Arkansas Water Plan 2014 Update

Appendix F
Gap Analysis Report

FINAL
Gap Analysis

Arkansas Natural Resources Commission

Arkansas State Water Plan Update

November 2014

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Acronyms

AF	acre-feet
AFY	acre-feet per year
ANRC	Arkansas Natural Resources Commission
AWP	Arkansas Water Plan
CDBG	Community Development Block Grant
CWSRF	Clean Water State Revolving Fund
DWINSA	Drinking Water Infrastructure Needs Survey and Assessment
DWSRF	Drinking Water Revolving Loan Fund
EPA	U.S. Environmental Protection Agency
MERAS	Mississippi Embayment Regional Aquifer Study
TWDB	Texas Water Development Board
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

Section 1

Introduction

Under Arkansas state law, the Arkansas Natural Resources Commission (ANRC) is responsible for preparing and periodically updating a statewide water resources planning document. The previous update of the Arkansas Water Plan (AWP) was completed in 1990. In 2012, ANRC initiated an update of the 1990 AWP to be completed in 2014. As part of this update, this report describes the gaps between water availability and water demand and the infrastructure necessary to use the available water.

The update to the AWP involves several major steps including the quantification of current and future demands and water availability and the gaps between them. The estimates of future water availability, demands, and gaps are intended for statewide and regional planning purposes, and are not intended to replace local water resource planning efforts. The gap analysis results presented in this report should be considered order of magnitude estimates. While every effort was made to use the best available data, the analysis is based on projections of supply and demand to the year 2050 that are inherently uncertain and as a result, the gap analysis results have a recognized level of uncertainty, but are adequate for statewide planning purposes.

This report documents the methods and results of the AWP gap analysis, which includes both water supply gaps and infrastructure gaps for municipal systems. It identifies the areas in Arkansas with water supply gaps and an estimate of the magnitude of those gaps. Two types of water sources were analyzed throughout all the AWP technical studies—surface water and groundwater. Both of those sources were evaluated to determine where the most significant potential for supply limitations may exist in the future. Water supply gaps are described in Sections 3 through 5 of this report.

This report also describes statewide infrastructure needs at the provider level. The basis of this analysis was a survey sent to water and wastewater providers throughout the state. The survey collected information on planning efforts, asset management plans and strategies, and current and planned funding sources. Overall, $5.74 billion in infrastructure needs was identified through 2024 for all water providers. Similarly, wastewater providers are estimated to need $3.76 billion in infrastructure improvements through 2023. The survey results are presented in Section 6 of this report.

The annual average 2050 groundwater gap across the state is estimated to be approximately 8,200,000 acre-feet per year (AFY) assuming sustainable groundwater pumping. On an annual average basis there is "excess surface water" and "total available surface water" in every major river basin; on a monthly basis the projected excess and total available surface water varies seasonally such that there is less available in the high demand months of June, July, and August. The statutory definition and associated analysis of *excess surface water* is discussed in later sections of this report. Similarly, the definition and associated analysis of *total available surface water* as used for planning purposes are also discussed in later sections of this report.

In areas where a groundwater gap is projected, the gap analysis assumes that surface water could be used to fill the groundwater supply gap. A combined source gap occurs when there is insufficient *excess surface water* or *total available surface water* to fill the groundwater supply gap. Conversely, a combined source surplus occurs when more supplies are available than are required to meet all demand within a river basin. For all areas, even those where no combined source gap is projected, it is important to note that the appropriate infrastructure may not be in place to utilize all of the available supply.

At the major basin level, the results of the water supply gap analysis are summarized below. All groundwater gaps are based on the assumption of sustainably managed aquifers (versus mined):

- **Arkansas River –** the Arkansas River basin has a projected groundwater gap of over 750,000 acre-feet (AF) in 2050; however, due to the substantial amount of excess surface water and total available water in the basin, there is a combined source surplus that ranges from 2,500,000 AF to 12,500,000 AF depending on the amount of surface water assumed available for development. An insignificant groundwater gap was identified for just the upper portion of the Arkansas River and a substantial combined source surplus was identified due to large amount of available surface water supplies available in this upper portion.

- **Bayou Bartholomew –** the Bayou Bartholomew basin's groundwater gap is estimated to be nearly 150,000 AF in 2050. This gap could be nearly filled with the development of excess surface water leaving a combined source gap of 30,000 AF. If total available surface water is developed above and beyond the identified amount of excess surface water, the combined source gap has potential to become a surplus greater than 300,000 AF.

- **Bayou Macon** – Bayou Macon's groundwater gap is projected to be 275,000 AF by 2050. The gap analysis determined that even under the assumption of developing total available surface water, a combined source gap of 170,000 AF remained in the basin.

- **Boeuf River** – the Boeuf River basin is projected to have a groundwater gap greater than 300,000 AF. Similar to Bayou Macon, full development of total available surface water would still leave a combined source gap of 110,000 AF. If only excess surface water were developed, the combined source gap would be 280,000 AF.

- **L'Anguille River –** the L'Anguille River's groundwater gap is estimated to be over 900,000 AF in 2050. A large amount of groundwater demand in a relatively small basin results in a combined source gap ranging between 560,000 AF and 830,000 AF depending on the amount of surface water assumed available for development.

- **Ouachita River** –The Ouachita River basin's groundwater gap was identified to be fairly insignificant. This fact coupled with a large amount of available surface water results in a combined source surplus ranging between 1,000,000 AF and 4,000,000 AF.

- **Red River** – The Red River's groundwater gap is projected to be just over 70,000 AF in 2050; however, ample surface water supplies exist and this gap can be fully eliminated. The combined source surplus assuming only excess surface water is available is greater than 1,000,000 AF.

- **St. Francis River** – The St. Francis River has the second largest groundwater gap, by basin, at an estimated 1,900,000 AF. Utilization of all available excess surface water would lessen this gap to 1,200,000 AF while development of all total available water would create a surplus in the basin of nearly 800,000 AF.

- **White River –** the White River has a projected groundwater gap in excess of 3,750,000 AF. However; due to the large amount of surface water in this basin the gap can be eliminated by developing all total available surface water leaving a surplus of over 4,750,000 AF. If only excess surface water is assumed available in the basin, a combined source gap of greater than 1,600,000 AF is projected to exist. Assuming development of all total available surface water in the basin, this gap becomes a surplus on the order of 4,750,000 AF. Considering only the upper portion of the basin, the water supply gap is much less dire due to a low amount of groundwater demand and a large amount of available surface water.

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Section 2

Background

Each of the five Water Resources Planning Regions was analyzed for current and future supply and demand conditions. The results of the supply and demand analyses are presented in two reports:

- AWP Water Availability Report (January 2014)
  http://www.arwaterplan.arkansas.gov/reports/water_availability_report_final%201.13.14.pdf
- AWP Water Demand Forecast Report (October 2013)
  http://www.arwaterplan.arkansas.gov/reports/awp_water_demand_forecast_report_10-17-13.pdf

The methods employed in characterizing the basins and identifying water supply challenges are documented in this report, and build on the results of the technical analyses in the AWP *Water Availability Report* and the AWP *Water Demand Forecast Report*.

For the AWP Update, one measure of surface water availability was selected to be *excess surface water*. Arkansas has statutorily defined excess surface water in A.C.A. § 15-22-304 as:

- Twenty-five percent of that amount of water available on an average annual basis above the amount required to satisfy existing and projected needs. Needs include:
  - Existing riparian rights as of June 28, 1985
  - The water needs of federal water projects existing on June 28, 1985
  - The firm yield of all reservoirs in existence on June 28, 1985
  - Maintenance of instream flows for fish and wildlife, water quality, aquifer recharge requirements, and navigation
  - Future water needs of the basin of origin as projected in the AWP

The excess surface water calculations presented in the AWP *Water Availability Report* used stream flow data for 9 major river basins and 44 smaller river basins within the larger basins. The surface water calculations are made with data from 51 gaging stations operated by the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE). Stream flow data collection sites within each river basin were selected based on the availability of adequate data and relevance to the required calculations. The data compilation and calculations are described in detail in the *AWP Water Availability Report*, Section 3.

Excess surface water is surface water that is available for non-riparian use or interbasin transfer and does not place any legal constraint on riparian users. It is reasonable to assume that a significant portion of future surface water withdrawals will be by riparian users (e.g., agricultural withdrawals along smaller streams within a basin). For this reason, surface water supplies and the gap were also assessed utilizing "total available surface water." The *total available surface water* is calculated similarly to excess surface water in that the water to meet the "needs" specified in A.C.A. § 15-22-304 is subtracted from the gaged flow, but the 25-percent factor is not applied to the remaining flow. In other words, total available surface water is the amount of surface water in a basin that is available for both riparian and non-riparian users after identified existing and future needs have been met. Due to omission of the 25-percent factor the calculated total available surface water is four times greater than calculated excess surface water.

Groundwater currently provides about 71 percent of the water supply in Arkansas. The 1990 AWP included a recommendation that critical groundwater areas be identified. This recommendation was implemented pursuant to the "Arkansas Ground Water Protection and Management Act" (Act 154 of 1991), which directed the ANRC to identify these critical groundwater areas based on significant groundwater level declines or water quality degradation.

Arkansas cooperated in a large-scale groundwater evaluation and modeling project conducted by the USGS covering the aquifers of the Mississippi embayment, which includes the eastern portion of the state, where the most significant groundwater development occurs. The AWP used the USGS Mississippi Embayment Regional Aquifer Study (MERAS) groundwater model to assess the potential for future groundwater production. The 2013 version of the USGS model was modified for the AWP groundwater availability assessment to extend the modeling period to 2050. The recharge, stream flow, and well pumping data (demands) were adjusted for the longer time period. Storage parameters were also modified to allow transient evaluation of defined groundwater development scenarios. The MERAS model was used to assess the availability of groundwater, to assess the impact of continuing to attempt to meet current and future demands from groundwater, and to estimate long-term sustainable groundwater production.

The Interior Highlands of western Arkansas has less reported groundwater use than other areas of the state, reflecting a combination of factors—prevalent and increasing use of surface water, less intensive agricultural uses, lesser potential yield of the resource, water quality concerns, and lack of detailed reporting. The various aquifers of the Interior Highlands generally occur in shallow, fractured, well-indurated, structurally modified bedrock of this mountainous region of the state, as compared to the relatively flat-lying, unconsolidated sediments of the Coastal Plain. The overall lower yields of the Interior Highlands aquifers result in domestic supply as the dominant use, with minor industrial, small municipal, and commercial supply use. Where greater volumes are required for growth of population and industry, surface water is the principal supplier of these water needs in the Interior Highlands.

To assess infrastructure needs throughout the state, public water and wastewater providers were surveyed to collect information on the infrastructure needs and estimated costs to meet the identified needs. Additionally, data from the U.S. Environmental Protection Agency's (EPA) Drinking Water Infrastructure Needs Survey and Assessment (DWINSA) was used to enhance the survey response data. The infrastructure survey was sent to all 699 public, community providers in the ANRC database. Of those, 261 providers responded to the survey, for an overall response rate of 38 percent, representing an estimated 67% of the population with supplied water and wastewater services. Response rates were representative across regions and providers of different sizes, ensuring that the survey data was representative of different provider circumstances and needs across the state.

Section 3

Water Supply Gap Analysis Methodology and Key Assumptions

The gap analysis quantifies the water availability gaps for surface water and groundwater across the state. A gap is defined as the difference between the demand and the supply available for that demand, when the former is greater than the latter. If supply is greater than demand, a surplus exists. Gap projections were completed for the 2050 planning horizon utilizing two approaches: (1) source based and (2) combined source. These two gap analysis approaches are summarized below, with further descriptions of surface water and groundwater provided in Section 3.1 and Section 3.2, respectively.

Source Based Gap

The source based gap analysis evaluates groundwater and surface water sources of supply (and its associated demand) separately and maintains separation when determining the total gap. The source based gap does not assume that surface water surplus (i.e., excess surface water) would be used to meet an identified groundwater gap within the same sub-basin/watershed. The supply source gap was evaluated using the equations and descriptions below.

Groundwater:

Groundwater Gap = Groundwater Demand – Groundwater Yield.

The groundwater demands are from the *AWP Water Demand Forecast Report* and the groundwater yield is calculated using the MERAS model.

Surface Water:

The surface water gap analysis utilized results of the excess surface water calculations presented in the *AWP Water Availability Report*, Section 3. These calculations determine the legally available (surplus) water within a watershed, also known as excess surface water. If a surplus exists, then by definition no gap exists. The *Water Availability Report* identified an annual surplus for all 9 major basins and 44 sub-basins. For the gap analysis, annual average excess surface water was recalculated at a monthly timestep to evaluate the seasonality of surface water in each major basin. In addition, the total available surface water was assessed in order to understand the total amount of surface water that may be available to riparian and non-riparian users without consideration of the 25-percent factor in the statutory definition of excess surface water.

Combined Source Gap

The combined source gap combines all available supply to meet all identified demand. In other words, if there is available water from any source within a sub-basin/watershed (source based surplus) it can be used to meet any demand within that same sub-basin/watershed. Two variations of the combined source gap were evaluated. The first assumed that only excess surface water was available to augment the groundwater supplies (i.e., fill the groundwater source based gap). The second assumed that the identified total available surface water was available to fill the gap. The combined source gap was simplified based on analysis showing that only a groundwater source based gap existed in some regions of the state and no surface water source based gap was identified. This analysis is discussed in more detail below. Of course, utilization of excess and total available surface waters would require infrastructure such as storage reservoirs, pipelines, pump stations, and potentially water treatment plants to be fully realized. The combined source gap is further defined by the equations below:

1. **Combined Source Gap (Excess Surface Water) = Groundwater Gap – Excess Surface Water**
2. **Combined Source Gap (Total Available Surface Water) = Groundwater Gap – Total Available Surface Water**

The above equations assume that the calculated source based surface water surplus (i.e., excess surface water, total available surface water) will be put to use; however, it will be up to the Water Resources Planning Regions to investigate further which groundwater gaps that water is most likely to fill and/or if other water management strategies may be utilized instead (e.g., reuse, conservations, etc.). In the areas where there is a gap beyond what the excess surface water or total available surface water can fill, additional water management recommendations should be considered. Gaps are summarized both by surface water hydrologic sub-basins in Section 4.

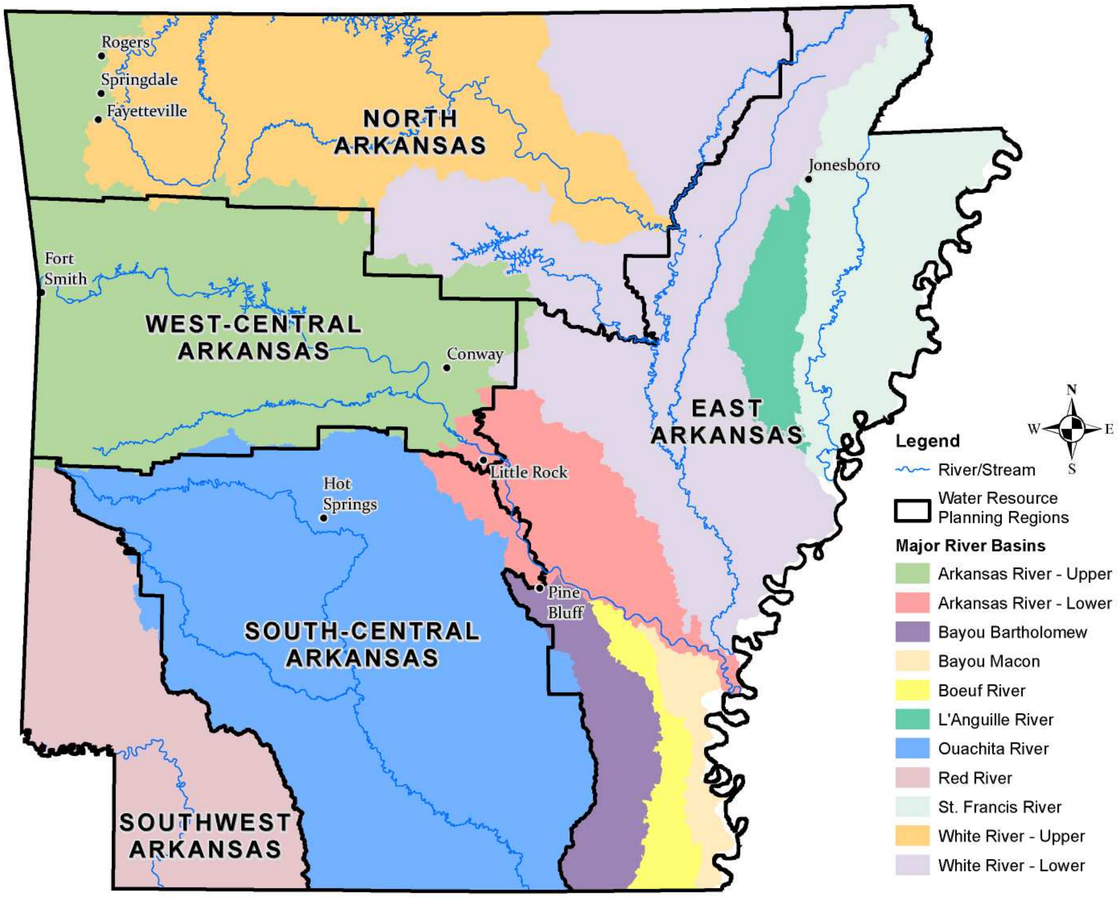


Figure 1. Overlay of Water Resources Planning Regions on Major Surface Water Basins

3.1 Surface Water Gap Analysis

The surface water supply availability was evaluated in the excess surface water calculations, as described in the *AWP Water Availability Report,* Section 3. The excess surface water calculations were then utilized to determine the total available surface water by simply removing the 25-percent factor. The measured stream flow utilized by the excess surface water calculations implicitly reflects the operating conditions that impact the stream at the time the data were recorded (e.g., hydrology, existing uses, infrastructure, or water quality constraints). Historic reservoir operations are also reflected in the stream gage record downstream of a reservoir. In addition, the calculated excess surface water excludes instream flow requirements and future demand for that watershed. These calculation steps are illustrated in **Figure 2**. The surface water supply availability results were presented as annual averages by sub-basin in the *AWP Water Availability Report*. This excess surface water availability analysis indicates that on an annual average basis, there is excess surface water and total available surface water available in all of the major basins and sub-basins in Arkansas. This finding concludes that there is no surface water source based gap.

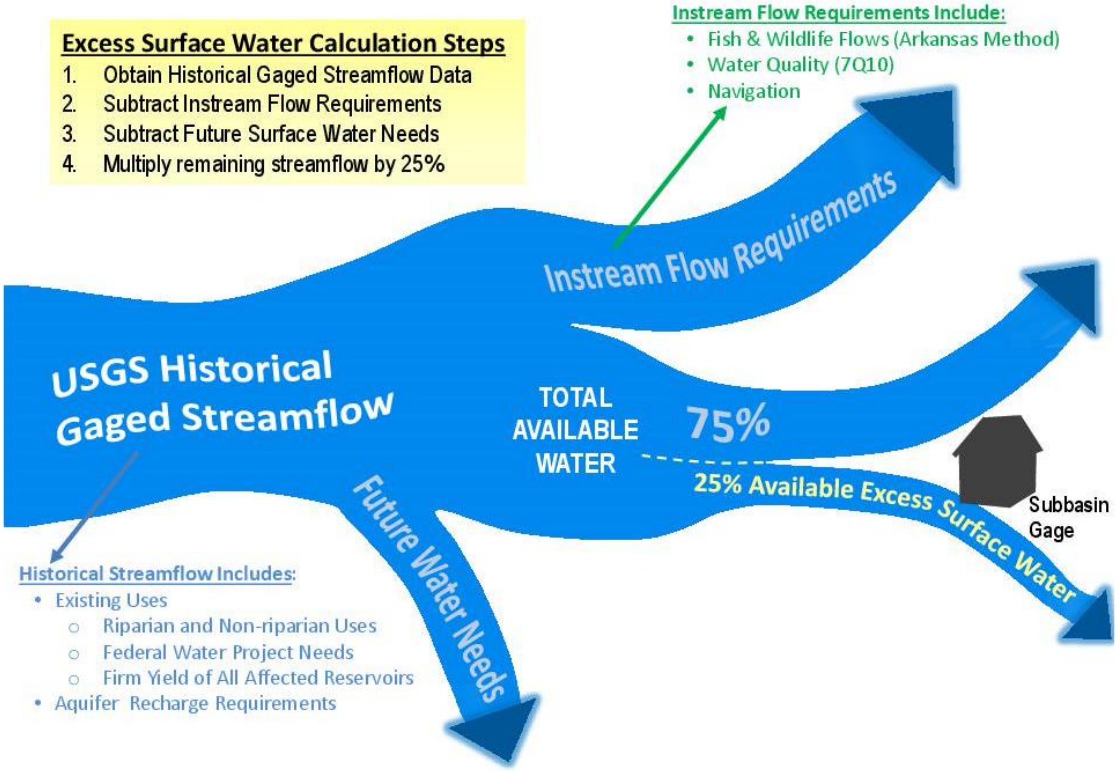


Figure 2. Excess Surface Water Calculation Steps

The statutory definition (discussed in Section 2.0) of excess surface water refers only to annual averages; however, for the benefit evaluating seasonal availability the same annual statutory requirements were applied at a monthly timestep. The seasonal gap analysis results are presented in Section 4 of this report.

The excess surface water calculation procedure was performed at a sub-basin level in the *AWP Water Availability Report*. For the gap analysis presented in Section 4, excess and total surface water is based on the major basin and thus the data from furthest downstream flow gages in the major basin are utilized for calculations such that when calculating excess or total available surface water at the downstream point in a basin, all flow upstream is included. This assumption means that the gap analysis is based on the accumulated flow in each major basin and the calculated excess surface water for the sub-basins shown in *AWP Water Availability Report* are not simply summed.

3.2 Groundwater Gap Analysis

Groundwater gaps were calculated as a function of modeled groundwater yields for areas within the MERAS model. Groundwater gaps for all other areas of the state are based on projected changes in groundwater demands. The area covered by the MERAS model are shown in **Figure 3**.

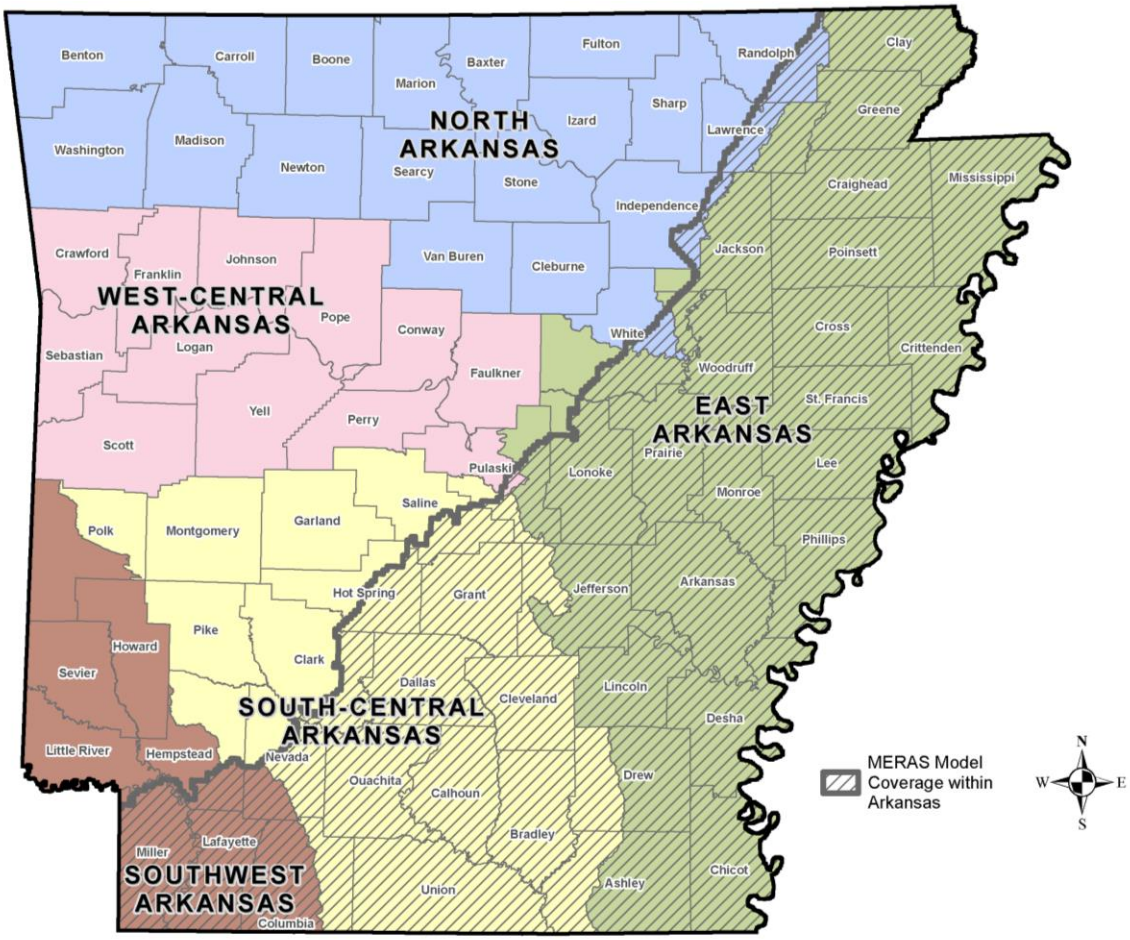
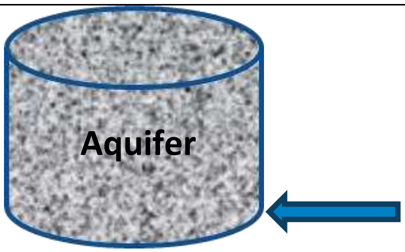
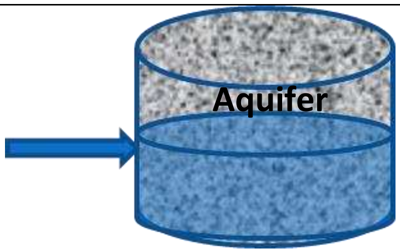


Figure 3. The MERAS Model Boundary with Respect to the Regional Water Resource Planning Regions

The groundwater gaps for modeled area were calculated using the MERAS groundwater model, for two of the different scenarios that were developed by the USGS (http://ar.water.usgs.gov/PROJECTS/MerasModel.html):

Scenario 1	Scenario 3
Mining scenario (aquifer storage allowed to be fully depleted) under *dry* climatic conditions	**Sustainable pumping scenario** (water levels allowed to drop to half aquifer thickness) under *dry* climatic conditions
Mining scenario under *wet* climatic conditions	**Sustainable pumping scenario** under *wet* climatic conditions
	

It is the goal of the ANRC for aquifers within Arkansas to be managed in a manner consistent with the sustainable pumping scenarios because of the damage that could occur to the aquifer if it was completely mined. Therefore, the gap analysis results are reported for the sustainable pumping scenario groundwater availability in the main body of this report. The gap analysis results for the full mining groundwater management scenarios are shown in Appendix A for comparison purposes.

Further, only the groundwater available under dry climatic conditions is used in the gap analysis to provide for conservative estimates of water supply gaps in 2050. A sensitivity analysis was conducted by changing the climatic conditions to assume wet hydrology. These results showed a marginal decrease in the identified groundwater gap of approximately 4 percent for both the full mining and sustainably pumped groundwater management plans when compared to dry conditions.

For areas outside the MERAS model area groundwater yields were assumed to be equal to the groundwater demands in 2010. The gap for these areas is calculated using a "delta demand" approach, defined as the difference between 2010 and 2050 groundwater demands. This assumption was made because groundwater availability (either due to quantity or quality) in the western portion of the state is largely unquantified because regional-scale models have not been developed.

3.3 Summary of Key Assumptions

This section summarizes the key assumptions presented in Section 3.1 and Section 3.2. This list of assumptions should be used as a quick reference; however, the more detailed description of the methodologies and assumptions presented in Section 3.1 and Section 3.2 should be referred to for full explanation.

- The gap analysis is based on the excess surface water and total available surface water at the furthest downstream gage in the major basin.
- Groundwater gaps for areas within the MERAS model coverage are based on the difference between modeled yields and projected demands.

- Groundwater gaps for areas outside of the MERAS model coverage are based on the difference between baseline (2010) and projected 2050 demands. This assumption is necessary because groundwater availability (either due to quantity or quality) in the western portion of the state is known qualitatively, but not quantitatively.
- The combined source gaps utilize the source based gaps and combine all available supply to meet identified demands in 2050 (i.e., excess surface water and total available surface water).
- The combined source gaps are only a statement of the physical and legal availability of water resources and not meant to infer that the appropriate infrastructure is in place to utilize all of the available surplus supply.

Section 4

2050 Gap Analysis Results

This section presents the results of the 2050 gap analysis based on the methodology presented in Section 3 of this report. This information served as input to the two different gap approaches discussed in Section 3—the source based gap and the combined source gap. The result of this is three different 2050 gaps/surpluses as follows:

1. 2050 source based gap for groundwater assuming sustainable pumping under dry climatic conditions.
2. Combined source gap assuming groundwater yield under sustainable pumping combined with excess surface water.
3. Combined source gap assuming groundwater yield under sustainable pumping combined with total available surface water.

4.1 2050 Source Based Gap Analysis Results

Table 1 summarizes the average monthly 2050 groundwater gap by major basin and sub-basin assuming the sustainable pumping groundwater management scenario. **Figure 4** illustrates the spatial distribution of the annual average 2050 groundwater gap by major basin and sub-basin. **Table 2** summarizes the average monthly 2050 groundwater gap by Water Resources Planning Region assuming the sustainable pumping groundwater management scenario. Source-based groundwater gaps are projected for all major river basins in the state, but the largest gaps are in the Lower White River and St. Francis River basin. The small projected gap in the Upper Arkansas River basin is in an area with no quantitative assessment of groundwater availability and thus may not be an actual gap. In terms of the Water Resource Regional Planning Areas, the East Regional Planning Area is projected to have a 2050 groundwater gap of over 7,000,000 AFY, which represents nearly 90 percent of the groundwater gap on a statewide basis.

The major basins are defined by hydrologic boundaries and due to the contiguous nature of surface water systems the major basin analysis presented in this section cannot be assessed at the Water Resources Planning Region level (which is based on non-hydrologic boundaries). However, as shown in Figure 1, some of the planning regions closely align with major basins such as the Red River and Ouachita Rivers with respect to the Southwest and South-central Arkansas regions. Other major basins cross multiple planning regions (e.g., Arkansas River, White River). **Table 3** details the relationship between each planning region and the major basins and can be used as a guide for assessing surface water availability at the planning region level.

Table 1. 2050 Groundwater Gap by Major Basin and Sub-basin Assuming Sustainable Pumping Under Dry Climatic Conditions (AFM)

Sub-basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (AFY)
Lower Arkansas													
Lower Arkansas Mainstem	7,045	7,324	7,200	19,323	87,797	171,867	229,474	176,625	24,876	10,281	7,141	6,709	755,663
Upper Arkansas													
Big Piney Creek	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadron Creek	25	25	25	25	25	25	25	25	25	25	25	25	298
Fourche La Fave River	2	2	2	2	2	2	2	2	2	2	2	2	28
Illinois Bayou	13	13	13	13	13	13	13	13	13	13	13	13	152
Illinois River	6	6	6	6	6	6	6	6	6	6	6	6	71
Lee Creek	-	-	-	-	-	-	-	-	-	-	-	-	-
Mulberry River	2	2	2	2	2	2	2	2	2	2	2	2	21
Petit Jean River	1	1	1	1	1	1	1	1	1	1	1	1	9
Point Remove Creek	-	-	-	-	-	-	-	-	-	-	-	-	-
Poteau River Tributaries	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper Arkansas Mainstem	102	102	102	102	102	122	158	122	122	102	102	102	1,339
Bayou Bartholomew													
Bayou Bartholomew Main Stem	1,303	1,295	1,321	3,531	13,776	31,161	35,091	30,670	5,462	1,417	1,323	1,281	127,632
Bayou Bartholomew Tributary	94	94	98	106	1,383	4,820	5,491	4,451	160	102	93	93	16,987
Bayou Macon													
Bayou Macon Main Stem	1,005	636	839	9,985	28,780	57,033	92,042	81,465	4,745	1,166	523	523	278,740
Boeuf River													
Boeuf River Main Stem	851	706	811	13,808	34,616	67,681	98,024	87,241	8,293	955	653	644	314,284
Boeuf River Tributaries	14	15	15	101	317	925	1,176	962	26	16	14	14	3,596
L'Anguille River													
L'Anguille River Main Stem	684	727	1,048	2,479	99,101	299,450	323,063	184,969	11,312	2,237	957	691	926,719
Ouachita River													
Lower Ouachita River Tributaries	234	234	234	234	234	234	234	234	234	234	234	234	2,804
Ouachita River Main Stem	706	706	706	706	744	827	836	815	713	707	706	706	8,876
Saline River	334	334	334	335	356	402	409	395	339	335	334	334	4,243
Upper Ouachita River	-	-	-	-	-	-	-	-	-	-	-	-	-
Red River													
Bayou Dorcheat	923	923	926	929	941	962	976	961	926	923	923	923	11,236
Little River	107	107	107	107	107	107	107	107	107	107	107	107	1,281
Lower Red River Tributaries	233	234	276	322	495	790	996	784	286	235	236	238	5,127
Millwood Lake	-	-	-	-	-	-	-	-	-	-	-	-	-
Red River Main Stem	1,292	1,294	1,897	2,555	5,229	10,373	13,647	10,149	2,159	1,293	1,292	1,292	52,472
St. Francis River													
St. Francis River Main Stem	4,184	4,204	4,644	7,091	162,797	562,460	614,772	489,368	34,353	4,539	4,501	4,198	1,897,110
Lower White													
Black River	617	614	623	6,141	43,668	111,617	138,757	128,204	4,921	831	605	605	437,203
Cache River	1,964	1,940	2,110	12,541	132,737	350,759	437,329	398,497	14,285	8,656	1,978	1,855	1,364,650
Devils Fork Little Red River	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower White	5,256	5,259	4,990	6,313	154,458	327,934	460,362	301,033	34,169	8,993	5,071	5,168	1,319,005
Middle Fork Little Red River	-	-	-	-	-	-	-	-	-	-	-	-	-
Middle White	3,006	3,074	3,107	11,496	57,162	131,773	198,952	179,459	10,641	4,704	2,962	2,933	609,269
South Fork Little Red River	1	1	1	1	1	1	1	1	1	1	1	1	16
Upper White													
Kings River	3	3	3	3	3	3	3	3	3	3	3	3	39
Upper White	1,497	1,498	1,504	1,592	2,902	6,444	10,453	9,462	2,445	1,517	1,513	1,527	42,354
Total	**31,504**	**31,372**	**32,943**	**99,850**	**827,756**	**2,137,791**	**2,662,402**	**2,086,027**	**160,627**	**49,401**	**31,321**	**30,229**	**8,181,223**

Table 2. 2050 Groundwater Gap by Regional Planning Area Assuming Sustainable Pumping Under Dry Climatic Conditions (AFM)

Regional Planning Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
East Arkansas	22,829	22,612	23,534	78,860	736,364	1,928,966	2,383,552	1,840,249	139,418	39,160	22,634	21,630	**7,259,810**
North Arkansas	3,172	3,194	3,220	11,358	63,436	155,986	209,023	191,338	10,802	4,016	3,161	3,164	**661,869**
South-central Arkansas	2,339	2,382	2,363	4,239	14,869	28,006	36,887	28,714	5,114	2,838	2,354	2,287	**132,391**
Southwest Arkansas	2,563	2,565	3,214	3,921	6,781	12,240	15,735	12,011	3,487	2,566	2,566	2,568	**70,219**
West-central Arkansas	601	619	612	1,472	6,307	12,591	17,202	13,714	1,806	821	606	580	**56,932**
Total	**31,504**	**31,372**	**32,943**	**99,850**	**827,756**	**2,137,790**	**2,662,401**	**2,086,026**	**160,627**	**49,401**	**31,321**	**30,229**	**8,181,221**

Table 3. Area Relationship Between Planning Regions and Major Basins

Planning Region	Major Basin Name	Major Basin Area (Sq. Mi.)	Major Basin Area within Planning Region (Sq. Mi.)	Percent of Major Basin within Planning Region
East Arkansas	Bayou Bartholomew	1,534	1,527	100%
East Arkansas	Bayou Macon	570	570	100%
East Arkansas	Boeuf River	773	773	100%
East Arkansas	L'Anguille River	956	956	100%
East Arkansas	Arkansas River – Lower	2,533	1,995	79%
East Arkansas	White River – Lower	10,605	6,230	59%
East Arkansas	St. Francis River	3,512	3,512	100%
North Arkansas	White River – Lower	10,605	4,316	41%
North Arkansas	Arkansas River – Upper	9,544	1,767	19%
North Arkansas	White River – Upper	6,525	6,493	100%
South-central Arkansas	Arkansas River – Lower	2,533	389	15%
South-central Arkansas	Ouachita River	11,559	11,309	98%
Southwest Arkansas	Red River	4,440	4,439	100%
West-central Arkansas	Arkansas River – Lower	2,533	149	6%
West-central Arkansas	Arkansas River – Upper	9,544	7,652	80%

Note: Instances where less than one percent of major basin was within a planning region were omitted from this table

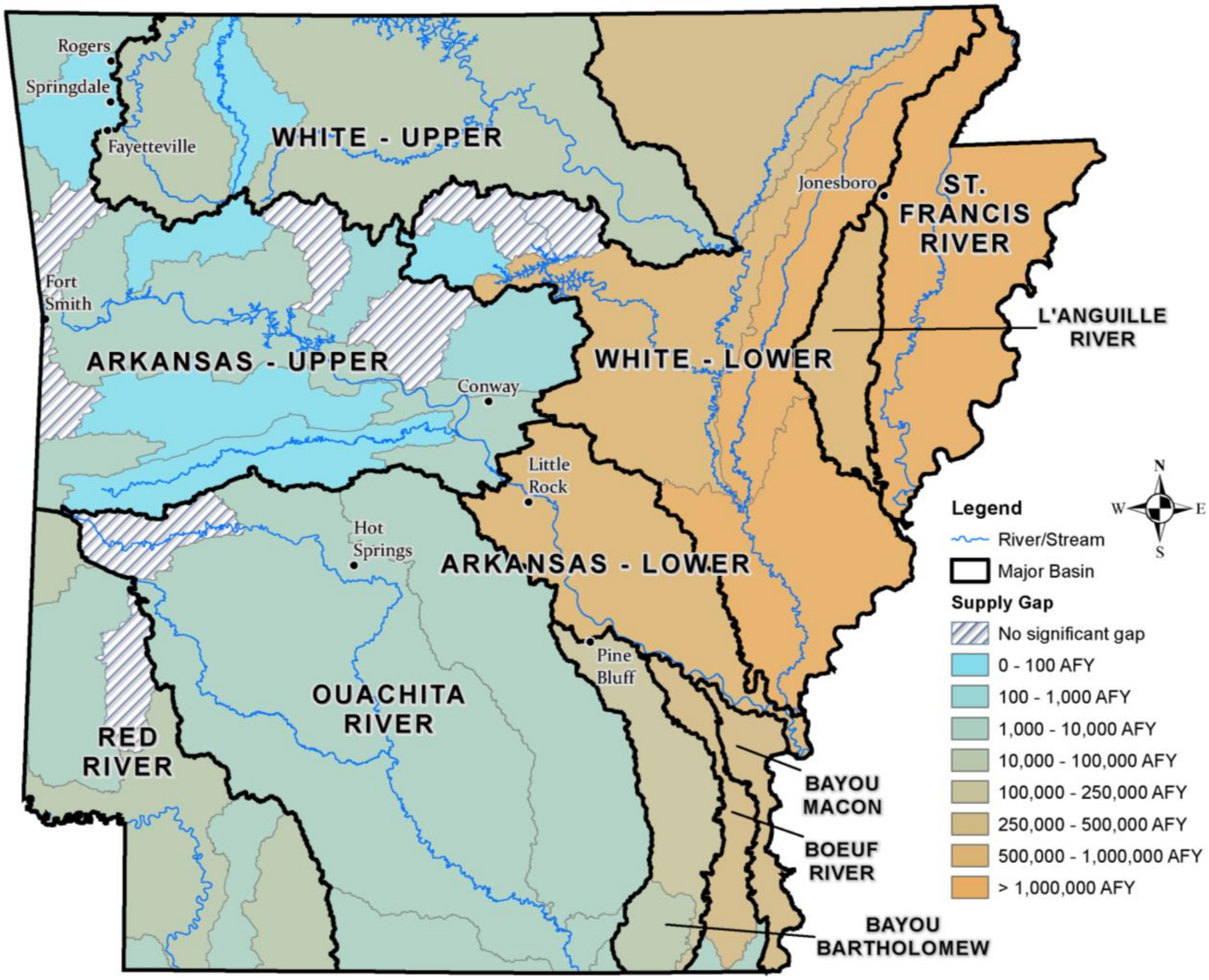


Figure 4. 2050 Groundwater Gap by Major Basin and Sub-basin Assuming Sustainable Pumping Under Dry Climatic Conditions

Excess surface water is presented on a monthly basis for each major basin within the state in **Table 4**. Due to their large size and different land use characteristics, the Arkansas River and White River basins' upper and lower portions are evaluated separately (see Figure 1). The upper and lower basins are hydrologically connected in both the Arkansas River and White River basins. As a result, the upper basin's excess surface water has been removed from total values in Table 4 to avoid double counting. **Figure 5** illustrates the spatial distribution of the annual average excess surface water for each major basin. Total available surface water is presented on a monthly basis for each major basin within the state in **Table 5**. Similar to Table 4, the upper portions of the Arkansas River and White River are not included in the totals for Table 5. **Figure 6** illustrates the spatial distribution of the annual average total available surface water for each major basin. These results clearly show that major basins in the state have identified total available surface water and excess surface water. This confirms the *AWP Water Availability Report* findings that no source based gap exists for current and projected surface water uses.

4.2 2050 Combined Source Gap

Table 6 summarizes the average monthly combined source gaps by major basin assuming sustainable pumping groundwater management scenario and augmentation of groundwater supplies is limited by excess surface water. **Figure 7** illustrates the spatial distribution of the annual average combined source gaps by major basin and sub-basin (assuming augmentation by excess surface water). **Table 7** summarizes the average monthly combined source gaps by major basin assuming sustainable pumping groundwater management scenario and augmentation of groundwater supplies is limited by total available surface water. **Figure 8** illustrates the spatial distribution of the annual average combined source gaps by major basin and sub-basin (assuming augmentation by total available surface water).

The combined source gap shown in Table 6 highlights that under sustainably pumped groundwater assumptions that even if all available excess surface water were utilized, a total combined source gap of over 4,200,000 AFY would still exist for the Bayou Bartholomew, Bayou Macon, Boeuf River, L'Anguille River, St. Francis River, and Lower White River basins. Table 7 repeats this analysis except rather than limiting groundwater augmentation to excess surface water it is assumed that the identified total available water (Table 5) is available. Under these assumptions the combined source gap in the Bayou Bartholomew, St. Francis River, and Lower White River basins no longer exists but instead a substantial surplus is identified. For example, assuming only excess surface water is available the Lower White River shows a combined source gap of over 1,600,000 AF. Changing the available surface water resource to total available water results in a combined source surplus of over 4,700,000 AF, a swing of nearly 6,400,000 AF. Still, even assuming the utilization of total available surface water, Bayou Macon, Beouf River, and the L'Anguille River basins have a combined source gap identified that together total over 800,000 AF.

Table 4. Monthly Excess Surface Water by Major Basin (AFM)

Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Arkansas River - Lower[1]	274,159	267,850	452,948	344,406	375,607	291,466	283,081	129,609	132,694	211,720	251,593	292,483	**3,307,616**
Arkansas River - Upper[1]	268,049	261,811	443,894	337,225	368,429	292,681	286,075	133,139	128,943	206,267	245,286	285,055	**3,256,854**
Bayou Bartholomew	16,414	17,541	20,356	13,681	11,022	5,150	4,192	2,950	3,517	3,330	5,188	11,174	**114,517**
Bayou Macon	3,687	4,508	4,723	2,698	3,282	739	1,041	528	1,243	815	1,071	2,797	**27,132**
Boeuf River[2]	8,636	10,635	9,179	4,641	5,256	(1,262)	(7,530)	(9,629)	4,948	1,728	4,682	6,682	**37,967**
L'Anguille River	11,353	14,453	14,545	8,532	8,186	2,500	3,118	3,653	5,294	3,557	4,954	10,658	**90,803**
Ouachita River	121,818	139,304	166,035	114,306	105,764	48,847	40,563	27,978	34,131	46,855	59,289	121,731	**1,026,619**
Red River	133,814	130,739	187,267	123,736	142,735	77,908	88,565	53,814	46,056	67,402	63,060	106,568	**1,221,666**
St. Francis River	82,974	91,058	102,954	75,686	67,798	42,046	44,308	28,599	20,995	23,456	30,250	60,338	**670,461**
White River - Lower[1]	232,663	243,607	289,996	220,455	216,886	127,712	163,704	137,524	96,355	84,126	122,573	195,655	**2,131,256**
White River - Upper[1]	87,915	89,089	115,844	93,823	87,710	53,147	70,533	47,527	29,264	25,547	51,325	78,866	**830,591**
Total	**885,518**	**919,695**	**1,248,003**	**908,142**	**936,538**	**595,105**	**621,043**	**375,027**	**345,232**	**442,989**	**542,660**	**808,085**	**8,628,038**

[1] The Upper and Lower basins are hydrologically connected. Upper basin Excess Surface Water has been removed from Total values to avoid double counting.

[2] Analysis of the Beouf River on a monthly basis showed that Total Available Surface Water was not present in June, July, and August (i.e. negative). For this reason, the 25% factor to determine Excess Surface Water was not applied for these months because it would artificially reduce this negative value.

Table 5. Monthly Total Available Surface Water by Major Basin (AFM)

Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Arkansas River - Lower[1]	1,096,636	1,071,401	1,811,792	1,377,626	1,502,428	1,165,862	1,132,323	518,436	530,777	846,880	1,006,373	1,169,932	**13,230,466**
Arkansas River - Upper[1]	1,072,197	1,047,245	1,775,574	1,348,902	1,473,716	1,170,722	1,144,300	532,558	515,771	825,067	981,144	1,140,219	**13,027,414**
Bayou Bartholomew	65,657	70,165	81,426	54,726	44,089	20,600	16,769	11,801	14,067	13,318	20,753	44,695	**458,068**
Bayou Macon	14,748	18,031	18,893	10,791	13,128	2,957	4,164	2,113	4,970	3,260	4,283	11,188	**108,529**
Boeuf River	34,544	42,541	36,717	18,563	21,024	(1,262)	(7,530)	(9,629)	19,792	6,913	18,729	26,729	**207,132**
L'Anguille River	45,414	57,814	58,179	34,130	32,746	10,000	12,470	14,614	21,174	14,226	19,816	42,631	**363,214**
Ouachita River	487,272	557,214	664,140	457,223	423,058	195,386	162,253	111,912	136,523	187,421	237,154	486,923	**4,106,478**
Red River	535,257	522,956	749,068	494,945	570,941	311,631	354,262	215,258	184,224	269,609	252,240	426,274	**4,886,664**
St. Francis River	331,895	364,231	411,815	302,743	271,192	168,184	177,233	114,396	83,981	93,825	120,999	241,350	**2,681,844**
White River - Lower[1]	930,650	974,426	1,159,984	881,821	867,545	510,848	654,817	550,095	385,421	336,504	490,293	782,618	**8,525,023**
White River - Upper[1]	351,660	356,356	463,378	375,292	350,838	212,588	282,132	190,109	117,057	102,190	205,302	315,462	**3,322,365**
Total	**3,542,073**	**3,678,780**	**4,992,013**	**3,632,567**	**3,746,150**	**2,384,207**	**2,506,762**	**1,528,995**	**1,380,929**	**1,771,957**	**2,170,641**	**3,232,340**	**34,567,416**

[1] The Upper and Lower basins are hydrologically connected. Upper basin Excess Surface Water has been removed from Total values to avoid double counting.

Table 6. 2050 Combined Source Gap by Major Basin Assuming Sustainable Pumping Under Dry Climatic Conditions with Excess Surface Water as a Source (AFM)

Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Arkansas River - Lower[1]	266,964	260,376	445,598	324,933	287,660	119,428	53,401	(47,187)	107,647	201,289	244,302	285,624	2,550,035
Arkansas River - Upper[1]	267,899	261,661	443,743	337,075	368,279	292,510	285,868	132,969	128,773	206,117	245,136	284,904	3,254,935
Bayou Bartholomew	15,017	16,152	18,937	10,044	(4,137)	(30,831)	(36,390)	(32,172)	(2,105)	1,810	3,772	9,800	(30,102)
Bayou Macon	2,683	3,872	3,885	(7,287)	(25,498)	(56,294)	(91,001)	(80,937)	(3,502)	(351)	548	2,274	(251,608)
Boeuf River[2]	7,770	9,914	8,353	(9,268)	(29,677)	(69,868)	(106,730)	(97,832)	(3,371)	758	4,015	6,024	(279,912)
L'Anguille River	10,670	13,726	13,497	6,053	(90,915)	(296,950)	(319,946)	(181,316)	(6,018)	1,319	3,997	9,967	(835,915)
Ouachita River	120,544	138,030	164,761	113,030	104,431	47,384	39,085	26,535	32,844	45,580	58,015	120,457	1,010,696
Red River	131,259	128,182	184,061	119,823	135,963	65,677	72,840	41,813	42,577	64,844	60,502	104,008	1,151,551
St. Francis River	78,790	86,854	98,310	68,595	(94,999)	(520,414)	(570,464)	(460,769)	(13,358)	18,917	25,749	56,139	(1,226,649)
White River - Lower[1]	220,317	231,217	277,658	182,368	(174,046)	(800,818)	(1,082,154)	(879,136)	29,890	59,421	110,439	183,563	(1,641,280)
White River - Upper[1]	86,415	87,588	114,337	92,228	84,804	46,700	60,076	38,062	26,816	24,028	49,809	77,335	788,198
Total	721,047	745,979	1,049,885	730,294	448,250	(522,085)	(666,660)	(613,646)	202,656	363,022	451,543	670,909	446,815

[1] The Upper and Lower basins are hydrologically connected. Upper basin Excess Surface Water has been removed from Total values to avoid double counting.

[2] Analysis of the Beouf River on a monthly basis showed that Total Available Surface Water was not present in June, July, and August (i.e. negative). For this reason, the 25% factor to determine Excess Surface Water was not applied because it would artificially reduce the identified monthly gap.

Table 7. 2050 Combined Source Gap by Major Basin Assuming Sustainable Pumping Under Dry Climatic Conditions with Total Available Surface Water as a Source (AFM)

Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Arkansas River - Lower[1]	1,089,441	1,064,077	1,804,592	1,358,303	1,414,631	993,995	902,850	341,811	505,900	836,599	999,232	1,163,223	12,474,803
Arkansas River - Upper[1]	1,072,047	1,047,095	1,775,424	1,348,752	1,473,565	1,170,552	1,144,094	532,387	515,601	824,916	980,994	1,140,069	13,025,496
Bayou Bartholomew	64,260	68,776	80,007	51,088	28,930	(15,380)	(23,813)	(23,321)	8,446	11,799	19,337	43,321	313,449
Bayou Macon	13,744	17,395	18,055	806	(15,652)	(54,076)	(87,877)	(79,352)	225	2,095	3,760	10,665	(170,211)
Boeuf River	33,678	41,820	35,891	4,654	(13,909)	(69,868)	(106,730)	(97,832)	11,473	5,943	18,062	26,070	(110,748)
L'Anguille River	44,730	57,087	57,132	31,650	(66,356)	(289,450)	(310,593)	(170,356)	9,863	11,989	18,859	41,940	(563,505)
Ouachita River	485,998	555,941	662,866	455,948	421,724	193,923	160,774	110,468	135,237	186,146	235,881	485,649	4,090,555
Red River	532,702	520,399	745,862	491,032	564,169	299,401	338,536	203,257	180,745	267,051	249,682	423,714	4,816,548
St. Francis River	327,711	360,027	407,171	295,652	108,395	(394,276)	(437,539)	(374,972)	49,627	89,286	116,499	237,152	784,733
White River - Lower[1]	918,305	963,537	1,149,154	845,329	479,518	(411,235)	(580,584)	(457,099)	321,404	313,319	479,675	772,057	4,794,880
White River - Upper[1]	350,160	354,855	461,871	373,697	347,933	206,141	271,676	180,644	114,609	100,670	203,785	313,932	3,279,972
Total	3,510,569	5,051,010	7,198,022	5,256,911	4,742,947	1,629,726	1,270,792	165,635	1,853,130	2,649,812	3,325,766	4,657,793	42,735,972

[1] The Upper and Lower basins are hydrologically connected. Upper basin Excess Surface Water has been removed from Total values to avoid double counting.

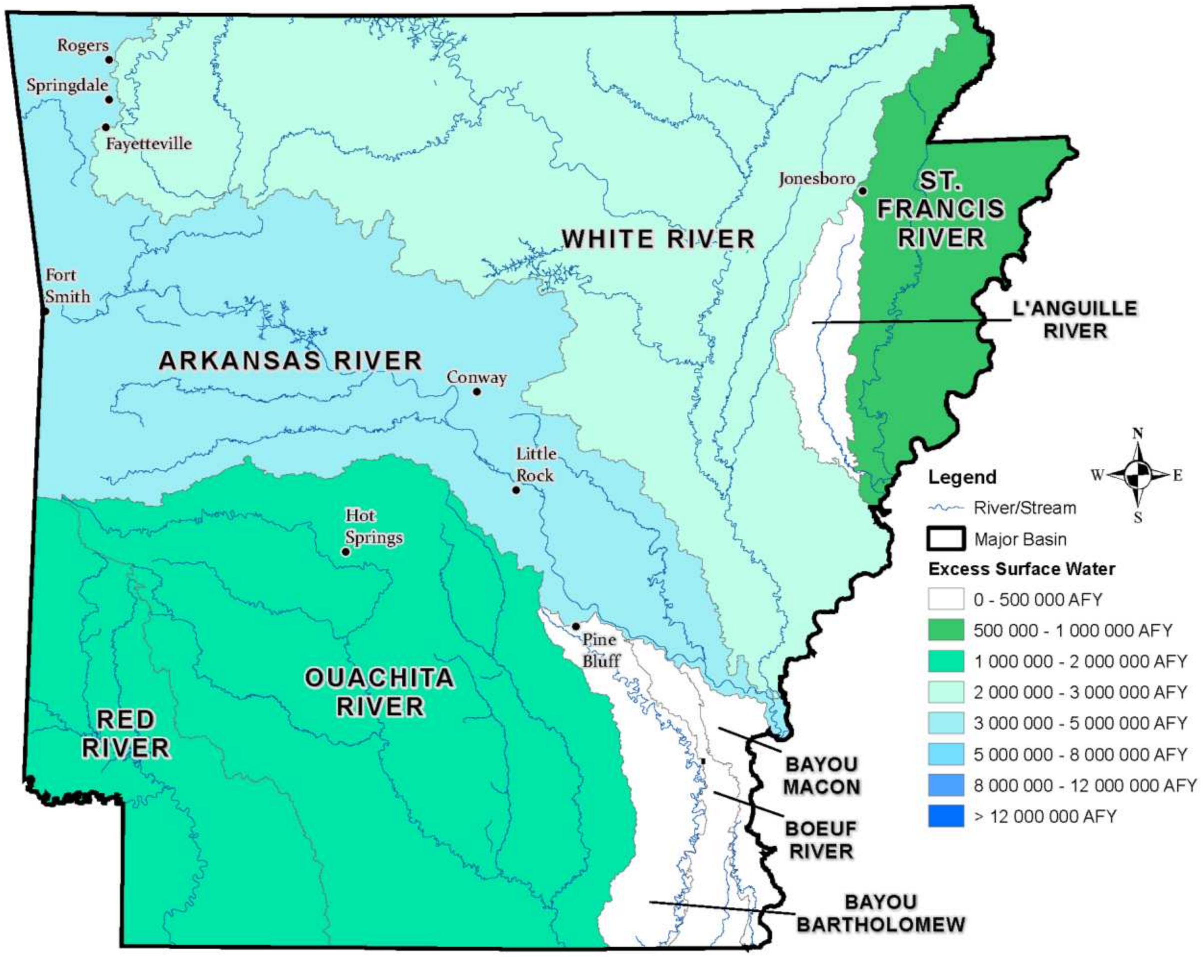


Figure 5. Average Annual Excess Surface Water by Major Basin

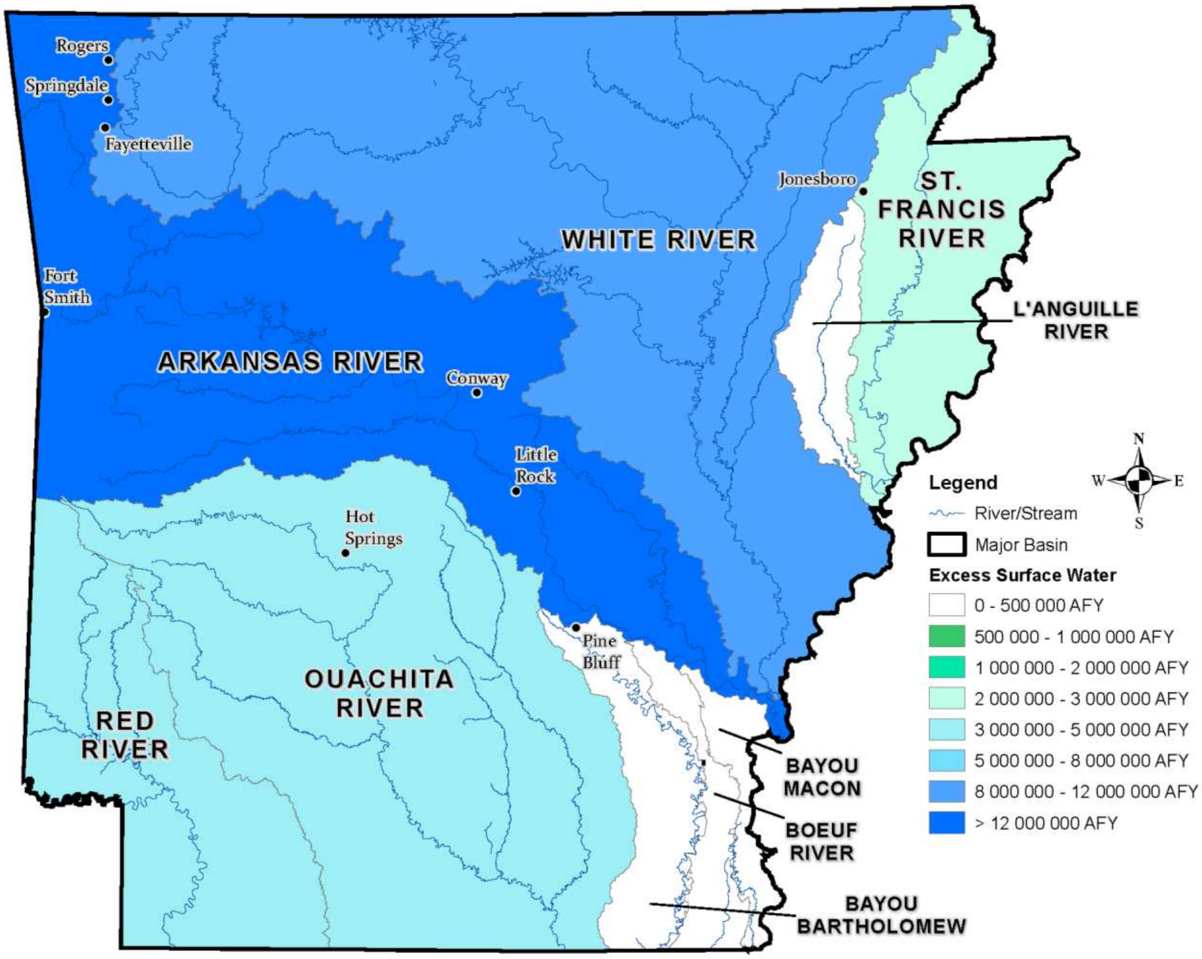


Figure 6. Average Annual Total Available Surface Water by Major Basin

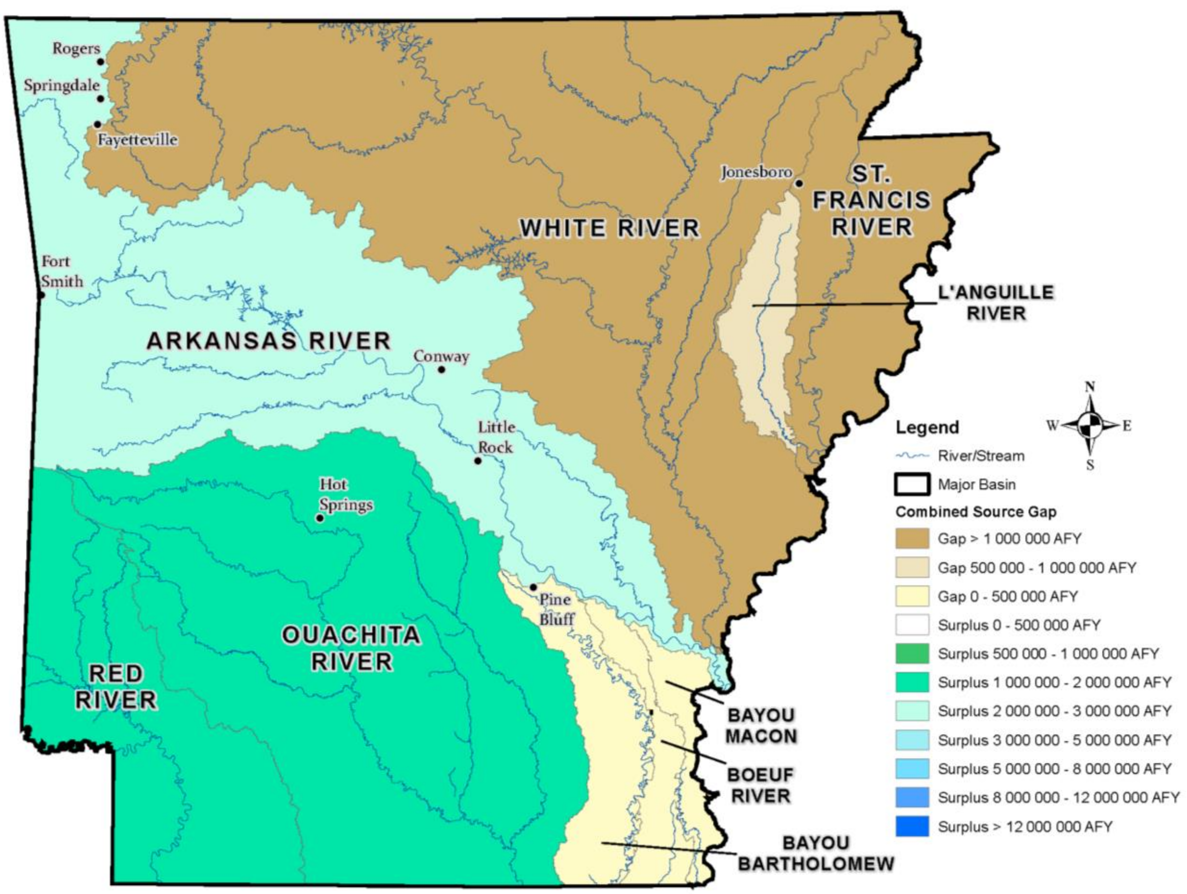


Figure 7. 2050 Combined Source Gap by Major Basin Assuming Sustainable Pumping Under Dry Climatic Conditions with Excess Surface Water as a Source

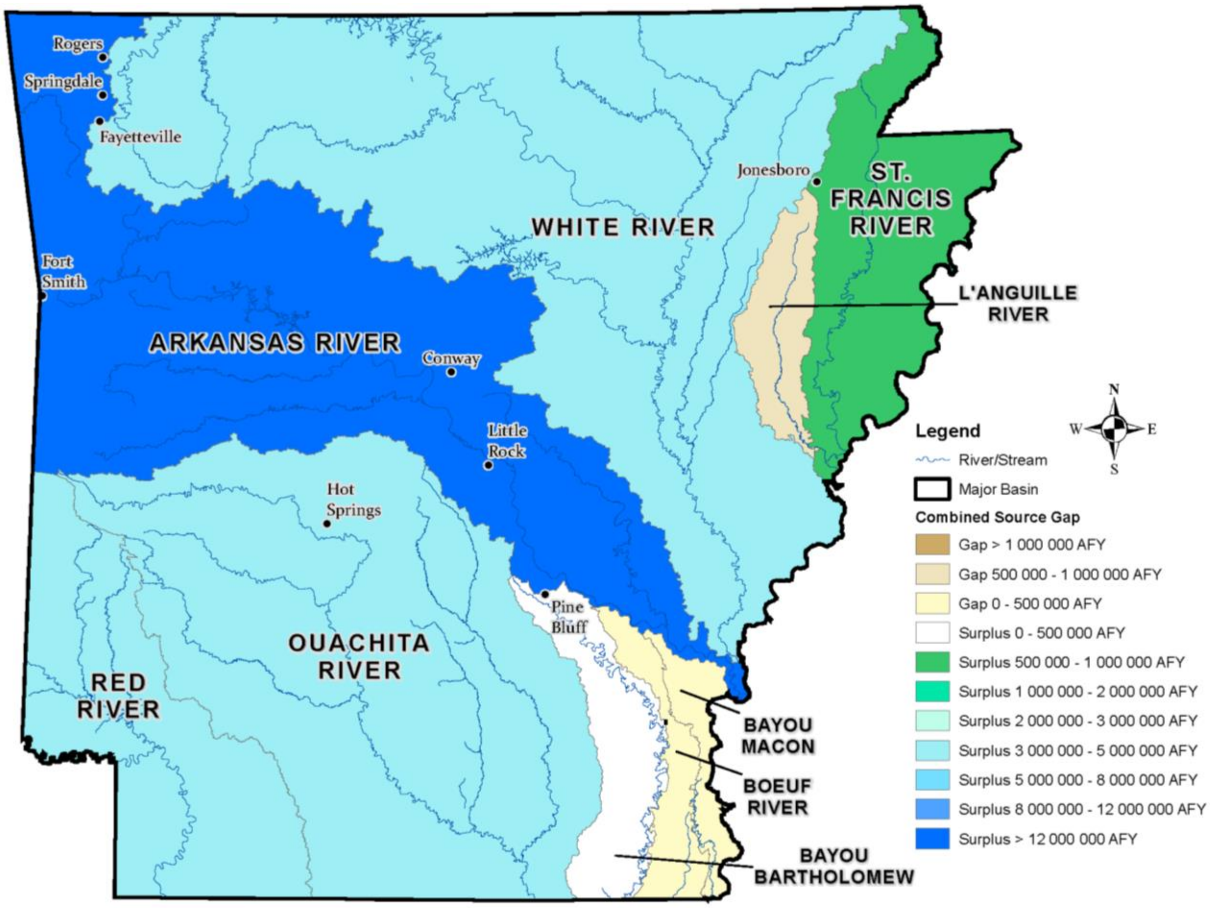


Figure 8. 2050 Combined Source Gap by Major Basin Assuming Sustainable Pumping Under Dry Climatic Conditions with Total Available Surface Water as a Source

4.3 Discussion of Results

The annual average 2050 groundwater gap across the state is estimated to be approximately 8,200,000 AFY assuming the sustainably pumped groundwater scenario (Table 2). If the mining groundwater management scenario is used the groundwater gap would be approximately 6,700,000 AFY (Appendix A). The combined source gap under the mining scenario is approximately 1,500,000 AFY, or 21 percent; lower than under the sustainable pumping mining scenario. That is because more groundwater is pumped from the aquifer under the mining scenario and fulfills more of the groundwater demand. These results show that the full-mining groundwater management plan will lower sourced based gaps; however, Planning Regions should consider the effects of a full mining groundwater management plan beyond 2050, as this scenario approximates full depletion of groundwater as a source of supply.

Table 4 identifies total statewide excess surface water in excess of 8,600,000 AF annually. The results are consistent with the *AWP Water Availability Report* in that on an annual average basis there is excess surface water available in every major basin. As expected, since annual excess surface water is calculated for each basin, Table 5 also shows that each basin has total available surface water on an annual average basis with a statewide total of nearly 35,000,000 AF. However, conducting the excess surface water and total available water analyses at a monthly timestep highlights the projected average seasonal variability of this water resource. For example, the Beouf River basin shows negative total available surface water during the high demand months of June, July, and August. For this basin only, the surface water calculation is based on the total available surface water for these months, because applying the 25-percent factor would artificially reduce the identified seasonal gap.

The combined source gap shown in Table 6 highlights that under sustainably pumped groundwater assumptions, even if all available excess surface water were utilized, a total, by basin combined source gap of over 4,200,000 AFY would still exist. Table 7 repeats this analysis except rather than limiting groundwater augmentation to excess surface water it is assumed that the identified total available water (Table 5) is available. Under these assumptions the combined source gap identified totaled over just 800,000 AF, a reduction of over 3,400,000 AF

Section 5

Limitations of Analysis

The 2050 Water Gap Analysis by source presented in Section 4 has certain limitations inherent in the approach used to calculate the gaps. Water Resources Planning Regions will benefit from a thorough understanding of these limitations when discussing strategies to fill the identified 2050 Gaps. Furthermore, Planning Regions should carefully review the key assumptions listed in Section 3.3.

5.1 Excess Surface Water Calculations

Excess surface water calculations from the *Water Availability Report* were utilized to identify surface water gaps and to determine the average monthly surface water availability that could be used to fill identified groundwater gaps. To be consistent with the State of Arkansas's statutory definition of supply availability (A.C.A. § 15-22-304), the ANRC has elected to use the excess surface water to assess surface water supplies. However, recognizing the limitations that excess surface water places on identified surface water availability, ANRC has also included total available surface water as part of the gap analysis. The process for calculating excess surface water and total available surface water is described in Section 3 of this report and in further detail in the *Water Availability Report*, Section 3.

While the excess surface water and total available surface water calculations do utilize gage data covering varying historical periods, the ultimate calculations are based on monthly averages. Because of this use of average monthly values, key historical periods of drought and surplus may not be captured in the 2050 gap analysis. Excess surface water and total available surface water calculations also take into account the "future water needs of the basin of origin as projected in the Arkansas Water Plan." In the case of the AWP Update, 2050 represents the long-term planning horizon. The gaps shown here are for 2050 only and no interim planning horizon is estimated.

5.2 Groundwater

The MERAS groundwater model is used to quantify groundwater yields and identify groundwater gaps. As pointed out in Section 3 of this report, the MERAS model covers the East Water Resources Planning Region and only portions of the other planning regions. There is no quantitative estimate of groundwater resources outside the MERAS model area. For this gap analysis, it was assumed that groundwater supply in areas outside the boundaries of the MERAS model is equal to the amount of groundwater used in 2010. The gap for these areas is set as equal to the increase in demand between 2010 and 2050. Each Water Resources Planning Region is encouraged to submit to ANRC additional information such as local groundwater studies and/or management plans that could be used to better inform the AWP Update.

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Section 6

Infrastructure Survey for the Arkansas Water Plan

6.1 Introduction and Background

The gap analysis described in this report provides a summary of current and projected water availability in the state and describes where there may be future gaps in water supply availability. This section provides an assessment of the infrastructure availability and needs. Infrastructure—from small local treatment and distribution systems to large regional storage and conveyance projects—is likely to be a key piece of the future water supply picture in Arkansas. Infrastructure will not only be needed to fill future water supply gaps, but to ensure that available water supplies identified in this Gap Analysis Report can be used. In addition, some areas may need to repair or replace aging infrastructure or develop strategies for managing systems that become oversized as populations shrink, taking revenue with them.

To assess infrastructure needs throughout the state, public water and wastewater providers were surveyed. A copy of the survey is provided in **Appendix B**. The survey collected information on planning efforts by each provider, including projects identified in master plans, asset management plans and strategies, and current and planned funding sources. The survey results are presented here, with an emphasis on infrastructure funding needs in the state. The survey results also provide data on rate and customer base changes, vulnerability assessments and emergency response plans, impacts on upcoming regulations, and a survey of other issues facing water and wastewater utilities. The full survey results are included electronically as part of Appendix B. Overall, the survey had a reasonable response rate, including a representative distribution of providers of different sizes and across different regions. It highlighted several differences in planning and needs for providers of different sizes in different regions.

Overall, through 2024, Arkansas water providers will need $5.74 billion to build, maintain, and replace required infrastructure. For comparison, EPA's DWINSA estimated that the water infrastructure need in Arkansas is approximately $6.10 billion through 2031 (USEPA 2013). Much of this cost must be financed at the local level, although some of the funds needed are expected to be available from federal loan and grant programs and providers will also look to public financing through the State of Arkansas, primarily through low-interest loans from the state's general obligation bond programs.

ANRC provided a list of water and wastewater providers in the state (the contacts database), including a total of 699 providers, representing water, wastewater, and combined utilities. All of the water providers have a Public Water Supply ID and are community systems. A paper copy of the survey was sent in the mail to all 699 providers, and a link to an online, electronic version of the survey was sent to all providers with an email address on file. In an effort to improve response rates, the deadline was extended to 9 weeks from the time the survey was sent out, and follow-up emails and calls were made by CDM Smith and ANRC.

The majority (almost 80 percent) of surveys were completed on paper. The electronic version of the survey restricts responses to certain logic rules, such as only accepting numbers for a numeric question, only asking questions that are relevant (such as details on a master plan only if a provider has one), and requiring a response to most questions before the survey can be submitted. The responses from the paper surveys were entered into the database of responses from the electronic survey, and these logic rules were applied to the electronic entries to the extent possible. For example, only numeric entries were entered for questions asking for a numeric response. In addition, numeric responses were vetted to ensure that the units as entered matched the units shown on the form. Any differences between the paper survey as received and the data entered into the final database is documented; see Appendix B for more details.

6.2 Survey Response Summary

As noted above, the survey was sent to all 699 public, community providers in the ANRC database. Of those, 261 providers responded to the survey, for an overall response rate of 38 percent. Two of those providers responded indicating that their systems had been dissolved and incorporated into other systems. A small number of providers also provided multiple survey responses; in this case, the survey with more questions completed was used. Survey responses included 136 water providers, 5 wastewater providers, and 120 respondents that provide both water and wastewater services.

Needs, priorities, and issues may differ between providers of different sizes, as well as in different regions. Some providers may need to plan for growth, others for shrinking populations, some areas have more limited water supply availability than others, and some areas might have older infrastructure. Response rates were reviewed to demonstrate representative response rates across regions and across providers of different sizes. Survey responses were analyzed by provider size and regions to ensure that the survey data was representative of different provider circumstances and needs across the state. The AWP Water Resources Planning Regions were used for this analysis; these regions are shown in **Figure 9**. Figure 9 shows the approximate locations of the municipal surface water withdrawals in the State of Arkansas. This figure depicts the dependence on surface water for municipal use in the northwestern half of the state, while the southeastern half depends almost entirely on groundwater for municipal use.

Each provider was assigned a size designation using the strata used in EPA's DWINSA in order to allow comparisons with the DWINSA data. As shown in **Table 8** below, DWINSA characterizes small providers as serving up to 3,300 people, medium providers as serving up to 100,000 people, and large providers as serving populations greater than 100,000.

Table 8 shows the response rate by residential population provided with water service. For providers who provided a survey response, **Figure 10** shows the portion of total providers within each size stratum as well as the portion of survey responses received. Retail population served was provided by ANRC for all public water suppliers in the state; for providers that have completed the survey, the self-reported value is used instead. The number of wholesale customers was not used to determine which size stratum each provider falls into. Table 8 shows that the response rate is higher among larger providers, who are more likely to have available staff as well as master plans and other relevant information readily available. Figure 10 shows that although medium and large providers are somewhat overrepresented in the survey response sample, small providers are still well represented by the survey responses.

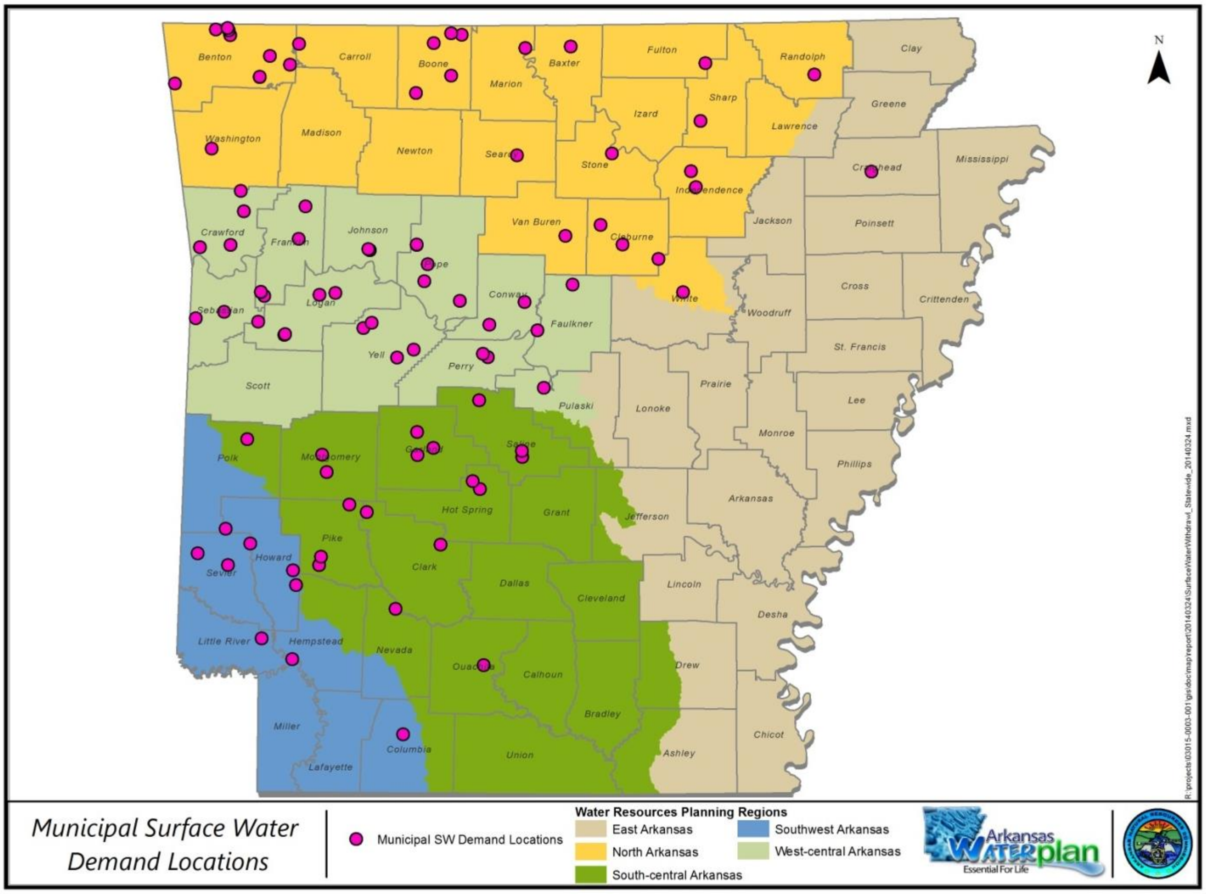

Figure 9. Municipal Surface Water Demand Locations

Table 8. Water Provider Survey Response by Residential Population Served

Provider Size	Residential Population Served	Total Provider Count	Total Survey Count	Response Rate
Small	0 - 3300	534	167	31%
Medium	3301 - 100000	154	88	57%
Large	100001 - 300000	1	1	100%

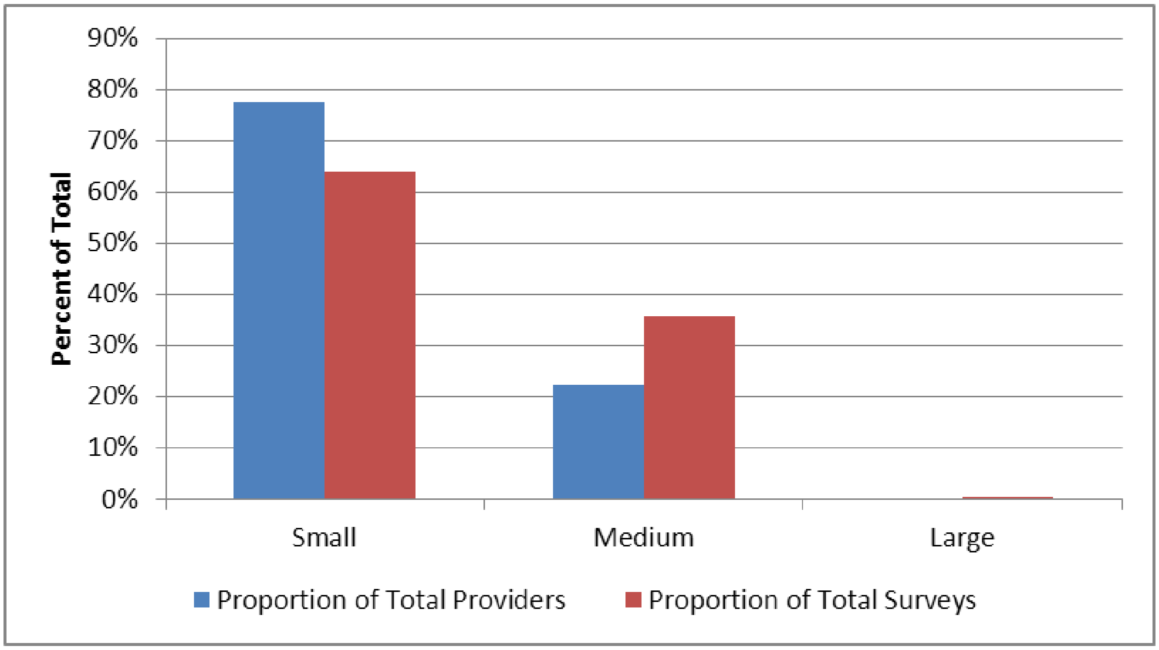

Figure 10. Water Provider Survey Response by Residential Population Served

Figure 10 also demonstrates that small providers make up a substantial majority (over 75 percent) of the total providers in the state. Although the small category includes providers that serve up to 3,300 people, many of these providers are considerably smaller; for example, the provider database from ANRC identifies 20 providers serving fewer than 50 people each. These small providers pose a unique challenge when planning at the statewide level, as their individual needs are small and widespread, but together they make up a large portion of the needs. Many of these providers also face the challenge of shrinking population and resulting reduced revenue streams, following the national trend of increased urban dwelling.

Similarly, **Table 9** shows the survey response rate by region, and **Figure 11** shows the distribution of responses and all providers by region. Response rate is relatively consistent across regions, but does show more variability than would be predicted by provider sizes in a given region.

Table 9. Water Provider Survey Response by Region

Region	Total Provider Count	Total survey count	Response Rate
South-Central	142	52	37%
East	203	69	34%
North	179	71	40%
West-Central	109	42	39%
Southwest	56	22	39%

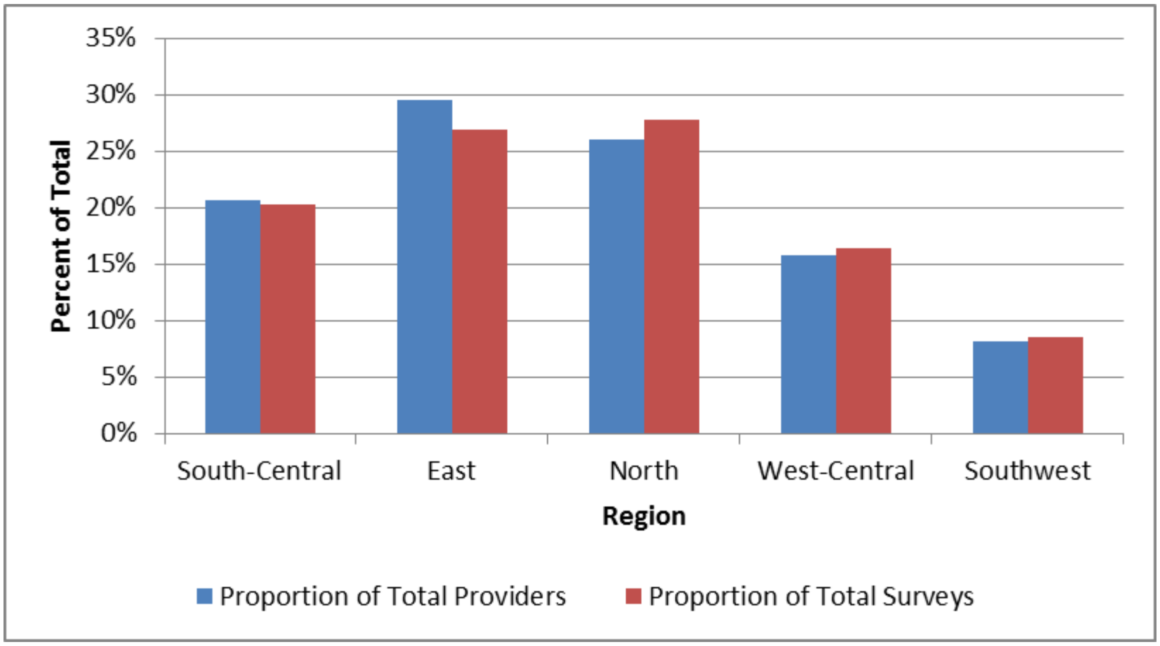

Figure 11. Water Provider Survey Response by Region

A 95 percent confidence interval can be calculated based on population size, number of respondents, and the variability in responses to a given question. For water providers (including combined providers), there were a total of 256 respondents out of a population of 687. When describing what percent of providers chose a given answer to a survey question, the resulting maximum 95 percent confidence interval of 4.9 percentage points. This means that if 100 percent of providers had responded to the survey, there is a 95 percent chance that the result would be within 5.2 percentage points of the actual survey results. The confidence interval increases when the results are divided into smaller populations, as when they are divided by provider size or region. This means that the response values can be extrapolated to apply to the entire population with less certainty. Therefore, the results presented by provider size or by region should be interpreted with greater caution.

For wastewater providers, no information on retail population served was available for providers that did not complete the survey, so no analysis was done to compare the size and region of responses to the overall distribution. **Table 10** shows the total response by wastewater providers by retail population served, and **Table 11** shows the total response by region. Both water and wastewater providers have only one response in the largest stratum. As shown in Table 10, some survey respondents did not provide data on retail population served. Out of those who did, small providers serving up to 3,300 people represent a slightly higher proportion of the wastewater surveys with a correspondingly lower number of medium-sized providers.

Similarly, as the total number of wastewater providers statewide is not known, a 95 percent confidence interval cannot be calculated. This value is assumed to be approximately equal to the confidence interval for water providers.

Table 10. Wastewater Provider Survey Response by Provider Size

Provider Size	Residential Population Served	Total Survey Count	Percent of Surveys Received
Small	0 - 3300	81	65%
Medium	3301 - 100000	32	26%
Large	100001 - 300000	1	100%
Information not provided		11	9%

Table 11. Wastewater Provider Survey Response by Region

Region	Total Survey Count	Percent of Surveys Received
South-Central	24	19%
East	39	31%
North	25	20%
West-Central	26	21%
Southwest	11	9%

6.3 Survey Response Analysis

The survey response rate was compared to several similar surveys to evaluate the reasonableness of the response rate.

The Texas Water Development Board (TWDB) conducts an annual survey to support demand forecasting as part of the state water planning effort. This is a good benchmarking point of comparison as it is a survey on a statewide planning effort that has been ongoing for a number of years. The most recent response rate for that survey is around 80 percent. This is a much higher response rate than this AWP survey; however, there are several key differences. TWDB has conducted this survey for over a decade and seen the response rate rise over time; 5 years ago the response rate was approximately 65 percent (Kluge 2014). The Texas legislature has also passed a mandate that required utilities to respond to the survey. Consequences of not responding include ineligibility for TWDB financial assistance and ineligibility to obtain water right permits, amendments or renewals from the Texas Commission on Environmental Quality ("*Water Use Survey*" 2014). As the AWP infrastructure survey is voluntary and has no formal incentives, it is expected that the response rate would be considerably lower.

Other surveys have been conducted at a regional level as part of TWDB statewide planning efforts. One region conducted a survey to solicit supply and demand information from water entities. There were no consequences to abstaining, and a similar survey had been conducted 5 years prior, making this survey more similar to the ANCR infrastructure survey. The response rate was 25 percent, lower than the response rate to the ANRC infrastructure survey.

Two primary factors are key to improving the survey response rate: survey frequency and incentives for completion or consequences for not responding to the survey. Incorporating incentives or enforceable consequences into the survey would give providers motivation to complete the survey. Over time, sending out the survey annually or every other year helps providers to know what to expect from the survey, the level of effort required, and to be able to access the required information more easily. As demonstrated in Texas, this results in a higher response rate. If the survey is sent out on a regular basis, it should also be reviewed periodically to ensure that the questions are specific and ask only for information that is useful and necessary. This will help to reduce the time spent by utility staff members responsible for completing the survey.

6.4 Selected Survey Data Summary

To identify infrastructure and related funding needs at the local level, the survey included several questions about master planning and asset management strategies, including the total cost of identified projects. The survey then asked for additional information on past and future funding sources.

Note that not all providers responded to all survey questions, so some questions have response rates lower than the overall survey response rate. In addition, as there was only one large wastewater and one large water provider in the state, 'large' survey responses are generally not shown where results are grouped by provider size. This is both to preserve anonymity and because the small and medium providers are more important in understanding what is happening in the state as a whole; the large providers are the exception since nearly all providers are small- or medium-sized.

Table 12 summarizes responses to the question, "Do you have a master plan or long-range plan?" for both water and wastewater providers. **Table 13** shows responses to this question broken down by provider size strata, and **Table 14** shows the results by region. About half of all water providers said that they had a master plan or long-range plan. However, that rate varied by provider size, with medium-sized providers significantly more likely than small providers to have a master plan. This may indicate a need for more planning by small providers. However, short-answer survey question responses for many small providers indicate that planning is taking place more informally by smaller providers; the needs of these providers can be managed using the knowledge of a small number of staff members.

Table 12. Do you have a master plan or long-range plan? - Overall Results

	Water		Wastewater	
	Number of Responses	Percent	Number of Responses	Percent
Yes	126	50%	44	37%
No	102	41%	61	51%
Not Sure	23	9%	14	12%
Total	251		119	

Table 13. Do you have a master plan or long-range plan? - by Provider Size

			Provider Size	
			Small	Medium
Water Providers	Yes	Number of Responses	62	63
	No		81	21
	Not Sure		22	1
	Total		165	85
	Yes	Percent	38%	74%
	No		49%	25%
	Not Sure		13%	1%
Wastewater Providers	Yes	Number of Responses	20	21
	No		46	11
	Not Sure		10	0
	Total		76	32
	Yes	Percent	26%	66%
	No		61%	34%
	Not Sure		13%	0%

Table 14. Do you have a master plan or long-range plan? - by Planning Region

			Region				
			South-Central	East	North	West-Central	Southwest
Water Providers	Yes	Number of Responses	30	24	37	25	10
	No		15	36	27	14	10
	Not Sure		7	7	5	3	1
	Total		52	67	69	42	21
	Yes	Percent	58%	36%	54%	60%	48%
	No		29%	54%	39%	33%	48%
	Not Sure		13%	10%	7%	7%	5%
Wastewater Providers	Yes	Number of Responses	7	11	12	10	4
	No		16	19	10	12	4
	Not Sure		1	5	3	3	2
	Total		24	35	25	25	10
	Yes	Percent	29%	31%	48%	40%	40%
	No		67%	54%	40%	48%	40%
	Not Sure		4%	14%	12%	12%	20%

Master planning also varied by region. This might indicate that some regions have more growth, limited water supply, or other factors that might drive providers to increased planning.

Wastewater providers showed lower rates of master planning overall, with a similar trend away from master planning by smaller providers. Variability between regions also existed, but to a lesser degree and in different regions than the water provider results.

For providers that indicated that they had a master plan, the average plan projected to the year 2024 for water providers and 2023 for wastewater providers.

Table 15 summarizes responses to the question, "Do you have an asset management plan for the repair and replacement of existing water system infrastructure?" **Table 16** summarizes responses by provider size and **Table 17** summarizes responses by planning region. Although levels of asset management planning are lower across the board than levels of more general master planning, the results show a similar pattern in that smaller providers are less likely to have asset management plans. There is some variability across regions, but the variability is lower than that for master planning. These trends hold for both water and wastewater providers.

Table 15. Do you have an Asset Management Plan? - Overall Results

	Water		Wastewater	
	Number of Responses	Percent	Number of Responses	Percent
Yes	59	23%	28	23%
No	151	59%	69	57%
Not Sure	45	18%	25	20%
Total	255		122	

Table 16. Do you have an Asset Management Plan? - by Provider Size

			Provider Size	
			Small	Medium
Water Providers	Yes	Number of Responses	32	27
	No		99	51
	Not Sure		36	9
	Total		167	87
	Yes	Percent	19%	31%
	No		59%	59%
	Not Sure		22%	10%
Wastewater Providers	Yes	Number of Responses	15	11
	No		44	18
	Not Sure		19	3
	Total		78	32
	Yes	Percent	19%	34%
	No		56%	56%
	Not Sure		24%	9%

Table 17. Do you have an Asset Management Plan? - by Planning Region

			Region				
			South-Central	East	North	West-Central	Southwest
Water Providers	Yes	Number of Responses	10	18	18	6	7
	No		27	37	45	30	12
	Not Sure		15	14	7	6	3
	Total		52	69	70	42	22
	Yes	Percent	19%	26%	26%	14%	32%
	No		52%	54%	64%	71%	55%
	Not Sure		29%	20%	10%	14%	14%
Wastewater Providers	Yes	Number of Responses	7	9	5	4	3
	No		13	18	15	17	6
	Not Sure		4	10	5	5	1
	Total		24	37	25	26	10
	Yes	Percent	29%	24%	20%	15%	30%
	No		54%	49%	60%	65%	60%
	Not Sure		17%	27%	20%	19%	10%

Providers with master plans were also asked to provide the total cost of projects identified within their plans. **Table 18** shows that the average cost per provider is $14.6 million for water providers and $25.1 for wastewater providers. **Table 19** shows this data by provider and **Table 20** shows the results by region. Predictably, the cost per provider varies significantly by provider size. There is also considerable variability between regions. Some of this variability may be explained by differing distributions of provider sizes within regions, but it may indicate that some regions have different planning and infrastructure funding needs than others.

Table 19 shows the average value of improvements by provider size. These average values were used to estimate the total cost of needed improvements statewide. For water providers, each provider was categorized as small, medium, or large based on the retail population served in the contacts database. The total value was then calculated using the average per-provider costs shown in Table 19. This gives an estimated total value of needed improvements of **$5.74 billion** statewide for water providers.

As noted above, master plans used to generate this number projected, on average, to the year 2024 for water providers. However, the survey did not ask in what year the master planning effort was conducted. Therefore, while it is expected that $5.74 billion will be needed by 2024, it is possible that some of this money has already been spent if a master plan is a few years old already.

For comparison, the 2011 DWINSA estimated that the water infrastructure need in Arkansas is approximately $6.10 billion through 2031 (USEPA 2013). This represents an overall difference of 6 percent; however, when the comparison is made based on provider size the differences are much greater with the DWINSA reporting $700 million, $4.35 billion, and $1.04 billion for large, medium, and small provider, respectively.

A similar calculation was performed for wastewater providers. However, since the contacts database did not include information on the number of wastewater providers or the population served, the total number of small, medium, and large providers was estimated from the survey response data. It was assumed that there is only one large provider in the state, and that the proportions of small and medium providers are the same as shown in Table 10. In addition, out of the total surveys received from water providers in the contact database, 47 percent of them are combined utilities, providing wastewater as well as water service. It was also assumed that this was representative of all the utilities in the contact database. Using these assumptions and the average per-provider costs shown in Table 19, the estimated total value of needed improvements is **$3.76 billion** statewide for wastewater providers. The average wastewater master plan surveyed projects to 2023. As noted for water providers, above, while it is expected that $3.76 billion will be needed by 2023, it is possible that some of this money has already been spent if a master plan is a few years old already.

Table 20 shows the estimated total cost for water providers by region. This value is calculated in the same way as the estimated total cost in Table 19, using the average per-provider cost shown in Table 19. However, this value is not shown for wastewater providers. Information on the number of water providers of each size per region is available from the contact database; this information is not available for wastewater providers. The number of assumptions that must be made and the smaller number of wastewater providers in each region makes it difficult to make a reliable estimate of total cost for wastewater providers on a regional basis.

Table 18. What is the total cost of all projects identified? - Overall Results

	Water	Wastewater
Number of Responses	93	32
Average Value	$14,599,000	$25,116,000

Table 19. What is the total cost of all projects identified? - by Provider Size

		Provider Size			Total
		Small	Medium	Large	
Water Providers	Number of Responses	37	55	1	
	Average Value	$5,730,000	$15,540,000	$291,050,000	
	Total Providers	534	154	1	
	Estimated Total	$3,059,700,000	$2,393,100,000	$291,100,000	**$5,743,800,000**
Wastewater Providers	Number of Responses	14	15	1	
	Average Value	$1,259,000	$33,883,070	$271,911,362	
	Estimated Total Providers	238	94	1	
	Estimated Total	$299,500,000	$3,185,300,000	$271,900,000	**$3,756,700,000**

Table 20 - What is the total cost of all projects identified? - by Planning Region

		Region					Total
		South-Central	East	North	West-Central	Southwest	
Water Providers	Number of Responses	24	24	21	17	7	
	Average	$6,044,000	$7,414,000	$14,557,000	$42,342,000	$1,322,000	
	Total Providers	142	203	179	109	56	
	Total – Estimated based on provider size	$1,107,900,000	$1,585,000,000	$1,457,300,000	$1,204,200,000	$389,500,000	$5,743,800,000
Wastewater Providers	Number of Responses	5	8	7	8	4	
	Total value	$311,230,000	$16,160,000	$158,190,000	$305,550,000	$12,600,000	
	Average	$62,246,000	$2,020,000	$22,599,000	$38,194,000	$3,149,000	

The survey also addressed how planned improvements will be paid for. **Table 21** shows how survey respondents planned to pay for the improvements identified in their master plans. **Table 22** shows these results by provider size and **Table 23** shows the results by planning region. Overall, smaller providers were more likely to mark 'not sure', and also more likely to rely on grant programs. Responses to this question also vary considerably between regions.

Table 21. How are improvements identified in planning documents expected to be funded? - Overall Results

	Water		Wastewater	
	Number of Responses	Percent	Number of Responses	Percent
Current Rates	97	39%	46	37%
Raise Rates	100	40%	57	46%
Bonds	64	25%	30	24%
Grants	83	33%	38	31%
Not sure	40	16%	18	15%
Other	42	17%	20	16%
Number of Responses - Total	251		124	

Table 22. How are improvements identified in planning documents expected to be funded? - by Provider Size

			Provider Size	
			Small	Medium
Water Providers	Current Rates	Number of Responses	59	38
	Raise Rates		54	45
	Bonds		26	37
	Grants		69	14
	Not sure		29	11
	Other		31	11
	Number of Responses - Total		164	86
	Current Rates	Percent	36%	44%
	Raise Rates		33%	52%
	Bonds		16%	43%
	Grants		42%	16%
	Not sure		18%	13%
	Other		19%	13%
Wastewater Providers	Current Rates	Number of Responses	28	17
	Raise Rates		29	24
	Bonds		8	21
	Grants		32	5
	Not sure		13	5
	Other		13	5
	Number of Responses - Total		79	40
	Current Rates	Percent	35%	43%
	Raise Rates		37%	60%
	Bonds		10%	53%
	Grants		41%	13%
	Not sure		16%	13%
	Other		16%	13%

Table 23. How are improvements identified in planning documents expected to be funded? - by Planning Region

			Region				
			South-Central	East	North	West-Central	Southwest
Water Providers	Current Rates	Number of Responses	25	19	32	11	10
	Raise Rates		15	37	24	15	9
	Bonds		15	13	18	15	3
	Grants		20	23	24	6	10
	Not sure		8	12	9	8	3
	Other		8	11	10	11	2
	Number of Responses - Total		51	69	69	41	21
	Current Rates	Percent	49%	28%	46%	27%	48%
	Raise Rates		29%	54%	35%	37%	43%
	Bonds		29%	19%	26%	37%	14%
	Grants		39%	33%	35%	15%	48%
	Not sure		16%	17%	13%	20%	14%
	Other		16%	16%	14%	27%	10%
Wastewater Providers	Current Rates	Number of Responses	11	10	10	9	6
	Raise Rates		10	19	11	10	7
	Bonds		4	8	7	9	2
	Grants		9	12	8	3	6
	Not sure		1	6	4	5	2
	Other		5	4	4	7	0
	Number of Responses - Total		24	38	25	26	11
	Current Rates	Percent	46%	26%	40%	35%	55%
	Raise Rates		42%	50%	44%	38%	64%
	Bonds		17%	21%	28%	35%	18%
	Grants		38%	32%	32%	12%	55%
	Not sure		4%	16%	16%	19%	18%
	Other		21%	11%	16%	27%	0%

In order to assess funding sources already in use, the survey includes data on participation in several government funding programs. **Table 24** shows the overall results; **Table 25** shows them by provider size and **Table 26** by region. The U.S. Department of Agriculture Farmer's Home program is the most popular program across nearly every provider size and region.

Table 24. Have you or do you participate in state and/or federal funding programs? - Overall Results

	Water		Wastewater	
	Number of Responses	Percent	Number of Responses	Percent
Community Development Block Grant (CDBG)	243	108%	243	215%
Drinking Water Revolving Loan Fund (DWSRF)	245	108%	244	216%
Clean Water State Revolving Fund (CWSRF)	244	108%	244	216%
ANRC State General Obligation Bonds (CGO)	243	108%	244	216%
ANRC Water/Sewer Solid Waste Fund - Water and Sewer	243	108%	244	216%
ANRC Water Development Fund - Water	247	109%	244	216%
U.S. Environmental Protection Agency (SAP Grant)	243	108%	243	215%
U.S. Department of Agriculture Rural Development (Farmer's Home)	252	112%	250	221%
Not sure	248	110%	247	219%
Other	245	108%	245	217%
Number of Responses - Total	226		113	

Table 25 - Have you or do you participate in state and/or federal funding programs? - by Provider Size

			Provider Size	
			Small	Medium
Water Providers	Community Development Block Grant (CDBG)	Number of Responses	15	11
	Drinking Water Revolving Loan Fund (DWSRF)		3	10
	Clean Water State Revolving Fund (CWSRF)		0	4
	ANRC State General Obligation Bonds (CGO)		12	11
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		14	6
	ANRC Water Development Fund -Water		31	8
	U.S. Environmental Protection Agency (SAP Grant)		1	2
	U.S. Department of Agriculture Rural Development (Farmer's Home)		67	27
	Not sure		45	11
	Other		31	17
	Number of Responses - Total		155	70
	Community Development Block Grant (CDBG)	Percent	10%	16%
	Drinking Water Revolving Loan Fund (DWSRF)		2%	14%
	Clean Water State Revolving Fund (CWSRF)		0%	6%
	ANRC State General Obligation Bonds (CGO)		8%	16%
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		9%	9%
	ANRC Water Development Fund -Water		20%	11%
	U.S. Environmental Protection Agency (SAP Grant)		1%	3%
	U.S. Department of Agriculture Rural Development (Farmer's Home)		43%	39%
	Not sure		29%	16%
	Other		20%	24%
Wastewater Providers	Community Development Block Grant (CDBG)	Number of Responses	5	4
	Drinking Water Revolving Loan Fund (DWSRF)		0	6
	Clean Water State Revolving Fund (CWSRF)		1	8
	ANRC State General Obligation Bonds (CGO)		4	6
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		11	3
	ANRC Water Development Fund -Water		0	0
	U.S. Environmental Protection Agency (SAP Grant)		1	2
	U.S. Department of Agriculture Rural Development (Farmer's Home)		34	2
	Not sure		22	9
	Other		12	11
	Number of Responses - Total		74	35
	Community Development Block Grant (CDBG)	Percent	7%	11%
	Drinking Water Revolving Loan Fund (DWSRF)		0%	17%
	Clean Water State Revolving Fund (CWSRF)		1%	23%
	ANRC State General Obligation Bonds (CGO)		5%	17%
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		15%	9%
	ANRC Water Development Fund -Water		0%	0%
	U.S. Environmental Protection Agency (SAP Grant)		1%	6%
	U.S. Department of Agriculture Rural Development (Farmer's Home)		46%	6%
	Not sure		30%	26%
	Other		16%	31%

Table 26 - Have you or do you participate in state and/or federal funding programs? - by Planning Region

			Region				
			South-Central	East	North	West-Central	South west
Water Providers	Community Development Block Grant (CDBG)	Number of Responses	6	6	7	5	2
	Drinking Water Revolving Loan Fund (DWSRF)		4	5	1	2	2
	Clean Water State Revolving Fund (CWSRF)		1	0	1	1	1
	ANRC State General Obligation Bonds (CGO)		2	8	6	5	2
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		4	3	10	2	1
	ANRC Water Development Fund -Water		8	6	13	9	3
	U.S. Environmental Protection Agency (SAP Grant)		0	0	2	1	0
	U.S. Department of Agriculture Rural Development (Farmer's Home)		18	26	30	14	6
	Not sure		11	13	12	9	11
	Other		12	17	10	7	2
	Number of Responses - Total		46	62	60	37	21
	Community Development Block Grant (CDBG)	Percent	13%	10%	12%	14%	10%
	Drinking Water Revolving Loan Fund (DWSRF)		9%	8%	2%	5%	10%
	Clean Water State Revolving Fund (CWSRF)		2%	0%	2%	3%	5%
	ANRC State General Obligation Bonds (CGO)		4%	13%	10%	14%	10%
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		9%	5%	17%	5%	5%
	ANRC Water Development Fund -Water		17%	10%	22%	24%	14%
	U.S. Environmental Protection Agency (SAP Grant)		0%	0%	3%	3%	0%
	U.S. Department of Agriculture Rural Development (Farmer's Home)		39%	42%	50%	38%	29%
	Not sure		24%	21%	20%	24%	52%
	Other		26%	27%	17%	19%	10%
Wastewater Providers	Community Development Block Grant (CDBG)	Number of Responses	2	4	3	0	1
	Drinking Water Revolving Loan Fund (DWSRF)		2	0	2	1	1
	Clean Water State Revolving Fund (CWSRF)		2	1	3	3	2
	ANRC State General Obligation Bonds (CGO)		0	4	2	2	2
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		3	2	4	5	0
	ANRC Water Development Fund -Water		0	0	0	0	0
	U.S. Environmental Protection Agency (SAP Grant)		0	0	2	1	0
	U.S. Department of Agriculture Rural Development (Farmer's Home)		5	14	7	6	5
	Not sure		7	7	6	6	5
	Other		4	9	5	7	0
	Number of Responses - Total		21	32	24	25	11
	Community Development Block Grant (CDBG)	Percent	10%	13%	13%	0%	9%
	Drinking Water Revolving Loan Fund (DWSRF)		10%	0%	8%	4%	9%
	Clean Water State Revolving Fund (CWSRF)		10%	3%	13%	12%	18%
	ANRC State General Obligation Bonds (CGO)		0%	13%	8%	8%	18%
	ANRC Water/Sewer Solid Waste Fund - Water and Sewer		14%	6%	17%	20%	0%
	ANRC Water Development Fund -Water		0%	0%	0%	0%	0%
	U.S. Environmental Protection Agency (SAP Grant)		0%	0%	8%	4%	0%
	U.S. Department of Agriculture Rural Development (Farmer's Home)		24%	44%	29%	24%	45%
	Not sure		33%	22%	25%	24%	45%
	Other		19%	28%	21%	28%	0%

6.5 Survey Data Limitations

The infrastructure survey provides a picture of planning efforts and of infrastructure and funding needs throughout the state. However, there are some limitations inherent to the survey approach. As discussed in Section 2, assuming that the results apply to the entire state is limited by the response rate and resulting sample size. The survey was reviewed to ensure that questions were clearly worded. However, additional error can be introduced if questions are misinterpreted or if numbers are provided in the incorrect units.

The infrastructure survey was intended to be focused on the needs of a single provider. Large scale, regional infrastructure; such as converting a region's primary supply from groundwater to surface water over time, was not included. This type of infrastructure will be assessed as part of the AWP alternatives analysis. In addition, the survey addresses only municipal infrastructure needs. Other sectors, including agriculture and self-supplied industrial water uses, will have additional needs not quantified here.

Section 7

Conclusion

The water supply gap analysis presented in this report shows that groundwater shortages are the biggest concern in 2050. There exists potential for full surface water augmentation of identified groundwater gaps for a majority of the state's river basins; however, the infrastructure, policies, and procedures to accomplish this need further evaluation at the regional and local levels. Based on the assumptions discussed in this report, the gap analysis results show that a majority of the eastern portion of the state is not projected to have enough identified excess surface water to fully augment the groundwater gap leaving over 4,000,000 AF identified as a combined source gap. However, if the total available surface water is considered as a source for surface water augmentation then the combined source gap is reduced approximately to 850,000 AF.

The combined source gap assessed the potential for surface water augmentation at the major basin level. Surface water augmentation would require infrastructure such as storage reservoirs, pipelines, pump stations, and water treatment plants to be fully realized. In addition, if surface water is to be transferred from one ecoregion to another, then water quality revisions may be necessary to avoid impairment determinations and to ensure that designated uses are maintained. This consideration is necessary where water chemistries and biology associated with each ecoregion differ across sub-basins or watersheds. It is recommended that other water management strategies such as water conservation, reuse or recycled water, and operational efficiency be considered by each of the Water Resources Planning Regions in addition to surface water augmentation during the alternatives analysis phase of the AWP Update. The infrastructure survey showed infrastructure needs for water and wastewater providers throughout the state, as well as providing a picture of the ongoing level provider-level planning. Overall, the survey had a reasonable response rate at 35 percent, including a representative distribution of providers of different sizes and across different regions. 51 percent of water providers and 38 percent of wastewater providers had master plans or long-term plans. Smaller providers of both types were less likely to have formal master plans, and master planning rates also varied by region. Extrapolating master plan cost values to include providers in the entire state gives an estimated total cost of $5.74 billion for water providers and $3.85 billion for wastewater providers. Planned funding sources for these improvements include bonds, grants, and current and future rates. All funding sources were relied on by at least 25 percent of providers, but smaller providers are significantly more likely to seek grants rather than rely on bonds or system revenue.

ANRC could address the low rate of master planning and asset management planning, particularly among smaller providers, by requiring long-range plans and/or asset management plans as a condition of financial assistance and Water Plan Compliance review. Such a policy would take into account the available resources of small systems and ANRC will adjust the level of effort and reporting frequency accordingly

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Section 8

References

AWP Water Availability Report (November 2014)
http://www.arwaterplan.arkansas.gov/reports/water_availability_report_final%201.13.14.pdf

AWP Water Demand Forecast Report (March 2014)
http://www.arwaterplan.arkansas.gov/reports/awp_water_demand_forecast_report_10-17-13.pdf

Kluge, K. 2014. Personal telephone correspondence, RE: Texas Water Development Board Water Use Survey. March 14.

Texas Water Development Board (2014, March 14). Water Use Survey. www.twdb.state.tx.us. Retrieved March 14, 2014 from http://www.twdb.state.tx.us/waterplanning/waterusesurvey/.

United States Environmental Protection Agency (2013, April). Drinking Water Infrastructure Needs Survey and Assessment: Fifth Report to Congress. www.epa.gov. Retrieved March 1, 2014 from http://water.epa.gov/grants_funding/dwsrf/upload/epa816r13006.pdf.

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Appendix A

Gap Analysis Results Under Full Mining Conditions

FINAL
Gap Analysis

Arkansas Natural Resources Commission

Arkansas State Water Plan Update

Appendix A
Gap Analysis Results Assuming Full Groundwater Mining

November 2014

CDM Smith

Table A1. 2050 Groundwater Gap by Major Basin and Subbasin Assuming Full Groundwater Mining Under Dry Climatic Conditions (AFM)

Subbasin	Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Lower Arkansas Mainstem	Arkansas River - Lower	5,417	5,632	5,536	14,858	67,510	132,154	176,450	135,813	19,128	7,905	5,491	5,159	581,054
Big Piney Creek	Arkansas River - Upper	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadron Creek	Arkansas River - Upper	25	25	25	25	25	25	25	25	25	25	25	25	298
Fourche La Fave River	Arkansas River - Upper	2	2	2	2	2	2	2	2	2	2	2	2	28
Illinois Bayou	Arkansas River - Upper	13	13	13	13	13	13	13	13	13	13	13	13	152
Illinois River	Arkansas River - Upper	6	6	6	6	6	6	6	6	6	6	6	6	71
Lee Creek	Arkansas River - Upper	0	0	0	0	0	0	0	0	0	0	0	0	3
Mulberry River	Arkansas River - Upper	2	2	2	2	2	2	2	2	2	2	2	2	21
Petit Jean River	Arkansas River - Upper	1	1	1	1	1	1	1	1	1	1	1	1	9
Point Remove Creek	Arkansas River - Upper	-	-	-	-	-	-	-	-	-	-	-	-	-
Poteau River Tributaries	Arkansas River - Upper	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper Arkansas Mainstem	Arkansas River - Upper	102	102	102	102	102	122	158	122	122	102	102	102	1,339
Bayou Bartholomew Main Stem	Bayou Bartholomew	810	805	821	2,195	8,564	19,372	21,815	19,067	3,396	881	823	796	79,346
Bayou Bartholomew Tributary	Bayou Bartholomew	32	32	33	36	468	1,630	1,858	1,506	54	35	31	31	5,746
Bayou Macon Main Stem	Bayou Macon	688	436	574	6,839	19,714	39,066	63,046	55,802	3,250	798	358	358	190,931
Boeuf River Main Stem	Boeuf River	659	547	628	10,696	26,816	52,429	75,935	67,582	6,425	740	506	499	243,462
Boeuf River Tributaries	Boeuf River	1	1	1	6	18	53	68	56	1	1	1	1	208
L'Anguille River Main Stem	L'Anguille River	623	662	954	2,258	90,232	272,650	294,150	168,415	10,299	2,037	872	629	843,781
Lower Ouachita River Tributaries	Ouachita River	10	10	10	10	10	10	10	10	10	10	10	10	120
Ouachita River Main Stem	Ouachita River	466	466	466	466	491	546	551	538	471	466	466	466	5,858
Saline River	Ouachita River	319	319	319	320	339	383	391	377	324	319	319	319	4,047
Upper Ouachita River	Ouachita River	-	-	-	-	-	-	-	-	-	-	-	-	-
Bayou Dorcheat	Red River	856	856	859	862	873	892	905	891	859	856	856	856	10,419
Little River	Red River	107	107	107	107	107	107	107	107	107	107	107	107	1,281
Lower Red River Tributaries	Red River	206	206	244	284	437	697	880	693	253	208	209	211	4,528
Millwood Lake	Red River	-	-	-	-	-	-	-	-	-	-	-	-	-
Red River Main Stem	Red River	1,260	1,262	1,850	2,491	5,099	10,114	13,307	9,897	2,106	1,261	1,260	1,260	51,166
St. Francis River Main Stem	St. Francis River	3,386	3,402	3,758	5,738	131,750	455,191	497,526	396,038	27,802	3,673	3,642	3,398	1,535,304
Black River	White River - Lower	591	588	597	5,881	41,818	106,888	132,878	122,772	4,713	795	580	579	418,680
Cache River	White River - Lower	1,760	1,738	1,890	11,237	118,940	314,299	391,871	357,075	12,800	7,757	1,772	1,662	1,222,803
Devils Fork Little Red River	White River - Lower	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower White	White River - Lower	4,362	4,365	4,142	5,240	128,208	272,202	382,125	249,874	28,362	7,465	4,209	4,289	1,094,844
Middle Fork Little Red River	White River - Lower	-	-	-	-	-	0	4	4	-	-	-	-	8
Middle White	White River - Lower	2,047	2,094	2,115	7,828	38,924	89,729	135,474	122,201	7,246	3,203	2,017	1,997	414,874
South Fork Little Red River	White River - Lower	1	1	1	1	1	1	1	1	1	1	1	1	16
Kings River	White River - Upper	3	3	3	3	3	3	3	3	3	3	3	3	39
Upper White	White River - Upper	1,111	1,112	1,117	1,182	2,155	4,784	7,761	7,025	1,815	1,126	1,124	1,134	31,447
Total		**24,867**	**24,794**	**26,176**	**78,690**	**682,628**	**1,773,375**	**2,197,324**	**1,715,916**	**129,594**	**39,798**	**24,806**	**23,915**	**6,741,882**

Table A2. 2050 Groundwater Gap by Regional Planning Area Assuming Full Groundwater Mining Under Dry Climatic Conditions (AFM)

Regional Planning Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
East Arkansas	17,918	17,782	18,535	61,341	605,684	1,595,945	1,963,016	1,508,931	112,361	31,663	17,848	17,024	**5,968,047**
North Arkansas	2,418	2,432	2,453	9,387	54,398	134,782	177,996	163,225	8,757	3,052	2,409	2,411	**563,720**
South-central Arkansas	1,613	1,645	1,631	3,071	11,235	21,321	28,146	21,866	3,743	1,996	1,624	1,573	**99,464**
Southwest Arkansas	2,434	2,436	3,065	3,749	6,521	11,817	15,205	11,594	3,330	2,437	2,436	2,438	**67,464**
West-central Arkansas	484	498	492	1,141	4,789	9,510	12,960	10,301	1,403	651	488	468	**43,185**
Total	**24,867**	**24,794**	**26,176**	**78,690**	**682,627**	**1,773,375**	**2,197,323**	**1,715,916**	**129,594**	**39,798**	**24,806**	**23,915**	**6,741,880**

Table A4. 2050 Combined Source Gap by Major Basin Assuming Full Mining Under Dry Climatic Conditions with Excess Surface Water as a Source (AFM)

Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Arkansas River - Lower[1]	268,592	262,068	447,261	329,398	307,947	159,141	106,424	(6,375)	113,395	203,664	245,952	287,174	2,724,641
Arkansas River - Upper[1]	267,899	261,661	443,743	337,075	368,278	292,510	285,868	132,969	128,772	206,116	245,136	284,904	3,254,932
Bayou Bartholomew	15,572	16,704	19,502	11,450	1,990	(15,852)	(19,481)	(17,623)	67	2,414	4,334	10,346	29,424
Bayou Macon	2,999	4,072	4,149	(4,142)	(16,432)	(38,327)	(62,005)	(55,273)	(2,008)	17	713	2,439	(163,798)
Boeuf River	7,976	10,087	8,550	(6,061)	(21,578)	(53,745)	(83,533)	(77,267)	(1,478)	988	4,176	6,182	(205,703)
L'Anguille River	10,731	13,791	13,591	6,275	(82,046)	(270,150)	(291,033)	(164,762)	(5,006)	1,519	4,082	10,029	(752,978)
Ouachita River	121,023	138,509	165,240	113,510	104,924	47,907	39,611	27,054	33,326	46,060	58,494	120,936	1,016,594
Red River	131,386	128,308	184,208	119,992	136,220	66,097	73,367	42,227	42,732	64,971	60,629	104,136	1,154,272
St. Francis River	79,588	87,656	99,196	69,947	(63,952)	(413,145)	(453,218)	(367,439)	(6,806)	19,783	26,608	56,940	(864,843)
White River - Lower[1]	222,786	234,820	281,250	190,267	(111,005)	(655,408)	(878,649)	(714,403)	43,234	64,905	113,994	187,126	(1,021,083)
White River - Upper[1]	86,800	87,974	114,725	92,638	85,551	48,360	62,768	40,499	27,446	24,418	50,199	77,728	799,105
Total[2]	1,215,351	1,245,651	1,781,415	1,260,350	709,898	(832,613)	(1,219,880)	(1,160,393)	373,675	634,855	814,316	1,147,940	5,970,565

[1] The Upper and Lower basins are hydrologically connected. Upper basin Excess Surface Water has been removed from Total values to avoid double counting.

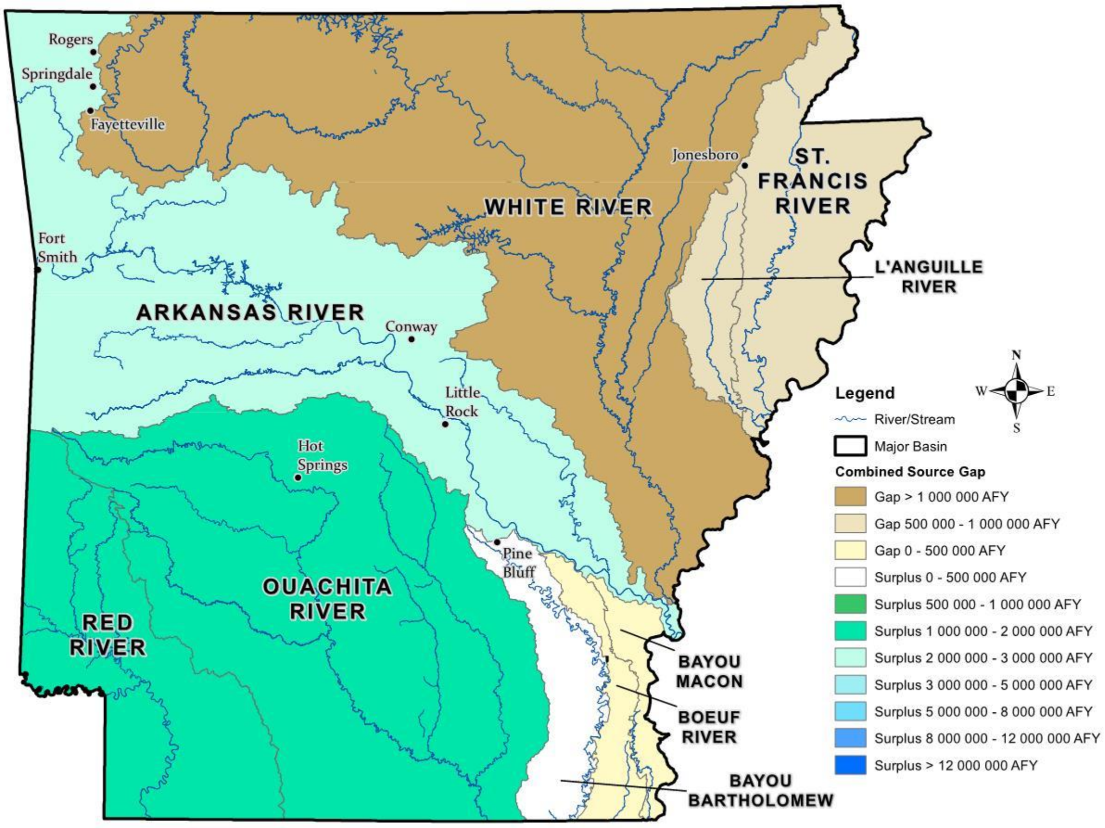
[2] Analysis of the Beouf River on a monthly basis showed that Total Available Surface Water was not present in June, July, and August (i.e. negative). For this reason, the 25% factor to determine Excess Surface Water was not applied because it would artificially reduce the identified monthly gap.

Table A4. 2050 Combined Source Gap by Major Basin Assuming Full Mining Under Dry Climatic Conditions with Total Available Surface Water as a Source (AFM)

Major Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual (AFY)
Arkansas River - Lower[1]	1,091,069	1,065,619	1,806,105	1,362,618	1,434,767	1,033,537	955,667	382,452	511,478	838,824	1,000,732	1,164,622	12,647,491
Arkansas River - Upper[1]	1,072,047	1,047,095	1,775,424	1,348,752	1,473,565	1,170,552	1,144,093	532,387	515,601	824,916	980,993	1,140,068	13,025,493
Bayou Bartholomew	64,816	69,328	80,571	52,494	35,056	(402)	(6,904)	(8,772)	10,618	12,403	19,899	43,868	372,975
Bayou Macon	14,060	17,596	18,319	3,952	(6,586)	(36,109)	(58,882)	(53,688)	1,720	2,462	3,925	10,830	(82,402)
Boeuf River	33,883	41,993	36,088	7,861	(5,810)	(53,745)	(83,533)	(77,267)	13,366	6,173	18,222	26,229	(36,538)
L'Anguille River	44,791	57,152	57,226	31,872	(57,486)	(262,651)	(281,680)	(153,802)	10,875	12,189	18,944	42,002	(480,567)
Ouachita River	486,477	556,420	663,345	456,427	422,217	194,447	161,301	110,987	135,718	186,625	236,360	486,128	4,096,453
Red River	532,828	520,526	746,008	491,201	564,425	299,821	339,063	203,671	180,900	267,178	249,809	423,841	4,819,270
St. Francis River	328,509	360,829	408,057	297,004	139,443	(287,007)	(320,293)	(281,642)	56,179	90,152	117,357	237,953	1,146,540
White River - Lower[1]	920,773	965,640	1,151,238	851,634	539,654	(272,272)	(387,537)	(301,832)	332,300	317,283	481,714	774,090	5,372,684
White River - Upper[1]	350,546	355,241	462,258	374,107	348,680	207,800	274,367	183,081	115,239	101,060	204,175	314,325	3,290,879
Total[2]	**4,939,800**	**5,057,438**	**7,204,639**	**5,277,921**	**4,887,926**	**1,993,971**	**1,735,663**	**535,575**	**1,883,993**	**2,659,265**	**3,332,131**	**4,663,956**	**44,172,277**

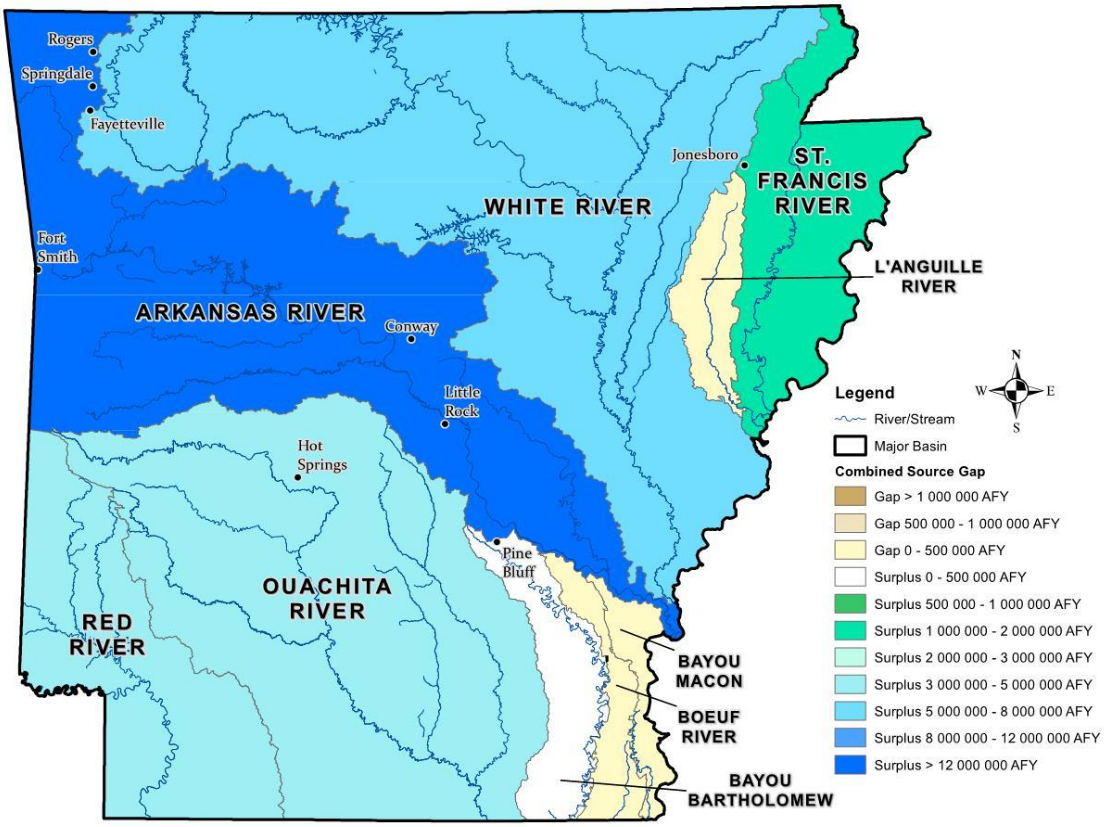
[1] The Upper and Lower basins are hydrologically connected. Upper basin Excess Surface Water has been removed from Total values to avoid double counting.

[2] Analysis of the Beouf River on a monthly basis showed that Total Available Surface Water was not present in June, July, and August (i.e. negative). For this reason, the 25% factor to determine Excess Surface Water was not applied because it would artificially reduce the identified monthly gap.



Document Path: O:\91107-Arkansas\MXD\Gap Analysis Report FINAL edits\AppendixFigures\FigureA3 - 2050 Combined Source Gap by Major Basin Sustainable Pumping Dry Climate Excess Surface Water Source.mxd Date Saved: 4/29/2014 Author: huseke

Figure A1. 2050 Groundwater Gap by Major Basin and Subbasin Assuming Full Groundwater Mining Under Dry Climatic Conditions assuming Excess Surface Water as a Source



Document Path: O:\91107-Arkansas\MXD\Gap Analysis Report FINAL edits\AppendixFigures\Figure A4 - 2050 Combined Source Gap by Major Basin Sustainable Pumping Dry ClimateTotal Available Surface Water Source.mxd Date Saved: 4/29/2014 Author: huseke

Figure A2. 2050 Groundwater Gap by Major Basin and Subbasin Assuming Full Groundwater Mining Under Dry Climatic Conditions assuming Total Available Surface Water as a Source

Appendix B

Complete Survey Results

Appendix B

Complete Survey Results

1.0 Introduction

As noted in Section 7, water and wastewater utilities were surveyed on a variety of information, including planning efforts by each provider and projects identified in master plans, asset management plans and strategies, current and planned funding sources, rate and customer base changes, vulnerability assessments and emergency response plans, impacts of upcoming regulations, and a review of other issues facing water and wastewater utilities. Surveys were filled out and completed either electronically or on paper. The results from both the electronic and paper surveys were compiled into a single *Access* database.

2.0 Database Guide

The *Access* database includes the following tables:

- QuestionResultsTable
- QuestionCodes
- Dups_Not_Used
- Response_By_Region
- Original_PWS_DB
- Original_Wastewater_DB
- Updated_Contact_DB

'Original_PWS_DB' and 'Original_Wastewater_DW' are the original databases of contact information for each public water supplier (PWS) and wastewater provider, respectively, in the State of Arkansas. Combined utilities are included in the 'Original_PWS_DB' table. The 'Original_Wastewater_DB' table includes a facility ID field, 'Fac_ID.' This ID is used only in the database (i.e., is not used elsewhere by ANRC or other entities) to uniquely identify the provider in other locations in the database. The 'PWS_ID' field in the 'Original_PWS_ID' table is used as the facility ID in tables that combine data from the two types of providers. This is the same PWS identification number used elsewhere by ANRC to identify each PWS system.

The 'Updated_Contact_DB' table contains updated contact information collected during the survey process. This table is a combination of the 'Original_PWS_DB' and 'Original_Wastewater_DB' tables. It has been modified if a provider filled out different information on the survey, and email and physical addresses were removed if the survey was returned to sender. It also includes a regional planning region for each provider. The region information is based on geocoding the address information in order to locate each provider in GIS. Many providers have a P.O. Box address or have contact information for an outside consultant, and the address in the database does not represent the physical facility location. Therefore, this field is not guaranteed to be accuracy. However, due to the large size of the planning regions, it is expected that the majority of these designations are correct.

The ‘Providers by Region’ table shows regions for survey respondents. Regional information is also shown in the ‘Updated_Contact_DB’ table. However, the ‘Provders_by_Region’ table is also needed because the survey results are anonymized, i.e. not tied to a particular provider. ‘Response_By_Region’ can be used to tie a particular survey result to a region; ‘Updated_Contact_DB’ can be used to tie a provider to a region.

‘Dups_Not_Used’ is data from surveys where two surveys were received from a single provider. In this case, the survey that was more complete (i.e. more questions were answered) was used; the additional data was moved to the ‘Dups_Not_Used’ table.

‘QuestionResultsTable’ is the full survey response data, containing the response to each question on the survey. The survey data in these two tables is anonymized; it is not tied to a facility ID or PWS ID, and no contact information is included in this table. They do include a “GIS_ID” field, which is used to match the data in ‘QuestionResultsTable’ to the data in ‘Response_By_Region’.

The headings in ‘QuestionsResultsTable’ are codes representing each question on the survey. **Exhibit A** shows a copy of the paper survey, with question ID numbers shown in blue boxes. Questions and IDs are are also shown in ‘QuestionCodes.’ Questions are the same for the paper and electronic versions of the survey. ‘QuestionsResultsTable’ also includes an additional field, ‘26’, which includes notes on inputting paper surveys into electronic form. This column includes notes on how questions were entered when the answer on the paper survey was unexpected, such as making assumptions about units when numbers appeared unreasonable.

Arkansas Water Plan Water Infrastructure Planning Survey

Exhibit A- Question Identification

Part 1 - General Information Survey

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1. ***Please select your system type***

☐ Water ☐ Wastewater ☐ Both

2. ***How many customers does your Water and/or Wastewater system serve (non-wholesale)?***

	WATER	**WASTEWATER**	
2A_W	a. Residential Customers ____________________	a. Residential Customers ____________________	**2A_WW**
2B_W	b. Residential – Total Population Served ____________________	b. Residential – Total Population Served ____________________	**2B_WW**
2C_W	c. Commercial/ Industrial Customers ____________________	c. Commercial/ Industrial Customers ____________________	**2C_WW**
2D_W	d. Other Customers ____________________	d. Other Customers ____________________	**2D_WW**
2E_W	e. Total	e. Total	**2E_WW**

3. ***How many wholesale customers does your Water and/or Wastewater system serve?***

3A_W	a. Residential Customers ____________________	a. Residential Customers ____________________	**3A_WW**
3B_W	b. Residential – Total Population Served ____________________	b. Residential – Total Population Served ____________________	**3B_WW**
3C_W	c. Commercial/ Industrial Customers ____________________	c. Commercial/ Industrial Customers ____________________	**3C_WW**
3D_W	d. Other Customers ____________________	d. Other Customers ____________________	**3D_WW**
3E_W	e. Total	e. Total	**3E_WW**

4. ***What is the size and capacity of your Water and/or Wastewater infrastructure system?***

4A_W	a. Treatment Capacity (mgd) ________________	a. Treatment Capacity (mgd) ________________	**4A_WW**
4B_W	b. Average Yearly Demand (mgd) ________________	b. Average Yearly Demand (mgd) ________________	**4B_WW**
4C_W	c. Peak Demand (mgd) ________________	c. Peak Demand (mgd) ________________	**4C_WW**

Part 2 - Planning and Management

---

5. ***Do you have a Water and/or Wastewater master plan or long-range plan? (If the answer is NO, please proceed to question 6; if YES, please respond to questions a through e)***

5_W	☐ Yes ☐ No ☐ Not Sure	☐ Yes ☐ No ☐ Not Sure	**5_WW**
5A_W	a. What are the main projects identified and cost? ________________ ________________ ________________	a. What are the main projects identified and cost? ________________ ________________ ________________	**5A_WW**
5B_W	b. What is the total cost of projects identified? ________________	b. What is the total cost of projects identified? ________________	**5B_WW**
5C_W	c. What year does the master plan project to? ________________	c. What year does the master plan project to? ________________	**5C_WW**
5D_W	d. Are you aware that you can receive Water Plan Compliance approval for your master plan through the Natural Resources Commission? ☐ Yes ☐ No	d. Are you aware that you can receive Water Plan Compliance approval for your master plan through the Natural Resources Commission? ☐ Yes ☐ No	**5D_WW**
5E_W	e. Who prepared your master plan or long-range plan (system or engineer)? ☐ Consulting Engineer ☐ Prepared In-House ☐ Other	e. Who prepared your master plan or long-range plan (system or engineer)? ☐ Consulting Engineer ☐ Prepared In-House ☐ Other	**5E_WW**
5F_W	If 'Other', please specify: ________________	If 'Other', please specify: ________________	**5F_WW**

6. ***If your system does not have a Water and/or Wastewater master plan or long-range plan, how does your system plan for improvements, upgrades, and extensions?***

6_W

6_WW

7. ***How are improvements identified in your master plan, long-range plan, or other planning document expected to be funded?***

7A_W	a. Current Rates	a. Current Rates	**7A_WW**
7B_W	b. Raise Rates	b. Raise Rates	**7B_WW**
7C_W	c. Bonds	c. Bonds	**7C_WW**
7D_W	d. Grants	d. Grants	**7D_WW**
7E_W	e. Not sure	e. Not sure	**7E_WW**
7F_W	f. Other	f. Other	**7F_WW**
	If 'Other', please specify:	If 'Other', please specify:	
7G_W			**7G_WW**

8. ***If you selected "current rates" in question 7: Are your current rates sufficient to cover capital costs for all planned improvements to your Water and/or Wastewater system?***

8_W	☐ Yes ☐ No ☐ Not Sure	☐ Yes ☐ No ☐ Not Sure	**8_WW**

9. ***If you selected "raise rates" in question 7: Have your future rate changes been adopted by your governing body (e.g., city council, board of directors, etc.)?***

9_W	☐ Yes ☐ No ☐ Not Sure	☐ Yes ☐ No ☐ Not Sure	**9_WW**

10. ***Select the most appropriate statement related to customer rate rates in the last 0-2 years:***

10_W			**10_WW**
	☐ Rates have increased in the past 0-2 yrs	☐ Rates have increased in the past 0-2 yrs	
	☐ Rates have decreased in the past 0-2 yrs	☐ Rates have decreased in the past 0-2 yrs	
	☐ Rates have not changed in the past 2 yrs	☐ Rates have not changed in the past 2 yrs	
	☐ Not sure	☐ Not sure	

11. ***Select the most appropriate statement related to customer rate rates in the last 2-5 years:***

11_W			11_WW
	☐ Rates have increased in the past 2-5 yrs	☐ Rates have increased in the past 2-5 yrs	
	☐ Rates have decreased in the past 2-5 yrs	☐ Rates have decreased in the past 2-5 yrs	
	☐ Rates have not changed in the past 2-5 yrs	☐ Rates have not changed in the past 2-5 yrs	
	☐ Not sure	☐ Not sure	

12. ***Do you have an Asset Management Plan for the repair and replacement of existing water system infrastructure?***

12_W	☐ Yes ☐ No ☐ Not Sure	☐ Yes ☐ No ☐ Not Sure	12_WW

13. ***Briefly describe your Asset Management Plan. For example, what percent of water infrastructure is replaced each year (e.g., pipe length, pump motors etc.)? What is the planning horizon (e.g., 5 years, 10 years)?***

13_W			13_WW
	______________________	______________________	
	______________________	______________________	
	______________________	______________________	
	______________________	______________________	
	______________________	______________________	

14. ***Have you or do you participate in state and/or federal funding programs?***

14A_W	a. Community Development Block Grant	a. Community Development Block Grant	14A_WW
14B_W	b. Drinking Water Revolving Loan Fund	b. Drinking Water Revolving Loan Fund	14B_WW
14C_W	c. Clean Water State Revolving Fund	c. Clean Water State Revolving Fund	14C_WW
14D_W	d. ANRC State General Obligation Bonds	d. ANRC State General Obligation Bonds	14D_WW
14E_W	e. ANRC Water/Sewer Solid Waste Fund – Water and Sewer	e. ANRC Water/Sewer Solid Waste Fund – Water and Sewer	14E_WW
14F_W	f. ANRC Water Development Fund – Water	f. ANRC Water Development Fund – Water	14F_WW
14G_W	g. U.S. environmental Protection Agency (SAP Grant)	g. U.S. environmental Protection Agency (SAP Grant)	14G_WW
14H_W	h. U.S. Department of Agriculture Rural Development (Farmer's Home)	h. U.S. Department of Agriculture Rural Development (Farmer's Home)	14H_WW
14I_W	i. Not sure	i. Not sure	14I_WW
14J_W	j. Other	j. Other	14J_WW
	If 'Other', please specify:	If 'Other', please specify:	
14K_W	______________________	______________________	14K_WW

15. ***What factors influenced your selection of the funding program?***

15_W

15_WW

16. ***Has your customer base increased or decreased in the past 10 years?***

16A_W

a. Residential

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16B_W

b. Commercial/Industrial

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16C_W

c. Other: ☐

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16D_W

d. Total: ______

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16A_WW

a. Residential

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16B_WW

b. Commercial/Industrial

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16C_WW

c. Other: ☐

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

16D_WW

d. Total: ______

☐ Increased ☐ Decreased

☐ Not applicable

☐ Not sure

17. ***FOR WATER SERVICE PROVIDERS: Have you updated your Water infrastructure vulnerability assessment in the past 3 years? (Initial and only required submission to the EPA under the Bioterrorism Act of 2002 was due in 2003/2004.)***

17_W

☐ Yes ☐ No ☐ Not Sure

18. ***FOR WATER SERVICE PROVIDERS: Have you updated your written emergency response plan for your Water infrastructure system? (Initial and only required submission to the EPA under the Bioterrorism Act of 2002 was due in 2003/2004.)***

18_W

☐ Yes ☐ No ☐ Not Sure

19. ***Has your Water and/or Wastewater infrastructure system considered working with another system in billing, operations, new facilities, or ownership?***

19_W ☐ Yes ☐ No ☐ Not Sure | ☐ Yes ☐ No ☐ Not Sure **19_WW**

20. ***If you provide only Water or only Wastewater services, do you have a business relationship with the other provider (billing, collection, or other operations)?***

20_W ☐ Yes ☐ No ☐ Not Sure **20_WW**

21. ***FOR WATER SERVICE PROVIDERS: How are upcoming regulations going to affect operation and management of your infrastructure system?***

21A_W a. Disinfection by-product

21B_W b. Other EPA regulations

21C_W c. Other non-EPA regulations

22. ***FOR WASTEWATER SERVICE PROVIDERS: How are upcoming regulations going to affect operation and management of your infrastructure system?***

a. Nutrient limits **22A_WW**

b. Other permit requirements **22B_WW**

c. Sewer Overflows or other capacity issues **22C_WW**

23. ***FOR WATER SERVICE PROVIDERS: Please individually score the below issues, with 1 meaning not important at all and 10 meaning extremely important, for your Water system.***

23A_W a. Aging Infrastructure

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23B_W b. Managing Capital Costs

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23C_W c. Managing Operational Costs (e.g., energy, chemical, etc.)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23D_W d. Funding or Availability of Capital

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23E_W e. Increasing/Expanding Regulation (e.g., disinfectant by-product rule)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23F_W f. Information Technology

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23G_W g. Treatment Technology

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23H_W h. Retiring or Lack of Qualified Personnel (e.g., operators)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23I_W i. Water Scarcity or Availability, and/or Conservation

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23J_W j. Water Loss (non-revenue water)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23K_W k. Other

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

23L_W Other: ____

24. ***FOR WASTEWATER SERVICE PROVIDERS: Please individually score the below issues, with 1 meaning not important at all and 10 meaning extremely important, for your water system.***

24A_WW

a. Aging Infrastructure

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24B_WW

b. Managing Capital Costs

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24C_WW

c. Managing Operational Costs (e.g., energy, chemical, etc.)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24D_WW

d. Funding or Availability of Capital

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24E_WW

e. Increasing/Expanding Regulation (e.g., disinfectant by-product rule)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24F_WW

f. Information Technology

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24G_WW

g. Treatment Technology

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24H_WW

h. Retiring or Lack of Qualified Personnel (e.g., operators)

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24I_WW

i. Inflow and Infiltration

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

24J_WW

j. Other

1 2 3 4 5 6 7 8 9 10 ☐ Not applicable

Other: ____ **24K_WW**

25. ***Other Information [please provide additional information that you would like the Arkansas Natural Resources Commission to consider in the updated Arkansas Water Plan].***

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