone vegetation. Additional nutrients can be contributed to the system when pasture lands are being eroded. Siltation/turbidity, typically associated with sedimentation, is the greatest cause of impairment to streams in Arkansas. This erosion, coupled with resource extraction such as gravel mining, disturbs the natural flows and increases turbidity levels causing greater impairment.

Accelerated streambank erosion is symptomatic of river or stream channel instability. The cause of stream

Figure 6.1
Unpaved Roads in Arkansas

Source: Arkansas Department of Transportation, 2017



instability is complex and can result from the cumulative effect of direct and indirect hydromodifications over a period of time. Causes include:

- Change in the flow regime due to an overall change in infiltration rates and increase in surface runoff from forest conversion to pasture; construction of roads (includes filling in headwater streams with fill material); and creation of urban environments (includes paving, filling in headwater streams and wetlands, forest removal, building construction).
- Changes in channel pattern and profile from resource extraction and/or straightening of stream.
- Increases of sediment load from other sources of sediment in the watershed, such as unpaved roads, ditches, gullies, construction sites and fill disposal sites.
- Cross channel obstruction.
- Grazing practices that impact riparian areas and indiscriminate cattle stream access.

Resource extraction of gravel from within the bankfull channel and floodplains of streams can also contribute to stream instability and turbidity. The separation of fines from the gravel aggregate as well as sedimentation from destabilized streambanks may result in limiting fish passage along stream segments and aquatic ecological degradation.

Routine dredging, a direct hydromodification, by the U.S. Army Corps of Engineers (USACE) is performed at a number of sites within Arkansas for the purpose of flood control and navigation. The number and duration of high flow periods, the intended use of the dredged waterway and other factors determine dredging frequency. Dredging typically increases turbidity in the waterbody by disturbing bottom sediments. Resuspended sediments, other accumulated materials, benthic sediments often results in the organic material being suspended within the water column, potentially adding to the oxygen depletion of the river or stream. Dredging spoils may reenter the stream if not properly placed or removed from the stream or ditch banks. Floodgate pulsing and flow regime changes associated with hydroelectric power generation are also a source of hydrologic modification.

Changing channel configurations has the potential to introduce streambank instability. Channel modifications occur through various methods such as:

- Clearing and snagging
- Physical modification
- New channel excavation

These practices are used as a way to initially improve the hydraulic conveyance of the stream. Unless sediment conveyance of the stream also is accounted for, the same practices may result in unstable channels and increased surface erosion.

Hydraulic modification that is designed and planned can introduce potential problems to fluvial systems. However, it is often the case that unpermitted facilities, or facilities not following their permit, create greater disturbances than those designed and planned. The types of water quality problems associated with these activities include disturbances to vegetation and soil during construction, channel scour due to increased water velocities and increased water temperature if overhanging riparian vegetation is removed.

Construction

Construction is an important economic activity in Arkansas. The U.S. Department of Commerce's Bureau of Economic Analysis estimated that 2014 Gross Domestic Product in the state's construction industry totaled $4.2 billion (Bureau of Economic Analysis, 2017). Major construction activities include the development of residential, commercial and industrial facilities as well as highways, streets and other infrastructure. Construction sites greater than one acre, including smaller sites that are part of a larger common plan of development that disturbs more than one acre, are regulated through ADEQ's NPDES stormwater program.

Beginning in 2008, ADEQ included new buffer zone requirements in its Stormwater Construction General Permit. The following is an excerpt of the language as it appears in the ADEQ document:

"A natural buffer zone as stated below shall be maintained at all times. Exceptions from this requirement for areas, such as water crossings, limited water access, and restoration of the buffer are allowed if the permittee fully documents in the SWPPP [Stormwater Pollution Prevention Plan] the circumstances and reasons for the buffer zone encroachment. Additionally, this requirement is not intended to interfere with any other ordinance, rule or regulation, statute or other provision of law.

A. For construction projects where clearing and grading activities will occur, the SWPPP must

provide at least twenty-five (25) feet of natural buffer zone, as measured horizontally from the top of the bank to the disturbed area, from any named or unnamed streams, creeks, rivers, lakes or other waterbodies. The 25-foot buffer zone needs to be vegetated and/or capable of reducing and filtering sediment laden flows.

B. The Department may also require up to fifty (50) feet of buffer zone, as measured from the top of the bank to the disturbed area, from established TMDL waterbodies, streams listed on the 303(d)-list, an Extraordinary Resource Water (ERW), Ecologically Sensitive Waterbody (ESW), Natural and Scenic Waterway (NSW), or any other uses at the discretion of the Director
C. Linear projects will be evaluated individually by the Department to determine natural buffer zone setbacks."

Construction sites can generate NPS pollution that threatens water quality if proper BMPs are not used. Pollutants associated with construction activities are so localized, compared to agricultural or forest production, that it is often difficult to correlate construction activity with water quality for a watershed. At a more local level, however, the amount of pollutant loading that can be delivered to a waterbody from a single construction site can be significant and clearly measured. Therefore, this program component will focus on developing and delivering education on BMPs and installation and maintenance at construction sites of all sizes. Its aim is reducing the amount of NPS pollution leaving construction sites, thereby reducing the pollutants that could potentially enter the waters of the state.

Water Quality Program Goals

ADEQ uses assessment criteria to determine "designated use impairment" from long-term, frequent exceedance of the water quality standards that may be linked to discernible and correctable sources (Arkansas Department of Environmental Quality, 2008). Siltation/turbidity of reservoirs and streams has been identified as the largest cause of NPS pollution. ADEQ has identified surface erosion as a source of siltation or turbidity.

The ultimate goal is to reduce surface erosion and sedimentation from rural roads, recreational trails, construction activities not covered by NPDES permits, land use activities and instream erosion or hydromodification through public awareness, education, training and other voluntary programs. Successful implementation will help maintain or improve water quality and the possibility of waters being impaired due to sediment.

Road construction and maintenance are not listed as specific sources of NPS pollution in the state's List of Impaired Waterbodies, but activities associated with these activities may contribute to sediment and other pollutants entering waterways.

Runoff controls are essential to preventing polluted runoff from reaching surface waters. Construction and maintenance project activities that do not install or adhere to proper BMPs, erosion control during and after construction of roads, highways and bridges can contribute large amounts of sediment and silt to runoff waters. This sediment can deteriorate water quality and lead to fish kills and other ecological problems. Heavy metals, oils, toxic substances and debris from construction traffic and spillage can be absorbed by soil at poorly maintained construction sites and carried off in runoff water to lakes, rivers and other waterbodies.

Runoff control measures can be installed before construction starts to reduce runoff pollution both during and after construction. Such measures can effectively limit the entry of pollutants into surface waters and ground waters, thereby protecting their quality, fish habitats and public health. Pesticides and fertilizers used along rights-of-way and adjoining land can pollute surface waters and ground water when they filter into the soil or are blown by wind from the area where they are applied.

The Arkansas Natural Resources Commission (ANRC), in collaboration with ADEQ, is the lead agency for implementation of efforts to address surface erosion across Arkansas. For all statewide programs, the overall strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in NPS pollutant loads, it will be viewed as successful. However, if the cooperative process does not result in nonpoint source reductions and water quality improvements, then state and local entities will investigate additional steps needed to enable waterbodies to meet their designated uses by using an adaptive management approach described in the introduction to this update.

Objectives

Paved and Unpaved Roads

6.1. Partner with various local and watershed entities to compile and analyze current road conditions and usage, providing information on the number of miles of unpaved roads, surface materials, stream crossings and road density using analysis of existing data, survey of county officials and other methods.

6.2. Review available construction and maintenance BMP manuals for low-volume and unpaved roads. Update and modify manuals as necessary and make available to county road crews and others upon request.

6.3. Use construction and maintenance BMP manual for low-volume and unpaved roads for targeted education programs for county judges, quorum courts, maintenance workers and other interested county/city personnel on pollution prevention for rural roads.

6.4. Continue to collaborate with the AHTD to ensure compliance with environmental laws, regulations and policies.

6.5. Continue to collaborate with AHTD, which maintains a manual of BMPs for construction stormwater management and provides training to its contractors and staff on BMPs.

6.6. Continue to ensure the most current List of Impaired Waterbodies does not indicate any stream segments or waters identified with Road Construction (RC) as the cause.

Construction

6.7. Continue to revise, as necessary, BMP manuals to address prevention, management and maintenance of runoff from surface erosion, including construction.

6.8. Deliver Arkansas Rural Services and the Nature Conservancy ongoing programs to disseminate surface erosion BMPs and information through a variety of means (such as distribution of the surface erosion manual, training workshops, website content and demonstration projects).

Instream Erosion/Hydromodification

6.9. Seek new sources of funding, leverage existing funding and promote increased cooperation aimed at shifting focus from bank stabilization to reach restoration.

6.10. Continue to implement a watershed-based assessment protocol and BMPs for streambank erosion as funds allow.

6.11. Prioritize stream reaches and sites for restoration within priority watersheds as funds allow.

6.12. Develop and promote education programs for landowners concerning streamside and lakeside property management to reduce sources of NPS pollution.

6.13. Develop and promote education programs for landowners and developers concerning proper stream corridor management and for professionals concerning stream corridor restoration practices.

6.14. Promote tax credits, cost-share and other incentive programs that are available for riparian zone and stream corridor restoration projects and conservation easements.

6.15. Improve coordination of existing data among cooperating entities. Current data available to help with understanding and addressing this problem include gauging stations/flow data for many streams; ADEQ West Fork White River Watershed Assessment Report, which provides local erosion prediction curves for streambanks; area rainfall data; Geographical Information Systems data; U.S. Forest Service (USFS) hydrological data; The Nature Conservancy flow model; regional discharge curves for the Ozark and Ouachita mountain areas; and ADEQ and Nature Conservancy ecoregional assessments.

6.16. As funds allow, develop data and conduct analysis to fill information gaps. Examples include (1) geological survey of groundwater, (2) fish and macroinvertebrate data and changes over time, (3) regional erosion prediction curves and streambank erosion potential data, (4) regional discharge curves for the Delta, Arkansas River Valley and Coastal Plains areas, (5) evaluation of riparian areas within critical watersheds, (6) change in stream length over time and (7) sediment transport data throughout the state.

Program Tracking and Evaluation

The ultimate measure of the program is whether or not streams are removed from ADEQ's List of Impaired Waterbodies. The desired evaluation outcome is that surface erosion will not be listed as a primary or secondary source contributing to impairment in future impaired waterbodies lists.

Through the five-year period of this plan, surface erosion education and outreach can be tracked on multiple levels. First, program activities such as the number of participants in education and training programs, number of fact sheets developed, and number of newspaper articles, brochures or other materials that are distributed can be documented. In addition, the program can maintain an informal inventory of assessments and restoration projects in planning, underway and completed among cooperating entities. These input measures track effort expended, which is a first and necessary step toward affecting change.

The second level of evaluation focuses on whether program activities result in human behavioral changes (i.e., BMP implementation). Currently, there are no systematic mechanisms for measuring human behavioral change. Given the wide-ranging sources of surface erosion, measuring behavioral change will need to be project specific. For example, to evaluate behavioral change after training county road crews to reduce erosion from unpaved roads, a survey could be conducted to determine the miles of roads paved with alternate materials and the miles of ditch maintained by alternative methods as a result of the training. Similar follow-up surveys could be constructed as a component of training for construction contractors. Where practical and cost effective, ANRC will require grantees to describe how they will attempt to measure behavioral change in their project requests.

Modeling may be used to estimate sediment reduction from restoration projects. The success of hydromodification projects in restoring fisheries can be measured through documenting changes in biological communities with various biological assessment protocols and matrices. The extent of intact riparian zone vegetation can be interpreted by GIS analysis land use and hydrography. Arkansas updates land use coverage approximately every five years, which creates the opportunity for periodic evaluation of riparian zones in priority watersheds.

For any of the goals to be achieved, agencies and organizations must cooperate and dedicate resources. Volunteers are also needed, as is the support of residents and environmental/natural resource groups. The state of the economy, program funding for education and monitoring and changes in federal or state regulations are external factors that could affect the program's outcome.

Brief Summary of Institutional Context

Rural Roads and Recreational Trails

County judges and their respective road maintenance departments are responsible for construction and maintenance of roads in unincorporated areas of their counties. The USFS maintains BMPs for construction of forestry roads in national forests. AFC has developed voluntary BMP guidelines for private and industry use, including construction of forest harvest roads, and monitors and reports on compliance with those guidelines every other year. Arkansas Rural Service, The Nature Conservancy, Arkansas Conservation Partnership and the University of Arkansas have cooperated to develop and deliver rural road maintenance training programs in some regions of the state.

Construction

ADEQ regulates construction sites of one acre or greater and smaller construction sites that are a part of a common plan (e.g., a subdivision). In collaboration with regional planning commissions, the University of Arkansas System Division of Agriculture, Cooperative Extension Service is working with communities subject to Phase II small municipal separate storm sewer systems (MS4s) NPDES permit requirements to help conduct construction education and technical assistance programs in Northwest Arkansas and the Pine Bluff area.

Instream Erosion

Stream restoration and design has become an increasingly important activity in both the public and private sectors for minimizing NPS pollution. Nonprofit organizations, higher education institutions and municipalities provide technical assistance and help secure funding for surface erosion assessment, restoration and education opportunities. Instream gravel mining is regulated by ADEQ under Regulation No. 15.

The U.S. Army Corps of Engineers regulates direct changes of a stream channel. Section 404 of the Federal Water Pollution Control Act establishes a permit program, administered by the Secretary of the Army, acting through the Chief of Engineers. USACE has the authority to review project plans and issue permits for altering stream channels. ADEQ also reviews project plans and must issue certification

short-term activity authorization permits before USACE can issue a Section 404 permit. Project managers and permit seekers who plan to modify stream channels must work with both USACE and ADEQ to ensure that stream geomorphology and long-term water quality is not negatively altered or impacted.

The Arkansas Game and Fish Commission implemented a Stream Teams Program in 1996. Stream Teams are groups of people who form or join a team and adopt a stream or other waterbody in the state for the purpose of keeping it clean and healthy. There are now more than 500 Stream Teams statewide that carry out a variety of activities including litter pickups, repair of eroding streambanks on willing owners' land and tree plantings to restore degraded riparian areas. They also work with local leaders to better manage their watersheds and a variety of other activities aimed at conserving the natural resource.

To the extent possible, coordinators incorporate natural channel design techniques to maximize aquatic and terrestrial habitat restoration. AGFC assists with implementation costs through their Stream Team mini-grants. Along with private landowners, groups that have provided funding include the Multi-Agency Wetlands Planning Team, Conservation Districts, the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), USFS, ANRC and municipalities.

ADEQ has provided assessment data, project review and technical assistance in the area of stream stability and restoration designs. ADEQ developed erosion prediction curves for the West Fork White River and used assessment methodologies to estimate sediment loading rates from lateral streambank erosion. ADEQ has also used assessment data to prioritize sites for restoration. ADEQ collected geomorphological data at several United States Geological Survey gauge station sites to develop Ozark regional discharge curves and collected reference reach data to develop reference reach geometry curves.

NRCS has provided technical assistance and cost-share, through its EQIP program, for stream stabilization projects. The national NRCS office also provides technical assistance in the area of natural channel design for stream restoration.

Paved Roads

Regulatory oversight exists for road construction in many instances. State highway construction projects are regulated under both the National Environmental Protection Act and the NPDES Construction Stormwater Permit program administered by ADEQ. However, there are several other types of road construction that are exempt from stormwater protection regulations and are a significant source of water quality degradation concern. When road construction may affect the quality of a waterbody, Section 404 and 401 permits from the U.S. Army Corps of Engineers and ADEQ may need to be obtained.

Through its Environmental Division, the Arkansas Department of Transportation provides multidisciplinary review and analysis of project development and operations to ensure compliance with environmental laws, regulations and policies. ARDOT provides training to its contractors and staff on BMPs for construction stormwater management. NPS-related activities routinely undertaken include geographic information systems analysis, wetland impact assessments and stormwater permitting. In addition, the division monitors water quality and implements wetland mitigation property management strategies. The highway department also offers its employees erosion and sediment control training and has several resources available, including a 2016 Erosion and Sediment Control Design and Construction Manual available at www.arkansashighways.com/stormwater/erosion_sediment_manual.aspx.

To learn more about ARDOT's stormwater management efforts, visit www.arkansashighways.com/stormwater/statewide_swmp.aspx. More information about AHTD's role in NPS reduction and abatement is in the road construction and maintenance section of the plan.

ANRC provides technical assistance and may provide financial assistance for streambank stabilization, sediment reduction projects and prevention initiatives. Periodically ANRC provides training opportunities in the state on stream restoration.

Several nonprofit organizations provide technical assistance and help secure funding for assessment, restoration and education opportunities. Watershed assessment projects that were conducted resulted in erosion prediction curves for sub-watersheds of the Illinois River and Upper Saline River. Also, a regional education program, Mid-South Watershed Training Program, was started. The program, funded by EPA's national office, includes training for environmental professionals and watershed coordinators in the area of applied fluvial geomorphology, watershed assessment

and natural channel design for reach restoration. The Nature Conservancy, Audubon Arkansas and the Upper White River Foundation have all partnered in support of the training program. The Nature Conservancy conducted a watershed assessment in northeastern Arkansas, with the assessment resulting in erosion prediction curves in the Delta.

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Section Seven

Urban Runoff

2018-2023 NPS Management Plan
Statewide Programs

Introduction

Arkansas' landscape is changing. Urban areas are spreading rapidly in some parts of the state. As urbanization of the landscape increases, stormwater management problems increase. The water flows off impervious surfaces, such as driveways, rooftops and sidewalks, into storm drains. These openings along roads and in parking lots connect to pipes that carry the water and pollutants directly to local streams or lakes. Because water cannot soak or percolate through impervious surfaces, there's more stormwater runoff from cities than in forests and fields.

The last National Water Quality Inventory report to Congress listed Urban Runoff in the top 10 sources of impairment of surveyed estuaries and surveyed lakes (U.S. Environmental Protection Agency, 2009). The Arkansas Department of Environmental Quality (ADEQ) identifies Urban Runoff as a source of contamination in its 2016 draft Impaired Waterbodies List.

The Urban Runoff Statewide Program focuses on pollutants that can be generated by households, businesses and municipalities not required to obtain National Pollution Discharge Elimination System (NPDES) permits, regardless if they are located in rural or urban counties.

Arkansas' Impaired Waterbodies List, commonly called the 303(d) List, identified urban runoff as a source of impairment for three waterways in Jefferson County. The presence of lead, pathogens and dissolved oxygen were noted issues for some of those segments.

Water Quality Program Goals

ADEQ has identified Arkansas waterways that are not fully supporting their designated uses in the agency's most recent List of Impaired Waterbodies. Urban runoff is listed as a potential source of impairment on that list.

Activities that take place in and around urban households and businesses may contribute in various forms to water quality impairment.

The ultimate goal of the urban runoff pollution prevention program is household and business sources of NPS pollution will never be identified as contributing to impairment of the waters of the state. Components of the program include, but are not limited to, increasing public awareness through education, training and other voluntary programs.

Objectives

7.1. Work with ADH to increase awareness of funding sources available for repairing malfunctioning or improperly installed septic systems.

7.2. As resources allow, cooperatively assist other state and federal agencies, groups or organizations to assess the impact of household and business use of fertilizers, pesticides, and other common products that do not require permits but can affect water quality. Knowledge gained may be utilized to develop information materials, target outreach and awareness programs and promote the use of appropriate BMPs.

7.3. Encourage cooperating entities like solid waste districts to work together to maintain a shared library of BMPs that is readily accessible to households, municipalities, employers and others for the use, handling, storage and disposal of chemicals, oils and grease, cleaning agents, adhesives, lawn products, etc.

7.4. As resources allow, continue to develop and implement targeted education programs for specific products and high-impact audiences (e.g., fertilizer and pesticide use, storage, handling, and disposal for street and road crews, public utilities, golf course managers and independent lawn maintenance crews).

7.5. Promote broad-based education programs aimed at increasing awareness and disseminating BMPs to urban and rural households and businesses (e.g., HOME*A*SYST, URBAN*A*SYST).

7.6. Encourage the development or modification of applicable programs to implement a household and business hazardous waste and chemical collection program.

Program Tracking and Evaluation

For the urban runoff statewide program, the desired evaluation outcome is that households and businesses are not contributing to impairment of Arkansas waterways through urban runoff. This is ultimately monitored through Arkansas' Impaired Waterbodies List, or 303(d) List. The program objectives represent interventions the state has identified as key to this goal.

Educational programs concerning runoff from business and household chemicals and fertilizers can be evaluated by the agencies conducting the education programs through attendance logs, attendee post-program evaluations and document behavior change. Hazardous waste collection programs can be evaluated by the volume or mass of hazardous waste collected.

Brief Summary of Institutional Context

Runoff From Homes, Businesses and Municipal Infrastructure

Management of household chemical and pesticide NPS pollution can best be achieved by an effective information, education, public awareness and collection programs. Local hazardous chemical pickup and disposal programs have been successful in eliminating hazardous chemicals ending up in the environment. Promotion, continuation and development of new programs are necessary for the successful prevention of water quality degradation resulting from household chemicals and fertilizers.

Some local cities have ordinances directing what should happen with pet and yard waste disposal and swimming pool drainage. Fayetteville has enacted a streamside ordinance. The city recognizes that streamside buffer areas improve water quality by reducing nutrients and protecting streambanks from erosion, thereby reducing the amount of sediments entering the stream.

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Section Eight

Developing Issues: Adapting the NPS Program to New and Changing Policies, Resources and Technologies

2018-2023 NPS Management Plan

Introduction

A basic premise of the Arkansas Nonpoint Source (NPS) Management Plan is found in its adaptive management design. The annual review process along with attention to new knowledge and experiences of stakeholders and new technical capabilities are all components of the current philosophy of having a flexible plan – a plan that is adaptive to change and sensitive to the developments taking place in the state and nationally.

The 2018-2023 NPS Management Plan identifies a number of issues and needs, but it is not inclusive of the full range of possible projects important to a successful statewide NPS management effort. Given the dynamics of the social, political and economic situation, this plan aims to strategically address the issues and needs that fit within the current capacity of the state program.

Stakeholders and the Arkansas Natural Resources Commission (ANRC) management team meet on a regular basis to discuss issues, review the available NPS modeling data and plan for activities and projects that address NPS pollution reduction.

Strengths of the NPS Planning Process:

- Strong relationships across agencies, organizations and other stakeholders
- Development of nine element plans
- New and emerging technologies
- Adoption of Best Management Practices (BMP)

Issues that need greater attention with the NPS Planning Process:

- The changing nature of NPS policy
- Public and private investments in the state
- The full potential of cross-program fund leveraging
- New and emerging technologies
- New organizational development and support
- New data and interpretation of data
- Educational opportunities associated with the program
- Nontraditional partnership opportunities

The plan should be an adaptive document focused on the future, changing as appropriate to represent the Arkansas circumstance, investment and priority needs.

The dynamic elements found in the Arkansas NPS Management Plan include:

- Activities of local conservation districts, watershed groups, and partners in implementation, education and outreach have expanded greatly over the past five years.
- Advanced technologies continue to play a major role in NPS planning, modeling, detection and remediation.
- Political and legal hurdles encountered in pursuit of new policies, such as Low Impact Development (LID) and Riparian Buffer Ordinances.
- The expanded role of regional water supply systems in source water protection.

Furthermore, new design strategies, understanding of stream geomorphology and adaptations of BMPs introduce the state to new management options. One such management strategy, Low Impact Development (LID), encourages systematic understanding of stormwater as an effective component of the landscape, both as an important resource and as a risk to the downstream ecosystem.

New knowledge of stream geomorphology and landscape design features allows the use of the landscape and natural system-emulating remediation tools to enhance water quality. These tools mimic natural systems and employ naturally occurring plant materials and geophysical features. This approach steps back from the human-centric system control designs of the past and works to employ the processes of natural landscapes and bioremediation to reduce the natural energy of stormwater and thereby capture and reduce the NPS pollution impact. These are a few of the innovations helping the state adapt to the natural world.

The NPS Management Plan may include investments of public utilities, municipalities and private organizations for NPS management efforts. Activities and investments by these organizations include:

- Establishing riparian forest buffers.
- Forest management schemes and reforestation complementary to the USDA conservation programs.
- Land acquisition, easements and ordinances initiated by public utilities and municipalities for the purpose of water quality improvement and enhancement.

These developments further strengthen the argument for the 2018-2023 NPS Management Plan to be flexible, constantly adapting to changing circumstances.

ANRC and its partners must have the potential to capture and quantify these and other activities taking place in the state. For the plan to be truly adaptive, it must be able to respond to new opportunities, resources, investments and priorities as they arise. To do this, ANRC must continue to collaborate with municipalities, public and private organizations, local watershed groups, nontraditional partners and others to address NPS management in Arkansas. Continued engagement by these partners requires a process that remains relevant to their perceived needs and benefits, adapting to their changing knowledge and situations.

The intent of this section is to give voice to the true nature of Arkansas' adaptive NPS Management Plan, making clear the planners' purpose of constant vigilance and attention to the immediate and future potential of NPS program needs. ANRC, as the lead agency, will remain in constant search of opportunities for strategic investment and partnerships, working in collaboration with stakeholders. The agency will seek the best possible science, data, public policy, education and economic tools to support and form its management decisions while taking public perception into consideration.

Current and Developing Issues

The program and policy landscape is ever changing, and several issues have developed in recent years that will impact NPS and the NPS planning process. Those issues are described.

Unpaved Roads

An unpaved road is any road, equipment path or automotive transportation corridor that is not paved, is open to public access and owned/operated by any federal, state, county, municipal or other governmental or quasi-governmental agencies. The main pollutant associated with unpaved roads is sediment. Sedimentation can originate from both maintenance activities and the lack thereof; however, best management practices (BMPs) including water diversion and retention devices can reduce the sediment load entering our streams, rivers and lakes. Given that approximately 85 percent of rural roads in Arkansas are unpaved (The Nature Conservancy, 2014), this is a major NPS issue.

As discussed in the Surface Erosion section, Arkansas has established an Unpaved Roads Program and Fund through Act 898 of 2015. The act aimed to create an incentive-based unpaved roads management program to encourage the utilization of best management practices on rural, unpaved roads to reduce erosion, improve water quality and support county finances.

Public Road Inventory Through a Linear Referencing System

The Federal Highway Administration (FHWA) issued a memorandum in 2012 to all states requiring them to develop an inventory of all public roads (paved and unpaved) through a Linear Referencing System (LRS) (FHWA, 2014). FHWA aimed to stop the use of multiple sources and different formats of road data in an effort to have one nationwide LRS to serve assessment and planning needs.

Conservation Practice Implementation

Conservation practices that improve soil health are seen as key strategies to address agriculturally related environmental concerns with water and pollution. Conservation funds through the Natural Resources Conservation Service (NRCS) are available to eligible agricultural producers to use best management practices for conservation; one leading practice is the use of cover crops. Research has shown that cover crops support water conservation, soil fertility, soil building, enhancement of organic matter, weed/pest control and reduce greenhouse gas emissions (Clark, 2008). Research suggests that improvement in soil health helps to address the excess nutrient loads such as those contributing to the Gulf Hypoxia issue (Clark, 2008). The NRCS, Arkansas Association of Conservation Districts, ANRC and the newly formed farmer led group, the Arkansas Soil Health Alliance is actively working to promote soil health and cover cropping.

Harmful Algal Blooms

Harmful algal blooms, or HABs, are an increasing concern for water resource managers.

HABs are occurring with increasing frequency and all around the country. The U.S. Environmental Protection Agency (EPA) and states are starting to take action. For example, the EPA recently issued health advisories related to HABs. Algae are important for the health of lakes and streams because they form the base of the food web, but sometimes these algae grow out of control and have detrimental effects.

Most harmful algal blooms happen in slow-moving, warm waters subjected to a lot of sunlight. High levels of nutrients like nitrogen and phosphorus also stimulate the growth of algae to the point of a harmful bloom.

The majority of HABs are caused by a type of algae called cyanobacteria. Cyanobacteria can produce compounds that cause taste and odor problems. They can also produce toxins that may cause nausea, vomiting and liver damage if ingested by humans, and skin contact with the toxins can cause rashes and irritation. Cyanobacteria toxins have even been known to be fatal for pets and livestock that drink contaminated water.

Cyanobacteria blooms can be particularly devastating in lakes and rivers used for drinking water supply and recreation. Taste and odor compounds and toxins can be very difficult and costly for drinking water utilities to adequately treat. Contact advisories and beach closures can cause significant economic losses for tourism and recreation too.

In an effort to understand HABs in Arkansas, a multi-interest workgroup was formed in November 2015 to begin discussing complex issues regarding HABs. The Arkansas HAB Workgroup has been separated into Recreation and Source Water Subcommittees. Each subcommittee has worked to communicate ongoing HAB monitoring and is working to develop recommendations for future monitoring and response protocols.

Stream Gauging

Available funding to support stream gauging in Arkansas is expected to decline in coming years, requiring more collaboration from non-governmental agencies to meet the need for streamflow measurement. The Arkansas Natural Resources Commission currently funds a large portion of stream gauging work done in the state by the U.S. Geological Survey, spending nearly $364,000 in 2017 on the cooperative agreement.

Pigweed Control and Dicamba Ban

Amaranthus palmeri, better known as “pigweed” or Palmer amaranth, has created significant problems for Arkansas farmers. This persistent weed is difficult to manage, having developed resistance to some herbicides and, with its large number of seeds, is extremely prolific.

A significant portion of soybeans and cotton planted in Arkansas contains a trait making the crops resistant to several herbicides, including dicamba. In 2017, the State Plant Board allowed in-crop use of an herbicide containing dicamba for use in fields planted with crops bred for dicamba tolerance. Previously, dicamba use in agriculture was limited to pasture and rangeland. Unmodified crops such as soybeans, peanuts and some horticultural crops are extremely sensitive to dicamba and can be damaged if the herbicide moves away from its intended targets.

Through the 2017 growing season, nearly 1,000 complaints alleging misuse of dicamba were filed with the Arkansas State Plant Board. In July 2017, a rule establishing a ban on the sale and use of dicamba in Arkansas went into effect for 120 days.

The governor appointed a taskforce in August 2017 to review the issue. The task force recommendations were accepted by the Pesticide Committee of the State Plant Board. The Arkansas State Plant Board eventually adopted new regulations on pesticides that contain the active ingredient dicamba, limiting the time of year when dicamba can be applied for agricultural uses. The regulations went into effect Feb. 1, 2018. Conversations regarding dicamba are likely to continue into the future.

If farmers turn to tillage for weed control, in theory, there is the potential for erosion and sediment entering waterways through runoff water. This type of scenario typically leads to turbidity in streams. However, there are several factors that might prevent tillage from being used, such as a lack of skilled farm labor and lack of equipment. Tillage has been used primarily for seedbed preparation and for furrow irrigation.

Natural Gas Drilling

Thousands of natural gas wells have been drilled in the Fayetteville Shale area over the past decade, prompting concern about the potential of the hydraulic fracturing process to pollute local waterbodies and groundwater.

In 2012, the U.S. Geological Survey issued a report saying scientists found no significant effects on groundwater quality from shale gas developing in the

two-county area they sampled (Kress, et al.). Since then, natural gas exploration has come to a near stop as oversupply and low prices led companies to moving their drilling rigs and operations elsewhere. This decline in drilling has reduced the threat of impairment for the time being.

The U.S. Environmental Protection Agency released a report in December 2016 saying the EPA found scientific evidence that hydraulic fracturing activities can impact drinking water resources under some circumstances, such as spills or inadequately treated hydraulic fracturing wastewater. Parts of the Lake Conway-Point Remove Watershed fall within the Shale area. The threat of impairment will return should natural gas exploration and production resume in Arkansas.

Arkansas Water Plan

An extensive group of stakeholders that included significant public participation and interagency cooperation developed the Arkansas Water Plan (AWP) through detailed technical evaluations and stakeholder input. The plan recognizes that while we continue to struggle with known water issues, the recommendations in this plan, when implemented, can meet the water demands of the citizens of Arkansas (State) through 2050. The NPS Program is one component of the larger AWP. Recommendations were made for addressing the issue of nonpoint source pollution in the State, shown below:

Improving Water Quality Through Nonpoint Source Management Priority Issue

Issue: Water quality is affected by nonpoint sources of pollutants and nonpoint source management projects need State funding in addition to federal funding.

Recommendations for improving water quality include:

1. Propose legislation to designate funding specifically for financing NPS management programs and implementing NPS management practices.
2. ANRC will collaborate with ADEQ and AGFC through the biennial Clean Water Act (CWA) water quality review processes, and the water quality criteria review to determine attainment or nonattainment of water quality standards in streams and identify the sources and causes of nonattainment:
   a. Streams impaired because of NPS pollution will be considered as priority streams for restoration through the NPS management program.
   b. Streams currently attaining water quality standards in priority watersheds will be considered for protection through the NPS management program.
3. Study whether nutrient management plans should be required outside current nutrient surplus areas.
4. Leverage funding from multiple sources such as Source Water Protection under the Safe Drinking Water Act, administered through the ADH, to address NPS pollution in watersheds with drinking water sources.

Water Quality Program Goals

The current plan lists state and federal agencies, nonprofit organizations and local government entities as key partners in the updating of the NPS Management Plan. The goal of this section is to encourage such organizations to expand their roles from simply being voices in the planning process to that of active partners in broader program implementation. Implementation is more than conservation projects. It may also include such activities as:

- Surveys
- Education
- Outreach
- Public policy initiatives
- Planning and organizational development
- Monitoring
- Implementation
- Other projects

The NPS Management Program will actively identify partners, strive to quantify the investments being made, assess needs and outcomes and encourage continued investments.

System Limitations and Alternatives

It is not possible to know every group and/or individual engaged to some degree in nonpoint source management. It is also difficult to anticipate the municipal policy preference best suited to improve water quality and mitigate NPS pollution.

Other variables include the emerging federal administrative changes that influence policy and funding that may impact the state NPS program and sustainability. In addition, state budget concerns may limit total program capacity from traditional sources while an expanding role by nonprofit organizations could completely change local investment and the

ultimate outcome of NPS programs. The challenge is to stay engaged with networks and stakeholders already working with ANRC to identify work being done and application of new knowledge and technologies in Arkansas while encouraging new involvement and investment by stakeholders.

Maintenance

This section will fulfill the original objective of maintaining the adaptability of the plan and focusing attention on the needs of the state and the plan as it relates to those needs. It is the intent of the section to more accurately capture the myriad of actions taking place in Arkansas that have a direct or indirect impact on the NPS management of the state.

Following are examples of Arkansas investments in NPS pollution management that have not been accounted for in previous NPS Management Plans.

- Conservation Districts provided technical assistance to thousands of landowners across the state and developed conservation plans in which conservation practices were applied. Many of the prescribed conservation practices and BMPs were implemented with private funds.
- Various groups such as the Friends of Fourche Creek and its partners removed more than 25 tons of trash over four cleanups, distributed 1,400 drain markers, initiated 17 drain murals in Central Arkansas and secured Marine Fuel Tax funds for a new boat ramp at a park in Little Rock.
- Streamside landowners received erosion assessment and education in the Beaver Watershed from the Beaver Watershed Alliance and in the Middle Fork Saline River area by the Arkansas Natural Heritage Commission.
- Northwest Arkansas Regional Planning Commission contracts with the University of Arkansas System Division of Agriculture, Cooperative Extension Service to provide 18 cities, Benton and Washington counties and the University of Arkansas regional urban stormwater education and outreach opportunities. Extension also provides storm-water education training for employees of those governments.

Non 319-Funded Federal Activities

Federally-funded activities outside the realm of the Section 319 program are not identified or counted against the state's NPS effort. It is not the intent of this section to in any way account for federal investment outside that of EPA. However, federal funding from sources such as the U.S. Fish and Wildlife Service, the U.S. Forest Service, the U.S. Department of Agriculture Natural Resources Conservation Service and the U.S. Department of Agriculture Farm Service Agency has been significant in recent years.

It would be a mistake to say that these funding sources and projects have not influenced the state's 319 management program. It would also be a mistake for the planning process to ignore these investments as the stakeholders review and direct the plan's implementation. These federal investments support and complement the NPS Management Plan. Most, if not all of the federal programs, require supplementary investments from both the public and private sectors and ANRC often plays a role in helping identify additional funding opportunities or partners.

Examples of collaborative federal activities in recent years that supplement ANRC's 319 efforts include:

- Use of the Regional Conservation Partnership Program in the Red River Watershed, the Illinois River Watershed and the Bayou Meto-Lower Arkansas Watershed. The voluntary program provides financial and technical assistance to agricultural producers for addressing resource concerns such as water quality, water quantity and wildlife. This initiative received major support from the Environmental Quality Incentives Program or EQIP and from the Regional Conservation Partnership Program or RCPP.
- Use of the Rice Stewardship Partnership to Sustain the Future of Rice program by Ducks Unlimited. Landowners in this projects supported by the Regional Conservation Partnership Program applied a systems approach using approved conservation practices for the purpose of addressing resource concerns to conserve water. The project area covered 30 rice-growing counties in Arkansas.
- Use of the Mississippi River Basin Healthy Watershed Initiative in the Strawberry Watershed and Caney Creek to target a new area in the impaired watershed where accelerated conservation funding has never been used. Conservation practices implemented aid in improving water quality and water quantity.

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Section
Nine

Common Best Management Practices

2018-2023 NPS Management Plan

Introduction

Many of the activities described earlier in this Plan contribute to the impairment of Arkansas waterways. However, that does not always need to be the case. Landowners and managers can take steps to prevent or reduce nonpoint source pollution (NPS) through the use of best management practices (BMPs). These practices, or strategies, can prevent or reduce the movement of sediment, nutrients, pesticides and other pollutants from the land to surface or ground water.

BMPs are designed to protect water quality from potential adverse effects of land management practices from all locations within a watershed. They can be used by homeowners, municipalities, farmers, industries, counties, state and federal government agencies or anyone who manages or owns lands. While BMPs are tailored to a particular land management situation and geographical location, they are implemented for the same basic goal of protecting our water sources.

The following pages provide an overview of common best management practices used to prevent or address nonpoint source pollution in a variety of settings. This is not an exhaustive list of BMPs but is meant to provide an initial idea of what steps can be taken to protect water quality. Consult with government agencies or organizations working within your field for more suggestions.

Common Best Management Practices Associated With Agriculture

The U.S. Environmental Protection Agency has long identified six management measures for controlling agricultural NPS (U.S. Environmental Protection Agency, 2003). They are:

1. Nutrient management
2. Pesticide management
3. Erosion and sediment control
4. Animal feeding operations
5. Grazing management
6. Irrigation water management

These practices are discussed using examples from the Natural Resources Conservation Service (NRCS). The majority of management practices utilized in the NPS program for agriculture are identified by the Natural Resources Conservation Service in their National Conservation Practice Standards and the State Field Office Technical Guide (FOTG), which is regularly updated and can be found online.

Other NRCS-approved practices may be used in Arkansas' NPS Pollution Management Program, provided those practices are part of an overall farm plan developed by or under the direction of NRCS. In addition, Arkansas continues the process of implementing regulations on the application of nutrients and poultry litter and for certification and training of nutrient applicators.

The following is a summary of management measures and practices to be utilized by the statewide agricultural NPS Pollution Management Program.

Nutrient Management Measures

The goal of this management measure is to minimize nutrient loss from agricultural lands occurring by edge-of-field runoff and by leaching. The focus of nutrient management is the increased efficiency with which applied nutrients are used by crops, thereby reducing the amount available to be transported to both surface and ground waters.

Develop, implement and periodically update a nutrient management plan to (1) apply nutrients at rates necessary to achieve realistic crop yields, (2) improve the timing of nutrient application and (3) use agronomic crop production technology to increase nutrient use efficiency. When the source of the nutrients is something other than commercial fertilizer, determine the nutrient value and the rate of availability of the nutrients. Determine and credit the nitrogen contribution of any legume crop. Soil and plant tissue testing should be used routinely. Refer to NRCS Technical List and apply BMPs as appropriate.

For row crop farmers who do not use animal manure as a fertilizer, soil testing is critical to determining proper fertilizer application rates. The University of Arkansas System Division of Agriculture offers free

soil testing to the public. The testing is funded by a special fee that the state levies on fertilizer purchases. These tests produce fertilizer and lime recommendations that assist in efforts to reduce application of excessive nutrients.

Programs to implement nutrient management include:

- **Nutrient Management Applicator Certification Program:**
  Arkansas Natural Resources Commission (ANRC) shall certify the competence of individuals to apply nutrients and provide training relating to nutrient application. The training shall, at a minimum, allow individuals to meet all requirements of the NRCS conservation practice standards for waste utilization and related practices for Arkansas as listed in the NRCS Field Office Technical Guide. All persons making nutrient application in Nutrient Surplus Areas as defined by the Arkansas General Assembly must be certified.
- **Nutrient Management Planner Certification Program:**
  ANRC has implemented a program to train and certify people who prepare nutrient management plans. Nutrient management plans will indicate how nutrients should be applied to fields and other land for crop production while protecting ground and surface water from excessive nutrient enrichment.
- **Nutrient and Poultry Litter Application and Management Plan:**
  ANRC will encourage prudent practices regarding the application and management of soil nutrients and poultry litter to protect and enhance the state's surface water quality while allowing for optimum soil fertility and proper plant growth. The primary goal is to maintain the benefits derived from the wise use of poultry litter, commercial fertilizers and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters of the state. In furtherance of this goal, these rules provide requirements applicable to NSAs. These rules are designed to protect the waters within the state from adverse effects of excess nutrients while allowing for maximum soil fertility and proper plant growth.

In 2010, ANRC adopted revisions to the Arkansas Phosphorus Index or P-Index, which is used to assess the risk of phosphorus runoff from pastures and hayland as part of a farm nutrient management plan in NSAs.

The major changes included expanding the index to include liquid swine and poultry litter and biosolids from wastewater treatment plants. Changes also include better accounting for the soluble phosphorus in applied manure/biosolids and mineralization of the organic phosphorus fraction. Transport changes included improved handling of pasture condition and grazing. The biggest changes were giving credit for phosphorus reduction from implementing several NRCS-approved conservation practices (Sharpley et al., 2010).

Pesticide Management Measures

The goal of this management measure is to reduce contamination of ground and surface water from pesticides. The basic concept, according to EPA's Pesticide Management Measures for Nonpoint Source Pollution, is to foster effective and safe use of pesticides without causing degradation to the environment.

To reduce contamination of ground and surface water from pesticides, consider the following series of steps or thought processes:

1. List pest problems, previous pest control measures, and cropping history.
2. Evaluate the soil and physical characteristics of the site including mixing, loading, and storage areas for potential leaching or runoff of pesticides.
3. Use integrated pest management strategies that apply pesticides only when an economic benefit to the producer will be achieved (i.e., applications based on economic thresholds) and apply pesticides efficiently and at times when runoff losses are least likely.
4. When pesticide applications are necessary and a choice of registered materials exists, consider the persistence, toxicity, runoff potential, and leaching potential of products in making a selection.
5. Periodically calibrate pesticide application equipment.
6. Use anti-backflow devices on the water supply hose in addition to other safe mixing and loading practices, such as a solid pad for mixing and loading and various new technologies for reducing mixing and loading risks.

Refer to NRCS Technical List and apply BMPs as appropriate.

Erosion and Sediment Control Measures

Apply the erosion component of a Resource Management System as defined in the Field Office Technical Guide of NRCS to minimize the delivery of sediment from agricultural lands to surface waters, or design and install a combination of management and physical practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to and including a 10-year, 24-hour frequency.

Soil erosion can be avoided by maintaining a protective cover on the soil and modifying the landscape to control runoff amounts and rates. To avoid and/or minimize water erosion, include high-residue, perennial and sod crops in the cropping system, grow cover crops, manage crop residues and shorten the length and steepness of slopes. To avoid and/or minimize wind erosion, keep soil covered with plants or residue, plant windbreaks, use stripcropping, increase surface roughness, cultivate on the contour and maintain soil aggregates at a size less likely to be carried by wind.

There has been increased interest in growing cover crops on row crop lands. Cover crops are non-cash crops used to conserve soil and water and to promote soil health. Cover crops are planted in the fall and are often chemically terminated in the spring before planting cash crops. To help promote cover crops and soil health, a group of early-adopter farmers have created a nonprofit called Arkansas Soil Health Alliance.

With increased concerns over both food production and natural resource sustainability, soil health is an emerging practice and science. Soil health is defined by NRCS as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans. Soil health may be thought of as the integrated effect of physical, chemical and biological properties and processes on soil. Better soil health is thought to protect water quality by reducing runoff and increasing water-holding capacity of the soil, improve infiltration, promote nutrient cycling, increase organic matter, improve structure and ultimately reduce irrigation and fertilizer needs.

While it is generally accepted that conservation practices such as nutrient management, cover crops, reduced-tillage, residue management, etc., can improve soil health, the questions remain: What is soil health? How is it measured? What kind of metrics are necessary to document the benefit of these practices on soil health? Additionally, how does soil health affect water quality and help farmers deal more effectively with climate change and weather extremes? Integrated soil health measurements, such as the Haney Test or Soil Health Test, provide an indexing approach to soil health that provides a relative comparison, but it is largely untested in Arkansas.

Animal Feeding Operations Management Measures

Animal feeding operations (AFOs) should be managed to minimize impacts on water quality and public health. To meet this goal, management of AFOs should address the following eight components:

1. Divert clean water. Siting or management practices should divert clean water (run-on from uplands, water from roofs) from contact with feedlots and holding pens, animal manure, or manure storage systems.

2. Prevent seepage. Buildings, collection systems, conveyance systems, and storage facilities should be designed and maintained to prevent seepage to ground and surface water.

3. Provide adequate storage. Liquid manure storage systems should be:

    - Designed to safely store the quantity and contents of animal manure and wastewater produced, contaminated runoff from the facility and rainfall from the 25-year, 24-hour storm.

    - Consistent with planned utilization or utilization practices and schedule. Dry manure, such as that produced in certain poultry and beef operations, should be stored in production buildings, storage facilities or otherwise covered to prevent precipitation from coming into direct contact with the manure.

4. Apply manure in accordance with a nutrient management plan that meets the performance expectations of the nutrient management measure.

5. Address lands receiving wastes. Areas receiving manure should be managed in accordance with the erosion and sediment control, irrigation and grazing management measures as applicable, including practices such as crop and grazing management to minimize movement of nutrient and organic materials applied and vegetated buffers or other management practices to trap, store and process materials that might move during precipitation events.

6. Recordkeeping. AFO operators should keep records that indicate the quantity of manure produced and its utilization or disposal method, including land application.
7. Mortality management. Dead animals should be managed in a way that does not adversely affect ground or surface water.
8. Consider the full range of environmental constraints and requirements. When citing a new or expanding facility, consideration should be given to the proximity of the facility to:
    - Surface waters
    - Extraordinary Resource Waters
    - Areas of high leaching potential
    - Areas of shallow groundwater
    - Sink holes, karst geology or other sensitive areas

    Additional factors to consider include siting to minimize off-site odor drift and the land base available for utilization of animal manure in accordance with the nutrient management measure. Manure should be used or disposed of in ways that reduce the risk of environmental degradation, including air quality and wildlife impacts, and comply with federal, state and local law.

Programs and practices to be utilized in implementation of animal feeding operations and management include:

- **Nutrient Management Applicator Certification Program**
- **Nutrient Management Planner Certification Program**
- **Nutrient and Poultry Litter Application and Management Plan**
- **Poultry Feeding Operations Registration Program:**
  Those who own or operate poultry feeding operations where 2,500 or more poultry are housed or confined on any given day are required to register annually their local conservation district. Such registration will include the following:
    - The number and type of birds housed or maintained by the operation
    - The location of the operation by latitude and longitude and county, township, range and section
    - The business address of the owner of the facility
    - The address of the facility if different from the owner's business address
    - The type of waste handling system
    - The type of litter management system and the amount of litter stored
    - The method used for carcass disposal
    - The acreage owned, controlled or used by the poultry feeding operation and used for landlord application of litter
    - Tons of litter produced, removed, transferred or otherwise used by the poultry feeding operation and the type of transfer or usage.
    - The poultry integrator or integrators with which the poultry feeding operation has contracted to provide poultry litter.
    - Any other relevant information deemed necessary by ANRC.
- **Approved Disposal of Poultry and Large Animal Carcasses:**
  Arkansas Livestock and Poultry Commission (ALPC) regulations specify acceptable disposal methods that address disease control concerns as well as environmental concerns. These regulations can be found at www.aad.arkansas.gov/regulations and include:
    - **Burial of Large Animal Carcasses:**
      Carcasses may be buried at a site at least 100 yards away from a well and in a place where a stream cannot be contaminated. Anthrax carcasses are to be covered with one inch of lime. Other carcasses may be covered with lime, particularly to control odors. All carcasses are to be covered with at least two feet of dirt. Carcasses are not to be buried in a landfill without prior approval of the state veterinarian.
    - **Approved Disposal of Poultry Carcasses:**
      Disposal of on-farm die-off of poultry may be through any method approved by ALPC including incineration, composting, extrusion, rendering, cooking for swine feed or on-farm freezing. All handling and movement of carcasses must be in conformance with the regulations of ALPC.

      In the event of a major die-off, rendering will be the method of choice for disposal,

except when death is caused by a disease entity. Alternately, a ditch may be used when dug two to four feet deep and covered by at least two feet of dirt. Lime may be used to control odor if needed. Commercial services may collect, process, and dispose of animal carcasses, provided that all applicable rules and regulations of the ALPC are followed.

In addition, NRCS and the University of Arkansas System Division of Agriculture, Cooperative Extension Service maintain recommendations for proper mortality disposal, including information about composting livestock. Refer to NRCS Technical List and apply BMPs as appropriate.

Grazing Management Measures

Manage rangeland, pasture and other grazing lands to protect water quality and aquatic and riparian habitat by:

1. Improving or maintaining the health and vigor of selected forage or cover crops and maintaining a stable and desired plant community while, at the same time, maintaining or improving water quality and quantity, reducing accelerated soil erosion, and maintaining or improving soil condition for sustainability of the resource. These objectives should be met through the use of one or more of the following practices:
    - Maintain enough vegetative cover to prevent accelerated soil erosion due to wind and water.
    - Manipulate the intensity, frequency, duration and season of grazing in such a manner that the impacts to riparian vegetation and water quality will be minimal.
    - Ensure optimum water infiltration by managing to minimize soil compaction or other detrimental effects.
    - Maintain or improve riparian and upland area vegetation.
    - Protect streambanks from erosion.
    - Manage for deposition of fecal material away from waterbodies and to enhance nutrient cycling through better manure distribution and increased rate of decomposition.
    - Promote ecological and stable plant communities on both upland and bottom land sites.
2. Excluding livestock, where appropriate, and/or controlling livestock access to and use of sensitive areas, such as streambanks, wetlands, estuaries, ponds, lake shores, soils prone to erosion and riparian zones, through the use of one or more of the following practices:
    - Use of improved grazing management systems (e.g., herding) to reduce physical disturbance of soil and vegetation and minimize direct loading of animal waste and sediment to sensitive areas.
    - Installation of alternative drinking water sources.
    - Installation of hardened access points for drinking water consumption where alternatives are not feasible.
    - Placement of salt and additional shade, including artificial shelters, at locations and distances adequate to protect sensitive areas.
    - Where necessary, provide stream crossings in areas selected to minimize the impacts of the crossings on water quality and habitat.
    - Use of exclusionary practices, such as fencing (conventional and electric), hedgerows, moats and other practices as appropriate.
3. Achieving either of the following on all rangeland, pasture, and other grazing lands not addressed above:
    - Apply the planning approach to implement the grazing land components in accordance with one or more of the following from NRCS: a Grazing Land Resource Management System; National Range and Pasture Handbook (U.S. Department of Agriculture-Natural Resources Conservation Service, 1997); and NRCS Field Office Technical Guide, including NRCS Prescribed Grazing 528A.
    - Maintain or improve grazing lands in accordance with activity plans or grazing permit requirements established by the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs of the U.S. Department of Interior, the USDA Forest Service or other federal land managers.

Refer to NRCS Technical List and apply BMPs as appropriate.

Irrigation Water Management Measure

To reduce NPS pollution of ground and surface waters caused by irrigation:

1. Operate the irrigation system so that the timing and amount of irrigation water applied match crop water needs. This will require as a minimum: (a) the accurate measurement of soil-water depletion volume and the volume of irrigation water applied, and (b) uniform application of water.
2. When applying pesticides through an irrigation system, include backflow prevention device(s) for wells; minimize the harmful amounts of chemigated waters that discharge from the edge of the field and control deep percolation. In cases where chemigation is performed with furrow irrigation systems, a tail water management system may be needed.

The following limitations and special conditions apply.

- In some locations, irrigation return flows are subject to other water rights or are required to maintain stream flow. In these special cases, onsite reuse could be precluded and would not be considered part of the management measure for such locations. In these locations, improvements to irrigation systems and their management should still occur.
- By increasing the water use efficiency, the discharge volume from the system will usually be reduced. While the total pollutant load may be reduced somewhat, there is the potential for an increase in the concentration of pollutants in the discharge. In these special cases, where living resources or human health may be adversely affected and where other management measures (nutrients and pesticides) do not reduce concentrations in the discharge, increasing water use efficiency would not be considered part of the management measure.
- In some irrigation districts, the time interval between the order for and the delivery of irrigation water to the farm may limit the irrigator's ability to achieve the maximum on-farm application efficiencies that are otherwise possible.
- In some locations, leaching is necessary to control salt in the soil profile. Leaching for salt control should be limited to the leaching requirement for the root zone.
- Where leakage from delivery systems or return flows supports wetlands or wildlife refuges, it may be preferable to modify the system to achieve a high level of efficiency and then divert the saved water to the wetland or wildlife refuge. This will improve the quality of water delivered to wetlands or wildlife refuges by preventing the introduction of pollutants from irrigated lands to such diverted water.
- In some locations, sprinkler irrigation is used for frost or freeze protection, or for crop cooling. In these special cases, applications should be limited to the amount necessary for crop protection and applied water should remain onsite.

Refer to NRCS Technical List and apply BMPs as appropriate.

Common Best Management Practices Associated With Silviculture

The Arkansas Forestry Commission (AFC) is the lead agency for interpreting, monitoring and updating forestry BMPs and management measures in Arkansas. In 2002, AFC completed a major update of their BMP guidelines after extensive public input and comment.

These management measures closely resemble EPA's National Management Measures to Control Nonpoint Source Pollution from Forestry (U.S. Environmental Protection Agency, 2005). The measures and practices below are excerpted from AFC's Best Management Practice for Water Quality Protection. The publication can be found at http://www.aad.arkansas.gov/Websites/aad/files/Content/5944986/BMPs.pdf.

Forest Chemicals

Pesticides/herbicides and fertilizers are forest chemicals. The following guidelines for the handling and application of forest chemicals will help prevent their translocation to open water sources.

If any hazardous chemical of reportable quantity is accidentally spilled during normal working hours, notify ADEQ. Outside of normal working hours, notify the Arkansas Department of Emergency Management at 1-800-322-4012. Take immediate measures to contain all chemical spills. Communicate spills to appropriate supervisors, landowners and authorities.

Forest Chemical Management

Follow label instructions. Do not aerially apply forest chemicals to Streamside Management Zones (SMZs) unless labeled for open water application or during a forest health emergency (e.g., gypsy moth). Chemicals should not be allowed to leak from equipment or containers. Do not service equipment near streams or other water sources. Properly dispose of empty containers. Minimize the use of streams, lakes, ponds or rivers as water sources. When this water is used to mix chemicals, do not contaminate water source. Chemicals should not be applied when water contamination is likely to occur from physical spray drift. Chemicals should not be applied immediately before precipitation or after a rain if there still is runoff. Consider upcoming storm predictions to time chemical application. Label containers according to state and federal regulations. Apply fertilizer at appropriate rates. Seek professional advice on application rates. Applicators should be properly licensed and trained and/or certified if applicable.

Harvesting

Harvesting timber is more inclusive than cutting trees. It includes layout and construction of access roads, skid trails for moving logs and strategic location of landings for transporting products out of the woods. Timber harvesting activities should be conducted to minimize the effects on soil and water. Special care should be taken on steeper slopes and near bodies of water. If possible, schedule harvests during periods of dry weather to reduce sediment runoff.

- **Design of Harvest Site:**
  Plan harvest size, skid trails and landing locations to reduce the area of ground disturbed. For areas subject to excessive erosion, plan harvest activities to encourage revegetation efforts during times of the year that favor successful revegetation. Sites should be inspected frequently during harvesting to identify soil movement into waterbodies. If erosion is occurring, promptly implement corrective BMPs. When harvesting is completed, disperse water from landings and skid trails using water bars, logging slash or vegetative cover. Be prepared to control and limit off-site soil movement. If revegetation or stabilization is needed, this work should occur as soon as possible after harvesting is complete. Compacted soils may need to be disked or scarified to improve water infiltration and create a suitable seedbed. Construct water bars on skid trails and firelines as needed. Pay attention to slope and soil type as it pertains to type of structure and spacing requirements. Where skid trails cross streams, install water bars or turnouts to divert all runoff away from stream channel. All areas to be seeded and/or mulched should be stable. Install traffic barriers to prevent off-road vehicle damage to recently stabilized areas.

- **Mechanical Site Preparation:**
  Mechanical site preparation involves the use of ground contact equipment to manipulate vegetation and soil conditions before reforestation. Methods most commonly used are shearing, raking, subsoiling, disking, chopping, windrow/piling, and bedding. Shearing, raking, windrow/piling, bedding, and disking are high intensity methods of mechanical site preparation that expose a greater percentage of the soil on the treated site. Subsoiling and chopping are lower intensity methods. Erosion potential increases with the higher intensity methods, especially in areas with steep slopes.

  Choose a site preparation method that exposes and disturbs the minimum mineral soil necessary to meet the desired reforestation objective. The boundaries of all SMZs should be defined before site preparation begins. Do not conduct mechanical site preparation in SMZs. Minimize crossing streams. If crossings are necessary, they should be kept to a minimum and made at right angles to the stream. Avoid intensive site preparation on soils NRCS has identified as highly erodible. Do not damage water control devices (i.e., culverts, wing ditches). When damage occurs, repair or replace the device promptly. Avoid heavy equipment operations in wet soil conditions. Intensive site preparation should always follow contour of land.

- **Log Landings:**
  Log landings or log decks are areas of concentrated equipment use and traffic. Well-planned and managed log landings will protect water quality. Take precautions to reduce rutting, soil compaction, and/or interference with water flow in order to reduce erosion. For example, if soils are wet, use special techniques such as logging mats and mulch. Locate landings to avoid or reduce stream crossings. Locate landings as part of planning the road system. Minimize the size and number of log

landings. Locate landings on dry sites so natural drainage disperses water onto the forest floor but not into a stream.

- **Felling and Bucking:**
  Fell trees away from a stream and keep debris out of the stream when-ever possible. If a tree is felled into a stream, protect the streambanks during tree removal. Fell trees so the butts face the direction of skid whenever possible. Promptly remove significant logging debris from streams. Significant debris can alter the flow of water and scour banks. However, some woody debris left in streams can be beneficial since it acts as a macroinvertebrate colonization medium and provides fish cover, so balance needs to be found on an individual site basis.

- **Skidding:**
  Skid trails serve as transport routes for equipment moving trees, logs or other material from the place of felling to a log landing or deck where they are stored or loaded for transport. Because heavy equipment is usually used in skidding, soil disturbance may occur. Plan skid trail layout to protect water quality. Follow the contour to the greatest extent possible. Timber should be skidded uphill either to a contour skid trail or more level ground. On slopes of 20 percent or greater, skid uphill. Skid trails on slopes should have occasional breaks in grade or logging slash that disperse water. Where stream crossings are planned, use portable crossing structures, culverts, poles or natural fords with firm bottoms, stable banks and gentle slopes. Do not use soil as a temporary fill material when water is in the stream. If a ford or crossing will cause excessive rutting or turbidity, then bridges, culverts, concrete slabs or other constructed fords should be used. Minimize the number of stream crossings. Skid across a stream only at stable locations identified during harvest planning. Upon completion of skidding, remove all temporary fill material from stream beds. If the banks are crushed or if soil is eroding, stabilize the streambanks. Do not use stream channels as skid trails.

- **Wet Weather Skidding:**
  Avoid logging in excessively wet areas or during excessively wet weather. If skidding in wet weather, take the following precautions to protect water quality: Stabilize bare areas during any temporary shut-downs in logging operation if needed to protect water quality; minimize skid trail construction at grades greater than 30 percent. With grades greater than 30 percent, install frequent rolling dips and follow contours. Stabilize these skid trails. If off-site soil movement occurs, control it with rolling dips, and prompt re-vegetation. Minimize straight runs of 300 feet or more at grades greater than 20 percent.

- **Harvest Site Closeout:**
  To ensure proper implementation of BMPs, a helpful final step is an onsite examination of the harvest area. This procedure is referred to as a "walkout." Review contracts or other documents that set-out BMPs required for the harvest area. Stabilize roads, skid trails, and log landings by using revegetation techniques if needed. Clean up spills. Haul litter, such as oil cans, grease containers, crankcase oil filters, old tires, and used fluids to a proper disposal facility. Remove significant logging debris from streams. Significant debris can alter the flow of the water and scour banks. Scatter woody debris above the high water mark of stream. Perform closeout erosion control on erodible areas before equipment is moved off the site.

Planning Practices

Careful planning is an essential first step to environmentally sound forest management. Seeking professional assistance during planning can be critical in protecting water quality. The selection of silvicultural operators such as loggers, site preparation contractors, foresters and others who have received BMP training can help ensure that BMP plans are prepared and understood before starting silvicultural activities.

- **Site Assessment:**
  Use available topographic maps, aerial photographs and site visits to locate and plan protection for the following:
  - Streams, drainage and crossings
  - Critical areas subject to rutting and/or erosion
  - Existing roads and trails
  - Proposed haul roads and skid trails
  - Log landing locations
  - Buffer zones for streams

- **Timing:**
  Determination of the best time of year for specific forestry activities.

- **Timber Sale Contract Requirements:** Inclusion of requirements for proper BMP implementation, installation, and maintenance in the timber harvest contract.
- **Special Planning for Wetlands, Obstructions and Areas to Avoid:** Identification of environmentally sensitive areas and provision to avoid impact from forestry activities on these areas.

Reforestation Practices

Reforestation should be completed as soon as practical after harvesting. Seek professional advice on reforestation options.

Machine plant along the contour of the land. Repair and stabilize any damage from machine planting that may cause erosion. Machine planting equipment should avoid crossing or turning around in roads, road ditches, wing ditches and waterbodies. Use existing access and stream crossing areas when planting. Preserve and replace all BMP harvesting or site preparation installations.

Fire

If a fire becomes "too hot," the entire humus layer can be consumed, exposing the underlying mineral soil to erosion. Arkansas Forestry Commission BMP Implementation Surveys (Arkansas Forestry Commission, 2011) have found that the erosion potential from sites burned too hot increases as slope increases. Extreme caution should be used when burning on slopes exceeding 20 percent.

- **Prescribed Fire:** Before ignition, moisture levels within the soil, forest fuels and the air should be sufficient to prevent major exposure or damage to the mineral soil, especially on moderate to severely erosive soils. Install firelines parallel to streams outside the SMZ. Do not plow firelines through the SMZ. Firelines within the SMZ should be constructed by hand. On final harvest cuts, when slopes of the site exceed 20 percent, individual fire strips should not exceed 300 feet in width between ignition and burnout. Buffers or breaks are recommended on slopes exceeding 20 percent.
- **Wildfire Suppression and Reclamation:** During wildfire emergencies, firefighting activities are not restricted by BMPs. Potential erosion problems should be corrected as soon as a wildfire is suppressed. Actively eroding gullies should be stabilized as part of wildfire reclamation. Inspect fire lines periodically and stabilize as needed to minimize runoff entering streams.
- **Firelines:** Control practices can be implemented during fireline construction to prevent erosion. Periodic inspection and proper maintenance can prevent erosion on established firelines. Use barriers such as roads, rights of way, and plowed fields as firelines. Install firelines on the contour as much as possible. Use bladed or harrowed firelines instead of plowed firelines whenever possible. On slopes exceeding 5 percent, and at approaches to streams and roads, install water bars with water turnouts in firelines according to the BMP recommendations for skid trails. Use hand tools or back blade firelines away from the edge of gullies, streams, or roads.
- **Fireline Maintenance:** Mowing or disking, rather than blading, should∞be used to maintain firelines to reduce exposing mineral soil.

Roadwork Practices

Proper road construction and maintenance protects water quality during and after silvicultural activities. BMP Implementation Surveys conducted by AFC indicate that practitioners should focus more attention on implementing forest road BMPs.

- **Road Location/Planning:** Use soil surveys, topographic maps, aerial photographs or site visits to plan road locations to protect water quality. Design roads to minimize stream crossings. Where stream crossings are required, cross at right angles to the stream, locate roads along the contour or along the crest of long ridges and maintain sufficient distance between the road and the SMZ to allow right-of-way maintenance.
- **Road Construction:** Use at least the minimum design standard that provides a road sufficient to carry the anticipated traffic load with minimum environmental damage. Remove timber from rights-of-way and deck it outside SMZs. Design roads no

wider than necessary. Balance cuts and fills to minimize excess excavated material. Place sidecast or fill material above the ordinary highwater mark of any stream except where necessary to stabilize stream crossings. Plan and conduct work so water quality is protected during heavy rain. When needed, use seeding and mulch-ing in a timely manner to reduce erosion. Implement appropriate BMPs during road construction.

- **Road Drainage:**
  Ensure good road drainage with a combination of properly constructed and spaced wing ditches, broad-based dips, rolling dips, culverts, and bridges. Wing ditches should be constructed so water will be dispersed and not cut channels across the SMZ. At cross drains (culverts or dips) install rip-rap or other devices at the outlets to absorb and spread water. Use brush barriers or check dams along road fill areas or other sensitive areas.
    - Install ditches, culverts, cross drains, and wing ditches at low points in the road. Use crowning, ditching, culverts, and/or out-sloping to drain roads naturally. Provide cross drainage on temporary roads. Provide out-fall protection if cross drains, relief culverts, and wing ditches discharge onto erodible soils or over erodible fill slopes. Use diversion or wing ditches wherever possible to carry road drainage water onto the undisturbed forest floor. Use adequate sized culverts to carry the anticipated flow of water
    - A road grade of less than 10 percent is preferred. Changing grade frequently, with rolling or broad-based dips, protects water quality better than by using long, straight, continuous grades. On highly erodible soils, grades should not exceed 8 percent. Grades exceeding 8 percent for 150 feet may be acceptable as long as appropriate BMPs are implemented. Graveling the road surface can help maintain stability. Install water turnouts, broad-based dips or rolling dips before a stream crossing to direct road runoff water into undisturbed areas of the SMZ. With the exception of stream crossings, roads should be located outside the SMZ.
    - Out-slope the entire width of the road where road gradient and soil type permit. Use cross drainage on in-sloped or crowned roads to limit travel distance of runoff water. Where roads are in-sloped or crowned, and gradients begin to exceed 2 percent for more than 200 feet, broad-based dips or rolling dips should be placed within the first 25 feet of the upgrade.
    - Road bank cuts normally should not exceed five feet in height, should be sloped, and the soil stabilized to prevent erosion. Cuts may need to be fertilized, limed, seeded, and mulched to establish cover.
- **Road Maintenance:**
  Crown or out-slope the road surface to disperse surface runoff and minimize erosion of the roadbed. Keep wing ditches free of blockages and keep culverts open and clean to allow unrestricted passage of water. Revegetate or stabilize erodible areas where natural vegetation is not sufficient to stabilize the soil. Minimize traffic on roads during wet conditions. Consider using geomat or rock to reduce road damage. Periodically inspect roads to see if BMPs remain effective. Re-establish vegetation as needed. Minimize traffic following maintenance work on sensitive road sections to allow them to stabilize. Keep roads free of obstructions to allow free flow of water from the road to the forest floor. Rework roads if road conditions deteriorate and may harm water quality.
- **Stream Crossings:**
  Cross streams only if the harvest site cannot reasonably be accessed otherwise. Remove temporary crossing structures after use. Stabilize and restore the streambanks. Permanent stream crossing should use bridges, culverts, shelf-rock fords, geoweb, concrete slabs, or other materials. Low water fords may be used if excessive turbidity is not created.
    - Design bridges to protect stream-crossing approaches from erosion. The streambank, stream channel and adjacent SMZ should have minimum disturbance. Construct stream crossings during periods of dry weather when stream flow is low

and the chance of erosion is minimal. Concrete slabs should be excavated so that the surface is level with the stream bottom and at the same slope. Concrete slab approaches should extend beyond the stream channel to prevent scour around the ends of the slab.

- Streambanks should be stable and stream bottoms should be hard. If not naturally stable, use materials such as geotextiles or temporary bridges. Use planking, geoweb, rock or other non-erosive material to reduce disturbance to unstable streambeds and streambed approaches.
- Remove from streams excess material and woody debris generated during road construction. Deposit this material above the ordinary high water mark. Stabilize the material. Use head walls, wing walls, rip-rap, or geomat if necessary.
- Inspect stream crossings frequently during operations to determine if erosion is being controlled. Streambanks should be stable and soil movement into the stream should be minimal. Correct erosion problems by implementing the BMPs.
- Except for crossings, equipment should stay out of streambeds.

- **Broad-Based Dips:**
  Broad-based dips are recommended for roads with less than 10 percent grade. Installation should take place after basic clearing and grading for roadbed construction. An energy absorber such as rip-rap and, in some cases, a level area where the water can spread, can be installed at the out-fall of the dip to reduce water velocity. On some soils the dip and reverse grade section may require bedding with crushed stone to avoid rutting the road surface. Broad-based dips should be placed cross the road in the direction of water flow. Broad-based dips are not recommended for constantly flowing water.

- **Rolling Dips:**
  Rolling dips are a cross between water bars and broad-based dips. Like broad-based dips, they have a reverse grade (except it is shorter) and they tip water off the road. Like water bars, they may also rely on a mound of soil at the downhill side. Rolling dips can be used on haul roads having a slope of 10 percent and greater.
  - Rolling dips can be used after basic clearing and grading for roadbed construction after logging is completed. A 10- to 15-foot long, 3 to 8 percent reverse grade is constructed into the roadbed by cutting from upgrade to the dip location and then using cut material to build the mound for the reverse grade. In hills, locate rolling dips to fit the terrain as much as possible. They should be spaced according to the slope of the planned roadbed.
  - Rolling dips are not suitable for constantly flowing water.

- **Wing Ditches:**
  Wing ditches collect and direct road surface runoff from one or both sides of the road away from the roadway and into undisturbed areas. Wing ditches move water from roadside ditches and disperse it onto undisturbed areas adjacent to the road.

- **Pipe Culverts:**
  Road and stream crossing culverts collect and transmit water safely from side ditches, seeps, natural drains, or streams under haul roads and skid trails without eroding the drainage system or road surface.
  - The pipe should be long enough so both ends extend at least one foot beyond the side slope of fill material. Culverts should be designed to carry the anticipated flow. The culvert should be placed with a 1 to 2 percent downgrade to prevent clogging. Lay the bottom of the culvert as close as possible to the natural grade of the ground or drain. Provide erosion protection for culverts. Lay aggregate or other suitable material on approaches to fords, bridges, and culvert crossings if needed to ensure a stable roadbed approach and reduce sediment in the stream. Fill for temporary culverts can be washed rock. Washed rock may remain in the channel when the culvert is removed. Remove culverts, bridges, and fill material other than washed rock from temporary stream crossings upon completion of operations

and return the crossing as close as possible to its original condition. Install erosion protection measures at the culvert outlet as needed to minimize downstream erosion.

- On larger streams and/or streams having substantial fisheries, box culverts utilizing the natural substrate as the culverts bottom may be a good substitute for pipe culverts since the stream substrate makes up the bottom of the culvert. This allows for migration of fish above and below the culvert due to stream velocity refugia being provided by the natural substrate. Using box culverts with a natural substrate bottom also alleviates any problem caused by high drops at the downstream end of the culvert (outlet).

- **Inactive Road Stabilization:**
  Waterbars are recommended for stabilizing inactive roads, firelines, and trails. Logging slash may also be effective. They act to divert side ditch and surface runoff, which minimizes erosion, and provides conditions suitable for revegetation.

- **Inactive Road Revegetation:**
  Covering bare soil is the first line of defense in preventing erosion. Revegetation is recommended for bare soil. Schedule revegetation when soil and weather conditions promote rapid germination of seeds and development of the plants. Plant seed to the proper depth, fertilize where needed, and use adequate seeding rates. Periodically inspect areas of revegetation to ensure successful reestablishment of the intended ground cover.

- **Inactive Road Protection:**
  Waterbars are essential to controlling soil erosion due to excessive water volume and velocity of road's runoff. Successful stabilization depends upon water control. Block vehicular traffic at entrances and exits of retired roads, firebreaks, and trails where vehicular traffic is expected. Use gating, large earthen berms, ditching, fencing, and similar barricades.

- **Storage and Handling of Fuel, Oil, Coolants and Products:**
  Restrict fueling and equipment maintenance work to designated areas of landings. Do not do this work near streams. Properly store fuel, oil, coolants and other products.

Streamside Management Zones (SMZs)

Vegetation and soils adjacent to waterbodies are critical for maintaining healthy aquatic systems. SMZs are buffer areas, strips of land immediately adjacent to waterbodies where timber management activities are specifically designed to protect water quality. SMZs are established on both sides of streams.

Streamside Management Zones:

1. Slow and spread the flow of water
2. Serve as a filter, which reduces movement of sediment and nutrients into waterbodies
3. Stabilize streambanks
4. Minimize logging debris from reaching a waterbody
5. Act as a buffer strip
6. Maintain cooler stream water temperatures and can cool down elevated temperatures
7. Provide an allochthonous energy source for aquatic biota and flora in the associated stream

AFC categorizes streams as ephemeral, non-ephemeral, braided, lakes and ponds. Standards for SMZs for each category are given as BMPs, except ephemeral streams which do not require SMZs.

In all SMZs, the following activities are discouraged:

1. Harvesting trees growing directly on banks or overhanging a waterbody
2. Prescribed fires that burn to mineral soil. Light cool burns are permitted
3. Locating portable sawmills or log decks in SMZs
4. Creating excessive rutting, especially where ruts run perpendicular to a stream
5. Leaving logging debris in front of cave entrances and in sinkholes if the effect is to change the natural flow of water

- **Non-ephemeral SMZs:**
  SMZ width is based on percent of the adjacent slope of the forest area:
  - Slope < 7 percent - minimum SMZ 35 feet
  - 7 percent < Slope < 20 percent - minimum SMZ 50 feet
  - Slope > 20 percent - minimum SMZ 80 feet

Retain a minimum of 50 square foot basal area per acre. Trees should be evenly spaced throughout the SMZ to maintain bank stability and protect water quality. Fell trees away from the stream except where safety is a concern.

- **Ephemeral SMZs:**
  Maintain an overstory of vegetation or trees if possible, if not, then maintain lower lying vegetation and intact forest floor. Mechanical site preparation should not disrupt the ephemeral stream channel. No SMZ required.
- **Braided Streams:**
  Consider multiple channels as one stream. The SMZ includes all land between the channels as well as the prescribed SMZ width adjacent to the most exterior channels. Follow other applicable SMZ guidelines for non-ephemeral streams.
- **Lakes and Ponds:**
  Minimum SMZ is 35 feet measured beginning at the break in slope at the top of the shoreline. Follow SMZ guidelines for non-ephemeral streams.

Common Best Management Practices Associated With Surface Erosion

Erosion occurs when individual soil particles are carried away from the road surface, ditch or road base by water, wind, ice or gravity. These soil particles are often transported by runoff to streams, ponds and lakes where they can alter the water chemistry, affecting the quality of water and fish habitat. Sediments can impact surface water ecosystems by adding excess nutrients that deplete oxygen supplies. This can lead to smothering of spawning and the feeding habitat of fish and contaminating drinking water supplies.

Sources of erosion include paved and unpaved roads, construction and hydromodification. By using appropriate BMPs and following accepted guidelines, erosion from roadways and construction projects can be controlled. The U.S. Environmental Protection Agency developed a list of general maintenance BMPs in the 1990s to help control erosion and polluted runoff at construction sites. More recently, the American Association of State Highway and Transportation Officials created the Construction Stormwater Field Guide to help departments of transportation stay in compliance with federal and state storm water regulations. Several BMPs from those publications are listed.

Sediment Control Practices

- **Retention Basins:**
  Sediment retention basins can be used in concert with proper ditching to create a basin where high-velocity, sediment-laden water has the opportunity to slow down and drop its sediment load. Although highly effective at sediment control, site selection for these basins must account for the incoming water volume so that the basin may be built large enough to handle the anticipated flows. Additionally, access must be provided for the routine maintenance of the basin.
- **Bank Stabilization:**
  Bank stabilization is the vegetative or structural means used to reduce or prevent erosion or failure of any slope. Erosion occurs when soil particles at the bank's surface are carried away by wind, water, ice or gravity. It can also be caused by stream currents and waves, obstacles in a stream, overbank drainage, heavy rainfall on unprotected land, freeze-thaw and dry cycles, seepage, and changes in land use. Bank failure occurs when an entire section of the bank slides to the toe of the slope. It can be caused by an increase of load on top of the bank, swelling of clays due to absorption of water, pressure of groundwater from within the bank, minor movements of the soil, and changes in stream channel shape.

  Stabilization of banks along roads and streams will prevent erosion and failure, both of which may contribute considerable amounts of sediment to surface waters. Preventing erosion and bank failure can also alleviate the need for expensive road repairs. Because such work may involve anything from vegetative plantings to complex construction of stonewalls and riprap slopes, it may be necessary for an on-site visit be made. Based upon the conditions noted at the site visit one or more BMPs or options may be available. Care should be taken when choosing a method. There are a number of trained biologists, hydrologists, and engineers in public and private agencies that can provide technical assistance on bank stabilization in Arkansas, including ANRC, ADEQ, NRCS, the U.S. Army Corps of Engineers,

the Arkansas Game and Fish Commission, The Nature Conservancy, the U.S. Fish and Wildlife Service and others.

- **Outlet Protection:**
  Outlet protection is important for controlling erosion at the outlet of a channel or culvert. Outlet protection works by reducing the velocity of water and dissipating the energy. Protections should be installed at every pipe, culvert, swale, diversions or other water conveyances where the velocity of flow may cause erosion at the pipe outlet and in the receiving channel. There are a number of outlet structures that can be used in a variety of situations. Outlet structures reduce the velocity of water carried by road ditches and culverts, therefore helping to control erosion and limit sedimentation. After passing through an outlet structure, water should outlet to areas with moderate slopes and vegetative filter zone before entering surface waters. This type of outlet, often referred to as daylighting, will allow for most of the sediments and other pollutants to be removed before runoff enters surface waters.

Construction Site BMPs

Construction activities normally result in soil disturbances on construction sites because of activities such as grading and clearing. BMPs should be used to contain sediment and prevent it from being transported off site. The following are techniques that can be used:

- Straw bale and waddle barriers should be bound, entrenched if applicable, and securely anchored to prevent deterioration. These barriers slows runoff flow and creates a pond behind the barrier where sediment can settle out. Straw bale and waddle barriers are most effective for filtering low storm flows, where structural strength is not required.
- Filter fabrics are engineering fabrics designed to retain sediment particles larger than a certain size and allow water to pass through. Filter fabrics can be used in silt fences or erosion control mats. Erosion control mats protect soil and seed from erosion and can be designed to allow vegetation to grow through the material.
- Silt fences are vertical fences of filter fabric that are entrenched and stretched across and attached to support poles. The fabric retains sediment on the construction site and allows relatively sediment-free water to pass through. Silt fences are placed to protect streams and surrounding property from sediment-laden runoff.
- Sediment basins are ponds created by excavation or the construction of a dam or barrier. Sediment basins primarily serve to retain or detain runoff to allow excessive sediment to settle out during construction. Sediment basins can be converted into permanent detention ponds or wetlands after construction.
- Stabilized entrances/exits reduce the amount of sediment carried off a construction site by vehicles. These entrances are designed to include stabilized pads of aggregate underlain with a filter fabric. Stabilized construction site entrances should be located at any point in the construction zone where vehicles enter and leave. Mud and debris should be adequately removed form wheels by washing or scraping before leaving a site if a stabilized entrance is not available.
- Stabilize upstream drainage areas before the construction of infiltration, bioretention or media filter BMPs.

Inspection BMPs

Inspection and maintenance of erosion- and sediment-control BMPs, both during and after construction, is important to ensure that BMPs are operating properly and effectively.

- Prepare and adhere to a schedule of regular maintenance for temporary erosion and runoff control BMPs. Maintenance operations should be performed regularly to maintain effectiveness include cleaning out accumulated sediment and replacing worn-out or deteriorated materials. Maintenance can include dredging and reshaping sediment basins and revegetating the slopes of grassed swales.
- Remove temporary BMPs from construction areas when they are no longer needed and replace them, where appropriate, with permanent BMPs.
- Schedule and periodically inspect and maintain permanent erosion and runoff controls. This should include a periodic visual inspection of permanent BMPs during runoff conditions to ensure that the controls are operating properly.
- Clean, repair, and replace permanent erosion and runoff control BMPs when necessary.

Roadside Landscape Maintenance BMPs

- Seeding and fertilizing promotes strong growth and provides long-term stabilization of exposed surfaces. Disturbed areas can be seeded during construction and after construction is completed. Sufficient watering and potentially refertilizing may be needed 30 to 40 days after the seeds germinate help establish dense growth. Fertilizer should be applied after the seeds germinate to allow for maximum uptake of available nutrients. This may reduce the risk of excess nutrients entering the adjacent streams.
- Overlaying cleared or freshly seeded areas with mulch or mats will assist to stabilize the area. Types of mulches include organic materials, straw, wood chips, bark or other wood fibers, or decomposed granite and gravel. Mats are made of natural or synthetic material and are used to temporarily or permanently stabilize soil.
- Wildflower cover has been successfully used by many state and county highway departments to provide attractive vegetation along roadways and erosion control. Careful consideration must be given to visibility, access, soil condition, climate, required maintenance and seed species when choosing sites for wildflower cover.
- Sodding with established grass blankets on prepared soil provides a quick vegetative cover to lessen erosion. Proper watering and fertilizing are important to ensure the vitality of newly placed sod.

Permanent Control BMPs

- Grassed swales are shallow, channeled grassed depressions through which runoff is conveyed. The grass slows the flow of runoff water, which allows sediment to settle out and water to infiltrate into the soil. Grassed swales can remove small amounts of pollutants such as nutrients and heavy metals. Check dams can be added to grassed swales to further reduce flow velocity and promote infiltration and pollutant removal.
- Filter strips are wide strips of vegetation located to intercept overland sheet flows of runoff. They can remove organic material, sediment, and heavy metals from runoff. Filter strips can consist of any type of dense vegetation from woods to grass but they cannot effectively treat high-velocity flows. They are therefore best suited to low-density developments.
- Terracing breaks a long slope into many flat surfaces where vegetation can become established. Small furrows are often placed at the edge of each terraced step to prevent runoff from eroding the edge. Terracing reduces runoff velocity and increases infiltration.
- Check dams are small temporary dams made of rock, logs, brush, limbs, or another durable material placed across a swale or drainage ditch. By reducing the velocity of storm flows, sediment in runoff can settle out and erosion in the swale or ditch is reduced.
- Detention ponds or basins temporarily store runoff from a site and release it at a controlled rate to minimize downstream flooding. Well-designed basins are highly effective pollutant removal tools. Effectiveness is greatest for suspended sediments (80 percent or more removal) and related pollutants such as heavy metals.
- Infiltration trenches are shallow, 3- to 8-feet deep (.91 to 2.44 m) excavated trenches that are backfilled with stone to create underground reservoirs. Runoff is diverted into the trenches, from which it percolates into the subsoil. Properly designed infiltration trenches effectively remove sediment from runoff and can remove some other runoff pollutants.
- Infiltration basins are relatively large, open depressions produced by either natural site topography or excavation. When runoff enters an infiltration basin, the water percolates through the bottom or the sides and the sediment is trapped in the basin. The soil where an infiltration basin is built must be permeable enough to provide adequate infiltration. Some pollutants, other than sediment, are also removed in infiltration basins.
- Constructed wetlands are areas inundated by water for a sufficient time to support vegetation adapted for life in saturated soil conditions. Wetlands effectively filter sediment, nutrients, and some heavy metals from runoff waters.

Instream Erosion

Restoration Approach and Prevention: Addressing unintended hydromodification resulting from land use changes and stream alteration requires a holistic approach. Entire reaches of stream instability should evaluated and restoration designs developed that will address not only streambank erosion, but aggradation or degradation. Habitat restoration should also be considered when developing a reach restoration design. Restoration designs include a multitude of factors and contain specified BMPs. In general, restoration designs should be based on an assessment of the stream's ability to transport its flow and sediment, while maintaining its dimension, pattern and profile. Reach restoration BMPs may include installation of grade control structures and rock veins, development of bankfull benches and re-establishing riparian areas.

Other approaches that could foster interest in restoration include:

- Encouraging the development of riparian buffer conservation easements through nonprofit organizations and local source water protection programs.
- Encouraging government agencies and nonprofit organizations to include streambank and other stream restoration techniques as elements of their conservation easement programs.
- Conducting an evaluation of stream restoration projects that have been implemented in the state and report on successes and failures.
- Using ANRC's wetland and riparian zone tax credit program to help finance streambank restoration projects. At this time, these programs are not funded and cannot finance restoration.

Common Best Management Practices Associated With Urban Runoff

Urbanization increases the variety and amount of pollutants carried into our nation's waters. In urban and suburban areas, much of the land surface is covered by buildings, pavement and compacted landscapes. These surfaces do not allow rain and snow melt to soak into the ground, which greatly increases the volume and velocity of stormwater runoff.

Stormwater gathers dust, debris, litter, animal waste and toxic substances as it flows across the ground and into storm drains. Residents and businesses can use BMPs to prevent polluted stormwater and thereby protect the water quality of streams, rivers, lakes and ground water. Oftentimes, a good best management practice at home can be a good practice for places of business, or vice versa. Business and residential practices are discussed in further detail.

Business Practices

Business owners and managers should take the time to educate employees about appropriate BMPs so they are aware of their impact on water quality and preventing pollution. Employees are often the first line of defense, especially when it comes to a spill. They should be aware of who to report an issue to, be kept informed of where BMP equipment or materials are kept and know how to effectively implement a BMP.

The following practices are geared toward the business place.

- **Vehicle Maintenance:** Many common vehicle maintenance and washing routines contribute to environmental pollution. Washing a vehicle in an area where water can flow into a storm drain or pouring used auto fluids into a gutter or storm drain pollutes the receiving stream or environment. Runoff from streets, parking lots and driveways may contain or contribute petroleum, petroleum products, chemicals, organic compounds, metals and asbestos to runoff. These chemicals, compounds or metals may drain into surface waters and disturb aquatic ecosystems or harm aquatic life.
    - *Cleaning/degreasing engines and equipment, auto and truck drive trains and airplanes (including landing gear):* Washwater should not be disposed of in storm drains. Typically this washwater requires treatment before discharge into the sanitary sewer system. Cleaning should take place on a wash pad, with or without soap. It would be best to discuss runoff needs with the facility operator.
    - *Truck trailer and boat cleaning (exterior only – food related)*: Sweep, collect and dispose of debris. Use dry cleaning methods as much as possible. Food residue must be disposed of as garbage or sent to the sanitary sewer. Avoid hosing down trailer. Washwater should not be discharged to the storm drain; it should be pumped to the sanitary sewer.

- *Truck trailer cleaning (interior only – where toxic substances may be encountered):* If toxic materials have been shipped in the trailer and there has been a spill, do not hose down the spill. Take immediate action to prevent the spread of the material and protect nearby storm drains.
- *Fleet vehicle washing (exterior only removing mainly soil – with soap):* Use wash pads that capture the washwater and discharge it to the sanitary sewer. Solids separation is required before disposal. Ideally, a separate wash area that captures washwater should be established. Use of temporary wash pads that can be drained to the sanitary sewer is also acceptable.
- *Taking caution near storm drains:* In areas near storm drains and an increased likelihood of wastewater entering the drains, washwater should be collected and pumped or otherwise discharged as follows:
  - Pumped or directed into sanitary sewer system clean-out opening or sink, or into an onsite private sanitary sewer manhole. Verify wastewater is not pumped or directed to a storm drain system.
  - Implement and completed solids separation before disposal.
  - Washwater may be discharged into an appropriate sized and approved vegetated area or landscaped area. Compounds contained in the wastewater may adversely affect the disposal area.

  Repetitive use or excessive wash volume to the same area may require permitting or approval from state and federal agencies. Discuss this practice with the property or facility owner. If proper or approved disposal is not possible, contact the appropriate state or federal agency for information.
- *Mobile auto detailing and cleaning boat (infrequent, light cleaning, rarely at same location; removing mainly soil, with minimum water volume) – with Soap:* Minimal runoff may remain on paved surfaces to evaporate. If there is sufficient water volume to reach the storm drain, seal the storm drain and pump the water to the sanitary sewer. For landscaped or soil areas, discharge should be directed to an area sufficient to contain the water. Discuss this practice with the property owner. Acceptable for minimal discharge flows. Repetitive use of the same area or excessive wash volume to the same area may be regulated.
- *Boat cleaning (where paint chips are being removed in preparation for painting)*: Filtered washwater must be discharged to sanitary sewer. Contact the local wastewater treatment plant for more information. Dispose of paint particles appropriately according to paint type (e.g., if paint is lead-based, copper-based or contains tributyltin or PCBs, consult the local wastewater treatment plant and hazardous waste for information on disposal of hazardous waste). If non-hazardous, material may be disposed of as solid waste after filtered paint particles have dried. This BMP is not intended to address the disposal of paint waste.

- **Shop Area Cleaning (interior cleaning of vehicle shop areas and paint booths):** Do not hose down shop floor into streets or parking lots. It is best to dry sweep regularly. Use nontoxic cleaning products. Baking soda paste works well on battery heads, cable clamps and chrome. Mix the baking soda with a mild biodegradable dishwashing soap to clean wheels and tires. For windows, mix white vinegar or lemon juice with water. To reduce or eliminate the generation of waste, fix sources of drips or leaks where possible. Routinely inspect the engine compartment and regularly replace worn seals on equipment.

  Do the following to avoid or control spills and leaks:

  1. Prepare and use easy-to-find spill containment and cleanup kits. Include safety equipment and cleanup materials appropriate to the type and quantity of materials that could spill.
  2. Pour clay-based cat litter, sawdust, cornmeal or other absorbents on spills.
  3. Change fluids carefully. Use a drip pan to avoid spills. Prevent fluid leaks from stored vehicles. Drain fluids such as unused gas, transmission and hydraulic oil, brake and radiator fluid from vehicles or parts kept in storage. Implement simple work practices to reduce the chance of spills.

4. Use a funnel when pouring liquids (i.e., lubricants or motor oil), and place a tray underneath to catch spills. Place drip pans under the spouts of liquid storage containers.
5. Clean up spills immediately using dry cleanup methods.
6. Never hose down a spill.

- **Property Maintenance:**
  Many common surface cleaning and washing routines contribute to environmental pollution. Washing buildings or paved surfaces into a gutter or storm drain may pollute or impact the environment. Water runoff from buildings, streets, parking lots and driveways can pick up sediment, debris and oil. These pollutants drain into surface waters, harming aquatic life.

- **Food-Related Business Activities:**
  The byproducts of food-related cleaning can harm the environment if they enter the storm drain system. Food businesses can cause harm by putting food waste in leaky dumpsters, not cleaning up outdoor food or chemical spills or by washing outdoor spills into the storm drain system. Other routine activities such as cleaning facility or transportation equipment can be sources of pollution. If not properly disposed, chemicals or compounds may be washed into the storm drains system during storm or wash down events.

    - *Conduct employee and client education:* Employees can help prevent pollution when you include water quality training in employee orientation and reviews. Promote good housekeeping practices. Common practices include:
      - Storage containers should be regularly inspected and kept in good condition.
      - Place materials inside rigid, durable, water-tight and rodent-proof containers with tight fitting covers. If appropriate containers or receptacle are not readily available, place plastic sheeting over materials or containers and secure the cover with ties and weighted objects. (Not appropriate for storing liquids).
      - Store materials inside a building or build a covered area that is paved and designed to prevent runoff from entering storm drains.
      - Develop written procedures and related actions regarding cleaning, cleaning compounds, proper disposal methods, chemical precautions and environmental concerns. Post or provide the information to employees and customers as appropriate.
      - Raise employee and customer awareness by stenciling storm drains near the work place.

- **Cleaning:**
    - *Cleaning restaurant floor mats, exhaust filters, etc.:* Do not wash restaurant or food industry-related equipment outdoors. Clean floor mats, filters, etc., inside building with discharge to a sanitary sewer (sink or floor drain). Cover, repair or replace leaky trash receptacles and compactors, and/or drain the pavement beneath them to the sewer. Rain can wash oil, grease and substances into storm drains. Wash greasy equipment such as vents and vehicles in designated wash areas with an appropriate oil/water separator before storing outside. Ensure that designated wash areas are properly connected to the sewer system.
    - *Washing grocery carts (with soap):* Washwater must be captured, filtered for particulates and pumped or drained to the sanitary sewer.
    - *Washing grocery carts (without soap):* Washwater must be captured, filtered for particulates and pumped or drained to the sanitary sewer. If hot water is used, hot or warm water discharge to a storm drain or channel is prohibited. Washwater may be discharged to the storm drain through a filter barrier (e.g., booms) to filter out debris.
    - *Wash down of lunch wagons/food carts:* Washwater must be discharged at a commissary equipped to accept and discharge wastewater to the sanitary sewer system. Never discharge any washwater (except melted ice) to gutters or storm drains. Trucks and carts and any equipment should be cleaned on a properly equipped wash pad.
    - *Mop water:* Dirty mop water should be disposed of through the sanitary sewer system if there are no contaminants in the water such as oil, antifreeze or heavy metals.

- **Waste Disposal:**
    - *Kitchen waste grease:* Never dispose of waste grease in the storm drain or storm channel or into the sanitary sewer system. Grease allowed to enter the sanitary sewer system will accumulate and cause blockages that can result in backups and overflows. Contact a grease disposal company.
    - *Trash disposal:* Trash includes all items that are discarded from a business with no intent for re-use. When trash is not properly placed in a trash bag and securely closed, it is vulnerable to being blown away and becoming litter. Trash can end up in stormwater that is transported to waterbodies, which is opposite of the desired outcome.
    - *Dumpster use:* Dumpsters should always have the lids closed, as trash easily and frequently blows away from uncovered waste containers and into the environment. Rainfall that interacts with trash can leach and transport hazardous materials and other potential pollutants from the trash to surface waters.
    - *Toxic waste disposal:* Toxic waste includes used cleaners, rags (soaked with solvents, floor cleaners and detergents) and automotive products (such as antifreeze, brake fluid, radiator flush and used batteries). Contact ADEQ for information about proper disposal.
    - *Kitchen waste disposal:* Purchase recycled products. By doing so, you help ensure a use for recyclable materials. Recycle the following materials:
        - Food waste (non-greasy, non-animal food waste can be composted)
        - Paper and cardboard
        - Glass, aluminum and tin containers
        - Pallets and drums
        - Oil and grease

- **Management of Outdoor Animal-Related Areas:**

  Animal waste from horses, livestock or domestic pets contribute to water pollution when the waste is improperly stored or left uncovered near small streams and storm drains. During rainfall, it is washed into storm drains and flows untreated directly into surface waters.

  Animal waste contains some nutrients – phosphorus and nitrogen – as well as bacteria. The nutrients fertilize the aquatic plants causing their proliferation, which depletes oxygen in the water, killing water life. The high bacteria levels in the water can cause gastrointestinal disorders and other medical problems.

  Sediment is also a common pollutant washed from pastures, hobby farms or other high-use areas used to house domestic animals. It creates multiple problems once it enters surface waters.

    - *Location and facilities design:* Locate barns, corrals or other high-use areas on the portion of property that drains away from the nearest street or storm channel. Outdoor runs and pens should be sited on flat areas and avoid areas subject to surface water runoff. Install gutters that will divert runoff away from livestock area.

      Design diversion terraces that drain into areas with sufficient vegetation to filter the flow. Protect manure storage facilities from rainfall and surface runoff. If outdoor pens and runs are roofed, the likelihood of waste runoff is greatly reduced. Diversions should be employed to keep rainwater from moving through exercise areas and runs
    - *Pasture management:* Confine horses in properly fenced areas except for exercise and grazing time. Corrals, stables and barns should be located on higher ground when possible and surrounded by pasture to act as a natural filtration system.

      Use fencing to keep horses away from environmentally sensitive areas and protect stream banks from contamination. Use manure and soiled bedding sparingly to fertilize pastures and croplands.
    - *Grazing management:* Establish healthy and vigorous pastures with at least 3 inches of leafy material present. Subdivide grazing areas into three or more units of equal size. Clip tall weeds and old grass to control weeds and stimulate grass growth. Rotate animals to clean pasture when grass is grazed down to 3 to 4 inches. Let pasture regrow to 8 to 10 inches before allowing another grazing. Keep animals away from wet fields when possible. During heavy rainfall, consider indoor feeding or constructing protective heavy-use areas,

which keeps more manure under a roof and away from runoff.

- *Manure collection and storage:* Collect soiled bedding and manure on a daily basis from stalls, paddocks and yards and place in temporary or long-term storage units. Store in sturdy, insect-resistant and seepage-free units such as:
  - Plastic garbage cans with lids
  - Fly-tight wooden or concrete storage sheds
  - Composters
  - Pits or trenches lined with an impermeable layer
- *Manure use and disposal:* Compost soiled bedding and manure for own use. Give away composted material to local greenhouses, nurseries and botanical parks. Transport manure to topsoil companies or composting centers. Fertilize pastures, cropland and lawns with manure and soiled bedding. Pasture fertilization should be in accordance with a nutrient management plan if application site is in a nutrient surplus zone. Generally, commercial pet facilities should be incorporating pet waste into properly sized private septic systems or into the municipal wastewater treatment system.

Residential Activities

What people do in and around their homes can affect water quality in nearby lakes and streams through the water that runs off a single-family yard or apartment complex. The flowing runoff collects and transports soil, pet waste, pesticides, fertilizer, oil and grease, leaves, trash and other potential pollutants. Following are some common best management practices related to cleaning activities and household hazardous materials. Landscaping, lawn maintenance and pet waste disposal are discussed later in this section.

- **Water Disposal:**
  Wastewater generated from cleaning homes, drive ways, patios and decks can harm the environment if they enter the storm drain system. Washing the exterior of homes or paved surfaces into a gutter or storm drain pollutes the environment.

  Water runoff from these activities can pick up sediment, debris and oil. These pollutants drain into surface waters, harming aquatic life. Oil and grease, for example, clog fish gills and block oxygen from entering the water. If oxygen levels in the water become too low, aquatic animals die. And, toxins found in degreasers and cleaners can, in high concentrations, harm aquatic life.

  - *Washing mobile homes, decks, roofs/shingles, awnings, pool decks and patios:* Discharge washwater to landscaped or soiled area. Be aware that soapy water may adversely affect landscaping. Discharge should be directed to an area large enough to contain all the water. Discuss this practice with the property owner.

    Treated wood shingles are often treated with a toxic material. Treated shingles should be dry swept only. Runoff from cleaning may be toxic to plants in a landscaped area and should never be discharged to the storm drain or sanitary sewer.
  - *Pool draining:* Pool draining into the street or storm drain may be against city and county ordinances. Contact local wastewater or solid waste district officials for requirements and additional information.
- **Household Hazardous Waste Disposal:**
  Household hazardous waste is defined as common everyday products that people use in and around their homes including paint, paint thinner, herbicides and pesticides that, due to their chemical nature, can be hazardous if not properly disposed.

  As a rule, people who generate household hazardous wastes should not pour them down the sink or put them in the regular trash unless they are certain the wastes are non-hazardous to humans or the environment. In general, only non-hazardous solids should be disposed of in the regular trash.

  When possible, buy only the amount of product needed so there are no leftovers to dispose of or store. Read the label before purchasing a product. Often, two products will do the same job, but one requires special disposal and the other does not.

  For example, latex paint versus solvent-based paint. Latex paint is water-based and is not classified as hazardous, while solvent-based paints are considered a hazardous material. In addition, other hazardous materials, such as turpentine or mineral spirits, are required for clean up when using a solvent-based paint. Soap and water are

all that are needed to clean up after using latex paint. The clear choice from an environmental perspective is latex paint. When possible, avoid purchasing products with POISON, DANGER, WARNING, FLAMMABLE, TOXIC, CORROSIVE or CAUTION on the label.

If potentially hazardous products must be purchased, read and follow the label directions. Store these items in their original container and never remove the label. Keep all hazardous products stored in a location away from children, and out of their reach.

- *Read the label:* Many products offer toll-free numbers with operators who can provide information on properly disposing of their product, or the label itself may provide instructions on proper disposal. Share unused material. Give it away to friends, relatives or neighbors who can use it. Never share materials that are not in their original container or that have been tampered with in any way.
- *Household hazardous waste collection events:* Take leftover hazardous materials to household hazardous waste collection events or facilities. Contact local solid waste district officials to find out the schedule for household hazardous waste events. Material should be tightly sealed in its original container, if possible, and placed in a cardboard box. Glass containers should be wrapped in towels, cloth or packaged in some other way to prevent breakage. Materials should be transported to the event in the trunk or bed of a vehicle.

  Items generally accepted at collection events include:

  - Automotive fluids
  - Household cleaners
  - Pool acids/chlorine
  - Solvents and thinners
  - Paints/stains/varnishes
  - Household and car batteries
  - Electronics

  Items generally not accepted at collection events include:

  - Ammunition
  - Medical waste
  - Explosive material
  - Radioactive material

- **Trash and Recyclables:**
  When trash is not properly placed in a trash bag and securely closed, it is vulnerable to being blown away and becoming litter. The same thing with unsecured recycling bins. These items can end up in stormwater that is transported to waterbodies, which is opposite of the desired outcome. Trash or recycling containers should always have the lids closed. Rainfall that interacts with trash can leach and transport hazardous materials and other potential pollutants from the trash to surface waters.

- **Landscaping and Lawn Maintenance:**
  Landscaping and garden maintenance activities can be major contributors to pollution and stream bank erosion. Soil, yard waste, over watering and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters and storm drains before entering surface waters. Poorly functioning sprinklers and over watering, for example, waste water and increase the number of pollutants flowing into storm drains.

  Fertilizers, pesticides and herbicides can be washed off lawns and landscaped areas when improperly applied. These chemicals not only kill garden invaders, they also harm useful insects and contaminate ground and surface water. Bare spots in lawns should be addressed because they can contribute to erosion and sediment entering storm drains.

  Leaves, grass clippings and tree trimmings that are swept or blown into the street and gutter are also polluters. These wastes clog catch basins, increasing the risk of flooding on streets, and carry garden chemicals into surface waters. As they decompose, they also absorb oxygen aquatic life need to survive. Clearing or removing streambank vegetation also is a contributor to streambank erosion and sedimentation problems in Arkansas.

  - *Garden location and site design:* Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting. Schedule grading and excavation projects for dry weather. Prevent erosion by planting fast-growing annual and perennial grasses. These will shield and bind the soil.
  - *Fertilizer:* Before applying any fertilizer, test your soil to discover how much fertilizer is actually needed. Your local county

Cooperative Extension Service office can assist you in testing soil samples for free.

- Follow USDA guidelines and label requirements when applying, storing and disposing of fertilizers.
- Use organic or non-toxic fertilizers if possible. Calibrate application equipment prior to application to prevent over application.
- Do not apply fertilizer near streets, storm drains, streamside buffers or other waterbodies.
- Store pesticides, fertilizers and other chemicals in covered areas to prevent runoff. If overspray occurs, sweep or vacuum oversprayed fertilizers and pesticides to prevent runoff into the storm drain during storm events. Do not apply fertilizer just before or during rainstorms.

◦ *Pesticide Use:*Commercial pesticide use is regulated by the Arkansas State Plant Board. The "chemicals-only" approach to pest control is only a temporary fix. A more common sense approach is needed for a long-term solution: Integrated Pest Management. Pest proofing your home is the best way to prevent unwanted invaders at this time or any other time of year.

Plan an "IPM" strategy in this order:

1. Physical Controls
   - Caulking holes or hand-picking
   - Barriers or traps
2. Biological Controls
   - Predatory insects (e.g. Green lacewings eat aphids)
   - Bacterial insecticides (e.g. *Bacillus thuringiensis* kills caterpillars)
3. Chemical Controls – Last Resort
   Use these least-toxic products:
   - Dehydrating dusts (e.g. silica gel)
   - Insecticidal soaps
   - Boric acid powder
   - Horticultural oils
   - Pyrethrin-based insecticide

◦ *Pesticide Disposal:* Household toxics such as pesticides, cleansers and motor oil can pollute surface and ground water if disposed of in storm drains or gutters. Rinse empty pesticide containers and treat rinse water as you would the product. Dispose of empty rinsed containers in the trash. Dumping toxics into the street, gutter or storm drain violates federal stormwater regulations. To dispose of household hazardous waste, contact local solid waste district officials or the University of Arkansas Division of Agriculture Cooperative Extension Service for instructions. Non-recyclable materials must be taken to an appropriate landfill or disposed of as hazardous waste.

◦ *Lawn Watering:* Discharging irrigation water to the storm drain system should be avoided. Over watering can transport pollutants like pet waste, fertilizers, and pesticides into the streets and eventually into the stormwater system. Help protect stormwater by following these simple lawn and household water guidelines:

- Adding or removing one minute from the watering time will change the amount of water you use by 25 percent.
- Don't water when it's windy or rainy.
- Schedule start times at least one hour apart. Use the cycle and soak method of watering.
- If the timer has a "skip day" mode, water lawns four to five days apart in

Safe Substitutes for Pest Control

- **Garden Aphids and Mites:** Mix 1 tablespoon of liquid soap and 1 cup of vegetable oil. Add 1 teaspoon of this mixture to a cup of water and spray. (Oil may harm vegetable plants in the cabbage family.)
- **Caterpillars:** When caterpillars are eating, apply products containing *Bacillus thuringiensis* to leaves.
- **Ants:** Place boric acid powder or hydramethylnon baits in problem areas, cracks and insect walkways. It is a mild poison, so be sure it is inaccessible to children and pets.
- **Roaches:** Apply boric acid powder to cracks and entry points (see ants above). Place bay leaves on pantry shelves.

If a pesticide must be applied, use one that is specifically designed to control the pest. The insect should be listed on the label. Approximately 90 percent of the insects on a lawn and garden are not harmful. Use pesticides only as directed.

the winter and two to three days apart in the spring and fall.
    - Check and adjust sprayers so that water doesn't fall on sidewalks, driveways and streets and run off site.

- *Erosion:* Even on gentle slopes, water from rain can remove large amounts of soil and deliver it to rivers and lakes. Planting grass or other groundcover is the best way to stop erosion. Putting straw or chip mulch over gardens or newly seeded areas will slow erosion.

  Slowing the flow of water as it moves through the property can help prevent erosion. Landscape low areas with shrubs and flowers adapted to wet conditions, which is sometimes known as a rain garden. More information about rain gardens can be found on the Cooperative Extension Service's website, www.uaex.edu. On steep slopes, build terraces or retaining walls to help prevent soil loss or incorporate rocks to help slow down water.

- *Lawn Waste Disposal:* Do not blow or rake leaves into the street, gutter or storm drains. In communities with curbside yard waste pickup, place clippings and pruning waste in approved containers for pickup or take clippings to a composting facility. Home composting may also be an option. Find more information about composting practices on the Cooperative Extension Service's website.

- **Pet Waste Disposal:**
  Pet waste contributes to bacterial contamination of streams, rivers and lakes. It contains bacteria such as E. coli and fecal coliform. Waters that contain high levels of bacteria are unfit for human contact. Pet waste also contains nutrients that can cause excessive amounts of algae to grow in waterways and can contribute to lowering dissolved oxygen in the water. Pet waste should be picked up regularly and disposed of in one of the following ways:

  - Flush down toilet.
  - Put it in the trash.
  - Bury it. Dig a hole about 6 inches deep and let nature do its thing. If you use compostable bags or gloves to pick up the waste, it can be buried all together but it will take longer to breakdown inside the bag.
  - Compost it. Dog waste can be composted but the compost SHOULD NOT be used in a garden or around edible plants.
  - Flush it from the outside. Send feces to the wastewater treatment plant without walking inside. Specials caps for a home's clean out drain will allow the waste to be disposed of in the already existing sewage system – DO NOT put the bag into the system.
  - Get your pet their own system. Digesters or pet septic units are easy to install and can be found for less than $100 in most cases.

- **Low Impact Development (LID):**
  The use of low-impact development strategies in urban areas have become more popular in recent years as a way to reduce erosion and nonpoint source pollution while mimicking a site's natural hydrology as the landscape is developed. LID focuses on materials used in constructing buildings and streets, and the design and landscaping used in parking lots, lawns and open spaces.

  Examples of LID include green roofs, bioswales, rain barrels and rain gardens, porous pavers and vegetated filter strips. More information about LID practices can be found at http://uacdc.uark.edu/models/low-impact-development/. These practices can benefit business, residential and municipal properties.

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Section Ten

Common Nonpoint Source Pollutants

2018-2023 NPS Management Plan

Introduction

Nonpoint source pollution, or NPS as it's frequently called, is generally caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, streams, wetlands and even underground sources of drinking water.

Typically, land use and land cover can dictate pollutants and their loads. Rain or runoff may increase in volume and velocity as vegetation is removed or altered, or soil disturbance increases and pervious surfaces decrease. As volume and velocities increase, the ability of pollutants to move also increases.

The following pages provide an overview of common NPS pollutants in context of land uses described in fuller detail earlier in the NPS Management Plan.

Pollutants Associated With Agriculture

Sediment

Excess sediment can smother benthic organisms. It can also cover critical stages of fish eggs and early life stages causing increased mortality. Sediment can interfere with photosynthesis by reducing light penetration and may fill in waterways, hindering navigation and increasing flooding. Sediment particles from agricultural lands typically carry nutrients, pesticides and other organic compounds into waterbodies.

Soil erosion is a natural process whereby soil particles are detached from the soil surface and become mobile. However, soil disturbance activities may increase soil particle movement. Frequently, some of these eroded soil materials, along with the undesirable chemicals dissolved in runoff water or attached to soil particles, are transported by the runoff water from land surfaces into bodies of water.

Nutrients

Nutrients are necessary to plant growth in a waterbody, but over-enrichment may lead to excessive algae growth, an imbalance in natural nutrient cycles, changes in water quality, especially dissolved oxygen and pH, and a decline in the number of desirable fish and macroinvertebrate species. Factors influencing nutrient losses are precipitation, temperature, soil type, kind of crop, land cover, nutrient mineralization and denitrification.

In general, runoff from watersheds in areas of agricultural use has significantly higher nutrient concentrations than drainage waters from forested watersheds. Increased nutrient levels may result from fertilizer application and animal wastes. Soluble nutrients may enter surface and ground water through runoff or infiltration. Others may be adsorbed onto soil particles and reach surface waters with eroding soil.

In 2003, the Arkansas General Assembly passed a law declaring specific regions of the state as Nutrient Surplus Areas (NSAs) for phosphorus and nitrogen. The Arkansas Soil Nutrient Application and Poultry Litter Utilization Act of 2003 defined Nutrient Surplus Areas as areas "in which the soil concentration of one or more nutrients is so high or the physical characteristics of the soil or area are such that continued application of the nutrient to the soil could negatively impact soil fertility and the waters within the state."

In these areas, special efforts are made to manage all sources of nutrient application. The Arkansas Natural Resources Commission (ANRC) is charged with administering statutes that apply to NSAs, including:

- The certification of applicators who apply nutrients to crops or pasture land;
- The certification of nutrient management plan writers or Comprehensive Nutrient Management Plan writers in cooperation with Natural Resources Conservation Service;
- Registering all poultry feeding operations; and
- Requiring development and implementation of nutrient management and poultry litter management plans.

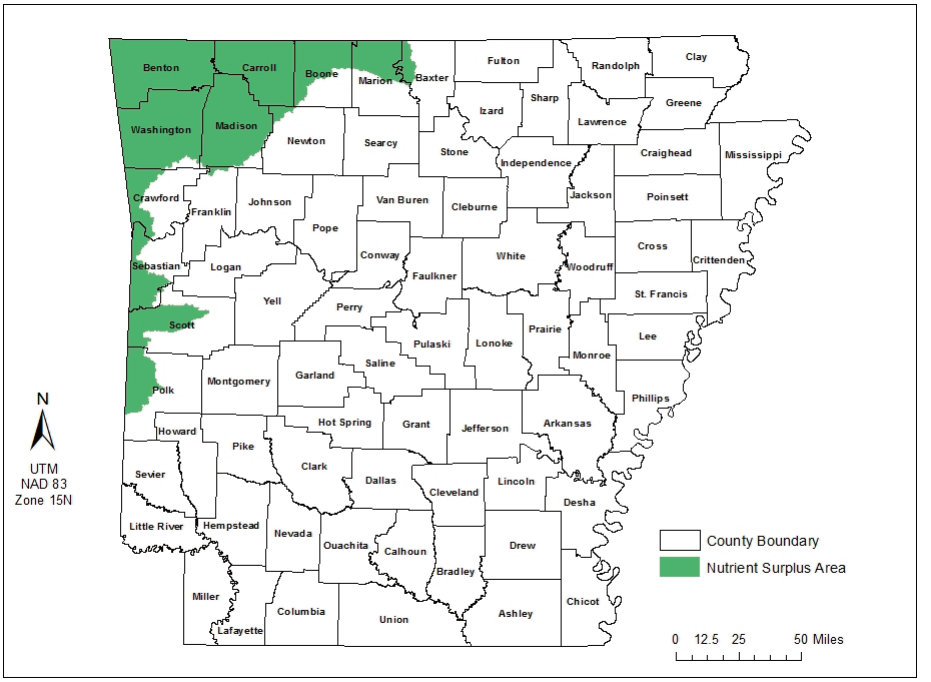
Nutrients of specific concern include:

Nitrogen

Excessive amounts of nitrogen may contribute to nutrient enrichment of waterbodies, stimulating algae blooms or other aquatic plant growth that may result in reduced dissolved oxygen levels.

Figure 10.1
Arkansas Nutrient Surplus Areas

Source: Arkansas Natural Resources Commission
Data Source: GeoStor
Map Created: March 2017



In addition to contributing to eutrophication, excessive nitrogen causes other water quality problems. Dissolved ammonia may be toxic to fish and freshwater mussels, depending on the concentration of ammonia in the water, the pH and the temperature of the water. High nitrate levels in drinking water are potentially dangerous, especially to infants. Nitrate is converted to nitrite in the digestive tract, reducing the oxygen-carrying capacity of the blood (methemoglobinemia) and resulting in brain damage or even death. The Environmental Protection Agency has set a limit of 10 mg/L nitrate-nitrogen in water used for human consumption (National Primary and Secondary Drinking Water Regulations, 1989).

Nitrogen is naturally present in soils within organic matter but often must be added for crop production. Nitrogen is added to the soil primarily by applying commercial fertilizers and manure, but also by growing legumes (biological nitrogen fixation) and incorporating crop residues. Not all nitrogen present in or on the soil is taken up for plant use at any one time. For example, in the eastern Corn Belt, it is normally assumed that about 50 percent of applied nitrogen is assimilated by crops during the year of application (Nelson, 1985).

Organic nitrogen normally constitutes the majority of the soil nitrogen. It is slowly converted (2 to 3 percent per year) to the more readily plant-available inorganic ammonium or nitrate. Organic nitrogen occurs as particulate matter in living organisms and as detritus. It occurs in dissolved form in compounds such as amino acids, amines, purines and urea. Inorganic forms of nitrogen are ammonium (NH_4), nitrate (NO_3) and nitrite (NO_2).

All forms of nitrogen within soil can affect water quality, but the inorganic chemical forms of nitrogen are generally most mobile, and thus of most concern as pollutants. Nitrate is highly mobile and can move readily below the crop root zone, especially in sandy soils. It can also be transported with surface runoff, but not usually in large quantities. Ammonium can become adsorbed by the soil and lost primarily with eroding sediment. Even if nitrogen is not in a readily available form as it leaves the field, it can be converted to an available form either during transport or after delivery to waterbodies.

Phosphorus

Phosphorus is rarely found in concentrations high enough to be toxic to higher organisms. However, phosphorus can contribute to the eutrophication of waterbodies and, in freshwater, it often is the limiting or controlling factor for eutrophication. Algae and other aquatic plants may consume dissolved inorganic phosphorus and convert it to the organic form. Manure and fertilizers increase the level of available phosphorus in the soil to promote plant growth, but many soils now contain higher phosphorus levels than plants need (Novais and Kamprath, 1978).

Phosphorus can be found in the soil in dissolved, colloidal or particulate forms. Runoff and erosion may potentially carry phosphorus that has been surface applied to nearby waterbodies. Dissolved inorganic phosphorus (orthophosphate phosphorus) is generally the only form directly available to aquatic plants. Particulate and organic phosphorus delivered to waterbodies may later be released and made available to algae or other aquatic plants if the bottom sediment of a stream becomes anaerobic, which can result in eutrophication or negatively affect aquatic life.

Organic Material

Animal waste and crop debris are the primary organic pollutants that result from agricultural activities. These materials can place an oxygen demand on receiving waters upon decomposition. If dissolved oxygen levels decrease and remain low, fish and other aquatic species will be stressed and/or die.

Fish kills may result when runoff, wastewater or manure enter surface waters, due to ammonia or dissolved oxygen depletion. The decomposition of organic materials can deplete dissolved oxygen supplies in water, resulting in anoxic or anaerobic conditions. Methane, amines and sulfide are produced in anaerobic waters, causing the water to acquire an unpleasant odor, taste and appearance. Such waters can be unsuitable for drinking, fishing and other recreational uses.

Solids deposited in waterbodies can accelerate eutrophication through the release of nutrients over extended periods of time. Because of the high nutrient and salt content of manure and runoff from manure-covered areas, contamination of groundwater can be a problem if storage structures are not built to minimize seepage. Animal feces may carry pathogens with the potential to cause diseases in humans. Runoff from fields receiving manure may contain increased numbers of bacteria if the manure has not been incorporated or the bacteria have not been subject to stress.

Pesticides

The term *pesticide* includes any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest or intended for use as a plant regulator, defoliant or desiccant. The principal pesticide pollutants that may be detected in surface water and in ground water are active and inert ingredients and any persistent degradation products. Pesticides and their degradation products may enter ground and surface water in solution, in emulsion or bound to soil colloids. For simplicity, the term *pesticides* will be used to represent "pesticides and their degradation products" in the following sections.

There are documented benefits of using pesticides (insecticides, herbicides, fungicides, miticides, nematicides, etc.) to control plant and animal pests and enhance production, but these chemicals may cause impairments to the uses of surface water and ground water. Some types of pesticides are resistant to degradation and may persist and accumulate in aquatic ecosystems for decades.

Pesticides are inherently toxic and may harm the environment by eliminating or reducing populations of desirable organisms. Pesticides in high enough doses can cause acute toxicity or sublethal toxicity, which includes more chronic effects such as behavioral and structural changes of an organism that jeopardize its survival. For example, certain pesticides have been found to inhibit bone development in young fish or to affect reproduction.

Herbicides in the aquatic environment can destroy the food source for higher organisms, which may then starve. Herbicides can also reduce the amount of vegetation available for protective cover and the laying of eggs by aquatic species. Also, the decay of plant matter exposed to herbicide-containing water can cause reductions in dissolved oxygen concentration (North Carolina State University, 1984).

A source of contamination from pesticide use is the result of normal application over time, misapplication or misuse. Other sources of pesticide contamination include atmospheric deposition, spray drift during the application process, spills, leaks and discharges that may be associated with pesticide storage, handling and waste disposal.

The primary routes of pesticide transport to aquatic systems are (U.S. Environmental Protection Agency, 2003):

- Direct application
- In runoff
- Aerial drift
- Volatilization and subsequent atmospheric deposition
- Uptake by biota and subsequent movement in the food chain

The amount of applied pesticide that leaves a field in the runoff and enters a stream primarily depends on the:

- Molecular structure
- Intensity and duration of rainfall or irrigation

- Length of time between pesticide application and rainfall occurrence
- Amount of pesticide applied and its soil/water partition coefficient
- Length and degree of slope and soil composition
- Extent of exposure to bare (vs. residue or crop-covered) soil
- Proximity to streams
- Method of application
- Extent to which runoff and erosion are controlled with agronomic and structural practices

Pesticide losses are generally greatest when rainfall is intense and occurs shortly after pesticide application, a condition for which water runoff and erosion losses are also greatest. Pesticides can be transported to receiving waters either in dissolved form or attached to sediment. Dissolved pesticides may be leached to ground water supplies. Both the degradation and adsorption characteristics of pesticides are highly variable.

Pollutants Associated With Silviculture

Compared to agriculture, the magnitude of nonpoint source pollution from silvicultural activities is generally less. However, forestry operations, such as timber harvesting and road construction, have the potential to degrade water quality in waterbodies receiving drainage from forest lands when BMPs are not followed, particularly in vulnerable headwater streams. These potential increases in water quality contaminants discussed below are usually proportional to the severity of site disturbance.

Pollutants typically associated with silviculture are discussed below along with some historical context.

Sediment

Sediment is typically the primary pollutant associated with forestry activities. Soil erosion is the detachment and movement of soil particles from the soil surface. Sediment yield is the amount of eroded soil material that actually enters waterbodies. Sediment that reaches waterbodies can be particularly detrimental to benthic organisms and many fish species when it covers food sources and spawning sites and smothers bottom-dwelling organisms and periphyton. Suspended sediments increase turbidity, adversely affecting aquatic vegetation photosynthesis and aquatic organism respiration. Turbid waters tend to have higher temperatures and lower dissolved oxygen concentrations. A decrease in dissolved oxygen levels can stress and/or kill aquatic vegetation, fish and benthic invertebrates.

Nutrients are also known to adhere to or be absorbed into sediment particles and could increase the amount of nutrients available in waterbodies, which could lead to increased water quality degradation.

Nutrients

Nutrients from forest fertilizers, such as nitrogen and phosphorus attached to soil particles and sediments, in solution, or transported by aerial deposition, can cause harmful effects in receiving waters. Excessive amounts of nutrients may cause enrichment of waterbodies, stimulating excess aquatic plant growth or algal blooms. Large blooms can result in reduced dissolved oxygen levels. This process, termed *eutrophication*, depletes the dissolved oxygen aquatic organisms need to survive.

Pesticides

Herbicides, insecticides and fungicides used to control forest pests and undesirable plant species can be toxic to aquatic organisms. Pesticides that are applied to foliage or soils are most readily transported to surface waters and potentially groundwater. Other chemicals that may be released during forestry operations include fuel, oil and coolants used in equipment for harvesting and road building operations.

Organic Debris

Organic debris includes residual logs, slash, litter, and soil organic matter generated by forestry activities. These materials place an oxygen demand on receiving waters upon decomposition. If dissolved oxygen levels decrease to low levels and remain low, fish and other aquatic species may be stressed and/or die. In addition, logging slash and debris dumped into streams can alter stream flows, increasing bank cutting and resulting sedimentation. However, in some ecosystems, small amounts of naturally occurring organic material can be beneficial to fish production.

Temperature

Increased temperatures in streams and waterbodies can result from vegetation removal in the riparian zone from either harvesting or herbicide use. Temperature increases can be dramatic in smaller headwater streams, adversely affecting aquatic species and habitat. Increased water temperatures can also decrease the dissolved oxygen holding capacity of a waterbody.

Pollutants Associated With Surface Erosion

Sediment

Soil erosion is the detachment and movement of soil particles from the soil surface. Frequently, some of these soil materials and the undesirable chemicals dissolved in runoff water or attached to soil particles are transported by the runoff into bodies of water. The percentage of soil that moves into bodies of water from eroding lands is variable. Sediment yield depends on the size of soil particles being transported, slope of the land and distance to the nearest waterbody, density of the vegetation the sediment has to move through, the shape of the drainage way and the intensity of the rain event.

Sediment sources of instream erosion include materials eroded by the sheer stress of the flow and the mass wasting of streambanks as the toe of the bank slope is eroded. Another source of sediment can come from a stream that is downcutting. Disturbances within the bankfull channel can also be a source. Activities such as resource extraction, instream construction and dredging can introduce fine sediment by dislodging soil, making it available for transport in the stream. Sediment from these sources can increase the stream turbidity concentrations and increase the potential for siltation, which in turn affects the aquatic habitat and the quality of downstream impoundments.

The quantity of soil loss from unpaved roads can be estimated by use of the water erosion prediction model developed by the U.S. Department of Agriculture that can be found at http://forest.moscowfsl.wsu.edu /cgi-bin/fswepp/wr/wepproad.pl. Predictions of areas with the potential for water quality problems can be made in combination with land use, climatological data and other data.

Nutrients

Soluble nutrients may reach surface water and groundwater through runoff or percolation. Others may be adsorbed or adhere to soil particles and reach surface waters as those particles are transported. Nutrients are necessary to plant growth in a waterbody, but over-enrichment leads to excessive aquatic plant growth; an imbalance in natural nutrient cycles; changes in water quality, especially dissolved oxygen concentrations; and a decline in the number of desirable fish species. Factors influencing nutrient losses include precipitation, temperature, soil type(s), types of vegetation, nutrient mineralization, denitrification, distance to waterbodies, percent of vegetative cover and the presence and size of riparian buffers or other best management practices.

Pesticides

The term *pesticide* includes any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest or intended for use as a plant regulator, defoliant or desiccant.

Despite the documented benefits of using pesticides (insecticides, herbicides, fungicides, etc.) to control plant pests and enhance production, these chemicals may in some instances cause impairments to the uses of surface water and ground water. Some types of pesticides are resistant to degradation and may persist and accumulate in aquatic ecosystems.

Pesticides may harm the environment by eliminating or reducing populations of desirable organisms, including endangered species. Sublethal effects include the behavioral and structural changes of an organism that jeopardize its survival. Herbicides in the aquatic environment can destroy the food source for higher organisms.

Household Chemicals and Fertilizers

Everyday household activities are a major contributor to polluted runoff, which is among the most serious sources of water contamination. When it rains, fertilizer from lawns, oil from driveways, paint and solvent residues from walls and decks and pet waste are all washed into storm sewers or nearby lakes, rivers and streams. If improperly disposed of, or accidentally spilled, chemicals and fertilizers may end up in surface or ground water.

All-purpose cleaner, ammonia-based cleaner, bleach, brass or other metal polish, dishwashing detergent, disinfectant, drain cleaner, floor wax or polish, glass cleaner, oven cleaner and scouring powder contain dangerous chemicals. Some examples are:

- Sodium hypochlorite (in chlorine bleach): if mixed with ammonia, it releases toxic chloramine gas. Short-term exposure may cause mild asthmatic symptoms or more serious respiratory problems;
- Petroleum distillates (in metal polishes): short-term exposure can cause temporary eye clouding. Longer exposure can damage the nervous system, skin, kidneys and eyes;

- Ammonia (in glass cleaner): eye irritant, can cause headaches and lung irritation;
- Phenol and cresol (in disinfectants): corrosive; can cause diarrhea, fainting, dizziness and kidney and liver damage;
- Nitrobenzene (in furniture and floor polishes): can cause skin discoloration, shallow breathing, vomiting and death. It is also associated with cancer and birth defects; and
- Formaldehyde (a preservative in many products): a suspected human carcinogen; it is a strong irritant to eyes, throat, skin and lungs.

Pathogens

Pathogens are disease-causing bacteria, viruses, protozoan parasites and other organisms. Fecal coliforms and/or *E. coli* are indicators that pathogens may be present. Pathogens and pathogen indicators associated with animal and human fecal wastes are carried in water and can move through the environment via stormwater runoff, groundwater and surface waters such as rivers (Thurston-Enriquez, 2007).

Understanding pathogen transport pathways is critical for identifying effective management strategies. This can be understood by connecting the sources of fecal pathogens to climate and the hydrodynamic conditions, including how the water flows from rainfall to the land, to runoff to the river, or to the groundwater.

Pollutants Associated With Urban Runoff

Nonpoint source pollutants associated with urban activities include sediment, nutrients, pathogens, household chemicals and trash. Suspended sediment is the primary pollutant in urban runoff, which can contain oil, grease, chemicals from lawn and landscaping management, road salts, metals, pathogens and toxic chemicals from automobiles, among others.

Common behaviors that have the potential to generate stormwater pollution include improper disposal of trash and recyclables, not picking up pet waste, over applying lawn chemicals, allowing water from automobile washing to enter the street and improper disposal of leftover paint, household chemicals and used oil.

In addition to pollutants that can be carried by runoff, the speed with which the water leaves properties can also contribute to surface erosion, sedimentation and hydromodification.

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Section
Eleven

Bayou Bartholomew

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 2B ◆ HUC 08040205
***EPA-Accepted Watershed Management Plan**

Introduction

Bayou Bartholomew begins near Pine Bluff, Arkansas, and flows generally southward towards its confluence with the Ouachita River west of Bastrop, Louisiana. The Arkansas portion of the watershed encompasses nearly 1 million acres in a seven-county area of southeast Arkansas, including parts of Jefferson, Cleveland, Drew, Chicot, Lincoln, Desha and Ashley counties. The main tributaries of Bayou Bartholomew in Arkansas are Deep Bayou, Ables Creek, Cutoff Creek, Bearhouse Creek, Overflow Creek and Chemin-A-Haut Creek. Figure 11.1 shows a map of the watershed.

The Bayou Bartholomew watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

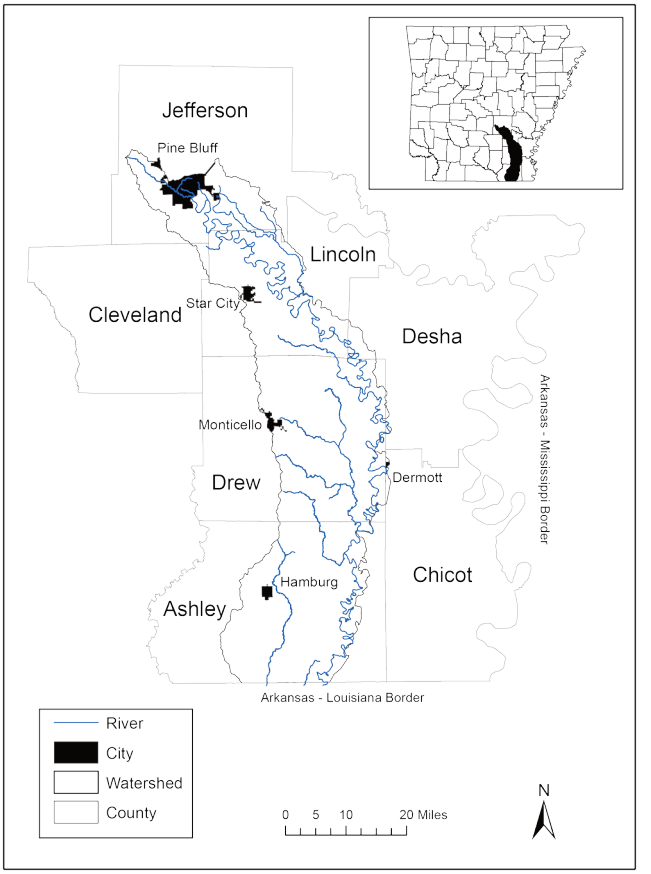
In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of Bayou Bartholomew and its tributaries as such:

> The waters within this segment have been designated as suitable for the propagation of fish, wildlife, primary and secondary contact recreation, as well as public, industrial, and agricultural water supplies. This segment contains a total of 489.3 stream miles, all of which are being assessed, which are mainly used as an irrigation water supply. However, many sections of these waterbodies are used by canoers and offer excellent fishing opportunities.
>
> Water quality is impacted in much of this segment by nonpoint pollution generated by row crop agriculture. Silt loads and turbidity are consistently very high, thus causing degradation to the aquatic life within many of these streams. For many years, the Bayou Bartholomew Alliance addressed these concerns through the implementation of best management practices on a watershed scale. Analyses have indicated an increasing trend in instream turbidity concentrations in Bayou Bartholomew since 1995.

ADEQ identified 13 waterways in this watershed as impaired on its 2016 List of Impaired Waterbodies,

Figure 11.1
Map of Bayou Bartholomew watershed

Source: GeoStor



which is also known as the 303(d) List. Several of the impaired waterbodies in this watershed are not supporting fish consumption, fisheries and personal contact uses (ADEQ, 2016).

Segments of the Bayou Bartholomew watershed listed as impaired on the 303(d) List can be viewed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In 2002, the U.S. Environmental Protection Agency (EPA) contracted with FTN Associates to prepare a total maximum daily load (TMDL) for Bayou Bartholomew in Arkansas. FTN Associates recommended reductions in turbidity in all analyzed reaches of the watershed. Necessary reductions were targeted from 29 to 37 percent during December 2001 through June 2002, the period exhibiting the highest historical flows. Since that time, three other TMDLs have been completed for Bayou Bartholomew, including one for mercury, pathogens and chloride, sulfate and total dissolved solids.

During the second half of Fiscal Year 2005, ADEQ started an intensive sampling program, involving approximately one well per square mile in the upper Bayou Bartholomew watershed, to assess the aerial distribution of arsenic with respect to geology and other attributes (IWQMR, 2008 Integrated Water Quality Monitoring and Assessment Report 305(b)). A total of 109 water samples were collected from irrigation wells in the upper portion of the Bayou Bartholomew watershed in Jefferson County. The investigation demonstrated that elevated arsenic (>10 µg/L) occurred almost solely in stream channel deposits (Qcm), with low arsenic concentrations in the overbank deposits (Qso). Ground water from the Qso deposits contained significantly higher sulfate concentrations than ground water in the Qcm deposits. A strong inverse relationship between arsenic and sulfate concentrations tends to support an earlier theory of sulfide formation as a solubility control on soluble arsenic in ground water.

ADEQ continues to sample wells in the Pine Bluff area as part of ground water monitoring efforts. The 2016 Integrated Water Quality Monitoring and Assessment Report, also known as the 305(b) Report, indicated ground water quality is generally good in the area. Arsenic is detectable in several wells, but well below Maximum Contaminant Levels or MCLs.

The streams draining the Pine Bluff area continue to be impacted by high concentrations of *E. coli* and elevated lead concentrations. Urban runoff has been identified as the source of bacteria. Other possible sources include failing underground storage tanks (septic tanks) and wastewater collection systems.

Nutrient enrichment of the waterbodies in this watershed is a concern. Elevated total phosphorus and total nitrogen have been identified at monitoring stations in some segments of Bayou Bartholomew – Deep Bayou and Cousart Bayou (ADEQ, 2016). However, detecting and determining the contribution and impact of nutrients from nonpoint sources is a challenge.

The U.S. Geological Survey (USGS) did extensive monitoring and analysis in the 1990s of surface and ground water quality in the Mississippi Embayment study area, a six-state region that includes the Bayou Bartholomew Watershed, as part of the National Water Quality Assessment Program (NAWQA). A summary of those findings is available at https://pubs.usgs.gov/circ/circ1208/index.html.

Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality.

Brief Description of Land Uses in the Watershed

Figure 11.2 shows land use in the Bayou Bartholomew watershed in 2011.

The following provides a partial snapshot of the watershed:

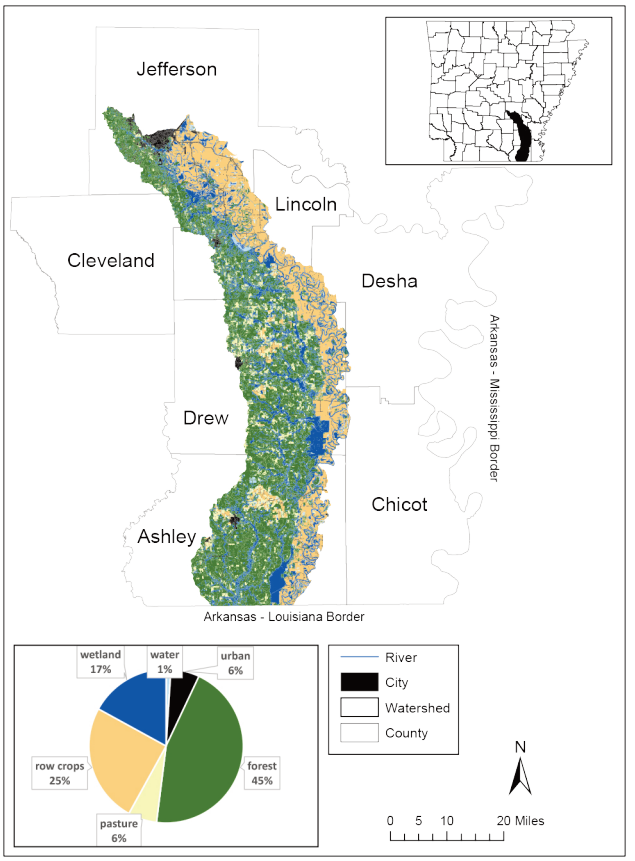
- Bayou Bartholomew contains a variety of landscapes ranging from rolling forested hills in the western portions to relatively flat farmland along much of the eastern section. Especially fertile farmland is located along Bayou Bartholomew and other areas lying in the ancient floodplain of the Arkansas and Mississippi Rivers. Much of the land west of Bayou Bartholomew is used for the production of timber (Layher and Phillips, 2002).
- Nearly 25 percent of the watershed's land area is cultivated in row crops, primarily rice and soybeans (MRLC, 2011). Cropland is predominantly found in the alluvial soils along the eastern portion of the watershed.
- Forests dominate in the western Gulf Plains portion of the watershed. Some 45 percent of the land is in forests and 6 percent is in pasture (National Land Cover Database, 2011). The forests

range from naturally diverse bottomland hardwoods and mixed pine/upland hardwoods to industrial stands of loblolly pine.

- Some poultry production occurs in and around Star City in Lincoln County.
- The Nature Conservancy and Winrock International piloted an EPA-funded project to create markets for conservation credits as an incentive for replanting bottomland hardwoods in order to reclaim environmentally sensitive croplands. The Bayou Bartholomew Alliance acquired several easements through this project.
- The stream now known as Bayou Bartholomew resides in a former course of the Arkansas River, which explains the numerous oxbow lakes along Bayou Bartholomew.

Figure 11.2
Distribution of Land Uses in the Bayou Bartholomew Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



- While the main stem of Bayou Bartholomew has escaped channelization, many of its tributaries have been altered through channelization, the addition of weirs and dams and other channel or flow alterations.
- Approximately 47,640 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011). Most of the city of Pine Bluff drains into the Bayou Bartholomew watershed. Other municipalities in the watershed are Star City, a portion of Monticello and Hamburg. Throughout much of the watershed, population is declining at an accelerated rate. For example, Jefferson County's population declined 8.1 percent from 2000 to 2010. Chicot County's population decreased 16.4 percent over the 10-year period (University of Arkansas at Little Rock, 2011).
- Pine Bluff, White Hall and a portion of Jefferson County are subject to Phase II stormwater requirements and routinely file renewal notices for their small Municipal Separate Storm Sewer System (MS4) NPDES permits. The governments have contracted with the University of Arkansas System Division of Agriculture's Cooperative Extension Service office in Jefferson County to conduct programs addressing the permit's public education and outreach and pollution prevention housekeeping requirements.

Water Quality Program Goals

The Bayou Bartholomew watershed has been a priority of the Arkansas NPS Pollution Management Plan since 1998. ANRC is again designating the Bayou Bartholomew watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan. Pollutants of concern within this Hydrologic Unit Area include:

- Siltation/turbidity
- Pathogens
- Total dissolved solids
- Chlorides
- Low dissolved oxygen
- Lead
- Sulfates
- Mercury

Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life on the most current List of Impaired Waterbodies.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Bayou Bartholomew watershed, targeting sub-watersheds where implementation can have the greatest impact.

These goals will be achieved through implementation of a Nine-Element Watershed Plan, which will complement the locally-led implementation of a Watershed Restoration Action Strategy (WRAS) published Sept. 8, 1999, by ANRC and developed by the Bayou Bartholomew Alliance. The Alliance developed the Nine-Element Watershed Plan in 2005. ANRC updated the document in 2009. The plan is available at http://arkansaswater.org/29-watershed/116-bayou-bartholomew-8040205.

In order to reach the short-term goal, wide-ranging partners will continue to build public support for implementation of management measures to restore designated uses in the watershed.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Projects to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the Plan.

The following objectives were previously identified with input from NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

11.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

11.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

11.3. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (e.g., a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

11.4. Continue to refine models as new data becomes available to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

11.5. Continue to focus on BMP implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forest land. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

11.6. Continue to provide and improve extensive education and training to promote BMP implementation (e.g., risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

11.7. Continue to encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambanks and restore riparian areas.

11.8. Continue to secure conservation easements through donations, as the opportunity arises, in an effort to protect lands along Bayou Bartholomew and its tributaries from development that would result in further NPS pollution.

11.9. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

11.10. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (e.g., recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

11.11. Encourage county and municipal elected officials as well as contractors, homebuilders, and consulting engineers to participate in construction and

urban education programs to improve stormwater management.

11.12. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement, the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

11.13. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

11.14. Continue to provide public education on proper application, storage and disposal of pesticides, regulations, and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

11.15. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

11.16. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating state and local agencies and nonprofit organizations working together in Bayou Bartholomew, the short-term objectives of this program can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Bayou Bartholomew watershed with the authority to implement the Nine-Element Watershed Management Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program through the Arkansas Conservation Partnership (ACP) as well as local coordination groups already in place.

Previously, significant local coordination had been achieved through the Bayou Bartholomew Alliance. The alliance is a 501(c)(3) nonprofit organization governed by a board of directors. In the past, board members represented a range of stakeholders in the watershed, including farmers, private and industrial forest landowners, municipalities and sportsmen. However, since the passing of the Alliance's founder, remaining members have said the board is stagnant.

This watershed would benefit from renewed attention of volunteers. In Jefferson County in this watershed, there has been an effort to provide public education and outreach and pollution prevention training as part of a contract between the county government, the University of Arkansas at Pine Bluff, the cities of Pine Bluff and White Hall and the Jefferson County office of the Cooperative Extension Service.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS Pollution Management activities in the Bayou Bartholomew watershed. ADEQ is responsible for maintaining the state's water quality inventory. ADEQ, USGS and the Arkansas Water Resources Center (AWRC) maintain monitoring stations in Bayou Bartholomew. ADEQ maintains a network of water quality monitoring stations in the Bayou Bartholomew watershed. ADEQ monitors two sites in Arkansas and one in Louisiana roughly on a monthly basis for a suite of water quality parameters.

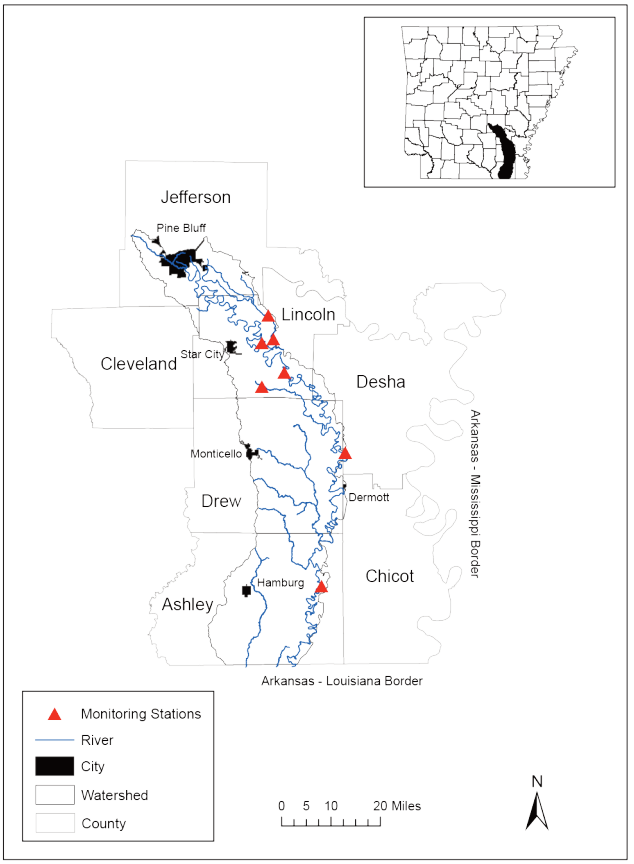
In addition, USGS operates monitoring stations and ANRC contracts with AWRC to maintain monitoring sites in Bayou Bartholomew. Figure 11.3 shows the monitoring stations in the watershed.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has compiled GIS databases and developed SWAT models of the Bayou Bartholomew watershed. These models are helpful in selecting sub-watersheds for more intensive implementation activities and also for evaluating the effectiveness of implementation within a sub-watershed or basin-wide.

The NPS Management program may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on

Figure 11.3
U.S. Geological Survey Monitoring Stations in the Bayou Bartholomew Watershed

Source: U.S. Geological Survey National Water Information System Map



their activities of the previous year and discuss their programs' successes, failures and future needs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Bayou Bartholomew watershed in March 2015. Participants identified sediment related to agriculture, water flow and nutrient runoff as local priorities that needed addressing.

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Section
Twelve

Beaver Reservoir Watershed (Upper White River and Kings River)

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 4K ◆ Hydrologic Unit Code 11010001
***EPA-Accepted Watershed Management Plan**

Introduction

The Beaver Reservoir, also known as the Upper White River watershed (HUC 11010001), consists of portions of Benton, Washington, Carroll, Madison, Boone, Newton and Franklin counties in Northwest Arkansas. This segment encompasses a 66-mile reach of the White River and its tributaries, including Beaver Lake, and an 85-mile reach of the Kings River and its tributaries. It also includes Long Creek and Yocum Creek. Figure 12.1 shows the location of the Beaver Reservoir watershed.

The Upper White River/Beaver Reservoir watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

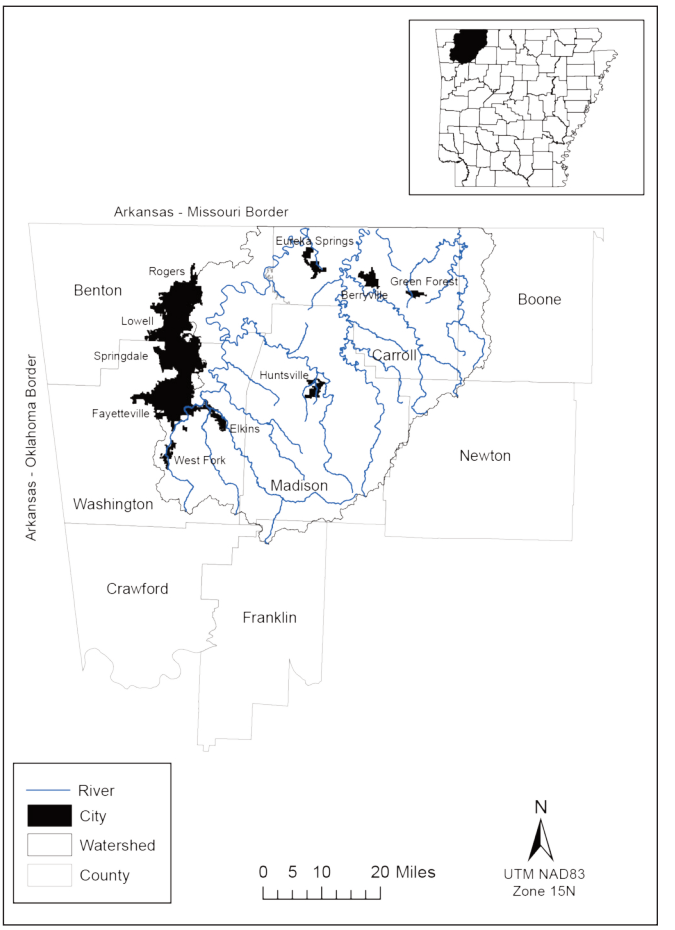
Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of the Upper White River watershed and its tributaries as such:

> Waters in this segment are designated for propagation of fish and wildlife; primary and secondary contact recreation; and domestic, agricultural, and industrial water supplies. Approximately 20 percent of these waters are designated as outstanding state or national resource waters. Waters in this segment, including Beaver Reservoir, are highly prized for canoeing and fishing. Primary contact recreation is also prevalent.
>
> The fisheries designated use was assessed as not supported in the West Fork of the White River and the White River downstream of the West Fork. The major cause was high turbidity levels and excessive silt loads. A TMDL to address this issue was completed in 2006.

Figure 12.1
Map of Beaver Reservoir Watershed

Source: GeoStor



A point source discharge to Holman Creek has impaired the drinking water use of the lower section of this stream by discharges of excessive levels of total dissolved solids. Additional investigation into this issue is ongoing.

ADEQ identified seven waterways in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Segments of the Beaver Reservoir watershed listed as impaired on the 303(d) List can be viewed at http://www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

The West Fork has a long history of being on the state's List of Impaired Waterbodies.

On ADEQ's 2016 list, a segment of the West Fork was listed as not supporting fisheries due to exceeding water quality standards for sulfates and total dissolved solids. The source was listed as unknown. A reach of the White River nearby is also identified on the 2016 list for exceeding sulfate and total dissolved solid standards, though no specific designated use is listed as being unsupported.

The West Fork continues to be listed for exceeding numeric criteria for turbidity. The source of this impairment was listed as sediment. A total maximum daily load (TMDL) previously prepared for these streams used total suspended solids (TSS) as a surrogate for turbidity (FTN, 2006).

In development of the TMDL, statistically significant relationships were found between turbidity and TSS (FTN, 2006). The completed TMDL called for a 32 to 58 percent reduction in TSS (Table 12.1). In its 2008 List of Impaired Waterbodies, ADEQ identified the major source of sediment in these two streams as surface erosion (ADEQ, 2008).

In 2002, ADEQ listed probable sources of sediment in these streams as (1) agricultural land clearing, (2) road construction and maintenance, and (3) gravel removal from stream beds (ADEQ, 2002). ADEQ conducted a survey of sediment sources in the West Fork of the White River in 2004 (Formica et al., 2004). The relative and estimated contribution from streambanks, paved and unpaved roads, urban areas, pasture, gullies and construction was considered.

A simulation model developed by Purdue University, called the Water Erosion Prediction Project (WEPP), was used to estimate sediment loads from pastures and unpaved roads. The study estimated sediment load to the West Fork totaling 35,795 tons per year. Streambank load was estimated to be 66.1 percent of the total. One 0.7-mile reach accounted for 25 percent of this load. Roadways and ditches accounted for 17.1 percent, and urban areas including construction were 10.9 percent. Pasture and other sources were 4.8 and 1.1 percent, respectively.

Brown et al. (2003) found decreased diversity of fish in the West Fork of the White River and that the macroinvertebrate community was composed mostly of pollution tolerant taxa. Disturbed riparian corridors and physical conditions in the stream were identified as the causes of the impact.

The Arkansas Water Resource Center and Beaver Watershed Alliance have been collecting water samples in recent years at nine sites to measure turbidity. In 2016, an AWRC researcher wrote that so far data suggests that the majority of the river does not have turbidity levels that exceed the state's water quality standard. Only two of the nine sample sites had high turbidity, which occurred in the most downstream section near Fayetteville (Scott, 2016).

The Beaver Watershed Alliance and Watershed Conservation Resource Center recently secured a $4.3 million Regional Conservation Partnership Program USDA grant toward an $8.8 million project to restore riparian areas along the West Fork,

Table 12.1. Summary of Turbidity TMDLs for the West Fork of the White River and the White River (FTN, 2006)

Reach ID	Stream Name	Flow Category	Loads (tons/day of TSS)				Percent Reduction Needed
			WLA	LA	MOS	TMDL	
110100001-023	White River	Base flow	0	0.606	0	0.606	32%
		Storm-flow	0	19.3	0	19.3	40%
110100001-024	West Fork White River	Base flow	0	0.111	0	0.111	53%
		Storm-flow	0	4.31	0	4.31	58%

implement best management practices and evaluate the outcomes in an attempt to reduce sediment and nutrient loads. This project is part of a larger effort to preserve water quality in Beaver Lake, the region's source of drinking water.

In 2008, the uppermost 1,500 acres of Beaver Reservoir were identified by ADEQ as not supporting the aquatic life designated use because of sediment. The source of this sediment was identified as surface erosion (ADEQ, 2008). The impaired reach of Beaver Lake extended from its headwater on the White River near Goshen downstream to near the confluence with War Eagle Creek.

This section of Beaver Lake remains on ADEQ's 2016 list, however, for turbidity and pathogens. The lake was listed as not supporting primary contact use in that section.

Holman Creek (reach 059) also remains on the list, though this time for total dissolved solids. It was previously identified as impaired for nitrates (ADEQ, 2008). In that case, a municipal point source was identified as a cause, and a TMDL was completed for Holman Creek in 2001 (ADEQ, 2008). Currently, the source of impairment related to total dissolved solids is identified as industrial and municipal point source. A tributary to Holman Creek is also identified similarly on the 2016 list.

One reach of the Kings River (reach 037) is also identified by ADEQ as impaired, though no unsupported designated use is listed. The segment is listed as exceeding water quality standards for sulfates and total dissolved solids with the source being unknown. Town Branch is also identified on the list as impaired due to not meeting nitrogen standards and so is Osage Creek near Berryville for exceeding total phosphorus standards.

Nutrient enrichment of the waterbodies in this watershed is a concern, both from point and nonpoint sources. In 2003, the Arkansas General Assembly established nutrient surplus areas, including the Upper White River watershed. Legislators enacted a package of laws requiring nutrient management plans, certifying nutrient planners and applicators and regulating nutrient application. These regulations were enacted in 2005.

Nutrients, nitrogen and phosphorus may be produced by either point sources or nonpoint sources. Total nitrogen loads to Beaver Reservoir were calculated to be 5.9 million pounds/year and are expected to increase 4 percent to 6.1 million pounds/year by 2055 (Tetra Tech, 2012). Nitrogen loads from point sources are expected to increase over that time from 195,000 pounds/year to 351,000 pounds/year, moving from 3.2 percent to 5.6 percent of the total nitrogen load.

Similarly, total phosphorus loads were calculated to be 171,000 pounds/year and are expected to increase 14 percent to 194,000 pounds/year by 2055. Phosphorus loads from point sources are expected to decrease over that time from 25,000 to 21,000 pounds/year, moving from 15 to 11 percent of the total phosphorus load. As can be seen from the existing loads and predicted changes, the majority of the load of phosphorus and nitrogen into Beaver Lake is from nonpoint sources.

Eutrophic conditions in the headwater reaches of Beaver Reservoir have been experienced for many years (Haggard et al., 1999). The Beaver Water District (BWD) commissioned Black and Veatch to study water quality problems in the reservoir. The 1982 study found that the problems experienced by the district were almost entirely due to high concentrations of algae and low dissolved oxygen at the intake. They concluded that phosphorus loading to the reservoir from both point and nonpoint sources (NPS) was the greatest impact on water quality at the time. The City of Fayetteville expanded its wastewater treatment facility in 1988 to add phosphorus removal capabilities. However, nonpoint source (NPS) pollution and/or recycling of nutrients sequestered in bottom sediments have increased to a point where little improvement has been noted. The study by Haggard, et al. (1999) found the condition of the reservoir was still eutrophic in the headwaters, although the trophic status of the reservoir depended somewhat on the lake level. They also found a relationship between nutrients and algae concentration in the reservoir.

Taste and odor problems have also been reported by Beaver Water District, the major provider of domestic water in Northwest Arkansas (Beaver Watershed Alliance, 2012). The taste and odor in BWD's water is caused by Geosmin and Methylisoborneo (MIB), which are by-products of algae metabolism. The presence of algae in the reservoir indicates a potential nutrient enrichment problem.

Beaver Water District occasionally conducts synoptic water quality surveys of the watershed, which include rapid bioassessments, geomorphologic surveys and water chemistry. In its 2012 Source Water Protection Plan, the water district stated it faced water quality issues such as fecal bacteria, turbidity, increasing organic carbon resulting in formation of disinfection

by-products, seasonal taste and odor issues related to algae and occasional high concentrations of manganese.

The Environmental Protection Agency in 2016 approved numeric standards for chlorophyll (an indicator of algae levels) and Secchi transparency in Beaver Lake, after more than a decade of discussion and studies by government agencies and watershed stakeholder groups. The standards limit the amount of chlorophyll in Beaver Lake at Hickory Creek to 8 micrograms per liter (Beaver Watershed Alliance, 2016). The federal agency also approved a standard of secchi transparency (clarity of water) at 1.1 meters. Both chlorophyll and secchi transparency measurements are taken over a five-year period during the growing season (May to October) to determine if water quality standards are met.

Another assessment to be mentioned is the U.S. Geological Survey's extensive monitoring and analysis of surface and groundwater quality in the Ozark Plateau study area as part of the National Water Quality Assessment Program. Major findings for the Ozark Plateau study area are available at www.usgs.gov/centers/lmg-water/science/ozark-plateaus-national-water-quality-assessment-nawqa-program?qt-science_center_objects=O#qt-science_center_objects.

Additionally, a U.S. Forestry Service (USFS) comparative assessment of 50 watersheds in Arkansas, Oklahoma and Missouri estimates potential erosion by land use for the Upper White River watershed. Based on 1992 National Resource Inventory data, pasture land had the highest potential erosion rate at 86 percent compared to other lands (including urban) with a 13 percent potential erosion rate and forestry with a 2 percent potential erosion rate. Compared to 1982, potential erosion rates increased for other lands and decreased slightly for pasturelands (USFS, 1999).

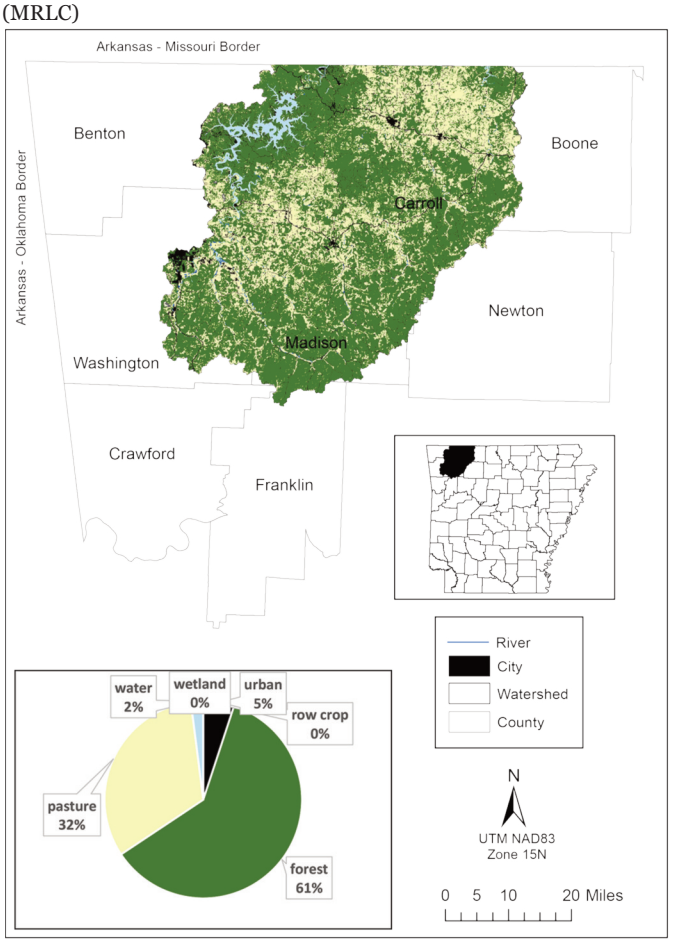
Brief Description of Land Uses in the Watershed

Figure 12.2 shows land use in the Beaver Reservoir watershed in 2011.

The following bullets provide a partial snapshot of the watershed:

- Beaver Water District is a major wholesale supplier of drinking water for municipalities and industry in Northwest Arkansas, providing water to Bentonville, Rogers, Springdale and Fayetteville. Each of these in turn sell BWD water to communities such as Farmington, Elkins, Greenland, Tontitown, Lowell, Bethel Heights, Cave Springs, and Bella Vista.
- There is significant growth in rural residential subdivisions, particularly in aesthetically attractive areas surrounding Beaver Reservoir.
- Major municipalities include portions of Fayetteville, Greenland, Rogers, Springdale, Lowell as well as West Fork, Eureka Springs and Berryville. Six municipalities on the Arkansas side of the watershed and portions of Washington and Benton counties, as well as the University of Arkansas, are subject to Phase II requirements for a small Municipal Separate Storm Sewer System (MS4) National Pollution Disposal Elimination System (NPDES) permit. With leadership

Figure 12.2
Distribution of Land Uses in the Upper White River Watershed
Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



from the Northwest Arkansas Regional Planning Commission, these entities have joined together to contract with the University of Arkansas System Division of Agriculture Cooperative Extension Service in Benton and Washington counties to conduct programs addressing the permit's public education and outreach and pollution prevention housekeeping requirements.
- Approximately 176,517 individuals lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011).
- The population of Washington and Benton counties grew 28.8 percent and 44.3 percent respectively from 2000 to 2010 (University of Arkansas at Little Rock, 2011). Madison and Carroll counties also grew substantially over the decade, growing 10.3 percent and 8.2 percent, respectively. Boone's population grew by 8.7 percent and Franklin's by 2 percent, while Newton County reported a decrease of 3.2 percent.
- As a result of this population growth, there is significant new construction, including residential, commercial and industrial, roads and other infrastructure. Construction can be found both within municipal boundaries and in rural areas of the watershed, where onsite waste disposal is used.
- Forest and pasture are the dominant agricultural land uses in the watershed at 61 percent and 32 percent, respectively (MRLC, 2011).
- The entire watershed is designated as a nutrient surplus area subject to new regulations for nutrient planning, nutrient application and certification of nutrient planners.
- Most forest land in the watershed is owned by private non-industrial landowners and the national forest.
- Resource extraction (for example, topsoil removal and gravel mining) primarily supports local construction projects.

Water Quality Program Goals

The Beaver Reservoir watershed has been a priority of the Arkansas NPS Management Plan since the comprehensive update of the program completed in 1998. ANRC is again designating the Beaver Reservoir watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan. Pollutants of concern within this hydrologic unit area include:

- Total dissolved solids
- Sulfates
- Siltation/turbidity
- Dissolved oxygen
- Nutrients

Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life on the 2016 303(d) List of Impaired Waterbodies (ADEQ, 2016).

The long-term goal in this priority watershed is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce the pollutant loading from the land uses in the watershed. This goal is to be met through the implementation of the Nine-Element Watershed Management Plan.

The Beaver Lake Watershed Protection Strategy was prepared in 2009 by Tetra Tech, an engineering consulting firm, on behalf of the Northwest Arkansas Council. The document focusing on the lake and its tributaries was updated in 2012 by the Beaver Watershed Alliance with funding from the U.S. Environmental Protection Agency and the Arkansas Natural Resources Commission. The goal of the revised version was to address gaps identified in the 2009 document and to facilitate and clarify correlation with the Nine Elements identified in the U.S. Environmental Protection Agency (EPA) Handbook for Developing Watershed Management Plans to Restore and Protect Our Waters. The watershed management plan can be found at www.beaverwatershedalliance.org

In addition, the Kings River Watershed Partnership has developed a watershed management plan for the Kings River and its tributaries. The plan can be found at www.kingsriverwatershed.org/publications.html

Public support will have to be further developed to implement the proposed activities to achieve short- and long-term goals for the identified pollutants.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are

described in more detail in earlier sections of the 2018-2023 NPS Management Plan.

The following objectives were previously identified with input from NPS Pollution Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

12.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

12.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

12.3. Promote and support strengthening of local capacity to implement the Nine Element Plan. Encourage local review of a range of options to identify the most effective institutional mechanism to lead/coordinate its implementation.

12.4. Identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target high impact restoration sites (e.g., streambank stabilization projects). Promote use of riparian tax credits and other cost-sharing programs to fund restoration projects and develop conservation easements.

12.5. Continue to refine models as new data become available to represent sediment and nutrient loads in the watershed, instream processes and lake response to enable prioritization of implementation projects in sub-watersheds.

12.6. Continue to encourage the development of comprehensive nutrient management plans (CNMPs) or nutrient management plans (NMPs), provide technical assistance, and make available financial assistance to animal agricultural operations where cost-share is a component of approved implementation projects.

12.7. Continue and strengthen ongoing comprehensive education and training programs to help poultry and livestock producers meet the requirements of new ANRC poultry litter and nutrient application regulations and ADEQ confined animal feeding operations (CAFO) regulations.

12.8. Continue to develop and provide coordinated, comprehensive education for city planners, elected officials, developers, contractors, property owners and others using workshops, print and electronic materials, demonstration projects, and other methods on topics such as stormwater pollution prevention plans, proper installation and maintenance of erosion and sediment control, planning tools to improve storm water management (e.g., low impact development (LID), greenways, cluster development) and other related topics.

12.9. Cooperate with and support the efforts of local nonprofit organizations, municipalities and other cooperating entities to develop and deliver a coordinated water quality education program with a local emphasis.

12.10. Identify groups for targeted education on specific high-impact activities (e.g., develop fact sheets for boaters about proper waste disposal and the impact of that at boat ramps and marinas; provide training to county elected officials, road departments, property owners associations on how to reduce erosion from rural roads; or provide education to homebuilders, developers and homeowners on methods and activities to reduce NPS pollution).

12.11. Carry out comprehensive information and education program quality for community leaders, including mayors, county judges, quorum courts, planning boards and commissions, conservation district directors, and others. Emphasize the need to protect water and the benefits of clean water for the economy, quality of life and the environment.

12.12. Identify severe erosion sites at rural road crossings and work with county government to develop and implement erosion control plans for high impact sites (e.g., promote use of conservation district hydromulcher for treatment).

12.13. Encourage development of urban forestry projects in municipalities within the watershed.

12.14. Continue to provide training to earth-moving contractors and their employees, public works department employees, county employees and others regarding operation and maintenance of construction and post-construction Best Management Practices (BMPs) through the partnership with the Northwest Arkansas Regional Planning Commission and the University of Arkansas System Division of Agriculture, Cooperative Extension Service in order to help them meet the requirements of EPA Phase II stormwater regulations for construction and municipal separate storm sewer systems (MS4s).

12.15. Review tax code to determine possible mechanisms to use tax incentives for water quality BMP implementation in nutrient surplus areas, especially for practices that minimize the direct impact of cattle on streams.

12.16. Work with elementary and secondary school teachers to develop teaching modules regarding water quality protection and conservation that meet curriculum requirements of the Arkansas Department of Education.

12.17. Build constituency for improved water quality by increasing volunteerism for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups, conducting water awareness days, building working relationships with groups that represent recreational users (e.g., bird watchers, paddlers, hunters, etc.) and other means.

12.18. Continue to promote LID and retrofit as applicable to reduce NPS pollution.

Program Coordination

No single entity currently possesses the authority to fully implement the Beaver Reservoir Watershed Action Strategy. However, there are many active watershed groups in this area, including Ozarks Water Watch (formerly known as the Upper White River Basin Foundation), that can leverage their efforts and cooperate to achieve mutual goals.

Other watershed groups include the Kings River Watershed Partnership, the Beaver Watershed Alliance, the Association for Beaver Lake Environment and the Audubon Arkansas' West Fork Watershed project. In addition, Beaver Water District hired a Manager of Environmental Quality in 2005 to help develop and implement watershed protection projects to protect the drinking water supply.

Previously, NPS Management Plan stakeholders identified the lack of a single entity with authority to implement a coordinated watershed action strategy as a critical missing link in effective management of the watershed. Local governments, watershed alliances and others local interests in the watershed will cooperate to determine potential legal mechanisms to establish an authority, preferably within existing statutory authorities. Until such an authority is established, ANRC can help facilitate coordination by continuing a discussion on priorities and proposals with the cooperating entities listed in this plan.

Timeline

When sufficient human and financial resources are available to cooperating entities, we believe the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Tracking and Evaluation

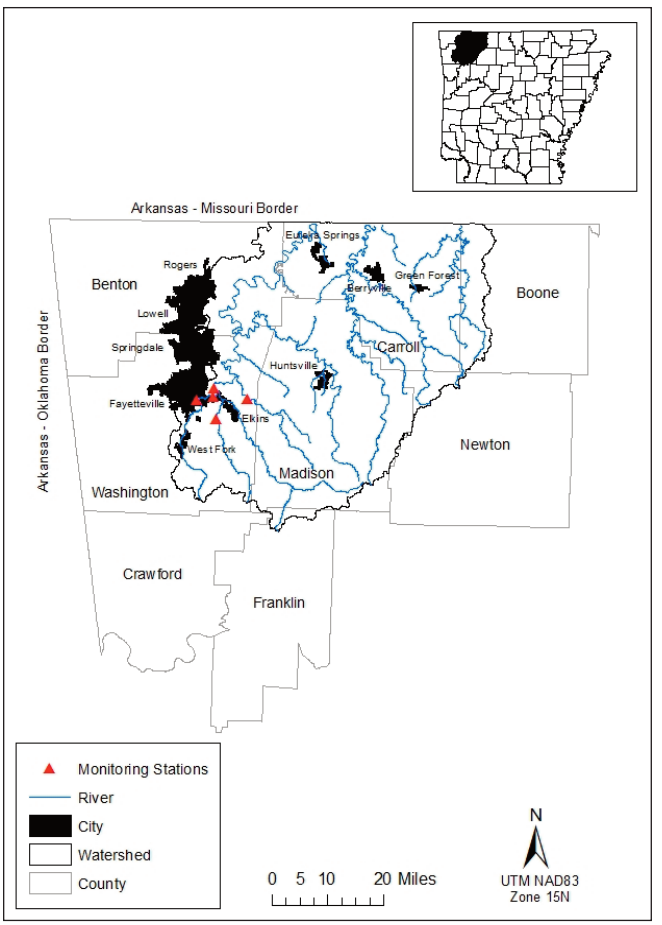
ADEQ maintains a network of 12 ambient water quality monitoring stations in the Upper White River watershed. These stations are monitored monthly for a suite of water quality parameters. In addition, the Arkansas Water Resources Center (AWRC) water quality lab maintains continuous monitoring stations on the West Fork of the White River and the White River. The Beaver Water District collects water quality data during base flow and storm events at tributaries to Beaver Reservoir. The U.S. Geological Survey (USGS) maintains five monitoring stations in the watershed. ADEQ evaluates data from these stations and from periodic synoptic surveys to determine water quality limited waters. The data will continue to be collected for the foreseeable future and can be used to track long-term changes in water quality in the watershed. Figure 12.3 shows USGS monitoring stations in the watershed.

The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. An effective evaluation of the watershed program could be implemented by an annual meeting of the cooperating entities where each reports on their activities of the previous year and discusses the successes, failures and future needs of their programs. This information, along with a summary of available water quality data and land use trends, could be assembled into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 12.3

U.S. Geological Survey Monitoring Stations in the Upper White River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Beaver Reservoir watershed in August 2015. Unlike many of Arkansas' watersheds, the Beaver Reservoir Watershed has a history of active watershed groups working to restore waterways or prevent further pollution.

Forum participants identified funding as their watershed's priority concern, saying that more money is necessary to meet the needs already identified by stakeholder groups. Participants also expressed two other priorities – continued focus on educating the public about nonpoint source pollution and sediment reduction by way of erosion control and streambank stabilization.

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Section
Thirteen

Cache River

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 4B ◆ HUC 08020302
***EPA-Accepted Watershed Management Plan**

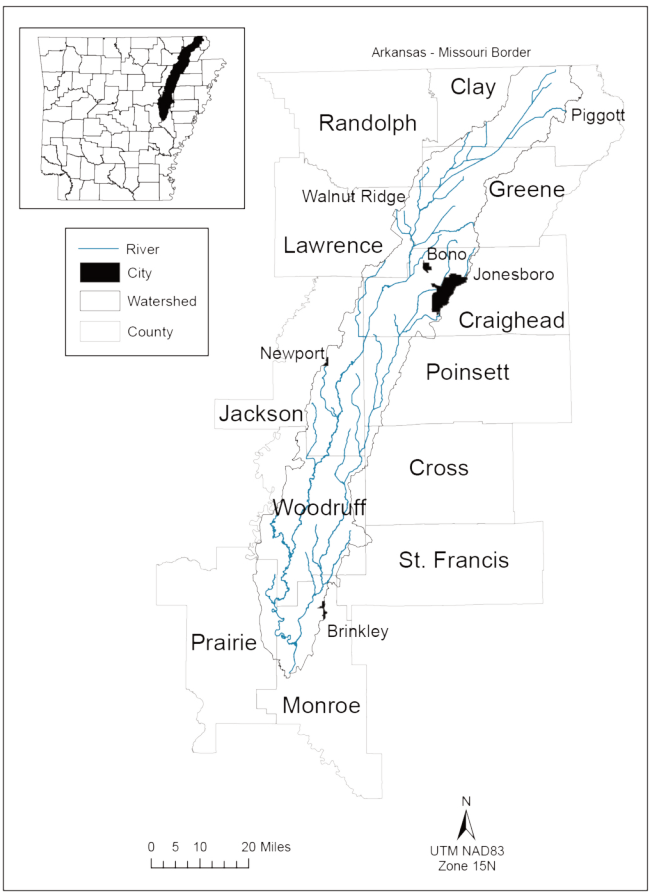
Introduction

Segment 4B, located in the northeastern part of Arkansas, is a long, narrow segment that includes parts of Greene, Craighead, Poinsett, Jackson, Woodruff, Monroe, Prairie, Lawrence and Clay counties. The segment includes Bayou DeView and Cache River and their major tributaries – Cow Ditch, Buffalo Creek and Flag Slough.

The Cache River originates in southern Missouri, entering Arkansas in Clay County. Bayou DeView originates on Crowley's Ridge in Greene County. Figure 13.1 shows a map of the watershed.

Figure 13.1
Map of Cache River Watershed

Source: GeoStor



The Cache River watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of Cache River and its tributaries as such:

> Waters in this segment are designated for propagation of fish and wildlife; primary and secondary contact recreation; and domestic, agricultural and industrial water supplies. The greatest use of waters in this segment is for irrigation water supply. However, local wetlands offer excellent hunting and fishing opportunities.
>
> The upper section of Bayou DeView and Lost Creek Ditch are not meeting the fisheries designated use because of elevated levels of chlorides and total dissolved solids. Potential sources include point source discharges and row crop agriculture activities.
>
> Several segments of the Cache River and Bayou DeView have been listed because of lead contamination. It is possible elevated metals detections are associated with the large winter and spring storm events that carry large amounts of clay particles into the waterbodies. Also, historic lead mine in headwaters streams of these waterbodies located in the foothills of the Ozark Mountains may also be contributing to this issue. Additional investigation is needed to more accurately assess this problem.

ADEQ identified seven waterways and one lake in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Several of the impaired waterbodies in this watershed are not supporting fisheries (ADEQ, 2016). Sources for impairment in the Cache and Bayou DeView were listed as agriculture.

Segments of the Cache River watershed listed as impaired on the 303(d) List can be viewed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In addition to ADEQ, surface water quality data has been collected over the past decade in the watershed by U.S. Geological Survey, The Nature Conservancy and Arkansas State University. All stakeholders identified sediment as a priority pollutant in the Cache River watershed. These studies analyzed water quality and potential sources of pollution.

Suspected sources of nonpoint source pollution include cropland and streambank erosion (FTN Associates, 2016). Almost 70 percent of the land in the upper Cache River is cultivated cropland. Septic systems and wildlife are other potential nonpoint sources in this watershed.

In 2006, FTN Associates prepared a total maximum daily load for the Cache River and Bayou DeView in this watershed. A TMDL study also has been completed addressing dissolved lead in the upper Cache River watershed (FTN Associates, 2016).

Brief Description of Land Uses in the Watershed

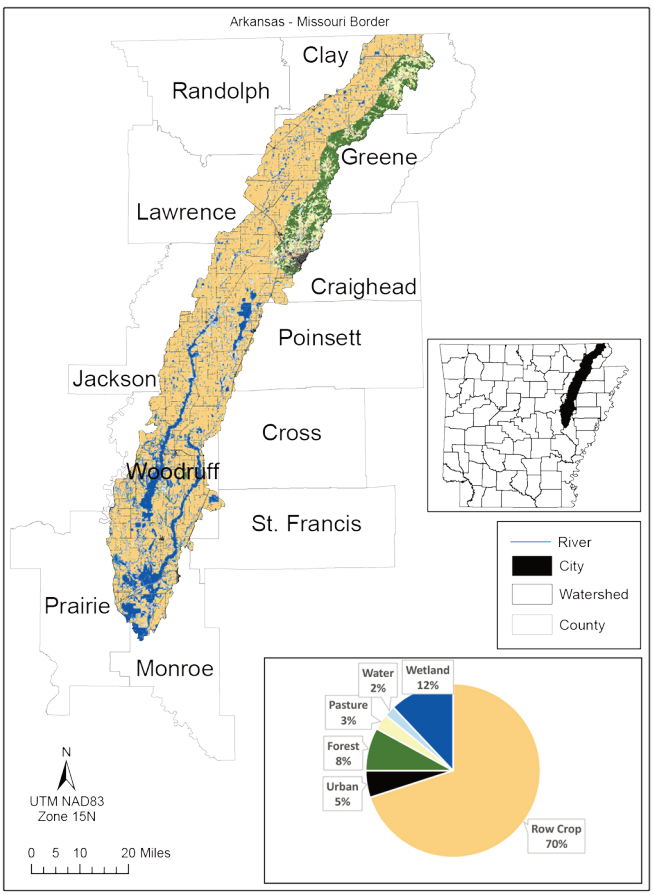
Figure 13.2 shows land use in the Cache River Watershed in 2011.

The following provides a partial snapshot of the watershed:

- The Cache River watershed includes more than 3,300 miles of streams and ditches. Drainage upstream of Grubbs has been significantly altered from natural conditions. Almost all streams in this portion of the watershed were channelized several decades ago and an extensive network of drainage ditches developed (FTN Associates, 2016).
- Seventy percent of the watershed's land area is cultivated in row crops. Approximately 8 and 3 percent of the land is under forest and pasture land uses, respectively (MRCL, 2011).
- The most commonly cultivated crops in the watershed are soybeans and rice. Corn, cotton and wheat are also grown. On Crowley's Ridge, crops include hay and fruit (FTN Associates, 2016).
- In the lower Cache River watershed, there are large areas of protected bottomland hardwood wetlands, including the Cache River National Wildlife Refuge and a number of State Wildlife Management Areas. The bottomland hardwood wetlands of the lower Cache River watershed have been designated as wetlands of international importance as habitat that supports migrating birds (FTN Associates, 2016).
- Approximately 87,733 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011).

Figure 13.2
Distribution of Land Uses in the Cache River Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MLRC)



Throughout much of the watershed, population is declining at an accelerated rate. Most decline took place in Monroe County (-20.5 percent), whereas the most gain in population took place in Craighead County (17.4 percent) from 2000 to 2010 (University of Arkansas at Little Rock, 2011). Jonesboro in Craighead County saw a 21 percent population growth between the 2000 census and 2010 census. The city continues to grow and is estimated at a population of 74,889 in 2016 compared to 67,263 in 2010, according to the U.S. Census Bureau.

Water Quality Program Goals

ANRC designated the Cache River watershed as a priority watershed for the first time in the 2011-2016 Nonpoint Source Pollution Management Plan.

Pollutants of concern within this Hydrologic Unit Area include:

- Chlorides
- Total dissolved solids
- Turbidity
- Sediment
- Minerals
- Lead
- Copper
- Low dissolved oxygen
- Sulfates

According to FTN Associates, nonpoint sources have been identified as the primary sources of these pollutants in the Cache River watershed. Sources include runoff from croplands and erosion from croplands, pasture, gullies and head cuts, land clearing on Crowley's Ridge, streambanks, stream channels and ditches.

The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Cache River watershed, targeting sub-watersheds where implementation can have the greatest impact. The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses.

Some of these goals have been realized in part in recent years. ADEQ removed four reaches of Bayou DeView from its 2014 303(d) List for lead impairment after more than a decade of education and best management practices by the Jackson County Conservation District and The Nature Conservancy. The two started providing technical and financial assistance in 2001 to help landowners implement water control and conveyance best management practices to manage the discharge of runoff from agricultural fields (ANRC, 2014).

They installed 430 water control structures, preventing approximately 36,980 tons of soil from eroding and entering Bayou DeView. These BMPs helped prevent sediment from leaving agricultural fields by controlling the rate, velocity and volume of the runoff. By slowing the runoff and preventing the sediment from reaching the stream, the BMPs decrease the amount of lead that enters the stream.

A second phase of the project involved identifying critical streambank erosion areas, which allowed ANRC to make more precise data-driven management decisions concerning funding allocation in the watershed. The Conservation District installed more water conveyance and control structures in the watershed, resulting in an estimated soil savings of approximately 220,000 tons per year. ADEQ testing showed fewer samples with lead presence, resulting in the 2014 delisting.

The Cache itself has seen some delistings as well. The 2016 ADEQ water quality assessment showed that Cache River reaches 017, 018, 019, 020 and 021 now meet the state's water quality standards for lead. Therefore, ADEQ has removed these five reaches from Arkansas' 2016 CWA section 303(d) List for lead impairment (ANRC, 2016). The stream remains listed as impaired for turbidity, and one reach remains listed for lead.

The delistings come after efforts by the Jackson County Conservation District, Cross County Conservation District, The Nature Conservancy, the Natural Resources Conservation Service, ADEQ and ANRC to address erosion issues along the waterway. A total of 13 water control structures were installed in the Cache River Watershed, which will prevent 3,805 tons of soil erosion per year (U.S. Environmental Protection Agency, 2016).

In 2016, FTN Associates hosted eight public meetings during a process sponsored by the Arkansas Natural Resources Commission to gather stakeholder feedback in creating a Nine-Element Watershed Plan for the Cache River. Stakeholders who participated included county judges, conservation districts, farmers, landowners, state and federal agencies and various nonprofits.

The Cache River Watershed-based Management Plan was completed in November 2016 and was submitted to the Environmental Protection Agency. The plan, which follows the steps outlined by the Environmental Protection Agency in the Handbook for Developing Watershed Plans, can be viewed at http://www.arkansaswater.org/319/pdf/Management%20Plans/Cache%20Watershed%20based%20Final%202016-11-28.pdf.

The plan, meant to be adaptive, targets erosion and sediment management with the expectation that activities to reduce erosion and sediment will also reduce the other pollutants of concern in the watershed. The plan also includes its own schedule and milestones for implementing activities addressing water quality concerns.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2018-2023 NPS Management Plan.

The following objectives were previously identified with input from the NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

13.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

13.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

13.3. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites (e.g., a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

13.4. Continue to develop models to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

13.5. Continue to focus on BMP implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop, animal agriculture and forestland. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

13.6. Continue to provide and improve extensive education and training to promote Best Management Practice (BMP) implementation (e.g., risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

13.7. Continue to encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambanks, and restore riparian areas.

13.8. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along the Cache River and its tributaries from development that would result in further NPS pollution.

13.9. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

13.10. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (e.g., recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

13.11. Encourage county and municipal elected officials as well as contractors, homebuilders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

13.12. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement, such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

13.13. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

13.14. Continue to provide public education on proper application, storage and disposal of pesticides, regulations, and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

13.15. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

13.16. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Cache River watershed, the short-term objectives of this program can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Cache River watershed with the authority to implement a Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program through the Arkansas Conservation Partnership (ACP) as well as through local coordination groups already in place.

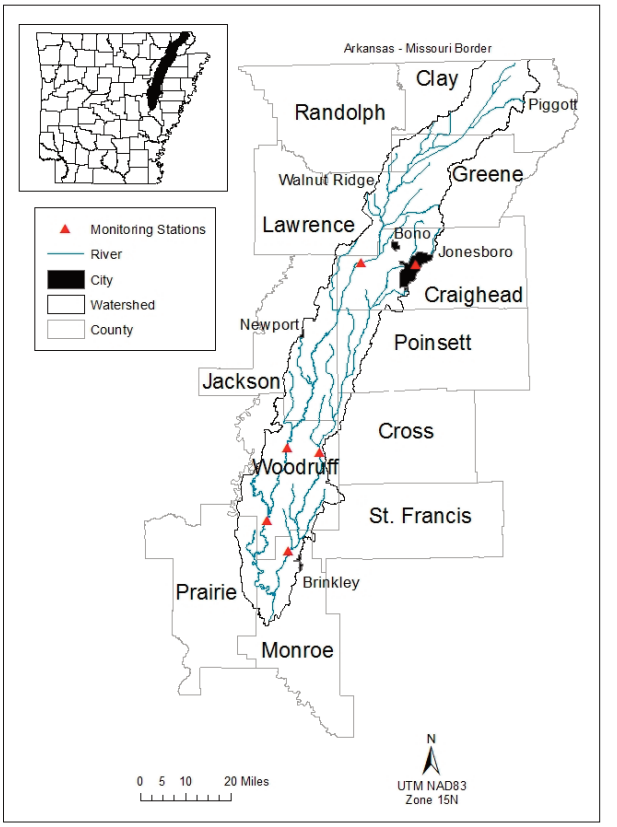
Significant local coordination is achieved through the Cache River Non-Profit Association, an organization that includes county judges for the nine counties of the watershed. The Nature Conservancy, Ducks Unlimited and the Lower Mississippi River Joint Venture also have projects in the watershed, and Arkansas State University conducts research in the watershed.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS management activities in the Cache River watershed. ADEQ is responsible for maintaining the state's water quality inventory. Figure 13.3 shows U.S. Geological Survey monitoring stations in the watershed.

Figure 13.3
U.S. Geological Survey Monitoring Stations in the Cache River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



The NPS Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. A local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Cache River Watershed in Newport in October 2014. Participants identified sedimentation as their watershed's priority concern that needed addressing. Participants also expressed concern over how water quality issues can impact their economy and about the effects of flooding.

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Section
Fourteen

Illinois River

Priority Watershed
2018-2023 NPS Management Plan
A portion of ADEQ planning Segment 3J ◆ HUC 11110103
***EPA-Accepted Watershed Management Plan**

Introduction

The Illinois River Watershed contains approximately 1.1 million acres of which approximately 493,500 acres (46 percent) are in Arkansas and approximately 576,000 acres (54 percent) are in Oklahoma. The Illinois River headwaters originate near Hogeye and flows westerly, crossing into Oklahoma approximately 5 miles south of Siloam Springs.

The Illinois River Watershed portion of segment 3J (HUC 11110103) occupies the northwestern corner of Arkansas and covers part of Benton County, a large part of Washington County and a small section of Crawford County. This segment, which is part of the Grand Neosho Basin, includes the Illinois River and its tributaries within Arkansas. The main tributaries in Arkansas are Osage Creek, Flint Creek and Spring Creek (Figure 14.1).

The Illinois River watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

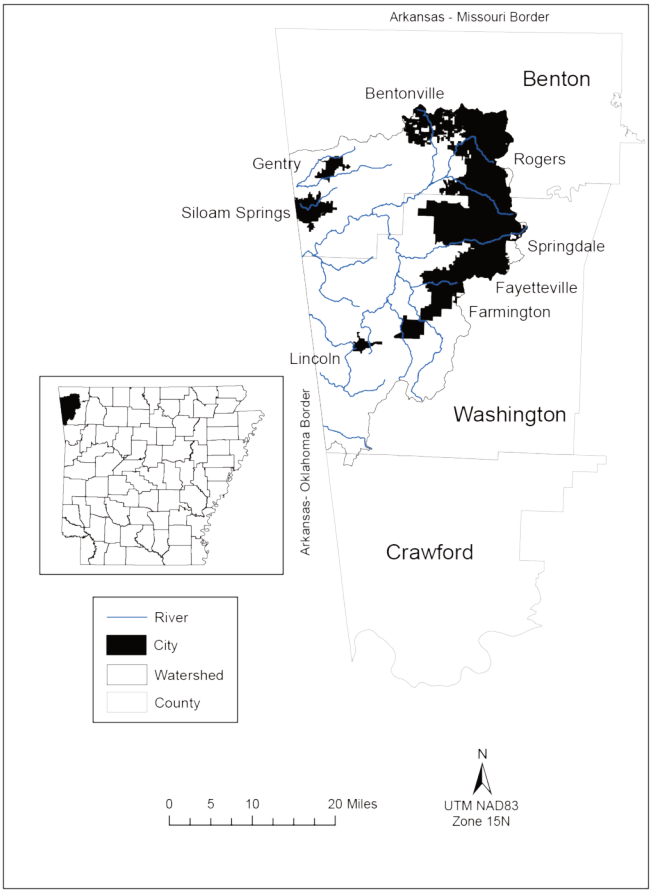
Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental (ADEQ) Quality summarized the water quality conditions of the Illinois River and its tributaries as such:

> Waters within this segment have been designated as suitable for the propagation of fish and wildlife; primary and secondary contact recreation; and public, industrial, and agricultural water supplies. Waterbodies in this segment are heavily used year-round for fishing, boating, and canoeing as well as and primary contact recreation activities in the warmer months.
>
> Nonpoint source impacts affecting waters in this segment are primarily from urban development, pasture lands which receive applications of poultry waste products, and surface erosion. Instream gravel removal destabilizes the streambed and causes excessive bank erosion. Road construction and

Figure 14.1
Map of the Illinois River Drainage Area in Arkansas Watershed

Source: GeoStor



maintenance also contributes to siltation problems. Animal agriculture practices contribute to pathogen impairments as well as streambank destabilization.

Three major municipal, point source discharges enter the Illinois River via Osage Creek and Clear Creek, and a minor municipal discharge enters the Illinois River from Muddy Fork of the Illinois River. Several of these facilities have upgraded their processes for advanced phosphorus removal.

Upgrades to the treatment facility on Town Branch Creek has corrected earlier problems and restored the fisheries designated use.

ADEQ identified six waterways and one lake in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Several of the impaired waterbodies in this watershed are not supporting primary contact (ADEQ, 2016). Sources for impairment in the Illinois River watershed were listed as agriculture and "unknown."

Segments of the Illinois River watershed listed as impaired on the 2016 303(d) List can be viewed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In preparing a management plan for the watershed, FTN Associates wrote that possible sources of pollutants include municipal wastewater treatment plant effluent, leaking sewers, illicit discharges, combined sewer overflow, failing septic systems, agriculture, fertilizer used in developed areas and golf courses, wildlife, domestic pets or other warm-blooded animals, and erosion from pasture, roads, road crossings and streambanks. The watershed management plan also mentions that because of karst geology, groundwater contaminated through infiltration might serve as a source of some pollutants when it discharges into the stream.

Waterbodies in this watershed are monitored by a variety of entities, including the Arkansas Department of Environmental Quality, U.S. Geological Survey (USGS), Arkansas Water Resources Center (AWRC), permitted dischargers and volunteers. This watershed has been the focus of extensive monitoring for some time as it has changed from its natural characteristics to an urban- and agriculture-dominated watershed (FTN Associates, 2012). ADEQ has been monitoring segments of the Illinois River and its tributaries since the early 1990s. Studies and monitoring have recorded data related to temperature, dissolved oxygen, turbidity, total dissolved solids, total suspended solids, nitrogen, phosphorus and many other parameters.

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) and the U.S. Forest Service (USFS) completed a Cooperative River Watershed study for the Illinois River and published its Resource Base Report. The study found the Illinois River and many of the lakes on its tributaries were eutrophic from excessive nutrients (USFS and NRCS, 1992).

ADEQ surveyed macroinvertebrate and fish communities in the Illinois River in 1995 and 1996 to assess the impact of municipal wastewater treatment facilities on water quality and aquatic life communities. In addition, the study characterized the effects of point source and NPS pollution on seasonal water quality (ADEQ, 1997). USGS collected periphyton samples at 51 stream sites in the Ozark Plateaus to determine the effect of different land uses. Results indicate that periphyton communities are affected by natural and land-use related factors, including nutrients, dissolved organic carbon, alkalinity, canopy shading, suspended sediment, embeddedness, stream morphometry and velocity (Peterson and Femmer, 2002). A more recent USGS study of the effects of land use, stream habitat and water quality on biological communities in wadable streams found that the Ozark Highlands fish index of biotic integrity and several fish metrics were adversely affected by increasing urban and agricultural land use and associated factors. Factors affecting these metrics included factors associated with nutrients, sediment and shading (Peterson, Justus and Meredith, 2014).

The Arkansas Water Resources Center prioritized sub-basins in the watershed in 1996 based on total phosphorus, total nitrogen and total suspended solids. Each sub-basin was given a low, medium or high prioritization for each of the three factors (AWRC, 1996).

The U.S. Geological Survey and the Arkansas Natural Resources Commission (ANRC) cooperated on a project to collect and analyze water quality samples to estimate nutrient loads for nitrogen and phosphorus for 1997-1999 using regression analysis. Total estimated phosphorus and nitrogen annual loads for calendar year 1997-1999 using the regression techniques on 35 samples were similar to estimated loads derived from integration techniques on 1,033 samples. Nitrogen and phosphorus estimates were higher than for comparable undeveloped watersheds (Green and Haggard, 2001).

A USFS comparative assessment of 50 watersheds in Arkansas and Oklahoma estimates potential erosion by land use for the Illinois River watershed. Based on 1992 National Resource Inventory (NRI) data, pasture land had the highest potential erosion rate at 72 percent compared to other lands (including urban) with a 15 percent potential erosion rate and forestry with a 2 percent potential erosion rate. Compared to 1982, potential erosion rates increased for pasture-lands and decreased for other lands (USFS, 1999).

USGS has done extensive monitoring and analysis of surface and ground water quality in the Ozark Plateau study area as part of the National Water Quality Assessment Program. Major findings for the Ozark Plateau study area are available at www.usgs.gov/centers/lmg-water/science/ozark-plateaus-national-water-quality-assessment-nawqa-program?qt-science_center_objects=O#qt-science_center_objects.

More recently, the Arkansas Water Resources Center evaluated water quality trends at six sites in the Illinois River and Beaver Lake watersheds using data collected through Section 319 projects. AWRC evaluated water quality trends at monitoring sites on three streams in the Illinois River watershed and identified decreasing trends for total suspended solids among other water quality parameters (FTN Associates, 2012). The monitoring site on the Illinois River near Savoy exhibited statistically significant decreasing trends for the majority of the constituents evaluated. AWRC continues to sample in the watershed as part of a longer-term effort to understand how water quality is changing.

The U.S. Environmental Protection Agency (EPA) Region 6 is preparing a total maximum daily load (TMDL) for phosphorus for the Illinois River watershed, which will identify phosphorus sources and load reduction estimates in the watershed (FTN Associates, 2012).

The health of this watershed is monitored by Arkansas and Oklahoma environmental officials as part of a larger agreement called the Joint Statement of Principles and Actions, which seeks to improve water quality in the watershed by reducing phosphorus concentrations and loads in the Illinois River. A 2003 agreement that adopted a numeric phosphorus standard was renewed in 2013, resulting in a two-year study of phosphorus and its effects on nuisance algal species.

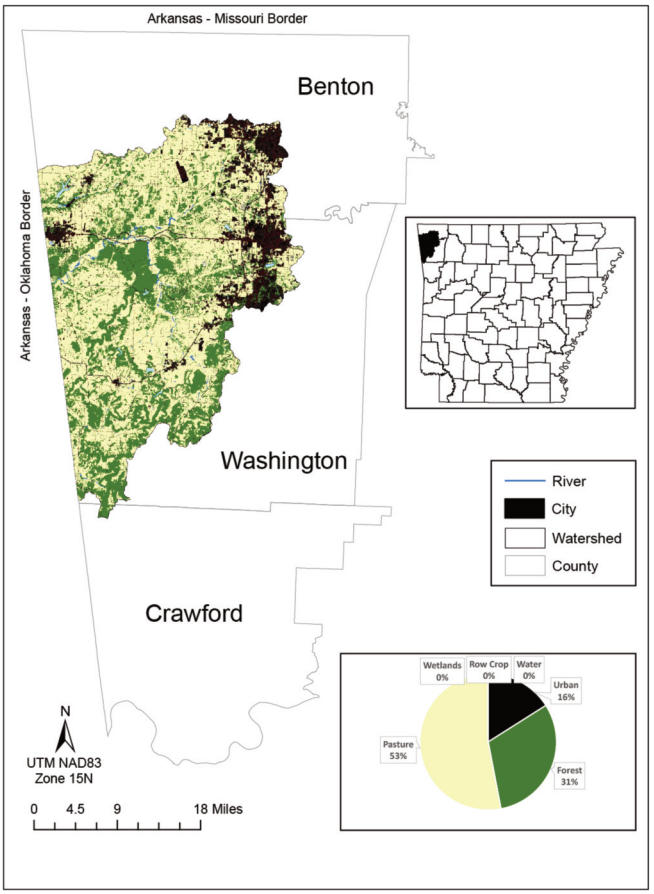
The study's results led to the Joint Study Committee recommending in 2016 an updated numeric phosphorus standard. The Joint Study Committee, which consisted of Arkansas and Oklahoma officials, recommended using a six-month average total phosphorus level of not to exceed 0.035 milligrams per liter based on water samples collected during critical conditions.

Brief Description of Land Uses in the Watershed

Figure 14.2 shows land use in the Illinois River watershed in 2011.

Figure 14.2
Distribution of land uses in the Illinois River Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



The following provide a partial snapshot of land uses in the watershed:

- There are seven drinking water sites in the Arkansas and Oklahoma portions of the watershed (U.S. Forest Service, 1999).
- An estimated 172,428 individuals lived in the Arkansas portion of the watershed as of the 2010 Census. (Biological and Agricultural Engineering Department, 2011).
- The population of Washington and Benton counties grew 28.8 percent and 44.3 percent from 2000 to 2010 (University of Arkansas at Little Rock, 2011). As a result, there is significant new construction, including residential, commercial and industrial, roads and other infrastructure. Construction can be found both within municipal boundaries and in rural areas of the watershed where onsite waste disposal is used.
- Fourteen municipalities in the watershed and portions of Washington and Benton counties as well as the University of Arkansas are subject to Phase II requirements for a small municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit. With leadership from the Northwest Arkansas Regional Planning Commission, these entities have joined together to contract with the University of Arkansas System Division of Agriculture, Cooperative Extension Service to provide education and technical assistance.
- The entire watershed is designated as a nutrient surplus area subject to new regulations for nutrient planning, nutrient application and certification of nutrient planners.
- Benton and Washington counties are the largest producers of broiler chickens in Arkansas. The watershed is home to 25 federally regulated food processing facilities (FTN Associates, 2012).
- Approximately 53 percent of the land area in the watershed is pasture while 31 percent was in forest and 16 percent was urban (Multi-Resolution Land Characteristics Consortium, 2011).
- The watershed provides habitat for four federally protected aquatic species: the Ozark cavefish, least darter, Oklahoma salamander and Neosho mucket. The presence of endangered species and other aquatic species of concern has resulted in several streams in the watershed being classified as ecologically sensitive waterbodies.
- Most forest land in the watershed is owned by private non-industrial landowners and the U.S. Forest Service.
- The Illinois River and its major tributaries in Arkansas exhibit a range of conditions, from areas with dense riparian forest buffers to areas of exposed and eroding streambanks with no vegetated buffers.
- The State of Oklahoma lists the Illinois River watershed on its List of Impaired Waterbodies.

Water Quality Program Goals

The Illinois River watershed has been a priority of the Arkansas Nonpoint Source (NPS) Management Plan since the comprehensive update of the program completed in 1998. ANRC is again designating the Illinois River watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan.

Pollutants of concern within this hydrologic unit area include:

- Turbidity
- Sediment
- Pathogens
- Nitrates
- Phosphorus

Though all the waterbodies in this segment have been designated as suitable for the various identified uses, some pollutants can threaten a waterbody's ability to fully meet the designated use (ADEQ, 2008).

The short-term goal of the program is to measurably reduce turbidity, nutrients and pathogens that reach waters of the Illinois River watershed, targeting sub-watersheds where implementation can have the greatest impact. The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses.

Some of these goals have been realized in part in recent years. ADEQ removed a 2.5-mile reach of the Illinois River from its 2014 303(d) list for turbidity after water samples showed a decline in exceedances of the turbidity standard (U.S. Environmental Protection Agency, 2015).

ANRC believes best management practices and education in the watershed helped achieve the delisting after more than a decade of work by local landowners and organizations – the Benton County Conservation District, the Washington County Conservation District, the Arkansas Game and Fish Commission, the University of Arkansas Water Resource Center, the University of Arkansas System Division of Agriculture Cooperative Extension Service, Natural Resources Conservation Service, ADEQ and ANRC.

The Illinois River Watershed Partnership was formed during this time and worked with stakeholders in the watershed to improve water quality.

Remaining goals will be achieved through implementation of a Nine Element Plan, which replaces a previous Watershed Restoration Action Strategy (WRAS). ANRC submitted a draft Nine Element Plan to the U.S. Environmental Protection Agency in March 2004 (ANRC, 2004). A later version was prepared in 2012 by FTN Associates on behalf of ANRC and the Illinois River Watershed Partnership. The plan is accessible at http://www.irwp.org/assets/PDF /UIRW-Watershed-Based-Plan-2012-11-30-Final.pdf.

The plan was created using an adaptive management approach, which means periodic assessments must be made to evaluate water quality in the watershed and make adjustments to the plan.

The plan targets pathogens, nitrates and sediment. The plan also includes its own schedule and milestones for implementing activities addressing water quality concerns.

Public support will have to be further developed to implement the proposed activities.

Objectives

Utilize the Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2018-2023 NPS Management Plan.

The following objectives were previously identified with input from the NPS Pollution Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

14.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

14.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

14.3. Promote and support strengthening of local capacity to implement the Nine Element Plan, encouraging local review of a range of options to identify the most effective institutional mechanism to lead implementation.

14.4. Use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites. Promote use of riparian tax credits and cost-sharing programs to fund restoration projects and develop conservation easements.

14.5. Continue to develop models to represent sediment and nutrient loads in the watershed, instream processes and lake response to enable prioritization of implementation projects in sub-watersheds.

14.6. Continue to encourage the development of comprehensive nutrient management plans (CNMPs) or nutrient management plans (NMPs), provide technical assistance and make available financial assistance to animal agricultural operations where cost-share is a component of approved implementation projects.

14.7. Continue and strengthen ongoing comprehensive education and training programs to help poultry and livestock producers meet the requirements of new ANRC poultry litter and nutrient application regulations and new ADEQ confined animal feeding operations (CAFO) regulations.

14.8. Continue to develop and provide coordinated, comprehensive education for city planners, elected officials, developers, contractors, property owners and others using workshops, print and electronic materials, demonstration projects and other methods on topics such as stormwater pollution prevention plans, proper installation and maintenance of erosion and sediment control, planning tools to improve stormwater management (e.g., low impact development, greenways, cluster development) and other related topics.

14.9. Cooperate with and support the efforts of local nonprofit organizations, municipalities and other cooperating entities to develop and deliver a coordinated environmental education program with a local emphasis.

14.10. Identify groups for targeted education on specific high impact activities (e.g., develop and post fact sheets for boaters on proper waste disposal and the potential impact at boat ramps and marinas; provide training to county elected officials, road departments and property owners associations on how to reduce erosion from rural roads; or provide education to homebuilders, developers and homeowners on methods and activities to reduce NPS pollution) as resources allow.

14.11. Identify severe erosion sites at rural road crossings and work with county government to develop and implement erosion control plans for high impact sites (e.g., promote use of conservation district hydromulcher for treatment).

14.12. Encourage development of urban forestry projects in municipalities within the watershed.

14.13. Carry out comprehensive information and education program quality for community leaders, including mayors, county judges, quorum courts, planning boards and commissions, conservation district directors and others. Emphasize the need to protect water and the benefits of clean water for the economy, quality of life and the environment.

14.14. Continue to provide training to earth-moving contractors and their employees, public works department employees, county employees and others regarding operation and maintenance of construction Best Management Practices (BMPs) through the partnership with the Northwest Arkansas Regional Planning Commission and the University of Arkansas System Division of Agriculture, Cooperative Extension Service in order to help them meet the requirements of EPA Phase II stormwater regulations for construction and municipal separate storm sewer systems.

14.15. Review tax code to determine possible mechanisms to use tax incentives for water quality BMP implementation in nutrient surplus areas, especially for practices that minimize the direct impact of cattle on streams.

14.16. Work with elementary and secondary school teachers to develop teaching modules regarding water quality protection and conservation that meet curriculum requirements of the Arkansas Department of Education.

14.17. Investigate the use of the Clean Water Revolving Loan Fund for alternative onsite wastewater systems.

14.18. Build constituency for improved water quality by increasing volunteerism for cleanups and streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups, conducting water awareness days, building working relationships with groups that represent recreational users (e.g., birdwatchers, paddlers, hunters, etc), and other means.

Timeline

Provided sufficient human and financial resources are available to the cooperating entities working together in the Illinois River watershed, the short-term objectives of this program can be met within five years of implementation of this update. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Illinois River watershed with the authority to implement the Nine Element Plan. However, the Illinois River Watershed Partnership formed in 2005 has undertaken significant efforts to implement the plan and accomplish public education goals and install water quality improvement structures.

ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership (ACP). In the construction and urban programs, there is significant coordination through a voluntary contractual agreement among municipalities, counties, the University of Arkansas System Division of Agriculture Cooperative Extension Service and the Northwest Arkansas Regional Planning Commission to provide education and training on stormwater management.

Program Tracking and Evaluation

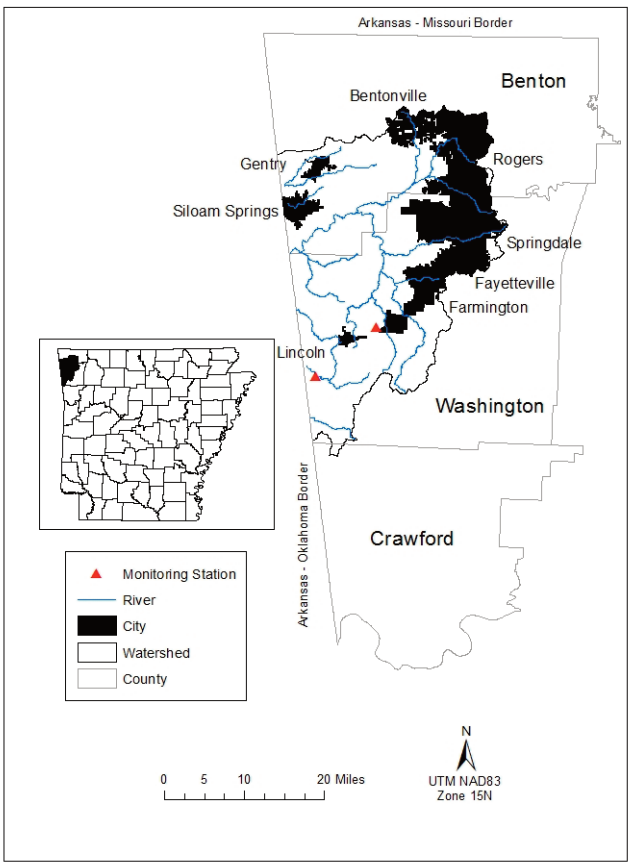
Water quality monitoring data will be used to evaluate the effectiveness of nonpoint source pollution management activities in the Illinois River watershed.

ADEQ is responsible for maintaining the state's water quality inventory. Eight monthly monitoring stations are maintained within the Illinois River Watershed. In addition, USGS and ANRC maintain monitoring sites in the watershed. Real-time flow data are available at the USGS stations as well as some water quality data. ANRC monitoring stations focus on sediment, nitrogen and phosphorus-related parameters, which are most significant in assessing nonpoint source pollution. Figure 14.3 shows the USGS monitoring stations in the watershed.

Figure 14.3

U.S. Geological Survey Monitoring Stations in the Illinois River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



BMP implementation data will be tracked for ANRC projects. New biosecurity provisions included in subsequent farm bills may make it difficult to obtain data files for NRCS cost-share projects to monitor implementation of agriculture BMPs. Implementation data for NRCS cost-share projects are available from the national NRCS website; however, data must be downloaded separately for each BMP, making the effort labor intensive and prone to human errors. Potentially, Conservation Districts could report aggregate BMP implementation by sub-watershed, thus maintaining confidentiality of landowners while still providing information needed for evaluation. Arkansas Forestry Commission (AFC) monitors silviculture BMP implementation biennially. ADEQ will monitor inspection and complaint data for related regulatory programs it administers (e.g., surface mining, NPDES permits, etc).

The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and frankly discuss their successes, failures and future needs of their programs. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Illinois River Watershed in August 2015. Unlike many of Arkansas' watersheds, the Illinois River Watershed has a history of active groups working to restore waterways or prevent further pollution.

Forum participants expressed continued concern that urban development was the greatest risk to water quality and could set back recent water quality improvement efforts. They referred to this risk as "urban disturbance," which is their term to describe the pollution associated with increased runoff as a result of urban growth and land use changes.

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Section
Fifteen

Lake Conway-Point Remove

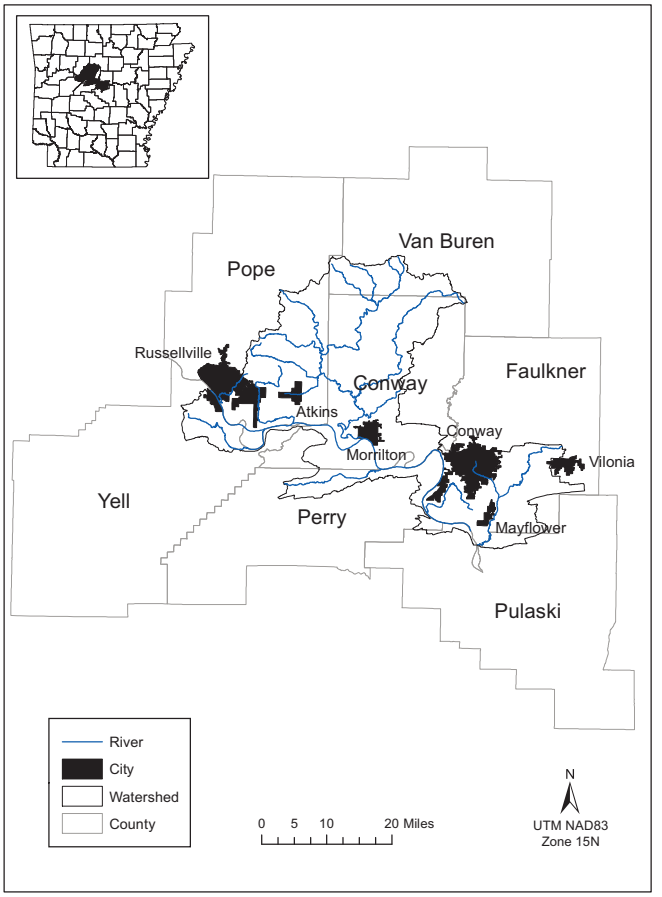
Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 3F ◆ HUC 11110203

Introduction

Segment 3F is located in the central portion of Arkansas and covers parts of Faulkner, Conway, Perry, Pope and Van Buren counties. This segment contains the Arkansas River and its tributaries – East and West Forks of Point Remove Creek, Overcup Creek, Gum Log Creek, Palarm Creek, and Galla Creek. Figure 15.1 shows a map of the watershed.

Figure 15.1
Map of Lake Conway-Point Remove Watershed

Source: GeoStor



The watershed is a nontraditional watershed as it is bisected into two distinct sections (Lake Conway and Point Remove) by the Caddo River in the northeast and the Petit Jean and Fourche La Fave Rivers in the southwest. The Arkansas River flows through the middle of the watershed, but because of its size, the surrounding watershed has very little impact on the river as a whole.

The Lake Conway-Point Remove watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of the Lake Conway-Point Remove Watershed and its tributaries as such:

> Waters within this segment have been designated as suitable for the propagation of fish and wildlife; primary and secondary contact recreation; and public, industrial, and agricultural water supplies. The Arkansas River and lakes (Overcup, Conway, and Brewer) in this segment offer excellent fishing and boating opportunities.
>
> Stone Dam Creek is impaired by a municipal point source discharge. Chronic ammonia toxicity and elevated nitrate levels exceed the drinking water maximum contaminant level. A TMDL to address these issues was completed in 2003.
>
> Whig Creek continues to be impaired by municipal and industrial point source discharges. Elevated levels of nutrients and copper are the cause of the

impairment. TMDLs were completed for this waterbody in 2000 (nitrite) and 2003 (copper).

White Oak Creek remains listed for high silt and turbidity levels. Nonpoint sources appear to be the major cause. A TMDL addressing this issue was completed in 2006.

Major streams and bayous entering the Arkansas River provide important habitat for alligator gar spawning. The United States Fish and Wildlife Service, the United States Corps of Engineers, the Arkansas Game and Fish Commission, and several other federal, state, and academic institutions, as well as local land-owners and concerned citizens are developing action plans to protect, manage, and restore these areas.

ADEQ identified five waterways in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Three of the impaired waterbodies in this watershed, White Oak Creek, Stone Dam Creek and Whig Creek, were listed as not supporting fisheries (ADEQ, 2016). Stone Dam Creek and Whig Creek also were listed as not supporting agricultural and/or industrial water supply uses because of copper, ammonia and nitrates. ADEQ's impaired waterbody list identified municipal point sources as the source of contamination for those two creeks.

Segments of the Lake Conway-Point Remove Watershed listed as impaired in the 2016 303(d) List can be viewed at http://www.adeq.state.ar.us /water/planning/integrated/303d/list.aspx.

When comparing the watershed to others in the state, such as the Illinois or Beaver watersheds, there is significantly less scientific study that has been performed in the Lake Conway-Point Remove watershed (University of Arkansas, 2014). A 1998 study was spurred by citizens concerned about the influence wastewater treatment plants and septic systems on lake water quality. Results showed elevated concentrations of metals but not at toxic levels. Nor did fecal coliform bacteria levels violate water quality standards.

ADEQ conducted a study in 2000 of the lake as part of a larger study looking at water quality in publicly owned lakes. Sampling results indicated water quality levels differed depending on where in the lake the samples were taken (University of Arkansas, 2014).

In 2003, the Arkansas Game and Fish Commission's Fisheries Division put together a Lake Conway Management Plan that recognized urbanization of the watershed as affecting the lake through accelerated silt accumulation in the water, modification of the lake's shoreline, increased surface runoff and health notices of high levels of fecal coliforms. The plan, which described the lake as having good water quality, was put together as part of a collaborative effort between the agency and the Lake Conway Citizens Advisory Committee.

A 2009 study utilizing the SPARROW watershed model resulted in the watershed being ranked in the top 150 watersheds for the Mississippi/Atchafalaya Basin for total phosphorus.

A 2015 study commissioned by the Arkansas Game and Fish Commission established some baseline water quality levels of Lake Conway and the extent of sedimentation present. The study documented phosphorous levels and found measured thickness of accumulated sediment averaged 2.4 feet over the entire lake (FTN Associates, 2015).

Brief Description of Land Uses in the Watershed

Figure 15.2 shows land use in the Lake Conway-Point Remove Watershed in 2011.

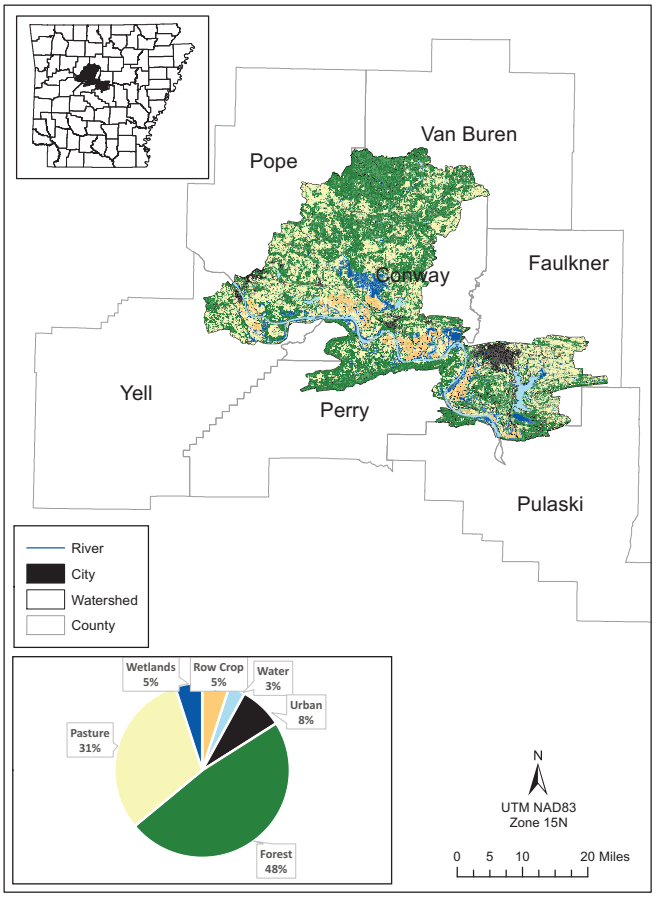
The following provides a partial snapshot of the watershed:

- Approximately 48 percent of the land is in forests and 31 percent is in pasture (MRLC, 2011). Five percent of the watershed's land area is cultivated in row crops, and eight percent is considered urban.
- Approximately 88,278 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011). Throughout the watershed, population is increasing at an accelerating rate. The most increase took place in Faulkner County (31.6 percent), whereas the least gain in population took place in Perry County (2.3 percent) from 2000 to 2010 (University of Arkansas at Little Rock, 2011).
- There is significant poultry, cattle and hog productions in portions of the watershed (University of Arkansas, 2014). Major crop types produced in the watershed include soybeans, corn grain and silage, rice and wheat.
- The northern portion of the watershed resides in the Fayetteville Shale formation of the Arkoma Basin. The Point Remove Creek portion of the watershed has experienced a boom in shale gas development in recent years. In 2009, there were more than 800 natural gas wells drilled in the

watershed (University of Arkansas, 2014). In 2017, ArcGIS showed 1,501 natural gas wells in the larger watershed, with nearly all of them on the Point Remove side.
- Lake Conway is the largest state-owned fishing lake in the state (Arkansas Game and Fish Commission, 2003).

Figure 15.2
Distribution of Land Uses in the Lake Conway-Point Remove Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



Water Quality Program Goals

The Lake Conway-Point Remove watershed was designated as a priority by ANRC during 2006-2011 NPS Pollution Management Plan and is again being designated as a priority watershed for the 2018-2023 NPS Pollution Management Plan. Pollutants of concern within this Hydrologic Unit Area include:

- Sediment
- Pathogens
- Metals
- Nutrients
- Chlorides
- Low dissolved oxygen

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Lake Conway-Point Remove watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan.

ANRC contracted with the University of Arkansas to create a Nine Element Plan for the watershed. The University's Community Design Center and Center for Agricultural and Rural Sustainability hosted public meetings and drafted a Nine Element Plan and Conway Urban Watershed Framework Plan. Stakeholders involved focused more specifically on Conway and how the landscape could improve water quality. The draft Nine Element Plan is currently incomplete.

However, a group called the Lake Conway-Point Remove Watershed Alliance formed out of the effort and has intentions to work on completing the Nine Element Plan. In order to reach short-term and long-term goals, public support must be developed for implementation of management measures to restore designated uses in the watershed.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the Plan.

The following objectives were previously identified with input from NPS Management Plan stakeholders. Cooperating entities are described in cooperating entities section of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

15.1. Continue development of the Nine Element Plan until U.S. Environmental Protection Agency (EPA) approval is obtained.

15.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

15.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

15.4. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (e.g., a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

15.5. Continue to refine models as new data becomes available to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

15.6. Continue to focus on Best Management Practices (BMPs) implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forest land. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

15.7. Continue to provide and improve extensive education and training to promote BMP implementation (e.g., risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport, including but not limited to no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

15.8. Continue to encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambanks and restore riparian areas.

15.9. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along the Arkansas River and its tributaries from development that would result in further NPS pollution.

15.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

15.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (e.g., recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

15.12. Encourage county and municipal elected officials as well as contractors, homebuilders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

15.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

15.14. Continue aquatic life assessments to assess response of waterbodies to NPS pollution control measures as resources allow.

15.15. Continue to provide public education on proper application, storage and disposal of pesticides, regulations, and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

15.16. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

15.17. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Lake Conway-Point Remove watershed, the short-term

objectives of this program can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Lake Conway-Point Remove watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements as appropriate.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS pollution management activities in the Lake Conway-Point Remove watershed. ADEQ is responsible for maintaining the state's water quality inventory. Figure 15.3 shows U.S. Geological Survey monitoring stations in the watershed.

The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

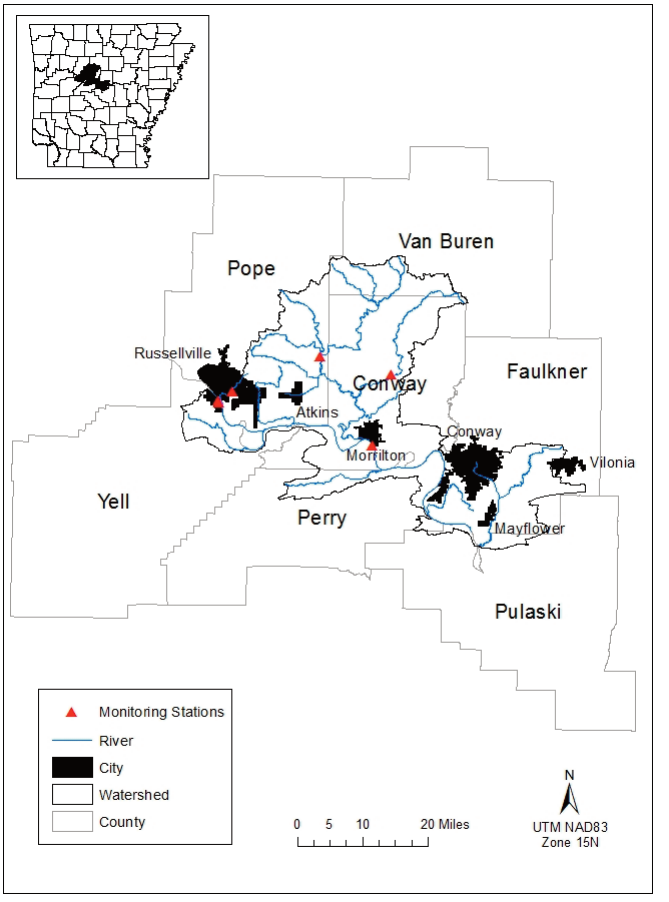
Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Lake Conway-Point Remove watershed in August 2015.

Participants identified water quality issues such as sedimentation, regulations and erosion as local priorities that need addressing. A group of stakeholders has worked with the University of Arkansas since 2013 to develop a Lake Conway-Point Remove Watershed plan to address nonpoint source pollution. A draft plan has been reviewed by the EPA. Stakeholders are in the process of addressing EPA recommendations for finalizing the plan.

Figure 15.3
U.S. Geological Survey Monitoring Stations in the Lake Conway-Point Remove Watershed

Source: U.S. Geological Survey National Water Information System Mapper



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Section
Sixteen

L'Anguille River

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 5B ◆ HUC 08020205
***EPA-Accepted Watershed Management Plan**

Introduction

The L'Anguille River watershed is located in northeast Arkansas and covers parts of Craighead, Poinsett, Cross, Woodruff, St. Francis and Lee counties. The L'Anguille River begins south of Jonesboro and flows generally southward to its confluence with the St. Francis River near Marianna.

Segment 5B includes the entire 98-mile length of the L'Anguille River. The principal tributaries include Brushy Creek, First Creek, Second Creek and Larkin Creek. Second Creek has been designated as an Extraordinary Resource Water. Figure 16.1 provides a map showing the location of the watershed.

The L'Anguille River watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of the L'Anguille River and its tributaries as such:

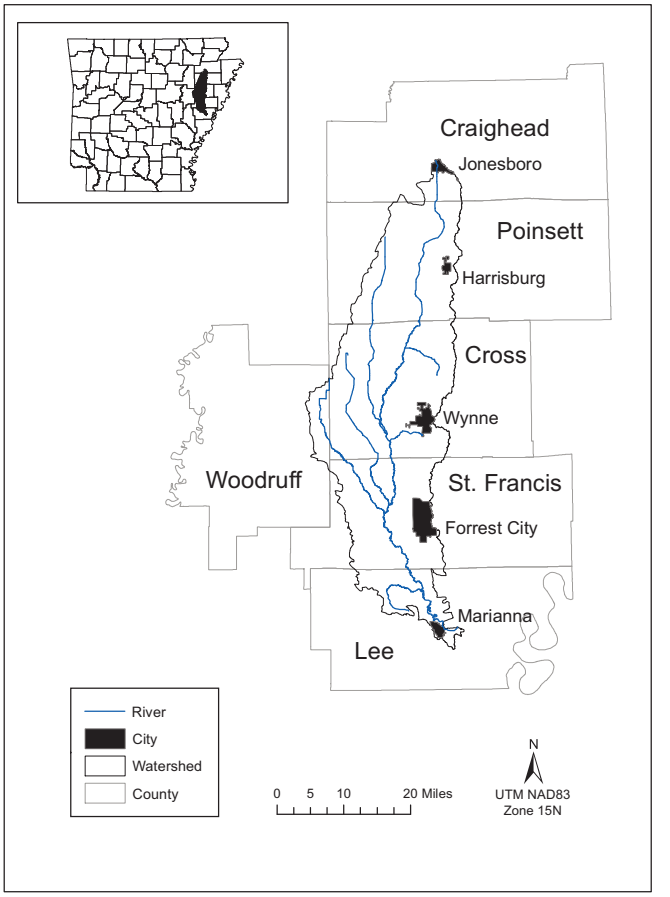
> Waters in the St. Francis basin, which contains the L'Anguille River watershed, are designated for propagation of fish and wildlife, primary and secondary contact recreation, and domestic, agricultural, and industrial water supplies. The three segments of the St. Francis basin are discussed as one unit due to the consistent nature of the water quality.

The entire St. Francis River Basin contains 933.1 stream miles with approximately 14 percent designated as outstanding resources. The L'Anguille River watershed contains 268 miles of streams.

The overriding impact of land use on water quality can be seen in this segment. Essentially all of the streams within these segments have high turbidity and silt loads carried into the streams from row crop agriculture activities. This condition was encouraged by the drainage of lowland areas and by ditching and the channelization of streams to facilitate the runoff. The continuation of such activities and the continuous

Figure 16.1
Map of L'Anguille River Watershed

Source: GeoStor



maintenance dredging of the ditches and streams has aggravated and further deteriorates the conditions.

Because of the very high levels of turbidity during high flows and consistently elevated values during other flows, the entire length of the L'Anguille River was assessed as not supporting the aquatic life uses.

Some reaches of the L'Anguille River were assessed as not supporting the aquatic life due to delta streams naturally having lower dissolved oxygen concentrations during the critical season and chlorides, sulfates, and total dissolved solids (ADEQ, 2016).

ADEQ identified nine stream segments in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Several of the impaired waterbodies in this watershed are not supporting fisheries. Sources for impairment in the L'Anguille watershed were listed as agriculture and surface erosion (ADEQ, 2016).

Segments of the L'Anguille River watershed listed as impaired on the 2016 303(d) List can be viewed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In 2001, the U.S. Environmental Protection Agency (EPA) contracted with FTN Associates to prepare a total maximum daily load (TMDL) for siltation or turbidity in the L'Anguille River watershed. FTN Associates recommended reductions in turbidity and fecal coliforms. The TMDL for turbidity for the L'Anguille River was expressed using total suspended solids (TSS) as a surrogate for turbidity. FTN Associates recommended that existing nonpoint source loads of TSS in the L'Anguille River be reduced by 38 percent during the summer critical period and 40 percent during the spring critical period. FTN Associates recommended that NPS loads of fecal coliforms in the upper two reaches of the L'Anguille River be reduced by 11 percent during the winter period and no reductions for the summer period.

Nutrient enrichment of the water bodies in this watershed is a concern. However, detecting and determining the extent of impacts of the contributions of nutrients from nonpoint sources is difficult. Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality. Improper management of nutrients can result in adjacent streams receiving nutrient inputs during storm events.

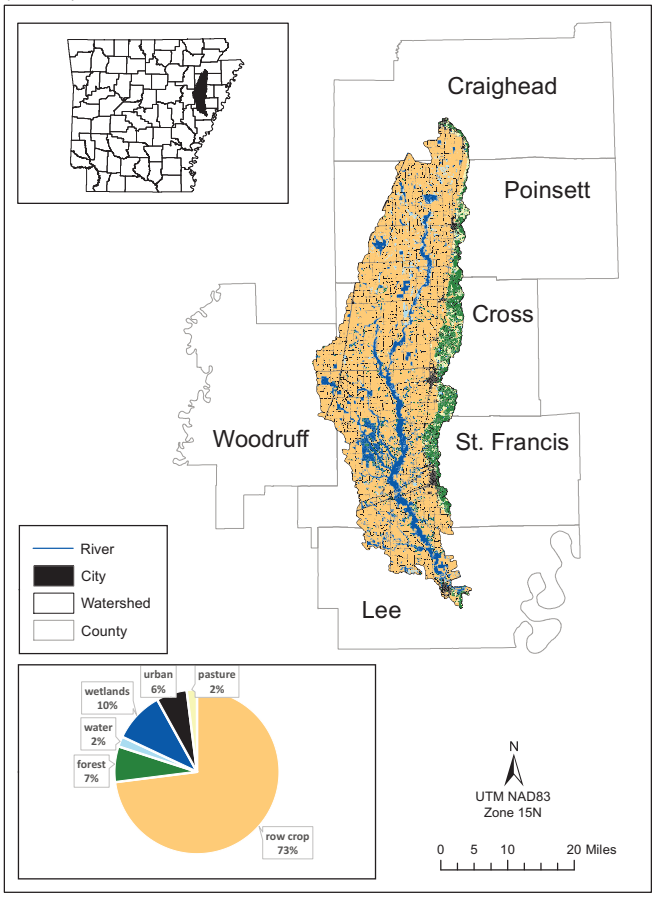
The U.S. Geological Survey (USGS) did extensive monitoring and analysis in the 1990s of surface and groundwater quality in the Mississippi Embayment study area, a six-state region that includes the L'Anguille Watershed, as part of the National Water Quality Assessment Program (Kleiss, Coupe, Gonthier, and Justus, 2000). A summary of those findings is available at https://pubs.usgs.gov/circ/circ1208/index.html.

Brief Description of Land Uses in the Watershed

Figure 16.2 shows land use in the L'Anguille River Watershed in 2011.

Figure 16.2
Distribution of Land Uses in the L'Anguille River Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



The following provides a partial snapshot of the watershed:

- Land use in the L'Anguille River watershed is predominantly agricultural. Nearly 73 percent of the land is cultivated in row crops, primarily rice and soybeans (MRLC, 2011).
- Some 7 percent of the land is in forests and 2 percent is in pasture (MRLC, 2011). Most of the land along Crowley's Ridge is in pasture or forest, which makes it an attractive area for rural residential development and raises the possibility of increased runoff of sediment from new home construction sites into adjacent streams after storm events.
- Although most of the main stem of the L'Anguille River is a meandering channel that has not been straightened, the majority of the tributaries and headwater streams have been dredged and channelized, particularly in the northern and western parts of the watershed. Much of the lower portion of the main stem has forested floodplains on both sides of the channel. Portions of the lower half of the L'Anguille River also have a braided channel.
- Approximately 33,116 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011). All but one county in this watershed has experienced population loss between 2000 and 2010. Craighead County, which is partly in the watershed, grew by 17.4 percent, but counties, such as Woodruff, lost 16.9 percent of its population (University of Arkansas at Little Rock, 2011).
- While only a small portion of Jonesboro drains into the watershed, suburban expansion is primarily southward into the L'Anguille River watershed. Jonesboro is subject to Phase II stormwater requirements and has a notice of coverage from August 1, 2014, through July 31, 2019, for a small municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit (ADEQ, 2014).
- Resource extraction occurs primarily on or near Crowley's Ridge.

Water Quality Program Goals

The L'Anguille River watershed has been a priority of the Arkansas NPS Pollution Management Plan since the development of a TMDL in 2001. ANRC is again designating the L'Anguille River watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan.

Pollutants of concern within this Hydrologic Unit Area include:

- Siltation/turbidity
- Nutrients
- Low dissolved oxygen
- Total dissolved solids
- Chlorides
- Sulfates

Some of these pollutants cause some waterbodies in the watershed to not fully meet their designated uses for aquatic life on the 2016 List of Impaired Water Bodies.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the L'Anguille River watershed, targeting sub-watersheds where implementation can have the greatest impact.

ANRC contracted with Audubon Arkansas for preparation of a Nine Element Plan. The L'Anguille River Watershed-Based Management Plan was completed in March 2009 and was accepted by the Environmental Protection Agency. The plan, which follows the steps outlined by the Environmental Protection Agency in the Handbook for Developing Watershed Plans, can be viewed at www.arkansaswater.org/data/L'Anguille%20Nine%20Element%20Plan%20Update%202009%20Mar%201.doc.

The plan, meant to be adaptive, targets erosion and sediment management with the expectation that activities to reduce erosion and sediment will also reduce the other pollutants of concern in the watershed. The plan also includes its own schedule for implementing activities addressing water quality concerns. Public support will have to be further developed to implement the proposed plans' activities.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and

programs to reduce their water quality impacts are described in more detail in earlier sections of the 2018-2023 NPS Management Plan.

The following objectives were previously identified with input from NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

16.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

16.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

16.3. As resources allow, use remote sensing and Geographical Informational Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (e.g., a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

16.4. Continue to refine models as new data become available to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

16.5. Consider obtaining conservation easements through donations as the opportunity arises in an effort to protect lands along the L'Anguille and its tributaries from development that would result in further NPS pollution.

16.6. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

16.7. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (e.g., recruiting volunteers for cleanups and streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

16.8. Encourage county and municipal elected officials as well as contractors, homebuilders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

16.9. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

16.10. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

16.11. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

16.12. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating entities working together in the L'Anguille River watershed, the short-term objectives of this plan can be met within five years of implementation of this plan. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the L'Anguille River watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership (ACP) as well as local coordination groups already in place.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS Pollution Management activities in the L'Anguille River watershed. ADEQ is responsible for maintaining the state's water quality inventory. Eight monthly monitoring stations are maintained within the L'Anguille River Watershed by ADEQ. In addition, the U.S. Geological Survey and the Arkansas Water Resource Center (AWRC) each maintain a monitoring site in the watershed. Real-time flow data is available at the USGS stations as well as some water quality data. Figure 16.3 shows U.S. Geological Survey monitoring stations in the watershed.

The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

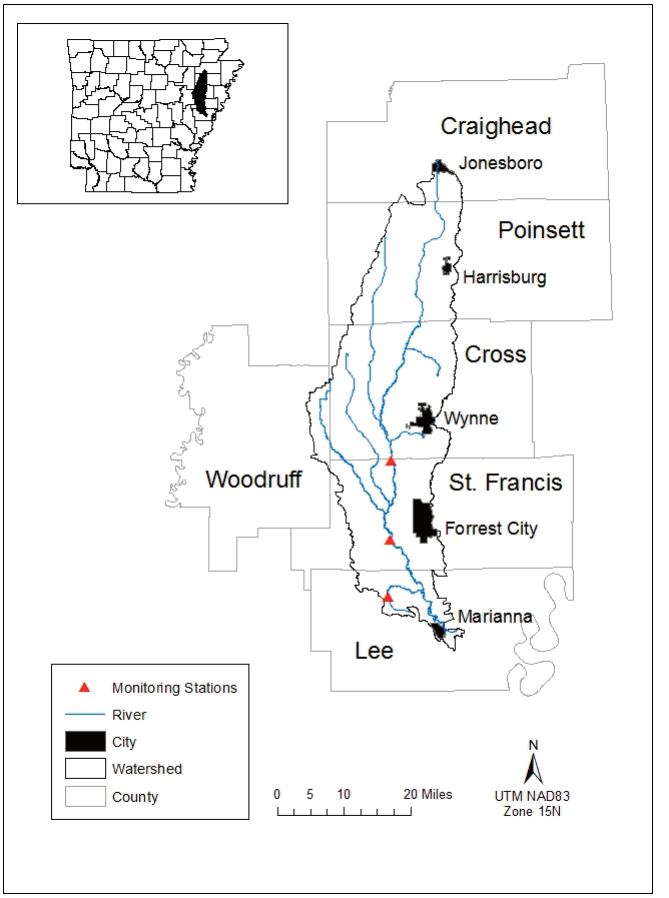
Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the L'Anguille River Watershed in August 2015. Participants identified erosion as their watershed's priority concern that needed addressing but also expressed concern over sedimentation and water velocity.

Forum participants reviewed a long list of stakeholders who should be engaged in addressing water quality concerns. Participants said the people who live near Crowley's Ridge, as well as developers of the properties, aren't aware of the impact they have on water quality downstream or do not see it as an issue. They recommended educating people living near Crowley's Ridge and the developers about the dual benefits of managing property aesthetics and water quality.

Figure 16.3
U.S. Geological Survey Monitoring Stations in the L'Anguille River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



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Section
Seventeen

Lower Little River

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 1C ◆ HUC 11140109
***EPA-Accepted Watershed Management Plan**

Introduction

Segment 1C is near the southwest corner of Arkansas close to the Arkansas-Louisiana-Texas borders with the western region on the Oklahoma border. The watershed includes all of Sevier County and parts of Hempstead, Howard, Little River and Polk counties. Segment 1C encompasses the entire reach of the Little River from its point of entrance into Arkansas to its confluence with the Red River. The major tributaries include Cossatot River, Saline River and Mine Creek. The major reservoirs located in this segment include DeQueen, Gillham and Dierks Reservoirs, all of which drain into Millwood Reservoir. Figure 17.1 shows a map of the watershed.

The Lower Little River Watershed was identified for the first time as a priority watershed in 2018-2023 Nonpoint Source Pollution Management Plan based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering have used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resource Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental quality summarized the water quality conditions of the Lower Little River watershed and its tributaries as such:

> The waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, public, industrial and agricultural water supplies and contain Ecologically Sensitive Waterbodies.

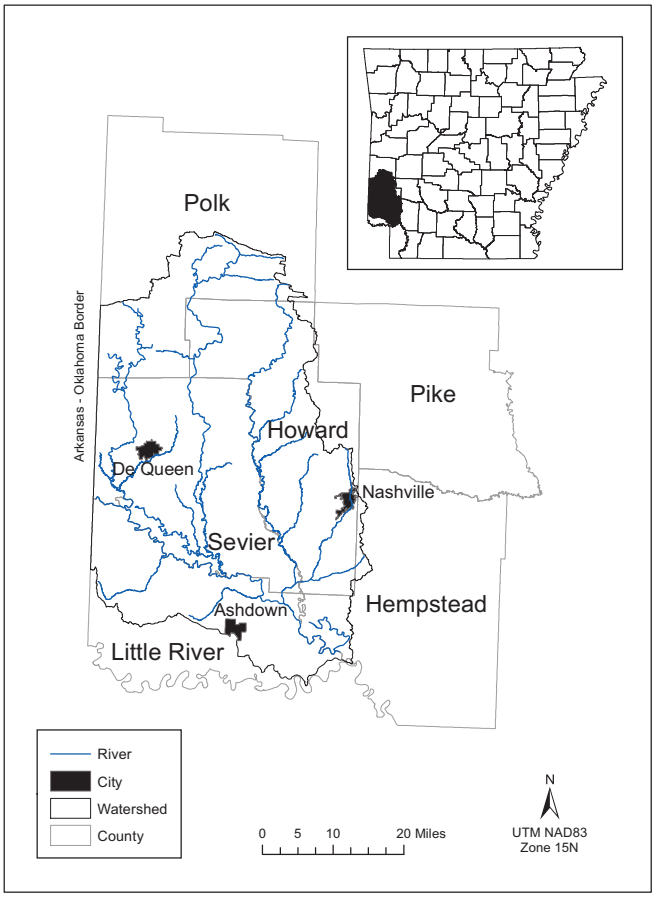
Overall water quality is good in the basin with the exception of a few long-term problem areas.

Bear Creek has shown major improvements over the last several years to the point that it has been delisted from the list of impaired waterbodies. There has been a significant decrease in nitrogen concentrations over the last decade.

The Rolling Fork River above DeQueen Reservoir historically has had elevated nutrient concentrations. Most recently, sulfates have been listed as impaired. The source is thought to be from a waste water

Figure 17.1
Map of Lower Little Watershed

Source: GeoStor



treatment facility. A TMDL addressing the nutrients was completed in 2006.

Mine Creek has elevated nutrients concentrations. The source is believed to be from the Tyson Foods Inc. waste water treatment facility in Nashville, Arkansas. Additional point source controls will be investigated to address these issues.

ADEQ identified five stream segments in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Holly Creek was identified as not supporting fisheries. Sources for impairment in the Lower Little watershed were listed as industrial point source and unknown sources (ADEQ, 2016).

Segments of the Lower Little watershed listed as impaired in the 2016 303(d) List can be viewed at http://www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In 2006, the U.S. Environmental Protection Agency (EPA) contracted with FTN Associates to prepare a total maximum daily load (TMDL) for nitrates and total phosphorus in the Lower Little watershed. FTN Associates recommended no reductions in nonpoint sources of pollution. Wasteload allocations were developed for the point source discharge. The allowable point source loads were based on the design flow for the Tyson poultry facility and concentrations of 10 mg/L of nitrate (recommended by ADEQ) and 2 mg/L of total phosphorus (Tyson's permit limit that was effective in 2007). Based on effluent concentrations of nitrate and total phosphorus, point source reductions were required for both nitrate and total phosphorus.

For discharges from point sources which are greater than 15 MGD, reduction of phosphorus below 1 mg/L may be required based on the magnitude of the phosphorus load (mass) and the type of downstream waterbodies (e.g., reservoirs, Extraordinary Resource Waters). Additionally, any discharge limits listed above may be further reduced if it is determined that these values are causing impairments to special waters such as domestic water supplies, lakes or reservoirs or Extraordinary Resource Waters. Arkansas does not have a numeric water quality standard for nitrate. ADEQ conducts their assessment for streams using a criterion of 10 mg/L to protect the designated use of domestic water supply (FTN, 2006).

Other TMDL's have been prepared in this segment for pathogens, fecal coliform and *Escherichia coli* (*E. coli*). A list of final TMDLs issued by ADEQ can be found at http://www.adeq.state.ar.us/water/planning/integrated/tmdl/default.aspx#Display.

Brief Description of Land Uses in the Watershed

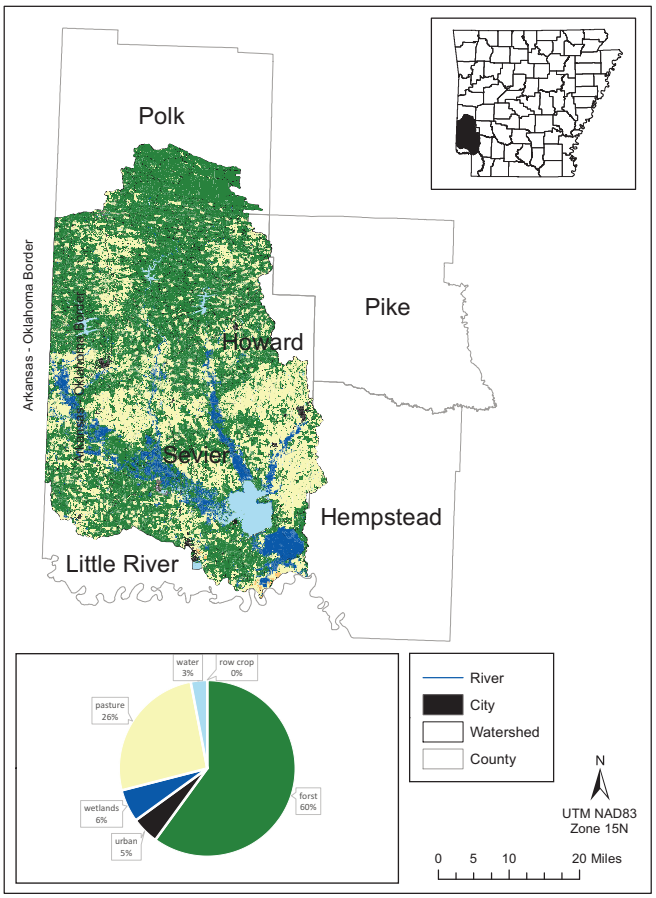
Figure 17.2 shows land use in the Lower Little Watershed in 2011.

The following provides a partial snapshot of the watershed:

- Approximately 60 percent of the watershed is forested, followed by pasture (26 percent), wetlands and urban areas (MRLC, 2011).

Figure 17.2
Distribution of Land Uses in the Lower Little Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



- The largest economic sector in the counties of the Lower Little River watershed is manufacturing – particularly poultry processing. Timber is also a significant industry. (FTN Associates, 2016)
- Between 2000 and 2010, population decreased in Hempstead, Howard and Little River while increasing in Polk and Sevier counties. Sevier County is completely in the watershed and grew the most by 8.3 percent (University of Arkansas at Little Rock, 2011).
- Counties making up the watershed had a combined population of 87,289, according to the U.S. Census.
- The four Corps of Engineers reservoirs within the watershed are used for drinking water as well as recreation and industrial water supply.
- The Cossatot River upstream of Gillham Lake is part of the National Wild and Scenic Rivers system. This section of the Cossatot River and its tributary Caney Creek are designated as Extraordinary Resource Waters. This section of the Cossatot River, and its tributary Brushy Creek, are designated Natural and Scenic Waterways.
- Several waterbodies in the Lower Little River watershed are designated as Ecologically Sensitive Waterbodies, including the Cossatot River upstream of Gillham Lake, the Little River upstream of Millwood Lake, and Grassy Lake and Yellow Creek downstream of Millwood Lake.

Water Quality Program Goals

The Lower Little watershed has been designated as a priority for the first time by ANRC for the 2018-2023 NPS Pollution Management Plan.

Pollutants of concern within this Hydrologic Unit Area include:

- Turbidity/sedimentation
- Sulfates
- Total dissolved solids
- Temperature
- Low dissolved oxygen
- Total phosphorus

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Lower Little watershed, targeting sub-watersheds where implementation can have the greatest impact.

Remaining goals will be achieved through implementation of a Nine Element Plan.

ANRC contracted with FTN Associates for preparation of a Nine Element Plan. The Lower Little Watershed-based Management Plan was completed in November of 2016 and later accepted by the EPA. The plan, which follows the steps outlined by the Environmental Protection Agency in the Handbook for Developing Watershed Plans, can be viewed at www.arkansaswater.org/21-newsflashes/364-lower-little-river-watershed-based-management-plan.

The plan, meant to be adaptive, targets erosion and sediment management with the expectation that activities to reduce erosion, sediment and pathogens in the watershed. The plan also includes its own schedule for implementing activities addressing water quality concerns. Public support will have to be further developed to implement the proposed plans' activities.

Objectives

Based on SWAT and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, availability of funds and other factors.

The 2018-2023 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2018-2023 NPS Pollution Management Plan.

The following objectives can be found in previous watershed chapters. Although they were not identified by stakeholders for this specific watershed, the Lower Little Watershed would benefit from their achievement. Table 3.3 identifies cooperating entities that will

partner to implement the NPS program in the Lower Little watershed.

17.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

17.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

17.3 Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites.

17.4. Continue to develop models to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

17.5. Continue to focus on Best Management Practices implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forest land.

17.6. Continue to provide and improve extensive education and training to promote BMP implementation.

17.7. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

17.8. Encourage county and municipal elected officials as well as contractors, homebuilder, and consulting engineers to participate in construction and urban education programs to improve stormwater management.

17.9. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

17.10. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

17.11. Continue to support water quality and biological monitoring in this watershed.

Timeline

Provided sufficient financial and human resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Lower Little watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Lower Little watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate.

Program Tracking and Monitoring

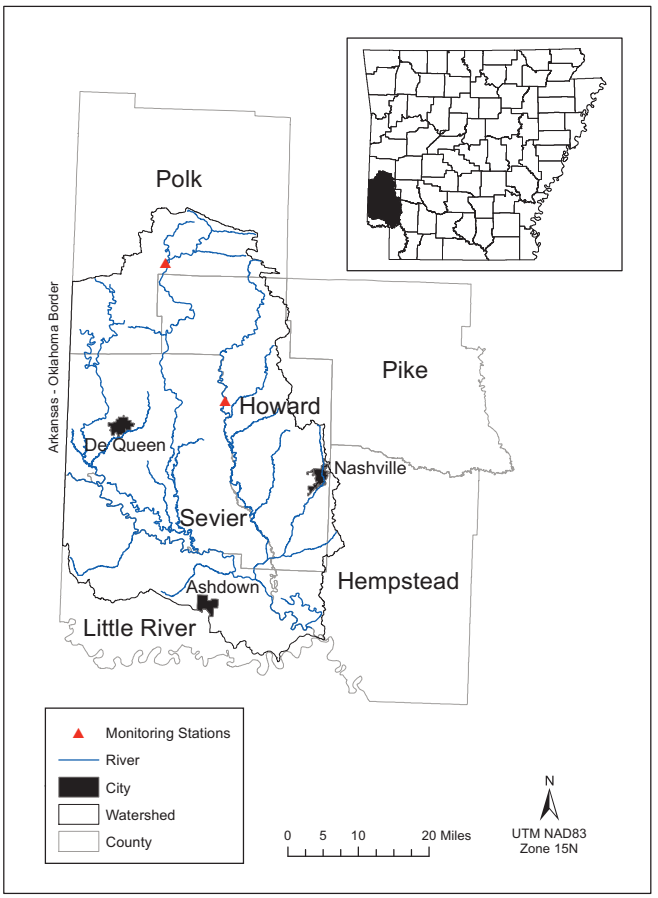
Water quality monitoring data will be used to evaluate the effectiveness of NPS Pollution Management activities in the Lower Little watershed. ADEQ is responsible for maintaining the state's water quality inventory. They maintain 14 ambient monitoring stations within the Lower Little watershed. In addition, the U.S. Geological Survey (USGS) maintains two water monitoring stations in the watershed. Real-time flow data is available at the USGS stations as well as some water quality data. Figure 17.3 shows USGS' monitoring stations in the watershed.

The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. A local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 17.3

U.S. Geological Survey Monitoring Stations in the Lower Little Watershed

Source: U.S. Geological Survey National Water Information System Mapper



Stakeholder Priorities

The Public Policy Center at the University of Arkansas System Division of Agriculture hosted a series of public meetings in priority watersheds identified in the 2011-2016 Nonpoint Source Pollution Management Plan. The Lower Little watershed was not included in that management plan and, therefore, did not benefit from this series of stakeholder meetings.

However, in preparation for creating a watershed management plan, FTN Associates held a series of local stakeholder meetings. Participants identified the following management strategies they'd like to see implemented in the watershed: stream crossings for livestock, forestry best management practices, buffer zones, litter control and/or export, fencing and alternate water supply, land leveling and erosion control training for unpaved roads.

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Section
Eighteen

Lower Ouachita-Smackover

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 2D ◆ HUC 08040201

Introduction

Segment 2D occupies the south central part of Arkansas and covers two 8-digit hydrologic unit code (HUC) watersheds – Lower Ouachita-Smackover (08040201) and Lower Ouachita-Bayou De Loutre (08040202). The Lower Ouachita-Smackover watershed covers Bradley, Dallas, Ouachita, Cleveland, Columbia, Nevada and Union counties. Segment 2D encompasses the lower Ouachita River and its tributaries from the confluence of the Little Missouri and Ouachita Rivers to the Louisiana state line. The major tributaries are Moro Creek, Camp Creek, Champagnolle Creek and Smackover Creek. Figure 18.1 shows a map of the watershed.

The Lower Ouachita-Smackover watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of Lower Ouachita-Smackover and its tributaries as such:

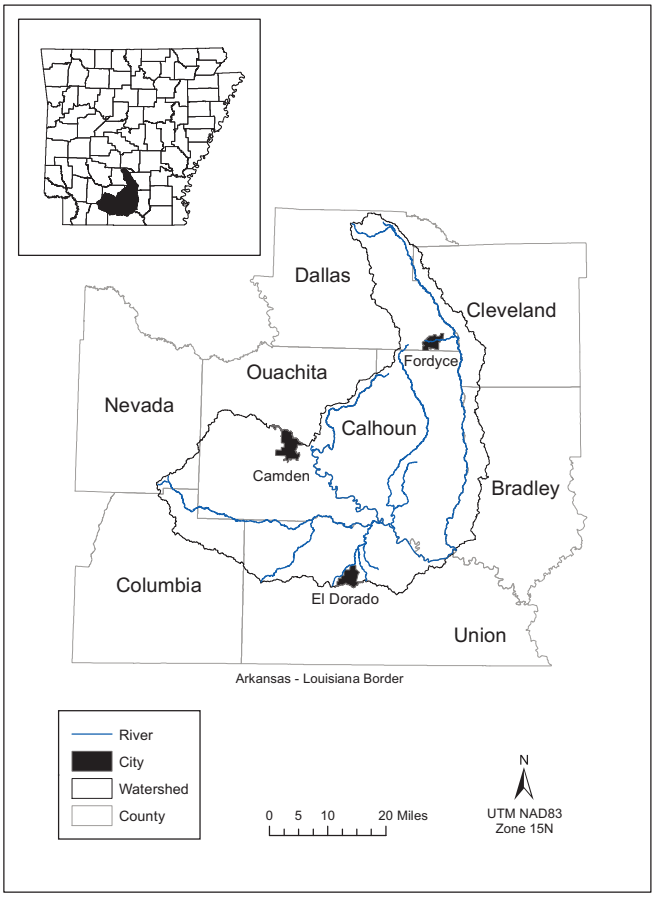
> The waters within this segment have been designated as suitable for propagation of fish and wildlife, primary and secondary contact recreation, as well as public, industrial, and agricultural water supplies.

The Lower Ouachita River, Champagnolle, and Moro Creeks have fish consumption advisories due to mercury contamination. A consumption advisory has been placed on 66.3 miles of the Ouachita River, 20.0 miles of Champagnolle Creek, and 12 miles of Moro Creek.

Bayou de L'outre and L'outre Creek have been listed as not attaining the agriculture and industrial water supply uses because of elevated levels of minerals and metals. A combination of nonpoint source pollution runoff and discharges from industrial

Figure 18.1
Map of Lower Ouachita-Smackover Watershed

Source: GeoStor



and municipal point sources are the suspected sources. Additional monitoring is needed to better assess impairments and delineate the sources.

Some of the most severe water quality problems exist in the unnamed tributary from El Dorado Chemical Company (ELCC), Flat Creek, and Salt Creek. The ELCC tributary contains ammonia at toxic levels; elevated nitrates, minerals (sulfates and total dissolved solids) and copper concentrations. The source is from the El Dorado Chemical Company discharge. Flat Creek and Salt Creek have elevated minerals (chlorides, sulfates, total dissolved solids) and ammonia concentrations. The exact source is unknown, but these streams drain basins from the northern edge of El Dorado where numerous oil and brine processing and storage facilities exist along with numerous abandoned pumping facilities (ADEQ, 2016).

ADEQ identified seven stream segments in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Several impaired stream segments in this watershed are not supporting fisheries, and several stream segments were designated as not supporting their designated use of primary contact recreation. The identified sources for impairment in the Lower Ouachita-Smackover watershed are listed as industrial point sources and unknown sources (ADEQ, 2016).

The segments of the Lower Ouachita-Smackover watershed listed as impaired in the 2016 303(d) List can be viewed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

Since 2002, the U.S. Environmental Protection Agency (EPA) has prepared or contracted with FTN Associates to develop 12 total maximum daily loads (TMDLs) for stream segments and lakes in the Lower Ouachita-Smackover watershed. Most of the TMDLs relate to mercury levels in fish tissue, but other pollutants addressed with TMDLs include chloride, sulfate, total dissolved solids, ammonia and turbidity.

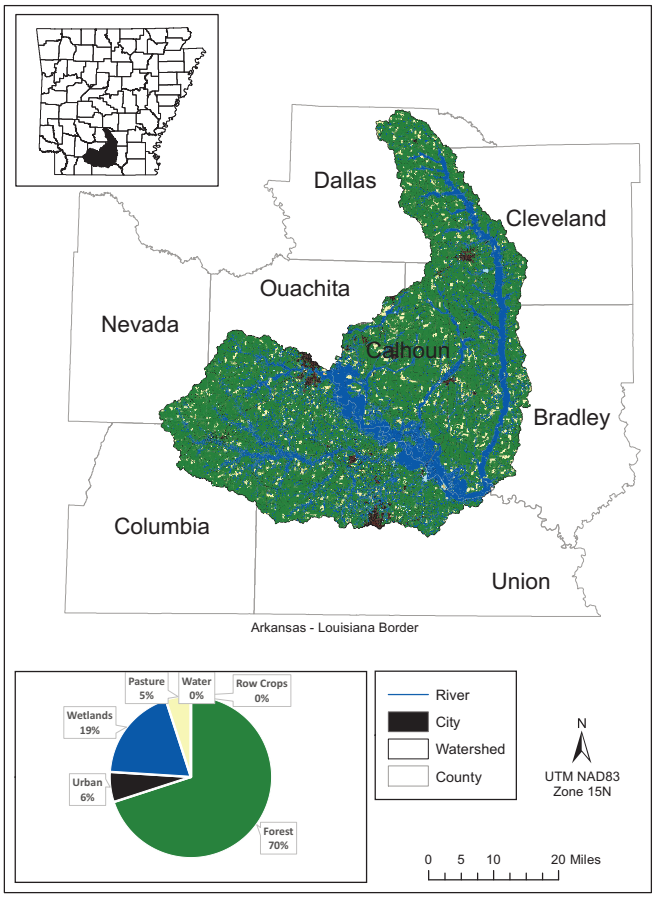
The specific TMDL values for each pollutant can be reviewed here: http://www.adeq.state.ar.us/water/planning/integrated/tmdl/default.aspx#Display.

Brief Description of Land Uses in the Watershed

Figure 18.2 shows land use in the Lower Ouachita-Smackover Watershed in 2011.

Figure 18.2
Distribution of Land Uses in the Lower Ouachita-Smackover Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



The following provides a partial snapshot of the watershed:

- Nearly 70 percent of the watershed's land is forested and 5 percent of the watershed's land area is under pasture (MRLC, 2011). The remaining land usage includes wetlands and urban areas.

- Approximately 39,809 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011). Throughout the watershed, population has been decreasing between 2000 and 2010, with the exception of Cleveland County. Most decrease took place in Dallas County (-11.9 percent), whereas the least decrease was in Columbia County (-4.1 percent) (University of Arkansas at Little Rock, 2011).
- The Ouachita River basin is in the Ouachita Mountain, South Central Plain, and Mississippi Alluvial Plain ecoregions. It has gently rolling topography, with hilly uplands, flatwood uplands, terraces and floodplains (FTN Associates, 2002).
- The geology of the Ouachita Mountains contains rocks with relatively high, naturally occurring mercury concentrations. The soils in the basin reflect this geology and also receive mercury from atmospheric deposition. (FTN Associates, 2002).

Water Quality Program Goals

The Lower Ouachita-Smackover watershed was first designated as a priority watershed in 2011-2016 NPS Pollution Management Plan. ANRC is again designating the Lower Ouachita Smackover watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan.

Pollutants of concern within this Hydrologic Unit Area include:

- Low dissolved oxygen
- pH
- Chlorides
- Sulfates
- Lead
- Total dissolved solids
- Pathogens
- Copper
- Lead
- Zinc
- Nitrogen
- Mercury

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Lower Ouachita-Smackover watershed, targeting sub-watersheds where implementation can have the greatest impact.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the Plan.

The following objectives were previously identified with input from NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

18.1 Continue development of the Nine Element Plan until EPA approval is obtained.

18.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

18.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

18.4. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (e.g., a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

18.5. Continue to develop models to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

18.6. Continue to focus on Best Management Practices (BMP) implementation to improve

conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forest land. As appropriate, direct technical assistance to landowners in targeted watersheds, giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

18.7. Continue to provide and improve extensive education and training to promote BMP implementation (e.g., risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport, including but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

18.8. Continue to encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambank and restore riparian areas.

18.9. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along Arkansas River and its tributaries from development that would result in further NPS pollution.

18.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

18.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (e.g., recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

18.12. Encourage county and municipal elected officials as well as contractors, homebuilders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

18.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

18.14. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

18.15. Continue to provide public education on proper application, storage and disposal of pesticides, regulations, and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

18.16. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

18.17. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Lower Ouachita-Smackover watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Lower Ouachita-Smackover watershed with the authority to implement a Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS management activities in the Lower Ouachita-Smackover watershed. ADEQ is responsible for maintaining the state's water quality inventory.

The NPS Management Plan may include as a condition of funding pre- and post-project

measurements of changes in water quality. The Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

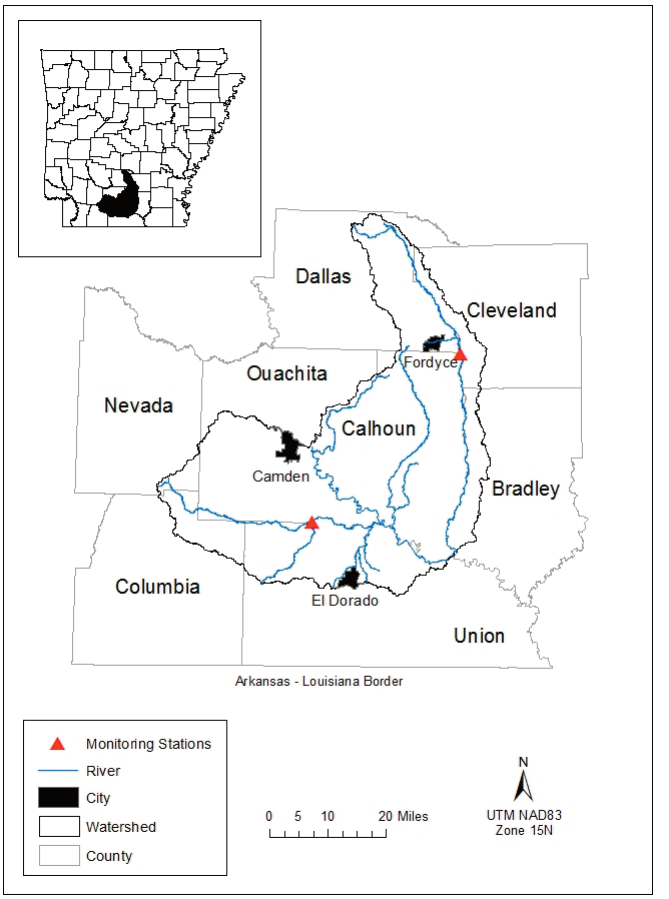
Real-time flow data is available at the USGS stations as well as some water quality data. Figure 18.3 shows U.S. Geological Survey monitoring stations in the watershed.

Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Lower Ouachita-Smackover Watershed in June 2015. People who attended the forum identified lack of education about water quality, erosion from forestry practices and concerns about drinking water as local priorities.

Figure 18.3
U.S. Geological Survey Monitoring Stations in the Lower Ouachita-Smackover Watershed

Source: U.S. Geological Survey National Water Information System Mapper



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Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K. (2015). Completion of the 2011 National Land Cover Database for the Conterminous United States-Representing a Decade of Land Cover Change Information. *Photogrammetric Engineering and Remote Sensing*, 81(5), 345-354.

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Section
Nineteen

Poteau River

Priority Watershed
2018-2023 NPS Management Plan
ADEQ planning segment 3I ◆ HUC 11110105

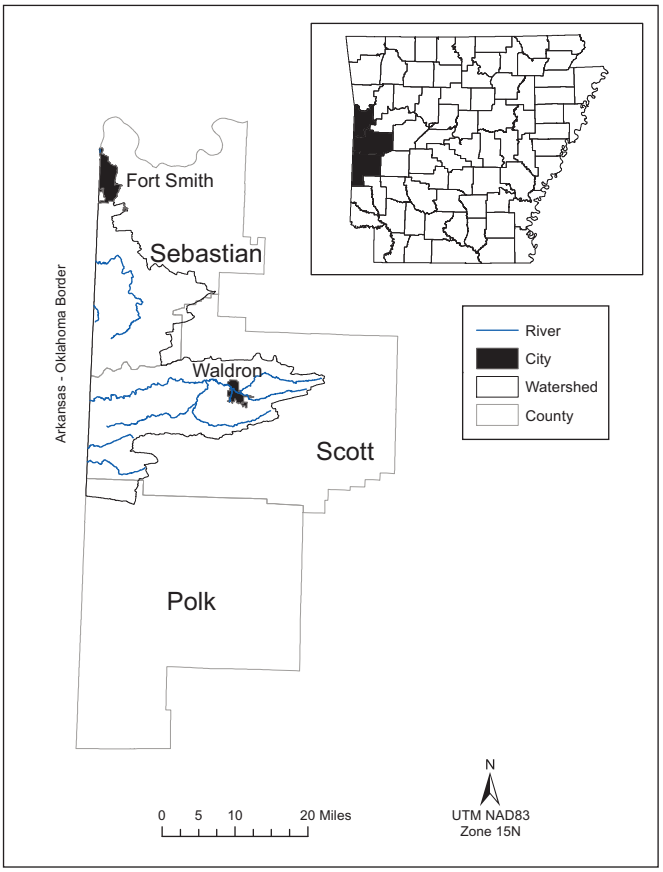
Introduction

Segment 3I is located on the western edge of Arkansas, just south of the Arkansas River. The Arkansas portion of the Poteau River watershed includes large portions of Scott and Sebastian counties and a small part of northwestern Polk County, covering an area of 1,889 square miles.

The waters of this segment include the Poteau River from its headwaters to the Oklahoma state line, as well as the tributary streams. Major tributaries in Arkansas include Jones Creek and James Fork. The largest share of the watershed is located in Oklahoma. Figure 19.1 shows the watershed.

Figure 19.1
Map of Poteau River Watershed

Source: GeoStor



The Poteau River watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resource Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of Poteau River and its tributaries as such:

> Waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. This planning segment contains 105.3 stream miles.
>
> A short section of the Poteau River below Waldron was listed as not supporting fisheries designated use due to elevated metals, total phosphorus, and minerals. Both a municipal and industrial discharge occurs in this segment. In addition, a short section of the Poteau River just above its confluence with the Arkansas River was listed as not supporting the fisheries designated use because of excessive turbidity (ANRC, 2016).

ADEQ identified one stream segment in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. A two-mile segment of the Poteau River is not supporting fisheries. Sources for impairment in the Poteau River watershed were listed as industrial point source, surface erosion and from unknown sources.

Segments of the Poteau River watershed listed as impaired in the 2016 303(d) List can be viewed at www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In 2005, the U.S. Environmental Protection Agency (EPA) contracted with FTN Associates to prepare a total maximum daily load (TMDL) for siltation or turbidity in the Poteau River watershed. FTN Associates recommended reductions in turbidity. The TMDL for turbidity for the Poteau River was expressed using total suspended solids (TSS) as a surrogate for turbidity. FTN Associates recommended that existing nonpoint source loads of TSS in the Poteau River for base flow values be reduced by 34 percent and that for storm flow values be reduced by 54 percent.

In 2006, EPA contracted with FTN Associates to prepare a total maximum daily load (TMDL) for phosphorus, copper and zinc in the Poteau River watershed. FTN Associates found that no nonpoint source reductions of copper and zinc were required for these TMDLs because the existing upstream concentrations of dissolved copper and dissolved zinc are less than the chronic water quality criteria. A nonpoint source reduction of 35 percent was recommended for phosphorus.

Nutrient enrichment of the waterbodies in this watershed is a concern, both from point and nonpoint sources. Known problems below wastewater treatment facilities do occur and are easily documented. However, detecting and determining the extent and impact of nutrients contributed from nonpoint sources (NPS) is more of a challenge. Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality. Confined animal operations in high concentrations within a watershed can result in application of animal manures at nutrient rates greater than can be assimilated, potentially resulting in nutrients being transported into adjacent streams during storm events. In addition, improper management of nutrients can also result in adjacent streams receiving nutrient inputs during storm events.

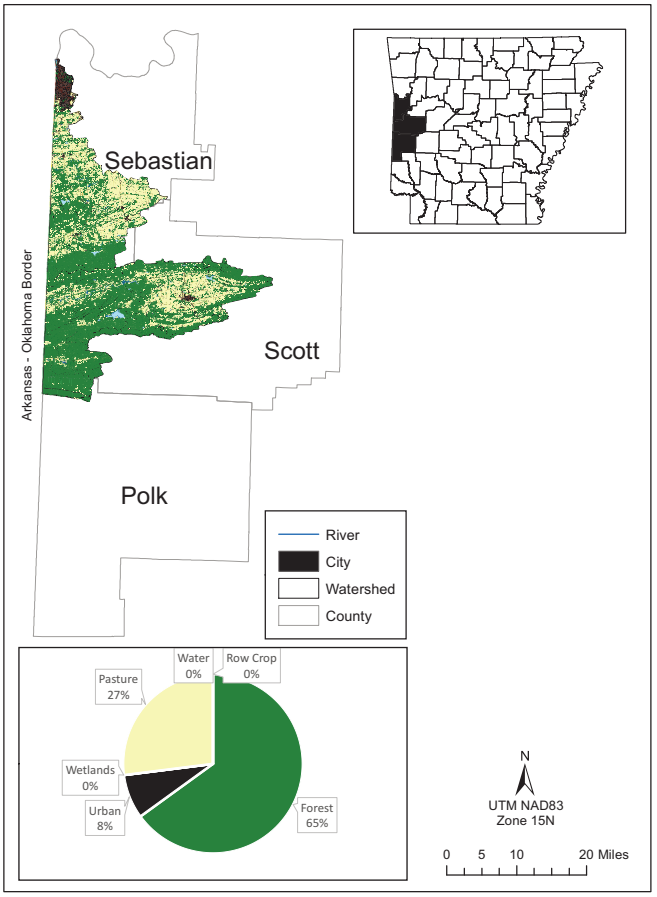
A U.S. Forest Service (USFS) comparative assessment of 50 watersheds in Arkansas, Oklahoma and Missouri estimated potential erosion by land use for the Poteau River watershed. Based on 1992 National Resource Inventory data, pasture land had the highest potential erosion rate at 67 percent compared to other lands (including urban), which had a 22 percent potential erosion rate. Cropland had a 7 percent potential erosion rate and forestry was at 2 percent. Potential erosion rates for pastureland and other lands increased from 1982 (USFS, 1999).

Brief Description of Land Uses in the Watershed

Figure 19.2 shows land use in the Poteau River Watershed in 2011.

Figure 19.2
Distribution of Land Uses in the Poteau River Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



The following provide a partial snapshot of the watershed.

- An estimated 65 percent of the land area is forested, 27 percent is pasture and 8 percent is urban (MRLC, 2011).
- The Poteau River watershed forests are comprised of a mix of pine, upland and bottomland forest types, and include private nonindustrial, industrial and public ownership.

- Poultry production and small cattle operations dominate agricultural production in the counties making up the watershed. Some 101 farms raised and sold 55 million birds in 2012 in the two counties that make up the majority of the Poteau River watershed (USDA, 2012).
- The entire watershed is designated as a nutrient surplus area subject to new regulations for nutrient planning, nutrient application and certification of nutrient planners.
- Approximately 55,471 people lived in the watershed as of the 2010 Census. (BAEG, 2011).
- Fort Smith grew from 2000 to 2010, while Waldron lost population during the same period. Sebastian and Scott counties added population between 2000 and 2010. Sebastian County's population grew 9.3 percent while Scott County added 2.2 percent population over the 10-year period (University of Arkansas at Little Rock, 2011).
- The City of Fort Smith is subject to Phase II stormwater requirements and has a notice of coverage from August 1, 2014 through July 31, 2019 for a small municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit (ADEQ, 2014).
- Significant communities in the watershed include Fort Smith and Waldron as well as a number of smaller towns. A portion of Fort Smith drains into the Poteau River watershed.
- The State of Oklahoma lists the Poteau River watershed on its List of Impaired Waterbodies (ODEQ, 2012).

Water Quality Program Goals

The Poteau River Watershed has been a priority of the Arkansas Nonpoint Source Pollution Management Plan since the comprehensive update completed in 1998. ANRC is again designating the Poteau River watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan.

Pollutants of concern within this Hydrologic Unit Area include:

- Sediment/turbidity
- Nitrogen
- Total phosphorous
- Copper
- Zinc

Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Poteau River watershed, targeting sub-watersheds where implementation can have the greatest impact.

Planning efforts are currently underway to develop a Nine Element Plan. Currently, there is no watershed group to provide coordination and leadership for development of a plan or its implementation. This institutional capacity and public support will have to be developed in order to implement proposed plans and implementation activities.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2018-2023 NPS Management Plan.

The following objectives were previously identified with input from NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

19.1. Begin development of a Nine Element Plan.

19.2. Begin to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

19.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

19.4. Begin to develop local institutional capacity to implement the Nine Element Plan (e.g., watershed groups).

19.5. As resources allow, identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and biological assessment to identify and target high impact restoration projects (e.g., streambank stabilization).

19.6. Continue to strengthen models to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in sub-watersheds.

19.7. Promote Best Management Practice implementation to improve conservation practices for erosion control, sediment retention and nutrient management on lands used for row crop and animal agriculture as well as timber production. As appropriate, direct technical assistance to landowners in targeted sub-watersheds giving emphasis to developing new conservation plans.

19.8. Continue to promote the development of comprehensive nutrient management plans (CNMPs) or nutrient management plans (NMPs).

19.9. Continue and strengthen ongoing comprehensive education and training programs to help poultry and livestock producers meet the requirements of ADEQ's confined animal feeding operations (CAFO) regulations.

19.10. Encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambanks and restore riparian areas.

19.11. Consider obtaining conservation easements through donations as the opportunity arises in an effort to protect lands along the Poteau River and its tributaries from development that would result in further NPS pollution.

19.12. Increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

19.13. Build constituency for improved water quality by promoting volunteerism and recreational use of the river (e.g., recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups).

19.14. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), and Wetland and Riparian Zone Tax Credit Program (through ANRC).

19.15. Continue to provide public education on proper application, storage and disposal of pesticides, regulations, and potential hazards of misuse (e.g., encourage use of FARM*A*SYST, URBAN*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

19.16. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

19.17. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating entities working together in the Poteau River watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. One goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Poteau River watershed with the authority to develop or implement a Nine Element Plan. The ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership as well as local coordination groups already in place. In addition, ANRC will promote the development and strengthening of local watershed groups to implement the watershed protection plan.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS Pollution Management activities in the Poteau River watershed. ADEQ is responsible for maintaining the state's water quality inventory. ADEQ maintains four monitoring stations within the watershed. In addition, USGS maintains three monitoring sites in the watershed. Real-time flow data is available at the USGS station as well as some water quality data. Figure 19.3 shows the USGS monitoring stations in the watershed.

The NPS Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. The NPS Management Plan

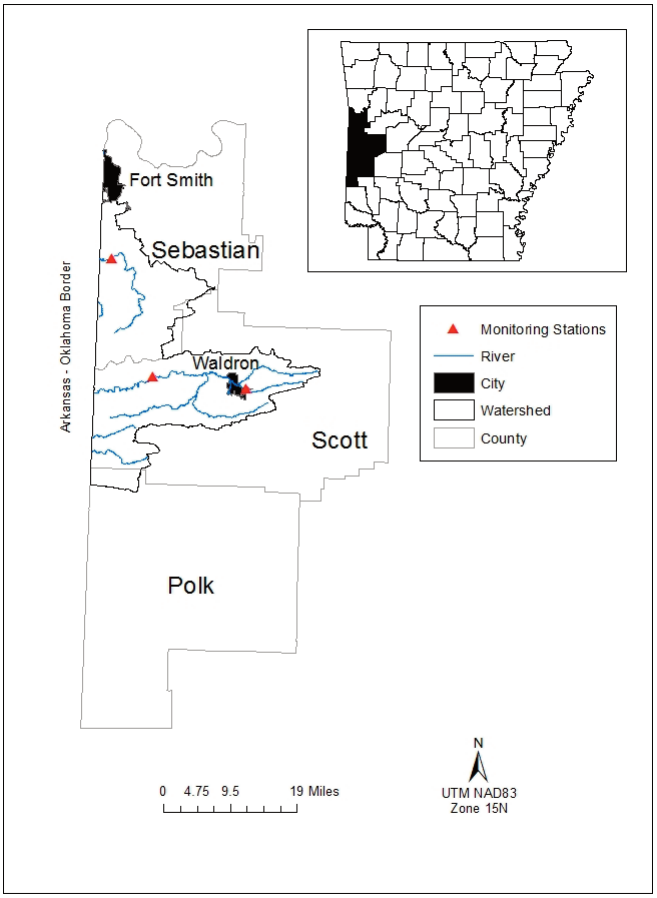
also encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Poteau Watershed in Waldron in September 2014. Participants identified unpaved roads and flooding as concerns that needed to be addressed in their watershed. Other identified concerns included erosion, excessive nutrients and sediment. All of these concerns can have an impact on water quality.

Figure 19.3
U.S. Geological Survey Monitoring Stations in the Poteau River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



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Section
Twenty

Strawberry River

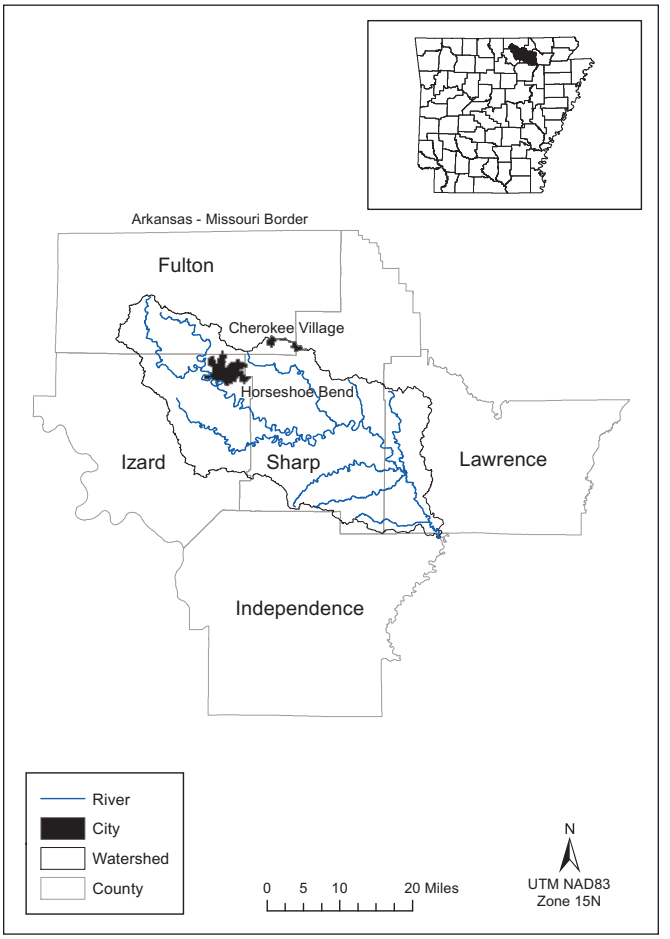
Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 4G ◆ HUC 11010012
***EPA-Accepted Watershed Management Plan**

Introduction

Segment 4G includes Strawberry River, a tributary of the Black River, which is located in the Ozark Highland ecoregion in north central Arkansas. The headwaters arise near the town of Salem in Fulton County. The watershed covers parts of Fulton, Greene Independence, Izard, Jackson, Lawrence, Randolph and Sharp counties. The segment includes Caney Creek, Coopers Creek, Little Strawberry Creek, North Big Creek, Piney Fork and Reeds Creek. Figure 20.1 shows a map of the watershed.

Figure 20.1
Map of Strawberry River Watershed

Source: GeoStor



The Strawberry River watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of Strawberry River and its tributaries as such:

> Fish and wildlife propagation, primary and secondary contact recreation, and domestic, agricultural, and industrial water supplies are the designated uses for waters within this segment. Also, 112.2 miles of these streams are designated as outstanding state or national resource waters.
>
> Almost 40 mile of Extraordinary Resource Waters in this segment do not support fisheries designated use due to excessive turbidity. The total suspended solids and total phosphorus levels show peaking values much above normal. This is likely from agricultural activities associated with pasturing and animal grazing to the edge of streambanks.
>
> Almost 40 miles of extraordinary resource waters in this segment were assessed as not supporting aquatic life uses due to excessive turbidity levels. The total suspended solids and total phosphorus levels show peaking values way above normal. This is most likely from agriculture activities probably associated

with pasturing and animal grazing to the edge of the streambank (ADEQ, 2016).

ADEQ identified 11 stream segments in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Several impaired stream segments in this watershed are not supporting fisheries and several stream segments were designated as not supporting their designated use of primary contact recreation. The identified sources for impairment in the Strawberry watershed are listed as surface erosion and pathogens. The main source of the turbidity is thought to be from unpaved county roads, streambank erosion, and adjacent pasture land. The main source of the fecal coliform bacteria is thought to be from adjacent agriculture land use activities (ADEQ, 2016).

The segments of the Strawberry River watershed listed as impaired in the 2016 303(d) List can be viewed at http://www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

In 2006, the U.S. Environmental Protection Agency (EPA) contracted with FTN Associates to prepare a total maximum daily load (TMDL) for siltation or turbidity in the Strawberry River watershed. FTN Associates recommended reductions in turbidity. The TMDL for turbidity for the Strawberry River was expressed using total suspended solids (TSS) as a surrogate for turbidity. FTN Associates recommended that existing nonpoint source loads of TSS in the Strawberry River impaired stream segments for base flow values not be reduced, but storm flow values be reduced from 50 to 58 percent depending on the segment.

In 2007, EPA prepared a total maximum daily load (TMDL) for pathogens in the Strawberry River watershed. EPA developed TMDLs for fecal coliform and *Escherichia coli* (*E. coli*) for 8 stream reaches – Dota Creek, Caney Creek, Mill Creek, Reeds' Creek, Strawberry River, Little Strawberry River and Cooper Creek.

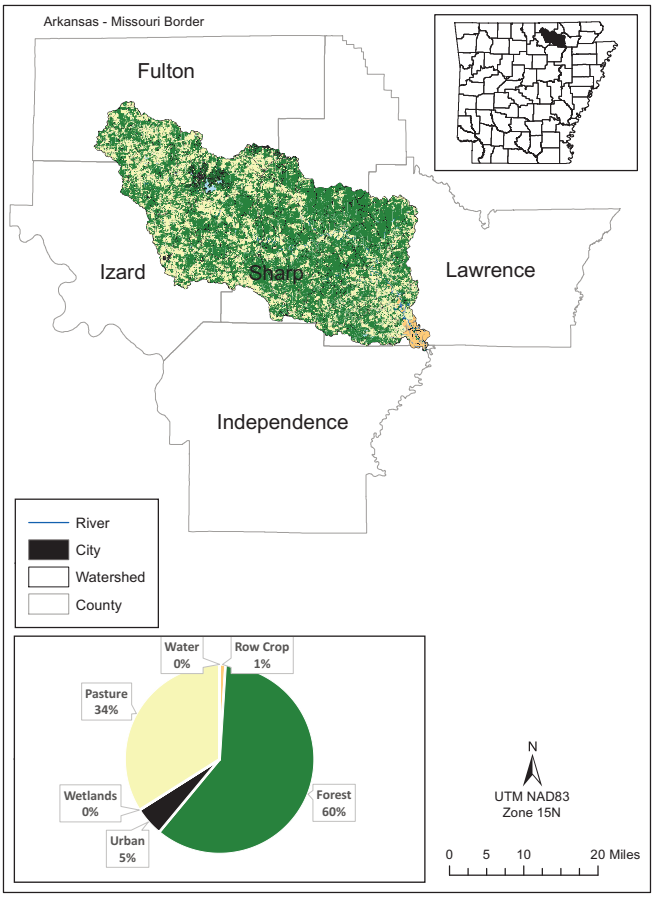
Brief Description of Land Uses in the Watershed

Figure 20.2 shows land use in the Strawberry River Watershed in 2011.

The following provides a partial snapshot of land uses in the watershed.

Figure 20.2
Distribution of Land Uses in the Strawberry River Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



- Nearly 60 percent of the watershed's land area is in forests and 34 percent is under pasture (MRLC, 2011). The remainder of the land is accounted for by urban areas and row crop.
- Approximately 20,027 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011). Throughout much of the watershed, population increased from 2000 to 2010 with the exception of Lawrence County (-2 percent). Most increase took place in Independence County (7.5 percent), whereas least gain in the population was in Sharp County (0.8 percent) (University of Arkansas at Little Rock, 2011).

- The Strawberry River is considered a high-quality water resource and is designated as Extraordinary Resource Waters and a Natural and Scenic Waterway. The river supports over 100 species of fish, including the indigenous Strawberry River darter, and over 30 species of mussels.
- The majority of the Strawberry River and the Little Strawberry River are also designated as Ecologically Sensitive Waterbodies.

Water Quality Program Goals

The Strawberry River watershed was first designated as a priority watershed in 2011-2016 NPS Pollution Management Plan. ANRC is again designating the Strawberry River watershed as a priority watershed for the 2018-2023 NPS Pollution Management Plan.

Pollutants of concern within this Hydrologic Unit Area include:

- Turbidity
- Pathogens
- Sediment

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Strawberry River watershed, targeting sub-watersheds where implementation can have the greatest impact.

ANRC contracted with FTN Associates for preparation of a Nine Element Plan. The Strawberry River Watershed-Based Management Plan was completed in November 2016. The Plan has been submitted to EPA for acceptance. The plan, which follows the steps outlined by the Environmental Protection Agency in the Handbook for Developing Watershed Plans, can be viewed at http://www.arkansaswater.org /21-newsflashes/366-strawberry-river-watershed-based-management-plan.

The plan, meant to be adaptive, targets erosion and sediment management with the expectation that activities to reduce erosion, sediment and pathogens in the watershed. The plan also includes its own schedule for implementing activities addressing water quality concerns. Public support will have to be further developed to implement the proposed plans' activities.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Pollution Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the Plan.

The following objectives and milestones were identified with input from the NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

20.1. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

20.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

20.3. As resources allow, use of remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (e.g., a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

20.4. Continue to develop models to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of-implementation projects in sub-watersheds.

20.5. Continue to focus on Best Management Practice (BMP) implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forest land. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

20.6. Continue to provide and improve extensive education and training to promote BMP implementation (e.g., risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

20.7. Continue to encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambanks and restore riparian areas.

20.8. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along Strawberry River and its tributaries from development that would result in further NPS pollution.

20.9. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

20.10. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (e.g., recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

20.11. Encourage county and municipal elected officials as well as contractors, homebuilders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

20.12. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement, Wetland Reserve Program (WRP), Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

20.13. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

20.14. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (e.g., encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

20.15. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

20.16. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Strawberry River watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Strawberry River watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership as well as local coordination groups already in place.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS Management activities in the Strawberry River watershed. ADEQ is responsible for maintaining the state's water quality inventory.

The NPS Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local

cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

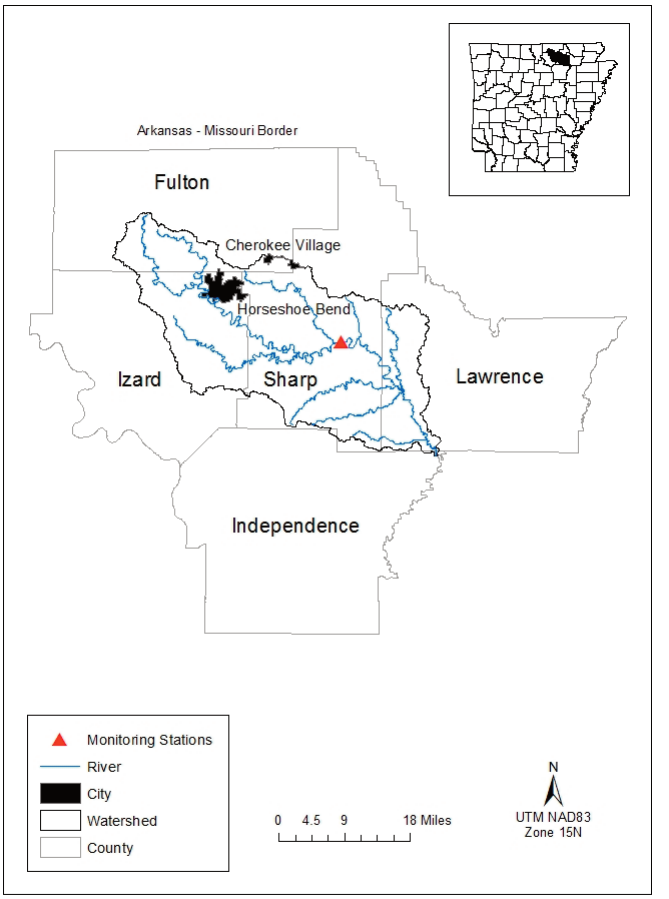
Figure 20.3 shows U.S. Geological Survey monitoring stations in the watershed.

Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Strawberry River Watershed in December 2014. Participants identified runoff from septic and sewer systems, streambank erosion and overall stream sedimentation as local priorities that needed addressing.

Figure 20.3
U.S. Geological Survey Monitoring Stations in the Strawberry River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



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Section
Twenty-One

Upper Saline River

Priority Watershed
2018-2023 NPS Management Plan
ADEQ Planning Segment 2C ◆ HUC 08040203
***EPA-Accepted Watershed Management Plan**

Introduction

The Upper Saline River watershed stretches across portions of Saline, Garland, Hot Spring, Grant, Dallas, Jefferson, Cleveland, Lincoln, Drew, Bradley and Ashley counties and has a total drainage area of approximately 839.2 square miles. Segment 2C encompasses the main stem of the Saline River and its tributaries and includes Hurricane Creek, Hudgins Creek, L'Agile Creek, Derrieusseaux Creek, and North, South, Middle and Alum Forks.

The Middle Fork and other headwaters of the Saline River are designated as Extraordinary Resource Waters (ERW) and Ecologically Sensitive Waters (ESW) under the Arkansas Pollution Control and Ecology Commission (APCEC), Regulation 2 (APCEC, 2011). The Upper Saline River watershed provides habitat for one or more species listed as threatened by the U.S. Fish and Wildlife Service. Figure 21.1 shows the location of the watershed.

The Upper Saline watershed was identified as a priority watershed based on a qualified risk-based assessment of all the 8-digit hydrologic unit code (HUC) watersheds in the state. More information about the selection process can be found in Appendix A.

The University of Arkansas System Division of Agriculture Department of Biological and Agricultural Engineering used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2018-2023 NPS Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes the SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

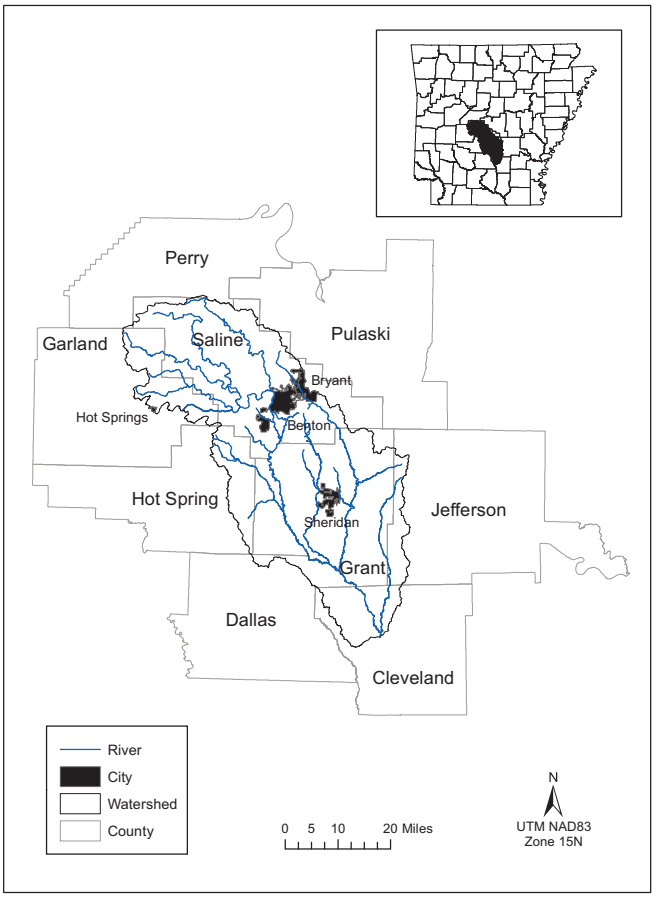
Assessment

In its 2016 305(b) report, the Arkansas Department of Environmental Quality summarized the water quality conditions of Upper Saline River and its tributaries as such:

> The waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. Slightly over one-half of the total stream miles within this segment are designated as extraordinary resource waters. This includes the Saline River and its primary headwater tributaries.
>
> The domestic water supply use has been removed from 83.8 miles in the Hurricane Creek sub-watershed because of excessive mineral content. Mineral content (chlorides, sulfates, and other dissolved minerals) originates in this basin from open-pit bauxite mining activities.

Figure 21.1
Map of Upper Saline River Watershed

Source: GeoStor



Water quality in Big Creek below the city of Sheridan effluent has improved, yet dissolved oxygen violations still occur as well as elevated Biologic Oxygen Demand (BOD) and Total Organic Carbon (TOC) levels (ADEQ, 2016).

ADEQ identified five waterways and two lakes in this watershed as impaired on its 2016 List of Impaired Waterbodies, which is also known as the 303(d) List. Several of the impaired waterbodies in this watershed are not supporting fish consumption, and an advisory has been placed on Grays and Monticello lakes and much of the lower Saline River because of mercury contamination. Turbidity is a source of impairment in the Upper Saline River watersheds Big Creek (ADEQ, 2016).

Segments of the Upper Saline River watershed are listed as impaired in the 2016 303(d) List and can be viewed at http://www.adeq.state.ar.us/water/planning/integrated/303d/list.aspx.

Since 2002, the U.S. Environmental Protection Agency (EPA) has prepared or contracted with FTN Associates to develop eight total maximum daily loads (TMDLs) for stream segments and lakes in the Upper Saline River watershed. Most of the TMDLs relate to mercury levels in fish tissue, but other pollutants addressed with TMDLs include turbidity, low dissolved oxygen and total dissolved solids.

The specific TMDL values for each pollutant can be reviewed here: http://www.adeq.state.ar.us/water/planning/integrated/tmdl/default.aspx#Display.

Brief Description of Land Uses in the Watershed

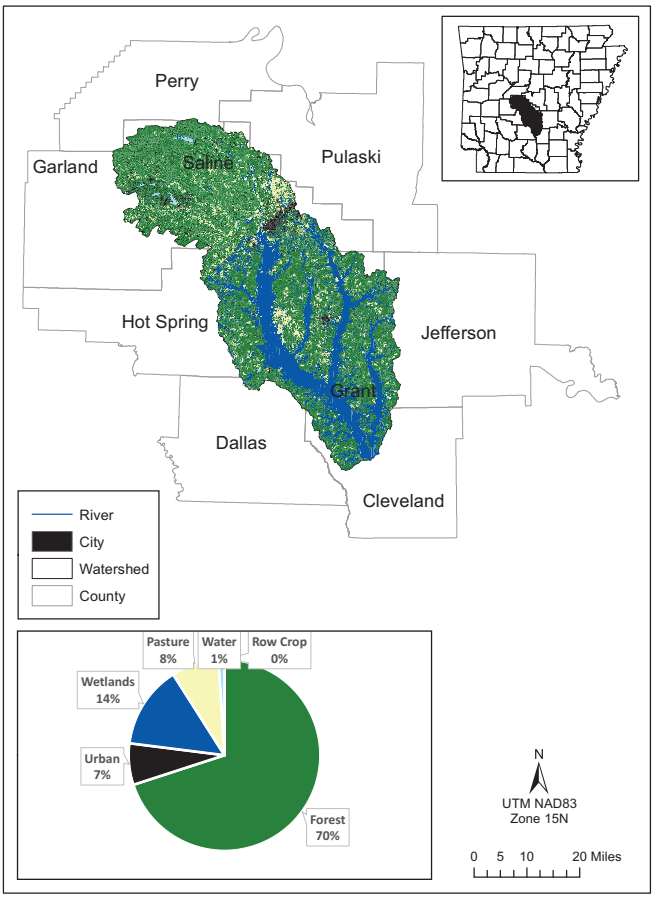
Figure 21.2 shows land use in the Upper Saline River Watershed in 2011.

The following provides a partial snapshot of land uses in the watershed.

- An estimated 70 percent of the land area is forested and 10 percent is in pasture (MRLC, 2011). The remaining land is identified as pasture, urban and wetlands.
- Upper Saline Watershed forests are comprised of a mix of pine, upland, and bottomland forest types. Three-quarters of the forestlands are owned by industrial firms.
- Small cattle operations dominate agricultural production in the nine-county area with poultry production playing a lesser role.

Figure 21.2
Distribution of Land Uses in the Upper Saline River Watershed

Source: 2011 National Land Cover Database
Data Source: Multi-Resolution Land Characteristics Consortium (MRLC)



- Approximately 139,699 people lived in the watershed as of the 2010 Census (Biological and Agricultural Engineering Department, 2011). The population is growing rapidly in the upper portion of the watershed. Saline County grew 28.2 percent from 2000 to 2010 (University of Arkansas at Little Rock, 2011), while the population declined in the lower portion. Jefferson County saw its population decline by 8.1 percent.
- The cities of Alexander, Benton, Bryant, Haskell, Shannon Hills and a portion of Saline County are subject to Phase II stormwater requirements with coverage from August 1, 2014 through July 31, 2019 for a small municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit (ADEQ, 2014).

- Major communities in the watershed include Benton, Bryant, Bauxite, Sheridan and Hot Springs Village (a gated retirement community with seven lakes and numerous golf courses).
- There are significant and varied resource extraction activities in the watershed, including both active and abandoned mine sites.

Water Quality Program Goals

ANRC continues to designate the Upper Saline River watershed as a priority watershed for the 2018-2023 NPS Management Plan. With input from the NPS Management Plan Stakeholder Group, a qualitative risk assessment matrix was developed to identify priority watersheds. The process and matrix are summarized in Section 1 and described in greater detail in Appendix A.

Pollutants of concern within the Hydrologic Unit Area include:

- Siltation/turbidity
- Chlorides
- Sulfates
- pH
- Mercury
- Low dissolved oxygen

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Upper Saline River watershed, targeting sub-watersheds where implementation can have the greatest impact.

ANRC contracted with the Nature Conservancy for preparation of a Nine Element Plan. The Upper Saline River Watershed-Based Management Plan was completed in January 2006. EPA accepted the plan in 2009. Utilizing the EPA-accepted Nine Element Plan and an adaptive approach, these goals may be achieved.

Objectives

Utilize the EPA-accepted Nine Element Plan, augmented by SWAT Modeling, to implement, promote or support NPS Management Project to manage, reduce or abate NPS constituents.

The 2018-2023 NPS Management Plan includes statewide goals and objectives focusing on reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the Plan.

The following objectives were previously identified with input from the NPS Management Plan stakeholders. Cooperating entities are described in Section 3 of this plan. Table 3.3 identifies cooperating entities that will partner to implement the NPS program in the watershed.

21.1. Develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

21.2. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

21.3. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites.

21.4. Promote Best Management Practice implementation to improve conservation practices for erosion control, sediment retention and nutrient management on lands used for row crop and animal agriculture as well as timber production. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans.

21.5. Encourage county, municipal and property owners associations elected officials as well as contractors, homebuilders and consulting engineers to participate in construction and urban education programs to improve stormwater management, erosion control and other conservation and pollution prevention measures.

21.6. Encourage landowners to establish riparian buffer strips, grass drainage ways, stabilize streambanks and restore riparian areas. Maintain streamside management zones (SMZs).

21.7. Consider obtaining conservation easements as the opportunity arises.

21.8. As resources allow, promote and support outreach and education within the watershed relative to water quality and NPS.

21.9. Build constituency for improved water quality by promoting volunteerism and recreational use of the river (e.g., recruiting volunteers for cleanups,

streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups).

21.10. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

21.11. Continue to promote and support public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (e.g., encourage use of FAM*A*SYST, URBAN*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

21.12. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline

Provided sufficient human and financial resources are available to the cooperating entities working together in the Upper Saline River watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. One goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Upper Saline River watershed with the capacity to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate.

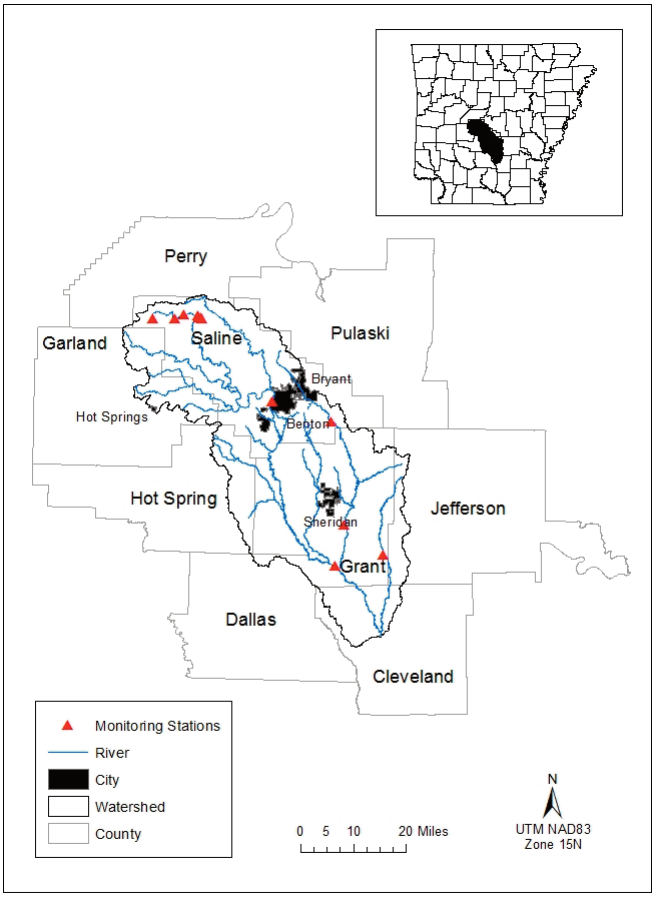
Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of nonpoint source pollution management activities in the Upper Saline River watershed. ADEQ is responsible for maintaining the state's water quality inventory. They maintain five monitoring stations within the Upper Saline River watershed. In addition, the U.S. Geological Survey (USGS) maintains 10 monitoring sites in the watershed. Real-time flow data is available at the USGS stations as well as some water quality data. Figure 21.3 shows USGS' monitoring stations in the watershed.

The NPS Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 21.3
U.S. Geological Survey Monitoring Stations in the Upper Saline River Watershed

Source: U.S. Geological Survey National Water Information System Mapper



Stakeholder Priorities

To encourage continued public input, the University of Arkansas System Division of Agriculture's Public Policy Center facilitated a water quality stakeholder forum for the Upper Saline Watershed in January 2015. Forum participants identified water quality issues such as sedimentation, wildlife diversity and drinking water as local priorities for addressing.

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Appendices

Appendix A

Watershed-Based Implementation

2018-2023 NPS Management Plan

Watershed-based implementation has been a goal of the nation's Nonpoint Source (NPS) Pollution Management Plan from its initiation. In Section 319 of the Clean Water Act (CWA), it was stated that "A State shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis within such State."

This emphasis has been consistent in guiding the development of State Management Programs ever since.

In 1997, the U.S. Environmental Protection Agency (EPA) increased its commitment to watershed implementation with the publication of *Picking Up the Pace,* which established specific policy to target risk through enhancing the total maximum daily load (TMDL) program and improving identification of waters impaired by nonpoint sources. The supplemental guidance for the program published that year (U.S. Environmental Protection Agency, 1997) stated that states are to use "a balanced approach that emphasizes both State-wide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened." Also that year, Congress made an additional $100 million available to states for implementation of projects that addressed identified water quality impairments.

In 2003, supplemental grant guidance issued for Section 319(h) grants stated "The priority objective for the use of Section 319(h) grant funds is to implement the national policy, set forth in section 101(a) of the CWA, that nonpoint source programs be implemented expeditiously to achieve the goals of the CWA, including the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters."

To achieve this objective, the guidance placed top priority on implementing on-the-ground measures and practices that would reduce pollutant loads and contribute to the restoration of impaired waters. In April 2013, the guidance was again updated, with some key changes mentioned in the introduction to this NPS Plan.

Arkansas has also emphasized watershed-based management in its Nonpoint Source Management Plan. In 1998, the Illinois River, Kings River, Yocum and Longs Creeks, Buffalo River, Big Piney Creek, Poteau River, Cossatot River, Smackover Creek and Bayou Bartholomew were identified as the priority watersheds for program implementation. These priorities have since been updated to include streams identified in the Arkansas Unified Watershed Assessment and those watersheds in which TMDLs have been developed. Because of new requirements from EPA to target efforts toward known impairments, changes have been made in Arkansas' regulatory environment since 1998, as well as the ever evolving issues of NPS pollution, and a need to re-evaluate these priorities.

Funding through EPA and other programs was not sufficient to fully treat any 8-digit hydrologic unit code (HUC) watershed in Arkansas. Therefore, the Arkansas Natural Resources Commission (ANRC) supported development of a two-phase qualitative risk assessment process to target nonpoint source efforts toward sub-watersheds within identified priority 8-digit HUC watersheds. Watersheds selected as priority watersheds through the risk assessment process are eligible for Section 319(h) funding from EPA Watershed Project funds. In addition, ANRC also encourages other state agencies to target their efforts towards these same watersheds.

Phase I of the process, initiated in 2004 for the development of 2006-2011 Arkansas' NPS Pollution Management Plan, was a qualitative risk-based assessment of all of the 8-digit HUC watersheds in the state. For this risk assessment, the NPS Plan Stakeholder Group selected 11 categories relevant to NPS pollution after a series of meetings and facilitated discussions. Categories used for the risk assessment were those that had readily available data or were computed from the readily available data. The relative importance of each category/sub-category was determined through discussion of the stakeholders. The appropriate data for each selected category/sub-category were compiled in an ArcView (ESRI, Inc., Redlands, CA) database, assigned a value of 0 to 10 based on the type of impairment and relative importance to develop a risk assessment matrix on watershed basis. Using a quintile classification approach, watersheds were ranked according to the

values assigned by the risk assessment matrix (Morgan and Matlock, 2008). Finally, eight watersheds falling in the top quintile were selected by the executive director of ANRC as priority watersheds. ANRC intended to develop a watershed management plan (Nine-Element Plan) in each of the selected priority watersheds in cooperation with local agencies and working partners.

In preparation for developing the 2011-2016 NPS Pollution Management Plan, the Stakeholder Group began deliberations in 2008. The recommendations in 2008 led to the revision of assessment matrix as shown in Table 1 and also in the scoring criteria for a few categories/sub-categories (discussed later as appropriate).

In 2013, stakeholders attending the annual Nonpoint Source Pollution Stakeholder Meeting agreed that a workgroup should convene to review the possibility of adding the presence of endangered species as a 13th category used for watershed prioritization. The Endangered Species Workgroup met in late 2013 and early 2014 to discuss whether the category should be added, whether to include threatened species as well as endangered species and how the category would be weighted. The workgroup ultimately endorsed the addition of the category. Stakeholders attending the 2014 NPS Stakeholder Meeting provided more feedback for the workgroup to consider. Finally, stakeholders attending the 2015 NPS Stakeholder Meeting approved including the new category in the matrix. The 13th category would be used in the determination of priority watersheds for the 2018-2023 NPS Management plan.

Following the same procedure used in previous selections of priority watersheds for the NPS Pollution Management Plan, watersheds falling in the top quintile have been selected by the executive director of ANRC as priority watersheds for the 2018-2023 NPS Pollution Management Plan.

The data under each category/sub-category has been continuously updated since 2008 based on the biennial water quality inventory published by the Arkansas Department of Environmental Quality (ADEQ) in its most recent List of Impaired Waterbodies.

For four of the priority watersheds identified in the 2006-2011 NPS Pollution Management Plan (all of these are common to 2011-2016 plan as well), the University of Arkansas System Division of Agriculture Biological and Agricultural Engineering Department completed development of Soil and Water Assessment Tool (SWAT) models. These models have generated 12-digit HUC sub-watersheds of the 8-digit watersheds. For each 12-digit HUC sub-watershed, the relative contribution of sediment, phosphorus and nitrogen concentration has been generated. The sub-watersheds have then been divided into quintiles by the relative concentration, and this data was provided to the Stakeholder Group for consideration in preparation of the watershed elements of the NPS Pollution Management Plan.

Phase II of the risk assessment will continue and be finalized as the Nine Element Plans for priority 8-digit HUC watersheds are completed. Information generated

Table 1. Categories Used for Watershed Prioritization

2006-2010 NPS Pollution Management Plan		2011-2016 NPS Pollution Management Plan		2018-2023 NPS Pollution Management Plan	
1	Waterbody Impairment	1	Waterbody Impairment	1	Waterbody Impairment
2	Human Health Impact	2	Designated Use Impact	2	Designated Use Impact
3	Biotic Impacts	3	Biotic Impacts	3	Biotic Impacts
4	Potential Human Exposure	4	Potential Human Exposure	4	Potential Human Exposure
5	Construction	5	Urban Suburban Population	5	Urban Suburban Population
6	Rural Roads	6	Impervious Surface	6	Impervious Surface
7	Non-Row Crop Agriculture	7	Economic Activity	7	Economic Activity
8	Row Crop Agriculture	8	Cropland	8	Cropland
9	Urban	9	Livestock and Pasture	9	Livestock and Pasture
10	Forestry	10	Unpaved Roads	10	Unpaved Roads
11	Priority of a Bordering State	11	Forestry	11	Forestry
		12	Priority of a Bordering State	12	Priority of a Bordering State
				13	Threatened or Endangered Species

through modeling of the priority 8-digit HUC watersheds on sediment and nutrient concentration, and a second risk assessment based on 12-digit HUC sub-watersheds within the priority 8-digit HUC watersheds are to be used to identify target areas within the 8-digit HUC watershed. The 12-digit HUC sub-watersheds that have the highest risk of impairment as indicated by SWAT model, other studies or locally available information, will become the target areas for implementation of nonpoint source management measures and programs.

Watersheds not included in the top priority list are not excluded from funding under the 319(h) grant program; they are only restricted to competing for Program funds (50 percent of the total funding).

Phase I Watershed Assessment

Selection of priority 8-digit HUC watersheds using a risk-based approach
(Submitted to the NPS pollution stakeholders for discussion)

Phase I of the watershed assessment and prioritization was to select the top priorities from among the 8-digit HUC watersheds within the state.

A current list of categories used for conducting risk assessment is as follows:

1. Waterbody Impairment
2. Designated Use Impact
3. Biotic Impacts
4. Potential Human Exposure
5. Urban Suburban Population
6. Impervious Surface
7. Economic Activity
8. Cropland
9. Livestock and Pasture
10. Unpaved Roads
11. Forestry
12. Priority of a Bordering State
13. Presence of Threatened or Endangered Species

Individual categories/sub-categories were assigned weights ranging from 0 to 10.

Parameters 1 through 4 and 12 were ranked using values assigned from 0 to 10 based on weights of various sub-parameters (see individual sub-parameters below for details). For parameters 5 through 11, the percentile of the criteria of interest in those parameters was calculated and multiplied by a weight of 10 or 5 (as appropriate for concerned parameter) to obtain a final score for updating the risk assessment matrix. The algorithm for computing the priority rankings for 8-digit HUC watersheds was:

> *Value of category 1* sum of the weights for categories 2 through 12. For category 13, the presence of endangered or threatened species conveys a weight of 10 points. No points are given in absence of endangered or threatened species.*

Waters with no identified impairments were given a value of 0 for category 1, so they dropped out of the ranking process, as their value was 0 by definition. The remaining watersheds were ranked by score and then divided into quintiles. The top quintile of watersheds was provided to the executive director of ANRC as a recommendation. The executive director then made the final choice of priorities.

The criteria by which each category was evaluated were:

Category I: Waterbody Impairment

An impaired waterbody (stream and lake) is defined as one that does not support all of its designated uses. Category 1 was divided into five sub-categories that assess the impairment of a waterbody. Each sub-category maintained a unique weight that was used in the final risk matrix calculation, depending on whether or not the sub-category's criteria were met. When a waterbody met several criteria, only the highest weight was used in the risk matrix computations.

Table 2. Waterbody Impairment Weights

Criteria	Weight
1(a) NPS-Related 2010 Impairment, Approved TMDL	10 (this assures that TMDLs are priority)
1(b) ADEQ 2010 "High" Priority	8
1(c) ADEQ 2010 "Medium" Priority	6
1(d) ADEQ 2010 "Low" Priority	2
1(e) Nutrient Sensitive Watershed	5
Waters With No Identified Impairment or Impacts	0

The primary source of the data for categories 1 to 3 was the most recent ADEQ List of Impaired Waterbodies. The list identifies waterbodies in Arkansas that do not comply with state quality standards. The list is used to prioritize watersheds based on the findings and is updated every two years.

Category 2: Designated Use Impact

Category 2 rankings are based on the designated use impairments found on ADEQ's List of Impaired Waterbodies. Category 2 was divided into six sub-categories that assess the designated use impairment of a waterbody. Each sub-category was assigned a unique weight that was used in the final risk matrix computation, depending on whether or not the sub-category's criteria for inclusion in the risk matrix were met. If a waterbody met several criteria, only the sub-category with the highest weight was used in the risk matrix computations.

Table 3. Designated Use Impact Weights

Criteria	Weight
2 (a) Aquatic Life Use (FSH)	10
2 (b) Primary or Secondary Use	9
2 (c) Drinking Water	8
2 (d) Environmentally Sensitive Water	5
2 (e) Ecological Resource Waters	4
2 (f) Agricultural or Industrial Use	2

Category 3: Biotic Impacts

Category 3 uses ADEQ's List of Impaired Waterbodies to rank the potential biotic impact of a waterbody. Category 3 was divided into five sub-categories that assess the biotic impact of a waterbody. Each sub-category was assigned a unique weight that was used in the final risk matrix calculation, depending on whether or not the sub-category's criteria were met. If a waterbody met more than one criterion, only the highest weight assigned was used in the risk matrix computations. The default weights are given in Table 4.

Table 4. Biotic Impact Weights

Category	Weight
3 (a) Aquatic Life (FSH)	10
3 (b) Sedimentation (Tb)	10
3 (c) Dissolved Oxygen (DO)	9
3 (d) Priority Organics (PO)	8
3 (e) Ammonia (AM)	4

Category 4: Potential Human Exposure

The risk to an individual from an environmental pollutant is the product of the effect of exposure to that pollutant and the chance of an exposure occurring. Pollutants that have a high chance of exposure were given more attention than pollutants to which humans generally are not exposed. The chance of exposure was measured by examination of the uses of a waterbody and determination of potential routes of exposure for persons making that use. Category 4 was divided into four sub-categories that assessed the risk of potential human exposure to the waterbody. Each sub-category was assigned a unique weight that was used in the final risk matrix calculation, depending on whether or not the sub-category's criteria for inclusion in the risk matrix were met. If a waterbody met several criteria, only the highest value was used in the risk matrix calculations. The default weights are given in Table 5.

Table 5. Potential Human Exposure Weights

Category	Weight
4 (a) Tributary to Public Water Surface	10
4 (b) Tributary to or Part of Recreational Lake	8
4 (c) Natural and Scenic River or Urban Stream	8
4 (d) All Other Waters	2

Category 5: Urban Population

NPS pollution can potentially increase with high population density in urban areas compared to less populated rural areas. Because watershed boundaries, in general, cover more than one county, a weighted average was calculated for each watershed based on the percentage area occupied by the watershed in each county. The final score for each watershed was obtained by multiplying the percentile of the density of population by the default weight of 10.

Category 6: Impervious Surface

Impervious surface in urban areas could become a potential source for NPS pollution. Impervious surfaces include asphalt, concrete, compacted soils and rooftops, among others. Urban land use data was used as a surrogate for impervious surface. The final score for each watershed was obtained by multiplying the percentile of the impervious surface by the default weight of 10.

Category 7: Economic Activity

Economic activity is usually accompanied with urbanization and construction. It could indirectly become a potential source for NPS pollution. This category was represented in the risk assessment matrix using three sub-categories: change in construction (7a), shale development (7b) and other economic activity (7c). The default weights for these sub-categories are given in Table 6.

Table 6. Economic Activity Weights

Category	Weight
7 (a) Change in Construction	5
7 (b) Shale Development	4
7 (c) Other Economic Activity	1

Category 8: Cropland

Runoff from dry and irrigated croplands could be a potential source for surface and groundwater pollution. Data from the U.S. Department of Agriculture's Census of Agriculture was used to find out the acreage of harvested cropland in each county. Many of the watersheds span several counties, so a weighted county-area average based on a watershed's percent within a county was produced for each watershed. The weighted average was used to obtain density of harvested cropland in each watershed. The final score for each watershed was obtained by multiplying the percentile of density of harvested cropland by the default weight of 10.

Category 9: Livestock and Pasture

Livestock and pasture have been reported to be potential source for surface and groundwater pollution. Many livestock operators in Arkansas fall below the minimum animal unit criteria to be covered by EPA confined livestock feeding operations (CAFOs) (Morgan and Matlock, 2008). These smaller operations are, therefore, managed as NPS pollution. Morgan and Matlock have also reported that improper management of poultry and livestock waste and direct access of cattle to streambanks could contribute to NPS pollution. Thus, Category 9 was broken down into two sub-categories, Pasture (9a) and Livestock (9b). Both these sub-categories were assigned a default weight of 5 each. A percentile rank for each sub-category was assigned to each watershed and the ranks were multiplied by the default weight of 5 for all watersheds.

Category 10: Unpaved Roads

Several reports have discussed the potential for sediment loading from unpaved roads. Road data from the Arkansas Department of Transportation was used to determine length of unpaved roads. The length of unpaved roads in each watershed was divided by watershed area to calculate the density of unpaved roads in the watershed. A final score for each watershed was obtained by multiplying the percentile of density of unpaved roads by the default weight of 10.

Category 11: Forestry

EPA, state and local authorities in recent years have realized the impact of forestry activities on NPS pollution. There is a correlation between forest ownership and an increase in NPS pollution. Morgan and Matlock (2008) found that public forests tend to be better managed and maintained than private forests and therefore have less NPS pollution. In order to determine each watershed's percentage of public (federal and state) and private forests, the following process was performed:

- Statewide areas under forest cover were obtained.
- The area under national and state forests was subtracted from the total statewide area under forest.
- Density of forest areas in each of the three categories was then obtained on 8-digit HUC watershed basis by dividing by the total watershed area.
- The ranking of density of forest area under each of the three categories was obtained using percentile criteria.
- Weights of 2, 3 and 5, respectively were assigned to density of federal, state and private forests.
- The final score for forestry category was the sum of scores obtained by multiplying percentile rank of density of federal forest, density of state forest and density of private forest with their respective weights.

Category 12: Priority of a Bordering State

Along the western, northern and southern borders of Arkansas, streams frequently flow into adjacent states. When those waters have been made a priority watershed for NPS implementation by the adjacent state, Arkansas has acknowledged that commitment by the adjacent state. In addition, some of the waters leaving Arkansas fail to meet the water quality standard of the adjacent

state. Those waters that have been made priorities by adjacent states were given a weight of 10 points in recognition of that adjacent state's needs.

Category 13: Presence of a Threatened or Endangered Species

Category 13 looks at the presence of a threatened or endangered species in the state based on data from the U.S. Fish and Wildlife Service. The agency's data revealed the presence of endangered species in 32 watersheds and the presence of threatened species in three watersheds. The agency does not have a hierarchy of species; therefore, the presence of a threatened or endangered species in a watershed will be given a weight of 10 points. If there are no threatened or endangered species in the watershed, the watershed is given 0 points for this category.

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Appendix B

SWAT Model Description

2018-2023 NPS Management Plan

Introduction

The following describes the conceptual 2009 version of the Soil and Water Assessment Tool (SWAT) and how the model was implemented and calibrated in the 2011-2016 NPS Management Plan for selected priority watersheds: Bayou Bartholomew, Beaver Reservoir (Upper White River), Illinois River and Lake Conway-Point Remove.

The Conceptual Model

The SWAT model was developed by the U.S. Department of Agriculture-Agriculture Research Service (USDA-ARS). It is a conceptual model that functions on a continuous time step. Model components include weather, hydrology, erosion/sedimentation, plant growth, nutrients, pesticides, agricultural management, channel routing and pond/reservoir routing. Agricultural components in the model include fertilizer, crops, tillage options, grazing and the capability to include point source loads (Neitsch et al., 2009). The SWAT model predicts the influence of land management practices on constituent yields from a watershed. SWAT is the continuation of more than 30 years of development within the USDA-ARS. The CREAMS, GLEAMS, and EPIC models (Knisel, 1980; Leonard et al., 1987; Williams et al., 1984) have each contributed to the scaling up of past field-scale models to one that includes large river basins. SWAT is a public-domain model that is actively supported by USDA-ARS at the Grassland, Soil, and Water Research Laboratory in Temple, Texas. There are more than 700 publications in peer-reviewed scientific journals that report development and applications of the SWAT model.

SWAT is a theoretical model that operates on a daily time step. In order to adequately simulate hydrologic processes, the watershed is divided into sub-watersheds through which streams are routed. The sub-units of the sub-watersheds are referred to as "hydrologic response units" or HRUs. HRUs are the unique combination of soil, land use and slope characteristics and are considered to be hydrologically homogeneous. Both sub-watersheds and HRUs are user defined, providing model users with some control over the resolution considered in the SWAT model (Neitsch et al., 2005). The model calculations are performed on a HRU basis and flow. Water quality variables are routed from HRU to sub-watersheds and subsequently to the watershed outlet. The SWAT model simulates hydrology as a two-component system, composed of land hydrology and channel hydrology. The land portion of the hydrologic cycle is based on a water mass balance. Soil water balance is the primary considerations by the model in each HRU, which is represented as (Arnold et al., 1998):

$$SW_t = SW + \sum_{i=1}^{t} (R_i - Q_i - ET_i - P_i - QR_i) \qquad (1)$$

where SW is the soil water content; i is time in days for the simulation period t; and R, Q, ET, P and QR, respectively, are the daily precipitation, runoff, evapotranspiration, percolation and return flow. The hydrologic cycle simulation by SWAT is shown in Figure B.1.

Water enters the SWAT model's watershed system boundary predominantly in the form of precipitation. Precipitation inputs for hydrologic calculations can either be measured data or simulated with the weather generator available in the SWAT model. Precipitation is partitioned into different water pathways depending on system characteristics. The water balance of each HRU in the watershed contains four storage volumes: snow, the soil profile (0-2 m), the shallow aquifer (2-20 m), and the deep aquifer (> 20 m). The soil profile can contain several layers. The soil-water processes include infiltration, percolation, evaporation, plant uptake, and lateral flow. Surface runoff is estimated using the SCS curve number or the Green-Ampt infiltration equation. Percolation is modeled with a layered storage routing technique combined with a crack flow model. Potential evaporation can be calculated using Hargreaves, Priestly-Taylor or Penman-Monteith method (Arnold et al., 1998).

Loadings of flow, sediment, nutrients, pesticides, and bacteria from the upland areas to the main channel are routed through the stream network of the watershed using a process similar to the hydrological model (HYMO) (Williams and Hann, 1972). The stream processes modeled by SWAT are shown in Figure B.2 and include channel sediment routing and

Figure B.1 Hydrologic cycle considered by SWAT model from Neitsch et al., 2005)

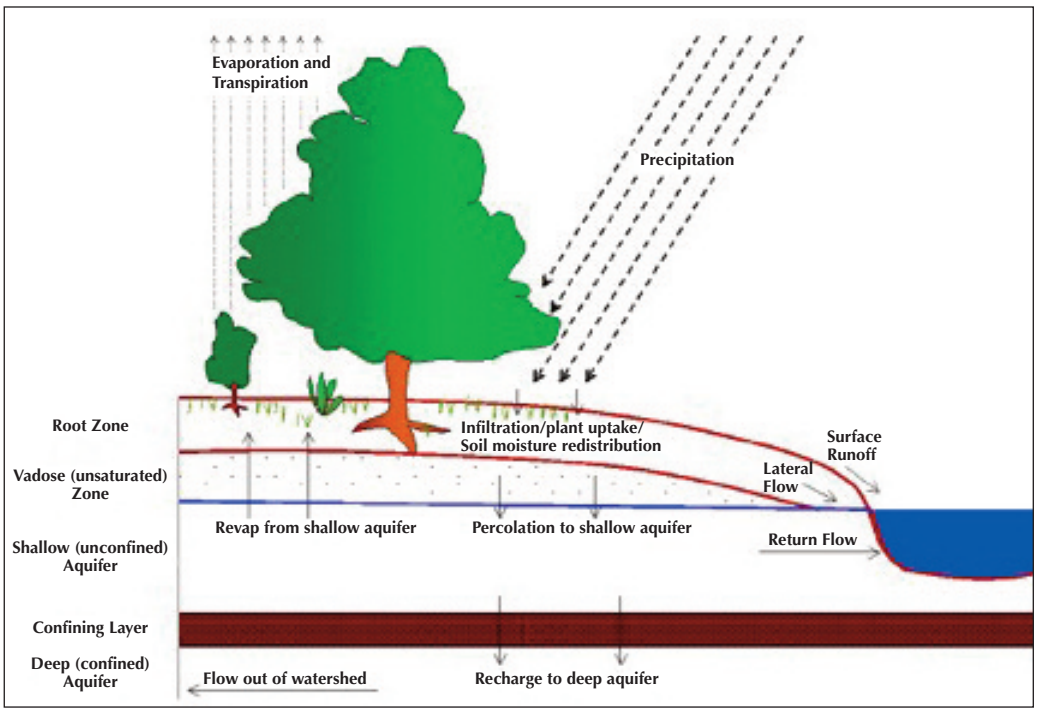
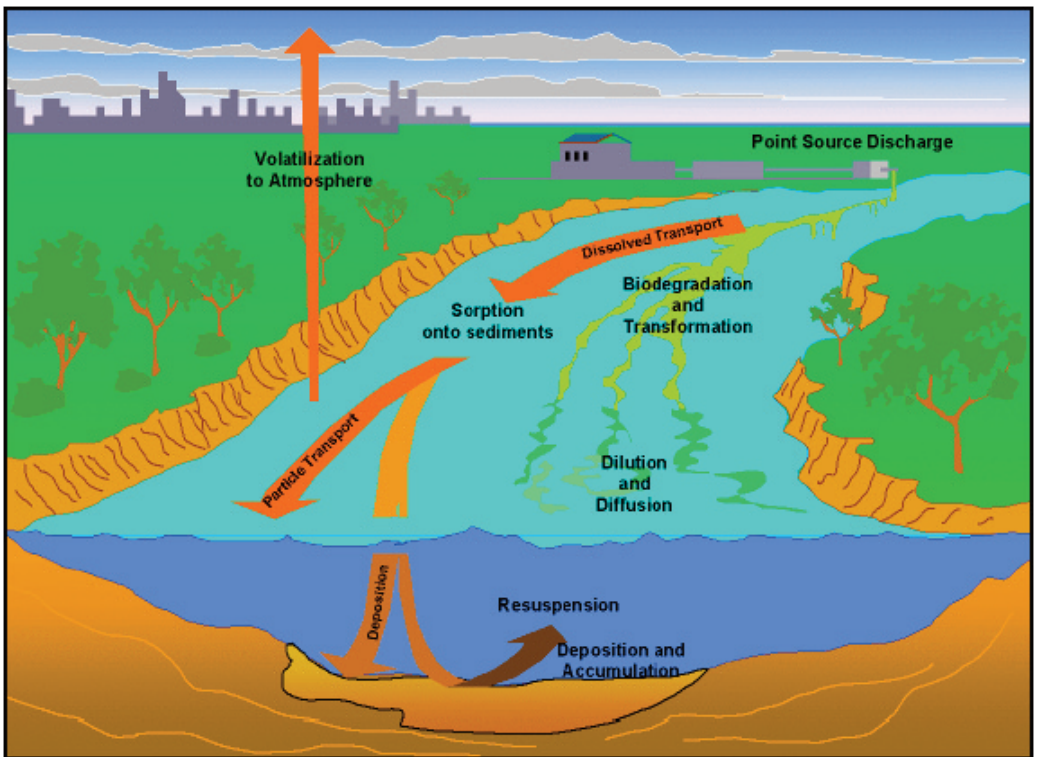


Figure B.2 instream processes considered by the SWAT model (from Neitsch et al., 2005)



nutrient and pesticide routing and transformation. The pond/reservoir routing allows for sediment settling and simplified nutrient and pesticide transformation routines. The command structure for routing runoff and chemicals through a watershed is similar to the structure for routing flows through streams and reservoirs.

The SWAT watershed model also contains algorithms for simulating erosion from the watershed. Erosion is estimated using the Modified Universal Soil Loss Equation (MUSLE). The equation estimates sediment yield from the surface runoff volume, the peak runoff rate, the area of the HRU, the Universal Soil Loss Equation (USLE) soil erodibility factor, the USLE cover and management factor, the USLE support practice factor, the USLE topographic factor and a coarse fragment factor.

After the sediment yield is evaluated using the MUSLE equation, the SWAT model further corrects this value considering snow cover effect and sediment lag in surface runoff. The SWAT model also calculates the contribution of sediment to channel flow from lateral and groundwater sources. Eroded sediment that enters channel flow is simulated in the SWAT model to move downstream by deposition and degradation (Neitsch et al., 2005).

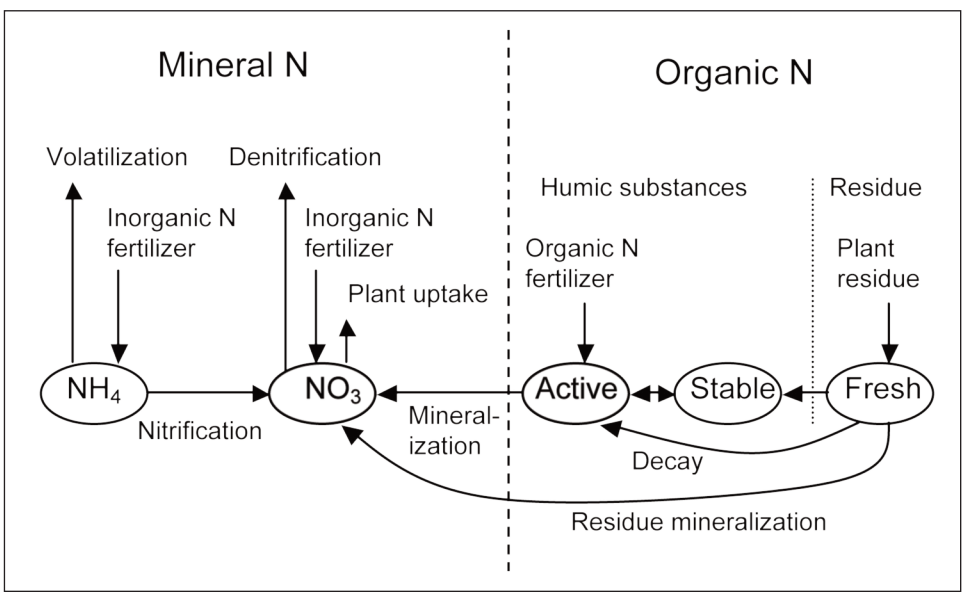
Soil nitrogen (N) is also simulated in the SWAT model. Soil nitrogen is partitioned into five nitrogen pools with two being inorganic (ammonium-N (NH_4-N) and nitrate-N (NO_3-N)) and three being organic (active, stable and fresh) (Figure B.3). The SWAT model simulates movement between nitrogen pools, such as mineralization, decomposition/immobilization, nitrification, denitrification, and ammonia volatilization.

Other soil nitrogen processes, such as nitrogen fixation by legumes and NO_3-N movement in water, are also included in the model. All soil nitrogen processes are simulated in the SWAT model using relationships described in the model's theoretical documentation (Neitsch et al., 2005).

Once nitrogen enters channel flow, the SWAT model partitions nitrogen into four pools: organic nitrogen, NH_4-N, nitrite-N (NO_2-N), and NO_3-N. The SWAT model simulates changes in nitrogen that result in movement of nitrogen between pools. The algorithms used to describe nitrogen transformations in channel flow were adapted from the QUAL2E model by SWAT model developers (Neitsch et al., 2005).

Large-area simulations are possible because of the advances in computer software and hardware, including speed and storage, geographical information system/spatial analysis and debugging tool software. SWAT model development primarily emphasizes (1) climate and management impacts, (2) water quality loadings and fate, (3) flexibility in basin discretization, (4) land use change impacts and (5) evaluation of conservation practices, also called Best Management Practices effectiveness.

Figure B.3 Flow chart of the soil nitrogen cycle simulated in the SWAT model (modified from Neitsch et al., 2005)



Another nutrient simulated in the soil profile of the SWAT model is phosphorus (P). Soil phosphorus is divided into six phosphorus pools. Three of the pools are characterized as mineral phosphorus and three are characterized as organic phosphorus (Figure B.4). Transformations of soil phosphorus between these six pools are regulated by algorithms that represent mineralization, decomposition, and immobilization. Other soil phosphorus processes included in the SWAT model are inorganic phosphorus sorption and leaching. The algorithms describing soil phosphorus dynamics are available in the SWAT model theoretical documentation (Neitsch et al., 2005).

Phosphorus that enters stream channels is evaluated in the SWAT model similar to nitrogen. Two pools of phosphorus are simulated for channel processes: organic phosphorus and inorganic/soluble phosphorus. The algorithms used in channel phosphorus calculations by the SWAT model were adapted from the QUAL2E model and are available in the SWAT model theoretical documentation (Neitsch et al., 2005).

While the SWAT model provides algorithms for calculating different watershed constituent dynamics, the ability of the SWAT model to depict processes in a particular watershed is partially dependant on the quality of input data. The input data that describe the physical structure of a watershed are generally incorporated into the model using the ArcSWAT interface. ArcSWAT is an extension to the ArcGIS (ESRI Inc., Redlands, CA) geographical information system (GIS) software. Mandatory GIS input files for ArcSWAT include the Digital Elevation Map (DEM), land use and soil layer. Other data that are not in GIS format are optional. Such additional data includes spatially referenced fertilizer, animal production, land management, weather and point source data.

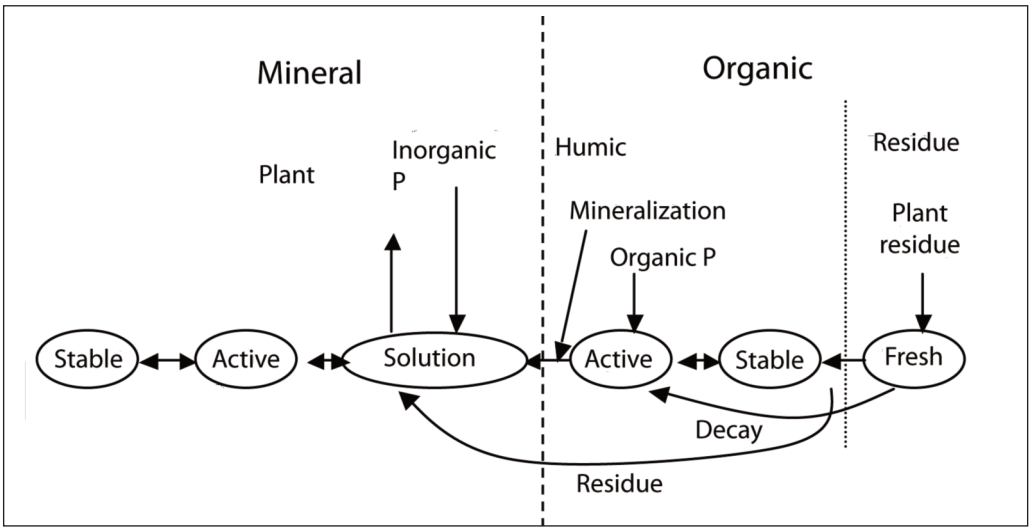
Inputs entered into the SWAT model are organized to have spatial characteristics. The SWAT model provides three spatial levels: the watershed, the sub-watersheds, and the HRUs. Each level is characterized by a parameter set and input data. The largest spatial level, the watershed, refers to the entire area being represented by the model.

Although the SWAT model simulates on a daily time step, the user can print aggregated output at a daily, monthly, or annual time scale. Key output variables include flow volume, nutrient yields, sediment yield, and plant biomass yields. These variables are provided on the sub-watershed or HRU spatial level depending on the output time step selected. The output files generated by the SWAT model are created in text and database file formats.

Model Limitations

It's a fact that watershed models are regarded overall as efficient and feasible because of the potential time and expense savings involved in assessing the impact of land management practices on water quality (Arnold et al., 1998). However, all models, including SWAT, are simplified representations of reality; therefore, model outputs reflect uncertainties in the available spatial and monitoring data sets.

Figure B.4 Flow chart of the soil phosphorus cycle simulated in the SWAT model (modified from Neitsch et al., 2005)



In most watershed modeling projects, model output is compared to corresponding measured data with the assumption that all error variance is contained within the predicted values and that observed values are error free (Moriasi et al., 2007). Though Willmott (1981) and American Society of Civil Engineers (1993) recognize that measured data are not error free, due to the relative lack of data on measurement uncertainty, measurement error was not considered in their recommendations.

Uncertainty estimates for measured streamflow and water quality data have recently become available (Harmel et al., 2006) and we recognize the importance of evaluating all related uncertainties in a modeling framework. Consequently, it is advisable that users of the model become aware of the causes of uncertainty which can broadly be classified into model uncertainty and data uncertainty. The quantification of uncertainty is an area of research and is desirable to understand the limits of model predictions.

A major limitation to large area hydrologic modeling is the spatial detail required to correctly simulate environmental processes. For example, it is difficult to capture the spatial variability associated with precipitation within a watershed. Another limitation is the accuracy of hydrologic response units simulating field variations including conservation practices. SWAT is being altered to account for landscape spatial positioning so that conservation practices such as riparian buffers and vegetative filter strips can be adequately simulated.

Data files also can be difficult to manipulate and can contain several missing records. The model simulations can only be as accurate as the input data. SWAT does not simulate detailed event-based floods, and hence, may not adequately capture pollutant loading during episodic events.

The user is encouraged to recognize both the promise and the limitations of watershed models and to constantly subject the modeling products to rigorous scrutiny.

SWAT Model Input

The 2009 version of the SWAT model, which was officially released in January 2010, was used in this application for the 2011-2016 NPS Management Plan. Mandatory GIS input files needed for the SWAT model include the Digital Elevation Model (DEM), LULC, and soil layers. One of the useful features of the SWAT2009 model is that it can simulate LULC change. LULC change was input into the model using multi-year land cover image files. Mandatory GIS data used to develop the watershed models are listed in Table B.1 and Table B.2. Based on threshold specifications and the DEM, the SWAT ArcSWAT interface was used to delineate the watershed into sub-watersheds. Subsequently, sub-watersheds were divided into HRUs by the user specified land use, soil, and slope percentages (Neitsch et al., 2005). Certified 12-digit HUC boundaries were used to create sub-watersheds in each model. The point source data for each watershed was obtained from ADEQ.

The ability of the SWAT model to include specific fertilizer types, fertilizer spreading, cattle grazing, and tillage operations adds to the model's utility in representing a particular watershed (Neitsch et al., 2005, 2009). These nonpoint components were integrated into the model based on best available information. Animal production was simulated in the SWAT model at the HRU level. Production animals in the watershed included chickens, turkeys, pigs and cows (beef and dairy). For each animal type, a fertilizer file was created in the SWAT model fertilizer database using standard manure compositions. Annual animal production rates

Table B.1. Temporal and/or Spatial Resolution of Mandatory Input Data for SWAT Modeling

Data Input	Bayou Bartholomew	Beaver Reservoir	Illinois River	Lake Conway Point Remove
DEM✧	10 meter	30 meter	10 meter	10 meter
Land use land cover (LULC)✦	28.5 meter 1992, 1999, 2001, 2004 and 2006	28.5 meter 1992, 1999, 2001, 2004 and 2006	28.5 meter 1992, 1993, 1999, 2001, 2004 and 2006	28.5 meter 1999, 2004 and 2006
Soil	1:24,000 SSURGO soils shape file	1:24,000 SSURGO soils shape file	1:24,000 SSURGO soils shape file	1:24,000 SSURGO soils shape file

✧10 meter DEM were resampled from 5 meter DEM (CAST) due to SWAT database size constraints.

✦1992 and 2001 layers were developed by National Land Cover Database (NLCD), while 1993, 1999, 2004 and 2006 layers were developed by the Center for Advanced Spatial Technologies (CAST).

Table B.2. Sources of Input Data for SWAT Modeling

Name	Input data for SWAT modeling	Source
Beaver Reservoir (Upper White)	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities
Illinois River	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities
Lake Conway-Point Remove	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities
Bayou Bartholomew	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities

for turkeys, pigs, and cows were obtained from National Agricultural Statistical Services (NASS). Animal production numbers were available from NASS on a head-per-county basis. To accommodate for the county level animal production data, the animals were partitioned by county into watershed numbers using the following steps:

1. Determine the land area within each county that is designated as agriculture (CA);
2. Determine the land area of the watershed within each county that is designated as agriculture (WA);
3. Calculate a proportion (PR) within each county (WA/CA); and
4. Multiply PR by each animal production type to determine the number of animals in the watershed. Based on these calculations, chicken, turkey and pig manures were simulated annually in the SWAT model at the HRU level as a mass per area.

Urban lawn management operations were represented through fertilization, lawn mowing and irrigation. Details for these operations including the dates and amount of mowing, fertilization, and irrigation were based on personal communications with extension agents/specialists and recommendations in University of Arkansas System Division of Agriculture, Cooperative Extension Service publications.

Weather data from multiple stations within the region were incorporated to provide the most representative precipitation and temperature data available. Precipitation estimates from the Next Generation Radar (NEXRAD) were incorporated, whenever available, because of its higher spatial resolution. Other meteorological data required by SWAT (solar radiation, wind speed and relative humidity) were estimated using the SWAT weather generator.

Initial values that were not available for SWAT model inputs, such as soil chemical composition, were established by simulating the model for four years. This warm-up period allows the model to "stabilize" or calculate values that become initial values for the period of interest. Therefore, after the warm-up period, the model was considered to represent conditions in the watershed. Specific data sets were identified to perform calibration and validation of the SWAT model. Measured flow and water quality data were acquired from available gauging stations within the watershed during the time period of interest. Whenever possible given the time constraints, the model was calibrated for flow, sediment, and nutrients data at annual and monthly time scales.

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Appendix C

Description of Public Participation and Development of Management Plan Update

2018-2023 NPS Management Plan

Introduction

Section 319 of the Clean Water Act (CWA) requires the states to:

- Assess their waters for impairment caused by nonpoint source (NPS) pollution, including identification of statewide sources of that pollution.
- Submit to the U.S. Environmental Protection Agency (EPA) a management program addressing each identified category of NPS pollution identified in the assessment.
- Report annually on their progress in implementing that program.

Arkansas' NPS Pollution Management Plan was first completed in 1994 for the period of 1994 through 1998. In 1998, a major update was completed that addressed the "key elements" of NPS management as identified in the Clean Water Action Plan. This update provided milestones for the years 1998 through 2002. A minor update was completed in 2002 extending the milestones through 2004. Further updates were published, most recently in 2012 for the years 2011-2016.

The goal this round was to develop an updated Arkansas NPS Pollution Management Plan including the addition of a new watershed to the program's priority list and desire for a more efficient and user-friendly manual.

Methodology

Arkansas' 2018-2023 NPS Pollution Management Plan was developed through exchanges with stakeholders who responded to multiple requests for input at annual stakeholder meetings and water conferences.

Six subgroups were formed to review the categories in the previous management plan. They looked for opportunities to provide updated research literature and at whether conditions had changed in a category. Individual consultations with agencies and interest groups were conducted where it seemed their input was most needed.

While no process can meet all of the needs of every interest group, this process provided for input from representatives of the interested parties during the update. The 2018-2023 NPS Management Plan builds upon efforts by past stakeholders and university staff.

The core team for this plan's collaborative process consisted of scientists and engineers from the Biological and Agricultural Engineering Department (BAEG) at the University of Arkansas, the University of Arkansas System Division of Agriculture Cooperative Extension Service and the director of Arkansas' NPS Pollution Management Plan at the Arkansas Natural Resource Commission Arkansas (ANRC). BAEG was responsible for data compilation, geographic information system databases, and water quality modeling. The University of Arkansas System Division of Agriculture Cooperative Extension Service conducted basic literature reviews, input into Best Management Practices and management measures, and coordinated stakeholder reviews. ANRC reviewed all material for conformance with agency policy.

A final document will be prepared and submitted to EPA Region 6 for review and comment on the final draft. The final document will be completed after EPA's review of the draft.

Results

More than 30 people representing 15 different organizations participated in the workgroups reviewing categories in the NPS Pollution Management Plan.

This draft contains the statewide elements of Agriculture, Silviculture, Surface Erosion and Urban Runoff. Priorities selected for implementation during 2017 through 2022 based on the qualitative risk assessment are the Bayou Bartholomew, Beaver, Cache River, Illinois River, Lake Conway-Point Remove, L'Anguille River, Lower Little, Lower Ouachita-Smackover, Poteau River, Strawberry River and Upper Saline River.

Appendix D

Short-Term Programmatic NPS Pollution Management Program Milestones

2018-2023 NPS Pollution Management Plan

The milestones listed are applicable to the timeframe this Plan spans. The goal is to have those applicable milestones achieved or completed by Sept. 30, 2023. The program management team will continue to use the adaptive management process to adjust objectives and to measure progress toward identified short-term milestones as appropriate.

Since 2005, project partners supported by Clean Water Act (CWA) Section 319 grants have met annually to review progress toward objectives and established program milestones. The NPS Pollution Management Plan Stakeholder Group has met in close coordination with the annual project review conference. More efficient use of resources is necessary as budget changes, focus, direction of national, regional, state and local agencies and leaders have occurred. A collective annual meeting of partners may no longer be economical or practical. Alternative venues and methods may be employed to facilitate the further development, review or update of the NPS Management Program. Project partners funded through the program will continue to be assessed by the Arkansas Natural Resources Commission (ANRC) NPS Management staff. The use of electronic media (social or other) will be utilized to disseminate new or updated information gained from project partners.

ANRC will review progress toward program milestones and discuss possible additions, deletions and/or revisions, as appropriate. This process will be ongoing by ANRC's NPS Management Program staff. Substantive changes of the Plan, upon consultation with U.S. Environmental Protection Agency (EPA) Region VI, will be incorporated as deemed appropriate. Substantive changes to the plan and the data of the change will be noted.

As previously noted, ANRC and EPA recognize the achievement of goals and milestones is subject to potential changes in national funding levels, in addition to environmental and weather-related factors, the national economic climate and other variables beyond the control of the state. EPA and the state must also recognize that changes to the goals and milestones can be influenced by revisions to national EPA guidance. Subsequently, Arkansas may choose to re-evaluate and update applicable goals and milestones to adjust for such changing factors. This adaptive management approach will enable the state to make appropriate modifications to the Management Program to continue to attain satisfactory progress.

Arkansas proposes the following short-term milestones for the NPS Pollution Management Plan for the period FFY 2018-2023:

1. Update the qualitative risk assessment matrix after ADEQ releases the impaired waters list and it is accepted by EPA. Priority watersheds will be evaluated and updated after the qualitative risk assessment matrix is updated.
2. Continue to conduct strategic baseline monitoring in selected high priority 12-digit hydrologic units to assist in the development of Watershed Based Plans. ANRC anticipates three to four priority watersheds will have baseline monitoring over the life of the plan.
3. Continue to employ a review process of a minimum of three NPS projects funded with CWA 319 grants aimed at improving project effectiveness. The review results will be reported annually in the NPS annual report.
4. As resources allow, continue cooperation with the Arkansas State Plant Board and the Abandoned Pesticide Program in the collection of data associated with the environmental risk reductions related to farmer participation in abandoned pesticide collection. Any developments in this area will be reported annually in the NPS annual report.
5. Continue to produce and submit the NPS annual report by the end of January each year.
6. Continue to report load reductions (sediments and nutrients) and BMPs in the Grants Reporting and Tracking System (GRTS) database each year. These results will be included in the NPS annual report.

7. Continue to partner and assist the Natural Resources Conservation Service (NRCS) in the review, selection or development of National Water Quality Initiative (NWQI), Mississippi River Basin Initiative (MRBI), Regional Conservation Partnership Program (RCPP), Environmental Quality Incentive Program (EQIP) or other conservation programs that will improve or enhance water quality in watersheds on an annual basis. ANRC also will participate in the State Technical Committee and its Water Quality subcommittee annually or as it convenes. ANRC will monitor (instream WQ monitoring) a minimum of two to four NRCS Program Initiatives (MRBI, RCPP or NWQI) 12-digit watersheds yearly through the life of this plan. Monitoring results will be assessed and reported in the NPS annual report as they become available.
8. Continue to evaluate and support instream water quality monitoring to assess the effectiveness of implemented 319(h) grant-funded projects or other projects (MRBI, NWQI, etc.), and report monitoring data to ADEQ annually or as appropriate.
9. Review ADEQ's 305(b) report and subsequent 303(d) list approved by EPA for delisted streams or stream segments and determine if 319(h) funded projects assisted in the delisting or improvement of water quality. Review of the 303(d) list will occur every two years, and draft success stories will be developed for delisted segments as appropriate. The goal is to develop and submit two to three success stories within the timeframe of this management plan.
10. Work with partners or other stakeholders to initiate or to have two to three watershed management plans accepted as meeting EPA's nine key elements within the timeframe of this NPS Management Plan. Progress on working with watershed groups and/or submission or acceptance of watershed plans will also be reported on an annual basis in the NPS annual report.
11. Snapshot reporting forms will be sent to nonprofit organizations, state and federal agencies, academic institutions and other entities. This form will be used to gather information from around the state on efforts to reduce nonpoint source pollution and to improve water quality. ANRC will utilize this information to better understand what activities are occurring within the state.

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