
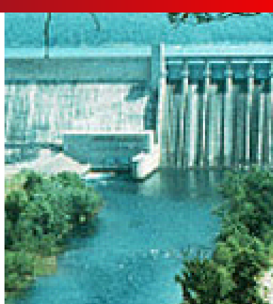

Mid Arkansas Water Resource Study

Prepared for
Little Rock District of
U.S. Army Corps of Engineers

In partnership with
Mid-Arkansas Regional Water Discussion Group,
Arkansas Soil & Water Conservation Commission, and
Ouachita River Water District

November 2002

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Black & Veatch Corporation

U.S. Army Corps of Engineers
USACE Contract No. DACW03-01-D-0002 Task Order No. 0003

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B&V File: B-1.1
Date: November 22, 2002

Mr. Michael Biggs, Hydraulic Engineer
Planning, Environmental and Regulatory Division
US Army Corps of Engineers
700 W. Capitol Ave., PO Box 867
Little Rock, Arkansas 72203-0867

Subject: Mid-Arkansas Regional Water Supply Study

Dear Mr. Biggs:

We are pleased to present the Mid-Arkansas Regional Water Supply Study. This study examines five alternative methods for supplying a future water supply to the central region of Arkansas to meet demand projected through the year 2050. Each alternative includes a combination of the following sources to meet this demand: Greers Ferry Lake, Lake Ouachita, DeGray Lake, Arkansas River, and Bell Creek Reservoir (a lake that is yet to be constructed).

The study includes an economic and non-economic evaluation of each alternative. The non-economic evaluation considered environmental issues, water quality, land acquisition, security, flexibility, treatment requirements, and public acceptance.

Cost opinions presented in this report should be regarded as reconnaissance level figures. As study refinements are made, the total cost of the project should become more accurate. We do not anticipate that the relative ranking of the alternatives would change as a result of future cost refinements.

The best alternative, Alternative 1, utilizes new raw water sources Greers Ferry Lake and Lake Ouachita. These sources provide a new supply from the north and from southwest of the study area such that, should some unforeseen event occur at the lakes or supply lines, water could still be supplied to most participants via Central Arkansas Water's infrastructure. This Alternative also provides the flexibility to divert to Alternative 2 as more information becomes available. The early activities and implementation plan are nearly identical between the two alternatives.

To implement a plan of this magnitude, it is important that the participants to this study remain united. Some type of institutional hierarchy needs be formed to accept both discretionary and congressionally approved raw water reallocations on behalf of the participants. The institutional formation should begin immediately. The process of requesting water reallocations should begin as soon as possible.

We appreciate this opportunity to serve the Corps and the other participants in this important and challenging project and look forward to the opportunity to work with you again.

Sincerely yours,

Earl Jenkins, Project Manager
Black & Veatch Corporation

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 9867
EARL E. JENKINS

ACKNOWLEDGEMENT

We want to thank all of those individuals who participated in this important study and the valuable input provided. We especially want to acknowledge the efforts of the following people who helped coordinate the meetings and provided special input in the development of study.

Mr. Michael Biggs, P.E., Corp of Engineers, served as the contracting officer. In this function Mike was instrumental in keeping the project focused and moving in a positive direction.

Mr. Steve Morgan, Director of Regionalization, Central Arkansas Water was charged with participant coordination that was no easy task. Steve arranged meeting times and places.

Mr. James McKenzie, Executive Director, Metroplan was invaluable in providing population projections.

Mr. Earl Smith, P. E., Division Chief, Arkansas Soil and Commission provided the project with a wealth of knowledge regarding both surface and groundwater in Arkansas.

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Purpose

The purpose of this study is to evaluate future water needs of central Arkansas and identify sources to meet those needs through the year 2050. The study culminates with comprehensive report identifying the needs, potential water sources that can best serve those needs and identifies the infrastructure necessary for implementation. The U.S. Army Corps of Engineers (USACE), Mid-Arkansas Region Water Discussion Group, Ouachita River Water District, and the Arkansas Soil and Water Conservation Commission sponsored this study. Participating entities and legal entities that funded this study and whose future needs are the primary purpose of this study, include:

- Benton Water PWS #484
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- Sardis Water Association PWS#493
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- Arkansas Soil and Water Conservation Commission
- U.S. Army Corps of Engineers

Potential raw water sources investigated included Lake Ouachita, DeGray Lake, Greers Ferry Lake, Lake Nimrod and the potential use of Bull Creek reservoir that has not been constructed. Lakes Winona and Maumelle are used to capacity for raw water supply to Central Arkansas Water. Also investigated, as potential raw water sources, were the aquifer system, the Arkansas River, and the Ouachita River.

Three progress meetings were held during the duration of the study with the sponsors and participating entities. The initial "Kick-off" meeting was held May 6, 2002 to discuss concerns of the participants and to obtain relevant participant data. The second meeting, held at approximately the 30 percent completion stage on June 27, 2002, was to obtain confirmation of population and water use projections and to discuss potential alternatives. The third meeting was held October 24, 2002 at approximately the 90 percent stage to obtain participants' comments regarding alternative formulation.

Population Projections

Metroplan compiled most of the population data. Current population data for individual entities were obtained from the Arkansas Department of Health website for those entities where Metroplan, city or county data could not be subdivided. These data were compiled by county and then urban population were broken out from the county data. Using the bases presented above the projected populations presented in Table ES-1 are used to establish future water demand for the service area.

Table ES-1
Population Projections for Participating Entities

Entity	2000	2010	2020	2030	2040	2050
Benton Water Works	21,906	32,859	35,901	38,943	41,985	45,027
Benton (Wholesale)[1]	17,895	20,520	23,145	25,769	28,394	31,019
Bryant	9,764	13,522	17,279	21,037	24,794	28,552
Cabot[2]	17,000	38,533	44,207	45,533	46,859	48,186
Central Arkansas Water	314,183	325,353	336,523	347,694	358,864	370,034
Conway Corporation	43,167	57,174	75725	100,295	132,838	175,941
Conway County RWDD	20,336	20,776	21,215	21,655	22,095	22,535
Grand Prairie	10,088	9,821	9,554	9,288	9,021	8,754
Hot Springs Village	10,500	13,658	16,816	19,974	23,133	26,291
Jacksonville	29,916	32,675	35,435	38,194	40,954	43,713
Jacksonville (Sales)	5,315	5,805	6,295	6,786	7,276	7,766
Maumelle Water Corp.	2,104	2,998	3,893	4,787	5,682	6,576
Maumelle Water Mgmt.	10,557	15,010	19,463	23,916	28,369	32,822
No. Pulaski County	6,297	7,060	7,823	8,586	9,350	10,113
Saline Co. W & SS FB	1,537	1,811	2,085	2,360	2,634	2,908
Other Saline County	19,338	21,827	24,316	26,805	29,294	31,783
Sardis Water Assoc.	11,506	14,955	18,404	21,852	25,301	28,750
Total	551,409	634,357	698,080	763,475	836,843	920,769

[1]Includes Tull, Salem, Southwest Water Association and West Bauxite.
[2]Includes Austin and Highway 319 Water Users Association.

There are water providers located in the vicinity of the study area who did not financially participate in this study but whose needs could be addressed by one or more of the regional alternatives. The approach used to project growth is based on including all of the population for Pulaski and Saline Counties. The participating entities currently serve the majority of the population in these counties. It is reasonable that a regional water supply could easily meet the demands of the other providers in these counties, therefore the entire population of these counties was included.

Projected Water Needs

Historical water use data were requested from each of the participating entities. These data were reviewed to develop average per capita water use and peak day water use for each service area. To calculate the projected water needs, the population projections were multiplied the historically based daily consumption factors developed for each entity. The daily consumption factors include all residential, commercial, and industrial flows. Using these values presumes that the rate of future commercial and industrial use will mirror the population growth.

Table ES-2 presents the peak and average flow for five general service areas. These areas were selected to reflect the proximity of groups of participants to a particular region, which facilitates the evaluation of alternative water supply sources. The five areas and the participants associated with each area are also presented in Table ES-2. Table ES-3 delineates flow required north and south of the Arkansas River. This data is important due to the location of the existing water treatment facilities and the difficult and costly means of transporting additional water across the river.

Table ES-2 Peak and Average Flow by Area						
	2000	2010	2020	2030	2040	2050
Conway Area [(1)]						
Avg. Flow, mgd	12	15	18	23	29	37
Peak Flow, mgd	20	24	31	39	50	64
CAW[(2)]–North of River						
Avg. Flow, mgd	28	34	37	39	41	43
Peak Flow, mgd	53	63	69	73	76	80
CAW[(3)]–South of River						
Avg. Flow, mgd	39	40	41	42	44	46
Peak Flow, mgd	77	80	82	86	89	92
Saline County[(4)]						
Avg. Flow, mgd	8	10	12	13	15	16
Peak Flow, mgd	13	17	20	22	25	27
Hot Springs Village						
Avg. Flow, mgd	2	3	4	5	5	8
Peak Flow, mgd	4	5	6	7	9	14
Total						
Avg. Flow, mgd	89	102	112	123	134	150
Peak Flow, mgd	167	189	209	227	249	277

[(1)] Includes Conway Corporation and Conway County.
[(2)] Includes CAW north of the river, North Pulaski County, Jacksonville, Cabot, Grand Prairie, and Maumelle Water Corporation.
[(3)] Includes CAW south of the river and Maumelle Water Management.
[(4)] Includes Benton, Bryant, Sardis, Saline Co. W&SSFB, and Other Saline County users.

Table ES-3 Flow by River Division						
	2000	2010	2020	2030	2040	2050
North of River						
Avg. Flow, mgd	40	49	55	62	70	80
Peak Flow, mgd	73	87	100	111	126	144
South of River						
Avg. Flow, mgd	49	53	57	61	64	70
Peak Flow, mgd	94	102	109	115	123	133
Total						
Avg. Flow, mgd	89	102	112	123	134	150
Peak Flow, mgd	167	189	209	226	249	277

Water Sources

Both groundwater and surface water are used as water supplies for this area and were considered for future water needs. Groundwater has served as a source of drinking water for many of the participating entities. Due to the safe yield concerns, concerns relating to poor water quality due to saline intrusions consistent with declining groundwater levels, and portions of this study area having been declared a "critical groundwater area" by the Arkansas Soil and Water Conservation Commission, alternatives utilizing groundwater sources will not be considered. All study participants who attended the June 27, 2002 meeting agreed to eliminate groundwater from further consideration as a future water source.

Data were collected about existing and potential surface water supplies and their available safe yield. Existing surface water supplies include Lakes Winona and Maumelle (Central Arkansas Water); Lake James H. Brewer (City of Conway and Conway County); North Fork of the Saline River, Lake Norrell (Benton); and Middle Fork of the Saline River and Lake Lago (Hot Springs Village). For this study, Benton and Hot Springs Village requested that the yield from their existing water sources not be included as available for future water needs. The safe yield available for future water supply from existing sources is approximately 143 mgd. This includes the planned improvements to Lake Brewer that will increase its firm yield another 9 mgd.

At the Kick-off meeting for this study, the potential surface water supplies that were identified for consideration included Greers Ferry Lake, Lake Ouachita, DeGray Lake, Bull Creek Reservoir, the Arkansas River, Nimrod Lake, and the Ouachita River. At the 30 percent in progress review meeting, the group narrowed the list of potential future water sources to Greers Ferry Lake, Lake Ouachita, DeGray Lake, Bull Creek and the Arkansas River. None of the rivers in Arkansas are considered to have a firm yield that would be available for water supply. Thus, impoundments would be required to store water taken from rivers for use as drinking water. For Corps lakes, all water storage has been allocated for specific uses including conservation, recreation, flood storage, and power generation. DeGray Lake is the only Corps lake included in this study that currently has storage specifically allocated for water use. However, the Chief of Engineers has the discretionary authority to reallocate up to 15 percent of the total storage capacity allocated to all purposes or 50,000 ac-ft, whichever is less, provided the reallocation has no severe effect on other authorized purposes or will not involve major structural or operational changes. Reallocation of larger volumes require congressional approval.

Table ES-4 presents a summary of the water supply available to meet future demand.

Table ES-4 Available Firm Yield from New Sources			
	Allocated storage yield, mgd(1)	Discretionary Storage yield, mgd(2)	Total Currently available, mgd
Arkansas River	0.0	0.0	0 (3)
Greers Ferry Lake	0.0	26.5	26.5
Lake Ouachita	0.0	30.75	30.75
DeGray Lake	120.0	29.29	149.29
Bull Creek	30.0	0.0	30.0

(1) Allocated storage is storage currently designated for water supply.

(2) Only remaining yield shown here, some of the 50,000 ac-ft of discretionary storage has been reallocated at Greers Ferry and Lake Ouachita

(3) Arkansas River has no firm yield available for water supply. Impoundment required.

Water Treatment Facilities

Water treatment needs will be based on providing sufficient treatment capacity to meet peak day demand for 2050. It is anticipated that peak hour demands will be met by providing sufficient storage of treated water. Existing plant capacities were reviewed to identify the plants that may be available for future needs through 2050. Current water treatment capacity in the region is 239 mgd, of which up to 223 mgd of treatment capacity was identified as available for use to meet future regional needs. The treatment plants at Hot Springs Village, Conway County and Conway Corporation will probably only be available for those specific areas due to geographic location. Benton's water treatment plant could be used in a regional system, should they desire it.

An additional 54 mgd of new treatment capacity will be required to meet the Year 2050 peak day demand primarily to serve the needs in the North of the River Area (40 mgd) and the Saline County Area (14 mgd). Future treatment capacity for Hot Springs Village and the Conway area was not included in this study as those entities desired only raw water from this project. Any new water treatment facility will need to provide finished drinking water that meets all current, pending and future drinking water regulations. The three lake sources considered have similar water quality that could be treated using conventional treatment consisting of coagulation, flocculation, sedimentation, granular media filtration, and disinfection. Treatment of water from Bull Creek would be considered comparable to the treating the existing lake sources. The higher turbidities of the Arkansas River, the potentially flashy nature of the stream, and compliance with Arkansas Department of Health's current policy for the Arkansas River require presedimentation and advanced water treatment in addition to the conventional treatment processes listed for lake sources.

Disinfection of all four source waters, treated as above, would be with free chlorine; chloramines would likely be needed as a secondary disinfectant within the distribution system. The potential for viruses and other pathogenic organisms within the Arkansas River water make the use of multiple disinfectants a wise investment. Ultra-violet irradiation would also be used in conjunction with other disinfectants.

Existing treatment facilities will likely have to blend their treated water with water from the new treatment facilities. The only major treatment modification anticipated is the conversion of their disinfection practice to the use of chloramines as a secondary disinfectant. This conversion would only be necessary if the new regional water works is unable to supply treated water that would meet the new DBP limits using free chlorine in the distribution system.

Alternatives

Five alternatives were developed to meet the water supply and treatment demand for Year 2050. During the June 27, 2002 progress meeting, the participants identified factors that should be considered in formulating or evaluating alternatives for water supply and treatment. The factors are listed below:

- Alternatives should include using a single source as the sole supply of water where practical.
- Alternatives could include using multiple sources of water in the study area. For example, water could come from both Greers Ferry and Lake Ouachita to meet the total demand.
- Conway Corporation and Conway County expressed no interest in options that involved new water supply sources south of the river nor the Arkansas River.
- Conway Corporation and Conway County are only interested in raw water, not treated water.
- Hot Springs Village is only interested in obtaining additional raw water.
- Benton is primarily interested in raw water. It should be noted for Benton that there are several alternatives where providing treated water to the Benton area may be regionally advantageous. Providing either raw or treated water was considered.

Each alternative uses a combination of the five primary water supply sources identified as a possible source for water. Two of the alternatives would require new river crossings to supply additional water north of the Arkansas River. Intakes, pumping, piping and treatment facilities have been sized on peak day demand values.

Alternative 1

Alternative 1 involves supplying water from Greers Ferry Lake to meet Conway area and North of the River Area demand of 23 mgd average day. This will require continued use of the existing Arkansas River crossings to meet the demand north of the river. The 26.5 mgd of yield currently available from discretionary storage currently is sufficient to meet the average day demand for Conway and north of the rivavailable For study purposes, a 25 mgd treatment is located near the Sherwood offices of Central Arkansas Water to serve the North of the River Area. Lake Ouachita will be used to provide water to Hot Springs Village, Saline County area and the South of the River area. A 14 mgd treatment plant would provide treated water for the Saline County Area. All of the remaining discretionary storage should be pursued for reallocation.

Lake Ouachita would be used to supply water through Lake Winona to meet the 24 mgd combined demand of Hot Springs Village and the Saline County area. The safe yield of raw water available in Lake Ouachita by reallocating remaining discretionary storage is 30.75 mgd. This water supply would be sufficient to meet the projected future demand south of the Arkansas River. A new, incrementally expandable, 14 mgd plant would be located in the vicinity of Lake Winona. Hot Springs Village and Saline County users would have the option of obtaining raw or treated water.

Alternative 2

Alternative 2 also involves supplying water from both Lake Ouachita and Greers Ferry. Water obtained from Greers Ferry will provide water to Conway Corporation and Conway County. The safe yield of raw water available in Lake Ouachita by reallocating the remaining discretionary storage is 30.75 mgd. This raw water supply would be sufficient to meet the projected future demand south of the Arkansas River but would not meet all of the needs north of the river. Congress would have to be petitioned for reallocation of water at Lake Ouachita to meet the future demand south of the river plus the "North of River" area. Water will be pumped from Greers Ferry to Lake Brewer to meet the water demand in the Conway area. Raw water would be pumped from Lake Ouachita to Lake Winona. Along the route, the line would branch to provide Hot Springs Village with 8 mgd of raw water. A new expandable 39 mgd WTP would be constructed in the vicinity of Lake Winona. The WTP would supply treated water to western Central Arkansas Water and Saline County users. In addition, the Saline County Area and Hot Springs Village could be provided treated water if they so choose.

Alternative 3

Alternative 3 primarily uses water from DeGray Lake. Of the water supply sources being considered in this study, DeGray Lake is the only lake where storage has been allocated for use as a water supply. Central Arkansas Water has the right of first refusal on 120 mgd of water from DeGray Lake. Alternative 3 would involve a 34 mgd average day supply of water from DeGray Lake to serve Hot Springs Village, Saline County users, and Central Arkansas Water. Treated or raw water could be supplied to Benton and Hot Springs Village. Demand north of the Arkansas River area would be met by transporting treated water from the new WTP at Winona through a new transmission main and river crossing. For this study, the crossing has been located near the I-440 Bridge. A total of 39 mgd of new treatment is required. This can be accomplished with two plants, one near Lake Winona and the other near Benton, or a single plant located near Winona. A variation to this alternative could be to treat the water near DeGray Lake and convey treated water to the north; this variation may be appealing to additional users such as Arkadelphia and Malvern. Greers Ferry would be used to satisfy the raw water needs for Conway Corporation and Conway County.

Alternative 4

Alternative 4 utilizes the Arkansas River as the water source for users in the North of the River Area, Greers Ferry for the Conway area and Lake Ouachita for users south of the river. Based on data available from the Arkansas Soil and Water Conservation Commission, the firm yield from the Arkansas River is considered to be zero. A raw water reservoir will be constructed furnished to provide 120 day storage of river water taken from a river intake pump station located on the northern side of the river. A pump station and pipeline will transport raw water from the impoundment to a new water treatment plant located near the Central Arkansas Water offices on Maryland Avenue or near the reservoir should Conway Corporation or Conway County have a desire for a treated water supply. Just as for the other alternatives, the Conway area would be supplied with water from Greers Ferry. Water would be provided to the Hot Springs Village and Saline County areas from Lake Ouachita in the same manner as for Alternative 1.

Alternative 5

Alternative 5 provides water from the Bull Creek reservoir, Greers Ferry and Lake Ouachita. The Bull Creek reservoir, which has not yet been constructed, would serve as a raw water source. Information from previous studies indicates that the firm yield for the reservoir can be 30 mgd. This water source would satisfy the "North of the River" projected water demand, but is remote to Conway Corporation and Conway County. This alternative is based on these two water users fulfilling their water needs from Greers Ferry as in the other alternatives. For costing purposes, a new plant would be constructed near the Central Arkansas Water offices on Maryland Avenue just as for

Alternative 1. The treatment plant could be located at the lake as a variation to this alternative with minimal cost differences. Lake Ouachita would provide water to areas south of the Arkansas River just as for Alternative 1. Lake Winona would also supply the raw water for a new WTP located near the lake to serve the western portions of Central Arkansas Water Saline County users and give Hot Springs Village the option of having treated water.

Evaluation

A comparative cost and non-cost evaluation of each alternative was conducted. The cost evaluation involved developing opinions for capital cost, present worth, equivalent annual costs for each alternative. The present worth and equivalent annual costs are used to determine which alternative is the most-cost effective. The present worth and equivalent annual cost analyses are based on a 50 year planning period as stated in the scope of services for this project. The non-cost factors include environmental constraints, public acceptance and security considerations.

Table ES-5 presents a summary of our opinion of the probable initial year capital cost, present worth, equivalent annual cost and a unit cost per 1,000 gallons for each alternative. Note that these costs do not include costs to connect to individual participant's distribution system nor are any institutional costs that may be required. These are better addressed as part of a program to determine the most appropriate institutional arrangement for the participants pursuing additional water supply.

Alternative 5 has the lowest present worth and lowest capital cost. However, Alternatives 1 and 2 have values that are within 5 percent of Alternative 5. At the level of cost development performed for this study, costs that are within 10 percent of the low cost are considered equal. Alternatives 3 and 4 fall outside of this 10 percent range. Alternative 3 has a significantly higher cost and could not be justified on a cost basis.

Table ES-5
Initial Year Capital Costs, Present Worth (PW), Equivalent Annual Cost (EAC), And Unit Cost per 1,000 gallons

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Initial Year Capital Costs	$695 M	$698 M	$918 M	$713 M	$662 M
Total PW	$818 M	$811 M	$1,045 M	$895 M	$775 M
Lowest PW or % >Lowest PW	6%	5%	34%	15%	Lowest PW
Rank based on PW	3	2	5	4	1
Total EAC	$53 M	$52 M	$67 M	$58 M	$50 M
New Treatment Cap., mgd	39.0	39.0	39.0	39.0	39.0
Cost per 1,000 gal.	$3.70	$3.70	$4.70	$4.10	$3.50

Notes
1. Institutional Costs not included. May vary between alternatives based on institutional arrangement(s) agreed to be participants.

A meeting of the study participants was held October 24, 2002 to discuss the alternatives and solicit input from the participants about how the benefits and concerns of each alternative. Issues such as water quality, environmental constraints, public acceptance, and security were discussed.

Conclusions and Recommendations

Based on the cost opinions presented in this chapter and the comments presented at the October 24, 2002 meeting the following observations and conclusions are made:

1. The budget level opinion of costs developed for this study indicate that Alternative 5 has the lowest present worth, lowest equivalent annual cost, and lowest capital cost of the five alternatives.
2. While Alternative 5 has the lowest present worth cost, it is acknowledged that the unknowns related to construction of a new water supply source pose a greater risk that the cost of the project could increase significantly compared to the other alternatives.
3. The budget level opinion of present worth and capital costs for Alternatives 1 and 2 are within 5 percent of and can be considered equal in cost to Alternative 5.
4. Alternative 3 has a substantially higher present worth cost when compared to the other alternatives.
5. Alternative 4 has a present worth of cost that is approximately 15 percent higher than Alternative 5.
6. Alternative 5 involves the construction of a new water supply source, Bull Creek Reservoir. While past studies have evaluated it as an alternative, consensus among the study participants and the USACE representatives at the October 24th meeting is that constructing a new lake for water supply would meet with much resistance, especially given that water is available from existing reservoirs at a comparable cost and with most likely a much lower environmental impact.
7. DeGray Lake provides much of the water supply for Alternative 3. It is the only lake that currently has storage allocated specifically for water supply. However, the cost to bring water from DeGray to this service area is projected to be substantially greater than obtaining water using one of the other alternatives.
8. Alternative 4 involves obtaining water from the Arkansas River. Several concerns were raised about this water source. Many of the previous studies of

the Arkansas River indicated that there was a strong public perception that the Arkansas River was not a good drinking water supply source, which was restated at the October 2002 meeting. The Arkansas River option involves constructing a new impoundment. The costs developed in this study are based on information from past reports that identified land on the Camp Robinson property. It is not a given that this land would be made available for an impoundment or may require a substantial increase in the projected costs to construct this impoundment. The Arkansas River is also seen as having a greater risk of contamination from toxins, poisons, and other potentially dangerous pollutants as compared to the lakes.

The group focused in on Alternatives 1 and 2 as being most favorable. Both alternatives require reallocation of water from Greers Ferry and from Lake Ouachita. Alternative 1 provides more flexibility in the number of water supply sources that can serve the region.

Based on this evaluation, it is recommended that the group pursue obtaining the firm yield available from the remaining discretionary storage at Greers Ferry Lake and Lake Ouachita. The primary objective of this study was to determine which water supply(ies) best meets the projected demand through the year 2050. Taking water from Greers Ferry and Lake Ouachita are considered to be the best sources for both Alternatives 1 and 2. Pursuing water from both areas places the region is a strong position to respond to growth both north and south of the river in a cost-effective manner. The initial steps to implement a regional approach to water supply are equally appropriate for alternatives 1 or 2, giving the participating members the flexibility to respond to changes in growth easily and with little or no lost effort.

1.0 Introduction

1.1 Purpose

The purpose of this study is to evaluate future water needs of central Arkansas and identify sources to meet those needs through the year 2050. The study culminates with comprehensive report identifying the needs, potential water sources that can best serve those needs and identifies the infrastructure necessary for implementation. The U.S. Army Corps of Engineers (USACE), Mid-Arkansas Regional Water Discussion Group, Ouachita River Water District, and the Arkansas Soil and Water Conservation Commission sponsored this study.

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- Sardis Water Association PWS#493
- Ouachita River Water District
- Arkansas Soil and Water Conservation Commission
- U.S. Army Corps of Engineers

The scope of work for this project included:

- Review available reports. The USACE provided 23 reports of previous studies pertinent to this study. The list of reports is contained in Appendix A.
- Define potential new water sources.

- Define the service area.
- Develop the history and background the water systems including water use and projected water use.
- Define the water needs for the service area.
- Define the water treatment requirements for each new water source.
- Examine transmission and pumping needs.
- Provide recommendations and costs including capital, O&M and other associated costs. As part of this charge, for security considerations, the overall water system was to have enhanced redundancy and survivability.

Potential raw water sources investigated included Lake Ouachita, DeGray Lake, Greers Ferry Lake, Lake Nimrod and the potential use of Bull Creek reservoir that has not been constructed. Lakes Winona and Maumelle are used to capacity for raw water supply by Central Arkansas Water. Also investigated, as potential raw water sources, were the aquifer system and the Arkansas River.

Three progress meetings were held during the duration of the study with the sponsors and participating entities. The initial meeting was held to discuss concerns of the participants and to obtain relevant participant data. The second meeting, held at approximately the 30 percent completion stage, was to obtain confirmation of population and water use projections and to discuss potential alternatives. The third meeting was held at approximately the 90 percent completion stage to obtain participants' comments regarding alternative formulation.

Five alternatives were developed using a combination of the new raw water sources to meet the projected 2050 demand. Each of the alternatives was developed in sufficient detail to obtain a "rough order of magnitude" cost.

1.1.1 Federal Authority

The Water supply Act of 1958, as amended, authorizes the Secretary of the Army to cooperate with local interests to provide storage in Corps of Engineers projects for water supply. The local interests must agree to pay the cost associated with the storage space. Paragraph 4-32d(1) of the Engineer Regulation (ER) 1105-2-100, "Policy and Planning," provides guidance for the reallocation of storage from other project purposes to water supply. The Chief of Engineers has the discretionary authority to reallocate 15 percent or 50,000 acre-feet, whichever is less, of the total storage capacity allocated to all authorized project purposes, provided the reallocation has no severe effect on other authorized purposes or will not involve major structural or operational changes.

1.1.2 Water Use Registration

Act 81 of 1957, as amended, empowers the Arkansas Soil and Water Conservation Commission (ASWCC) to register the use of all surface water. Act 1051 of 1985 requires the registering of all non-domestic ground water use with the Commission. Act 154 of 1991 provides the Commission the authority to develop a comprehensive ground water protection program, designate critical ground water areas, cost-share on installation of water conservation practices, establish ground water rights within critical areas, establish fees for ground and surface water withdrawals, develop an education/information program, and delegate management powers to regional water districts and conservation districts.

Act 81 of 1957 requires all diverters of surface water (streams, lakes, ponds, etc.) to register their diversion of surface water by quantity, location, type of use and name of user on an annual basis with the Commission. Exceptions to this rule are withdrawals of less than one acre-foot a year, diffused surface water or those natural lakes or ponds in exclusive ownership of one person. However, if that lake or pond is fed by or refilled by a well or another surface water source that source may need to be registered. The Commission is required to furnish each registrant a Certificate of Registration. The Commission utilizes these registrations for the allocation of water and as a basis for determining the state's overall usage and water needs for inclusion in the Arkansas Water Plan.

Act 1051 of 1985 requires all users of ground water to register their withdrawal of ground water, excluding water withdrawn from individual household wells used exclusively for domestic use and wells having a maximum potential flow rate of less than 50,000 gallons a day. The quantity, location, type of use and name of user must be registered on an annual basis with the Commission. The Commission utilizes these registrations to help establish a comprehensive ground water protection program.

Act 154 of 1991 requires all users of surface and ground water be assessed an annual water use fee in the amount of $10 per registered-surface water diversion and $10 per registered well, which are payable at the time of water use reporting, (October 1 through March 1). Fees collected will be utilized for cost-share on water conservation practices, administration, and information/education programs.

Act 154 of 1991 also requires a regulatory program. The requirement of a water right for the utilization of a well applies only to critical ground water areas in which the Commission has declared the regulatory program to be in effect. The regulatory program and issuance of water rights are limited to critical areas only. Critical ground water areas designation will be effective after public hearings are held describing the proposed action, the reasons therefore, and the recommended boundaries. These public hearings will be held in every affected county. There will be no limitations on ground water pumpage unless an affordable alternative exists. Existing wells will be exempt from the regulatory program under the "grandfather clause" or this Act. Exemptions from the regulatory program may also be granted if an individual can demonstrate a 20 percent reduction in ground water use or an implemented conversion plan. Water rights are transferable to replacement wells. Within one year of the establishment of the regulatory authority, newly constructed wells will be issued a water right for the amount requested.

1.1.3 Water Rights

Arkansas follows the "reasonable use" theory of water use by riparian--landowners whose property borders a watercourse, stream, or lake. Landowners may beneficially use water as long as they do not cause unreasonable damage to fellow riparians. Household use is given the highest priority, and use of over 1 acre-foot of water per year requires registration through the Commission or your local conservation district.

Groundwater is also subject to the reasonable use doctrine and to some regulation under the Arkansas Groundwater Protection and Management Act, which provides for the establishment of "critical groundwater areas."

For drainage, the "common enemy doctrine" applies, allowing a landowner to prevent damage to property by runoff without causing damage to neighbors.

1.2 Background

Water supply studies have been conducted by several of the entities that are participating in this study. A listing of the studies and other documents received from the USACE for review is presented in Appendix A. None of the studies include all of the service area that has been identified for this regional study nor have all studies included all of the potential sources for evaluation. Where applicable, information from the previous studies was used in the study. The goal for this study is to provide a comprehensive study that includes and addresses the needs of participants through a regional or clustered approach to water supplies.

2.0 Service Area and Participants

The following paragraphs provide a brief description of each water service provider that participated in this study. The water service providers included in this study have been placed into two groups. The first group, referred to as participating entities, includes water providers who are participating financially and have requested that their projected water needs be addressed. The second group, referred to as other water service entities, includes providers who did not financially participate in this study but whose needs could also be addressed by one or more of the regional water supply alternatives considered. Figure 2-1 illustrates the boundaries of the participating entities.

2.1 Participating Entities

2.1.1 Benton Water PWS #484

Benton Water is a utility service for the City of Benton, Arkansas in Saline County. The utility provides water to the city and wholesales water to Tull Water Association, Salem Water Association, Southwest Water Association, and West Bauxite Water Association. The treatment plant is designed to treat up to 13.3 million gallons per day of surface water taken from the Saline River. During low flow periods, the city releases water from Lake Norrell, a city-owned impoundment and a tributary of the North Fork of the Saline River. The Chenault Reservoir, a raw water reservoir having a storage volume of approximately 190 million cubic feet or the capability to supply the City raw water at a rate of 12 mgd for 120 days, is available to provide water to the treatment plant. Raw water is pumped from the Saline River to the Chenault Reservoir. There is a total of 3.90 million gallons of treated water storage within the service area including 2.15 MG of elevated storage.

2.1.2 Bryant Water PWS #486

The City of Bryant is located in Saline County between Benton and Little Rock. Bryant Water exclusively serves the City of Bryant and purchases treated water from Central Arkansas Water. The amount of purchased water is limited by the facilities serving the city. The City has two stand pipes, each capable of storing 1.0 million gallons.

2.1.3 Cabot Water PWS #338

Cabot Water primarily serves the City of Cabot, which is located in northern Lonoke County. Cabot supplies all of its own water and sells water to Hwy 319 Water

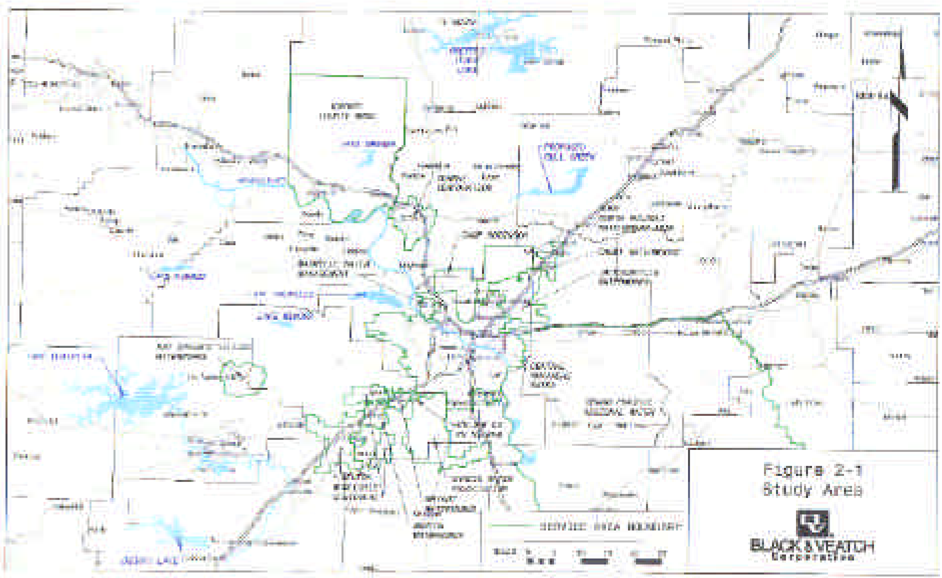


Figure 2-1
Study Area

Users in Faulkner County and the City of Austin located in Lonoke County. Cabot collects groundwater from 6 wells, each with a capacity of 1.0 mgd. The treatment plant has a 4.2 mgd capacity. Arkansas Soil & Water Conservation Commission (ASWCC) has limited Cabot to a 3.0 mgd removal rate from the aquifer. Cabot has requested that this be increased to 4.0 mgd. Cabot has approximately 4.63 million gallons of storage. Cabot has a concern about continuing to use wells as a long term solution and are working with Central Arkansas Water for long term surface water dependency.

2.1.4 Central Arkansas Water PWS #465

Central Arkansas Water is a new public water service entity resulting from the merger of the Little Rock Municipal Water Works and the North Little Rock Water Works on July 1, 2001. Central Arkansas Water directly serves the communities of Little Rock, North Little Rock, Sherwood, and Cammock Village and wholesales treated water to Jacksonville, Bryant, the North Pulaski Waterworks Association, Shannon Hills Water Department and Brushy Island Improvement District. Central Arkansas Water has to the two largest treatment plants in the service area: the 150 mgd Jack T. Wilson water treatment plant (WTP) and the 25 mgd Ozark Point WTP. Lake Winona supplies surface water that is treated at Ozark. Lake Maumelle primarily supplies water to the Wilson plant, but can also provide water to Ozark. The Jackson Reservoir is a 100 million gallon raw water storage reservoir that can feed water to either plant.

Central Arkansas Water's primary service area is divided by the Arkansas River with both of the existing treatment plants located south of the river. Six pipelines that cross the Arkansas River provide treated water to the north side of river. A seventh pipeline is planned by Central Arkansas Water that will be carried over the river by the proposed Murray Park foot bridge that will feed their intermediate pressure system on the north side of the river. Table 2-1 presents capacity data for these pipeline crossings.

2.1.5 Conway Corporation PWS #189

Conway Corporation operates the water system serving the City of Conway, Arkansas that is located in Faulkner County. The City of Conway is the only customer for Conway Corporation. The city has experienced unprecedented growth since 1960 and is expected to continue growing at a rapid pace for the next 30-50 years. Water obtained from Lake Brewer is treated at the 15 mgd Gleason WTP. An 8-mgd expansion of the WTP is under construction and scheduled to be completed in 2004. Based on an April 1999 technical design memoranda prepared by McGoodwin, Williams, & Yates in association with Black & Veatch, the safe yield for Lake Brewer was determined to be 16.7 mgd, of which 11 mgd is available for the City of Conway, 4.4 mgd for the Conway

Table 2-1 Central Arkansas Water Treated Water Pipelines Crossing over the Arkansas River			
Location	Diameter, in	Capacity @ 3 fps mgd[1]	Capacity @ 5 fps, mgd[1]
I-440 Bridge	24	6.1	10.2
I-430 Bridge	24	6.1	10.2
I-430 Bridge	30	9.5	15.9
I-30 Bridge	24	6.1	10.2
Broadway	16	2.7	4.5
Main	16	2.7	4.5
Murray Park (future)	36	12.7	22.9
Total Capacity, mgd		46.9	78.2
Firm Capacity, mgd [2] nearest mgd		33.2	55.3

Notes:
[1]Per discussions with Central Arkansas Water, it is preferred that for average day demand flow, velocities remain in the 3 feet per second (fps) range or lower and 5 fps when providing peak day flows.
[2]Firm Capacity based on having largest line out of service.

County Regional Water Distribution District and 1.3 mgd for the low-flow maintenance release. Based on growth projections anticipated for Conway, a new water supply source could be required as soon as 2006.

2.1.6 Conway County Regional Water Distribution District PWS #119

Conway County RWDD serves all of Conway County. The District operates an 8 mgd plant in Plumerville that treats water obtained from Lake Brewer. Raw water is conveyed 5 miles from Lake Brewer to the plant. The District's contract with the Conway Corporation permits the District to draw 4.5 mgd average on an annual basis or a maximum daily withdrawal of 7.5 mgd. The District owns a 16 inch pipeline that crosses the Arkansas River from Morrilton to Oppelo. Conway County wholesales water to Oppelo, Plumerville and Menifee.

2.1.7 Grand Prairie Regional Water District PWS #738

The Grand Prairie Regional Water District covers approximately 4,500 square miles that is generally bounded by US Highway 40 on the north, the White River on the east and the Arkansas River on the south and west. Formed in 1984, the District covers all of Arkansas county, the portion of Jefferson County east of the Arkansas River, the portions of Lonoke and Prairie Counties south of Highway 40 and a small portion of

Monroe County. Stuttgart is located within the service area but is not served by the water district. Currently all of the service connections in the District are residential. Wholesale customers include Humnoke, Coy, and Ulm and all within the boundary of the District.

Grand Prairie supplies treated water from two plants that treat groundwater. The Lonoke plant has a peak capacity of 2.0 mgd. Chlorine, polymer, potassium permanganate, and fluoride are added to the water. The capacity of the Lonoke plant can be doubled, but the supply lines to the plant would have to be increased. The second plant is located in DeWitt and has a peak capacity of 1.0 mgd, which cannot be increased. Chlorine and fluoride are added to the water at the DeWitt plant. The District has nine storage tanks that have a total storage capacity of 1.7 million gallons. A 1.0 million-gallon ground storage tank is located in Lonoke, which gives the District a total of 2.7 million gallons of storage.

2.1.8 Hot Springs Village Waterworks PWS #208

Hot Springs Village is a private resort / retirement unincorporated community located in Garland and Saline Counties. Hot Springs Village pumps water from an intake located on the Middle Fork of the Saline River to Lake Lago, a water storage lake constructed in 1974. Water from Lake Lago is treated with a 4 mgd plant that was upgraded in 1996. The plant currently treats an average day flow of approximately 1.9 mgd. Ultimate build out of the resort is approximately 66,000 people. Hot Springs Village projects that this would require an average day treatment requirement of 6.6 mgd and 14 mgd peak day flow. A report prepared by Garver and Garver indicates that the Middle Fork of the Saline River in conjunction with the offsite storage of Lake Lago is adequate to meet the needs for ultimate build out.

2.1.9 Jacksonville Waterworks PWS #466

The City of Jacksonville is located northeast of North Little Rock along Highway 67. Jacksonville provides water to its retail customers and wholesales treated water to Bayou Two Water Users, Furlow Water Users, Little Rock Air Force Base and the Cabot Water Department. Jacksonville owns two treatment plants, an East plant and West plant. The West plant no longer provides treatment and serves as a metering station for water that is purchased from Central Arkansas Water. Jacksonville purchases on average 3.0 mgd daily from Central Arkansas Water. The well field that used to serve the West Plant is no longer used except for emergencies. The wells are located in the 100 year flood plain and the water quality is poor. Raw water is conveyed from eleven wells located in Lonoke County to the East Plant through a 24 inch pipeline.

The treatment capacity of the East Side Plant is approximately 7.0 mgd while the West Side Plant has a capacity of approximately 3.5 mgd. Treatment at each plant consists of aeration for iron and manganese removal, coagulation with lime, sedimentation, and disinfection with chlorine gas. Additional treatment for water purchased from Central Arkansas Water includes chlorine gas, soda ash and zinc phosphate. The system serves approximately 30,000 people including the Little Rock Air Force Base, which draws water directly from storage at the West Side Plant.

2.1.10 Maumelle Water Corporation PWS #464

The Maumelle Water Corporation serves an area in the western part of Pulaski County, south of the Arkansas River; a map of service area was not provided. Service is provided to approximately 2,375 people through 950 residential meters with an average daily demand of approximately 330,000 gallons per day. Maumelle Water Corporation obtains their water from three wells that pump raw water from the Alluvial Aquifer. Wells 1 and 2 each have a capacity of 300,000 gallons per day. Well 3 has a design capacity of 432,000 gallons per day. Soda ash and chlorine are added to the water.

2.1.11 Maumelle Water Management PWS #463

The information presented here is taken from the Arkansas Department of Health database. Water Management serves approximately 10,500 people using ground water. It has an average day demand of approximately 2.2 mgd and a peak demand of 5.0 mgd.

2.1.12 North Pulaski County Waterworks Association PWS #725

As noted by the name, North Pulaski generally serves the northern portions of Pulaski County that is not served by Central Arkansas Water or Jacksonville. North Pulaski serves approximately 2,700 residential and industrial/commercial customers and until recently provided water to one wholesale customer, Vilonia. North Pulaski no longer serves Vilonia. Average demand for 2001 was 975,000 gallons per day of which approximately 100,000 gallons per day was sold to Vilonia. North Pulaski purchases all of its water from Central Arkansas Water.

2.1.13 Saline County Waterworks and Sanitary Sewer Facilities Board PWS #491

The Saline County Water Works and Sanitary Sewer Facilities Board (FB) serves an area located just east of the City of Bryant and is bounded on the south and east by the Sardis Water Association. The Board serves approximately 560 residential customers and has no industrial/commercial connections. Groundwater from two wells are chlorinated and distributed to their customers. The current average day usage is approximately 120,000 gallons per day. The Saline County FB is currently negotiating with Central Arkansas Water for a supplemental water supply.

2.1.14 Sardis Water Association PWS #493

Sardis Water Association serves an area covering approximately 100 square miles with approximately 4,500 metered customers. Sardis operates three treatment plants that treat groundwater from 6 wells with a combined total capacity of 4.6 million gallons per day. Sardis provides all water used in their service area and has no wholesale customers. They have a two-way master meter with the City of Shannon Hills that is used only in emergency situations. The average water demand is approximately 1.1 million gallons per day for a population of 12,180. Sardis indicates that the water table continues to decline, which results in less capacity and poorer quality water. They project that water shortages could occur within 5-10 years, thus they are interested in an alternative source.

2.2 Non Participating Entities

As previously discussed, there are water providers located in the vicinity of the study area who did not financially participate in this study but whose needs could be addressed by one or more of the regional alternatives. The approach used to project growth is based on including all of the population for Pulaski and Saline Counties. As is discussed in Chapter 3, the participating entities currently serve a great majority of the population in these counties. It is reasonable that a regional water supply could easily meet the demands of the other providers in these counties, therefore the entire population of these counties were included. The following entities and other entities not specifically listed but located in Pulaski or Saline Counties could benefit from this approach.

- Haskell
- Salem Water Users
- East End Water Users
- Southwest Water Users Association
- West Bauxite Water Association
- Tull
- 145th Street Water and Sewer
- Oakwood MHP Waterworks
- Stone Village MHP Waterworks
- Woodson-Henley Water Company
- Alcoa
- Bennett Acres
- Benton Services Center
- Chicot Road
- Ward
- Woodland Hills

3.0 Growth Projections and Projected Water Needs

3.1 Population Projections

Population and population projections are important for this study because it is from the population data that water use is derived. Metroplan compiled most of the population data. Current population data for individual entities were obtained from the Arkansas Department of Health website for those entities where Metroplan, city or county data could not be subdivided. These data were compiled by county and then urban population were broken out from the county data. The data for Conway, Faulkner, Lonoke, Pulaski, and Saline counties are shown in Table 3-1.

Table 3-1
County Population Data from Metroplan

	2000	2010	2020	2030	2040	2050
Conway	20,336	20,776	21,216	21,655	22,095	22,535
Faulkner	86,014	108,730	137,522	158,711	179,900	201,088
Lonoke	52,828	63,459	72,989	77,633	82,337	87,011
Pulaski	361,474	389,809	405,079	428,657	446,341	458,130
Saline	83,529	94,545	112,323	127,566	142,809	158,053

3.1.1 Conway County

The principal water provider in the county is Conway County Regional Water Distribution District and they serve greater than 90 percent of the county's population. For future water use requirements in the county, it is anticipated that Conway County Regional Water Distribution District will serve the entire county population.

The Metroplan data for Conway County is proposed. Conway County provided a projected growth rate that is faster indicating that they will grow from 20,500 to 30,500 in 2020, but does not show a projected 2050 population.

3.1.2 Conway Corporation

The City of Conway is located in Faulkner County. Conway Corporation only sells water within Conway's city limits. The City of Conway anticipates expanding and can do so with relative ease to the south and west. A recently prepared report for the Conway Corporation projects the 2030 population to be approximately 95,000. The projected population for 2050 would be 160,000 using the same curve. For Faulkner County, Metroplan projects the 2000 of slightly more than 83,000 to grow to nearly 160,000 by 2050. Metroplan also acknowledges that the census tract level projections for

Conway are somewhat low. For the purposes of this report, for year 2050 a service area population of 160,000 for the Conway Corporation will be used.

3.1.3 Pulaski County

It is reasonable to assume that all of the Pulaski County could be served by a regional water supply. Therefore the population data developed by Metroplan will be used to identify the projected growth for entities serving Pulaski County. Pulaski County includes Central Arkansas Water, Jacksonville Waterworks, North Pulaski, Maumelle Water Corporation, and Maumelle Water Management that are parties to this study. The county also includes 145th Street Water & Sewer, Maumelle Water Corporation, Oakwood MHP Waterworks, Stone Village MHP Waterworks, and Woodson-Hensley Water Company. These entities represent a 2000 population of approximately 4,000 or 1 percent of the present county population. This population is included for the purposes of this study; the county population as projected by Metroplan was used as presented.

For this study, Metroplan projections are used for Jacksonville, Maumelle (for Maumelle Water Management) and for each community respectively. For Central Arkansas Water, Metroplan projections are used for Little Rock, North Little Rock, Sherwood, and include Shannon Hills from Saline County. For North Pulaski County, the year 2000 retail population from Arkansas Department of Health data are used with a projected growth rate of 0.53 percent, which reflects the straight line growth rate calculated from Metroplan's year 2000 to 2050 growth for Pulaski County.

3.1.4 Saline County

It is reasonable to assume that all of Saline County could be served by a regional water supply. Therefore the population data developed by Metroplan will be used to identify the projected growth for entities serving Saline County. The Saline County entities contributing to this study are Benton Waterworks, Bryant Waterworks, Saline County Waterworks & Sanitary Sewer Facilities Board, and the Sardis Water Association. Benton wholesales water to the Salem Water Users, Southwest Water Association, Tull Water Association, and West Bauxite Water Association. The other significant users in the county are the Haskell Water System and East End Water that have a combined population of approximately 6,800, which is less than 10 percent of the county population.

It is proposed that the total county population as presented by Metroplan be used. Most of population is divided among the participating entities with the rest of the population identified in the study as "Other Saline County Users". It is anticipated that by 2050, all of Saline County will require some type of regional water supply to meet their needs.

3.1.5 Cabot

The Metroplan projects the present population of 15,261 to grow to approximately 42,000 by 2050. The public water service entities Austin and Highway 319 have been included in the population projections. Cabot indicates in their entity data sheet that they will be growing to 50,000 by the year 2020 according to data from Metroplan. This differs from Metroplan data.

3.1.6 Hot Springs Village

Projections by Metroplan indicate that the current population of 8,397 in Hot Springs Village will grow to approximately 21,000 in the year 2050. Hot Springs Village shows that full development of the village would be 60,000. However, no projected rate of growth is provided in the Hot Springs data for full development.

3.1.7 Grand Prairie Water District

The Grand Prairie Water District serves portions of Arkansas, Prairie, Monroe, and Lonoke Counties. While population is projected to significantly increase in Lonoke County, the populations of the remaining counties will remain steady or decline by 2050. In addition, the Grand Prairie Water District has the potential to serve area customers that presently do not have water service.

Data from Grand Prairie indicates that the District presently serves a population of approximately 12,500 and projects a population of 16,000 by 2008. Using a 0.5% per year straight-line growth rate, year 2050 population would be approximately 20,000. Metroplan projects that growth in the Grand Prairie service will decline. The area is presently losing population and the Metroplan data will be used in this analysis.

3.1.8 Total Projected Population

Figure 3-1 graphically depicts and Table 3-2 presents the projected service area population growth, which are based on the information presented above. These projections were used to establish future water demand for the service area.

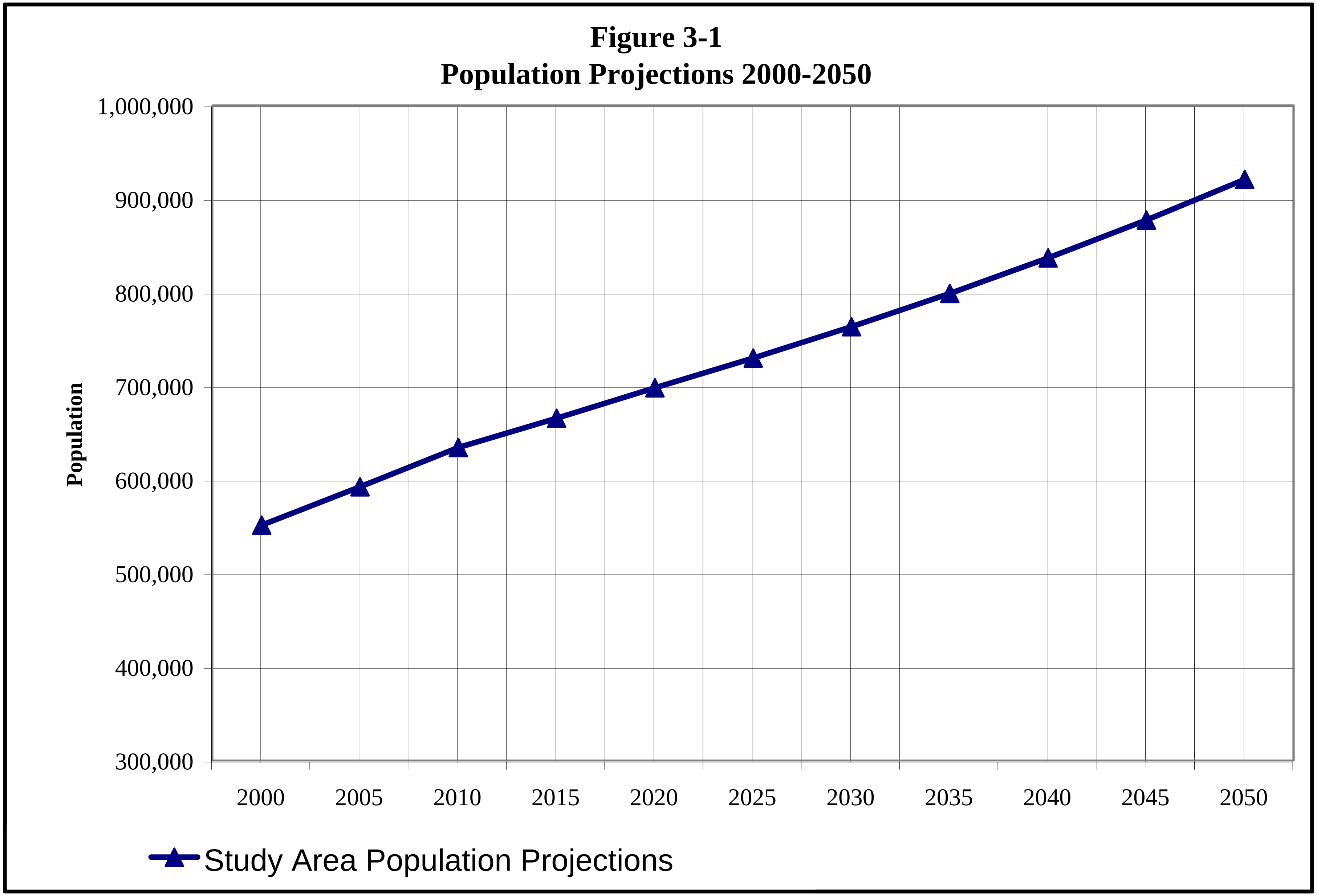


Figure 3-1
Population Projections 2000-2050
Population
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Study Area Population Projections

Table 3-2 Population Projections for Participating Entities						
Entity	2000	2010	2020	2030	2040	2050
Benton Water Works	21,906	32,859	35,901	38,943	41,985	45,027
Benton (Wholesale)(1)	17,895	20,520	23,145	25,769	28,394	31,019
Bryant	9,764	13,522	17,279	21,037	24,794	28,552
Cabot(2)	17,000	38,533	44,207	45,533	46,859	48,186
Central Arkansas Water	314,183	325,353	336,523	347,694	358,864	370,034
Conway Corporation	43,167	57,174	75,725	100,295	132,838	175,941
Conway County RWDD	20,336	20,776	21,215	21,655	22,095	22,535
Grand Prairie	10,088	9,821	9,554	9,288	9,021	8,754
Hot Springs Village	10,500	13,658	16,816	19,974	23,133	26,291
Jacksonville	29,916	32,675	35,435	38,194	40,954	43,713
Jacksonville (Sales)	5,315	5,805	6,295	6,786	7,276	7,766
Maumelle Water Corp.	2,104	2,998	3,893	4,787	5,682	6,576
Maumelle Water Mgmt.	10,557	15,010	19,463	23,916	28,369	32,822
No. Pulaski County	6,297	7,060	7,823	8,586	9,350	10,113
Saline Co. W & SS FB	1,537	1,811	2,085	2,360	2,634	2,908
Other Saline County	19,338	21,827	24,316	26,805	29,294	31,783
Sardis Water Assoc.	11,506	14,955	18,404	21,852	25,301	28,750
Total	551,409	634,357	698,080	763,475	836,843	920,769

(1)Includes Tull, Salem, Southwest Water Association and West Bauxite.

(2)Includes Austin and Highway 319 Water Users Association.

3.2 Projected Water Needs

Historical water use data was requested from each of the entities participating in this study. These data were reviewed to develop average per capita water use and peak day water use for each service area. To calculate the projected water needs for the study area, the population projections shown in Table 3-2 were multiplied by the daily consumption factors developed from the historical data for each entity. The daily consumption factors include all residential, commercial, and industrial flows. Using these values, presumes that rate of future commercial and industrial use will mirror the population growth.

Table 3-3 presents the peak and average flow for five general service areas. These areas were selected to reflect the proximity of group of participants to a particular region, which facilitates the evaluation of alternative water supply sources. The five areas and the participants associated with each area are also presented in Table 3-3. Average and peak flow water use data for each entity is presented in Appendix B. Table 3-4 delineates flow required north and south of the Arkansas River. This data is important due to the location of the existing water treatment facilities and the difficult and costly means of transporting additional water across the river.

Table 3-3
Peak and Average Flow by Area

	2000	2010	2020	2030	2040	2050
Conway Area [(1)]						
Population	63,503	77,950	96,940	121,950	154,933	198,476
Avg. Flow, mgd	12	15	18	23	29	37
Peak Flow, mgd	20	24	31	39	50	64
CAW[(2)]**–North of River**						
Population	180,126	213,618	231,251	244,538	257,823	271,109
Avg. Flow, mgd	28	34	37	39	41	43
Peak Flow, mgd	53	63	69	73	76	80
CAW[(3)]**–South of River**						
Population	215,334	223,638	231,942	240,247	248,551	256,855
Avg. Flow, mgd	39	40	41	42	44	46
Peak Flow, mgd	77	80	82	86	89	92
Saline County[(4)]						
Population	81,946	105,493	121,130	136,766	152,403	168,039
Avg. Flow, mgd	8	10	12	13	15	16
Peak Flow, mgd	13	17	20	22	25	27
Hot Springs Village						
Population	10,500	13,658	16,816	19,974	23,133	26,291
Avg. Flow, mgd	2	3	4	5	5	8
Peak Flow, mgd	4	5	6	7	9	14
Total						
Population	551,409	634,356	698,079	763,475	836,843	920,770
Avg. Flow, mgd	89	102	112	123	134	150
Peak Flow, mgd	167	189	209	227	249	277

[(1)] Includes Conway Corporation and Conway County.

[(2)]Includes CAW north of the river, North Pulaski County, Jacksonville, Cabot, Grand Prairie, and Maumelle Water Corporation.

[(3)] Includes CAW south of the river and Maumelle Water Management.

[(4)] Includes Benton, Bryant, Sardis, Saline Co. WWSSPFB, and Other Saline County users.

Table 3-4
Population and Flow by River Division

	2000	2010	2020	2030	2040	2050
North of River						
Population	243,629	291,567	328,191	366,488	412,757	469,585
Consumption, gpcpd	163	167	167	168	169	170
Avg. Flow, mgd	40	49	55	62	70	80
Peak Flow, mgd	73	87	100	111	126	144
Peak/Avg.	1.83	1.78	1.82	1.79	1.80	1.80
South of River						
Population	307,780	342,790	369,888	396,987	424,086	451,185
Consumption, gpcpd	159	155	154	154	151	(1)
Avg. Flow, mgd	49	53	57	61	64	70
Peak Flow, mgd	94	102	109	115	123	133
Peak/Avg.	1.92	1.92	1.91	1.89	1.92	1.90
Total						
Avg. Flow, mgd	89	102	112	123	134	150
Peak Flow, mgd	167	189	209	226	249	277

Notes:

(1) Per capita consumption is projected to continue downward in this area through Year 2050. The flow values for Year 2050 in this area include an additional amount of flow requested by Hot Springs Village to meet project build out needs for their development even though projected build out is expected by Year 2050. Population values were not adjusted, therefore any per capita value for Year 2050 for this region would be skewed.

4.0 Water Supply Sources

4.1 Introduction

Both groundwater and surface water are used as water supplies for this area and were considered for future water needs.

4.2 Groundwater Sources

Groundwater in central Arkansas is drawn from two aquifer systems: the alluvial aquifer system and the Mississippi Embayment aquifer system. The alluvial system consists of the Arkansas River aquifer and the more extensive Mississippi River Valley aquifer. The Mississippi Embayment aquifer underlies the alluvial aquifers although these aquifers are connected to each other throughout eastern Arkansas.

The alluvial aquifers can yield large quantities of water; properly constructed wells can yield 500 gpm almost anywhere in the system. Wells in the Mississippi River Valley system have been reported to yield as much as 5,000 gpm.

The Mississippi Embayment aquifer system is comprised of several aquifers: the Nacatoch, the Wilcox, the Sparta, and the Cockfield. The Sparta, the most productive aquifer, is capable of producing yields in excess of 1,000 gpm.

The City of Maumelle uses the Arkansas River alluvial aquifer for drinking water. The Mississippi Embayment is used by England and Ward (Cockfield), Cabot, Grand Prairie East End and Coy (Sparta) and Sardis (Wilcox). The quality of water from these aquifers is generally suitable for most purposes. The water may contain excess hardness, iron and manganese, but is conventionally treatable for drinking water.

As a result of large scale groundwater withdrawals primarily for rice farming, groundwater levels in the state are declining. Declining aquifer water levels create a multitude of problems for everybody. Because of the excessive withdrawals of groundwater, the safe yield has been approached or exceeded in the alluvial and Sparta aquifers. Due to the safe yield concerns, concerns relating to poor water quality due to saline intrusions consistent with declining groundwater levels, and portions of this study area having been declared a “critical groundwater area” by the Arkansas Soil and Water Conservation Commission, alternatives utilizing groundwater sources will not be considered. Eliminating groundwater from further consideration as future water source was agreed to by all participants of this study who attended the June 27, 2002 meeting. Several of the existing entities currently use groundwater and already are experiencing difficulty in obtaining adequate water from their sources.

4.3 Surface Water Sources

Data were collected about existing and potential surface water supplies and their available "safe" (i.e. firm) yield. Existing water supplies include Lakes Winona and Maumelle (Central Arkansas Water); Lake James H. Brewer (City of Conway and Conway County); North Fork of the Saline River, Lake Norrell (Benton); and Middle Fork of the Saline River and Lake Lago (Hot Springs Village). Potential water supplies that are reviewed include Greers Ferry Lake, Lake Ouachita, DeGray Lake, Bull Creek Reservoir, the Arkansas River, Nimrod Lake, and the Ouachita River. This section provides a definition of safe yield and discretionary storage as used in this study, describes the existing water supplies, and evaluates potential future surface water sources and their available "safe" yield.

4.3.1 Safe yield

The safe yield for a river is defined by the Arkansas Department of Environmental Quality (ADEQ) as the amount of water available from a dependable stream flow that is present in a stream 95 percent of the time during the year minus the discharge necessary to maintain minimum stream flow conditions established for that stream (Ref.11). From ADEQ references, neither of the rivers being considered in this study have a safe yield that would be available as a water supply. Impoundments or other sources of water would need to be developed to supply water from the Ouachita and Arkansas Rivers.

The safe yield for an impoundment is based on the storage capacity of the impoundment and the amount of reliable inflow to the lake to replenish the water used. The United States Army Corps of Engineers has established how much usable storage is available and has defined a firm yield from that storage for DeGray Lake, Lake Ouachita, and Greers Ferry (Ref. 8).

For purposes of this study, the term "safe yield" and "firm yield" are synonymous.

4.3.2 Discretionary Storage in USACE Lakes

The Water Supply Act of 1958, as amended, authorizes the Secretary of the Army to cooperate with local interests to provide storage in USACE projects for water supply. The local interests must agree to pay the cost associated with storage space. The Chief of Engineers has the discretionary authority to reallocate up to 15 percent or 50,000 ac-ft, whichever is less, of the total storage capacity allocated to all purposes, provided the reallocation has no severe effect on other authorized purposes or will not involve major structural or operational changes. Larger changes in allocation require congressional approval. Each of the USACE lakes considered in this study has a usable storage that has been allocated for power, joint power/water, or water use.

Reallocation of discretionary storage requires a study to evaluate the impact on hydropower or other uses, which may take up to 18 months (Ref. 30). Reallocation costs include reimbursement for reservoir capital and operation and maintenance costs. The cost of water reallocated is based on the greater of reallocated storage costs, loss of benefits, loss of revenue, or replacement costs (Ref. 19). The time required for the study and costs of reallocation should be considered in evaluating alternatives that involve reallocation of discretionary storage.

In addition to cost and schedule considerations, there may be resistance to reallocation of discretionary storage by recreational and power users. The reallocation may result in environmental impacts due to a drop in the water level or reduction in downstream releases (Ref. 8 and 30). However, in general, these impacts are likely to be minimal based on the relative size of the reservoirs being considered and the small volume of the discretionary storage involved. Because of its smaller size, DeGray Lake is an exception to this generalization. The removal of 50,000 acre-feet from this reservoir may have an impact on the water level and downstream releases because the total reservoir storage is only 635,000 acre-feet over 14,000 acres (Ref. 24).

4.3.3. Existing Surface Water Supplies

Several entities currently use surface water as their supply for drinking water. These include Central Arkansas Water (Lakes Winona and Maumelle), City of Conway and Conway County (Lake James H. Brewer), Benton (North Fork of the Saline River and Lake Norrell), Hot Springs Village (Middle Fork of Saline River and Lake Lago). All other water supply for entities in this study comes from groundwater.

4.3.3.1 Lake Winona and Lake Maumelle. These lakes are owned and operated by Central Arkansas Water. Facilities are in place to remove up to the 23 mgd safe yield of Lake Winona. Plans are underway to provide facilities that will maximize the 93 mgd safe yield from Lake Maumelle. There is no additional capacity that is available from these lakes to meet future demands. However, these lakes will continue to provide water to the area throughout the study period.

4.3.3.2 Lake James H. Brewer. This lake supplies water for the City of Conway (through Conway Corporation) and to Conway County. Lake Brewer has a safe yield of approximately 16.7 mgd, of which approximately 15.4 mgd is available as a drinking water supply. The City of Conway uses approximately 11 mgd and Conway County 4.4 mgd. A June 2002 draft report prepared by the USACE indicates that another 9 mgd of safe yield can be obtained from Lake Brewer by raising the elevation of the dam. This would result in Lake Brewer being able to provide up to a total of 24 mgd of safe yield for drinking water.

4.3.3.3 North Fork of the Saline River, Lake Norrell, and Chenault Reservoir. The Benton Water Treatment Plant receives water from the North Fork of the Saline River. During low flow periods, the city releases water from Lake Norrell, a city-owned impoundment on a tributary of the river. The Chenault Reservoir, a raw water reservoir having a storage volume of approximately 190 million cubic feet or the capability to supply the City raw water at a rate of 12 mgd for 120 days, is also available to provide water to the treatment plant. Raw water is pumped from the Saline River to the Chenault Reservoir.

4.3.3.4 Middle Fork of the Saline River and Lake Lago. Hot Springs Village receives water from the Middle Fork of the Saline River. Water is pumped from the river to Lake Lago, near Hot Springs Village, and stored until pumped to the treatment plant for processing. Data from Hot Springs Village indicate that the Saline River can provide sufficient amounts of water to meet Year 2050 demand. However, Hot Springs Village has requested that for this study, their current source of water not be considered as available for all of their flow.

4.3.4 Future Surface Water Supplies

Several lakes and rivers were identified in the kickoff meeting as potential water supply sources that could meet future water supply demands identified in this study. The following paragraphs describe and evaluate these potential water supply sources. Table 4-1 presents a summary of the pertinent data relevant to these sources, including size, storage allocations, critical elevations, and safe yield of water that could be available for use.

4.3.4.1 Greers Ferry. Greers Ferry Lake is located in north central Arkansas in Cleburne and Van Buren counties. The lake is one of the six original flood control lakes in the White River Basin plan authorized by the Flood Control Act of 1938. The dam site is about three miles northeast of Heber Springs. The 1700 feet long concrete dam rises approximately 243 feet above the riverbed. The top of the flood control pool at elevation 487 covers 40,500 acres and creates a nearly 350-mile shoreline. The Flood Control Act of 1954 provided for hydroelectric power generation in conjunction with flood control. The lake was ready for flood control use in January 1962, and all work was completed during 1964.

Table 4-1
Water Supply Yield from Lakes and Other Water Sources

Water source	Owner	Date Built	Total storage	Minimum Pool Storage		Power and Water Storage		Flood Control Storage		Water Elevation in downstream pool	Yield Available for Allocation Power or Water Supply	Future Water Supply Allocated to others	Potentially Available Yield for Mid-Arkansas Region	Total Discretionary Storage USACE	Safe Yield Available From Discretionary Storage	Amount of Discretionary Storage Already Allocated.	Safe Yield Associated with Allocated Discretionary Storage	Safe Yield Available From Remaining Discretionary Storage	Total Additional Water Available for Mid-Arkansas Regional Supply Study	Comments
			acre-feet	acre-feet	Elev.	acre-feet	Elev	acre-feet	Elev	ft	mgd	mgd	mgd	ac-ft	mgd	ac-ft	mgd	mgd	mgd	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	
																		= col. (15) - (17)	= col. (13)+ (18)	
Sources listed in Scope of Work																				
Greers Ferry Lake	USACE	**1964**	2,844,000	1,147,000	435.00	763,000	~461.00	934,000	487.00	266.00	595	0	0	50,000	39.06	16103	12.587	26.473	26.473	Reallocation in excess of 50,000 ac-ft requires Congressional authorization.
Lake Ouachita	USACE	**1953**	2,762,000	865,000	535.00	1,280,000	578.00	617,000	592.00	399 normal pool 374 low level	792	0	0	50,000	31.75	1573	1	30.75	30.75	Reallocation in excess of 50,000 ac-ft requires Congressional authorization. N. Garland received 1 mgd from discretionary storage in 1995.
DeGray Lake - Values from USCOE 1987 report (ref. 34)	USACE	**1972**	620,400	261,500	367.00	393,200	408.00	227,200	423.00	209.00	250 mgd (152 mgd for water supply, 98 mgd for water quality)	32	120	50,000	31.79	3,937.50	2.5	29.29	149.29	Current water supply allocation is to Kimzey and comes from the discretionary allocation of 50,000 ac-ft.. 32 mgd designated to Clark County area and 120 mgd to C-A-W still available.
Bull Creek Reservoir	USACE	Not Built				~ 50,000	315.00				30	0	30	n/a	0	0	0	0.00	30.00	Data from references 30 and 22. Safe Yield is 30 mgd as per reference 22 (1999 report), downrated from 50 mgd presented in reference 30 (1975 report).
Arkansas River	USACE	n/a												n/a					Requires an impoundment	The river has 0 safe yield, therefore must build an impoundment to provide adequate water supply for safe yield. See references 14,15 and 22 and 30. Ref. 30 pg 33 (1975), states 7 day 2year low flow is 4000 mgd and 7 day 20 year flow 750 mgd.
Other Sources identified in May 6, 2002 initiation meeting																				
Ouachita River		n/a												n/a					n/a	Based on June 26 meeting, no further consideration will be given to Ouachita River as a regional water supply. See text for discussion.
Lake Nimrod	USACE	~1940s	336,000	29,000	342	n/a	n/a	307,000	373					n/a			0.3 City of Plain View		n/a	Data provided by USACE 8/8/2002 fax of pertinent data for Nimrod Dam. Based on discussions with USACE, Nimrod should not be considered further for use as a regional water supply. See text for discussion.
Existing Sources Dedicated to specific water service entities																				
Lake James H. Brewer	Conway Corp.										15.5								9	Current total average capacity is 16.75 mgd. ~1.3 mgd dedicated to water quality. 11 mgd dedicated to Conway. Conway County RWDD contracts with Conway Corp for up to a maximum of 7.5 mgd with average at 4.4 mgd. Could be used strictly as a source for Conway and Conway Co. but not a regional supply for others in region. Additional capacity of 9 mgd being considered based on 2002 USACE study of Lake Brewer.
Lake Maumelle	Cent. Ark Water	1958	219,440				290.00												0	From UALR 9/2000 report (ref 24). Based on safe yield analysis study by FTN (ref 23). No ability to expand capacity.
Lake Winona	Cent. Ark Water	1938	41,730				740.00												0	From UALR 9/2000 report (ref 24). Based on safe yield analysis study by FTN (ref 23). No ability to expand capacity.
Saline River	Benton																		n/a	Currently 4.5 mgd of this is used by Benton. Per discussions at June 27 meeting will not consider for future regional water supply.
Chenault Reservoir	Benton																		n/a	Used as a 120 day storage to handle 12 mgd flows during drought conditions. Benton suggested a June 26 meeting that for this study, it not be considered source for future regional water supply.
Lake Lago / on Middle Fork of Saline River	Hot Springs Village	1974																	n/a	Solely dedicated to Hot Springs Village. Per Hot Springs Village request, will not considered a source for future regional water supply.
Groundwater	Sardis Water Assoc.																		n/a	See attachment C of data from Sardis. Could continue to expand well field but water table declining and water shortages expected in next 5-10 years. Also, not considering groundwater as viable future supply for the region.

Greers Ferry has a storage capacity of 2.8 million acre-feet, which includes approximately 934,000 acre-feet for flood control and 763,000 ac-ft for power water storage (Ref.19). When constructed, none of the storage provided in Greers Ferry was allocated for water supply. Discretionary storage of 50,000 ac-ft can be reallocated for water supply use by the USACE without Congressional approval. Based on information from USACE, approximately 16,100 ac-ft of the 50,000 have already been allocated for water supply use. Approximately 1280 ac-ft of storage can provide 1 mgd of firm yield water supply, based on data from the USACE. The 50,000 ac-ft of storage equates to a firm yield of 39.1 mgd, of which 12.6 mgd has already been allocated. Construction of an intake on the reservoir will require either an Environmental Assessment or Environmental Impact Statement in compliance with the National Environmental Policy Act.

4.3.4.2 Lake Ouachita (Blakely Mountain Dam). Blakely Mountain Dam is located approximately 10 miles northwest of Hot Springs in Garland County. The 1,100-foot long earth-filled structure standing 235 above the streambed on the Ouachita River forms Lake Ouachita. The lake is operated for flood control, hydroelectricity production, fish and wildlife conservation, and recreational purposes. Blakely Dam was placed in operation in the spring of 1953. The drainage area tributary to the dam is approximately 1,100 square miles. At the spillway crest elevation of 592, the lake extends up the valley for nearly 39 miles and covers a surface area of 48,300 acres. The minimum power pool elevation of the lake is 535.

Lake Ouachita has a storage capacity of approximately 2.77 million acre-feet, which includes 617,000 acre-feet for flood control, 1.28 million acre-feet for power generation, and 865,000 acre-feet for a minimum permanent pool. When constructed, none of the storage provided in Lake Ouachita was allocated for water supply. However, nearly all of the 50,000 ac-ft of discretionary storage is available, which would provide a safe yield of 31.75 mgd. Currently only 1,573 ac-ft of storage (which equates to 1 mgd of safe yield) has been allocated to North Garland for drinking water, leaving approximately 30.75 mgd of water available. Construction of an intake on the reservoir will require either an Environmental Assessment or Environmental Impact Statement in compliance with the National Environmental Policy Act.

4.3.4.3 DeGray Lake. DeGray Lake, completed in 1972, is located on the Caddo River near Arkadelphia in Clark County. The earth-filled dam is 3,400 feet long and stands 243 feet above the streambed. The lake was constructed for flood control, power generation, recreation, water quality control, and water supply. The spillway crest elevation of 423 creates a lake with an area of 17,000 acres. A re-regulating dam and pool below the main dam assures storage for a minimum 250 mgd water supply.

DeGray Lake has water storage above the minimum pool of approximately 620,000 ac-ft: 393,000 for power and water storage and 227,200 for flood control storage. The 393,000 ac-ft of power and water storage can provide a safe yield of 250 mgd. Of that 250 mgd, 98 mgd (the yield from ~150,000 ac-ft) is required for water quality. The remaining 152 mgd is available for joint use power and water supply. It is understood that the joint use is intended to mean that water use for water supply be taken from the re-regulation pool downstream of power generation.

The Ouachita River Water District signed a Memorandum of Agreement with the USACE in 1988 to be responsible for the payment of all costs allocated to this water supply. In 1988, the Ouachita River Water District granted the Little Rock Municipal Water Works the option to purchase water in Lake DeGray and the perpetual right to use such water not to exceed 120 mgd of water supply (Ref. 31).

In addition to the allocation for water described above, the USACE also has authority for allocating up to 50,000 ac-ft for a designated use, including water supply uses. The safe yield water supply available from this discretionary storage is approximately 31.8 mgd. Currently, 3,937.50 ac-ft of discretionary storage has already been allocated to Kimzey, which equates to about 2.5 mgd.

4.3.4.4 Bull Creek Reservoir (Future). The Bull Creek Reservoir has not yet been constructed nor have definite plans been made to construct it. Its proposed location is northwest of the City of Beebe. The 1975 Central Arkansas Water Study commissioned by the Mid Arkansas Regional Water Distribution District identified a site for this reservoir and estimated a safe yield of 50 mgd. In 1999, a report titled "Source and Lake Study for Water Supply and Treatment" indicated that the safe yield of the reservoir should be in the range of 30 mgd. The 1999 report indicated that the project will be subject to environmental review, engineering design, and construction, with a projected schedule of 5 years minimum to complete.

4.3.4.5 Arkansas River. By ADEQ definition, the Arkansas River does not have a safe yield that can be used for a regional water supply. An impoundment would be required to store water during higher flows to meet future water demands. This option was considered in the 1999 report titled "Source and Lake Study for Water Supply and Treatment" prepared for the cities of North Little Rock and Jacksonville and will be compared on a similar basis for this study. The water quality of the Arkansas River is considered less than the quality found in the other potential sources.

4.3.4.6 Nimrod Lake. Nimrod Lake is located on the Fourche La Fave River in the Ouachita Mountain area of west central Arkansas in Perry and Yell counties near Danville. The project was authorized by the Flood Control Act of 1938 and is one of the original eight lakes in the comprehensive flood control plan for the Arkansas River. The project is approved for flood control and other purposes, including the possible development of hydroelectric power. Nimrod Dam is more than 1,000 feet long and nearly 100 feet high. The top of the conservation pool elevation is 345.0. The pool has a storage capacity of 41,000-acre feet. At elevation 373, the top of the flood control pool, Nimrod Lake has a storage volume of 336,000 ac-ft and a surface area of 18,300 acres.

A 1990 USACE report indicates an analysis of the probable maximum flood at Nimrod Lake predicted the dam would be overtopped and possibly abutments washed out by this flood. There is no record found of a yield study being conducted for this lake.

4.3.4.7 Ouachita River. During the May kick-off meeting for this study, the Ouachita River was mentioned as a possible water source. If considered as a water supply source for this study area, water would be taken from the Ouachita River downstream of Lake Hamilton and most likely near Arkadelphia. According to Arkansas Soil and Water Conservation Commission, no rivers in Arkansas have a safe yield that can be used for water supply. Therefore, an impoundment would be required to store water taken from the river. During June 27, 2002 in progress review meeting, it was concluded by the participants that the Ouachita River should not be considered as a future source for this area. A preliminary comparison of this option to DeGray Lake suggests that both options would require pumping stations and piping that would be comparable, but that Ouachita River would require significant additional cost. For example, to pump from the Ouachita River would require having to pump against an additional 200+ feet of static head and would require the construction of an impoundment, both of which would result in additional cost as compared to DeGray Lake. Using the Ouachita River would also require significantly more effort to address environmental issues and to gain access to land than DeGray Lake. The Ouachita River will be removed from further consideration, as it is evident that DeGray Lake is more beneficial.

The use of Greers Ferry Lake, Lake Ouachita, DeGray Lake, Bull Creek Reservoir, and the Arkansas River as potential surface water supply sources will be carried through in the alternatives to be evaluated later in the report. Bull Creek Reservoir has not been constructed so water quality data from this source are not available. Some water quality data for the remaining four sources are shown in Table 4-2.

Table 4-2
Water Quality Summary of Potential Sources

Constituent		Arkansas River[1] Van Buren	Arkansas River[1] Pine Bluff	Lake DeGray[4]	Greers Ferry[2]	Lake Ouachita[3,4]
PH, units	mean	7.9	7.9			6.6
	range	6.4 - 8.8	7.3 - 9.2	6.6 - 7.4	6.22 - 8.26	6.6 - 7.3
Turbidity, NTU	mean	28	25			1.3
	range	0 - 120	2 - 100	0.6 - 3	2.6 - 31.4	0.6 - 1.5
Alkalinity, mg/L $CaCO_3$						
	mean	97	75		21	
	range	5 - 1280	31 - 107			-
Total dissolved solids, mg/L				(From Conductivity)	(From Conductivity)	(From Conductivity)
	mean	410	320	30[3]		31
	range	100 - 800	100 - 710		34 - 107	
Total hardness, mg/L						
	mean	180	162			
	range	83 - 270	75 - 270		20.1 - 21.9	
Chloride, mg/L	mean	132	107			
	range	30 - 305	28 - 225		3.0	
Total Organic Carbon, mg/L		3.2		2.6 - 3.7	1.6	2.8 - 3.7
Total coliform, no./100 mL						
	mean	76	72			
	range	0 - 420	0 - 410			
Sodium, mg/L	mean	81	67			
	range	11 - 185	12 - 148			
Sulfate, mg/L	mean	90	77	4.0[3]	4.2	3.8
	range	23 - 140	11 - 156			

(1)Source: Moore, James W., "Determination of the Suitability of Arkansas River Water for Municipal, Industrial and Agricultural Use", AR Soil and Water Conservation Commission/U. S. Corps of Engineers.

(2)STORET Sta. No. 07075025.

(3)Saline Co. Water Supply Alternatives Study.

(4)Little Rock Municipal Water Works Water Resource Study.

5.0 Water Treatment

5.1 Description of Existing Water Treatment Facilities

For this study, water treatment needs will be based on providing sufficient treatment capacity to meet peak day demand for 2050. It is anticipated that peak hour demands will be met by providing sufficient storage of treated water.

Existing plant capacities were reviewed to identify the plants that may be available for future needs through 2050. As indicated on Table 5-1, current water treatment capacity in the region is 239 mgd. Of that capacity, up to 223 mgd of treatment capacity was identified as available for use to meet future regional needs. The treatment plants at Hot Springs Village, Conway County and Conway Corporation will probably only be available for those specific areas due to that remote location. Benton's water treatment plant could be used in a regional system, should they desire it.

Input was received from WTP operators about the ability to expand their existing treatment facilities. Following is a summary:

- The Benton WTP could be expanded to provide additional treatment.
- Central Arkansas Water's Jack H. Wilson plant could be expanded but the influent piping is a major concern with the congestion of the existing piping.
- Central Arkansas Water's Ozark WTP is at capacity and cannot be expanded.
- Conway's Gleason Plant will provide 23 mgd and could be expanded to meet Conway's needs.
- Conway County's WTP could be expanded to meet Conway Co. needs.
- Hot Springs Village WTP can be expanded to 14 mgd, which would meet Hot Springs Village's projected water demand.

5.2 Status of Safe Drinking Water Act Regulations

A brief discussion of the Safe Drinking Water Act (SDWA) is included here. The purpose of this discussion is to establish the general requirements that treated water from existing facilities, as well as from any new treatment plant, will be required to meet. A full discussion of all regulations is beyond the scope of this report, and the interested reader is referred to the appropriate *Federal Register* and the various Guidance Manuals associated with these rules. Most of the information can be obtained online at the website maintained by the United States Environmental Protection Agency (EPA), http://www.epa.gov/epahome/lawregs.htm.

Table 5-1
Projection of Existing Treatment Capacity that can be used for Year 2050 Demand

Information about Existing Treatment Facilities						Future Use of Existing Facilities		
Existing Treatment	Owner	Type of Treated Water	Water Source	Type of Disinfection	Plant Design Peak Day Capacity, mgd	Could plant be used to meet future regional needs?	Capacity that could be used to meet regional needs (considered to equal to peak day demand), mgd	Comments
Benton Water Treatment Plant	Benton	Surface	Saline River, Chenault Reservoir, Lake Norrell	chlorine	13.3	See Comments	13.3	Could probably continue to use to serve Benton area and much of Saline County. Chenault has a 120 day storage at a rate of 12 mgd used only in drought conditions.
Jack H. Wilson Plant	Cent. Ark. Water	Surface	L.Maumelle	chlorine	150.0	Yes	150.0	Supply at capacity. Plant could be expanded but influent piping congestion a major problem.
Ozark Point Plant	Cent. Ark. Water	Surface	L.Winona	chlorine	25.0	Yes	25.0	Plant and supply at capacity.
Gleason Plant 1	Conway Corporation	Surface	Lake James H. Brewer	chlorine	15.0	See Comments	15.0	Would continue to serve Conway, Arkansas. To be regional, would have to change current institutional arrangement.
Gleason Plant 2	Conway Corporation	Surface	Lake James H. Brewer	chlorine	8.0	See Comments	8.0	Would continue to serve Conway, Arkansas. To be regional, would have to change current institutional arrangement.
DeWitt	Grand Prairie	ground-water wells	-	chlorine	1.0	No	0	
Lonoke Treatment	Grand Prairie	ground-water wells	-	chlorine	3.0	No	0	

Table 5-1 (Continued) **Projection of Existing Treatment Capacity that can be used for Year 2050 Demand**								
Information about Existing Treatment Facilities						Future Use of Existing Facilities		
Existing Treatment	Owner	Type of Treated Water	Water Source	Type of Disinfection	Plant Design Peak Day Capacity, mgd	Could plant be used to meet future regional needs?	Capacity that could be used to meet regional needs (considered to equal to peak day demand), mgd	Comments
Hot Springs Village WTP	Hot Springs Village	Surface	Lake Lago, Mid. Fork of Saline River	chlorine	4.0	See Comments	4.0	Plant can be expanded to 14.0 mgd and meet HSVPOA projected demand.
East Treatment Plant	Jacksonville	ground-water wells	Alluvial aquifer	chlorine	7.0	No	0	
West Metering Plant	Jacksonville	purchased	treated water from Central Ark. Water	chlorine	n/a	No	0	
Plant 1, 2 and 3	Sardis Water Association	ground-water wells	-	chlorine	2.1	No. See Comments	0	Could possibly expand to 4.6 mgd peak capacity (based on well field supply) but concern about capacity declining. Do not count on for this assessment of regional water supply.
Conway Co. RWDD WTP	Conway Co. Regional WDD	Surface	Lake Brewer	chlorine	8.0	See Comments	8	
Cabot	Cabot	ground-water wells	-	chlorine	3.0	No	0	Cabot looking to go away from groundwater.
Total, nearest mgd					239		223	

5.2.1 Overview

Prior to 1974, drinking water standards were developed by each individual state and were based primarily on the historic standards from the U. S. Public Health Service (USPHS). The USPHS standards gave limits for some aesthetic concerns such as taste, odor, and color; and also addressed disinfection, primarily through limits on coliform organisms.

The Safe Drinking Water Act (SDWA) was passed by Congress in 1974 and for the first time America had a framework for implementing uniform water quality standards for drinking water. The law gave the USEPA the necessary tools to enforce national regulations and required states to develop companion rules that were as least as stringent as the federal regulations. The SDWA has subsequently been amended in 1986 and 1996 until today limits for 93 contaminants have been set. Some of the rules set standards and limits that can cause conflict with a different regulation. For example, maximum contaminant levels (MCLs) have been set for various disinfection byproducts (DBPs) while other rules are stressing an increased level of disinfection to ensure pathogen-free treated water.

A listing of SDWA regulations and the dates when they were or are expected to be proposed, finalized, and effective is given in Table 5-2. Dates for pending and future rules are best estimates at this time; these dates frequently are delayed depending upon EPA's ability to develop and process the rules. For the purposes of this discussion, all the SDWA regulations will be broken into four groups:

- Completed regulations – A few regulations had a limited time of application and these have been fully completed.
- Current regulations – This group of rules has been promulgated and is currently in effect.
- Pending regulations – These regulations have been proposed or finalized but are not yet effective at the local level.
- Future regulations – This final grouping contains anticipated rules but ones that have not yet appeared in draft form.

Table 5-2 Schedule for Promulgation of SDWA Regulations (Current October 8, 2002)			
Regulation	Proposed	Final	Effective
Fluoride	11/85	4/86	10/87
Trihalomethanes	2/78	11/79	11/83
8 VOCs (Phase I)	11/85	7/87	1/89
Surface Water Treatment Rule	11/87	6/89	6/93
Coliform Rule (revisions expected by 2005)(9)	11/87	6/89	12/90
Lead & Copper Minor Revisions	8/88 4/98	6/91 1/00	1/92 1/01
26 Synthetic Organic Contaminants(1), 7 Inorganic Contaminants (Phase II)	5/89	1/91(1)	7/92
MCLs for barium, pentachlorophenol (Phase II)	1/91	7/91	1/93
Phase V Organics, Inorganics	7/90	7/92	1/94
Radionuclides (Phase III) - except radon Radon - Delayed by new administration	4/00 11/99	12/00 8/03	12/07 8/06(2)
Sulfate	12/94	Decision made not to regulate 6/02	
MCLs for aldicarb, aldicarb sulfoxide, aldicarb sulfone	8/04	8/05	8/08(2)
Disinfectants/Disinfection Byproducts Stage 1 DBPR Stage 2 DBPR	 7/94 5/03	 12/98 5/04	 1/02(4,5) 5/04(6,8)
Information Collection Rule	2/94	5/96	Completed
Interim ESWTR Stage 1 - Long Term Enhanced SWTR Stage 2 - Long Term Enhanced SWTR	7/94 4/00 5/03	12/98 1/02 5/04	1/02(4) 1/05(5) 5/04(8)
Filter Backwash Recycle Rule	4/00	6/01	12/03
Consumer Confidence Reports Rule	2/98	8/98	9/98
Ground Water Rule (GWR)	5/00	6/03	6/06
Operator Certification - State Guidance	3/98	2/99	2/01
Unregulated Contaminants - Monitoring Only(7)	2/99	9/99	1/01
Five New Drinking Water Contaminants	4/02	9/04	2/06
Chlorine Gas as Restricted Use	9/00	9/02	9/03
Source Water Protection Program – Guidance(3)	8/97	Completed	Completed
Arsenic	6/00	2/02	1/06

Notes:
(1) MCL, MCLG for atrazine to be reconsidered.
(2) Assumes regulation in effect 3 years after final promulgation.
(3) Program required as part of 1996 Amendments.
(4) For PWS serving > 10,000.
(5) Effective Jan. 2005 for PWS serving < 10,000.
(6) Running annual averages to be computed at each sampling location (LRAA) including sites with high DBPs.
(7) Tiered monitoring approach pending availability of analytical methods.
(8) Monitoring begins.
(9) Revised TC Rule may become Distribution System Rule.

5.2.2 Completed Regulations

The category of completed rules applies only to a select few SDWA rules that were promulgated for a certain reason and season and do not continue on indefinitely. Generally, this category of rules does not carry MCLs for delivered treated water but are for investigative purposes only. Normally these rules involve testing and/or monitoring for certain contaminants with the results of these investigations being used for planning purposes for future regulations. SDWA regulations that fall into this category within Table 5-2 are the Information Collection Rule, the Sulfate Rule, and Guidance for the voluntary Source Water Protection Program.

5.2.3 Current Regulations

SDWA rules in this category are currently in effect and all present treatment facilities covered by these rules should be producing treated water that complies with all aspects of these regulations. Regulations in this category include the Fluoride Rule, the 1979 Trihalomethane Rule which is the first regulation that addressed disinfection byproducts (DBPs), the Phase I Rule for eight volatile organic chemicals (VOCs), the Surface Water Treatment Rule, the Interim Enhanced Surface Water Treatment Rule, the Coliform Rule, the Stage 1 Disinfectants and Disinfection Byproducts Rule, the Lead and Copper Rule, the Phase IIA Rule for 26 SOCs and 7 IOCs, the Phase IIB Rule for barium and pentachlorophenol, the Phase V Rule for several organic chemicals and some inorganics, and guidance for Operator Certification.

5.2.4 Pending Regulations

Pending regulations are of high interest to water purveyors as they may involve capital costs or increased operating expenses in order for a treatment facility to comply. As mentioned above, pending regulations are rules where the requirements have been formally published by EPA in the *Federal Register*, but the rules are not yet effective and the actual implementation of the rules may be subject to interpretation by state agencies and the EPA. Pending rules of particular interest for this study are:

- Radionuclides. Although most of the MCLs remained the same as previously adopted in 1991, the new radionuclides rule measures radioactivity at the entry point to the distribution system as opposed to within the distribution system itself. Regulated contaminants are beta/photon emitters, alpha emitters, combined radium 226 and 228 and uranium. The new source of supply for the Central Arkansas Water Supply will be a surface water source and normally radioactivity is not an issue for a surface supply. Existing wells within the service area are not projected to be used as a central supply. If they continue to be used by an individual owner, sampling and compliance with this Rule will be necessary. Radionuclides data for the prospective surface supplies were not available but special treatment for these contaminants would not be expected. Prior to finalizing the source water(s), a sample should be collected for testing of radionuclides to confirm this assumption.

- Long-term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR). This Rule makes the provisions of the Interim Enhanced Surface Water Treatment Rule applicable to communities serving less than 10,000 people. This Rule will not have any effect for the larger water systems that serve more than 10,000 people as they are already in compliance with the provisions of this Rule as part of the IESWTR. As noted in Table 5-2, the IESWTR became effective in January 2002. It would affect smaller systems such as the Maumelle Water Corporation that currently use groundwater for their supply but under the new regional concept would begin receiving treated surface water. The change for these smaller systems would be primarily some sampling and reporting as all the treatment requirements would need to be met at the central facility prior to discharging water to their system.
- Filter Backwash Recycle Rule (FBRR). The FBRR has only a few criteria for compliance and all issues would be fully satisfied during the design of the new regional treatment facility.
- Arsenic. A new arsenic limit of 0.01 mg/L has been established and all systems must be in compliance by December 2006. Difficulty meeting the arsenic MCL is not anticipated for any of the water sources being considered here. Some sampling for arsenic should be done prior to the design of the new treatment facility to confirm that removal of arsenic during treatment is not necessary.

5.2.5 Future Regulations

Future regulations of primary concern are the Stage 2 Disinfectants and Disinfection Byproduct Rule and the Long-term 2 Enhanced Surface Water Treatment Rule. Both of these rules are fairly well defined already because of the negotiated approach used by EPA to develop these rules. Revisions to the Total Coliform Rule or the development of a Distribution System Rule, that would incorporate modifications to the TCR, are being discussed; but at this point, nothing definite has been decided. The Stage 2 DBPR and the LT2ESWTR will have the dual roles of increasing disinfection requirements while having stricter limits on the amount of disinfection byproducts allowed. Parties involved in the negotiations of these Rules signed an Agreement in

Principle which lays the framework of the technical requirements of these Rules. This Agreement in Principle is included as Appendix C of this report. In short, the requirements of these two Rules will need to be satisfied during the design of the new treatment works. For the purposes of this discussion, the most critical requirement will be the need to maintain DBPs less than 80 µg/L and 60 µg/L for trihalomethanes and haloacetic acids, respectively, at all locations within the extended distribution system.

5.3 State Of Arkansas Requirements

5.3.1 General

The Primacy Agent for the enforcement of SDWA regulations is the Division of Engineering of Arkansas Department of Health (ADH). Plans and specifications for a new water treatment facility will need to be submitted to the ADH for their review and approval. The ADH relies primarily on the latest edition of the Recommended Standards for Water Works (Upper Mississippi River – Great Lakes Board of State Sanitary Engineers), commonly referred to as the Ten State Standards.

As a general policy, the ADH desires treatment of river water to include advanced treatment if the Arkansas River is used as a drinking water source. The Department of Health views the river as a vulnerable water resource. Discussions with state representatives indicate that they believe that ozone and biological filtration would be required to treat Arkansas River water. In a December 1987 memorandum to then Governor Bill Clinton from Dr. M. Joycelyn Elders, who was Director of the Arkansas Department of Health, the department's position was that either activated charcoal contactors or reverse osmosis would be required. These requirements would add both capital and operating costs to any alternative that included using the Arkansas River.

5.3.2 Relation to Federal Regulations

The latest revision to Rules and Regulations Pertaining to Public Water Systems is dated January 1, 2002. This document and the 1997 Edition of the Ten State Standards have been reviewed. All basic engineering criteria will be met during design and construction. Two ADH criteria that relate to use of the watershed should be noted. They are:

- Recreational Use. *"Artificial lakes and all other bodies of water serving as reservoirs for city or other public water supplies shall not be used for recreational or other purposes in a manner whereby the water supply might become contaminated and thus become a potential hazard to public health."*
- Other Reservoir Sources. "*In the case of large multi-purpose reservoirs developed, owned and operated by the federal government, the water system*

owner shall effectively control a restricted buffer zone on land around the water intake structure. The extent of this restricted buffer zone will be determined on an individual basis by the Arkansas Department of Health after a sanitary survey of the proposed intake site has been made. All possible sources of contamination are prohibited within this restricted buffer zone."

As this project moves forward, it will be important to keep the appropriate departments within the ADH fully informed.

5.4 Treatment Modifications

5.4.1 Modifications to Existing Treatment Plants

Treatment facilities that will be blending their treated water with water from the new treatment facility are the Benton Water Treatment Plant and the two Central Arkansas plants, the Jack Wilson WTP and the Ozark WTP. The only major treatment modification that may be required at these facilities is the conversion of their disinfection practice to the use of chloramines as a secondary disinfectant. This conversion would only be necessary if the new regional water works is unable to supply treated water that would meet the new DBP limits using free chlorine in the distribution system.

5.4.2 New Treatment Facilities

Any new water treatment facility will need to provide finished drinking water that meets all current, pending, and future drinking water regulations. The three lake sources considered have similar water quality that could be treated using conventional treatment consisting of coagulation, flocculation, sedimentation, granular media filtration, and disinfection. The higher turbidities of the Arkansas River, the potentially flashy nature of the stream, and compliance with Arkansas Department of Health's current policy for the Arkansas River require presedimentation and advanced water treatment in addition to the conventional treatment processes listed for lake sources.

Disinfection of all four source waters, treated as above, would be with free chlorine and chloramines would likely be needed as a secondary disinfectant within the distribution system. The potential for viruses and other pathogenic organisms within the Arkansas River water make the use of multiple disinfectants a wise investment. Ultra-violet irradiation would also be used in conjunction with other disinfectants.

The use of chloramines as a secondary disinfectant is a departure from the disinfection practice now used in the region. Selecting chloramines is based on the need to keep DBPs low enough to meet the Stage 2 requirements of 80 µg/L for THMs and 60 µg/L for HAA5 within all member utilities distribution systems. DBPs normally increase with residence time and the concern is that the combined travel time from the new facilities to individual member distribution systems, when combined with the travel time within the member's distribution systems, will cause the MCLs to be exceeded. This decision is based on best engineering judgment at this time. The need to convert to chloramines should be confirmed or abandoned based on actual simulated testing of the selected water source and the alternative selected for implementation.

A primary disadvantage to using chloramines at any new facility is that any utility that accepts treated water from the regional water works would also need to convert to chloramines to match disinfectants within the distribution system. This would be an additional capital expense for Benton and Central Arkansas Water and would also slightly change the water quality that customers within these systems are currently used to receiving.

6.0 Description of Alternatives

6.1 Alternatives

Alternatives were developed to meet the water supply and treatment demand for Year 2050. During the June 27, 2002 progress meeting, the participants identified factors that should be considered in formulating or evaluating alternatives for water supply and treatment. The factors are listed below:

- Alternatives should include using a single source as the sole supply of water where practical.
- Alternatives could include using multiple sources of water in the study area. For example, water could come from both Greers Ferry and Lake Ouachita to meet the total demand.
- Conway Corporation and Conway County expressed no interest in options that involved new water supply sources south of the river nor the Arkansas River.
- Conway Corporation and Conway County are only interested in raw water, not treated water.
- Hot Springs Village is only interested in obtaining additional raw water.
- Benton is primarily interested in raw water. It should be noted for Benton that there are a several alternatives where providing treated water to Benton and the surrounding area may be regionally advantageous. Therefore, providing either raw or treated water will be considered.

Five primary alternatives have been developed. Each alternative uses a combination of the five primary water supply sources identified as a possible source for water. Two of the alternatives would require new river crossings to supply additional water north of the Arkansas River. Intakes, pumping, piping and treatment facilities have been sized on peak day demand values.

Figures 6-1 through 6-5, located at the end of this chapter, present a flow schematic of each alternative.

6.1.1 Alternative 1

Figure 6-1 presents the improvements proposed in Alternative 1. The safe yield currently available for reallocation from the remaining discretionary storage in Greers Ferry Lake is 26.5 mgd. The additional water supply needed north of the river is 56 mgd. Up to 33 mgd of that demand can be met by the water furnished by Central Arkansas Water through the Arkansas River crossings, leaving 23mgd of water supply that must be obtained from another source. The remaining discretionary storage in Greers Ferry is sufficient to meet this additional water demand.

A new water treatment plant would be located in the area near the Central Arkansas Water offices on Maryland Avenue to serve the "North of the River" area. The Arkansas River crossings would continue to provide treated water from the Ozark and Wilson plants to the users in the "North of the River" region, which is primarily served by Central Arkansas Water.

Lake Ouachita would be used to supply water through Lake Winona to meet the 24 mgd combined demand of Hot Springs Village and the Saline County area. The safe yield of raw water available in Lake Ouachita by reallocating remaining discretionary storage is 30.75 mgd. This would be sufficient to meet the projected future demand south of the Arkansas River. A raw water line would carry water from Lake Ouachita to Lake Winona. A branch line would feed the Hot Springs Village area. Lake Winona would serve as a reservoir for the water from Lake Ouachita that is designated for use by the Saline County area. A new incrementally expandable 14 mgd plant would be located in the vicinity of Lake Winona. Hot Springs Village and Saline County users would have the option of obtaining raw or treated water.

Improvements proposed for this alternative include:

- A new intake pump station and raw water transmission system sized to ultimately convey up to 38 mgd of raw water from Greers Ferry. The system would be constructed in stages. For the initial phase, the intake pump station and raw water force mains would be sized to supply of 25 mgd, 13 mgd to Lake Brewer and 12 mgd to a new water treatment plant located in the North Little Rock/Sherwood area. In the future, flow to the treatment plant would be expanded to 25 mgd by additional pumps at the intake structure and a parallel force main to the treatment plant.
- A new 25 mgd water treatment plant to serve the north of river region. For purposes of costing, the water treatment plant has been located immediately north of Central Arkansas Water's offices on Maryland Avenue. The initial phase of construction will be sized to treat 12.5 mgd, with a 12.5 mgd expansion to be constructed in the future.
- A new intake pump station at Lake Ouachita.
- A new raw water force main from Lake Ouachita routed within the southern border of the Ouachita National Forest except for a small segment that parallels an existing cross-country pipeline route to Lake Winona. The route roughly parallels a route that which was established in the 1975 report titled "Central Arkansas Water Study" prepared for the Mid Arkansas Regional

Water Distribution District. This line would branch to provide Hot Springs Village with raw water service. The branch could terminate at Lake Lago or the WTP for Hot Springs Village.

- A new raw water pipeline from Lake Winona to a new expandable 14 mgd water treatment plant located near Lake Winona. The WTP would be to supply treated water to western Central Arkansas Water and Saline County users. In addition, Benton and Hot Springs Village could be provided with treated water. Pipeline costs for raw or treated water service into Benton have been included. A siting study to determine the most appropriate location of the treatment plant should be conducted as part of the future study of these facilities.

6.1.2 Alternative 2

Figure 6-2 presents Alternative 2, which envisions water being taken from both Lake Ouachita and Greers Ferry. Water obtained from Greers Ferry will provide water to Conway Corporation and Conway County. The safe yield of raw water available in Lake Ouachita by reallocating the remaining discretionary storage is 30.75 mgd. This would be sufficient to meet the projected future demand south of the Arkansas River but would not meet all of the needs north of the river. Congress would have to be petitioned for reallocation of water at Lake Ouachita to meet 34 mgd demand required for future demand south of the river plus the "North of River" area**.** Additional crossing(s) will be required to carry treated water from south of the river to north of the river in the Little Rock/North Little Rock area. Water will be sent from Greers Ferry to Lake Brewer to meet the water demand in the Conway area. This alternative would involve pumping raw water from Lake Ouachita to Lake Winona. Along the route, the line would branch to provide Hot Springs Village with 8 mgd of raw water. A new expandable 39 mgd WTP would be constructed in the vicinity of Lake Winona. The WTP would be to supply treated water to western Central Arkansas Water and Saline County users. In addition, the Saline County Area and Hot Springs Village could be provided treated water if they so choose.

Improvements proposed for this alternative include:

- A new intake pump station at Lake Ouachita.
- A new raw water force main from Lake Ouachita, routed within the southern border of the Ouachita National Forest except for a small segment that parallels an existing cross-country pipeline route, to Lake Winona. The route roughly parallels a route that which was established in the 1975 report titled "Central Arkansas Water Study" prepared for the Mid Arkansas Regional

Water Distribution District. A branch pipeline will be routed to Hot Springs Village to convey raw water.

- A new intake and raw water pipeline from Lake Winona to the new water treatment plant would be required. A siting study to determine the most appropriate location of the treatment plant should be conducted as part of the design of these facilities.
- A new intake pump station at Greers Ferry to serve the Conway area.
- A new pipeline from Greers Ferry to Lake Brewer to convey water for use in the Conway area.
- A new treated water transmission line from the new WTP to north of the river. A crossing located near or on the I-440 Bridge is proposed for the purposes of this study. The transmission main could serve southeastern Saline County users and those users in the eastern "North of the River" area.

6.1.3 Alternative 3

Alternative 3 primarily uses water from DeGray Lake as shown in Figure 6-3. Of the water supply sources being considered in this study, DeGray Lake is the only lake where storage has been allocated for use as a water supply. Central Arkansas Water has the right of first refusal on 120 mgd of water from DeGray Lake. This water is targeted from the re-regulation pool. However, the cost of pumping this water is more than the cost of the power generated. Therefore, raw water supply is proposed to originate from the conservation pool. An additional 29.3 mgd of is available from the remaining discretionary storage in DeGray Lake. Alternative 3 would involve taking a 34 mgd average day supply of water from DeGray Lake to serve Hot Springs Village, Saline County users, the South of the River and North of the River areas. Treated or raw water could be supplied to Benton and Hot Springs Village. A variation to this alternative could be to treat the water near DeGray Lake and convey treated water to the north; this variation may be appealing to additional users such as Arkadelphia and Malvern. To satisfy the needs for Conway Corporation and Conway County, an intake pump station and raw water transmission main from Greers Ferry to Lake Brewer would be constructed. Demand north of the Arkansas River area would be met by transporting treated water from the new WTP at Winona through a new transmission main and river crossing. For this study, the crossing has been located near the I-440 Bridge.

A crossing located near or on the I-440 Bridge is proposed for the purposes of this study. A total of 39 mgd of new treatment is required. This can be accomplished with two plants, one near Lake Winona and the other near Benton, or a single plant located near Winona.

Improvements proposed for this alternative include:

- A new intake pump station at DeGray Lake.
- New raw water force mains from DeGray Lake to a new treatment facility in the Saline County area and one near Winona with a branch line to carry raw water to Hot Springs Village. For this study the pipelines have been routed near highways and roads.
- A new intake pump station at Greers Ferry to serve the Conway area.

6.1.4 Alternative 4

Alternative 4 utilizes the Arkansas River as the water source for users north of the river as shown in Figure 6-4. Based on data available from the Arkansas Soil and Water Conservation Commission, the firm yield from the Arkansas River is considered to be zero. This zero safe yield source will be considered because data from the Corps of Engineers indicate that, even in the drought years of 1963 – 1965, flow in the river exceeded the 3,000 cfs minimum requirement in every month. A raw water reservoir will be furnished to provide 120 days' storage. In this alternative, a river intake pump station would be constructed on the northern side of the river to pump water to a raw water reservoir (approximately 320 acres) located between North Little Rock and Conway (just west of the Lake Conway discharge to the Arkansas River). A previous study proposed a similar alternative for treating water from the Arkansas River where the impoundment was located on the Camp Robinson property located north of the North Little Rock area. Concerns about the availability of this land and associated cleanup have prompted considering a location between North Little Rock and Conway. A pump station and pipeline will transport raw water from the impoundment to a new water treatment plant. The treatment plant may be located near the Central Arkansas Water offices on Maryland Avenue or near the reservoir should Conway Corporation or Conway County have a desire for a treated water supply. Just as for the other alternatives, the Conway area would be supplied with water from Greers Ferry. Water would be provided to the Hot Springs Village and Saline County areas from Lake Ouachita in the same manner as for Alternative 1.

Improvements anticipated for this alternative include:

- A new river intake pump station on the north bank of the Arkansas River.
- New raw water pipelines from the river intake to a new impoundment located between North Little Rock and Conway (just west of the Lake Conway discharge to the Arkansas River).
- A new pump station and pipelines to carry water from the impoundment to at new water treatment plant.
- A new intake pump station at Greers Ferry and pipeline to Lake Brewer to serve the Conway area.
- A new 25 mgd water treatment plant to serve the north of river region. The initial phase of construction will be to size a 12.5 mgd facility, with a 12.5 mgd expansion constructed in the future.
- A new intake pump station at Lake Ouachita.

- A new raw water force main from Lake Ouachita routed within the southern border of the Ouachita National Forest except for a small segment that parallels an existing cross-country pipeline route to Lake Winona. The route roughly parallels a route that which was established in the 1975 report titled "Central Arkansas Water Study" prepared for the Mid Arkansas Regional Water Distribution District. This line would branch to provide Hot Springs Village with raw water service. The branch could terminate at Lake Lago or the WTP for Hot Springs Village.
- A new raw water pipeline from Lake Winona to a new expandable 14 mgd water treatment plant located near Lake Winona. The WTP would be to supply treated water to western Central Arkansas Water and Saline County users. In addition, Benton and Hot Springs Village could be provided with treated water. Pipeline costs for raw or treated water service into Benton have been included. A siting study to determine the most appropriate location of the treatment plant should be conducted as part of the future study of these facilities.

6.1.5 Alternative 5

Alternative 5 provides water from the Bull Creek reservoir as shown on Figure 6-5. The Bull Creek reservoir, which has not yet been constructed, would serve as a raw water source. Information from previous studies indicates that the firm yield for the reservoir can be 30 mgd. This water source would satisfy the “North of the River” projected water demand, but is remote to Conway Corporation and Conway County. This alternative is based on these two water users fulfilling their water needs from Greers Ferry as in the other alternatives. For costing purposes of this study, a new plant would be constructed near the Central Arkansas Water offices. The treatment plant could be located at the lake as a variation to this alternative with minimal cost differences. Lake Maumelle and Lake Winona would supply the water for Central Arkansas Water. Lake Winona would also supply the raw water for a new WTP located near the lake to serve the western portions of Central Arkansas Water Saline County users and give Hot Springs Village the option of having treated water.

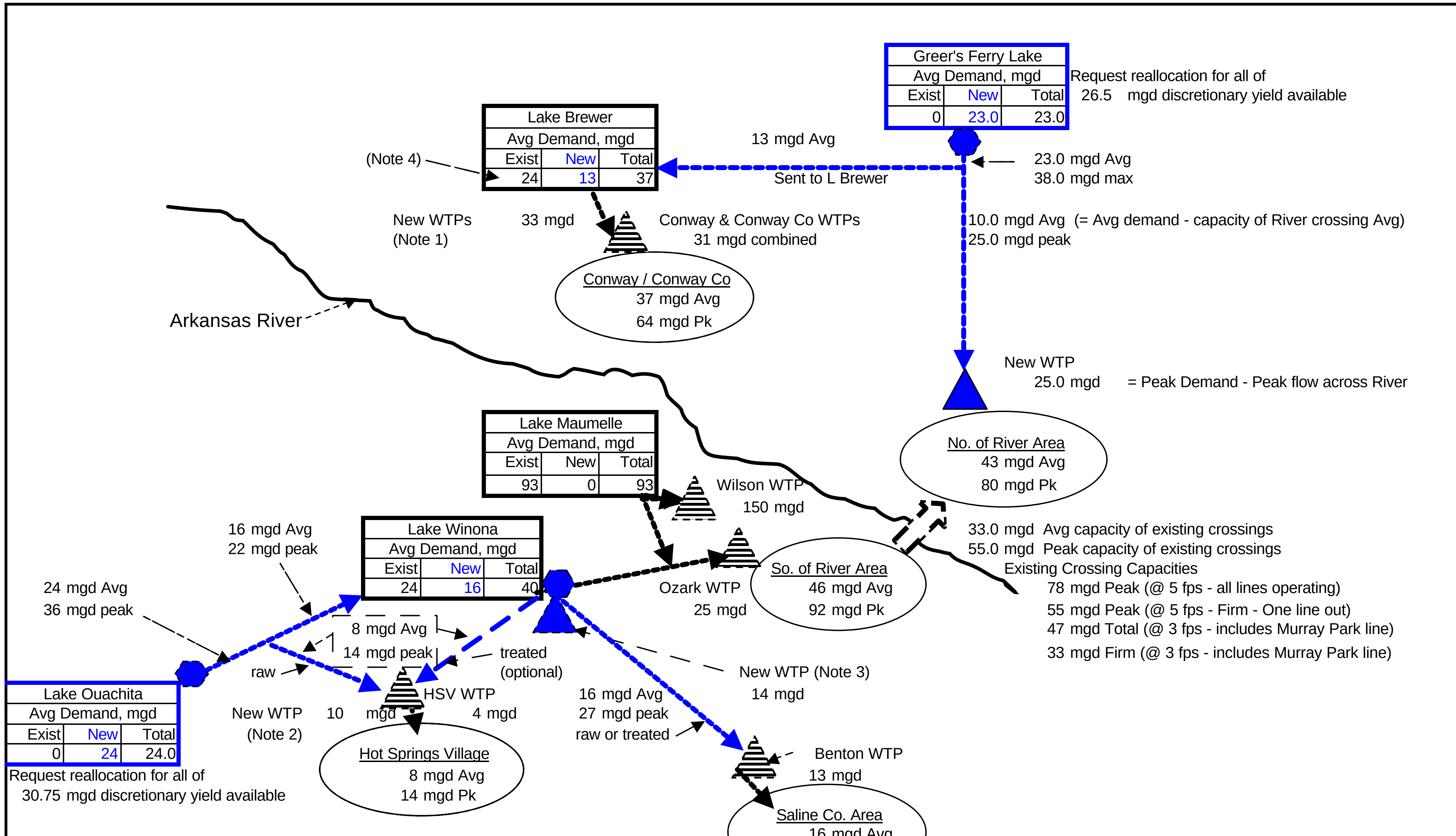
Improvements include:

- A new reservoir and new intake pump station.
- New raw water pipelines from the intake to a new 25 mgd water treatment plant located near the Central Arkansas Water. The initial phase of construction will involve sizing a 12.5 mgd facility, with a 12.5 mgd expansion constructed in the future.

- A new intake pump station at Greers Ferry to serve the Conway area.
- A new pipeline from Greers Ferry to Lake Brewer to convey water for use in the Conway area.
- A new intake pump station at Lake Ouachita.
- A new raw water force main from Lake Ouachita routed within the southern border of the Ouachita National Forest except for a small segment that parallels an existing cross-country pipeline route to Lake Winona. The route roughly parallels a route that which was established in the 1975 report titled "Central Arkansas Water Study" prepared for the Mid Arkansas Regional Water Distribution District. This line would branch to provide Hot Springs Village with raw water service. The branch could terminate at Lake Lago or the WTP for Hot Springs Village.
- A new raw water pipeline from Lake Winona to a new expandable 14 mgd water treatment plant located near Lake Winona. The WTP would be to supply treated water to western Central Arkansas Water and Saline County users. In addition, Benton and Hot Springs Village could be provided with treated water. Pipeline costs for raw or treated water service into Benton have been included. A siting study to determine the most appropriate location of the treatment plant should be conducted as part of the future study of these facilities.

6.2 Lake Nimrod

Lake Nimrod could be utilized in the same manner as Lake Ouachita and at approximately the same cost. However, based on conversations with the USACE, there is insufficient data on the safe yield of this lake. The USACE advised that their analyses indicate that the probable maximum flood would likely overtop the dam and as a result little has been done with projecting water use for power generation or water supply from this lake. The lake is smaller than Ouachita but there is no competition for the water stored in Nimrod. With the chance of dam being overtopped, the design of an intake structure would be complicated and costs would likely be significant. It is possible that a side-hill vacuum primed pump station could work as the intake pump station reducing the risk of mechanical/structural damage from floods of low frequency return periods. Given there is insufficient data about a safe yield, no further consideration will be given to Nimrod.



Existing Treatment Capacity, mgd		Existing Safe Yield, mgd	
Benton Plant	13.3	L. Brewer (Note 4)	24.0
Jack H. Wilson Plant	150.0	L. Maumelle	93.0
Ozark Point Plant	25.0	L. Winona	24.0
Gleason Plant 1	15.0		
Gleason Plant 2	8.0		
Hot Springs Village WTP	4.0		
Conway Co. RWDD WT	8.0		
Total	223.3	Total	141.0

Description of Alternative

> Water from Greer's Ferry to new WTP in area of Sherwood/N Little Rock
> Raw water will be supplied to L. Brewer from Greer's Ferry to meet Conway area demand
> Continue to use River crossings to serve No. of River area
> New water supply for Hot Springs Village and Saline Co. from L Ouachita
> New line from Ouachita to Winona. New intake at Winona.
> L. Winona can be a storage reservoir for water from Ouachita.
> New WTP near Winona (See Note 3)
> Petition for remaining available yield from Greer's Ferry discretionary storage.

WATER SUPPLY - Firm Yield Based on Average Day Demand

NORTH OF RIVER	Net 2050 Demand	New Supply	
Conway / Conway Co	13.0	13.0	From Greer's Ferry
No. of River Area	10.0	10.0	From Greer's Ferry
Subtotal No. of Arkansas	23.0	23.0	

SOUTH OF RIVER	Net 2050 Demand	New Supply	
South of River Area	(41.3)	-	Water supply sufficient for area
Saline Co. Area	16.0	16.0	From Ouachita through Winona
Hot Springs Village	8.0	8.0	From Ouachita
Subtotal So. of Arkansas	(17.3)	24.0	From Ouachita

TREATMENT REQUIREMENTS - Based on Peak Day Demand

NORTH OF RIVER	Net 2050 Demand	New Trtmnt	
Conway / Conway Co	33.0	33.0	Note 1
No. of River Area	25.0	25.0	New North of River WTP
Subtotal No. of Arkansas	58.0	58.0	mgd of new treatment required

SOUTH OF RIVER	Net 2050 Demand	New Trtmnt	
South of River Area	(43.0)	-	Sufficient Capacity available
Saline Co. Area	14.0	14.0	New plant @ Winona Note 3
Hot Springs Village	10.0	10.0	Note 2
Subtotal So. of Arkansas	(19.0)	24.0	mgd of new treatment

Notes:

1. Conway and Conway Co will require additional treatment to meet future needs. However, for purposes of study, only include the cost of providing raw water to Lake Brewer will be included, per discussions with Conway Corporation.
2. Hot Springs Village will require additional treatment to meet future needs. However, for purposes of study and per request of HSV, will only include cost to bring raw water to HSV.
3. Treatment Plant location at Winona could serve Saline Co., Hot Springs Village, western part of Central Arkansas Water. For costing purposes, only the cost to treat 14 mgd flow required by Saline County area has been included.
4. The 24 mgd existing capacity includes the capacity gained by increasing dam at Lake Brewer per 2002 Corps of Engineers report for Conway Corporation.

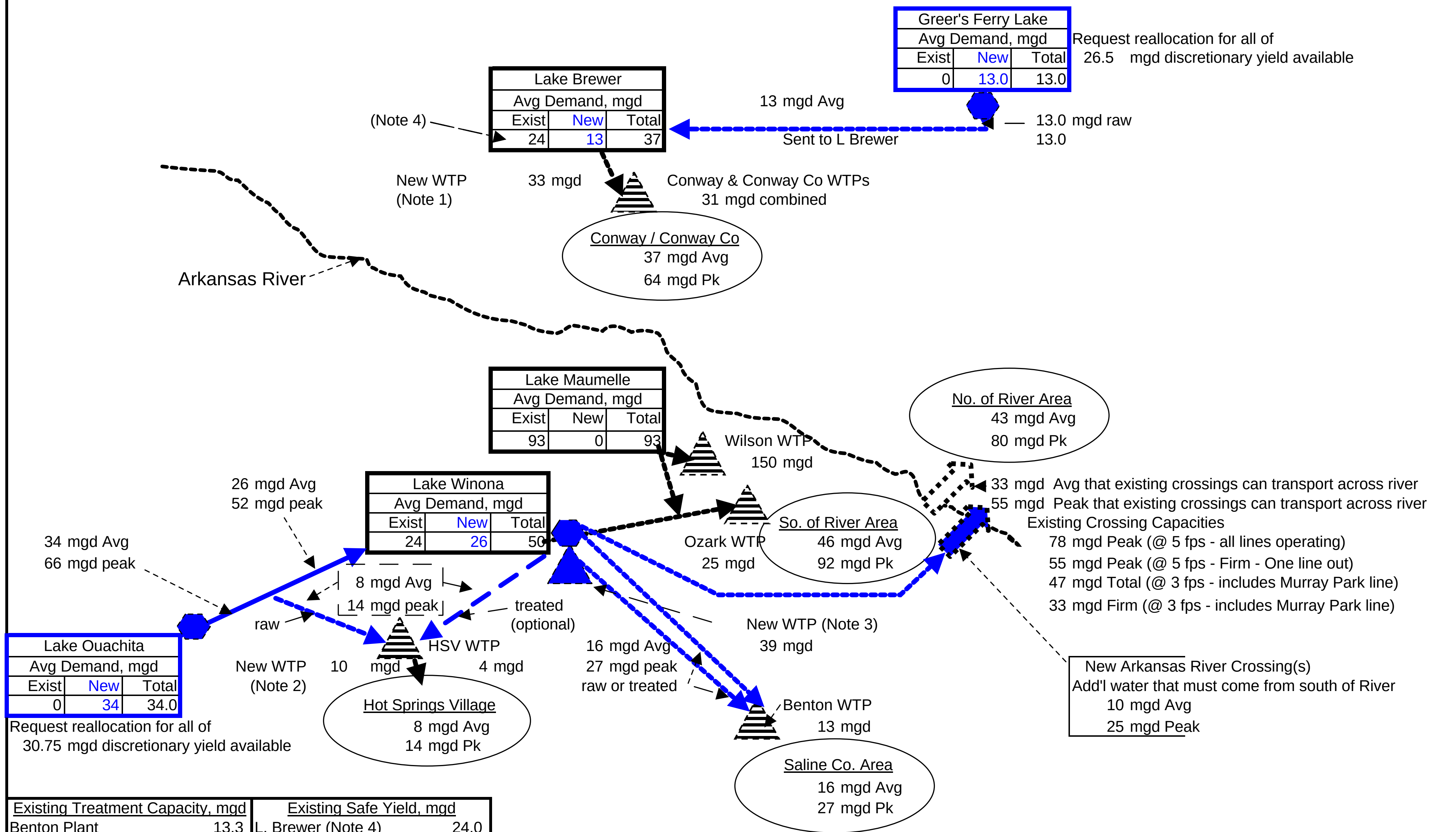
LEGEND

- Existing pipelines
- New pipelines
- New pipelines (optional route)
- New intake / PS
- New WTP
- Existing WTP capacity based on peak day
- Regional 2050 Demand for Water
- Water Supply Source (Exist | New)

Figure 6-1
Alternative 1

BLACK & VEATCH Corporation

Cygnet 41131
File: Alternatives schematics.xls Tab: Alt 1 Greers Ferry



Existing Treatment Capacity, mgd	
Benton Plant	13.3
Jack H. Wilson Plant	150.0
Ozark Point Plant	25.0
Gleason Plant 1	15.0
Gleason Plant 2	8.0
Hot Springs Village WTP	4.0
Conway Co. RWDD WTI	8.0
Total	223.3

Existing Safe Yield, mgd	
L. Brewer (Note 4)	24.0
L. Maumelle	93.0
L. Winona	24.0
Total	141.0

Description of Alternative

- > Raw water from Lake Ouachita to serve all but Conway Area
- > Use Greer's Ferry for Conway area water supply. (Per Conway representatives, there is no interest in alternative water supply from south of Arkansas River. To make alternative comparable to other alternatives, the cost to provide raw water to Conway is included.)
- > New pipeline from Greer's Ferry to Lake Brewer
- > L. Maumelle and Winona will supply Wilson WTP and Ozark WTP
- > New pipeline from L. Ouachita to Winona. New intake at Winona.
- > New Arkansas River crossing(s) to serve "North of River Area".
- > New 54 mgd plant (Note 3). Could also be 40 mgd plant at Winona and 14 mgd plant near Benton.
- > Petition for remaining discretionary storage at Ouachita.
- > New pipeline(s) from Winona to Saline Co. area. Could transport either raw or treated water depending on location of WTP that serves Saline Co.

WATER SUPPLY - Firm Yield Based on Average Day Demand

NORTH OF RIVER	Net 2050 Demand	New Supply	
Conway / Conway Co	13.0	13.0	From Greer's Ferry
No. of River Area	10.0	-	From new river crossings
Subtotal No. of Arkansas	32.0	13.0	mgd from new source
			mgd from existing supply

SOUTH OF RIVER	Net 2050 Demand	New Supply	
South of River Area	(47.0)	-	Water supply sufficient for area
Saline Co. Area	16.0	16.0	From Ouachita through Winona
Hot Springs Village	8.0	8.0	From Ouachita
Subtotal So. of Arkansas	(23.0)	24.0	From Ouachita

TREATMENT REQUIREMENTS - Based on Peak Day Demand

NORTH OF RIVER	Net 2050 Demand	New Trtmnt	
Conway / Conway Co	33.0	33.0	Note 1
No. of River Area	25.0	-	obtain from south of river
Subtotal No. of Arkansas	58.0	33.0	mgd of new treatment required

SOUTH OF RIVER	Net 2050 Demand	New Trtmnt	
South of River Area	(43.0)	25.0	New plant @ Winona Note 3
Saline Co. Area	14.0	14.0	New plant @ Winona Note 3
Hot Springs Village	10.0	10.0	Note 2
Subtotal So. of Arkansas	(19.0)	49.0	mgd of new treatment

Notes:

1. Conway and Conway Co will require additional treatment to meet future needs. However, for purposes of study, only include the cost of providing raw water to Lake Brewer will be included, per discussions with Conway Corporation.
2. Hot Springs Village will require additional treatment to meet future needs. However, for purposes of study and per request of HSV, will only include cost to bring raw water to HSV.
3. Treatment Plant location at Winona could serve Saline Co., Hot Springs Village, and Central Arkansas Water. For costing purposes, only the cost to treat 14 mgd flow for Saline County area plus 40 for CAW north of river is included.
4. The 24 mgd existing capacity includes the capacity gained by increasing dam at Lake Brewer per 2002 Corps of Engineers report for Conway Corporation.

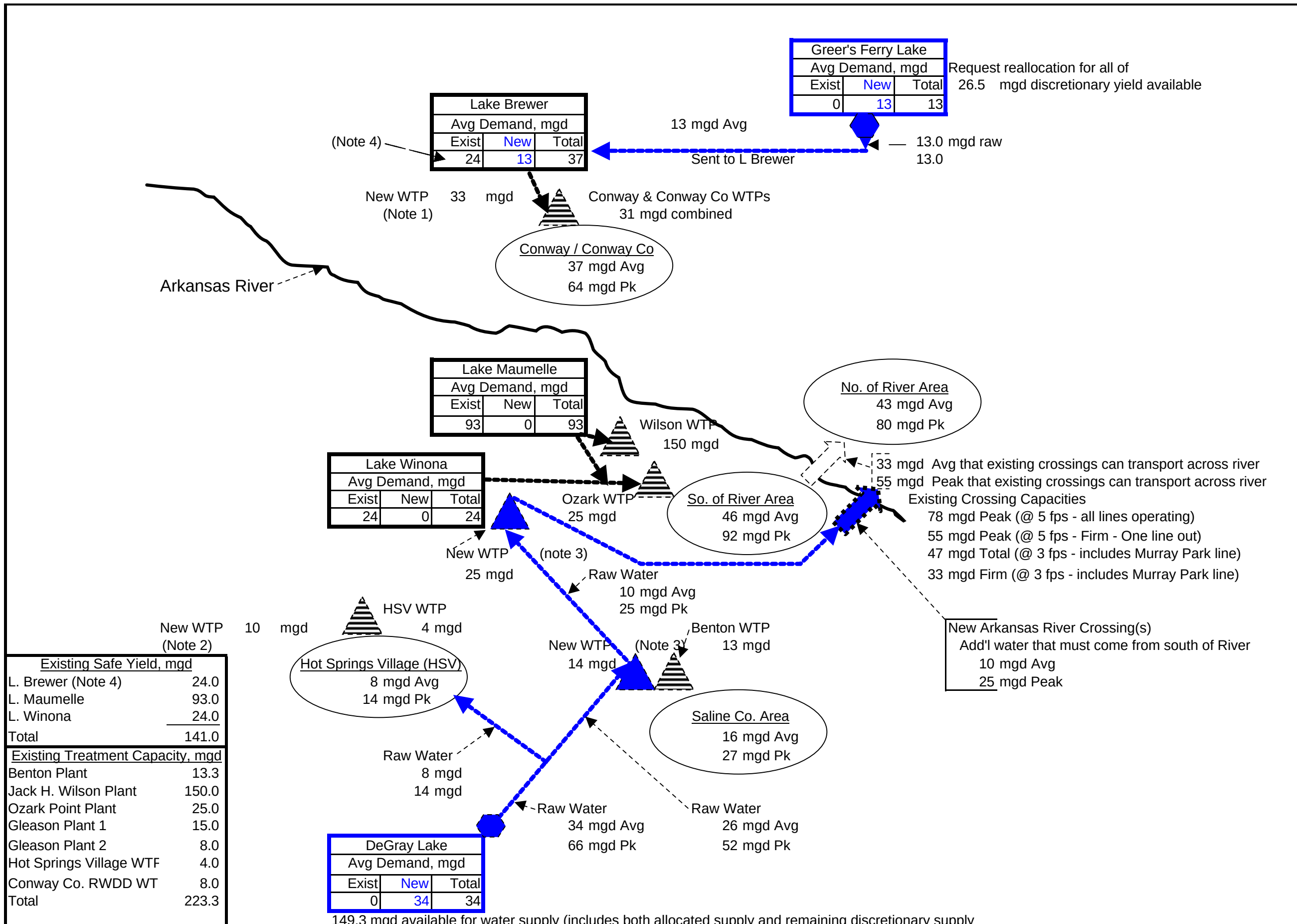
LEGEND

- Existing pipelines
- New pipelines
- New pipelines (optional route)
- New intake / PS
- New WTP
- Existing WTP capacity based on peak day
- Regional 2050 Demand for Water
- Exist / New - Water Supply Source

Figure 6-2
Alternative 2

BLACK & VEATCH
Corporation

Cygnet: 96153
File: Alternatives schematics.xls Tab: Alt 2 Ouachita



Existing Safe Yield, mgd	
L. Brewer (Note 4)	24.0
L. Maumelle	93.0
L. Winona	24.0
Total	141.0

Existing Treatment Capacity, mgd	
Benton Plant	13.3
Jack H. Wilson Plant	150.0
Ozark Point Plant	25.0
Gleason Plant 1	15.0
Gleason Plant 2	8.0
Hot Springs Village WTF	4.0
Conway Co. RWDD WT	8.0
Total	223.3

Description of Alternative

- > Raw water supply from DeGray
- > New treatment plant to serve CAW needs (Note 3)
- > Use Greer's Ferry for raw water supply to Conway Area.
- > Additional treatment provided to Saline Co. (Note 3)
- > River crossing(s) required to provide treated water to "North of River Area".

WATER SUPPLY - Firm Yield Based on Average Day Demand

NORTH OF RIVER	Net 2050 Demand	New Supply	
Conway / Conway Co	13.0	13.0	From Greer's Ferry
No. of River Area	10.0	-	From DeGray Lake so. of river
Subtotal No. of Arkansas	32.0	13.0	mgd from New water supply
			mgd from existing supply

SOUTH OF RIVER	Net 2050 Demand	New Supply	
South of River Area	(47.0)	10.0	New supply for no. of river area
Saline Co. Area	16.0	14.0	From DeGray Lake
Hot Springs Village	8.0	10.0	From DeGray Lake
Subtotal So. of Arkansas	(23.0)	34.0	mgd from DeGray Lake

TREATMENT REQUIREMENTS - Based on Peak Day Demand

NORTH OF RIVER	Net 2050 Demand	New Trtmnt	
Conway / Conway Co	33.0	33.0	Note 1
No. of River Area	25.0	-	obtain from south of river
Subtotal No. of Arkansas	58.0	33.0	mgd of new treatment required

SOUTH OF RIVER	Net 2050 Demand	New Trtmnt	
South of River Area	(43.0)	25.0	New plant @ Winona Note 3
Saline Co. Area	14.0	14.0	New plant Saline Co. area Note 3
Hot Springs Village	10.0	10.0	Note 2
Subtotal So. of Arkansas	(19.0)	49.0	mgd of new treatment

Notes:

1. Conway and Conway Co will require additional treatment to meet future needs. However, for purposes of study, only include the cost of providing raw water to Lake Brewer will be included, per discussions with Conway Corporation.
2. Hot Springs Village will require additional treatment to meet future needs. However, for purposes of study and per request of HSV, will only include cost to bring raw water to HSV.
3. Treatment Plant at Saline Co. for 14 mgd. Second WTP at Winona could serve Hot Springs Village and Central Arkansas Water. For costing purposes, the WTP for Saline area is sized for 14 mgd and the Winona WTP is sized for 25 mgd to meet CAW projected demand.
4. The 24 mgd existing capacity includes the capacity gained by increasing dam at Lake Brewer per 2002 Corps of Engineers report for Conway Corporation.

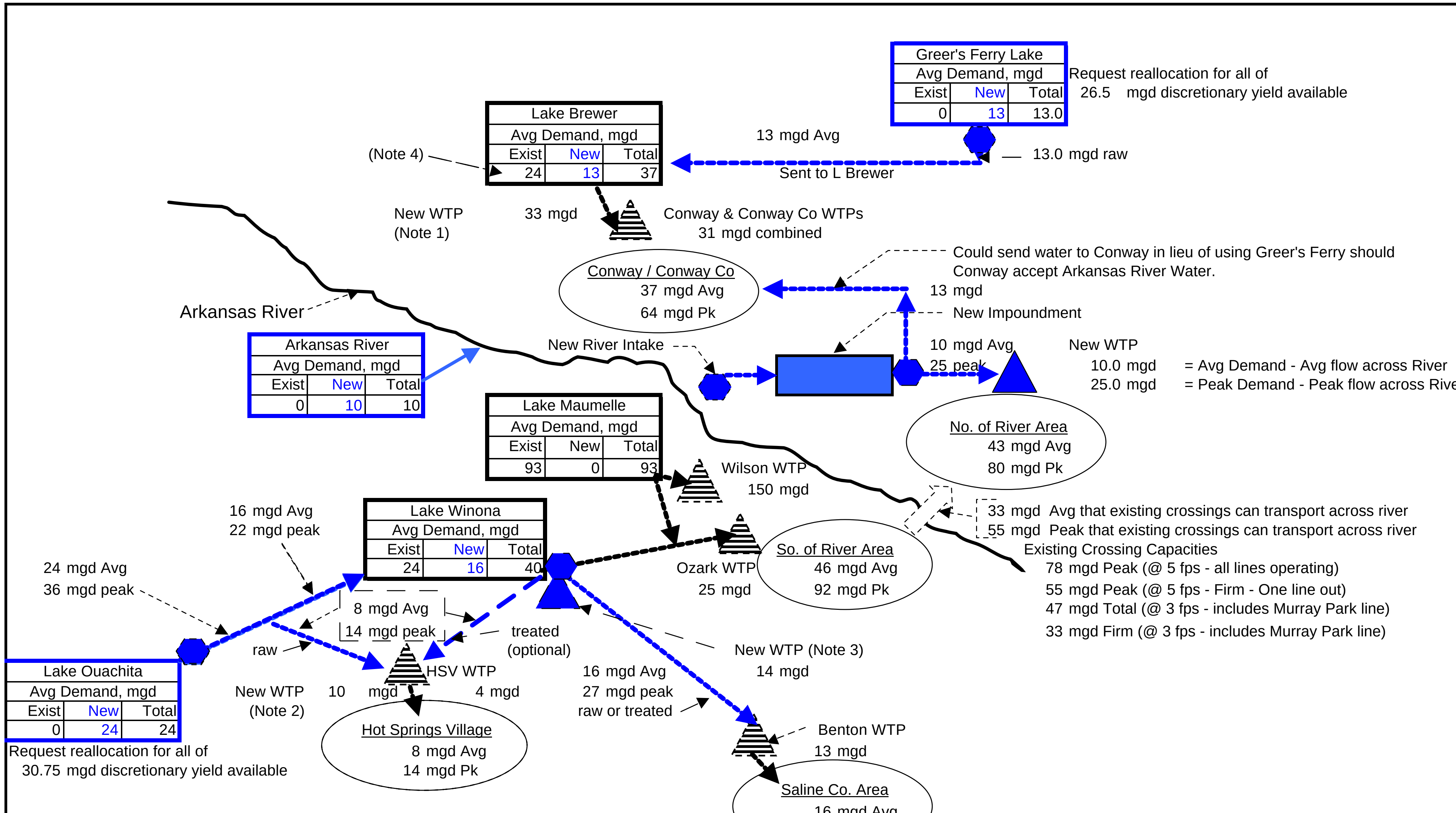
LEGEND

- Existing pipelines
- New pipelines
- New pipelines (optional route)
- New intake / PS
- New WTP
- Existing WTP capacity based on peak day
- Regional 2050 Demand for Water
- Exist New - Water Supply Source

Figure 6-3
Alternative 3

BLACK & VEATCH Corporation

Cygnet: 41131
File: Alternatives schematics.xls Tab: Alt 3 DeGray



Existing Treatment Capacity, mgd	
Benton Plant	13.3
Jack H. Wilson Plant	150.0
Ozark Point Plant	25.0
Gleason Plant 1	15.0
Gleason Plant 2	8.0
Hot Springs Village WTP	4.0
Conway Co. RWDD WTF	8.0
Total	223.3

Existing Safe Yield, mgd	
L. Brewer (Note 4)	24.0
L. Maumelle	93.0
L. Winona	24.0
Total	141.0

Description of Alternative

> New Arkansas River intake and impoundment
> Water from Arkansas R. to new WTP in area of Sherwood/N Little Rock
> Raw water will be supplied to L. Brewer from Greer's Ferry to meet Conway area demand
> Continue to use River crossings to serve No. of River area
> New water supply for Hot Springs Village and Saline Co. from L Ouachita L. Winona can be a storage reservoir for water from Ouachita.
> New intake at Winona
> New WTP located near Lake Winona (see note 3)

WATER SUPPLY - Firm Yield Based on Average Day Demand

NORTH OF RIVER	Net 2050 Demand	New Supply	
Conway / Conway Co	13.0	13.0	From Greer's Ferry
No. of River Area	10.0	10.0	From Arkansas River
Subtotal No. of Arkansas	32.0	23.0	

SOUTH OF RIVER	Net 2050 Demand	New Supply	
South of River Area	(47.0)	-	Water supply sufficient for area
Saline Co. Area	16.0	16.0	From Ouachita through Winona
Hot Springs Village	8.0	8.0	From Ouachita
Subtotal So. of Arkansas	(23.0)	24.0	From Ouachita

TREATMENT REQUIREMENTS - Based on Peak Day Demand

NORTH OF RIVER	Net 2050 Demand	New Trtmnt	
Conway / Conway Co	33.0	33.0	Note 1
No. of River Area	25.0	25.0	mgd from New North of River
Subtotal No. of Arkansas	58.0	58.0	mgd of new treatment required

SOUTH OF RIVER	Net 2050 Demand	New Trtmnt	
South of River Area	(43.0)	-	Sufficient Capacity available
Saline Co. Area	14.0	14.0	New plant @ Winona Note 3
Hot Springs Village	14.0	10.0	Note 2
Subtotal So. of Arkansas	(15.0)	24.0	mgd of new treatment

Notes:
1. Conway and Conway Co will require additional treatment to meet future needs. However, for purposes of study, only include the cost of providing raw water to Lake Brewer will be included, per discussions with Conway Corporation.
2. Hot Springs Village will require additional treatment to meet future needs. However, for purposes of study and per request of HSV, will only include cost to bring raw water to HSV.
3. Treatment Plant location at Winona could serve Saline Co., Hot Springs Village, and western part of Central Arkansas Water. For costing purposes, only the cost to treat 14 mgd flow required by Saline County area has been included.
4. The 24 mgd existing capacity includes the capacity gained by increasing dam at Lake Brewer per 2002 Corps of Engineers report for Conway Corporation.

LEGEND

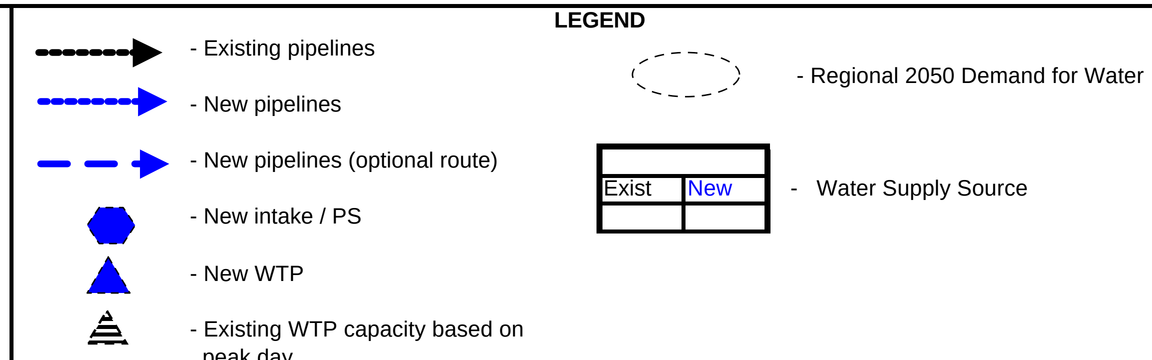
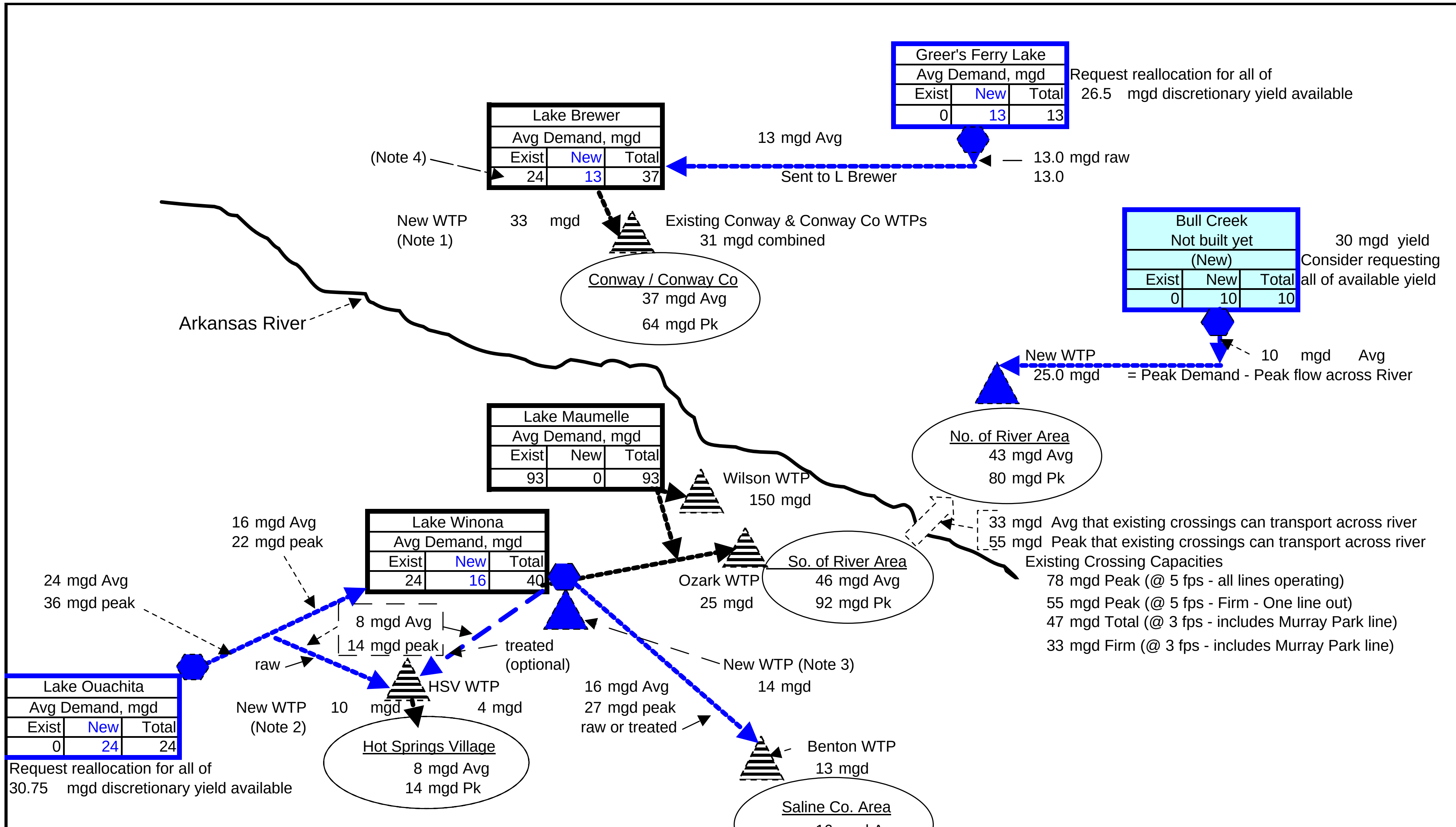


Figure 6-4
Alternative 4

BLACK & VEATCH Corporation

Cygnet 41131
File: Alternatives schematics.xls Tab: Alt 4 Arkansas River



Existing Treatment Capacity, mgd	
Benton Plant	13.3
Jack H. Wilson Plant	150.0
Ozark Point Plant	25.0
Gleason Plant 1	15.0
Gleason Plant 2	8.0
Hot Springs Village WTF	4.0
Conway Co. RWDD WTI	8.0
Total	223.3

Existing Safe Yield, mgd	
L. Brewer (Note 4)	24.0
L. Maumelle	93.0
L. Winona	24.0
Total	141.0

Description of Alternative

> Construct Bull Creek Reservoir
> Bull Creek to provide water for North of River Area.
> Use Greer's Ferry for Conway area water supply.
> New WTP in Sherwood/ N. Little Rock area.
> Construct an intake and new pipeline from Greer's Ferry to Lake Brewer
> Construct new intake at Lake Winona
> New water supply for Hot Springs Village and Saline Co. from L Ouachita
L. Winona can be a storage reservoir for water from Ouachita.
> New WTP at Winona. (See Note 3)

WATER SUPPLY - Firm Yield Based on Average Day Demand

NORTH OF RIVER	Net 2050 Demand	New Supply	
Conway / Conway Co	13.0	13.0	From Greer's Ferry
No. of River Area	10.0	-	From Bull Creek
Subtotal No. of Arkansas	32.0	13.0	

SOUTH OF RIVER	Net 2050 Demand	New Supply	
South of River Area	(47.0)	-	Water supply sufficient for area
Saline Co. Area	16.0	16.0	From Ouachita through Winona
Hot Springs Village	8.0	8.0	From Ouachita
Subtotal So. of Arkansas	(23.0)	24.0	From Ouachita

TREATMENT REQUIREMENTS - Based on Peak Day Demand

NORTH OF RIVER	Net 2050 Demand	New Trtmnt	
Conway / Conway Co	33.0	33.0	Note 1
No. of River Area	25.0	25.0	mgd from New North of River WTP + 15 mgd from so. of river
Subtotal No. of Arkansas	58.0	58.0	mgd of new treatment required

SOUTH OF RIVER	Net 2050 Demand	New Trtmnt	
South of River Area	(43.0)	-	Sufficient Capacity available
Saline Co. Area	14.0	14.0	New plant @ Winona Note 3
Hot Springs Village	14.0	10.0	Note 2
Subtotal So. of Arkansas	(15.0)	24.0	mgd of new treatment

Notes:
1. Conway and Conway Co will require additional treatment to meet future needs. However, for purposes of study, only include the cost of providing raw water to Lake Brewer will be included, per discussions with Conway Corporation.
2. Hot Springs Village will require additional treatment to meet future needs. However, for purposes of study and per request of HSV, will only include cost to bring raw water to HSV.
3. Treatment Plant location at Winona could serve Saline Co., Hot Springs Village, western part of Central Arkansas Water. For costing purposes, only the cost to treat 14 mgd flow required by Saline County area has been included.
4. The 24 mgd existing capacity includes the capacity gained by increasing dam at Lake Brewer per 2002 Corps of Engineers report for Conway Corporation.

LEGEND

- Existing pipelines
- New pipelines
- New pipelines (optional route)
- New intake / PS
- New WTP
- Existing WTP capacity based on peak day
- Regional 2050 Demand for Water
- Exist | New - Water Supply Source

Figure 6-5
Alternative 5

BLACK & VEATCH
Corporation

Cygnet: 41131
File: Alternatives schematics.xls Tab: Alt 5 Bull Creek

7.0 Evaluation of Alternatives

7.1 Evaluation Criteria

A comparative cost and intangible evaluation of each alternative was conducted. The cost evaluation involved developing opinions for capital cost, present worth, equivalent annual costs for each alternative. The present worth and equivalent annual costs are used to determine which alternative is the most-cost effective. The present worth and equivalent annual cost analyses are based on a 50 year planning period as stated in the scope of services for this project. The intangible factors include environmental constraints, public acceptance and security considerations.

7.2 Cost Evaluation Criteria

7.2.1 Cost of Alternatives

Each alternative consists of discrete items or processes that were assigned a cost based primarily on Black & Veatch's historical data. These costs are based on the minimal level of detail provided in this report and are considered valid for comparison of alternatives. As the alternative(s) are developed in further studies or design, these costs will be refined with the level of detail provided.

7.2.2 Opinion of Probable Capital Costs

7.2.2.1 Intake Cost and Pump Station. There are two distinct structures required; one for USACE lakes and one for the private lakes or impoundments. The USACE structure has to be capable of protecting the equipment to an elevation approximately 60 feet above the conservation pool. The intakes located in private waters are less complicated. All intakes were assumed to have provided vehicle access.

For each intake, the cost of the structure was estimated based on the use of concrete as the preferred structural frame. Equipment costs were based of cost obtained from suppliers and escalated to derive installed costs.

7.2.2.2 Pipeline Cost. Our opinion of the probable cost for large diameter pipelines is $6.00 per foot per inch diameter based on this level of detail. This cost includes easements in rural areas, appurtenances such as fittings, air release valves, blow-off lines, small stream crossings (including the permit), bedding, and fractured rock excavation. Easements in developed areas were estimated at $13.00 per foot of pipe. All pipes were assumed to have four feet of cover.

7.2.2.3 Water Treatment Plant Cost. The construction cost of the water treatment plants was obtained from our database of historical plant costs. It was assumed that the plants would utilize conventional treatment except for the treatment of Arkansas River water. The plant for treatment of the Arkansas River water would utilize ozone. For conventional treatment plants of this size, the construction cost is estimated to be approximately $1.2 million per million gallons per day of capacity. For the Arkansas River alternative, a projected cost of $1.6 million per million gallons per day of capacity was used to account for the cost of additional treatment provided by ozonation facilities.

7.2.2.4 Land Cost. Land costs were based on data obtained from previous reports and these costs were escalated.

7.2.2.5 Other Costs. A $300,000 cost for an Environmental Impact Statement was assigned to the alternatives requiring pipelines to traverse the Ouachita National Forrest. An Environmental Impact Statement will be required for the area encompassing the Bull Creek Reservoir. A $2,000,000 cost has been included to cover this requirement.

7.2.2.6 Present Worth and Equivalent Annual Cost of Capital Improvements. The present worth (PW) and equivalent annual cost (EAC) analyses were used to determine which alternative(s) are the most cost-effective. Present worth of future costs over the 50- year study period were calculated using a 6.125 percent interest rate as directed by the USACE. Costs for future equipment and facilities replacement were placed in the appropriate year of the present worth analysis. Service life for facilities and equipment were based on the following:

Land/Easement	Permanent
Pipelines, structures	50 Years
Intakes, pump stations	50 Years
Treatment Plant structures	50 Years
Process, general, electrical equipment	20 Years

At the end of the 50-year period, those facilities that still have assumed useful life, were given a discounted salvage value.

7.2.3 Opinion of Probable Operation and Maintenance Costs

Cost opinions were developed for operating and maintaining pumping and treatment facilities plus special costs such as payment to the USACE for use of storage from their lakes. Three types of cost were considered: Pumping and conveyance costs; treatment operating and maintenance (O&M); and cost of storage from USACE lakes.

Pumping costs are based on a preliminary sizing and routing to convey water to the general locations indicated in Figures 6-1 through 6-5. The power costs used for this analysis are based on values provided by Central Arkansas Water, which is $0.068/kWh.

7.2.3.1 Treatment Operating and Maintenance Costs. Operation and maintenance costs for a conventional water treatment plant typically range between $300 and $500 per day per million gallons treated. For this study, $500 per day per million gallons of treated water was used to cover the additional raw water transmission activities not typically associated with a conventional facility. This cost covers labor, power at the plant, chemicals, spare parts, general maintenance, and sludge disposal.

7.2.3.2 Cost of Storage from UASCE Lakes. When storage in a USACE lake has been reallocated for water supply, there is an associated cost. USACE procedures require that the cost of the reallocated storage be the highest of the following:

- Lost power benefits that include benefits foregone plus revenues foregone plus the replacement cost of power.
- Or cost of lost flood storage
- Or the updated cost of storage in the federal project.

This procedure for determining the cost of storage will be required to obtain water from Lake Ouachita and Greers Ferry. Obtaining storage from DeGray differs because some of the storage in DeGray Lake was allocated for water and because of an agreement between the Ouachita River Water District and the USACE the basis for paying for the construction of the lake storage will be based on paying off the original construction loan amount at an interest rate of 2.74 percent. DeGray may also have a cost for lost power benefit if the water is taken from the conservation pool instead of the downstream pool. The actual cost of the reallocated storage will not be known until the USACE conducts a reallocation study. A discussion of the method used to estimate these costs is presented in Appendix D.

7.2.4 Present Worth Analysis and Equivalent Annual Costs

The total present worth of each alternative is the sum of the initial capital costs, discounted future capital costs, discounted salvage value credit, discounted annual O&M costs and discounted annual costs for use of lake storage for water supply. To determine the equivalent annual costs, the present worth of capital costs was annualized at a 6.125 percent interest rate over 50 years beginning in year 2005 and added to the average undiscounted O&M costs and cost of storage.

Table 7-1 presents a summary of our opinion of the probable initial year capital cost, present worth and equivalent annual cost for each alternative. Table 7-2 shows the new water supply and treatment capacity being provided with each alternative and a cost per 1,000 gallons for each alternative. These costs do not include costs to connect to individual participant's distribution system nor are any institutional costs that may be required. Institutional cost should be part of the program to determine the most appropriate institutional arrangement for the participants pursuing additional water supply.

The values in Tables 7-1 and 7-2 show that Alternative 5 has the lowest present worth and lowest capital cost. However, Alternatives 1 and 2 have values that are within 5 percent of Alternative 5. At the level of cost development performed for this study, costs that are within 10 percent of the low cost are considered equal. Alternatives 3 and 4 fall outside of this 10 percent range. Alternative 3 has a significantly higher cost and could not be justified on a cost basis.

Table 7-1
Summary of Initial Year Capital Costs, Present Worth, and Equivalent Annual Cost

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Initial Year Cap. Costs ($Million)	**$695**	**$698**	**$918**	**$713**	**$662**
Present Worth (PW) 50 Year period, $ Million					
PW-Capital Costs (incl. land costs)	$729	$731	$948	$812	$695
PW-O&M Costs	$74	$64	$82	$70	$ 67
PW Cost of water from Corps Lakes (Note 1)					
PW Cost of Lost Power Benefit	$16	$16	$15	$12	$12
PW Cost of Storage	$11	$11	$6	$9	$9
PW Cost of Lost Flood Storage	Note 1	Note 1	Note 1	Note 1	Note 1
PW of Greater of Costs for Corps Lake Water	$16	$16	$15	$12	$12
Total PW ($Million)	**$818**	**$811**	**$1,045**	**$894**	**$775**
Lowest PW or % > Lowest PW	6%	5%	34%	15%	Lowest PW
Rank based on PW	3	2	5	4	1
Equivalent Annual Cost (EAC), $ Million					
EAC Capital Costs (includes land costs)	$47.0	$47.0	$61.0	$52.4	$44.9
EAC O&M Costs	$4.8	$4.1	$5.3	$4.5	$4.3
EAC - Use of Corps Lakes (note 1)					
EAC for Cost of Lost Power	$1.0	$1.0	$1.0	$0.8	$0.8
EAC for Cost of Storage	$0.7	$0.7	$0.4	$0.6	$0.6
EAC for Flood Storage	Note 1	Note 1	Note 1	Note 1	Note 1
EAC - Costs for Corps Lake Water	$1.0	$1.0	$1.0	$0.8	$0.8
Total EAC (Nearest $1M)	**$53**	**$52**	**$67**	**$58**	**$50**

Notes

[1] Reallocation from Corps lakes will require an annual payment to the Corps based on the greatest of three costs: lost power benefit cost; annual O&M cost for maintaining storage; or cost for lost flood storage. US Army Corps of Engineers must determine actual value through a reallocation study. For purposes of this study, Corps advises that for recent storage reallocations for lakes located within the jurisdiction of the USACE Little Rock office, reallocation has been from flood storage as it has typically resulted in the lowest cost. To obtain budget level costs for this study, USACE recommends taking the larger of the estimated values for lost power benefit cost and annual O&M cost for storage. Cost of lost power benefit may be overstated but if adjusted downward would not change the ranking of alternatives.

Table 7-2 New Water Supply and Treatment Provided by Each Alternative Planning Period through 2050					
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
Average Day Demand, mgd					
Conway Area	13.0	13.0	13.0	13.0	13.0
North of River	10.0	Note 1	Note 1	10.0	10.0
South of River	0.0	10.0	10.0	0.0	0.0
Saline County Area	16.0	16.0	16.0	16.0	16.0
Hot Springs Village	8.0	8.0	8.0	8.0	8.0
Total	47.0	47.0	47.0	47.0	47.0
Peak Day Demand, mgd					
Conway Area	33.0	33.0	33.0	33.0	33.0
North of River	25.0	Note 1	Note 1	25.0	25.0
South of River	0.0	25.0	25.0	0.0	0.0
Saline County Area	14.0	14.0	14.0	14.0	14.0
Hot Springs Village	10.0	10.0	10.0	10.0	10.0
Total	82.0	82.0	82.0	82.0	82.0
New Treatment Cap., mgd					
Conway Area	Note 2	Note 2	Note 2	Note 2	Note 2
North of River	25.0	Note 3	Note 3	25.0	25.0
South of River	0.0	25.0	25.0	0.0	0.0
Saline County Area	14.0	14.0	14.0	14.0	14.0
Hot Springs Village	Note 2	Note 2	Note 2	Note 2	Note 2
Total	39.0	39.0	39.0	39.0	39.0
Cost per 1,000 gallons					
Equivalent Annual Cost	$53,000,000	$52,000,000	$67,000,000	$58,000,000	$50,000,000
New Treatment Cap., mgd	39.0	39.0	39.0	39.0	39.0
Cost per 1,000 gal. (Note 4)	$3.70	$3.70	$4.70	$4.10	$3.50

Notes:

1 Water to meet north of river demand comes from south of the river source (Lake Ouachita for Alt. 2 and DeGray Lake for Alt. 3).

2 Only raw water provided to Hot Springs Village and Conway area.

3 Treatment to meet north of river demand provided by new treatment south of the river. River Crossing(s) required to transport treated water to north of river.

4 Includes cost for raw water supply to Hot Springs Village and Conway areas.

7.3 Intangible Factors

A meeting of the study participants was held October 24, 2002 to discuss the alternatives and solicit input from the participants about the benefits and concerns of each alternative. Issues such as water quality, environmental constraints, public acceptance, and security were discussed. Table 7-3 located presents a summary of the comments provided about each alternative.

7.3.1 Environmental Constraints

Permits will be required for crossing the extraordinary water resource streams. An Environmental Impact Statement will be required for construction in the Ouachita National Forest. While these are important condition, neither appear to have major consequences to project implementation.

7.3.2 Security Considerations

In the wake of September 11, the security of water systems has become a significant concern. The Public Health, Security, and Bioterrorism Preparedness and Response Act requires that all water utilities serving over 3,300 customers perform a vulnerability assessment. These vulnerability assessments must be performed on a set schedule, dependent on the size of the facility. It is recommended that the assessment be updated whenever system modifications, such as the proposed water supply and treatment alternatives, are implemented. Potential security issues associated with each of proposed alternatives are likely to be relatively similar. However, a more detailed analysis will be required during design to fully identify security requirements for the selected alternative.

In general, system facilities are prioritized with respect to their importance in achieving the water system's mission. Defining the mission requires participation of utility decision makers to determine minimum capacity, pressure, and quality requirements. If there is redundancy in the system (e.g., multiple supply, treatment, and distribution facilities that can provide minimum service in the event of loss of one or more of the system components), this reduces the priority for a redundant facility. With respect to the proposed alternatives, all the facilities proposed will supplement rather than replace existing facilities. Therefore, the alternatives will create additional redundancy in the water systems and, therefore, enhance existing security.

Specific security requirements for the facilities proposed under the selected alternative should be evaluated during design. Security countermeasures that are actually implemented will depend on the priority of the facility, the threat the utility wishes to protect against, the relative risk associated with that threat, and the cost of the countermeasures. Typical security countermeasures that may be considered include the following:

- Limiting access to the facilities. This may not be completely feasible for an intake on a multi-use reservoir. However, in general, facilities may be fenced to control or restrict access. Hatches, doors, and windows to intake structures, pumping facilities, valve structures, treatment plants (especially high service pumps and chlorine gas storage areas), can be hardened and locked.

- Providing measures to detect security breaches. Intrusion detection switches, motion detectors, and closed circuit TV cameras may be installed on critical facilities and tied to alarms monitored by system personnel. It may also be desirable to work with local law enforcement or hire a security service to periodically check remote facilities.
- Working with other agencies with respect to interdependencies. It may be possible to enhance security at the reservoirs by working with USACE and the hydropower companies. In addition, the power supply is a critical element at pump stations and treatment plants. It may be desirable to ensure that power is available from more than one source.

7.4 Conclusions and Recommendations

Based on the cost opinions presented in this chapter and the comments presented at the October 24 meeting the following observations and conclusions are made:

- The budget level opinion of costs developed for this study indicate that Alternative 5 has the lowest present worth and lowest capital cost of the five alternatives.
- While Alternative 5 has the lowest present worth cost, it is acknowledged that the unknowns related to construction of a new water supply source pose a greater risk that the cost of the project could increase significantly when compared to the other alternatives.
- The budget level opinion of present worth and capital costs for Alternatives 1 and 2 are within 5 percent of and can be considered equal in cost to Alternative 5.
- Alternative 3 has a substantially higher present worth cost when compared to the other alternatives.
- Alternative 4 has a budget level opinion of cost that is approximately 15 percent higher than Alternative 5.
- Alternative 5 involves the construction of a new water supply source, Bull Creek Reservoir. While past studies have evaluated it as an alternative, consensus among the study participants and the USACE representatives at the October 24th meeting is that constructing a new lake for water supply would meet with much resistance, especially given that water is available from existing reservoirs at a comparable cost and with most likely less environmental impact.

- DeGray Lake provides much of the water supply for Alternative 3. It is the only lake that currently has storage allocated specifically for water supply. However, the cost to bring water from DeGray to this service area is projected to be substantially greater than obtaining water using one of the other alternatives.
- Alternative 4 involves obtaining water from the Arkansas River. Several concerns were raised about this water source. Many of the previous studies that studied the Arkansas River indicated that there was a strong public perception that the Arkansas River was not a good drinking water supply source, which was restated at the October 2002 meeting. The Arkansas River option involves constructing a new impoundment. The costs developed in this study are based on information from past reports that identified land on the Camp Robinson property. It is not a given that this land would be made available for an impoundment. This may require a substantial increase in the projected costs to construct this impoundment. The Arkansas River is also seen as having a greater risk of contamination from toxins, poisons, and other potentially dangerous pollutants as compared to the lakes.

The group focused in on Alternatives 1 and 2 as being most favorable. Both alternatives require reallocation of water from Greers Ferry and from Lake Ouachita. Alternative 1 provides more flexibility in the number of water supply sources that can serve the region. Having to construct a new lake makes Alternative 5 less desirable than Alternatives 1 and 2. Alternative 3 is substantially higher than Alternatives 1 or 2 and should not be pursued unless those alternatives are not available through reallocation of their storage for water supply. Alternative 4 is more expensive than Alternatives 1 or 2 and has a perception of providing poorer water quality by using the Arkansas River as a water source and being a greater risk of contamination.

Based on this evaluation, it is recommended that the group pursue obtaining the firm yield available from the remaining discretionary storage at Greers Ferry Lake and Lake Ouachita. The primary objective of this study is to determine which water supply(ies) best meets the projected demand through the year 2050. Taking water from Greers Ferry and Lake Ouachita are considered to be the best sources for both Alternatives 1 and 2. Pursuing water from both areas places the region is a strong position to respond to growth both north and south of the river in a cost-effective manner. The initial steps to implement a regional approach to water supply are equally appropriate for alternatives 1 or 2, giving the participating members the flexibility to respond to changes in growth easily and with little or no lost effort.

Table 7-3
Matrix of Intangibles

Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Water Supply	There is sufficient supply available from Corps lakes provided reallocated discretionary storage is approved by USACE or reallocated storage approved by Congress.	There is sufficient supply available from Corps lakes provided reallocated discretionary storage is approved by USACE or reallocated storage approved by Congress.	DeGray has sufficient allocated storage. There is sufficient supply available from Greers Ferry to serve Conway area provided reallocated discretionary storage is approved by USACE.	No safe yield from the River; properly sized impoundment is required. There is sufficient supply available from Greers Ferry provided reallocated discretionary storage is approved by USACE.	Bull Creek, if constructed, would have a limited yield of 30 mgd. Land acquisition, permitting, and legal entanglements could prevent dam construction for decades while gaining only a limited additional water supply.
Water Quality	Water quality of the lakes are essentially equal. Lake Ouachita is located in a national forest. This "protected" watershed should result in less degradation of the water quality in the lake.	Water quality of the lakes are essentially equal. Lake Ouachita is located in a national forest. This "protected" watershed should result in less degradation of the water quality in the lake.	Water quality of Greers Ferry and DeGray Lakes are essentially equal.	Compared to the other alternatives, this alternative has poorer water quality because much of the water would come from the Arkansas River. Also a concern exists about toxic influent from run off or spills in the river.	Water quality from Bull Creek cannot be defined at this time. Quality expected to be better than the Arkansas River and may be as good as water from the Corps lakes.
Land Acquisition					
Greers Ferry Lake Arkansas River Bull Creek Pipelines	Would require pipeline easement acquisition along private property. Attempt to use land near highway right of ways to control costs.	Would require pipeline easement acquisition along private property. Attempt to use land near highway right of ways to control costs.	Would require pipeline easement acquisition along private property. Attempt to use land near highway right of ways to control costs.	Would require pipeline easement acquisition along private property. Attempt to use land near highway right of ways to control costs.	Would require pipeline easement acquisition along private property. Attempt to use land near highway right of ways to control costs.
Lake Ouachita Pipelines	Routing within national forest could reduce the land acquisition negotiations but must deal with impacts to the national forest. Consider route along existing electrical transmission lines where possible.	Routing within national forest could reduce the land acquisition negotiations but must deal with impacts to the national forest. Consider route along existing electrical transmission lines where possible.		Routing within national forest could reduce the land acquisition negotiations but must deal with impacts to the national forest. Consider route along existing electrical transmission lines where possible.	Routing within national forest could reduce the land acquisition negotiations but must deal with impacts to the national forest. Consider route along existing electrical transmission lines where possible.
DeGray Lake Pipelines			Would require easement acquisition along private property. Attempt to use land near highway right of ways to control costs.		
River Crossings		Would require negotiating with Arkansas Dept of Transportation to attach to existing bridge(s). Route of pipeline to crossing must pass through metropolitan areas that are costly.	Would require negotiating with Arkansas Dept of Transportation to attach to existing bridge(s). Route of pipeline to crossing must pass through metropolitan areas that are costly.		
Arkansas River Impoundment or Bull Creek Reservoir				Actual location for impoundment must be selected if this alternative is selected. Locating an impoundment may not be possible. Available land is limited and could be very costly to acquire if at all.	Expect it to be difficult to get constructed. Requires acquiring large amount of land and relocating homes. USACE does not have a strong desire to build a new lake. Litigation expected to acquire necessary land.
Reliability of Water Supply to Region	Adds Greers Ferry and Lake Ouachita to serve north of river, south of river and Saline Co. areas. Maximizes sources for water which increase opportunity to continue to provide drinking should one water source be contaminated. Dual raw water pipelines have been provided.	Adds Lake Ouachita to serve north of river, south of river and Saline Co. areas as a new source. Alternative 1 provides two new sources	Adds DeGray Lake to serve north of river, south of river and Saline Co. areas as a new source. Alternative 1 provides two new sources	Adds Arkansas River to serve the north of river area and Lake Ouachita for south of river and Saline Co. areas. The watershed of the Arkansas River is vastly larger than those of the lakes and would be much more difficult to control toxins and runoff pollutants from contaminating the water supply.	Adds Bull Creek to serve the North of river and Lake Ouachita for south of river and Saline Co. areas
Other	Community Water also uses Greers Ferry as a water supply. Pursuit of Greers Ferry as a source should recognize any future needs of Community Water and perhaps entertain arrangements that has mutual benefits. Environmental groups such as "Save Greers Ferry Lake" can be expected to voice concerns about use of Greers Ferry. Everyone in study area can get off of groundwater	Everyone in study area can get off of groundwater	Members of University of Arkansas Little Rock team that is conducting a study for several Saline Co water providers indicated that those providers do not consider DeGray as a preferred option for their needs. Everyone in study area can get off of groundwater	This alternative appears to have the same concerns as alternatives 1 and 2 plus additional concerns surrounding the Arkansas River. Everyone in study area can get off of groundwater	Everyone in study area can get off of groundwater

USCOE
Mid-Arkansas Regional Water Supply Study
LOG OF REFERENCE MATERIALS
B&V Project No. 41131

Log No.	Date Rec.	Key Words	DESCRIPTION OF MATERIAL	Date of Material	Author	Hard Copy Location	Electronic Copy?
1		Contract	Contract with USCOE. Under separate cover		N/A	BV file	No
2	04/01/02	Study	Report on Raw Water Resource Investigations. Prepared for Little Rock Municipal Water Works.	Jan-72	Forrest & Cotton, Inc.	Library	No
3	04/01/02	Study	Water Supply System- North Little Rock, Arkansas. Prepared for The North Little Rock Water Commission.	Mar-74	Hudgins, Thompson, Ball of Arkansas Inc	Library	No
4	04/01/02	Study	Arkansas State Water Plan. Water and Related Land Resources Appendix "A". Existing Water and related land resource development Supplement "1" - Lakes of Arkansas	1976	Dept of Commerce. Div of Soil & Water Resources	Library	No
5	04/01/02	Study	Arkansas State Water Plan. Water and Related Land Resources Appendix "B". Existing and Projected Water Use in Arkansas; Supplement "1" - Projected Water Requirements and Surface Water Availability. Special Report No. 61	Apr-78	Arkansas Soil & Water Conservation Commission	Library	No
6	04/01/02	Draft Study	Feasibility Report for Water Resource Development. Fourche Bayou Basin. Vicinity Little Rock, Arkansas. Volume I Main Report	May-79	USCOE	Library	No
7	04/01/02	Study	Little Rock Metropolitan Area Urban Study. Technical Report Volume V. Master Plan for Water Distribution. Prepared for USCOE	Feb-79	Garver & Garver for USCOE	Library	No
8	04/01/02	Study	Little Rock Metropolitan Area Urban Study. Technical Report Volume XXI Water Supply Phase II Report 2. Part of Series of reports for a broad look at all significant water sources for the Pulaski/Saline County Area through year 2080	Nov-1979	USCOE	Library	No
9	04/01/02	Study	Lake DeGray Water Supply. Prepared for Little Rock Municipal Water Works Urban Study Supplement.	Feb-82	Garver & Garver	Library	No
10	04/01/02	Study	Special Report in the Grand Prairie of the Lower White and Bayou Meto Basins prepared for Soil and Water Conservation Commission. "Using Target Levels to Develop a Sustained Yield Pumping Strategy in Arkansas, A Riparian Rights State."	May-84	Richard C. Peralta and Ann W. Peralta	Library	No
11	04/01/02	Study	Arkansas State Water Plan. Executive Summary Draft	Jun-88	Arkansas Soil & Water Conservation Commission	Library	No
12	04/01/02	Study	Arkansas State Water Plan. Arkansas River Basin. Prepared for Arkansas Soil & Water Conservation Commission.	??	USCOE	Library	No
13	04/01/02	Study	Report on Water Supply, Treatment, and Distribution for the Little Rock Municipal Water Works; Little Rock Arkansas	Aug-88	The Benham Group	Library	No

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Log No.	Date Rec.	Key Words	DESCRIPTION OF MATERIAL	Date of Material	Author	Hard Copy Location	Electronic Copy?
14	04/01/02	Study	Determination of the Suitability of arkansas River Water for Municipal, Industrial, and Agricultural Use. Volume 1 Prepared for Arkansas Soil & Water Conservation Commission and USCOE	Jan-89	James Moore, Dept Civil engrg. Univ. of Arkansas	Library	No
15	04/01/02	Study	Determination of the Suitability of arkansas River Water for Municipal, Industrial, and Agricultural Use. Volume 2 Water Quality Data. Prepared for Arkansas Soil & Water Conservation Commission and USCOE	May-90	James Moore, Dept Civil engrg. Univ. of Arkansas	Library	No
16	04/01/02	study	Central Arkansas Water Supply Reconnaissance Report. Estimation and Analysis of Water Supply Benefits-Central Arkansas Study. Prepared for USCOE-Little Rock	Feb-90	Conley & Hardy Consulting Engr.	Library	No
17	04/01/02	Study	Central Arkansas Water Study, Reconnaissance Report.	Apr-90	USCOE	Library	No
18	04/01/02	Study	Greers Ferry Diversion, North Little Rock Regional Water Study. Prepared for North Little Rock Regional Water Study	Nov-91	Parsons, Brinkerhoff, Gore & Storrie, Inc.	Library	No
19	04/01/02	Study	Water Resource Study. Little Rock Municipal Water Works.	Apr-92	Garver & Garver	Library	No
20	04/01/02	Study	Central Arkansas Water Resource Study Update. Prepared for Arkansas Soil & Water Commission, Little Rock, Arkansas.	Nov-94	Garver & Garver	Library	No
21	04/01/02	Report	Water Resources Development in Arkansas 1995-2005.	Jan-95	USCOE Little Rock District	Library	No
22	04/01/02	Study	Source and Lake Study for Water Supply and Treatment. Prepared for North Little Rock Water Department - Jacksonville Water Works.	May-99	Marlar Engrs. And Garver Engineers	Library	No
23	04/01/02	Draft Study	Safe Yield Study for Lakes Maumelle and Winona. Little Rock Municipal Water Works.	Sep-99	FTN Associates Ltd.	Library	No
24	04/01/02	Study	"Water for our Future: Overcoming Regional Paralysis. A report by the Water Study Task Force.	Sep-00	Univ. of Arkansas - Little Rock	Library	No
25	04/01/02	Meeting Report	Central Arkansas Regional Water Discussion. Report on the Subcommittee on Instituational Option	Sep-01		Library	No
26	04/01/02	Study	Water Supply Alternatives Study - Long Term County Wide Plan Salina County, Arkansas. Prepared at the Direction of Saline County Quorum Court and Terry Parsons, County Judge. Author assisted by OEI Facilities and McLaughlin, Hibbs & Smith.	Oct-96	Saline County Water Users Committee	Library	No

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Log No.	Date Rec.	Key Words	DESCRIPTION OF MATERIAL	Date of Material	Author	Hard Copy Location	Electronic Copy?
27	04/01/02	Maps	North Little Rock Water Department Exhibits 5 through 9. Water demand. 1985 Improvements program and 2000 improvements program.			Library	No
28	04/11/02	Telefax	From Mike Biggs USCOE to Earl Jenkins BV. Presents Blakely Mountain Lake Critical Period Dependable Yield analysis and Lake Ouachita Storage.	Apr-02	USCOE	Library	No
29	04/01/02	Telefax	From Joel Anderson UALR to Tom Holden "USCOE" for meeting June 5, 2000	Jun-01	Univ. of Arkansas - Little Rock	Library	No
30	05/13/02	Study	Central Arkansas Water Study prepared for Mid-Arkansas Regional Water Distribution District (Beebe, Cabot, Jacksonville, North Little Rock, and US Air Force.	Nov-75	Benham Blair & Affiliates. Inc.	Library	No
31	05/13/02	Agreement	Option Agreement between Ouachita River Water District and Board of Commissioners of the Little Rock Municipal Water Works	Apr-88	Ouachita River Water District	Library	No
32	05/13/02	Various Documts	Documents pertaining to Lake DeGray. Includes 1968 Agreement between US Army and Ouachita River Water District (ORWD) with a sample contract for withdrawal of water supply; 1988-9 letters between ORWD to AS&WCC concerning Memorandum of Agreement and Option Agreement with LRMWW; AS&WCC resolution passing Option Agreement	1988-1989	Various including ORWD; AS&WCC; and US Army	Library	No
33	05/15/02	Study	Report for Conway Corporation prepared by B&V and MWY for water supply and treatment for Conway Arkansas.	Apr-99	Black & Veatch /McGoodwin-Williams-Yates	Library	No
34	05/20/02	Study	Proceedings of the DeGray Lake Symposium. Environmental and Water Quality Operational Studies. Prepared for USCOE by R.H. Kennedy and Joe	Jul-05	RH Kennedy / Joe Nix	Library	No
35	06/27/02	Draft Study	USACE study for Conway, Arkansas to determine additional safe yield for Lake Brewer if the water elevations are raised. Water would be used by	Jun-00	USACE	Library	No
36	06/27/02	Report	USACE study for Lake Ouachita for reallocation of 1 mgd water to North Garland Water District for water supply. Report evaluated alternative water supply options for N. Garland. Evaluated reallocation alternatives for Ouachita. A cost of storage analysis is included.	Aug-95	USACE	Library	No

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Log No.	Date Rec.	Key Words	DESCRIPTION OF MATERIAL	Date of Material	Author	Hard Copy Location	Electronic Copy?
37	06/27/02	Documents	Collection of data received from USACE 6/25/2002 meeting with Mike Biggs in Little Rock Arkansas. Includes ref # 35 above, excerpts from Greer's Ferry Water Control Manual; Appendix - White River minimum flow study that shows a firm yield analysis for Greer's Ferry, Exec Summary from Clinton Ark reallocation request for Greer's ferry; Exec Summary from Heber Springs reallocation request for Greer's Ferry; Excerpts from Chap 2 and 4 of USACE Water Supply Handbook which addresses cost of storage for municipal and industrial water supply.	Various	USACE	Library	No
38	10/20/02	Report	Ouachita River Water District Regional Water Supply Study	Sep-02	FTN Associates Ltd.	Library	No
39	10/20/02	Report	Final Environmental Impact Statement - For Greer's Ferry Shoreline Management Plan.	Apr-02	USACE	Library	Yes
40	08/01/02	Report	USACE Hydropower Analysis Center. Power Benefits Foregone due to storage reallocation report for White River Minimum Flow Study White River Basins	Jun-02	USACE	Library	No
41							
42							

Table 1 - Summary of Projected Water Demand for 2000-2050 (per capita use includes commercial and industrial demand)											
Year	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Comments
Population	551,409	592,392	634,357	665,568	698,080	729,916	763,475	799,018	836,843	877,294	920,769	sum of individual entities
Population Check	551,409	592,392	634,357	665,568	698,080	729,916	763,475	799,018	836,843	877,294	920,769	
Calculated Ave Per Capita water use, gpcd	161	160	159	159	159	159	158	159	159	160	162	Calculated = Ave Water Demand / Pop
Calculated Peak Day to Ave Day Ratio	1.88	1.86	1.86	1.85	1.86	1.85	1.86	1.85	1.86	1.85	1.85	Calculated = Peak Day / Ave Day Demand
Ave Projected Water Demand, mgd	**89**	**95**	**101**	**106**	**111**	**116**	**121**	**127**	**133**	**140**	**149**	**sum of individual entities**
Peak Day Water Demand, mgd	**167**	**177**	**188**	**196**	**206**	**215**	**225**	**235**	**247**	**259**	**276**	**sum of individual entities**

Figure 1 - Water Demand Projections /Average Per Capita Loading From 2000-2050

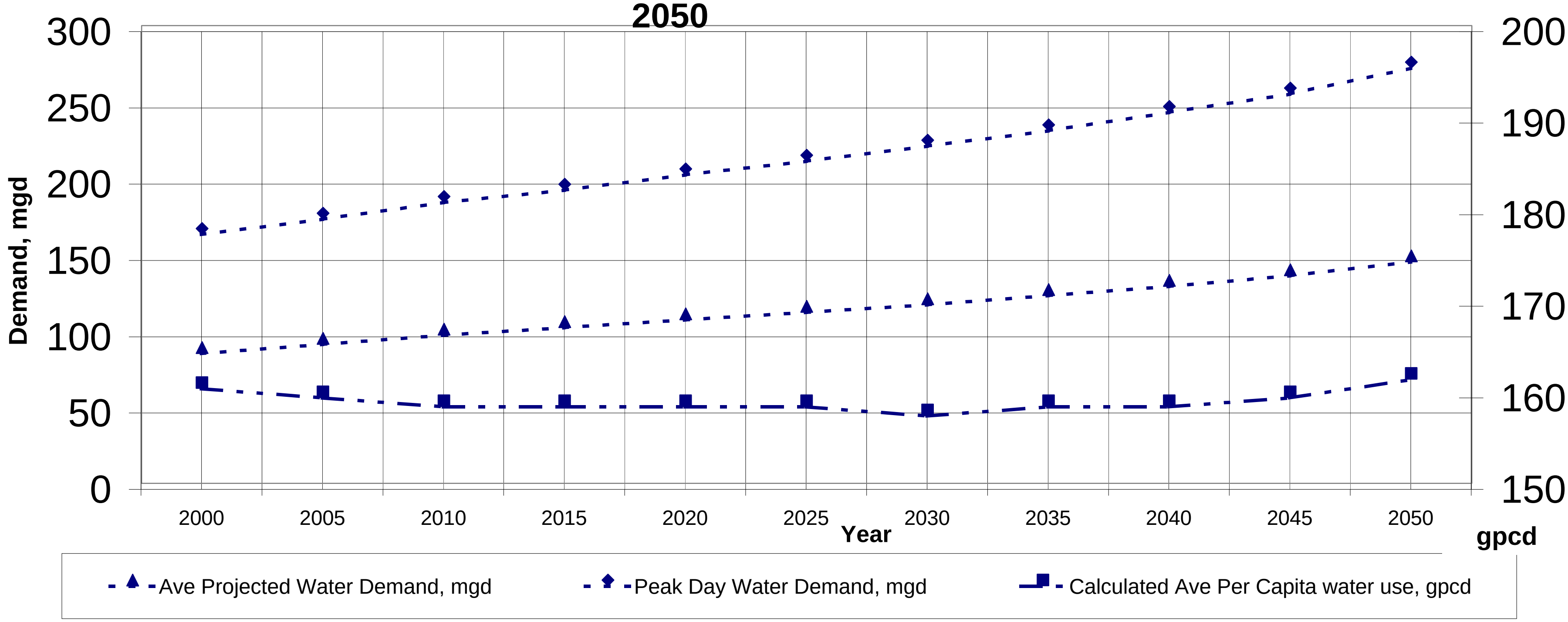

Table 2 - Peak and Average Flow by general area

		2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Comments
Conway Area, pop.		63,503	70,235	77,949	86,794	96,940	108,584	121,950	137,301	154,933	175,193	198,476	Conway Corp plus Conway Co.
Ave flow, mgd		12	13	15	16	18	20	23	26	29	33	37	Sum of ave flows for each entity
Peak flow, mgd		20	22	24	27	31	34	39	44	50	56	64	Sum of peak flow for each entity
No. of River Region, pop		180,126	196,872	213,618	222,435	231,251	237,895	244,538	251,181	257,823	264,466	271,109	Includes CAW north of river, No. Pulaski, Jackville, Cabot, Grand Prairie, Maumelle Wtr Mgmt, others north of river
Ave flow, mgd		28	31	34	35	37	38	39	40	41	42	43	Sum of ave flows for each entity
Peak flow, mgd		53	58	63	65	69	70	73	74	76	78	80	Sum of peak flow for each entity
So. of River Region, pop		215,334	219,486	223,638	227,790	231,942	236,095	240,247	244,399	248,551	252,703	256,855	CAW south of river, Maumell Wtr Corp,
Ave flow, mgd		39	39	40	41	41	42	43	44	44	45	46	Sum of ave flows for each entity
Peak flow, mgd		77	79	80	82	83	84	86	87	89	90	92	Sum of peak flow for each entity
Saline Co Area, pop		81,946	93,720	105,493	113,312	121,130	128,948	136,766	144,584	152,403	160,221	168,039	Benton, Bryant, Sardis, Saline Co WWSSPFB, and other Saline Co. users
Ave flow, mgd		8	9	10	11	12	13	13	14	15	16	16	Sum of ave flows for each entity
Peak flow, mgd		13	15	17	18	20	21	22	23	25	26	27	Sum of peak flow for each entity
Hot Springs Village, pop		10,500	12,079	13,658	15,237	16,816	18,395	19,974	21,553	23,133	24,712	26,291	Hot Springs Village Area
Ave flow, mgd		2	3	3	3	4	4	5	5	5	6	8	Sum of ave flows for each entity
Peak flow, mgd		4	5	5	6	6	7	7	8	9	9	14	Sum of peak flow for each entity
Total Check		551,409	592,392	634,356	665,568	698,079	729,917	763,475	799,018	836,843	877,295	920,770	
Ave flow, mgd		89	95	102	106	112	117	123	129	134	142	150	Difference with totals above is in rounding of values
Peak flow, mgd		167	179	189	198	209	216	227	236	249	259	277	Difference with totals above is in rounding of values

Table 3 - Population and Flow North and South of Arkansas River [1]

		2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Comments
Population North of River		243,629	267,107	291,567	309,229	328,191	346,478	366,488	388,481	412,757	439,659	469,585	
per capita ave flow rate, gpcd		164	165	168	165	168	167	169	170	170	171	170	calculated = ave flow below / population
Pk / AA ratio		1.83	1.82	1.78	1.80	1.82	1.79	1.81	1.79	1.80	1.79	1.80	calculated = peak flow / ave flow in next rows
Ave flow, mgd		40	44	49	51	55	58	62	66	70	75	80	calculated = sum of areas north or river from Table 2
Peak flow, mgd		73	80	87	92	100	104	112	118	126	134	144	calculated = sum of areas north or river from Table 2
Population South of River		307,780	325,285	342,790	356,339	369,888	383,438	396,987	410,537	424,086	437,635	451,185	
per capita ave flow rate, gpcd		159	157	155	154	154	154	154	153	151	153	155	calculated = ave flow below / population
Pk/AA		1.92	1.94	1.92	1.93	1.91	1.90	1.89	1.87	1.92	1.87	1.90	calculated = peak flow / ave flow in next rows
Ave flow, mgd		49	51	53	55	57	59	61	63	64	67	70	calculated = sum of areas north or river from Table 2
Peak flow, mgd		94	99	102	106	109	112	115	118	123	125	133	calculated = sum of areas north or river from Table 2
Totals Check													
Ave flow, mgd		89	95	102	106	112	117	123	129	134	142	150	cacluated = sum of north and south of river
Peak flow, mgd		167	179	189	198	209	216	227	236	249	259	277	cacluated = sum of north and south of river
Note 1	Values reflect input received at June 27, 2002 meeting from public water service entities.												

Table 4 - Water Demand by Public Water Service Entity (per capita use includes commercial and industrial demand)												
Year	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Comments
Benton Water Works												
Population	21,906	27,383	32,859	34,380	35,901	37,422	38,943	40,464	41,985	43,506	45,027	Metroplan values
Ave Per Capita water use, gpcd	90	90	90	90	90	90	90	90	90	90	90	Based on Entity Data Sheet data
Peak Day to Ave Day Ratio	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	Based on Entity Data Sheet data
Average Projected Water Demand, mgd	1.97	2.46	2.96	3.09	3.23	3.37	3.50	3.64	3.78	3.92	4.05	
Peak Day Water Demand, mgd	3.39	4.24	5.09	5.32	5.56	5.79	6.03	6.26	6.50	6.73	6.97	
Wholesale Customers of Benton WW												
Population	17,895	19,207	20,520	21,832	23,145	24,457	25,769	27,082	28,394	29,707	31,019	From Metroplan
Ave Per Capita water use, gpcd	105	105	105	105	105	105	105	105	105	105	105	Based on Entity Data Sheet data.
Peak Day to Ave Day Ratio	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	Based on Entity Data Sheet data. Seems low
Average Projected Water Demand, mgd	1.88	2.02	2.15	2.29	2.43	2.57	2.71	2.84	2.98	3.12	3.26	
Peak Day Water Demand, mgd	2.29	2.46	2.63	2.80	2.96	3.13	3.30	3.47	3.64	3.81	3.97	
Bryant, City of												
Population	9,764	11,643	13,522	15,400	17,279	19,158	21,037	22,916	24,794	26,673	28,552	From Metroplan
Ave Per Capita water use, gpcd	109	109	109	109	109	109	109	109	109	109	109	Based on Entity Data Sheet data.
Peak Day to Ave Day Ratio	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	Based on Entity Data Sheet data.
Average Projected Water Demand, mgd	1.06	1.27	1.47	1.68	1.88	2.09	2.29	2.50	2.70	2.91	3.11	
Peak Day Water Demand, mgd	2.02	2.41	2.80	3.19	3.58	3.97	4.36	4.75	5.13	5.52	5.91	
Cabot, City of												
Population	17,000	27,767	38,533	41,370	44,207	44,870	45,533	46,196	46,859	47,523	48,186	From Metroplan includes Austin / Hwy 319
Ave Per Capita water use, gpcd	125	125	125	125	125	125	125	125	125	125	125	Based on Entity Data Sheet data.
Peak Day to Ave Day Ratio	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	Based on Entity Data Sheet data.
Average Projected Water Demand, mgd	2.13	3.47	4.82	5.17	5.53	5.61	5.69	5.77	5.86	5.94	6.02	
Peak Day Water Demand, mgd	3.32	5.41	7.51	8.07	8.62	8.75	8.88	9.01	9.14	9.27	9.40	
Central Arkansas Water												
Population North of River	100,953	102,833	104,713	106,594	108,474	110,354	112,234	114,114	115,995	117,875	119,755	Includes Shannon Hills population
Population South of River	213,230	216,935	220,640	224,345	228,050	231,755	235,459	239,164	242,869	246,574	250,279	
Total Population	314,183	319,768	325,353	330,938	336,523	342,109	347,694	353,279	358,864	364,449	370,034	
Ave Per Capita water use, gpcd	180	180	180	180	180	180	180	180	180	180	180	Based on 61 ave flow 2001 (w/ wholesale flow)
Peak Day to Ave Day Ratio	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	Based on 121.7 peak flow 2001 (w/ wholesale flow)
Ave Projected Demand north of river, mgd	18.17	18.51	18.85	19.19	19.53	19.86	20.20	20.54	20.88	21.22	21.56	Retail flow only, wholesale flow not included.
Ave Projected Demand south of river, mgd	38.38	39.05	39.72	40.38	41.05	41.72	42.38	43.05	43.72	44.38	45.05	Retail flow only, wholesale flow not included.
Total Ave Projected Water Demand, mgd	56.55	57.56	58.56	59.57	60.57	61.58	62.58	63.59	64.60	65.60	66.61	Retail flow only, wholesale flow not included.
Peak Day Water Demand no. of river, mgd	36.34	37.02	37.70	38.37	39.05	39.73	40.40	41.08	41.76	42.43	43.11	Retail flow only, wholesale flow not included.
Peak Day Water Demand so. Of river, mgd	76.76	78.10	79.43	80.76	82.10	83.43	84.77	86.10	87.43	88.77	90.10	Retail flow only, wholesale flow not included.
Total Peak Day Water Demand, mgd	113.11	115.12	117.13	119.14	121.15	123.16	125.17	127.18	129.19	131.20	133.21	Retail flow only, wholesale flow not included.
Conway Corporation												
Population	43,167	49,679	57,174	65,799	75,725	87,148	100,295	115,426	132,838	152,878	175,941	From Conway Corp. Report
Ave Per Capita water use, gpcd	184	184	184	184	184	184	184	184	184	184	184	Based on Entity Data Sheet data.
Peak Day to Ave Day Ratio	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	Based on Entity Data Sheet data.
Average Projected Water Demand, mgd	7.94	9.14	10.52	12.11	13.93	16.04	18.45	21.24	24.44	28.13	32.37	
Peak Day Water Demand, mgd	14.30	16.45	18.94	21.79	25.08	28.86	33.22	38.23	44.00	50.63	58.27	
Conway County RWDD												
Population	20,336	20,556	20,776	20,996	21,215	21,435	21,655	21,875	22,095	22,315	22,535	From Metroplan / Data sheet values much higher
Ave Per Capita water use, gpcd	197	197	197	197	197	197	197	197	197	197	197	Based on Entity Data Sheet data.
Peak Day to Ave Day Ratio	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	Based on Entity Data Sheet. Ratio seems low
Average Projected Water Demand, mgd	4.01	4.05	4.09	4.14	4.18	4.22	4.27	4.31	4.35	4.40	4.44	
Peak Day Water Demand, mgd	5.21	5.26	5.32	5.38	5.43	5.49	5.55	5.60	5.66	5.71	5.77	
Grand Prairie												
Population	10,088	9,955	9,821	9,688	9,554	9,421	9,288	9,155	9,021	8,888	8,754	From Metroplan
Ave Per Capita water use, gpcd	104	104	104	104	104	104	104	104	104	104	104	Based on Entity Data Sheet data.
Peak Day to Ave Day Ratio	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	Based on Entity Data Sheet data.
Average Projected Water Demand, mgd	1.05	1.04	1.02	1.01	0.99	0.98	0.97	0.95	0.94	0.92	0.91	
Peak Day Water Demand, mgd	1.62	1.59	1.57	1.55	1.53	1.51	1.49	1.47	1.44	1.42	1.40	

Table 4 (cont'd) - Water Demand by Public Water Service Entity (per capita use includes commercial and industrial demand)

Year	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Comments
Hot Springs Village												
Population	10,500	12,079	13,658	15,237	16,816	18,395	19,974	21,553	23,133	24,712	26,291	From Metroplan. HSV projection much higher
Ave Per Capita water use, gpcd	226	226	226	226	226	226	226	226	226	226	305	2050 value adjusted to achieve 8 mgd demand
Peak Day to Ave Day Ratio	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.75	2050 value adjusted to achieve 14 mgd demand
Average Projected Water Demand, mgd	2.37	2.73	3.09	3.44	3.80	4.16	4.51	4.87	5.23	5.58	8.02	6/27 request of HSV want minimum 8 mgd 2050
Peak Day Water Demand, mgd	3.94	4.53	5.12	5.72	6.31	6.90	7.49	8.09	8.68	9.27	14.03	6/27 request of HSV want minimum 14 mgd 2050
Jacksonville												
Population	29,916	31,296	32,675	34,055	35,435	36,815	38,194	39,574	40,954	42,333	43,713	From Metroplan
Ave Per Capita water use, gpcd	110	110	110	110	110	110	110	110	110	110	110	From Entity Data Sheet
Peak Day to Ave Day Ratio	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	From Entity Data Sheet
Average Projected Water Demand, mgd	3.29	3.44	3.59	3.75	3.90	4.05	4.20	4.35	4.50	4.66	4.81	
Peak Day Water Demand, mgd	4.67	4.89	5.10	5.32	5.53	5.75	5.97	6.18	6.40	6.61	6.83	
Jacksonville Wholesale												
Population	5,315	5,560	5,805	6,050	6,295	6,541	6,786	7,031	7,276	7,521	7,766	2000 pop from ADH for Bayou II, Furlow; LRAFB
Ave Per Capita water use, gpcd	124	124	124	124	124	124	124	124	124	124	124	From Entity Data Sheet
Peak Day to Ave Day Ratio	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	From Entity Data Sheet
Average Projected Water Demand, mgd	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	
Peak Day Water Demand, mgd	1.03	1.08	1.13	1.18	1.23	1.27	1.32	1.37	1.42	1.46	1.51	
Maumelle Water Corporation												
Population	2,104	2,551	2,998	3,446	3,893	4,340	4,787	5,234	5,682	6,129	6,576	ADH pop Yr 2000. 2050 based on Metro. rate
Ave Per Capita water use, gpcd	108	108	108	108	108	108	108	108	108	108	108	From Ark Dept of Health Data
Peak Day to Ave Day Ratio	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	From Ark Dept of Health Data
Average Projected Water Demand, mgd	0.23	0.28	0.32	0.37	0.42	0.47	0.52	0.57	0.61	0.66	0.71	
Peak Day Water Demand, mgd	0.50	0.61	0.71	0.82	0.92	1.03	1.14	1.24	1.35	1.46	1.56	
Maumelle Water Management												
Population	10,557	12,784	15,010	17,237	19,463	21,690	23,916	26,143	28,369	30,596	32,822	From Metroplan data
Ave Per Capita water use, gpcd	210	210	210	210	210	210	210	210	210	210	210	From Ark Dept of Health Data
Peak Day to Ave Day Ratio	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	From Ark Dept of Health Data
Average Projected Water Demand, mgd	2.22	2.68	3.15	3.62	4.09	4.55	5.02	5.49	5.96	6.43	6.89	
Peak Day Water Demand, mgd	5.03	6.09	7.16	8.22	9.28	10.34	11.40	12.46	13.52	14.58	15.65	
No. Pulaski County WW												
Population	6,297	6,679	7,060	7,442	7,823	8,205	8,586	8,968	9,350	9,731	10,113	Includes Vilonia
Ave Per Capita water use, gpcd	112	112	112	112	112	112	112	112	112	112	112	Based on entity data. ADH has 110
Peak Day to Ave Day Ratio	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	From Entity Data Sheet. Seems low
Average Projected Water Demand, mgd	0.71	0.75	0.79	0.83	0.88	0.92	0.96	1.00	1.05	1.09	1.13	
Peak Day Water Demand, mgd	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.19	1.24	1.29	
Saline County WW SS PFB												
Population	1,537	1,674	1,811	1,948	2,085	2,223	2,360	2,497	2,634	2,771	2,908	Based on Metroplan data
Ave Per Capita water use, gpcd	82	82	82	82	82	82	82	82	82	82	82	From Ark Dept of Health Data
Peak Day to Ave Day Ratio	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	From Ark Dept of Health Data. Entity data 1.4
Average Projected Water Demand, mgd	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.22	0.23	0.24	
Peak Day Water Demand, mgd	0.26	0.29	0.31	0.33	0.36	0.38	0.40	0.43	0.45	0.47	0.50	
Other Saline County Users												
Population	19,338	20,583	21,827	23,072	24,316	25,561	26,805	28,050	29,294	30,539	31,783	Includes Haskell, East End; and unserved
Ave Per Capita water use, gpcd	100	100	100	100	100	100	100	100	100	100	100	From Ark Dept of Health Data
Peak Day to Ave Day Ratio	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	From Ark Dept of Health Data
Average Projected Water Demand, mgd	1.93	2.06	2.18	2.31	2.43	2.56	2.68	2.80	2.93	3.05	3.18	
Peak Day Water Demand, mgd	3.35	3.56	3.78	3.99	4.21	4.42	4.64	4.85	5.07	5.28	5.50	
Sardis Water Association												
Population	11,506	13,230	14,955	16,679	18,404	20,128	21,852	23,577	25,301	27,026	28,750	From ADH w/ Metroplan rate for Saline Co.
Ave Per Capita water use, gpcd	90	90	90	90	90	90	90	90	90	90	90	From Ark Dept of Health Data
Peak Day to Ave Day Ratio	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	Based on entity data sheet data
Average Projected Water Demand, mgd	1.04	1.19	1.35	1.50	1.66	1.81	1.97	2.12	2.28	2.43	2.59	
Peak Day Water Demand, mgd	1.79	2.06	2.33	2.60	2.87	3.13	3.40	3.67	3.94	4.21	4.48	

Agreement in Principle
Stage 2 Rules

U.S. ENVIRONMENTAL PROTECTION AGENCY

MICROBIAL/DISINFECTION BYPRODUCTS (M-DBP)
FEDERAL ADVISORY COMMITTEE

STAGE 2 M-DBP AGREEMENT IN PRINCIPLE

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U.S. ENVIRONMENTAL PROTECTION AGENCY

**MICROBIAL/DISINFECTION BYPRODUCTS (M-DBP)
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STAGE 2 M-DBP AGREEMENT IN PRINCIPLE

1.0 Introduction

Pursuant to requirements under the Safe Drinking Water Act (SDWA), the Environmental Protection Agency (EPA) is developing interrelated regulations to control microbial pathogens and disinfectants/disinfection byproducts (D/DBPs) in drinking water. These rules are collectively known as the microbial/disinfection byproducts (M-DBP) rules.

The regulations are intended to address complex risk trade-offs between the two different types of contaminants. In keeping with a phased M-DBP strategy agreed to by stakeholders during the 1992-93 negotiated rulemaking on these matters and affirmed by Congress as part of the 1996 Amendments to the Safe Drinking Water Act, EPA issued the final Stage 1 Disinfectants and Disinfection Byproducts Rule (DBPR) and Interim Enhanced Surface Water Rule (IESWSTR) in December 1998. These two rules built upon stakeholder agreements reached in 1993 but also reflected the more recent 1997 Agreement in Principle signed by stakeholders who participated in an intensive Stage 1 M-DBP Federal Advisory Committee Act (FACA) negotiation process from March to July 1997.

As part of the 1996 amendments to the SDWA, Congress established deadlines for the M-DBP rules, beginning with a November 1998 deadline for promulgation of both the IESWTR and the Stage 1 D/DBP Rule. Related statutory deadlines for the Stage 2 M-DBP process require that EPA promulgate a Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR) by May 2002. The Agency plans to promulgate the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) by May 2002, as well. The central challenge of the Stage 2 M-DBP rule development process has been to assess information and research not fully considered in the Stage 1 process or only available since 1998 and evaluate whether and to what degree EPA should establish revised or additional DBP and microbial standards to protect public health.

As agreed to during Stage 1, EPA has convened a Stage 2 M-DBP Advisory Committee made up of organizational members (parties) named by EPA (see Attachment A). The purpose of the Advisory Committee is to develop recommendations for the Stage 2 DBPR and LT2ESWTR to be proposed in 2001. This Committee met from March 1999 through September 2000, with the initial objective to reach consensus. This document is the Committee's statement on the points of agreement reached. This document is separated into Part A and Part B. The recommendations in each part stand alone and are independent of one another.

2.0 Agreement in Principle

The Stage 2 M-DBP Federal Advisory Committee (Stage 2 FACA) considered both the strengths and limitations of new M-DBP information as well as the related technical and policy issues involved in developing a Stage 2 DBPR and a LT2ESWTR under the Safe Drinking Water Act and recommends that the Environmental Protection Agency base the applicable sections of its anticipated Stage 2 DBPR and LT2ESWTR proposals on the elements of agreement described below.

This agreement in principle Part A and B represents the consensus of the parties on the best conceptual principles that the Committee was able to generate within the allocated time and resources available.

The ___________________, a party to the negotiations, agrees that:

2.1 The person signing Part A or Part B of this agreement is authorized to commit this party to the terms of Part A or Part B, as the case may be.

2.2 EPA agrees to develop a Proposed Rulemaking in 2001 in accordance with applicable statutes and procedural requirements that will reflect recommendations contained in this Agreement in Principle, and will obtain comments from Stage 2 FACA parties and the public.

2.3 Each party and individual signatory that submits comments on the Stage 2 DBPR and LT2ESWTR proposals agrees to support those components of the proposals that reflect the recommendations contained in this Agreement in Principle. Each party and individual signatory reserves the right to comment, as individuals or on behalf of the organization he or she represents, on any other aspect of the proposals.

2.4 If new information becomes available that significantly affects the basis for provisions in this Agreement in Principle, EPA agrees to publish this information in a NODA and will consider whether it is necessary to reconvene the FACA.

2.5 EPA will work jointly with stakeholders while developing guidance documents in order to ensure that technical issues are adequately addressed prior to the final rule. EPA agrees to publish revised guidance documents that reflect consideration of comments on earlier drafts.

2.6 Concurrent with publication of the proposed rules, EPA will publish a draft guidance document that includes ozone and chlorine dioxide CT tables for the inactivation of *Cryptosporidium* (UV tables are addressed in 5.0). EPA will request comment in the proposed LT2ESWTR on whether any of the CT tables or other criteria in the guidance document should be incorporated into the final LT2ESWTR.

2.7 EPA will consider all relevant comments submitted concerning the Stage 2 DBPR and LT2ESWTR Notice(s) of Proposed Rulemaking and in response to such comments will make such modifications to the proposed rule(s) and preamble(s) as EPA determines are appropriate when issuing a final rule.

2.8 Recognizing that under the Appointments Clause of the Constitution governmental authority may be exercised only by officers of the United States and recognizing that it is EPA's responsibility to issue final rules, EPA intends to issue final rules that are based on the provisions of the Safe Drinking Water Act, pertinent facts, and comments received from the public.

2.9 Each party agrees not to take any action to inhibit the adoption of final rule(s) to the extent it and corresponding preamble(s) have the same substance and effect as the elements of the Agreement in Principle Part A or Part B or both parts as evidenced by the signature following each part.

2.10 EPA will hold a stakeholder meeting during the comment period to update stakeholders on new information germane to the Stage 2 DBPR and LT2ESWTR.

2.11 Implementation Schedule

2.11.a Compliance schedules for the LT2ESWTR will be tied to the availability of sufficient analytical capacity at approved laboratories for all large and medium affected systems to initiate *Cryptosporidium* and *E.coli* monitoring, and the availability of software for transferring, storing, and evaluating the results of all microbial analyses.

1) If the availability of adequate laboratory capacity or data management software for microbial monitoring under LT2ESWTR for large or medium systems is delayed then monitoring, implementation, and compliance schedules for both the LT2ESWTR and Stage 2 DBPR described under 2.11.c will be delayed by an equivalent time period.

2.11.b The principle of simultaneous compliance reflected in the Stage 1 M-DBP rules will be continued in the Stage 2 M-DBP rules.

1) The principle of simultaneous compliance means that systems will address the Stage 2 DBPR and LT2ESWTR requirements concurrently in order to protect public health and optimize technology choice decisions.

2.11.c Implementation Schedule

1) Once the Stage 2 M-DBP rules have been promulgated, systems will conduct *Cryptosporidium* (Section 4.1) and IDSE (Section 3.1.a) monitoring and submit the results to their States/Primacy Agency. Large and medium systems must submit a report with the results of the Initial Distribution System Evaluation (IDSE) (including any monitoring) and the results of the *Cryptosporidium* monitoring two years and two and a half years after rule promulgation, respectively. Small systems must submit a report recommending new DBP compliance monitoring locations and supporting data with the results of their IDSE, including any monitoring, and *Cryptosporidium* monitoring 4 years and 5 years after rule promulgation respectively.*

2) Systems will comply with the Stage 2 DBPR MCL for TTHMs/HAA5 in two phases:

   a) Phase 1: 3 years after rule promulgation, all systems must comply with 80/60 running annual average (RAA) and 120/100 locational running annual average (LRAA) based on Stage 1 monitoring sites.

   b) Phase 2: Systems must comply with 80/60 LRAA based on new sampling sites identified under the IDSE. This will begin 6 years after rule promulgation (with an additional 2 year extension available for systems requiring capital improvements) for large and medium systems. For small systems required to do *Cryptosporidium* monitoring, compliance with the 80/60 LRAA will begin 8.5 years after rule promulgation (with an additional 2 year extension available for systems requiring capital improvements). For all other small systems, compliance with the 80/60 LRAA will begin 7.5 years after rule promulgation (with an additional 2 year extension available for systems requiring capital improvements).

* Systems which monitor for an indicator organism (*e.g. E. coli*) and do not monitor for *Cryptosporidium* must submit the results of the indicator monitoring three and one half years after rule promulgation.

PART A

3.0 DISINFECTION BYPRODUCTS

The requirements in the Stage 2 DBPR will apply to all community water systems and non-transient non-community water systems that add a disinfectant other than UV or deliver water that has been disinfected.

The Stage 2 DBPR is designed to reduce DBP occurrence peaks in the distribution system based on changes to compliance monitoring provisions. Compliance monitoring will be preceded by an initial distribution system monitoring (IDSE)/study to select site-specific optimal sample points for capturing peaks. The FACA recognizes that TTHM and HAA5 concentrations vary over time and space and therefore agrees that compliance monitoring locations should reflect this variability.

3.1 TTHM/HAA5

Compliance with each MCL will be determined based on a Locational Running Annual Average (a running annual average must be calculated at each sample location). Systems will comply with the Stage 2 DBPR MCL in two phases:

Phase 1: 3 years after rule promulgation, all systems must comply with a 120/100 locational running annual average (LRAA) based on Stage 1 monitoring sites and also continue to comply with the Stage 1 80/60 running annual average.

Phase 2: 6 years after rule promulgation (with an additional 2 year extension available for systems requiring capital improvements) large and medium systems must comply with an 80/60 LRAA based on new sampling sites identified under the IDSE. For small systems required to do *Cryptosporidium* monitoring, compliance with the 80/60 LRAA will begin 8.5 years after rule promulgation (with an additional 2 year extension available for systems requiring capital improvements). For all other small systems, compliance with the 80/60 LRAA will begin 7.5 years after rule promulgation (with an additional 2 year extension available for systems requiring capital improvements).

3.1.a Initial Distribution System Evaluation (IDSE)

IDSEs are studies conducted by Community Water Systems and are intended to select new compliance monitoring sites that more accurately reflect sites representing high TTHM and HAA5 levels. The studies will be based either on system specific monitoring or other system specific data that provides equivalent or better information on site selection. Systems will recommend new or revised monitoring sites to their State/Primacy Agency based on their IDSE study. IDSE results will not be used for compliance purposes.

Systems conducting IDSE monitoring shall monitor for one year under a schedule determined by source water type (e.g., surface water vs. ground water) and system size as discussed in 1-3 below. As a part of the monitoring schedule, all systems conducting IDSE monitoring must monitor during the peak historical month for DBP levels or water temperature. All IDSE samples will be paired (i.e., TTHM and HAA5 sample at each site).

1) Surface Water Systems ≥10,000:

   Systems must monitor bimonthly on a regular schedule of approximately every 60 days† for one year at 8 distribution system sites per plant (at sites that are in addition to the Stage 1 DBPR compliance monitoring sites).

   The location of the 8 sites will be determined by residual disinfectant type as follows:

   a) for plants with chloramine distribution systems: 2 near distribution system entry point, 2 at average residence time, & 4 at points representative of highest THM and HAA5 concentrations;

   b) for plants with chlorine distribution systems: 1 near distribution system entry point, 2 at average residence time, & 5 at points representative of highest THM and HAA5 concentrations.

2) Surface Water Systems < 10,000:

   a) 500 – 9,999: Systems must monitor quarterly on a regular schedule of approximately every 90 days for one year at 2 distribution system sites per plant (at sites that are in addition to the Stage 1 DBPR compliance monitoring sites).

   b) under 500: System must monitor semi-annually on a regular schedule of approximately every 180 days for one year at 2 distribution system sites per plant (at sites that are in addition to the Stage 1 DBPR compliance monitoring sites).

      i) This monitoring requirement for systems under 500 may be waived if the State/Primacy Agency determines that the monitoring site approved for Stage 1 DBPR compliance is sufficient to represent both the highest HAA5 and the highest TTHM concentrations. The State/Primacy Agency must submit criteria for this determination to EPA as part of their Primacy application.

3) Ground Water Systems

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† The objective of this monitoring provision and similar monitoring provisions herein after is to prevent systems from avoiding monitoring during peak occurrence.

Multiple wells drawing water from a single aquifer may, with State/Primacy Agency approval, be considered one treatment plant.

a) ≥10,000: Systems must monitor quarterly on a regular schedule of approximately every 90 days for one year at 2 distribution system sites per plant (at sites that are in addition to the Stage 1 DBPR compliance monitoring sites)

b) <10,000: Systems must monitor semi-annually on a regular schedule of approximately every 180 days for one year at 2 distribution system sites per plant (at sites in addition to the Stage 1 DBPR compliance monitoring sites)

i) This monitoring requirement for systems under 500 may be waived if the State/Primacy Agency determines that the monitoring site approved for Stage 1 DBPR compliance is sufficient to represent both the highest HAA5 and the highest TTHM concentrations. The State/Primacy Agency must submit criteria for this determination to EPA as part of their Primacy application.

4) System Specific Studies – In lieu of the IDSE monitoring, systems may perform an IDSE study based on other system specific monitoring or system specific data which will provide comparable or superior selection of new monitoring sites that target high DBP levels. EPA agrees to work with stakeholders to develop guidance on criteria for system specific studies.

5) Systems that certify to their State/Primacy Agency that all samples taken in the last 2 years were below 40/30 are not required to conduct the IDSE.

3.1.b. Long Term Compliance Monitoring (Phase 2)

Principles of the reduced compliance monitoring strategy reflected in the Stage 1 DBPR shall be continued in the Stage 2 DBPR. These principles are designed for systems with very low DBP levels.

Systems will collect paired samples (TTHM and HAA5) at each compliance monitoring sample site with the possible exception of some systems serving < 500 people.

1) Surface Water Systems ≥ 10,000:

Systems must monitor quarterly on a regular schedule of approximately every 90 days‡ at 4 distribution system sites per plant. At least 1 quarterly sample must be taken during the peak historical month for DBP levels.

The location of the 4 sites in the distribution system will be determined as follows:

- One representative average from among current Stage 1 locations
- One representative highest HAA5 identified under IDSE
- Two at highest TTHM identified during IDSE

2) Surface Water Systems < 10,000

a) 500 - 9,999: Systems must monitor quarterly on a regular schedule of approximately every 90 days at the highest TTHM and the highest HAA5 points in the distribution system as identified under the IDSE. The State/Primacy Agency may determine, based on the results of the IDSE, that the site representative of the highest TTHM is at the same location as the site representative of the highest HAA5 and thus may determine that the system only has to monitor at a single site.

b) under 500: Systems must monitor annually at the site representing the highest TTHM and the highest HAA5 points in the distribution system as identified under the IDSE. If the State/Primacy Agency determines, based on the results of the IDSE, that this site is not representative of both the highest TTHM and HAA5 concentrations, the system should collect unpaired samples at two sites in the distribution system (i.e., TTHM only at one site and HAA5 only at another site).

i) If the State/Primacy Agency has waived the requirement to conduct the IDSE, systems under 500 will conduct annual sampling at the point of maximum residence time in the distribution system during the month of warmest water temperature.

ii) Systems under 500 have the option of moving to quarterly compliance sampling consistent with the Stage 1 sampling strategy.

‡ The objective of this monitoring provision and similar monitoring provisions herein after is to prevent systems from avoiding monitoring during peak occurrence.

3) Groundwater Systems

a) ≥10,000: Systems must monitor quarterly on a regular schedule of approximately every 90 days at the highest TTHM and the highest HAA5 points in the distribution system as identified under the IDSE. The State/Primacy Agency may determine, based on the results of the IDSE, that the site representative of the highest TTHM is at the same location as the site representative of the highest HAA5 and thus may determine that the system only has to monitor at a single site.

b) 500 – 9,999: Systems must monitor annually at the highest TTHM and the highest HAA5 points in the distribution system as identified under the IDSE. The State/Primacy Agency may determine, based on the results of the IDSE, that the site representative of the highest TTHM is at the same location as the site representative of the highest HAA5 and thus may determine that the system only has to monitor at a single site.

i) Ground water systems under 10,000 have the option of moving to quarterly compliance sampling consistent with Stage 1 sampling strategy.

c) under 500: Systems must monitor annually at the site representing the highest TTHM and the highest HAA5 points in the distribution system as identified under the IDSE. If the State/Primacy Agency determines, based on the results of the IDSE, that this site is not representative of both the highest TTHM and HAA5 concentrations, the system should collect unpaired samples at two sites in the distribution system (i.e., TTHM only at one site and HAA5 only at another site).

i) If the State/Primacy Agency waives the requirement for systems under 500 to conduct the IDSE, they will conduct annual sampling at the point of maximum residence time in the distribution system during the month of warmest water temperature.

ii) Ground water systems under 500 have the option of moving to quarterly compliance sampling consistent with Stage 1 sampling strategy.

3.1.c. Wholesale and Consecutive Systems

The FACA has considered the issues of consecutive systems and recommends that EPA propose that all wholesale and consecutive systems must comply with provisions of the Stage 2 DBPR on the same schedule required of the wholesale or consecutive system serving the largest population in the combined distribution system.

Principles:
- Consumers in consecutive systems should be just as well protected as customers of all systems, and
- Monitoring provisions should be tailored to meet the first principle.

The FACA recognizes that there may be issues that have not been fully explored or completely analyzed and therefore recommends that EPA solicit comments.

3.1.d. Peaks

Recognizing that significant excursions of DBP levels will sometimes occur, even when systems are in full compliance with the enforceable MCL, public water systems that have significant excursions during peak periods are to refer to EPA guidance on how to conduct peak excursion evaluations, and how to reduce such peaks. Such excursions will be reviewed as a part of the sanitary survey process. EPA guidance on DBP level excursions will be issued prior to promulgation of the final rule and will be developed in consultation with stakeholders.

3.2. Bromate MCL

The Stage 2 M-DBP Advisory Committee has considered the present potential that reducing the bromate MCL to 0.005 mg/L would both increase the concentration of other DBPs in the drinking water and interfere with the efficacy of microbial pathogen inactivation. Therefore, the Committee recommends for purposes of Stage 2 that the bromate MCL remain at 0.010 mg/L. This recommendation is based upon current alternative technology utilization and upon current understanding of bromate formation as a result of bromide concentrations. EPA commits to review the bromate MCL as part of the 6 year review and determine whether the MCL should remain at 0.010 mg/L or be reduced to 0.005 mg/L or a lower concentration. As a part of that review, EPA will consider the increased utilization of alternative technologies and whether the risk/risk concerns reflected in today's recommendation remain valid. The FACA agrees that it is important to continue research on bromate detection, formation, treatment, and health effects.

4.0 LT2ESWTR

The requirements of the LT2ESWTR will apply to all public water systems that use surface water or ground water under the direct influence of surface water.

The FACA recognizes that systems may need to provide additional protection against *Cryptosporidium*, and that such decisions should be made on a system specific basis. The LT2ESWTR incorporates system specific treatment requirements based on a 'Microbial Framework' approach. This approach generally involves assignment of systems into different categories (or bins) based on the results of source water *Cryptosporidium* monitoring. Additional treatment requirements depend on the bin to which the system is assigned. Systems will chose technologies to comply with additional treatment requirements from a 'toolbox' of options.

4.1. Monitoring and Treatment Requirements for Filtered Systems

4.1.a Monitoring for Bin Classification

1) Systems ≥ 10,000

For purposes of bin classification, source water *Cryptosporidium* monitoring shall be conducted using EPA Method 1622/23 and no less than 10L samples. EPA will provide guidance for those cases where it is not possible to process a 10 L sample.

a) *Cryptosporidium*, *E. coli*, and turbidity source water sampling shall be carried out on a predetermined schedule for 24 months with two choices:

i) Bin classification based on highest 12 month running annual average if monthly samples, OR

ii) Optional bin classification based on 2 year mean if facility conducts twice per month monitoring for 24 months (i.e. 48 samples). Systems may carry out additional sampling but it must be evenly distributed over the 2 year monitoring period.

b) Systems with at least 2 years of historical *Cryptosporidium* data that is equivalent in sample number, frequency, and data quality (*e.g*. volume analyzed, percent recovery) to data that would be collected under the LT2ESWTR with EPA Method 1622/23 may use those data to determine bin classification in lieu of further monitoring. Systems which are able to use historical data in lieu of conducting new monitoring must submit such *Cryptosporidium* data to the State/Primacy Agency for consideration in selecting bin placement.

c) Systems that provide 2.5 logs of treatment for *Cryptosporidium* (equivalent to Bin 4, including inactivation) in addition to conventional treatment are exempt from monitoring for purposes of selecting bin placement. Conventional treatment is defined as coagulation, flocculation, sedimentation and granular media filtration.

d) EPA agrees to work with stakeholders to develop a guidance manual with appropriate QA/QC procedures for *Cryptosporidium* sampling

2) Systems < 10,000

a) Based on the large system monitoring under 4.1.a, EPA will work with stakeholders to evaluate alternative indicators and system characterization scenarios for predicting *Cryptosporidium* occurrence in small systems. This evaluation will include new information on surrogates, including *E. coli*, and will assess whether *E. coli* concentrations of 10 and 50 per 100ml are appropriate values to trigger *Cryptosporidium* monitoring in lakes/reservoirs and flowing streams, respectively.

b) In the absence of an alternative indicator specified by the State/Primacy Agency, based on EPA guidance, source water *E. coli* levels trigger *Cryptosporidium* monitoring as described below:

   i) Systems must begin one year of biweekly *E. coli* source water monitoring 2 years after large systems initiate *Cryptosporidium* monitoring.

   ii) Systems must conduct *Cryptosporidium* monitoring if *E. coli* concentrations exceed the following levels:

      - annual mean > 10/100 ml for lakes and reservoirs

      - annual mean > 50/100 ml for flowing streams

c) Systems that provide 2.5 logs of treatment for *Cryptosporidium* (equivalent to Bin 4, including inactivation) in addition to conventional treatment are exempt from monitoring for purposes of selecting bin placement.

d) The FACA recommends that *E.coli* monitoring for small systems will begin two and one half years after rule promulgation and also that *Cryptosporidium* monitoring be comprised of 24 samples over 1 year. The FACA also recommends that EPA solicit comment on any additional approaches to expedite small system compliance.

e) EPA will work with stakeholders to explore the feasibility of developing alternative, lower frequency, *Cryptosporidium* monitoring criteria for providing a conservative mean estimate.

4.1.b Action Bins (for conventional treatment plants):

1) The bins have been structured considering the total *Cryptosporidium* oocyst count, uncorrected for recovery, as measured using EPA Method 1623 and 10 L samples.

2) Systems have 3 years following initial bin classification to meet the treatment requirements associated with the bin (see Bin Requirements Table below). The State/Primacy Agency may grant systems an additional 2 year extension to comply when capital investments are necessary.

3) Systems currently using ozone, chlorine dioxide, UV, or membranes in addition to conventional treatment may receive credit for those technologies towards bin requirements.

4) Bin requirements table is shown below:

Bin Requirements Table

Bin Number	Average *Cryptosporidium* Concentration	Additional treatment requirements for systems with conventional treatment that are in full compliance with IESWTR§
1	*Cryptosporidium* < 0.075/L	No action
2	0.075/L ≤ *Cryptosporidium* < 1.0/L	1-log treatment (systems may use any technology or combination of technologies from toolbox as long as total credit is at least 1-log)
3	1.0/L ≤ *Cryptosporidium* < 3.0/L	2.0 log treatment (systems must achieve at least 1-log of the required 2-log treatment using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration)
4	*Cryptosporidium* ≥ 3.0/L	2.5 log treatment (systems must achieve at least 1-log of the required 2.5-log treatment using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration)

5) The additional treatment requirements in the bin requirement table are based, in part, on the assumption that conventional treatment plants in compliance with the IESWTR achieve an average of 3 logs removal of *Cryptosporidium*. The total *Cryptosporidium* removal requirements for the action bins with 1 log, 2 log, and 2.5 log additional treatment correspond to total *Cryptosporidium* removals of 4, 5, and 5.5 log respectively.

6) FACA recommends that EPA request public comment on whether current guidance regarding *Giardia* treatment requirements for meeting the Surface Water Treatment Rule need to be revised (to be consistent with multiple barrier concept in the current guidance and the FACA recommendations herein).

4.1.c Toolbox

§ FACA has not addressed direct filtration systems. EPA will address direct filtration systems in connection with bins 2-4 in the proposed LT2ESWTR and request comment.

1) Meeting the log treatment requirements identified for each “Action Bin” may necessitate one or more actions from an array of management strategies which include watershed control, reducing influent *Cryptosporidium* concentrations, improved system performance, and additional treatment barriers.

2) Based on available information, the FACA recommends that LT2ESWTR employ a "toolbox" approach, and that the following tools when properly designed and implemented receive the following log credit (or range of credit). As recognized previously in this Agreement, EPA must employ the best information available in developing the final rule and will request comment on the proposed log credits assigned in the following table.

3) EPA will provide guidance for determining if toolbox options are properly designed and implemented.

4) Table with microbial toolbox components and associated potential log credit is shown on the next page:

Microbial Toolbox Components
To Be Used in Addition to Existing Treatment,
Please See Next Page

Microbial Toolbox Components
To Be Used in Addition to Existing Treatment

APPROACH	**Potential Log Credit** 0.5	1	2	>2.5
Watershed Control				
Watershed Control Program (1)	X			
Reduction in oocyst concentration (3)	As measured			
Reduction in viable oocyst concentration (3)	As measured			
Alternative Source				
Intake Relocation (3)	As measured			
Change to Alternative Source of Supply (3)	As measured			
Management of Intake to Reduce Capture of Oocysts in Source Water (3)	As measured			
Managing Timing of Withdrawal (3)	As measured			
Managing Level of Withdrawal in Water Column (3)	As measured			
Pretreatment				
Off-Stream Raw Water Storage w/ Detention ~ X days (1)	X			
Off-Stream Raw Water Storage w/ Detention ~ Y weeks (1)		X		
Pre-Settling Basin w/Coagulant	X	→		
Lime Softening (1)	→	→		
In-Bank Filtration (1)		X	→	→
Improved Treatment				
Lower Finished Water Turbidity (0.15 NTU 95% tile CFE)	X			
Slow Sand Filters (1)				X
Roughing Filter (1)	X	→	→	→
Membranes (MF, UF, NF, RO) (1)				X
Bag Filters (1)		X	→	→
Cartridge Filters (1)			X	
Improved Disinfection				
Chlorine Dioxide (2)	X	X		
Ozone (2)	X	X	X	
UV (2)				X
Peer Review / Other Demonstration / Validation or System Performance				
Peer Review Program (*ex. Partnership Phase IV*)		X		
Performance studies demonstrating reliable specific log removals for technologies not listed above. This provision does not supercede other inactivation requirements.	As demonstrated			

Key to table symbols: (X) indicates potential log credit based on proper design and implementation in accordance with EPA guidance. Arrow indicates estimation of potential log credit based on site specific or technology specific demonstration of performance.

Table footnotes: (1) Criteria to be specified in guidance to determine allowed credit, (2) Inactivation dependent on dose and source water characteristics, (3) Additional monitoring for *Cryptosporidium* after this action would determine new bin classification and whether additional treatment is required.

4.1.d Reassessment and Future Monitoring

1) Systems that provide a total of 2.5 logs of treatment (equivalent to Bin 4 including inactivation) for *Cryptosporidium* in addition to conventional treatment are exempt from reassessment and future monitoring.

2) Four years after initial bin characterization, EPA will initiate a stakeholder process to review available methods and the bin characterization structures. EPA will conduct a stakeholder process to determine the appropriate analytical method, monitoring frequency, monitoring location, etc., for this second round of national assessment monitoring.

3) Six years after completion of the initial bin characterization, systems will conduct a second round of monitoring, equivalent or superior to the initial round from a statistical perspective, as part of a national reassessment . In the absence of an improved *Cryptosporidium* method (specified by the State/Primacy Agency, based on EPA guidance or rule and appropriate adjustment factors) site-specific reassessment monitoring will utilize method 1623 and site specific re-binning will occur under the current bin structure and time interval. If a new monitoring method is used, or the assumptions underlying the current bin structure change, the resulting data will be used for a site specific risk characterization in accordance with a revised bin structure (may require a revised rule) reflecting the changes in the underlying method.

4) As part of the three-year sanitary survey process, the Primacy Agency will assess any significant changes in the watershed and source water. The Primacy Agency will determine with the systems what follow-up action is appropriate. Actions that may be deemed appropriate include those outlined in the toolbox in this agreement.

4.2 Unfiltered Systems

4.2.a Unfiltered systems must:

1) Continue to meet filtration avoidance criteria, and

2) Provide 4 log virus inactivation, and

3) Provide 3 log *Giardia lamblia* inactivation, and

4) Provide 2 log *Cryptosporidium* inactivation.

4.2.b Overall inactivation requirements must be met using a minimum of 2 disinfectants.

4.2.c Ongoing monitoring and any eventual reassignment to risk bins for unfiltered systems will be consistent with requirements for other systems of their size, with the provision that unfiltered systems must demonstrate that their *Cryptosporidium* occurrence level continues to be less than or equal to 1 in 100 liters (or equivalent, using advanced methods) or provide 3 logs of *Cryptosporidium* inactivation.

4.3 Uncovered Finished Water Reservoirs

4.3.a Systems with uncovered finished water reservoirs must:

1) Cover the uncovered finish water reservoir, or

2) Treat reservoir discharge to the distribution system to achieve a 4 log virus inactivation, unless

3) State/Primacy Agency determines that existing risk mitigation is adequate.

a) Systems must develop and implement risk mitigation plans.

i) Risk mitigation plans must address physical access, surface water run-off, animal and bird waste, and on-going water quality assessment.

ii) Risk mitigation plans must account for cultural uses by tribes.

5.0 ULTRAVIOLET LIGHT

5.1 Based on available information, EPA believes that ultraviolet (UV) disinfection is available and feasible. However, information is needed in order to clarify how UV disinfection will be used as a tool for compliance with the proposed LT2ESWTR. Issues of particular importance include engineering issues like: hydraulic control, reliability, redundancy, monitoring, placement of sensors, lamp cleaning and replacement, and lamp breakage, as well as confirmation of the information underlying EPA's assessment that UV is available and feasible.

5.2 Concurrent with publication of the proposed rules, EPA will publish the following:

5.2.a Tables specifying UV doses (product of irradiance (I) and exposure time (T)) needed to achieve up to 3 logs inactivation of *Giardia,lamblia*, up to 3 logs inactivation of *Cryptosporidium*, and up to 4 logs inactivation of viruses.

5.2.b Minimum standards to determine if UV systems are acceptable for compliance with drinking water disinfection requirements. These standards will address the following:

1) A UV Validation Protocol to be established for drinking water applications

of UV technology.** Protocol to be premised on post-filter application of UV. Protocol will include the following:

a) Water quality criteria and site specific performance demonstration requirements for alternative placement of UV treatment in WTP.

b) Demonstration of adherence with the UV dose tables for inactivation per the identified protocols

c) Testing of UV reactors to validate performance under worst case conditions (These independent testing protocols would necessarily encompass a range of worst case conditions appropriate to the range of WTPs that must comply with the LT2ESWTR).

d) Minimum UV sensor performance characteristics (e.g. accuracy, stability, sensitivity).

2) Description of on-site monitoring required to ensure ongoing compliance with required dose, including necessary testing and calibration of UV sensors.

5.2.c UV Guidance Manual, the purpose of which is primarily to facilitate design and planning of UV installations by familiarizing State/Primacy Agencies and utilities with important design and operational issues, including:

1) Redundancy, reliability and hydraulic constraints in UV system design including design limitations with respect to plant/pipe size

2) Design considerations to account for water quality (*e.g*. UV absorbance, turbidity), lamp fouling and aging

3) Appropriate operations and maintenance protocols to ensure performance of UV lamp (e.g., sleeve cleaning systems).

4) Recommendations for water systems when soliciting UV disinfection systems to ensure conformance to criteria described under **5.2.b**.

5) Instructions on routine equipment and water quality monitoring practices used to assure reliable UV performance over time.

5.3 The availability of UV disinfection is a fundamental premise of this Agreement in Principle. The FACA recommends that EPA incorporate into the final LT2ESWTR

** The FACA recommends that EPA analyze the Deutscher Verein des Gas und Wasserfaches (DVGW) Technical Guidelines W 294 in developing the validation protocol.

provisions in **5.2** that will facilitate the approval of UV technology by Primacy Agencies. EPA agrees in the proposed LT2ESWTR to request comment on which criteria should be incorporated into the final LT2ESWTR.

5.4 EPA agrees to publish revised IT tables and revised guidance manuals as part of the final LT2ESWTR that reflect comments on earlier drafts.

5.5 EPA agrees to conduct a stakeholder meeting during the comment period for the proposed LT2ESWTR to update stakeholders on a range of issues including the status of UV and any outstanding guidance manual issues.

5.6 If EPA identifies substantial new information related to the availability or feasibility of UV, EPA agrees to publish this information in a NODA. If EPA determines that this information significantly impacts the basis for provisions in this agreement, EPA agrees to reconvene the FACA to address feasibility and availability of UV.

6.0 HEALTH RISK REDUCTION AND COST ANALYSIS (HRRCA)

EPA agrees to include in the Stage 2 DBPR and LT2ESWTR proposals an estimate of public health effects, and a health risk reduction and cost analysis (HRRCA). EPA agrees to use costing analysis that was developed to support the FACA process as part of its HRRCA analysis and where there is a significant difference in costing information EPA will use HRCCA to explain the difference. EPA also agrees to request comments from the Science Advisory Board prior to proposal.

Stage 2 M-DBP Agreement in Principle
PART A, Section 1.0 – 6.0 agreed to by:

____
Name, Organization date

PART B

7.0 DISTRIBUTION SYSTEMS

7.1 The FACA recognizes that finished water storage and distribution systems may have an impact on water quality and may pose risks to public health.

7.2 The FACA recognizes that cross connections and backflow in distribution systems represent a significant public health risk

7.3 The FACA recognizes that water quality problems can be related to infrastructure problems and that aging of distribution systems may increase risks of infrastructure problems.

7.4 The FACA recognizes that distribution systems are highly complex and that there is a significant need for additional information and analysis on the nature and magnitude of risk associated with them.

7.5 Therefore, the FACA recommends that beginning in January 2001, as part of the 6-year review of the Total Coliform Rule, EPA should evaluate available data and research on aspects of distribution systems that may create risks to public health and, working with stakeholders, initiate a process for addressing cross connection control and backflow prevention requirements and consider additional distribution system requirements related to significant health risks.

8.0 MICROBIAL WATER QUALITY CRITERIA

The FACA recommends the development of national water quality criteria funded by EPA under the Clean Water Act for microbial pathogens for stream segments designated by states/tribes for drinking water use. The FACA recognizes that both nonpoint sources and point sources may be a significant contributor to microbial contamination of drinking water and both must be responsible for reducing their individual contributions to microbial contamination to achieve water quality standards.

Stage 2 M-DBP Agreement in Principle
PART B, Section 1.0 – 8.0 agreed to by:

____
Name, Organization date

ATTACHMENT A
Stage 2 M/DBP FACA Committee Members

All Indian Pueblo Council, Pueblo Office of Environmental Protection
Dave Esparza, All Indian Pueblo Council

International Ozone Association
Michael Dimitriou, Aquasource

U.S. Environmental Protection Agency
Cynthia Dougherty, Office of Ground Water and Drinking Water, Office of Water

Physicians for Social Responsibility
Cathey Falvo, New York Medical College

Chlorine Chemistry Council
Peggy Geimer, MD, Arch Chemicals, Inc.

National Association of People with AIDS
Jeffrey K. Griffiths, Tufts Univ. Schools of Medicine & Veterinary Medicine

Association of State Drinking Water Administrators
Richard L. Haberman, CA Dept. of Health Services - Drinking Water Field Operations Branch

Environmental Council of the States
Barker G. Hamill, Bureau of Safe Drinking Water

National Association of State Utility Consumer Advocates
Christine Hoover, Office of Consumer Advocate, PA

Unfiltered Systems
Rosemary Menard, Water Resources Management Group, Portland Water Bureau

National Association of Water Companies
Richard Moser, American Water Works Service Company

Natural Resources Defense Council
Erik Olson, Natural Resources Defense Council

Conservation Law Foundation
David Ozonoff, School of Public Health, Boston University

American Water Works Association
David Paris, Manchester Water Treatment Plant

National Association of Metropolitan Water Agencies
Brian Ramaley, Newport News Waterworks

Water and Wastewater Equipment Manufacturers Association
Charles Reading, Jr., Safewater Solutions

National Rural Water Association
Rodney Tart, Harnett County Public Utility, NC

National League of Cities
Bruce H. Tobey, Mayor of Gloucester, Massachusetts

National Environmental Health Association
National Association of County and City Health Officials
Chris Wiant, TriCounty Health Department

National Association of Regulatory Utility Commissioners
John Williams, Florida Public Service Commission

Clean Water Action
Marguerite Young, Clean Water Action

Appendix D
COST OF STORAGE AT CORPS LAKES

When storage in a USACE lake has been reallocated for water supply, there is an associated cost. USACE procedures require that the cost of the reallocated storage be the highest of the following:

- Lost power benefits that include benefits foregone plus revenues foregone plus the replacement cost of power.
- Or cost of lost flood storage
- Or the updated cost of storage in the federal project.

This procedure for determining the cost of storage will be required to obtain water from Lake Ouachita and Greers Ferry. Obtaining storage from DeGray differs because some of the storage in DeGray Lake was allocated for water and because of an agreement between the Ouachita River Water District and the USACE the basis for paying for the construction of the lake storage will be based on paying off the original construction loan amount at an interest rate of 2.74 percent. DeGray will also have a cost for lost power benefit if the water is taken from the conservation pool. The actual cost of the reallocated storage cannot be determined until the USACE conducts a reallocation study.

HYDROPOWER LOSSES

Three types of loss to the energy industry occur with water reallocation. The first is the actual energy loss to the industry, the second loss is dependable capacity and third, the loss of revenue. The procedure used to calculate these losses are based on the procedure outlined in the August 1995 Reallocation Report issued by the USACE Vicksburg Office for the North Garland County Regional Water District on Lake Ouachita. Energy loss from the reservoirs can be calculated using the hydropower equation:

Lost Energy Kilowatt-hours (kWh) = 1.547Q*h*e*t/11.81

Where:
1.547 = cfs per mgd
Q = withdrawal rate in mgd
h = average generating head in feet
e = average unit efficiency
t = hours

Tables 1, 2 and 3 present the hydropower losses projected for Lake Ouachita, DeGray Lake and Greers Ferry Lake.

Table 1
LAKE OUACHITA HYDROPOWER LOSSES

Month	**Head (h)**	**Efficiency (e)**	**Hours (t)**	**Constant[(1)]**	**Energy Loss (kWh)**
January	169	0.85	744	0.13099	14,000
February	169	0.85	672	0.13099	12,645
March	169	0.85	744	0.13099	14,000
April	169	0.85	720	0.13099	13,355
May	169	0.85	744	0.13099	14,000
June	169	0.85	720	0.13099	13,550
July	169	0.85	744	0.13099	14,000
August	169	0.85	744	0.13099	14,000
September	169	0.85	720	0.13099	13,550
October	169	0.85	744	0.13099	14,000
November	169	0.85	720	0.13099	13,550
December	169	0.85	744	0.13099	14,000
Annual Energy Loss/mgd					164,845

[(1)]Constant = 1.547/11.81 = .013099

Table 2
GREERS FERRY LAKE HYDROPOWER LOSSES

Month	Head (h)	Efficiency (e)	Hours (t)	Constant[(1)]	Energy Loss (kWh)
January	182	0.85	744	0.13099	15,077
February	182	0.85	672	0.13099	13,618
March	182	0.85	744	0.13099	15,077
April	182	0.85	720	0.13099	14,590
May	182	0.85	744	0.13099	15,077
June	182	0.85	720	0.13099	14,590
July	182	0.85	744	0.13099	15,077
August	182	0.85	744	0.13099	15,077
September	182	0.85	720	0.13099	14,590
October	182	0.85	744	0.13099	15,077
November	182	0.85	720	0.13099	14,590
December	182	0.85	744	0.13099	15,077
Annual Energy Loss/mgd					177,514

[(1)]Constant = 1.547/11.81 = .013099
Head provided by USACE.

Table 3
DeGray Lake Hydropower Losses

Month	Flow (mgd)	Head (h)	Efficiency (e)	Hours (t)	Constant[1]	Energy Loss (kWh)
January	44	158	0.85	744	0.13099	13,080
February	44	158	0.85	672	0.13099	11,815
March	44	158	0.85	744	0.13099	13,080
April	44	158	0.85	720	0.13099	12,660
May	44	158	0.85	744	0.13099	13,080
June	44	158	0.85	720	0.13099	12,660
July	44	158	0.85	744	0.13099	13,080
August	44	158	0.85	744	0.13099	13,080
September	44	158	0.85	720	0.13099	12,660
October	44	158	0.85	744	0.13099	13,080
November	44	158	0.85	720	0.13099	12,660
December	44	158	0.85	744	0.13099	13,080
Annual Energy Loss/mgd						154,015

[1]Constant = 1.547/11.81 = .013099

The loss in dependable capacity cannot be quantified directly as the energy loss. Capacity losses should be calculated by using an average availability method that relies on a simulated period of record flow data and the amount of time capacity must be sustained. The tools to perform the simulation of period of record flow data are not readily available. We have calculated the dependable capacity loss based on the loss of annual potential energy and the assumption that the generating plant would maintain the same plant factor.

Loss of Capacity = Average annual energy loss/(plant factor)(hours per year)
Loss of Capacity = (kWh/year)/(0.24)(8,760)

The loss in dependable capacity cannot be quantified directly as the energy loss. Capacity losses should be calculated by using an average availability method that relies on a simulated period of record flow data and the amount of time capacity must be sustained. The tools to perform the simulation of period of record flow data are not readily available. We have calculated the dependable capacity loss based on the loss of annual potential energy and the assumption that the generating plant would maintain the same plant factor.

Loss of Capacity = Average annual energy loss/(plant factor)(hours per year)
Loss of Capacity = (kWh/year)/(0.24)(8,760)

Because of the time and resources required to prepare a an assessment to quantify the effects upon hydropower generation, data provided in the USACE Lake Ouachita Reallocation Report, 1995, will be used for the power costs. In order to utilize the unit values contained in that report, they must be updated to current price levels. The unit capacity value of $118.31 was used and is based on one-third coal-fired plants and two-thirds combustion turbine plants.

2002 Unit Energy Value = 37.92 mills/kWh X (July 2002 ENR/Oct 1995 ENR

= 37.92 mills/kWh X (6605/5432)

= 46.11 mills/kWh

2002 Unit Capacity Value = $118.31 per kW/year X (6605/5432)

= $142.86 per kW/year

The hydropower revenue that would be lost because of the storage reallocation is also based on the 1995 report. The energy charge is 6.23 mills per kWh and the capacity charge is $36.83 kW per year. The calculation of the annual hydropower benefits foregone due to reallocation from the hydropower storage is presented in Table 4.

Table 4
Hydropower Benefits Foregone Due To Reallocation From Hydropower Storage, mgd

Item	DeGray	Ouachita	Greers Ferry
Annual energy losses (kWh)	154,015	164,845	177,514
Energy value (mills per kWh)	46.11	46.11	46.11
Annual energy benefit foregone ($)	7,100	7,600	8,185
Capacity losses (kW)	73.25	78.40	69.6
Capacity value ($/kW/year)	142.86	142.86	142.86
Capacity benefit foregone ($)	10,465	11,200	9,950
Energy revenue value (mills per kWh)	6.23	6.23	6.23
Annual energy revenue forgone ($)	960	1,025	910
Capacity revenue value ($/kW/year)	36.83	36.83	36.83
Capacity revenue forgone ($)	2,700	2,900	2,565
Total annual benefit foregone ($)	20,271	21,700	20,700

A case may be made for not having to incur the lost power costs. It appears the City of Clinton, Arkansas received a reallocation of 1.76 mgd from Greers Ferry and energy credits were given to the power industry. The City of Heber Springs received a reallocation of 2.873 mgd from Greers Ferry with no allocated costs for storage.

There are other costs, such as flood damages prevented, that may be attributed to reallocated storage. We have not included these debatable costs due to the speculative nature of the assumptions that have to be made.

Another cost that may be attributed to reallocation is the prorated cost of allocated storage. This cost includes the annual cost for initial construction at current prices plus the prorated annual O&M costs to maintain the allocated storage. For Greers Ferry and Lake Ouachita an annual cost of $15,600 per mgd is used to cover the cost of storage. The agreement between Ouachita River Water District and the USACE, includes a different provision for cost of storage at DeGray Lake. The District agreed to pay an annual charge to cover the interest related to the storage allocated for water supply and in return will pay off the construction cost based on a 2.74% interest rate on the original principal. Using this approach, we project that the annual cost of storage at DeGray to be approximately $6,300 per year.