US Army Corps of Engineers®
Little Rock District

WHITE RIVER MINIMUM FLOWS REALLOCATION STUDY REPORT

JULY 2004

DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1100 COMMERCE STREET
DALLAS TX 75242-0216

Reply to
Attention of:

CESWD-PDS-P

MEMORANDUM FOR Commander, US Army Corps of Engineers (CECW-ZA), 441 G St. NW, Washington, DC 20314-1000

SUBJECT: White River Minimum Flows, Arkansas/Missouri, Reallocation Report

I concur in the conclusions of the District Engineer.

JEFFREY J. DORKO
Colonel, EN
Commanding

Executive Summary

White River Minimum Flows Study

29 July 2004

Authorization. The Water Resource Development Acts (WRDA) of 1999 (Section 374) and 2000 (Section 304) modified the basic authorization and operation for the five multipurpose White River Basin lakes: Beaver, Table Rock, and Bull Shoals Lakes on the White River; Norfork Lake on the North Fork River; and Greers Ferry Lake on the Little Red River (See Figure 1. Under the original authorization, water levels have been managed primarily for flood control and hydroelectric power generation, and to a lesser extent water supply. The directive in WRDA 1999 and 2000 creates a new procedure for storing and managing water in the five lakes and requires the Corps to assess project benefits in view of these changes. Because all of the storage space in the lakes is already allocated to existing purposes and no unused storage or surplus storage available, there would need to be a reallocation of storage to implement the added measure. The reallocated storage is intended to provide small releases from participating reservoirs whenever flood or hydropower releases are not being made to ensure continuous minimum stream flow downstream. The specific amounts authorized to provide minimum flows necessary to sustain tail water trout fisheries within each of the White River Lakes is:

Beaver Lake	1.5	feet
Table Rock Lake	2	feet
Bull Shoals Lake	5	feet
Norfork Lake	3.5	feet
Greers Ferry Lake	3	feet

Further, the Secretary of the Army was directed to transmit to Congress a report by the Chief of Engineers to determine if reallocations would adversely affect other authorized purposes and identify Federal costs that will be incurred as a result of the project modifications. The report would also include the findings whether the work is technically sound, environmentally acceptable, and economically justified.

The report is intended to provide and overview of an array of alternatives evaluated to respond to the fore mentioned legislative directive. Each alternative storage reallocation scenario are presented with technically sound solutions to providing the minimum flows. Also, they have been found likely to be environmentally acceptable. The technical solutions come at some cost, but the real challenge is finding a balance in the economic equation between existing project purposes and the newly added requirements. Further, the designation of the added new procedure to reallocate storage to sustain minimum flows as recreation, ecosystem restoration or mitigation has significant impacts on cost, who bears that cost, the implementation and outputs of each alternative scenario. An array of alternative scenarios and their costs and benefits are summarized on

the following pages. Based on existing law, legislative authorities, and Corps policy, and absent any further direction from Congress, the Corps would implement reallocation as recreation (cost shared 50/50). Implementation of these modifications is conditioned on further direction by Congress by selecting one or more of the alternative scenarios. A Non-Federal sponsor and completing National Environmental Protection Act (NEPA) compliance will be required before implementation.

Facility Capabilities. In June 2001, the Little Rock District Corps of Engineers (SWL) in coordination with the Arkansas Game and Fish Commission (AG&FC), Missouri Department of Conservation (MDC), Southwestern Power Administration (SWPA), and the U.S. Geological Survey (USGS) conducted minimum flows test releases. Investigations were conducted to determine existing release capabilities at each dam to meet the minimum flows criteria. With the exception of Bull Shoals, the participating dams could not generate hydropower with their main turbines while making the minimum flow releases. Bull Shoals could generate a small amount of power while discharging the target flows but the other four facilities had to pull power from the grid and run the turbines like motors in order to produce the target flows. The target releases through the Bull Shoals turbine did not produce noticeable cavitations. The tests also concluded that the target discharge could not be made with existing station service (SS) units. Therefore before minimum flows can be implemented, facility modification must be made to each participating facility, with the exception of Bull Shoals.

The release alternatives studied included use of existing SS units and a new siphon system, new SS units capable of making entire minimum flow release, and siphon only system. At Bull Shoals only, the existing main turbine was included as a possible release alternative.

Storage Reallocation Scenarios. WRDA authorized the Little Rock District Corps of Engineers to reallocate specific “feet” of storage from each of the five White River reservoirs. Three reallocation plans were formulated. The Corps modeled and studied minimum flows storage reallocations from flood pool only, conservation pool only, and a 50 percent flood pool and 50 percent conservation pool (50/50) reallocation scenarios (note: for reallocation of flood storage the result is an increase to average lake levels. This increase could necessitate relocation of some lake recreation and access facilities. An estimate for the relocations is included in the report. The requirement for relocations is an issue for additional study prior to implementation of minimum flows.) At each dam, for each proposed storage reallocation, three release alternatives have been modeled and analyzed (except at Bull Shoals, where four release alternatives have been modeled and analyzed). WRDA directed the Corps to determine whether the minimum flow reallocations and modifications would adversely affect other authorized purposes. Therefore the intent of Congress through WRDA was to identify reallocation and release scenarios that meets the minimum flows criteria in a manner that is not only economically advantageous but also minimizes impacts/effects to the flood control, recreation, and hydropower purposes. The following alternatives are alternatives that produce results that minimize adverse

impacts to existing, authorized users, are economically justified, technically sound, and been found to likely be environmentally acceptable. Flood benefits, hydropower benefits, and recreation benefits as well as ecological impacts were used to identify these alternatives. The Arkansas Game and Fish Commission, as a potential local sponsor, has expressed that the locally preferred implementation plan for the Arkansas reservoirs is the identified NED plan. For a more detailed discussion of locally preferred plans, see Section VII, Locally Preferred Plans, in the White River Minimum Flows Reallocation Study Report.

Table 1 lists some of the pertinent costs associated with the NED and alternate plans for each project site. Specifically, and in order from left to right, Table 1 details the Federal and Non-Federal sponsors' financial obligation for the capital cost of the updated cost of storage. The Federal and Non-Federal sponsor would be required to pay 50 percent of the updated cost of storage if the project is designated recreation or they would pay 65 percent (Federal) and 35 percent (Non-Federal) if the project were designated ecosystem restoration. Each project alternative has impacts to hydropower. Although hydropower is not the only authorized project purpose that is affected, it is the project purpose that is affected the most. The Hydropower Analysis Center (HAC) computed the hydropower benefit losses to the power-marketing agency, Southwestern Power Administration (SWPA). Although HAC followed Corps guidance and policy when it computed the hydropower benefit losses, SWPA computed their own benefit losses and these values have been listed for comparison purposes. Lastly, each alternative has a construction cost associated with it. Table 1 details the Federal and Non-Federal sponsors' financial obligation for the capital cost of the construction cost. The Federal and Non-Federal sponsor would be required to pay 50 percent of the construction cost if the project is designated recreation or they would pay 65 percent (Federal) and 35 percent (Non-Federal) if the project were designated ecosystem restoration.

a. Beaver Lake. BV4, Siphon and existing SS unit with a conservation pool reallocation, reduces hydropower benefits by 0.4 percent and improves flood control benefits. The benefit to cost ratio for BV4 is 6.3 to 1.0 and would be considered the National Economic Development (NED) plan. First costs for implementation are $827,000. The minimum flows operation at Beaver Lake would improve eight miles of trout fishery with an annual improvement to the trout fishing industry of $364,000.

The alternate plan to the NED plan is a scenario that minimizes negative impacts to authorized project purposes or produces the most improvement to existing users. The alternate to the NED plan is plan BV5, new SS unit with a conservation pool reallocation, improves hydropower benefits by 0.7 percent and improves flood control benefits. The benefit to cost ratio for BV5 is 1.4 to 1.0. First costs for implementation are $5,615,000. The minimum flows operation at Beaver Lake would improve eight miles of trout fishery with an annual improvement to the trout fishing industry of $364,000.

b. Table Rock Lake. The NED Plan is TR5, new SS units with a conservation pool reallocation, reduces hydropower benefits by 0.5 percent,

improves flood control benefits, and improves in-pool recreation benefits. The benefit to cost ratio for TR5 is 1.3 to 1.0. First costs for implementation are $10,678,000. The minimum flows operation at Table Rock Lake would improve 22 miles of trout fishery with an annual improvement to the trout fishing industry of $1,000,000.

The alternate plan to the NED plan is a scenario that minimizes negative impacts to authorized purposes or produces the most improvement to existing users. An alternate plan that meets these criteria is TR8, new SS units with a 50/50 reallocation, reduces hydropower benefits by 0.3 percent , decreases flood control benefits, and decreases in-pool recreation benefits. The benefit to cost ratio for TR8 is 1.2 to 1.0. First costs for implementation are $11,643,000. There are no environmental concerns with this plan. The minimum flows operation at Table Rock Lake would improve 22 miles of trout fishery with an annual improvement to the trout fishing industry of $1,000,000.

c. Bull Shoals Lake. Plan BS3, using the main turbine to achieve the minimum flows with a flood pool reallocation, reduces hydropower benefits by 1.6 percent and results in a 1 percent reduction in flood control benefits, however, the plan produces significant increases in tailwater benefits. Because of this improvement to the tailwater fishery and the resulting net increase in project benefits, the benefit to cost ratio for this plan is 71 to 1, and is considered the NED plan. First costs for implementation are $462,000. The minimum flows operation at Bull Shoals Lake would improve 66 miles of trout fishery with an estimated annual improvement to the trout fishing industry of $2,999,000.

No alternate plan was chosen for Bull Shoals. The NED plan represents the plan most likely to be accepted by the non-federal sponsor and stakeholders due to its low hydropower losses, relative to other plans, and its low first costs. All other plans have greater hydropower losses and/or greater annual costs that reduce the benefit to cost ratio to a fraction of the NED plans benefit to cost ratio.

d. Norfork Lake. NF4, existing SS unit and siphon with a conservation pool reallocation, reduces hydropower benefits by 3.2 percent, improves flood control benefits, and improves in pool recreation benefits. The benefit to cost ratio for NF4 is 16 to 1.0 and is considered the NED plan. First costs for implementation are $975,000. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000.

An alternate plan is NF2, new SS unit with a flood pool reallocation, improves hydropower benefits by 0.6 percent, reduces flood control benefits, and reduces in pool recreation benefits. The benefit to cost ratio for NF2 is 2.2 to 1.0. First costs for implementation are $9,788,000. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000.

A second alternate plan is plan.NF8, new SS unit with a 50/50 reallocation, has no impact to hydropower, reduces flood control benefits, and

reduces in pool recreation benefits. The benefit to cost ratio for NF2 is 2.2 to 1.0. First costs for implementation are $9,788,000. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000.

e. Greers Ferry Lake. GF4, existing SS unit and siphon with a conservation pool reallocation, reduces hydropower benefits by 1.8 percent, improves flood control benefits, and improves in pool recreation benefits. The benefit to cost ratio for GF4 is 20.2 to 1.0 and is considered the NED plan. First costs for implementation are $959,000. The minimum flows operation at Greers Ferry Lake would improve 30 miles of trout fishery with an annual improvement to the trout fishing industry of $1,363,000.

An alternate plan is GF5, new SS unit with a conservation pool reallocation, improves hydropower benefits by 0.3 percent, improves flood control benefits, and improves in pool recreation benefits. The benefit to cost ratio for GF5 is 3.52 to 1.0. First costs for implementation are $6,711,000. The minimum flows operation at Greers Ferry Lake would improve 30 miles of trout fishery with an annual improvement to the trout fishing industry of $1,363,000.

Environmental Summary. Little Rock District is coordinating with natural resource agencies in the preparation of an Environmental Impact Statement. An environmental summary identifying impacts to the ecological features associated with each reallocation alternative is included in Chapter III, Environmental Summary. This report package does not include a draft EIS but will quantitatively and/or qualitatively identify potential impacts (beneficial or negative). If approved, this report is not sufficient for reallocation and release implementation. The NEPA process must be completed including a complete EIS with full public involvement. The Nature Conservancy will perform the Independent Technical Review of the Draft EIS.

Figure 1
Study Area Map

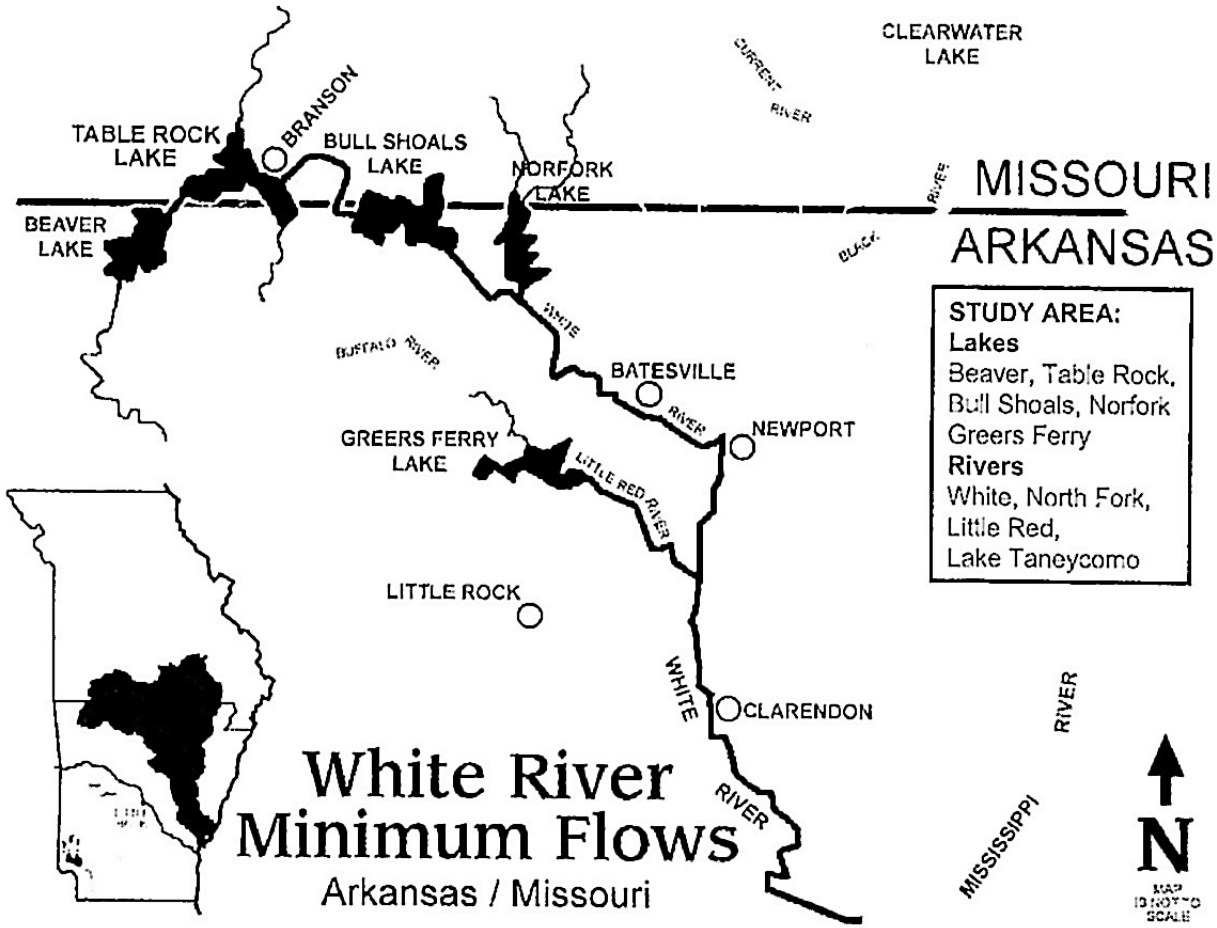

Table 1
Executive Cost Summary Table

Alternative	Update Storage Cost - Cost Sharing Alternatives (First Cost)			Hydropower Benefits Forgone (Annual $'s) (1,3)		Facility Costs-Cost Sharing Alternatives (First Costs)		
	Recreation	Ecosystem Restoration				Recreation	Ecosystem Restoration	
	50% Federal 50% Non-Federal (each)	65% Federal	35% Non-Federal	HAC Benefit Calculations	SWPA Benefit Calculations	50% Federal 50% Non-Federal (each)	65% Federal	35% Non-Federal
BV4 (2)	$ 2,157,000	$ 2,804,100	$ 1,509,900	$ 49,000	$ 483,000	$ 413,500	$ 537,500	$ 289,450
BV5	2,157,000	2,804,100	1,509,900	(92,000)	424,000	2,807,500	3,649,750	1,965,250
TR5 (2)	4,090,500	5,317,650	2,863,350	147,000	1,387,000	5,339,000	6,940,700	3,737,300
TR8	4,594,000	5,972,200	3,215,800	95,000	579,000	5,821,500	7,567,950	4,075,050
BS3 (2)	11,877,000	15,440,100	8,313,900	797,000	361,000	231,000	300,300	161,700
NF2	4,844,000	6,297,200	3,390,800	(72,000)	(6,000)	4,894,000	6,362,200	3,425,800
NF4 (2)	3,599,000	4,678,700	2,519,300	410,000	1,101,000	487,500	633,750	341,250
NF8	4,197,000	5,456,100	2,937,900	2,000	402,000	4,894,000	6,362,200	3,425,800
GF4 (2)	5,028,500	6,537,050	3,519,950	228,000	1,098,000	478,500	623,350	335,650
GF5	5,028,500	6,537,050	3,519,950	(45,000)	939,000	3,355,500	4,362,150	2,348,650

(1) Benefit calculations take into account the generation of energy from the minimum flow releases.
(2) NED Plan — alternative costs do not include interest during construction or operation and maintenance cost.
(3) See Main report, Section VI,b. Hydropower Revenues Forgone .

White River Minimum Flows
Reallocation Study
Report

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WHITE RIVER MINIMUM FLOWS STUDY

I. Study Background.

a. Authorization

The Water Resource Development Acts (WRDA) of 1999 (Section 374) and 2000 (section 304) modified the basic authorization and operation for the five multipurpose White River Basin lakes: Beaver, Table Rock, and Bull Shoals Lakes on the White River; Norfork Lake on the North Fork River; and Greers Ferry Lake on the Little Red River (See Figure 1. Under the original authorization, water levels have been managed primarily for flood control and hydroelectric power generation, and to a lesser extent water supply. The directive in WRDA 1999 and 2000 creates a new procedure for storing and managing water in the five lakes and requires the Corps to assess project benefits in view of these changes. Because all of the storage space in the lakes is already allocated to existing purposes and no unused storage or surplus storage available, there would need to be a reallocation of storage to implement the added measure. The reallocated storage is intended to provide small releases from participating reservoirs whenever flood or hydropower releases are not being made to ensure continuous minimum stream flow downstream. The specific amounts authorized to provide minimum flows necessary to sustain tail water trout fisheries within each of the White River Lakes is:

Beaver Lake	1.5 feet
Table Rock Lake	2 feet
Bull Shoals Lake	5 feet
Norfork Lake	3.5 feet
Greers Ferry Lake	3 feet

In addition, the Secretary was directed to transmit to Congress a report by the Chief of Engineers to determine if reallocations would adversely affect other authorized purposes, and if any Federal costs will be incurred in connection with the modification. Section 374 of WRDA 1999 and Section 304 of WRDA 2000 are quoted below.

Water Resource Development Act (WRDA) of 1999, Section 374 states:

SEC. 374. WHITE RIVER BASIN, ARKANSAS AND MISSOURI 1999.

(a) IN GENERAL. - Subject to subsection (b), the project for flood control, power generation, and other purposes at the White River Basin, Arkansas and Missouri, authorized by section 4 of the Act of June 28,1938 (52 Stat. 1218, chapter 795), and modified by House Document 917, 76th Congress, 3rd Session, and House Document 290, 77th Congress, 1st Session, approved August 18, 1941, and House Document 499, 83rd Congress, 2d Session, approved September 3, 1954, and by section 304 of the

Water Resource Development Act of 1996 (110 Stat. 3711) is further modified to authorize the Secretary to provide minimum flows necessary to sustain tail water trout fisheries by reallocating the following amounts of project storage: Beaver Lake, 1.5 feet; Table Rock Lake, 2 feet; Bull Shoals Lake, 5 feet; Norfork Lake, 3.5 feet; and Greers Ferry Lake, 3 feet.

(b) REPORT. -

(1) IN GENERAL. - No funds may be obligated to carry out work on the modification under subsection (a) until completion of a final report by the Chief of Engineers finding that the work is technically sound, environmentally acceptable, and economically justified.

(2) TIMING. - The Secretary shall submit the report to Congress not later than July 30, 2000.

(3) CONTENTS. - The report shall include determinations concerning whether-

(A) the modifications under subsection (a) adversely affects other authorized project purposes; and

(B) Federal costs will be incurred in connection with the modification.

Water Resource Development Act (WRDA) of 2000, Section 304 states:

SEC. 304. WHITE RIVER BASIN, ARKANSAS AND MISSOURI 2000.

(a) IN GENERAL. - Subject to subsection (b), the project for flood control, power generation, and other purposes at the White River Basin, Arkansas and Missouri, authorized by section 4 of the Rivers and Harbors Act of June 28,1938 (52 Stat. 1218), and modified by House Document 917, 76th Congress, 3rd Session, and House Document 290, 77th Congress, 1st Session, approved August 18, 1941, and House Document 499, 83rd Congress, 2d Session, approved September 3, 1954, and by section 304 of the Water Resource Development Act of 1996 (110 Stat. 3711) is further modified to authorize the Secretary to provide minimum flows necessary to sustain tail water trout fisheries by reallocating the following recommended amounts of project storage: Beaver Lake, 1.5 feet; Table Rock Lake, 2 feet; Bull Shoals Lake, 5 feet; Norfork Lake, 3.5 feet; and Greers Ferry Lake, 3 feet.

(b) REPORT. -

(1) IN GENERAL. - No funds may be obligated to carry out work on the modification under subsection (a) until the Chief of Engineers, through completion of a final report, determines that the work is technically sound, environmentally acceptable, and economically justified.

(2) TIMING. - Not later than January 1, 2002, the Secretary shall transmit to Congress the final report.

(3) CONTENTS. - The report shall include determinations concerning whether-

(A) the modifications under subsection (a) adversely affects other authorized project purposes; and

(B) Federal costs will be incurred in connection with the modification.

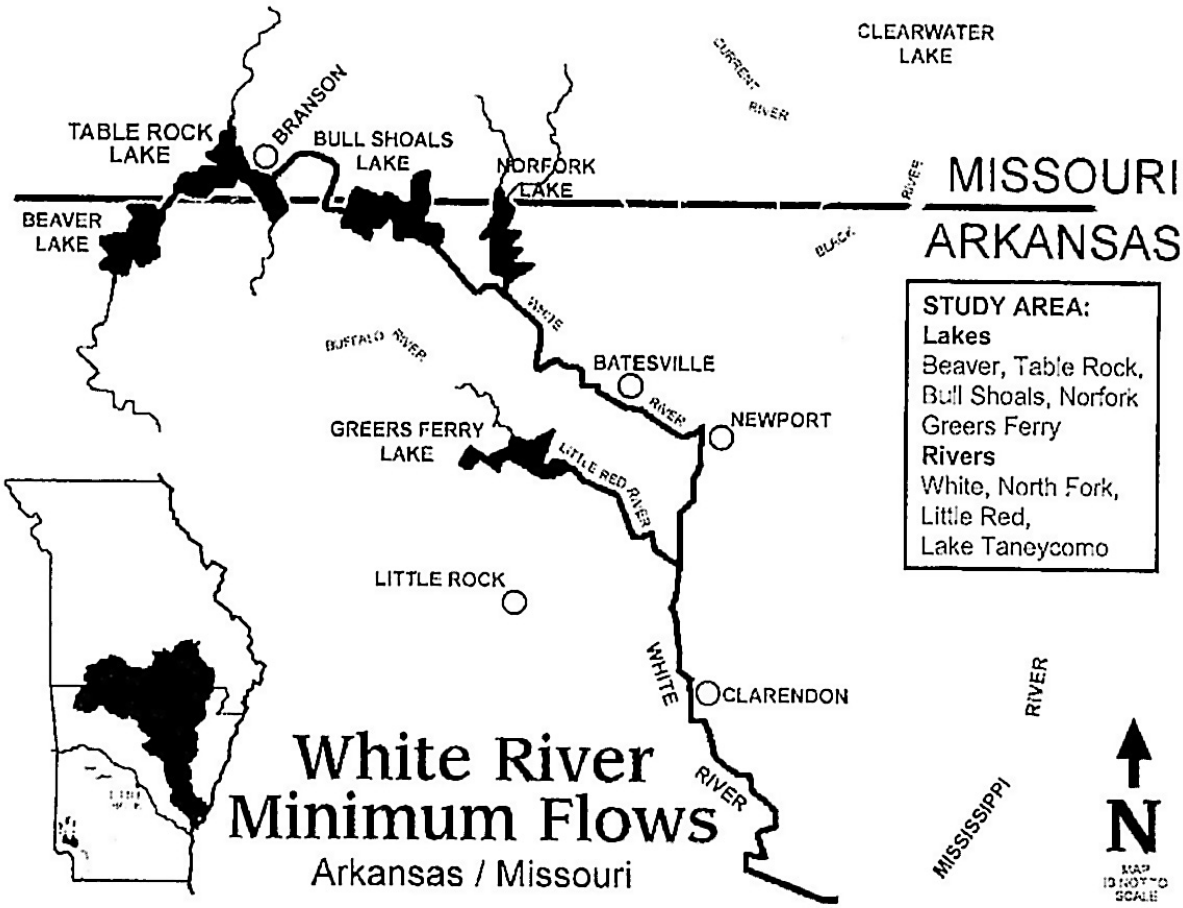
The report is intended to provide and overview of an array of alternatives evaluated to respond to the fore mentioned legislative directive. Each alternative storage reallocation

scenario are presented with technically sound solutions to providing the minimum flows. Also, they have been found likely to be environmentally acceptable. The technical solutions come at some cost, but the real challenge is finding a balance in the economic equation between existing project purposes and the newly added requirements. Further, the designation of the added new procedure to reallocate storage to sustain minimum flows as recreation, ecosystem restoration or mitigation has significant impacts on cost, who bears that cost, the implementation and outputs of each alternative scenario. An array of alternative scenarios and their costs and benefits are summarized on the following pages. Based on existing law, legislative authorities, and Corps policy, and absent any further direction from Congress, the Corps would implement reallocation as recreation (cost shared 50/50). Implementation of these modifications is conditioned on further direction by Congress by selecting one or more of the alternative scenarios. A Non-Federal sponsor and completing National Environmental Protection Act (NEPA) compliance will be required before implementation.

b. <u>Location</u>

The study area includes Beaver, Table Rock, Bull Shoals, Norfork, and Greers Ferry Lakes and their respective tailwaters along the White, North Fork, and Little Red Rivers. Figure 1 displays a map of the White river projects.

Figure 1: Study Area Map



Pertinent data for each project can be seen in the Pertinent Data Table below.

	BEAVER LAKE PERTINENT DATA		TABLE ROCK LAKE PERTINENT DATA		BULL SHOALS LAKE PERTINENT DATA	
Authorized Purposes	Current Storage Allocation		Current Storage Allocation		Current Storage Allocation	
Flood Control Pool	287,343 acre-ft	elev. 1120.43 - 1130	760,000 acre-ft	elev. 915 - 931	2,360,000 acre-ft	elev. 654 - 695
Conservation Pool	elev. 1077 - 1120.43		elev. 846 - 915		elev. 588 - 654	
- Hydropower	808,100 acre-ft		1,134,905 acre-ft		2,083,120 acre-ft	
- Water Supply	129,207 acre-ft		95 acre-ft		880 acre-ft	
- Fish and Wildlife	0 acre-ft		27,000 acre-ft		0 acre-ft	
- Recreation	0 acre-ft		0 acre-ft		0 acre-ft	

	NORFORK LAKE PERTINENT DATA		GREERS FERRY LAKE PERTINENT DATA	
Authorized Purposes	Current Storage Allocation		Current Storage Allocation	
Flood Control Pool	732,000 acre-ft	elev. 552 - 580	921,682 acre-ft	elev. 461.38 - 487
Conservation Pool	elev. 510 - 552		elev. 435 - 461.38	
- Hydropower	704,600 acre-ft		714,357 acre-ft	
- Water Supply	2,400 acre-ft		13,961 acre-ft	
- Fish and Wildlife	0 acre-ft		0 acre-ft	
- Recreation	0 acre-ft		0 acre-ft	

The lakes involved in the study have recreation facilities surrounding the lakes and downstream of the dams. The Corps has developed and continues to maintain over 80 parks around the participating lakes. These parks offer public use areas that include picnicking and camping facilities, launching ramps, and swim beaches. Also located on the lakes are commercial boat dock concessions where boat rental, boat storage, and other recreational supplies are available. The lakes support millions of recreational visits each year. In the 1960s, Table Rock Lake was termed “the fastest developing lake in the U.S.,” while Beaver reservoir developed into a residential lake with a few resorts. By 1982, Greers Ferry Lake was the seventeenth most visited Corps project in the nation. Additionally, according to the Arkansas Game and Fish Commission (AG&FC), the tailwaters of the five lakes support approximately 408,000 angler days per year, and 149,000 boat launches.

Currently, the lakes are authorized for flood control, hydropower, and water supply, but lake levels are not managed for the benefit of recreation. The directive in WRDA 1999 and 2000 creates a new operational consideration for the five lakes, and requires that the Corps reevaluate the use of these lakes considering the benefits of minimum flows to tailwater fisheries.

c. Project Operation

The objective of the existing White River Basin water management plan is to provide a comprehensive system of water use for the entire White River Basin. The plan incorporates all the basin projects and their many purposes. The plan provides seasonal flood control and hydropower releases based on the agricultural needs of the lower basin, and other land uses downstream of the projects. The plan also addresses the needs of the downstream fishery by providing a mechanism to maintain cool water temperatures based on monitored and forecasted ambient air temperatures. It

also provides a deviation procedure to respond to unforeseen and emergency conditions which either are not in the plan or for which the plan is singulary inadequate.

1. Flood Control

The release of flood storage from Beaver, Table Rock, Bull Shoals, and Norfork Lakes is regulated by the Newport Guide Curve. Newport is located on the White River about 161 miles downstream of Bull Shoals Dam and just below the confluence with the Black River. Essentially, the amount of water released from the lakes is based on the stage (river height) at Newport. When the river stage at Newport is high, the lakes are storing water to prevent downstream flooding. Storing water causes lake levels to rise, filling up flood storage. Water is released from the lakes when the river stage at Newport begins to drop, until the lake levels are lowered back to the top of conservation pool. The lakes are lowered as quickly as possible to provide room for future floods, but at a rate which will not cause excess flooding downstream.

Once the release flow for a project is determined, the water is routed through the power turbines, or infrequently through the spillway or conduits as needed to meet the flood release requirement. Turbine releases are used as the first priority release mechanism unless they are incapable of supporting the required release.

The regulation plan calls for holding flood waters in Beaver's flood pool whenever there is flood control storage in use at Table Rock or Bull Shoals. Beaver releases will be restricted thus conserving flood control storage in Table Rock, for the protection of the local reach immediately downstream, and in Bull Shoals, for flood regulation on the lower White River. For Bull Shoals and Table Rock, there is a prorated release plan based on respective reservoir storage in use, that provides for balanced reservoir filling. The regulation plan also provides for the prorating of flood control releases between Bull Shoals and Norfork so as to maintain equal percentages of available flood control storage in Norfork and the Beaver, Table Rock, Bull Shoals system. This provision amounts to a ratio of about 1.5 to 1.0 inches of runoff on the respective drainage areas and will better insure the full use of the total combined flood control storage when needed. Greers Ferry does not balance storage relative to the other four projects because the distance from the control points of the other projects precludes effective balancing. The releases from Greers Ferry are controlled by downstream regulating capacity primarily at Georgetown on the White River and secondarily to Judsonia on the Little Red River. Similarly to the four upper White River Basin projects, the primary release mechanism at Greers Ferry is the main hydropower turbines. If the turbines are incapable of making the required flood control release, addition releases are made through the spillway and or the conduit. Once the projects have emptied their flood control storages, hydropower and seasonal fishery requirements determine the project releases.

2. Hydroelectric Power

Hydropower produced at Corps dams in this region is marketed by the Southwestern Power Administration (SWPA). As described in the previous Flood Control section, the degree to which hydropower requirements control the quantity and timing of water releases depends on the elevation of the water stored and the stages at the downstream regulating control points.

When the lake elevations are in the flood pool, the Corps of Engineers controls the quantity and timing of all releases, until the conservation pool is reached. The one exception is the daily release volume needed for the generation of "firm power." Normally, hydropower production is constrained during downstream flood conditions. Even so, during flood control operations minimum hydropower releases are made to meet the requirements of firm power as set forth in the MOU between the Corps and SWPA dated 23 July 1980. Table 7-09, page 7-21 of the White River Master Manual lists minimum daily hydropower release volumes. During flood control operations, hydropower will be reduced to not less than these values. When restricted to firm power, the firm energy remaining for that day is computed by prorating the number of hours left in the day. If flooding conditions warrant greater restrictions, the Corps will declare a flood emergency and notify SWPA in accordance with the guidelines set forth in the draft Operating Arrangement between the Corps and SWPA. When in the flood pool, the primary objective of generation is to provide releases for recovery of flood storage space and operation requirements are forwarded to SWPA each weekday. Once in the conservation pool, SWPA determines the amount and timing of releases based on power needs, unless there is an overriding flood control or project need (e.g., additional releases in anticipation of a forecasted storm). Routine turbine releases are established at rates which will not exceed downstream regulating criteria.

3. Fisheries

The White River Lakes support in-lake and downstream fisheries that provide an important economic base for tourism. Construction of the dams and operation of the hydropower features contributed to the destruction of the warm water tailwater fisheries due to cold water releases. To replace the lost warm water fisheries, federally constructed fish hatcheries were constructed at Norfork and Greers Ferry. (Note: construction of the hatcheries was not part of the Corps White River projects. Rather, the hatcheries were funded under Department of Interior appropriations prior to the current concept of "mitigation".) This resulted in the development of a put-and-take cold water fishery downstream of each of the five multipurpose hydropower projects. The dependence of these trout fisheries upon hydropower releases has required consideration of downstream water temperatures when scheduling releases.

The largest of the fisheries is below Bull Shoals, extending downstream about 78 miles to Sylamore Creek. The North Fork River below Norfork is also a cold water fishery. Similar fisheries are below Beaver and Table Rock, both extending into the upper reaches of downstream lakes. The Lake Taneycomo fishery just downstream of Table Rock Lake is about 22 miles long and is the most densely used of the downstream fisheries. Below Greers Ferry the cold water fishery extends about 25 miles.

At Bull Shoals and Norfork a combined 2,000 day-second-feet (DSF) 3-day running average release is made when air temperatures at Calico Rock are forecasted at or above 85 degrees F and pool elevations are above 649 at Bull Shoals and 545 at Norfork. These requirements are part of a Memorandum of Understanding (MOU) between the Corps and SWPA. The Corps regulator must monitor the temperature sensors; these sensors are located below each of the hydropower projects and near the towns of at Fairview, Calico Rock, Sylamore, and Pangburn. These sensors request supplementary releases or changes in timing of releases as needed to keep water temperatures from exceeding 75 degrees F. The worst case scenario is a hot, dry 3-day weekend when generation requirements are at a minimum. At such times, without extra (non-power-related) releases pools in the river may be isolated by shoals and the fish may be unable to seek refuge in cooler waters.

d. <u>Problems</u>

The White River lakes were authorized and constructed primarily for flood control, hydroelectric power generation, and water supply. At Beaver, water supply storage was included in the original Congressional project authorization. Following construction, additional water supply storage has been added through reallocation at Beaver and at the other lakes. Also, subsequent to the construction of the lakes, municipal and industrial water supply, recreation, and environmental enhancement needs have developed.

Before the dams on the White, North Fork, and Little Red Rivers were built, these rivers provided warm-water fisheries. After construction of the dams, the tailwaters below the dams could not sustain warm-water fisheries because of the cold water hydropower releases. Federally constructed trout hatcheries were constructed and put-and-take trout were introduced and sustained in the tailwaters to offset the loss of the warm-water fisheries. However, no specific storage was ever authorized (prior to WRDA 99) in the lakes to maintain a minimum flow in the tailwaters. During periods of non-hydroelectric power generation, cold water releases are reduced drastically and the wetted perimeter of the tailwater is reduced.

The AG&FC has spent years studying the wetted perimeter in the tailwaters below the White River Dams that would most closely simulate healthy, natural trout fisheries. The result of the AG&FC's studies were the identification of optimum wetted perimeters obtained by the following target releases in cubic feet per second (cfs): Beaver Lake, 136 cfs; Table Rock Lake, 400 cfs; Bull Shoals Lake, 800 cfs; Norfork Lake, 300 cfs;

and Greers Ferry Lake, 200 cfs. The AG&FC obtained Congressional sponsorship for Section 374 of the Water Resources Development Act (WRDA) of 1999 and Section 304 of WRDA 2000, modifying the authorization of the White River lakes to reallocate specific amounts of project storage for the tailwater trout fisheries. Through this specific allocation of storage in the lakes for the trout fisheries, minimum flows may be sustained in the tailwaters during times of non-hydropower generation, increasing wetted perimetter and improving water quality.

The storage specified by WRDA is not enough to sustain the Minimum Flows releases during extreme drought years if the AG&FC target releases are maintained. "Yield" is defined as the rate of flow that a specific storage can provide while being discharged 24-hours per day, seven days per week, 365 days per year. Typically yield is defined as the constant release that can be sustained through a basin's drought of record. Study findings estimate the specified storage to be 80% to 90% "reliable" while meeting the proposed Minimum Flows criterea. While the storage identified in WRDA does not yield the target flow identified by the AG&FC, WRDA did not direct the Corps to optimize Minimum Flows releases to reflect the actual yield of the reallocated storage. No funds were to be obligated to carry out facilities modifications necessary to comply with the Minimum Flows criteria, "until the completion of a final report by the Chief of Engineers finding that the work is technically sound, environmentally acceptable, and economically justified".

e. Base Conditions

In the absence of action, the White River system will continue to be operated in accordance to current operational procedures; i.e., the lakes will be operated to provide flood control, hydroelectric power, municipal and industrial water supply, with due consideration to recreation and fish and wildlife demands. If the minimum flows provisions included in WRDA 1999 and 2000 are implemented, Little Rock District will include "minimum release" of water to sustain the downstream trout fishery. The Acts authorize the Corps to reallocate storage at each lake. The stored water will be used to make the target releases during low flow, hot weather periods when hydropower is not being generated. Since the WRDA specified storages cannot sustain the target minimum flows through a drought of record, there will be years when the Minimum Flows releases will be terminated because the Minimum Flows storage is depleted. These releases could not be implemented again until inflows recharge the storage.

II. Study Methodology and Models

The five projects identified in WRDA 1999 and 2000 are multipurpose projects. Each project has flood control, hydropower, water supply, recreation, and fish and wildlife functions. Little Rock District used the existing SUPER reservoir routing model to simulate 50 years of historical rainfall runoff in order to determine the impacts of the proposed minimum flows operations on other authorized purposes. Paragraph II.d., below, contains a detailed description of the use of the SUPER

model. Output from the SUPER model was used to identify impacts to flood control and in-lake recreation. SUPER output was sent to Northwestern Division's Hydropower Analysis Center to quantify impacts to hydropower purposes. Little Rock District contracted with the University of Arkansas at Fayetteville to apply empirical economic methods to estimate willingness to pay for recreation impacts to the tailwater fisheries. North Pacific Division Hydropower Design Center devised non-power and power producing release alternatives, and the U.S. Geological Survey (USGS) performed minimum flows test release flow measurements.

a. Facility Modifications

In June 2001, Little Rock District, in coordination with the AG&FC, MDC, SWPA, and USGS, conducted minimum flows test releases. Investigations were conducted to determine existing release capabilities at each dam to meet the minimum flows criteria. USGS took flow measurements to calibrate the main turbines, as well as to measure leakage, existing station service unit discharge, and hatchery outflow. The test releases produced a low flow-rating curve for the existing main turbines. Biologists measured the conditions produced by the target releases confirming that the releases did produce the favorable biological conditions predicted by the AG&FC. Local fishermen, landowners, and outfitters participated in the test release by observing and commenting on conditions produced by the target minimum flows release. The river conditions produced by the target flows were favorable to most wade fishermen, boat fishermen, outfitters, and landowners.

With the exception of Bull Shoals, the minimum flow releases through the participating dams were not adequate to generate hydropower with their main turbines. Bull Shoals could generate a small amount of power while discharging the target flows, but the other four facilities had to pull power from the grid and run the turbines like motors in order to produce the target flows. The target releases through the Bull Shoals turbine did not produce noticeable cavitations. The tests also concluded that the existing station service (SS) units could not pass enough flow to meet the target discharge rates. Therefore, before minimum flows can be implemented, facility modifications must be made to each participating facility, with the exception of Bull Shoals. Little Rock District and North Pacific Division Hydropower Design Center (HDC) devised non-power and power producing release alternatives.

1. Existing Station Service Units and Siphons

The existing dam facilities include station service units (SS) that generate power for use by the Corps dam facilities. The SS units could be connected to the power grid so SWPA could market the excess power produced by the minimum flows target release not needed by the Corps facilities. However, the existing SS units are too small to make the full minimum flows release and will need an auxiliary release from a proposed siphon system. The auxiliary siphon system would include valves, a pipe through and along the dam, and a multi-layered intake

system on the lakeside. This option provides the ability to remotely operate the valves to discharge a portion of the minimum flow releases in concert with the existing station service units. It would not affect other operations of the dam or powerhouse. The siphon is a non-power producing option.

2. New Station Service Units

One alternative considered was the installation of new SS units that would be large enough to discharge the entire minimum flows release. Similarly to the existing SS units, the proposed new SS units would be connected to the power grid so SWPA could market the excess power not needed by the Corps facilities.

3. Main Turbine

At Bull Shoals the minimum flows release was large enough to generate a small amount of hydropower with the existing main turbine. Use of the main turbine to facilitate minimum flows releases is considered an intermediate option or possibly the final solution at Bull Shoals. The remote operating computer language, SCADA, can be modified to use the main turbine for minimum flow releases. Test releases in June 2001 revealed that the use of main turbines to make minimum flows releases is only feasible at Bull Shoals.

4. Siphon Only

A siphon system includes valves, a pipe through and along the dam, and a multi-layered intake system on the lakeside. This option provides the ability to remotely operate the valves to discharge the minimum flows releases. It would not affect other operations of the dam or powerhouse. This is the only non-power producing option. A siphon only system has the most adverse impacts for the hydropower industry since no power can be generate and marketed during the minimum flow releases.

b. Alternatives for Reallocation

WRDA authorized the Little Rock District Corps of Engineers to reallocate specific vertical feet of storage from each of the five White River reservoirs. WRDA did not specify from which storage zone to reallocate the vertical feet of storage. Currently the lakes are divided into two zones, the flood pool and the conservation pool. Since each lake naturally has a roughly trapezoidal cross-section, its area increases with increasing elevation, so that the volume of storage provided by reallocating storage from the conservation pool is less than the volume of storage provided by the same vertical feet of storage from the flood pool. This is illustrated in Figures 2, 3, and 4 below.

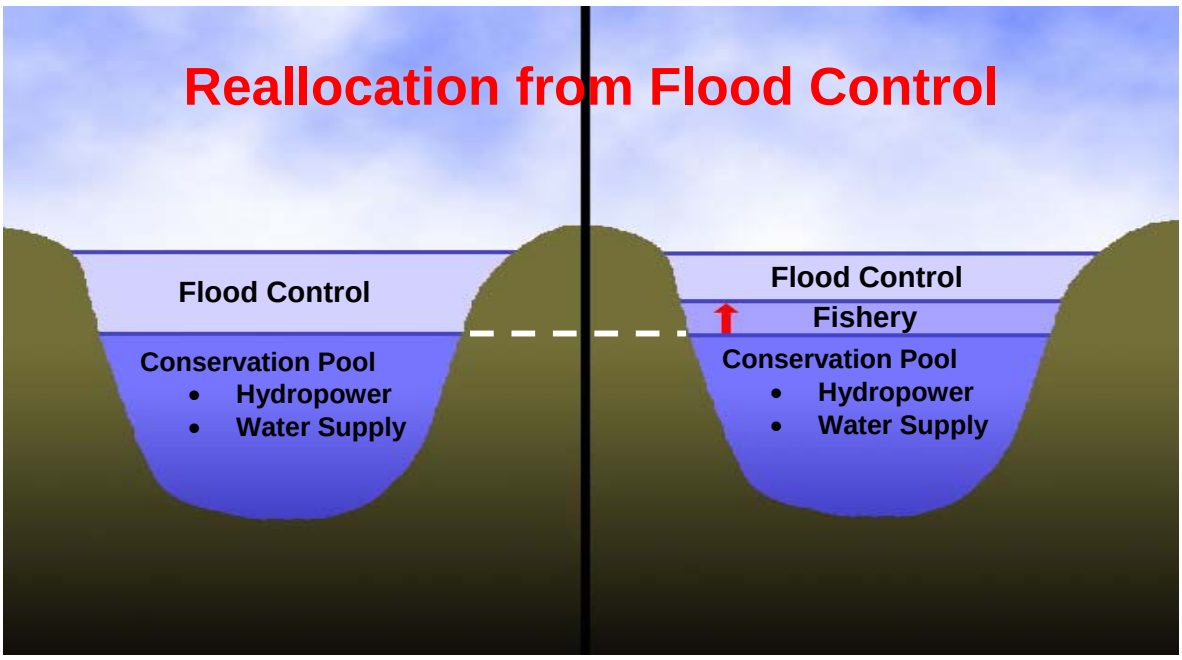
Three reallocation plans were formulated.

1. Reallocate from Flood Pool

The volume of the proposed minimum flows storage, in acre-feet, corresponding to the vertical feet of storage authorized in WRDA 1999 and 2000 was calculated by adding the proposed feet of storage to the elevation defining the current top of conservation pool (see Figure 2). A flood pool reallocation would therefore increase the volume of the conservation pool while reducing the volume of the flood pool by raising the top of conservation pool by the WRDA specified feet of storage. The volume of the incremental increase in conservation storage is calculated using the existing elevation-storage tables for each participating lake.

A flood pool reallocation would result in some changes to the Corps' flood operations. The Corps would continue to evacuate floodwaters as quickly as possible to provide maximum protection from future rainfall runoff. However, with a Flood Pool reallocation the Corps would cease flood operations sooner. Once flood releases are concluded, at the top of the new Conservation Pool, SWPA would either begin hydropower operations or minimum flows releases will resume.

Figure 2: Flood Pool Reallocation



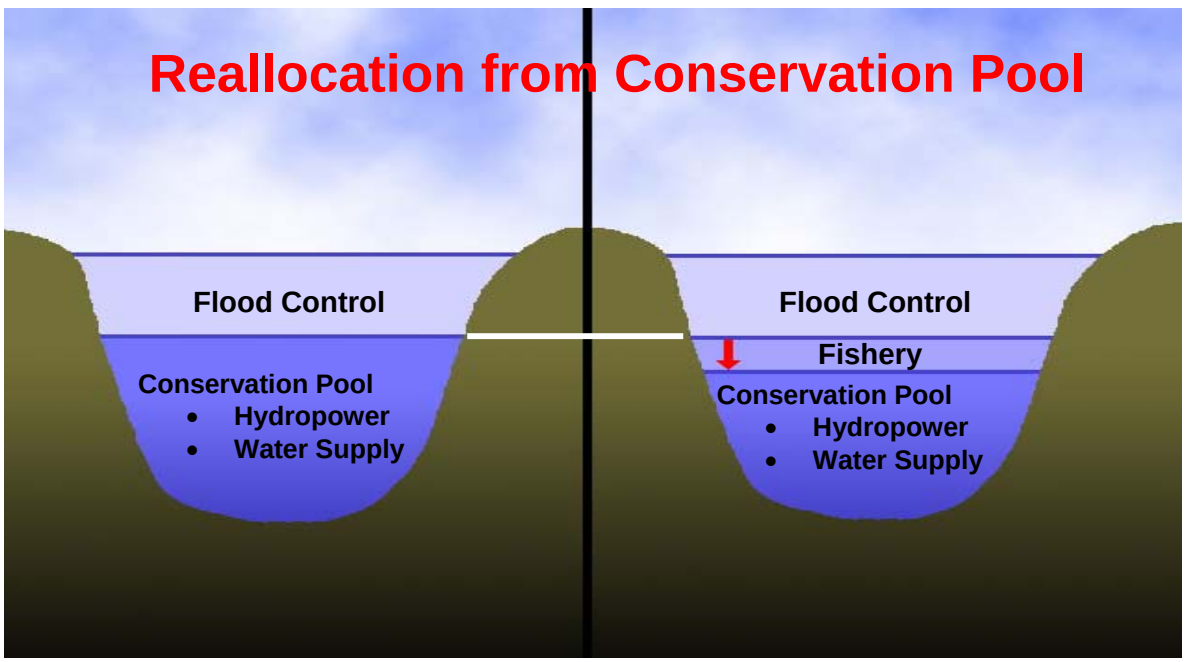
2. Reallocate from Conservation Pool

A conservation pool reallocation for minimum flows releases is a proportional reduction of volume used for hydropower generation. The volume of storage per foot at the top of the conservation pool is greater than volume of storage taken from the bottom of conservation pool. Therefore, the mid-point of storage was

chosen as a reference point for the storage reallocation calculation so that a conservative volume of storage from the conservation pool would be taken from hydropower and designated for minimum flows. The mid-point method provides an average value of volume for the minimum flow releases in a manner equitable to both the hydropower purpose and the WRDA recommendation.

The volume of the proposed minimum flows storage, in acre-feet, corresponding to the vertical feet of storage authorized in WRDA 1999 and 2000 was calculated by first identifying the elevation representing the total storage mid-point of the Conservation Pool (see Figure 3). Second, the WRDA feet of storage was divided in half and added and subtracted to the mid-point elevation in order to establish the elevations bounding the volume of storage representing the WRDA feet. Finally, the acre-feet of storage to be reallocated for the minimum flows releases from the conservation pool was calculated by using the existing Conservation Pool elevation-storage tables, applying the upper and lower elevations bounding the WRDA storage to get respective acre-feet of storage, and taking the difference between to these two values, thus determining the incremental value of minimum flows storage in acre-feet corresponding to the WRDA specified vertical feet.

Figure 3: Conservation Pool Reallocation



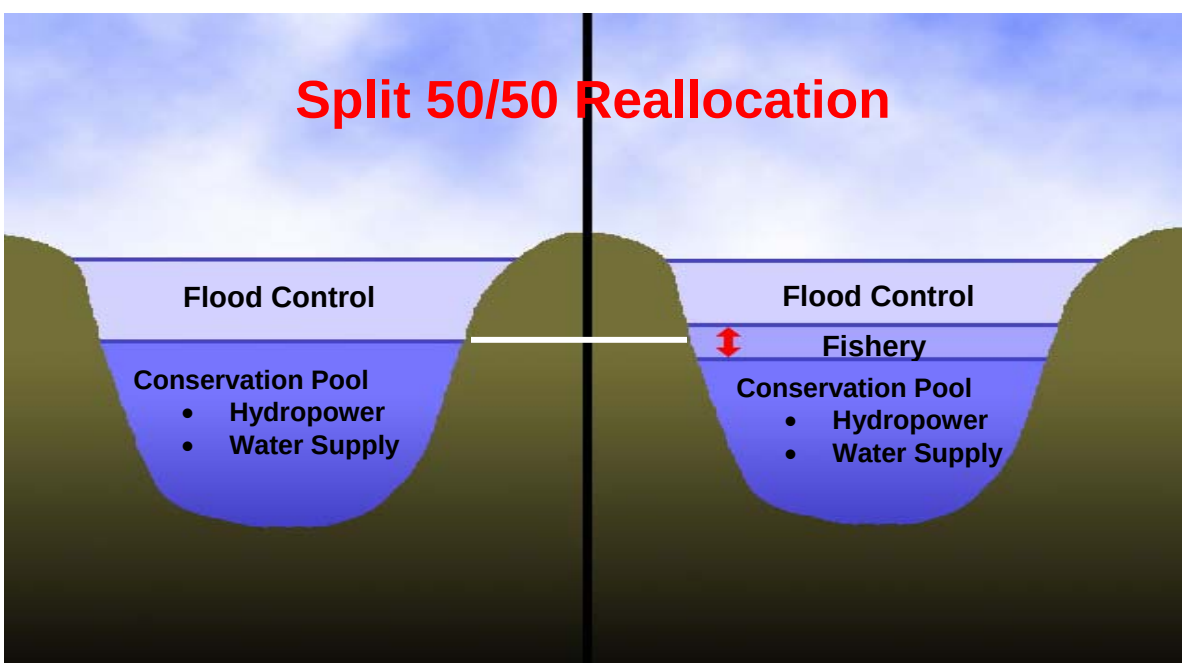
The reallocated Conservation Pool storage does not affect current flood operations. However, the minimum flows storage reallocated from the conservation pool reduces the storage available for hydropower generation. When the flood pool is empty, power is generated using water specifically allocated for that purpose. Once Corps flood releases are concluded, SWPA will still have the opportunity to use authorized storage to generate hydropower

electricity. If SWPA chooses to not make hydropower releases, the minimum flow operations begin. During droughts the conservation pool may be depleted and refilled only when rainfall occurs. When hydropower storage is depleted due to drought, power-generating operations are stopped until inflows recharge conservation pool storage. Similarly to hydropower, in drought years the minimum flow releases will be halted whenever the specific volume of minimum flow storage has been used and will not be restarted until inflows have recharged the storage.

3. <u>Reallocate 50/50</u>

The volume of the proposed minimum flows storage, in acre-feet, corresponding to the feet of storage authorized in WRDA 1999 and 2000 was calculated in two steps. First, half of the proposed feet of storage was added to the elevation corresponding to the current top of conservation pool (see Figure 4). This resulted in an incremental increase in the top of conservation pool. The second step was similar to the conservation pool volume calculations mentioned in the **Conservation Pool Reallocation** paragraph above. With the 50/50 reallocation plan, the elevation of conservation pool storage mid-point was again located, and one quarter of the feet of WRDA defined storage was added and subtracted to the mid-point elevation. This defined a volume of storage corresponding to half of the required feet of storage. Applying the upper and lower elevations bounding the WRDA storage to get respective acre-feet of storage, then taking the difference between to these two values, half of the incremental value of minimum flows storage in acre-feet was calculated. The volume of the incremental rise into the flood pool was added to the incremental portion of the conservation pool to get the total volume of minimum flows storage corresponding to the WRDA feet of storage.

Figure 4: Split 50/50 Pool Reallocation



This reallocation scenario will result in reduced flood releases and reduced hydropower generation capability. The Corps will continue to evacuate floodwaters as quickly as possible to provide maximum protection from future rainfall runoff. However, with a flood pool reallocation the Corps will cease flood operations sooner than current operations. Once flood releases are concluded at the top of the new conservation pool, SWPA will either begin hydropower operations or minimum flows releases will resume. The reallocated conservation pool storage does not affect current flood operations. However, the portion of storage reallocated from the conservation pool reduces the storage available for hydropower generation. When the flood pools are empty, power is generated using water specifically allocated for that purpose. During droughts the power pool may be depleted and the lakes are refilled only when rainfall occurs. Once inflows replenish hydropower storage, SWPA will again have the opportunity to use their authorized storage to generate hydropower electricity. Similarly to hydropower, in drought years the minimum flow releases will be halted whenever the specific volume of minimum flow storage has been used and will not be restarted until inflows have recharged the storage.

c. <u>Hydropower</u>

The impact upon hydropower generation that will be caused by the proposed reallocation of storage for minimum flows releases from the five Corps of Engineers projects was calculated by Northwestern Division's Hydropower Analysis Center (HAC) using SUPER model output provided by Little Rock District. The hydropower valuation analysis included power benefits foregone, revenues forgone, and credit to the Federal Power Marketing Agency (Southwestern Power Administration). A copy of the Power Benefits Forgone Due to Storage Reallocation Report, prepared by HAC, is included in this report package as Appendix C. If a conservation pool reallocation plan is selected, and proposed minimum flows release methods does not generate power, SWPA's ability to produce hydropower benefits will be negatively impacted. SWPA's benefits, in certain cases, can be made whole by a combination of power producing release alternatives designated and Hydropower Yield Protection Operation (HYPO) reallocation plans (see paragraph **e. <u>Hydropower Yield Protection Operation</u>** below). For instance, Little Rock District's plan formulation includes proposed release alternatives capable of generating marketable power that minimizes impacts to SWPA, holds SWPA's yield whole, and in some instances produces net hydropower gains. Flood pool reallocation plans with HYPO keep SWPA's yield whole. The combination of flood pool reallocations with HYPO and marketable power from minimum flows releases significantly reduce negative impacts to SWPA.

It is noted that HAC and SWPA's hydropower impact analysis do not agree. HAC calculates capacity loss using the average year method, while SWPA contends that for this system, dependable capacity can only be calculated using the critical drought years. For NED analysis, the average year method is accepted and in agreement with current Corps policy. Therefore, that procedure is utilized in this report. Appendix A contains decision matrices that compare Corps and SWPA economic justification calculations. The SWPA calculations are included for comparison only; Corps hydropower calculations are used for economic justification.

d. SUPER model

The storage reallocation scenarios were modeled using the SUPER program, developed at the Southwestern Division of the Corps of Engineers. The SUPER program simulates, on a daily basis, the regulation of a system of multipurpose reservoirs based on a specified plan of regulation. The hydrologic output is presented in average daily values such as average daily lake level elevations. Project releases and river flows are given as daily average flows. Pool elevations are given as midnight elevations. For the White River Minimum Flows Study, Little Rock District modified the SUPER model algorithm to include a function that allowed SUPER to stop minimum flows releases when storage was depleted and restart releases once storage was recharged. Consistent with other Little Rock District uses of SUPER, the impacts of White River Minimum Flows operations were simulated over a 50-year period of record of historic rainfall and inflow.

The White River "Current Conditions" model was updated to reflect changes since 1998. The "Current Conditions" model is SUPER run W01X01 (first White River run of 2001). The changes are listed as follows:

(a) Hydropower. SWPA revised the SUPER hydropower loadings in April 2001. These changes were incorporated into the model. The power plant efficiency was changed to 0.85 for all the hydropower projects.

(b) Reservoir Leakage and Water Supply Withdraw.

Project	House (cfs)	Leakage (cfs)	Hatchery (cfs)	Total (cfs)	Water Supply (cfs)
Beaver	20	35	18	73	261.2
Table Rock	20	80	20	120	0.12
Bull Shoals	50	160	0	210	1.55
Norfork	20	55	40	115	7.74
Greers Ferry	20	30	20	70	20.86

(c) Flood and Recreation Benefits. The updated economics data is now current to FY-2001. The variables XLP (Late Plant Cost in dollars per acre), XNP (Net Profit in dollars per acre), and XPC (Production Cost in dollars per acre) were updated for improved pasture, Unimproved pasture, Soybeans, rice, corn, cotton, grain sorghum, alfalfa, wheat, double crop soybeans, and double crop wheat. The stage damage

curves for Normal Cleanup were updated for Beaver, Table Rock, Bull Shoals, Norfork, and Greers Ferry lakes. The Recreation Benefit functions were updated for Beaver, Table Rock, Bull Shoals, Norfork, and Greers Ferry lakes.

The White River "Current Conditions" model was modified to simulate water supply reallocation from the power pool. The changes are listed as follows:

Required Minimum Flows Release. The existing house release, leakage rate, and hatchery discharge were subtracted from the target flow in order to identify the additional release needed to meet the minimum flows criteria. The incremental portions of the minimum flows release are shown below.

Project	House (cfs)	Leakage (cfs)	Hatchery (cfs)	Increase (cfs)	F/W Release Req'd (cfs)
Beaver	20	35	18	63	136
Table Rock	20	80	20	280	400
Bull Shoals	50	160	0	590	800
Norfork	20	55	40	185	300
Greers Ferry	20	30	20	130	200

The White River "Current Conditions" model was modified to simulate water supply reallocation from the flood pool. Below are descriptions of the storage reallocation scenarios. The run number is W02X08. The changes are listed as follows:

Raise top of Power Pool. The top of Power Pool was raised for each hydropower project to model the effect of reallocation from the flood pool. The Power Pools were raised as follows:

Project	Current Cond. EL. (ft.)	Increase (ft-msl)	Reallocated EL. (ft-msl)
Beaver	1120.43	1.5	1121.93
Table Rock	915	2	917
Bull Shoals	654	5	659
Norfork	552	3.5	555.5
Greers Ferry	461.3	3	464.3

Required Fishwater Release. The existing house release, leakage rate, and hatchery discharge were subtracted from the target flow in order to identify the additional releases needed to meet the minimum flows criteria. The incremental portions of the minimum flows release are identical to the releases for a conservation pool reallocation.

The White River "Current Conditions" model was modified to simulate splitting the water supply reallocation between the conservation pool and flood pool. The run number is W02X09. The changes are listed as follows:

Raise top of Power Pool. The top of Power Pool was raised for each hydropower project to model the effect of dividing the reallocation between the flood pool and the power pool. The Power Pools were raised as follows:

Project	Current Cond. EL. (ft.)	Increase (ft-msl)	Reallocated EL. (ft-msl)
Beaver	1120.43	0.75	1121.18
Table Rock	915	1	916
Bull Shoals	654	2.5	656.5
Norfork	552	1.75	553.75
Greers Ferry	461.3	1.5	462.8

Required Fishwater Release. The existing house release, leakage rate, and hatchery discharge were subtracted from the target flow in order to identify the additional releases needed to meet the minimum flows criteria. The incremental portions of the minimum flows release are identical to the releases for a conservation pool reallocation.

e. Hydropower Yield Protection Operation (HYPO)

Expanding conservation storage into the flood control pools will reduce the critical period dependable yield (which is produced from storage and inflow) per unit of storage. This occurs because, even though there is more conservation storage available from which to draft water, the inflow into the reservoir remains the same. Since existing water supply users will be sharing the same inflow, the yield per unit of storage decreases even though the total yield of the project increases. To avoid such negative impacts, sufficient storage will be reallocated to maintain the dependable yield of the existing water supply users while supplying water for fishery needs. This additional storage required to keep existing users whole is termed Dependable Yield Mitigation Storage (DYMS). This was applied to all water supply users. However, for hydropower the amount of time and or reliability of the storage assigned to the WRDA specified storage, was reduced in order to lessen the adverse Hydropower impacts. This operation is called Hydropower Yield Protection Operation (HYPO).

WRDA 1999 and 2000 authorized the Corps to reallocate a specified number of vertical feet of storage from each project to supply a minimum fishery flow. Three scenarios are evaluated; supplying fishery flow from the existing conservation storage, from a split of the needed storage with ½ from the existing conservation storage and ½ from the flood control storage, and all of the needed storage coming from the flood control pool. Figure 5 below is a table of the reallocated storage including the DYMS and HYPO storage to maintain the yield of the water supply users and the storage needed to minimize impacts to hydropower yield.

Figure 5: HYPO Data

100% FLOOD POOL REALLOCATION			
Project	WRDA Storage (Acre-Feet)	DYMS - HYPO (Acre-Feet)	Trout Storage (Acre-Feet)
Table Rock	87,000	48,308	38,692
Bull Shoals	233,000	111,271	121,729
Norfork	78,600	46,499	32,101
Greers Ferry	95,700	66,410	29,290

50% FLOOD POOL 50% CONSERVATION POOL REALLOCATION			
Project	WRDA Storage (Acre-Feet)*	DYMS - HYPO (Acre-Feet)	Trout Storage (Acre-Feet)
Table Rock	43,000	24,251	18,749
Bull Shoals	114,500	57,549	56,951
Norfork	38,900	21,881	17,019
Greers Ferry	47,600	39,241	8,359

* This is the flood control portion of the WRDA storage only. The total trout storage available to AG&FC also includes storage from Conservation Pool.

Project	WRDA Con. Storage (AF)	Trout Storage (AF)	Total Storage (AF)
Table Rock	34,500	18,749	53,249
Bull Shoals	98,800	56,951	155,751
Norfork	29,200	17,019	46,219
Greers Ferry	41,600	8,359	49,959

The input data for the reservoir routing model "SWD-SUPER", with the fishery storage accounting, was revised to include the DYMS and HYPO storage amounts, reducing the storage for the fishwater account. The resulting output was subjected to hydropower analysis. Benefits foregone were reduced as was energy gained through the fishwater release options. Revenue foregone was also reduced. Credit to the power-marketing agency, SWPA, was reduced as well, except for Beaver. The differences in the benefits come from the fact that under the DYMS and HYPO adjustment there is less water released for fish and in most years more water is retained in reservoir storage producing more energy.

f. Recreation

The incremental impact to recreation was considered for both lake recreation and tailwater recreation for each reallocation scenario. The tailwater recreation calculation was not part of the SUPER model analysis.

1. Tailwater Recreation

The University of Arkansas at Fayetteville (UAF) was contracted to estimate the economic benefits of increased minimum flows in the White, Norfork, and Little Red Rivers. UAF used the contingent valuation method (CVM) and statistical inference to determine respondent's willingness-to-pay, and then extrapolated those values to a broader population. The UAF report identifies two sets of values corresponding to tailwater recreation benefits associated with the proposed Minimum Flows releases. Copies of the UAF reports, CVM calculations, and CVM explanations are included in Appendix D.

Little Rock District hosted an Alternative Formulation Briefing (AFB) on 20 November 2003. Among the attendees, it was agreed that the Little Rock District would revise the CV benefits to eliminate existence values from the study. An existence value is a benefit received without direct use of a resource. For example, it would be the benefit someone derives from simply knowing the minimum flow releases had improved the trout habitat, without their actually fishing there. In order to remove these existence values, Little Rock District used data from the original surveys that indicated which respondents currently fish or would start fishing the tailwaters as a result of minimum flows implementation. This data was then used to recalculate the two sets of CV benefits. The most conservative revised estimate for tailwater recreation benefits is more than $3.4 million. The most optimistic revised value for tailwater benefits is over $21 million. The District has chosen to use the mid-point value from the conservative set of CV benefits. The average annual value of this benefit is about $7,044,000. It is noted that, because of the removal of existence values from the analysis, these estimates are based on a small sample size, and reflect less than fully rigorous statistical inference. See Appendix D for a complete explanation of the CVM calculations.

The CVM benefits were distributed by prorating increased recreation benefits by trout stream miles below each participating reservoir. The trout stream miles below Bull Shoals and Norfork Lakes are shared and were computed by splitting the river miles below the confluence of the Norfork and White Rivers. The miles of trout stream credited to each reservoir and the associated benefits are listed below in Table 1. A data request to AG&FC revealed that the statistical data defining the recreational capacity of trout fisheries in Arkansas could not be provided within the current Corps study schedule. AG&FC did qualitatively confirm that the capacity of the fisheries included in the study could adequately sustain the increased recreational demand that would result from the proposed

minimum flows operations. See Appendix D for preliminary trout stream recreation demand and capacity calculations.

TABLE 1: Miles of Trout Stream by Project

SITE	Downstream Trout Fishery (miles)	Annual Benefits per Site
Beaver Lake	8	$364,000
Table Rock Lake	22	$1,000,000
Bull Shoals Lake	66	$2,999,000
Norfork Lake	29	$1,318,000
Greers Ferry Lake	30	$1,363,000
TOTALS	155	$7,044,000

In addition to the multi-reservoir analysis, a single reservoir analysis was completed to estimate the benefits of Minimum Flows. The underlying reason for the examination of benefits for a single reservoir is due to the uncertainty of implementing Minimum Flows at all five reservoirs. Therefore, Bull Shoals was chosen for this examination because it is one of the two projects cited in the surveys, it has the lowest implementation costs, and Bull Shoals has the most downstream trout fishery miles.

For this analysis, nearly identical procedures were used to calculate benefits. The most conservative and optimistic benefit estimates are $2.5 and $3.25 million, respectively. An explanation of the benefit calculations is in Appendix D.

2. Lake Recreation

The impact to lake recreation was calculated using SWD's SUPER model. SUPER uses seasonal visitor day curves to calculate recreation benefits with respect to pool elevation. The SUPER model analyzes historical information to estimate damages based on changes to stage and duration levels. There is a negative correlation between high-water conditions and visitor accessibility. SUPER model used the historical data and unit day values to determine the change in recreation benefits.

The unit day values were obtained by using Economic Guidance Memorandum 01-01, Unit Day Values for Recreation, fiscal year 2001. EGM 01-01 describes the unit day value method as the following:

> "The unit day value method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Federal or Federally assisted recreation resources. … By applying a carefully thought-out and adjusted unit day value to estimated use, an approximation is obtained that may be used as an estimate of project recreation benefits."

The unit day value estimate was based on a point scale in the guidance memorandum. Points were assigned, by informed opinion, to five different categories: Recreation Experience, Availability of Opportunity, Carrying Capacity, Accessibility, and Environmental Quality. This value was used in conjunction with the SUPER model's stage duration and visitor data to determine the change in recreation benefits due to a change in stage and duration from the implementation of minimum flows.

Table 2 details the affected areas, change in recreation benefits, and costs to maintain and relocate facilities. The campsites and day use areas that would be inundated by water due to increased stage and duration are campgrounds and parks. The costs associated with a flood pool and split reallocation are due to relocating roads, parking lots, restrooms, picnic areas, boat ramps, and electrical facilities.

TABLE 2: Recreation Facility Costs and Benefits Foregone

	# of campsites & day use areas affected			Change in Recreation Benefits			Cost to Relocate Facilities		
Reallocation Scenario	Conservation Pool	Flood Pool	Split 50/50	Conservation Pool	Flood Pool	Split 50/50	Conservation Pool	Flood Pool	Split 50/50
Lake									
Beaver	N/A	49	25	3,000	(21,000)	(8,000)	N/A	$ 5,777,000	$ 2,889,000
Table Rock[1]	N/A	11	6	13,000	(97,000)	(43,000)	N/A	33,424,000	16,712,000
Bull Shoals	N/A	106	53	(33,000)	(139,000)	(51,000)	N/A	22,886,000	11,443,000
Norfork	N/A	84	42	13,000	(70,000)	(25,000)	N/A	12,212,000	6,106,000
Greers Ferry	N/A	31	16	14,000	(207,000)	(100,000)	N/A	7,681,000	3,841,000

[1] Table Rocks relocation costs are disproportional to the number of campsites affected due to 1.8 million square feet of roads and parking lots that would need to be relocated.

g. Flood Control

Flood control impacts were calculated by SUPER model. All stage damage curves were updated with the latest crop and property values. The benefits gained or forgone at the downstream index station for each reallocation alternative was distributed to the participating projects by prorating downstream impacts based upon historic flood damage prevention ratios. HEC-PBA, Project Benefit Accomplishment, package is a program that generates distribution ratios used to account for flood damages prevented with respect to contributing projects. The actual distribution ratios calculated for the years 1996 through 2001for the White River Basin were averaged and used to distribute flood control impacts associated with the White River Minimum Flows SUPER runs. The HEC-PBA values used in this study process went into the annual Reservoir Control Center (RCC) Reports for 1996 through 2001 and sent to SWD and HQUSACE.

h. Cost of Storage

The authorizing legislation directed the Corps to identify Federal costs incurred in connection with the project modifications. Costs for modifications to turbines, operating systems, relocations, and other costs, have been identified and are displayed in Appendix A, Economics. However, the legislation was silent on the issue of "storage costs". When the Corps reallocates storage for new water supply customers, the customer, in accordance with Corps regulations must repay the cost of that storage. Both WRDA 1999 and 2000 authorized the reallocation of storage for the purpose of minimum flow releases to be used to improve the trout habitat without mention of cost of storage. A letter dated 15 July 2003 from Congressman Boozman, 3rd District, Arkansas, stated that, "the intent of Congress was to require the local sponsor to cost share construction costs construction expenses, it was never their intent to require either Southwestern Power Administration or the project sponsors to pay for water storage reallocated for this project." Also, SWPA has made it clear that their financial burden should be reduced proportionally for any storage taken away from hydropower for use by another purpose.

1. Actual Cost of Storage

Under this alternative the sponsor would be required to repay the original cost of the storage that is being reallocated. The five White River Projects were completed during the period 1945 to 1965. Little Rock District's final cost allocation reports provided the finalized construction costs and interest rate for each project. These costs and interest rates were used to estimate the cost of storage that would have been charged if minimum flows had been implemented at the completion of each project. These costs are detailed in Appendix A. Although Little Rock District does not recommend cost of storage as a local cost, it is shown for informative purposes.

2. Updated Cost of Storage

Under this alternative the sponsor would be required to repay the updated cost of storage. Updated cost means the original costs of the project have been inflated to FY03 dollars. The storage cost is then based on this updated cost, the planning interest rate, and the amount of the reallocation. Again, Little Rock District's final cost allocation reports provided the finalized construction costs for each project. As directed in the IWR Report 96-PS-4, Chapter 4, Sections 4-5, the Engineering News Record (ENR) and Civil Works Construction Cost Index System (CWCCIS) were used to inflate project dollars. These costs and the current planning interest rate were used to estimate the updated cost of storage.

3. Calculating Storage Costs

Both the actual and updated storage costs are calculated similarly. The joint-use project costs, joint-use Operation and Maintenance (O&M) costs, and usable

project storage data were taken from the final cost allocation reports and used to determine the storage cost. The ratio of the proposed reallocation to usable project storage is multiplied by the joint-use project cost to determine the cost of storage. Also, the ratio of the proposed reallocation to usable project storage is multiplied by the joint-use O&M cost to determine the proportional share of O&M that would need to be paid. The cost of storage and proportional share of O&M costs make up the total storage cost. This cost is then amortized over a 50-year period at the applicable interest rate. The actual cost of storage calculations use the actual joint-use costs, actual joint-use O&M, and a 2.5 percent interest rate while the updated cost of storage uses the updated joint-use project costs, FY03 joint-use O&M costs, and the FY04 planning interest rate, 5.625 percent. Appendix A shows the cost of storage by plan. For plan identification see tables in Section IV, Plan Formulation.

i. NEPA

Little Rock District, in preparing an Environmental Impact Statement (EIS), conducted multiple public meetings in 2001. An environmental summary identifying impacts to the ecological features associated with each reallocation alternative is included in Section III, Environmental Summary. This report package does not include a draft EIS but will quantitatively or qualitatively identify potential impacts (beneficial or negative). The NEPA process must be completed including a complete EIS with full public involvement prior to implementation of Minimum Flows measures.

III. Environmental Summary

This is a quantitative and qualitative summary of impacts identified in the development of the draft EIS. The draft EIS is under development and has not been distributed for public review. The NEPA document will require public review prior to implementation of the project.

The alternatives being analyzed in the ongoing study consist of reallocating storage for minimum flow releases out of the flood control pool, conservation (hydropower) pool, or a combination of 50 percent flood control and 50 percent conservation pool. The lake effects are direct effects to the USACE lands within the multipurpose projects' area or the tailwaters of each.

The H&H analyses and Super output were the primary tools used in this evaluation. The following is a brief description of the considerations used in this environmental consideration document. Table 3 below indicates the changes in the surface area of the conservation pool and flood pool under the different alternatives considered.

TABLE 3: Surface Area Change of the Conservation Pool Relative To Each Alternative

LAKE	REALLOCATION (feet)	STORAGE POOL	CONSERVATION POOL ELEVATION	SURFACE AREA (acre)	ACRE INCREASE	CHANGE (%)	STORAGE (acre ft)
Beaver	1.5	Conservation Pool	1,120.43	28,370			1,664,198
		Flood Pool	1,121.93	28,895	525	1.9	1,707,098
		50/50	1,121.18	28,633	263	0.9	1,685,648
Table Rock	2	Conservation Pool	915	43,070			2,702,000
		Flood Pool	917	44,140	1,070	2.5	2,789,000
		50/50	916	43,600	530	1.2	2,745,000
Bull Shoals	5	Conservation Pool	654	45,440			3,048,000
		Flood Pool	659	48,005	2,565	5.6	3,281,000
		50/50	656.5	46,715	1,275	2.8	3,162,500
Norfork	3.5	Conservation Pool	552	21,990			1,251,200
		Flood Pool	555.5	22,933	943	4.3	1,329,900
		50/50	553.75	22,454	464	2.1	1,290,138
Greers Ferry	3	Conservation Pool	461.44	31,598			1,924,360
		Flood Pool	464.44	32,654	1,056	3.3	2,020,300
		50/50	462.94	32,118	520	1.6	1,972,080

a. Lake or Shoreline Impacts

1. Lake Fisheries

Fisheries management options of large multipurpose reservoirs are limited due to the water level management objectives. Many times, lakes of this nature exemplify the "boom or bust" condition in standing crops. The shoreline is characterized by bluffs, shelf-rock, boulder, and cobble. Clay, silt, and sandy substrates are limited but occasionally occur in tributaries. There is very little aquatic vegetation and vegetative cover occurs only when encroaching terrestrial vegetation is inundated.

When comparing the effects of the proposed alternatives on the in-lake fisheries of the White River reservoirs, effects can generally be categorized as “minor adverse” if during the spawning and growing season of March through August lake levels are less than current operating conditions. Conversely, effects are said to be beneficial if the lake levels are higher during this same period. This is due to the fact that a healthy fishery requires that during the spawning season of March through June water levels should ideally be rising to flood potential spawning habitat and then remain stable or decline slowly during the growing period through summer.

Hydrologic modeling indicates that in general reallocation from the flood control pool essentially raises the top of the conservation pool and therefore would provide higher water levels in the lakes than under the current operating procedures. In theory and as stated previously these higher water levels would provide better spawning habitat for the lake fishery. The actual change in water

levels depends on the amount of reallocation and other hydrologic conditions such as rainfall and inflows from upstream releases, would not be the same for every reservoir, and would differ from year to year.

Therefore, in general, reallocation from the flood control pool could provide beneficial effects to the lake fishery, however due to the topography of the White River Lakes with their steep shorelines the beneficial effects would be less than lakes with a definite flood plain around its shoreline.

In contrast to reallocation from the flood control pool, reallocation from the conservation (hydropower) pool would generally lower the conservation pool and therefore result in lower water levels than are currently obtained under the current operating procedures.

This lower lake level would be different in every reservoir and would be dependent on hydrologic conditions such as rainfall and upstream inflows.

Lower lake levels would not provide additional spawning habitat and could potentially exclude existing habitat that now exists. Therefore, this would generally be adverse to the fishery of the lakes.

Hydrologic modeling of reallocating from the conservation pool has shown that during the spawning and growing period lake levels would generally be lower, however in some of the reservoirs during some years the difference would be immeasurable.

A “split” reallocation of 50 percent from the flood pool and 50 percent from the conservation pool would result in lake levels that are generally higher than current conditions but lower than if taken out of the flood control pool. From an in-lake fishery viewpoint, this alternative would provide some beneficial effects through higher lake levels but not as high as from the flood control pool.

As previously stated the topography of the reservoirs (steep sided) limits the benefits of high water levels for spawning since there are limited flood plains to inundate. Higher water levels would provide some benefit for a few years by inundating vegetated areas that are currently never flooded. This would be temporary however, since the fishery habitat would eventually return to their current conditions since this vegetation would be drowned out. The health of the in-lake fisheries has and continues to be limited not by higher or lower lake levels alone but by the timing of lake levels during critical periods of the year.

In conclusion, the following general statements can be made about the alternatives being studied when compared to current conditions:

Reallocation from the flood control pool will provide limited minor benefits to the in-lake fishery by temporarily providing limited additional spawning habitat. The

"split" alternative would potentially provide less benefit than the flood control reallocation. The reallocation of the conservation (hydropower) pool would result in minor adverse effects by potentially eliminating existing spawning habitat. It should be noted that much of the time during the spawning and growing season the water levels are almost immeasurable compared to current conditions therefore this adverse effect may not even exist some of the time. The operation of a multipurpose projects cause water level fluctuations that can be detrimental to the natural reproduction and recruitment of some species of fish. Generally, reallocation from the conservation pool will result in long-term negative effects and reallocation from the flood pool would result in short-term positive effects, due to the inundation of terrestrial vegetation, but after a period of years, the area will exhibit the characteristics of current littoral area (sparse shoreline vegetation and fish habitat).

Regardless of the minimum flow reallocation, the productivity of the lake fisheries is currently, and will continue to be, largely influenced by water level management of the multipurpose reservoirs.

2. <u>Terrestrial Vegetation</u>

It is assumed that any reduction in inundation duration will result in minor beneficial effects to the shoreline terrestrial vegetation by decreasing the time the area is inundated thus allowing productivity increases in vegetation components. A reallocation from the conservation pool is expected to produce minor benefits, whereas reallocation from the flood pool will produce minor adverse affect to vegetation. In either case, the density of the vegetation component is expected to be similar to current conditions after a few years of water level management.

3. <u>Wildlife</u>

The terrestrial wildlife effects are expected to track with the Terrestrial Vegetation and Wetland features. In general, a positive effect on the vegetation feature will result in habitat benefits to the terrestrial wildlife of the littoral area. Likewise, if the wetland feature exhibits a positive effect, the wildlife (small mammals and bird species) using this habitat will benefit. A minor positive effect is expected from additional terrestrial vegetation if the reallocation is made from the conservation pool due to duration reductions. Any reallocation from the Flood Pool will result in a short term negative effects due to the decrease of habitat available for some littoral wildlife species. A negative short term effect is expected as the existing terrestrial vegetation is lost but a long term positive effect is possible as the shoreline vegetation reestablishes.

4. <u>Water Quality</u>

There is no effect expected on the water quality of the reservoirs, this conclusion is based largely on Temperature and Dissolved Oxygen Hydrodynamics models

completed by the USGS. Outside of the USGS study, there is potential for short-term minor increase in turbidity as vegetation dies and reservoir operations affect unprotected bank areas. In an effort to assess the impact of increased minimum flows on temperature and dissolved oxygen concentrations of reservoir water quality, the USGS developed hydrodynamic temperature, and dissolved oxygen models for each of the reservoirs with the exception of Greers Ferry. The Table Rock model is in draft. Simulations included (1) the impact of additional minimum flows on tailwater temperature and dissolved oxygen qualities (current conditions) and (2) increasing the water surface elevation to account for the proposed reallocated storage. In scenario (1) water temperatures appeared to increase ($<1^{o}C$) and dissolved oxygen appeared to decrease (<2.2 mg/l). Conversely, scenario (2) apparently lowered the outflow water temperature ($<1^{o}C$) and increased the dissolved oxygen concentrations ($<1^{o}C$). However, these results were within the boundaries or similar to the error between measured and simulated water column values. These results have been consistent in all of the models. While this modeling effort is worthy of note, the results are considered inconclusive for the minimum flow study.

5. Groundwater

The effects on aquifer recharge are intended to be captured in the groundwater feature. The effects are solely based on the premise that reduction or increase in duration of the conservation pool area will directly affect the recharge of the aquifer. Reallocation from the conservation pool will result in a long-term minor negative effect due to a reduction in duration. Conversely, a flood pool reallocation would be of long-term minor benefit due to the increased duration.

6. Tailwater Impacts

Increases in wetted area (amount of bottom substrate that is always covered) and duration will increase at each tailwater. The wetted area is important but the duration increase of this area is a critical component of increased ecological function. Increased wetted area (primarily riffle areas) is the sources of aquatic invertebrate production. Wetted area would substantially increase the area available for aquatic invertebrate (particularly aquatic insects) production. Increased aquatic insect production would not only provide a direct increase in forage available for trout but also for organisms such as sculpins, dace, stonerollers, and crayfish that are essential to the production of fish species. The increase in abundance of primary forage levels should translate to increased growth rates for trout.

Implementation of the target flow will result in wetted area increases ranging from 0.8 percent to 52 percent. Table 4 below shows the length and wetted area increase for each tailwater. The Beaver tailwater is directly influenced by Table Rock Lake and this accounts for the small percent increase of the wetted area.

Likewise, the Table Rock tailwater is influenced by Lake Taneycomo. The increase duration of this area is still beneficial to the ecosystem.

The tailwater water quality should improve from any release strategy that might result in dissolved oxygen (DO) increases. It is assumed that any alternative that includes installation of a new service unit would have technology that will increase the DO of the outflow. Selective withdrawal using a siphon release should allow for selection of DO concentrations and temperature of the outflow. An aeration mechanism would be needed with a siphon release. In addition to the DO concentration upon release, the shear volume of the proposed minimum releases will result in reaeration to increase as the flow passes through riffle/shoal areas. Reaeration rates will be more efficient in the upper areas of each tailwater. Maintenance of optimum temperatures will be better in the tailwater by avoiding periods of non-release.

TABLE 4: Tailwater: Wetted Areas

	River Mile		CFS					
Tailwater	Up Stream	Down Stream	Current Minimum	Target Minimum	Increase (acre)	Percent Increase	Acre per Mile	Acre per Mile Increase
Beaver	608.8	604.8	55	136	0.7	0.8	22.1	0.2
Table Rock	528.73	522.98	120	400	8.46	4.51	34.07	1.47
Bull Shoals	418.6	329.4	210	800	1490	32.1	68.8	16.7
Norfork	4.468	0.185	115	300	28.53	52.37	19.38	6.67
Greers Ferry	78.9	49	70	200	57.3	11.3	18.9	1.9

b. Threatened and Endangered Species

The duration data generated from the SUPER model simulations were used to evaluate potential effects on Threatened and Endangered species considering the Elevations of Concern identified by US Fish and Wildlife Service (USFWS). The differences observed annually and seasonally were evaluated for each elevation of concern. Additional analyses will be completed prior to the Draft EIS. The USACE completed a Biological Assessment (BA) on the endangered species at Bull Shoals and submitted it to USFWS. A brief discussion follows.

1. Beaver Lake

The USFWS identified several elevations of concern on the Beaver project relative to the potential affects on Threatened and Endangered (T&E) species. The elevations are 1110, 1120, 1130 and 1140. (See Table 5.) The species of concern at 1110, 1120 and 1130 was the endangered gray bat and its habitat (Pigeon Roost Cave). The reallocation will result in less duration of the elevation of concern. This difference will result in an increase in the availability of use of the natural entrance of the cave and is considered a positive effect. Concerns for

the Ozark cave fish led to the inquiry about changes at 1120 – 1140. There have been no adverse effects identified to T&E species at Beaver.

TABLE 5: Beaver Annual Pool Elevation Data

Beaver Lake Annual Pool Elevation-Duration for Pool Elevations of Interest				
Elevation	Current	Conservation	Flood	Split 50/50
1110	91.2	86.65	86.92	86.74
1120.4	45.86	42.69	42.83	42.79
1121	38.19	35.98	36.59	35.26
1121.2	36.87	34.5	35.28	33.93
1121.9	30.77	28.52	28.98	27.94
1130	0.34	0.31	0.33	0.29
1140	0	0	0	0

Beaver Lake Differences in Annual Pool Elevation: Duration for Pool Elevations of Interest (Alternative minus Current)			
Elevation	Conservation	Flood	Split 50/50
1110	-4.54	-4.28	-4.45
1120.4	-3.17	-3.03	-3.07
1121	-2.21	-1.61	-2.93
1121.2	-2.37	-1.6	-2.94
1121.9	-2.25	-1.79	-2.84
1130	-0.04	-0.02	-0.05
1140	0	0	0

2. <u>Bull Shoals</u>

The USFWS identified 670, 675, and 690 as elevations of concern on the Bull Shoals project relative to the potential impacts on the endangered Tumbling Creek Cave Snail and its habitat. A recovery plan for this species has been completed by USFWS. The concern is that the velocities of drainage system of cave (and resulting sedimentation) are affected at the higher lake levels. There is <3 percent increase in duration at the 670 elevation if any storage in reallocated from the flood pool. A slight reduction (<1 percent) in duration is expected if the storage is reallocated from the conservation pool. There have been no adverse effects identified to T&E species at Bull Shoals. The USACE completed a Biological Assessment (BA) and submitted to USFWS in May 2004. The BA concluded the reallocation may affect but not likely to adversely affect the species. The conclusion was based on the following: 1) statistical analysis that Bull Shoals lake levels do not have statistically significant effect on the flows within Tumbling Creek cave, 2) the cave snail is not known to occur in the lower reaches

of the drainage system and spring discharge areas, and 3) the elevation of concern (670 msl) is currently met or exceeded 38.4 days annually and a 10.4 days increase is not considered significant. An official response to the BA has not been received at this time.

TABLE 6: Bull Shoals Annual Pool Elevation Data

Bull Shoals Lake Annual Pool Elevation-Duration for Pool Elevations of Interest				
Elevation	Current	Conservation	Flood	Split 50/50
654	59.92	51.39	81.96	69.60
656.5	30.26	27.96	71.54	51.82
657	28.00	26.06	68.88	38.84
659	23.01	21.43	53.01	27.96
670	10.65	9.96	13.48	11.32
675	7.60	7.03	9.42	8.17
690	2.02	1.90	2.23	2.05
695	0.57	0.46	0.61	0.54

Bull Shoals Lake Differences in Annual Pool Elevation: Duration for Pool Elevations of Interest (Alternative minus Current)			
Elevation	Conservation	Flood	Split 50/50
654	-8.53	22.03	9.68
656.50	-2.31	41.27	21.56
657	-1.94	40.88	10.84
659	-1.58	30.00	4.95
670	-0.69	2.83	0.67
675	-0.57	1.82	0.57
690	-0.12	0.21	0.03
695	-0.11	0.04	-0.03

3. <u>Greers Ferry</u>

The USFWS identified 480, 490, and 500 as elevations of concern relative to the potential impacts on the candidate species yellow cheek darter in the Archey Fork arm. The percent difference between the current condition and each alternative plan is less than 1 percent on an annual or seasonal basis; therefore, there have been no adverse effects identified to T&E species at Greers Ferry.

TABLE 7: Greers Ferry Annual Pool Elevation Data

Greers Ferry Lake Annual Pool Elevation-Duration for Pool Elevations of Interest				
Elevation	Current	Conservation	Flood	Split 50/50
461	44.46	39.14	66.08	53.83
462.0	21.66	20.00	60.80	47.89
463	15.13	13.94	55.73	32.48
464	11.98	11.19	40.78	14.01
480	0.98	0.81	1.22	0.94
487	0.16	0.13	0.18	0.16
490	0.00	0.00	0.00	0.00
500	0.00	0.00	0.00	0.00

Greers Ferry Lake Differences in Annual Pool Elevation: Duration for Pool Elevations of Interest (Alternative minus Current)			
Elevation	Conservation	Flood	Split 50/50
461	-5.32	21.61	9.37
462.00	-1.65	39.14	26.23
463	-1.19	40.60	17.35
464	-0.79	28.80	2.03
480	-0.17	0.24	-0.04
487	-0.03	0.02	0.00
490	0.00	0.00	0.00
500	0.00	0.00	0.00

4. Table Rock

The USFWS identified 940, 960, and 1100 as critical elevations for T&E species around the lake. These elevations are above the top of the flood pool and will not be affected by this reallocation.

5. Norfork Lake

The elevations identified by USFWS as critical elevations (> 580) are above the top of the flood pool and will not be affected by this reallocation.

IV. Plan Formulation

In keeping with the National Economic Development (NED) objective to enhance the Nation's output of goods and services and to improve national economic efficiency there exists an opportunity to evaluate the reallocation of storage in Beaver, Table Rock, Bull Shoals, Norfork, and Greers Ferry. This report identifies implementable plans including the NED plan, but the Corps of Engineers is not recommending any plan for implementation.

The NED plan is the alternative that reasonably maximizes economic net benefits. In this report, however, alternative costs have not been fully developed, and do not include interest during construction or annual operation and maintenance costs. Alternative net benefits are therefore subject to change after more comprehensive analyses are performed. The term "NED plan" is used in this report only with that caveat.

As stated previously, three storage reallocation scenarios at each lake have been analyzed: Flood Pool reallocation, Conservation Pool reallocation, and a 50/50 Flood/Conservation Pool reallocation. Also at each dam, for each proposed storage reallocation, three release alternatives have been modeled and analyzed (except at Bull Shoals, were four release alternatives have been modeled and analyzed). Appendix A, Economics, includes the decision matrices that were used to compare the economic impacts and outputs of each plan. No reallocation scenario adversely affects existing water supply users. All plans that are identified as potentially implementable and have a flood pool storage reallocation will include DYMS for water supply users and HYPO for hydropower. In keeping with the intent of Congress to identify plans that minimize impacts to existing users, implementable plans were identified that either improved flood control, recreation, and hydropower benefits, or had the smallest negative impacts.

a. <u>Beaver Lake</u>

Nine plans for implementing minimum flows at Beaver Lake were analyzed. Table 8, below, identifies each plan. Each plan was evaluated based on economic impacts to recreation, hydropower, and flood control; Table 9 is a summary of economic impacts by plan. The plans discussed in detail, see Section V, Final Array of Plans, are plans that meet the WRDA requirements to be economically justified, technically sound, environmentally acceptable, with minimal impact to existing uses. As part of the NEPA process, Little Rock District shared minimum flows reallocation and release plans with the U.S. Fish and Wildlife Service (USF&W). USF&W indicated that any flood pool reallocation at Beaver Lake could cause significant negative ecological impacts due to the cumulative impacts of previous water supply reallocations, and identified the most environmentally friendly reallocation plan as a conservation pool reallocation. The previous water supply storage reallocations have resulted in raising the top of Beaver Lake's conservation pool 0.43 feet from 1120.0 to 1120.43. This has reduced Beaver's flood control capacity and impacted karst topography. The U.S. Fish and Wildlife Service considers any new encroachment into the flood pool unacceptable. Based on USF&W coordination, conservation pool reallocations are the only environmentally acceptable storage reallocation at Beaver Lake.

TABLE 8: Beaver Plan Identification

LAKE	REALLOCATION SCENARIO	RELEASE METHOD	PLAN ID
BEAVER	FLOOD POOL	SIPHON & SS UNITS	BV1
	FLOOD POOL	NEW SS UNIT	BV2
	FLOOD POOL	SIPHON ONLY	BV3
	CON. POOL	SIPHON & SS UNITS	BV4
	CON. POOL	NEW SS UNIT	BV5
	CON. POOL	SIPHON ONLY	BV6
	50/50	SIPHON & SS UNITS	BV7
	50/50	NEW SS UNIT	BV8
	50/50	SIPHON ONLY	BV9

TABLE 9: Beaver Plan Summary

Beaver Lake Summary*

Flood Pool Reallocation	First Costs	Annual Costs[4]	Hydropower Benefits	% Change of Hydro Benefits	Flood Benefits[3]	Tailwater & In-Pool Rec. Benefits	Total Annual Benefits	Net Benefits	B/C Ratio
BV1	$ 827,000	$ 50,000	$ (75,000)	-0.6%	$ (10,000)	$ 340,000	$ 255,000	**$ 205,000**	**5.10**
BV2	$ 5,615,000	$ 338,000	$ 66,000	0.5%	$ (10,000)	$ 340,000	$ 396,000	**$ 58,000**	**1.17**
BV3	$ 713,000	$ 43,000	$ (216,000)	-1.6%	$ (10,000)	$ 340,000	$ 114,000	**$ 71,000**	**2.65**
Conservation Pool Reallocation									
BV4[1]	$ 827,000	$ 50,000	$ (49,000)	-0.4%	$ 2,000	$ 363,000	$ 316,000	**$ 266,000**	**6.32**
BV5[2]	$ 5,615,000	$ 338,000	$ 92,000	0.7%	$ 2,000	$ 363,000	$ 457,000	**$ 119,000**	**1.35**
BV6	$ 713,000	$ 43,000	$ (191,000)	-1.4%	$ 2,000	$ 363,000	$ 174,000	**$ 131,000**	**4.05**
Split Pool Reallocation									
BV7	$ 827,000	$ 50,000	$ (44,000)	-0.3%	$ (1,000)	$ 356,000	$ 311,000	**$ 261,000**	**6.22**
BV8	$ 5,615,000	$ 338,000	$ 97,000	0.7%	$ (1,000)	$ 356,000	$ 452,000	**$ 114,000**	**1.34**
BV9	$ 713,000	$ 43,000	$ (184,000)	-1.4%	$ (1,000)	$ 356,000	$ 171,000	**$ 128,000**	**3.98**

[1] NED Plan — *see discussion on p. 31, and note 4 below*

[2] Alternate Plan

[3] Includes Downstream and In-Pool Flood Benefits

[4] Annual Costs are the annualized first costs and used in calculating the b/c ratio. First costs are comprised of construction costs. O&M and interest during construction will need to be computed and incorporated into the annual costs prior to implementation.

* This table summarizes the benefit and cost tables shown in Appendix A. All cost and benefit data is derived from the tables in Appendix A. All other data in this table is for information only.

b. Table Rock Lake

Nine plans for implementing minimum flows at Table Rock Lake were analyzed. Table 10, below, identifies each plan. Each plan was evaluated based on economic impacts to recreation, hydropower, and flood control; Table 11 is a summary of economic impacts by plan. The plans discussed in detail, see Section V, Final Array of Plans, are plans that meet the WRDA requirements to be economically justified, technically sound, environmentally acceptable, with minimal impact to existing uses.

TABLE 10: Table Rock Plan Identification

LAKE	REALLOCATION SCENARIO	RELEASE METHOD	PLAN ID
TABLE ROCK	FLOOD POOL	SIPHON & SS UNITS	TR1
	FLOOD POOL	NEW SS UNIT	TR2
	FLOOD POOL	SIPHON ONLY	TR3
	CON. POOL	SIPHON & SS UNITS	TR4
	CON. POOL	NEW SS UNIT	TR5
	CON. POOL	SIPHON ONLY	TR6
	50/50	SIPHON & SS UNITS	TR7
	50/50	NEW SS UNIT	TR8
	50/50	SIPHON ONLY	TR9

TABLE 11: Table Rock Summary

Table Rock Lake Summary*

Flood Pool Reallocation	First Costs	Annual Costs[4]	Hydropower Benefits	% Change of Hydro Benefits	Flood Benefits[3]	Tailwater & In-Pool Rec. Benefits	Total Annual Benefits	Net Benefits	B/C Ratio
TR1	$ 2,727,000	$ 164,000	$ (533,000)	-1.7%	$ (40,000)	$ 896,000	$ 323,000	**$ 159,000**	**1.97**
TR2	$ 11,643,000	$ 700,000	$ (101,000)	-0.3%	$ (40,000)	$ 896,000	$ 755,000	**$ 55,000**	**1.08**
TR3	$ 2,316,000	$ 140,000	$ (727,000)	-2.3%	$ (40,000)	$ 896,000	$ 129,000	**$ (11,000)**	**0.92**
Conservation Pool Reallocation									
TR4	$ 1,762,000	$ 106,000	$ (705,000)	-2.2%	$ 5,000	$ 1,005,000	$ 305,000	**$ 199,000**	**2.88**
TR5[1]	$ 10,678,000	$ 642,000	$ (147,000)	-0.5%	$ 5,000	$ 1,005,000	$ 863,000	**$ 221,000**	**1.34**
TR6	$ 1,351,000	$ 82,000	$ (922,000)	-2.9%	$ 5,000	$ 1,005,000	$ 88,000	**$ 6,000**	**1.07**
Split Pool Reallocation									
TR7	$ 2,727,000	$ 164,000	$ (601,000)	-1.9%	$ (18,000)	$ 954,000	$ 335,000	**$ 171,000**	**2.04**
TR8[2]	$ 11,643,000	$ 700,000	$ (95,000)	-0.3%	$ (18,000)	$ 954,000	$ 841,000	**$ 141,000**	**1.20**
TR9	$ 2,316,000	$ 140,000	$ (810,000)	-2.5%	$ (18,000)	$ 954,000	$ 126,000	**$ (14,000)**	**0.90**

[1] NED Plan — *see discussion on p. 31, and note 4 below*

[2] Alternate Plan

[3] Includes Downstream and In-Pool Flood Benefits

[4] Annual Costs are the annualized first costs and used in calculating the b/c ratio. First costs are comprised of construction costs. O&M and interest during construction will need to be computed and incorporated into the annual costs prior to implementation.

* This table summarizes the benefit and cost tables shown in Appendix A. All cost and benefit data is derived from the tables in Appendix A. All other data in this table is for information only.

c. Bull Shoals Lake

Twelve plans for implementing minimum flows at Bull Shoals Lake were analyzed. Table 12, below, identifies each plan. Bull Shoals is the only project where the existing main turbines can be used to make the proposed minimum flows releases and generate power. Each plan was evaluated based on economic impacts to recreation, hydropower, and flood control; Table 13 is a summary of economic impacts by plan.

The plans discussed in detail, see Section V, Final Array of Plans, are plans that meet the WRDA requirements to be economically justified, technically sound, environmentally acceptable, with minimal impact to existing uses.

TABLE 12: Bull Shoals Plan Identification

LAKE	REALLOCATION SCENARIO	RELEASE METHOD	PLAN ID
BULL SHOALS	FLOOD POOL	SIPHON & SS UNITS	BS1
	FLOOD POOL	NEW SS UNIT	BS 2
	FLOOD POOL	MAIN TURBINE	BS 3
	FLOOD POOL	SIPHON ONLY	BS 4
	CON. POOL	SIPHON & SS UNITS	BS 5
	CON. POOL	NEW SS UNIT	BS 6
	CON. POOL	MAIN TURBINE	BS 7
	CON. POOL	SIPHON ONLY	BS 8
	50/50	SIPHON & SS UNITS	BS 9
	50/50	NEW SS UNIT	BS 10
	50/50	MAIN TURBINE	BS 11
	50/50	SIPHON ONLY	BS12

TABLE 13: Bull Shoals Summary

Bull Shoals Summary*

Flood Pool Reallocation	First Costs	Annual Costs[3]	Hydropower Benefits	% Change of Hydro Benefits	Flood Benefits[2]	Tailwater & In-Pool Rec. Benefits	Total Annual Benefits	Net Benefits	B/C Ratio
BS1	$ 1,714,000	$ 104,000	$ (2,350,000)	-4.6%	$ (79,000)	$ 2,860,000	$ 431,000	**$ 327,000**	**4.14**
BS2	$ 12,991,000	$ 782,000	$ (793,000)	-1.6%	$ (79,000)	$ 2,860,000	$ 1,988,000	**$ 1,206,000**	**2.54**
BS3[1]	$ 462,000	$ 28,000	$ (797,000)	-1.6%	$ (79,000)	$ 2,860,000	$ 1,984,000	**$ 1,956,000**	**70.86**
BS4	$ 1,331,000	$ 81,000	$ (2,582,000)	-5.1%	$ (79,000)	$ 2,860,000	$ 199,000	**$ 118,000**	**2.46**
Conservation Pool Reallocation									
BS5	$ 1,526,000	$ 92,000	$ (3,206,000)	-6.3%	$ 12,000	$ 3,007,000	$ (187,000)	**$ (279,000)**	**(2.03)**
BS6	$ 12,803,000	$ 770,000	$ (1,484,000)	-2.9%	$ 12,000	$ 3,007,000	$ 1,535,000	**$ 765,000**	**1.99**
BS7	$ 274,000	$ 16,000	$ (1,487,000)	-2.9%	$ 12,000	$ 3,007,000	$ 1,532,000	**$ 1,516,000**	**95.75**
BS8	$ 1,143,000	$ 69,000	$ (3,435,000)	-6.8%	$ 12,000	$ 3,007,000	$ (416,000)	**$ (485,000)**	**(6.03)**
Split Pool Reallocation									
BS9	$ 1,714,000	$ 104,000	$ (2,749,000)	-5.4%	$ (28,000)	$ 2,962,000	$ 185,000	**$ 81,000**	**1.78**
BS10	$ 12,991,000	$ 782,000	$ (1,090,000)	-2.2%	$ (28,000)	$ 2,962,000	$ 1,844,000	**$ 1,062,000**	**2.36**
BS11	$ 462,000	$ 28,000	$ (1,093,000)	-2.2%	$ (28,000)	$ 2,962,000	$ 1,841,000	**$ 1,813,000**	**65.75**
BS12	$ 1,331,000	$ 81,000	$ (2,980,000)	-5.9%	$ (28,000)	$ 2,962,000	$ (46,000)	**$ (127,000)**	**(0.57)**

[1] NED Plan — *see discussion on p. 31. and note 4 below*

[2] Includes Downstream and In-Pool Flood Benefits

[3] Annual Costs are the annualized first costs and used in calculating the b/c ratio. First costs are comprised of construction costs. O&M and interest during construction will need to be computed and incorporated into the annual costs prior to implementation.

* This table summarizes the benefit and cost tables shown in Appendix A. All cost and benefit data is derived from the tables in Appendix A. All other data in this table is for information only.

d. Norfork Lake

Nine plans for implementing minimum flows at Norfork Lake were analyzed. Table 14, below, identifies each plan. Each plan was evaluated based on economic impacts to recreation, hydropower, and flood control; Table 15 is a summary of economic impacts by plan. The plans discussed in detail, see Section V, Final Array of Plans, are plans that meet the WRDA requirements to be economically justified, technically sound, environmentally acceptable, with minimal impact to existing uses.

TABLE 14: Norfork Plan Identification

LAKE	REALLOCATION SCENARIO	RELEASE METHOD	PLAN ID
NORFORK	FLOOD POOL	SIPHON & SS UNITS	NF1
	FLOOD POOL	NEW SS UNIT	NF2
	FLOOD POOL	SIPHON ONLY	NF3
	CON. POOL	SIPHON & SS UNITS	NF4
	CON. POOL	NEW SS UNIT	NF5
	CON. POOL	SIPHON ONLY	NF6
	50/50	SIPHON & SS UNITS	NF7
	50/50	NEW SS UNIT	NF8
	50/50	SIPHON ONLY	NF9

TABLE 15: Norfork Summary

Norfork Lake Summary*

Flood Pool Reallocation	First Costs	Annual Costs[4]	Hydropower Benefits	% Change of Hydro Benefits	Flood Benefits[3]	Tailwater & In-Pool Rec. Benefits	Total Annual Benefits	Net Benefits	B/C Ratio
NF1	$ 3,834,000	$ 230,000	$ (153,000)	-1.2%	$ (33,000)	$ 1,242,000	$ 1,056,000	**$ 826,000**	**4.59**
NF2[2]	$ 9,788,000	$ 589,000	$ 72,000	0.6%	$ (33,000)	$ 1,242,000	$ 1,281,000	**$ 692,000**	**2.17**
NF3	$ 3,644,000	$ 219,000	$ (324,000)	-2.5%	$ (33,000)	$ 1,242,000	$ 885,000	**$ 666,000**	**4.04**
Conservation Pool Reallocation									
NF4[1]	$ 975,000	$ 58,000	$ (410,000)	-3.2%	$ 2,000	$ 1,321,000	$ 913,000	**$ 855,000**	**15.74**
NF5	$ 6,929,000	$ 417,000	$ (128,000)	-1.0%	$ 2,000	$ 1,321,000	$ 1,195,000	**$ 778,000**	**2.87**
NF6	$ 785,000	$ 47,000	$ (598,000)	-4.7%	$ 2,000	$ 1,321,000	$ 725,000	**$ 678,000**	**15.43**
Split Pool Reallocation									
NF7	$ 3,834,000	$ 230,000	$ (259,000)	-2.0%	$ (14,000)	$ 1,292,000	$ 1,019,000	**$ 789,000**	**4.43**
NF8[2]	$ 9,788,000	$ 589,000	$ (2,000)	0.0%	$ (14,000)	$ 1,292,000	$ 1,276,000	**$ 687,000**	**2.17**
NF9	$ 3,644,000	$ 219,000	$ (443,000)	-3.5%	$ (14,000)	$ 1,292,000	$ 835,000	**$ 616,000**	**3.81**

[1] NED Plan — *see discussion on p. 31, and note 4 below*

[2] Alternate Plan

[3] Includes Downstream and In-Pool Flood Benefits

[4] Annual Costs are the annualized first costs and used in calculating the b/c ratio. First costs are comprised of construction costs. O&M and interest during construction will need to be computed and incorporated into the annual costs prior to implementation.

* This table summarizes the benefit and cost tables shown in Appendix A. All cost and benefit data is derived from the tables in Appendix A. All other data in this table is for information only.

e. Greers Ferry Lake

Nine plans for implementing minimum flows at Greers Ferry Lake were analyzed. Table 16, below, identifies each plan. Each plan was evaluated based on economic impacts to recreation, hydropower, and flood control; Table 17 is a summary of economic impacts by plan. The plans discussed in detail, see Section V, Final Array of Plans, are plans that meet the WRDA requirements to be economically justified, technically sound, environmentally acceptable, with minimal impact to existing uses. There are 74 acres of property around Greers Ferry Lake that the Corps does not own or have flood easements. Any reallocation plan that requires raising the conservation pool would result in an effort to acquire easements or purchase the property. The Real Estate Plan cannot be completed until reallocation plans are finalized. Also, due to the cumulative impacts of previous and future water supply reallocations, and with regards to the possibility of negative environmental impacts resulting from raising the top of conservation pool, the most environmentally friendly reallocation plan is a conservation pool reallocation.

TABLE 16: Greers Ferry Plan Identification

LAKE	REALLOCATION SCENARIO	RELEASE METHOD	PLAN ID
GREERS FERRY	FLOOD POOL	SIPHON & SS UNITS	GF1
	FLOOD POOL	NEW SS UNIT	GF2
	FLOOD POOL	SIPHON ONLY	GF3
	CON. POOL	SIPHON & SS UNITS	GF4
	CON. POOL	NEW SS UNIT	GF5
	CON. POOL	SIPHON ONLY	GF6
	50/50	SIPHON & SS UNITS	GF7
	50/50	NEW SS UNIT	GF8
	50/50	SIPHON ONLY	GF9

TABLE 17: Greers Ferry Summary

Flood Pool Reallocation	First Costs	Annual Costs[4]	Hydropower Benefits	% Change of Hydro Benefits	Flood Benefits[3]	Tailwater & In-Pool Rec. Benefits	Total Annual Benefits	Net Benefits	B/C Ratio
GF1	$ 1,523,000	$ 91,000	$ (82,000)	-0.6%	$ (36,000)	$ 1,149,000	$ 1,031,000	**$ 940,000**	**11.33**
GF2	$ 7,275,000	$ 438,000	$ 140,000	1.1%	$ (36,000)	$ 1,149,000	$ 1,253,000	**$ 815,000**	**2.86**
GF3	$ 1,366,000	$ 82,000	$ (188,000)	-1.4%	$ (36,000)	$ 1,149,000	$ 925,000	**$ 843,000**	**11.28**
Conservation Pool Reallocation									
GF4[1]	$ 959,000	$ 57,000	$ (228,000)	-1.8%	$ 4,000	$ 1,373,000	$ 1,149,000	**$ 1,092,000**	**20.16**
GF5[2]	$ 6,711,000	$ 404,000	$ 45,000	0.3%	$ 4,000	$ 1,373,000	$ 1,422,000	**$ 1,018,000**	**3.52**
GF6	$ 802,000	$ 48,000	$ (351,000)	-2.7%	$ 4,000	$ 1,373,000	$ 1,026,000	**$ 978,000**	**21.38**
Split Pool Reallocation									
GF7	$ 1,523,000	$ 91,000	$ (156,000)	-1.2%	$ (13,000)	$ 1,261,000	$ 1,092,000	**$ 1,001,000**	**12.00**
GF8	$ 7,275,000	$ 438,000	$ 105,000	0.8%	$ (13,000)	$ 1,261,000	$ 1,353,000	**$ 915,000**	**3.09**
GF9	$ 1,366,000	$ 82,000	$ (276,000)	-2.1%	$ (13,000)	$ 1,261,000	$ 972,000	**$ 890,000**	**11.85**

[1] NED Plan — *see discussion on p. 31. and note 4 below*

[2] Alternate Plan

[3] Includes Downstream and In-Pool Flood Benefits

[4] Annual Costs are the annualized first costs and used in calculating the b/c ratio. First costs are comprised of construction costs. O&M and interest during construction will need to be computed and incorporated into the annual costs prior to implementation.

* This table summarizes the benefit and cost tables shown in Appendix A. All cost and benefit data is derived from the tables in Appendix A. All other data in this table is for information only.

V. Final Array of Plans

WRDA directed the Corps to determine whether the minimum flow reallocations and modifications would adversely affect other authorized purposes. To carry out this purpose, we identified reallocation and release scenarios that meet the minimum flows criteria in a manner that is economically advantageous and minimizes impacts to the flood control, recreation, and hydropower purposes. We have determined that the NED plan for the five lakes would produce about $7 million in annual tailwater benefits. The plan would also produce some adverse economic impacts to flood control, in-pool recreation, and hydropower. If an investment is made (except at Bull Shoals) to replace the existing house generating units (Station Service, SS) with larger units capable of handling the specified minimum flows, then the adverse impacts to hydropower are ameliorated (and if automatic venting turbines are used, environmental benefits are achieved). Also, in cases where flood control storage is reallocated, maintaining SWPA's yield (HYPO), this would marginally decrease the minimum flows reliability (recall that the specified storage reallocations are not matched with the specified minimum flows releases and are not 100 percent reliable) while minimizing adverse hydropower impacts. In addition, we have found that reallocating these relatively small amounts of flood control storage does not significantly affect the projects' flood control benefits.

The following alternatives produce results that minimize adverse impacts to existing authorized users, are economically justified, technically sound, and likely to be found environmentally acceptable. Flood benefits, hydropower benefits, and recreation benefits as well as ecological impacts were used to identify these alternatives. The EIS is currently in progress; therefore the ecological impacts have not been finalized and are preliminary. No significant ecological issues are expected with any of the described plans. For comparison purposes only, Little Rock District replaced HAC's hydropower valuation numbers with SWPA's numbers in the economic justification matrix. The decision matrix with SWPA's numbers can be seen in Appendix A. The use of SWPA's numbers changes the impact to hydropower revenues, benefits, and the benefit to cost ratio. In some cases the use of SWPA's hydropower numbers change which plans are considered the NED plan and in some cases which plan is most attractive as an alternate plan.

a. Beaver Lake

The NED and alternate plans for Beaver Lake are BV4 and BV5, respectively. When SWPA's numbers are used instead of HAC's numbers, there is no change in the NED plan or the alternate plan.

BV4, Siphon and existing SS unit with a conservation pool reallocation, reduces hydropower benefits by 0.4 percent (**using Corps hydropower numbers**) and improves flood control benefits. The benefit to cost ratio for BV4 is 6.3 to 1.0, and it would be considered the National Economic Development (NED) plan. First costs for implementation are $827,000. There are no environmental concerns with this

plan. The minimum flows operation at Beaver Lake would improve eight miles of trout fishery with an annual improvement to the trout fishing industry of $364,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For BV4 hydropower benefits are reduced 4.0 percent and the benefit to cost ratio is –3.52 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

BV5, new SS unit with a conservation pool reallocation, improves hydropower benefits by 0.7 percent (**using Corps hydropower numbers**) and improves flood control benefits. The benefit to cost ratio for BV5 is 1.35 to 1.0. First costs for implementation are $5,615,000. There are no environmental concerns with this plan. The minimum flows operation at Beaver Lake would improve eight miles of trout fishery with an annual improvement to the trout fishing industry of $364,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For BV5 hydropower benefits are reduced 3.1 percent and the benefit to cost ratio is -0.17 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

b. <u>Table Rock Lake</u>

The NED and alternate plans for Table Rock Lake are TR5, and TR8. When SWPA's numbers are used instead of HAC's numbers the NED plan is TR1, and the most likely alternative plan is TR2.

TR5, new SS units with a conservation pool reallocation, reduces hydropower benefits by 0.5 percent (**using Corps hydropower numbers**), improves flood control benefits, and improves in-pool recreation benefits. The benefit to cost ratio for TR5 is 1.34 to 1.0, and it is considered the NED plan. First costs for implementation are $10,678,000. There are no environmental concerns with this plan. The minimum flows operation at Table Rock Lake would improve 22 miles of trout fishery with an annual improvement to the trout fishing industry of $1,000,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For TR5 hydropower benefits are reduced 4.3 percent and the benefit to cost ratio is –0.59 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

TR8, new SS units with a 50/50 reallocation, reduces hydropower benefits by 0.3 percent (**using Corps hydropower numbers**), decreases flood control benefits, and decreases in-pool recreation benefits. The benefit to cost ratio for TR8 is 1.2 to 1.0. For a 50/50 reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $15,841,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $11,643,000. There are no environmental concerns with this plan. The minimum flows operation at Table Rock Lake would improve 22 miles of trout fishery with an annual improvement to the trout fishing industry of $1,000,000. For comparison only, Little Rock District is

showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For TR8 hydropower benefits are reduced 1.8 percent and the benefit to cost ratio is 0.51 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

TR1, Siphon & existing Station Service Unit and flood pool reallocation, reduces hydropower benefits 1.7 percent (**using Corps hydropower numbers**), decreases flood control benefits, and decreases in-pool recreation benefits. The benefit to cost ratio for TR1 is 2.0 to 1.0. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $31,681,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $2,727,000. There are no environmental concerns with this plan. The minimum flows operation at Table Rock Lake would improve 22 miles of trout fishery with an annual improvement to the trout fishing industry of $1,000,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For TR1 hydropower benefits are reduced 0.9 percent and the benefit to cost ratio is 3.4 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

TR2, new Station Service Unit with a flood pool reallocation, reduces hydropower benefits 0.3 percent (**using Corps hydropower numbers**), decreases flood control benefits, and decreases in-pool recreation benefits. The benefit to cost ratio for TR2 is 1.08 to 1.0. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $31,681,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $11,643,000. There are no environmental concerns with this plan. The minimum flows operation at Table Rock Lake would improve 22 miles of trout fishery with an annual improvement to the trout fishing industry of $1,000,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For TR2 hydropower benefits are not affected (0.0 percent change) and the benefit to cost ratio is 1.24 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

c. <u>Bull Shoals Lake</u>

The NED plan for Bull Shoals Lake is BS3. BS3 is still the best plan using SWPA's hydropower values. No alternate plan was chosen for Bull Shoals. The NED plan represents the plan most likely to be accepted by the non-federal sponsor and stakeholders due to its low hydropower losses, relative to other plans, and its low first costs. All other plans have greater hydropower losses and/or greater annual costs that reduce the benefit to cost ratio to a fraction of the NED plans benefit to cost ratio.

BS3, main turbine with a flood pool reallocation, reduces hydropower benefits by 1.6 percent **(using Corps hydropower numbers)**, an approximate reduction in flood

control benefits of 1 percent, and reduces in-pool recreation benefits. The benefit to cost ratio for BS3 is 70.9 to 1.0, and it is considered the NED plan. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $21,693,000. This cost is not included in the economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $462,000. There are no environmental concerns with this plan. The minimum flows operation at Bull Shoals Lake would improve 66 miles of trout fishery with an annual improvement to the trout fishing industry of $2,999,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For BS3 hydropower benefits are reduced 0.7 percent and the benefit to cost ratio is 86.4 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

d. <u>Norfork Lake</u>

The NED and alternate plans for Norfork Lake are NF2, NF4, and NF8. When SWPA's hydropower numbers are used instead of HAC's hydropower numbers the NED plan is NF1, and the most likely alternative plan is NF2.

NF4, existing SS unit and siphon with a conservation pool reallocation, reduces hydropower benefits by 3.2 percent **(using Corps hydropower numbers)**, improves flood control benefits, and improves in pool recreation benefits. The benefit to cost ratio for NF4 is 15.7 to 1.0, and it is considered the NED plan. First costs for implementation are $975,000. There are no environmental concerns with this plan. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For NF4 hydropower benefits are reduced 9.2 percent and the benefit to cost ratio is 2.7 to 1.0. SWPA's hydropower evaluation for all plans studied is shown in Appendix A.

NF2, new SS unit with a flood pool reallocation, improves hydropower benefits by 0.6 percent **(using Corps hydropower numbers)**, reduces flood control benefits, and reduces in pool recreation benefits. The benefit to cost ratio for NF2 is 2.2 to 1.0. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $11,576,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $9,788,000. There are no environmental concerns with this plan. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For NF2 there is no impact to hydropower benefits and the benefit to cost ratio is 2.1 to 1.0.

NF8, new SS unit with a 50/50 reallocation, has no impact to hydropower benefits **(using Corps hydropower numbers)**, reduces flood control benefits, and reduces in pool recreation benefits. The benefit to cost ratio for NF2 is 2.2 to 1.0. For a 50/50 reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $5,788,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $9,788,000. There are no environmental concerns with this plan. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For NF8 hydropower benefits are reduced 3.2 percent and the benefit to cost ratio is 1.49 to 1.0.

NF1, Siphon and existing Station Service Unit with a flood pool reallocation, reduces hydropower benefits 1.2 percent **(using Corps hydropower numbers)**, reduces flood control benefits, and reduces in pool recreation benefits. The benefit to cost ratio for NF1 is 4.6 to 1.0. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $11,576,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $3,834,000. There are no environmental concerns with this plan. The minimum flows operation at Norfork Lake would improve 29 miles of trout fishery with an annual improvement to the trout fishing industry of $1,318,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For NF1 hydropower benefits are reduced 1.4 percent and the benefit to cost ratio is 4.5 to 1.0.

e. <u>Greers Ferry Lake</u>

The NED and alternate plans for Greers Ferry Lake are GF4, and GF5. When SWPA's hydropower numbers are used instead of HAC's hydropower numbers the NED plan is GF1, and the most likely alternative plan is GF2.

GF4, existing SS unit and siphon with a conservation pool reallocation, reduces hydropower benefits by 1.8 percent **(using Corps hydropower numbers)**, improves flood control benefits, and improves in pool recreation benefits. The benefit to cost ratio for GF4 is 20.2 to 1.0, and it is considered the NED plan. First costs for implementation are $959,000. There are no environmental concerns with this plan. The minimum flows operation at Greers Ferry Lake would improve 30 miles of trout fishery with an annual improvement to the trout fishing industry of $1,363,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For GF4 hydropower benefits are reduced 8.7 percent and the benefit to cost ratio is 4.3 to 1.0.

GF5, new SS unit with a conservation pool reallocation, improves hydropower benefits by 0.3 percent **(using Corps hydropower numbers)**, improves flood control benefits, and improves in pool recreation benefits. The benefit to cost ratio for GF5 is 3.5 to 1.0. First costs for implementation are $6,711,000. There are no environmental concerns with this plan. The minimum flows operation at Greers Ferry Lake would improve 30 miles of trout fishery with an annual improvement to the trout fishing industry of $1,363,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For GF5 hydropower benefits are reduced 7.2 percent and the benefit to cost ratio is 1.08 to 1.0.

GF1, Siphon and existing SS Unit with a flood pool reallocation, reduces hydropower benefits 0.6 percent **(using Corps hydropower numbers)**, reduces flood control benefits, and reduces in pool recreation benefits. The benefit to cost ratio for GF1 is 11.3 to 1.0. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $7,280,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $1,523,000. There are no environmental concerns with this plan. The minimum flows operation at Greers Ferry Lake would improve 30 miles of trout fishery with an annual improvement to the trout fishing industry of $1,363,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For GF1 hydropower benefits are reduced 1.1 percent and the benefit to cost ratio is 10.7 to 1.0.

GF2, new Station Service Unit with a flood pool reallocation, increases hydropower benefits 1.1 percent **(using Corps hydropower numbers)**, reduces flood control benefits, and reduces in pool recreation benefits. The benefit to cost ratio for GF2 is 2.9 to 1.0. For a flood pool reallocation the construction costs needed to relocate roads, bridges, and park facilities is estimated to be approximately $7,280,000. This cost is not included in the Economic analysis but is included in order to identify impacts to existing lake uses. First costs for implementation are $7,275,000. There are no environmental concerns with this plan. The minimum flows operation at Greers Ferry Lake would improve 30 miles of trout fishery with an annual improvement to the trout fishing industry of $1,363,000. For comparison only, Little Rock District is showing hydropower impacts and benefit to cost ratio using SWPA's hydropower evaluation. For GF2 hydropower benefits are increased 0.1 percent and the benefit to cost ratio is 2.6 to 1.0.

VI. Implementation and Cost Apportionment

WRDA 1999 and 2000 authorized the Secretary to provide minimum flows necessary to sustain tailwater trout fisheries by reallocating project storage. The reallocation and release scenarios studied result in significant ecological improvement to the cold-water fishery not only to trout but to all the aquatic species inhabiting the affected rivers, as well as provide benefits to the trout fishing recreation industry. WRDA instructed the

Corps to identify any Federal costs incurred, but did not provide guidance on cost sharing, project purposes, and cost of storage.

a. Storage Costs

Paragraph h of section II defines actual and updated storage costs. The difference between actual and updated cost of storage is the dollar amount of joint-use project costs that is used to calculate the cost of storage. Actual cost of storage uses the projects joint-use project cost from the final cost allocation reports, which were finalized in the early 1970's. Updated cost of storage uses joint-use project costs that have been inflated to present day values. When cost of storage is calculated, it is primarily based on the joint-use project costs and the percentage of water that is going to be reallocated out of the usable storage in the reservoir. Southwestern Power Administration is paying the actual cost of storage. Tables 18 and 19 detail the actual and updated annual cost of storage as well as the cost sharing responsibilities for recreation and ecosystem restoration, respectively.

TABLE 18: Federal and Non-Federal Cost Sharing Amounts, Actual Storage Costs

Reservoir	Annual Cost of Storage	Cost Apportionment Actual Costs		
	Actual Costs[1]	50% Fed/Non Fed	65% Federal	35% Non-Federal
Beaver Lake				
-Conservation Pool Reallocation	$ 31,000	$ 15,500	$ 20,150	$ 10,850
-Flood Pool Reallocation	41,000	20,500	26,650	14,350
-50/50 Pool Reallocation	36,000	18,000	23,400	12,600
Table Rock Lake				
-Conservation Pool Reallocation	$ 41,000	$ 20,500	$ 26,650	$ 14,350
-Flood Pool Reallocation	52,000	26,000	33,800	18,200
-50/50 Pool Reallocation	46,000	23,000	29,900	16,100
Bull Shoals Lake				
-Conservation Pool Reallocation	$ 90,000	$ 45,000	$ 58,500	$ 31,500
-Flood Pool Reallocation	107,000	53,500	69,550	37,450
-50/50 Pool Reallocation	98,000	49,000	63,700	34,300
Norfork Lake				
-Conservation Pool Reallocation	$ 35,000	$ 17,500	$ 22,750	$ 12,250
-Flood Pool Reallocation	47,000	23,500	30,550	16,450
-50/50 Pool Reallocation	40,000	20,000	26,000	14,000
Greers Ferry Lake				
-Conservation Pool Reallocation	$ 63,000	$ 31,500	$ 40,950	$ 22,050
-Flood Pool Reallocation	72,000	36,000	46,800	25,200
-50/50 Pool Reallocation	67,000	33,500	43,550	23,450

[1] Actual costs are sunk costs.

TABLE 19: Federal and Non-Federal Cost Sharing Amounts, Updated Storage Costs

Reservoir	Annual Cost of Storage Updated Costs	Cost Apportionment Updated Costs 50% Fed/Non Fed	65% Federal	35% Non-Federal
Beaver Lake				
-Conservation Pool Reallocation	$ 276,000	$ 138,000	$ 179,400	$ 96,600
-Flood Pool Reallocation	366,000	183,000	237,900	128,100
-50/50 Pool Reallocation	321,000	160,500	208,650	112,350
Table Rock Lake				
-Conservation Pool Reallocation	$ 554,000	$ 277,000	$ 360,100	$ 193,900
-Flood Pool Reallocation	699,000	349,500	454,350	244,650
-50/50 Pool Reallocation	623,000	311,500	404,950	218,050
Bull Shoals Lake				
-Conservation Pool Reallocation	$ 1,200,000	$ 600,000	$ 780,000	$ 420,000
-Flood Pool Reallocation	1,430,000	715,000	929,500	500,500
-50/50 Pool Reallocation	1,309,000	654,500	850,850	458,150
Norfork Lake				
-Conservation Pool Reallocation	$ 472,000	$ 236,000	$ 306,800	$ 165,200
-Flood Pool Reallocation	635,000	317,500	412,750	222,250
-50/50 Pool Reallocation	550,000	275,000	357,500	192,500
Greers Ferry Lake				
-Conservation Pool Reallocation	$ 683,000	$ 341,500	$ 443,950	$ 239,050
-Flood Pool Reallocation	785,000	392,500	510,250	274,750
-50/50 Pool Reallocation	732,000	366,000	475,800	256,200

b. <u>Hydropower Revenues Foregone</u>

When the Corps reallocates storage for municipal and industrial water supply the water supply user pays the higher of hydropower benefits foregone, hydropower revenues foregone, hydropower replacement cost, flood control benefits foregone, or the updated cost of storage, Little Rock District projects are usually governed by the updated cost of storage. Hydropower revenues foregone are based on the current rates of the marketing agency, which in the case of White River Minimum Flows is the Southwestern Power Administration (SWPA). At the time that the Hydropower Analysis Center wrote its report, *White River Basin Projects White River, Arkansas and Missouri, White River Minimum Flow Study, Power Benefits Foregone Due To Storage Reallocation, August 2003,* the rates that were in effect were from 01 January 2002 and were:

Energy Charge: 7.00 mill/kWh
Capacity Charge: $30.72/kW-year

The energy charge would be applied to the average annual energy losses and the capacity charge would be applied to the loss in marketable capacity. The first value, energy charge, is the charge applied to the annual energy losses from the reallocation of storage. The second value, capacity charge, is applied to the capacity losses the

power marketing agency experiences from the reallocation. Table 20 details the revenue losses at each project.

Cost of storage is charged to recover possible losses to hydropower. In addition, the power marketing agency (PMA) can also receive a credit from the Treasury when Federal power delivery contracts require market purchases of power as a result of storage reallocations and withdrawals (ER 1105-2-100, Appendix E, E-57, pg. E-220). Should be noted that there is no way to reduce hydropower's costs absent revenue to the US Treasury from a cost-sharing sponsor or from specific legislation.

Table 20: Hydropower Revenues Foregone and PMA Credit

Reservoir	Revenues Foregone Due To Storage Reallocation (Annual $'s)		
	Energy Revenue Foregone	Capacity Revenue Foregone	Total Revenue Foregone
Beaver Lake			
-Conservation Pool Reallocation	$ 41,588	$ 1,031	$ 42,619
-Flood Pool Reallocation	48,771	1,031	49,802
-50/50 Pool Reallocation	40,605	1,031	41,636
Table Rock Lake			
-Conservation Pool Reallocation	$ 156,832	$ 668,364	$ 825,196
-Flood Pool Reallocation	131,865	170,941	302,806
-50/50 Pool Reallocation	137,959	460,141	598,100
Bull Shoals Lake			
-Conservation Pool Reallocation	$ 401,111	$ 1,119,283	$ 1,520,394
-Flood Pool Reallocation	278,542	882,706	1,161,248
-50/50 Pool Reallocation	337,576	986,640	1,324,216
Norfork Lake			
-Conservation Pool Reallocation	$ 93,536	$ 20,309	$ 113,845
-Flood Pool Reallocation	58,092	(26,674)	31,418
-50/50 Pool Reallocation	73,015	2,252	75,267
Greers Ferry Lake			
-Conservation Pool Reallocation	$ 81,883	$ 8,728	$ 90,611
-Flood Pool Reallocation	66,277	(813)	65,464
-50/50 Pool Reallocation	45,475	(3,624)	41,851

If this report results in an implementation plan for White River Minimum Flows reallocation and operation, the construction costs necessary to meet the Minimum Flows criteria must be cost shared. A case can be made, based on on-going NEPA analysis, that this project is environmental in nature and be identified as an Ecosystem Restoration project as defined by ER 1105-2-100, pg F-17, sec F-19 a. An Ecosystem Restoration project is cost shared 65 percent federally and 35 percent non-federally. It could also be considered a recreation project resulting in a 50 percent Federal, 50 percent Non-Federal cost share due to the artificial cold-water fishery is not a natural riverine environment within the project area, and the trout stocked in the rivers are

non-native species (brown trout are native to Europe and Asia; rainbow and cutthroat trout are native to the western U.S.) The purpose of ecosystem restoration projects, as defined in ER 1165-2-501, is to restore significant ecosystem functions, structures and dynamic processes that have been degraded. Since trout are a non-native species, improvements for trout fishery could be classified and cost-shared as Recreation. However, the Arkansas Game and Fish Commission, Missouri Department of Conservation, and the Nature Conservancy maintain significant environmental impacts indicate ecosystem restoration. See Section IV. Environmental Summary, for ecological impacts resulting from proposed minimum flows.

c. <u>OMRR&R</u>

OMRR&R is operation, maintenance, repair, rehabilitation, and replacement costs. OMRR&R costs were not calculated and will need to be computed and included in the annual costs prior to implementation.

d. <u>Project Purpose</u>

1. <u>Recreation</u>

Implementation of Minimum Flows could be viewed as recreation because the majority of the project benefits stem from recreational fishing. There is no way to restore the original environment and therefore the existing fishery represents a recreational project rather than an environmental restoration project.

2. <u>Restoration</u>

Implementation of the project could be viewed as restoration because this project is environmental in nature as defined by ER 1105-2-100, pg F-17, sec F-19.a. The cold-water fishery in the tailwaters is not a natural riverine environment within the project area, and the trout stocked in the rivers are non-native species (brown trout are native to Europe and Asia; rainbow and cutthroat trout are native to the western U.S.) The purpose of ecosystem restoration projects, as defined in ER 1165-2-501, is to restore significant ecosystem functions, structures and dynamic processes that have been degraded. The original attempts to establish a cold-water fishery failed to include minimum flows. If the Corps were to construct a dam today minimum flows would be part of the mitigation plan.

3. <u>Mitigation</u>

The State considers White River Minimum Flows to be mitigation instead of restoration and should be fully federally funded. However, Corps policy and legal opinion is that this is not mitigation and not an option for consideration in the absence of legislation declaring the purpose of this project to be mitigation for damage to the lost warm water fishery

e. Cost Sharing

If White River Minimum Flows is implemented, all facility modifications must be cost shared between the Federal Government and a Non-Federal Sponsor. Table 21 details the implementation costs and identifies the Federal and Non-Federal shares.

Table 21: Federal and Non-Federal Implementation Cost Share

Plan Identification	Implementation First Costs	50% Federal & NonFederal Cost Share	65% Federal Cost Share	35% NonFederal Cost Share
BV4	$ 827,000	$ 413,500	$ 537,550	$ 289,450
BV5	5,615,000	2,807,500	3,649,750	1,965,250
TR5	10,678,000	5,339,000	6,940,700	3,737,300
TR8	11,643,000	5,821,500	7,567,950	4,075,050
BS3	462,000	231,000	300,300	161,700
NF2	9,788,000	4,894,000	6,362,200	3,425,800
NF4	975,000	487,500	633,750	341,250
NF8	9,788,000	4,894,000	6,362,200	3,425,800
GF4	959,000	479,500	623,350	335,650
GF5	6,711,000	3,355,500	4,362,150	2,348,850

VII. Locally Preferred Plan

a. Potential Sponsor View

The preferred plans for the Arkansas lakes are consistent with the States' belief that fish and wildlife impacts have never been appropriately mitigated. The AG&FC believes the public will benefit through a minimum flow operation more so than what is being experienced under the project's current operation. The excerpts below constitute AG&FC's preferred options:

1. AG&FC prefers, "the listed National Economic Development (NED) plan for each of the Arkansas projects: Beaver, Bull Shoals, Norfork and Greers Ferry. We agree with the Little Rock District Corps of Engineers' findings that the NED plans provide the best solutions for implementing the minimum flow plan. These outcomes will result in only slight or modest impacts to hydropower, flood control and in-lake recreation while implementing minimum flow under the lowest costs".

2. It is AG&FC's position, "that the cost of storage should be a federal responsibility and that the local sponsor, the Arkansas Game and Fish Commission, should not pay any cost of storage. As Congressman John Boozman highlighted in his letter to the Corps on July 15, 2003, the purpose of Section 374 of WRDA 1999 was to partially mitigate losses associated with construction of the dams by providing a more stable aquatic environment. Furthermore, we would argue that incremental changes in flow as a result of evolving power demands over the past few decades

have further deteriorated the in-stream ecosystems. Thus, any restoration costs should be a federal responsibility borne as a benefit to the nation".

3. As mentioned above, AG&FC, "view this project as appropriate mitigation for the loss of habitat to support a native fishery. We believe any implementation costs should be at 100 percent federal expense".

4. AG&FC recognizes, "that the preferred option for Bull Shoals Lake may impact some lake facilities. However, we believe that any decision to relocate facilities should be based on a more in-depth evaluation of actual, real-time loss of use. We will work with the SWL to identify these facilities as part of a monitoring process once minimum flows are implemented".

5. The interim report mentions a credit to the marketing agency in order to reduce their liability to the federal government for loss of storage. AG&FC, "fully support this position".

A copy of the AG&FC's comments concerning the Locally Preferred Plans is in Appendix E. At this time Missouri has not expressed a Locally Preferred Plan for Table Rock Lake.

b. <u>Southwestern Power Administration View</u>

The excerpts below constitute Southwestern Power Administration's Views preferred options:

The Southwestern Power Administration (Southwestern), an agency of the Department of Energy, is authorized by Section 5 of the Flood Control Act of 1944 to market the electricity produced at the U.S. Army Corps of Engineers (Corps) hydropower projects in a six-state area to public bodies, mostly rural electric cooperatives and municipalities, at cost-based rates designed to repay to the U.S. Treasury all the costs associated with the hydropower production, including a joint-use portion of the original investment, with interest, the operation and maintenance expenses, and all specific hydropower costs. Southwestern markets power from 24 projects located in four states. The five Corps hydropower projects in the White River basin account for more than 30 percent of the energy and nearly 40 percent of the capacity Southwestern markets. Output from those projects account for more than one-third of the average annual revenues Southwestern deposits in the U.S. Treasury from all generating resources. The electricity's value comes from its reliability. The reliability comes from the availability of the very water storage that is being considered for reallocation. Of the 17 reservoirs that Southwestern markets as a system, 57 percent of the total hydropower storage is located in those five White River projects. A loss of that water storage will negatively impact the reliability and marketability of the electricity. Any loss of electrical energy and capacity from the projects will have to be taken from our current customers, mostly rural farmers and communities suffering from the current difficult economic situation, and force them to

pay higher electrical rates. Since all of the water storage in the five projects is already allocated to an authorized purpose and since those purposes are already fully utilizing that water storage to maximize the benefits to their purpose, any reallocation of the water storage for another purpose will have to come at an expense to an existing authorized purpose. Therefore, Southwestern believes that the beneficiary of any reallocated storage should provide compensation for the expenses involved and the benefits foregone by the other project purposes. As such, Southwestern believes it should not be required to continue recovering expenses in its rates for benefits its customers would no longer receive if a portion of its water storage were reallocated. Any reallocation from the projects' conservation storage would result in an electrical capacity loss, likely a significant loss, and could lead to a de-allocation of power to our customers, ultimately impacting six million end-users in six states. A storage reallocation from the flood control pool at the projects with an effort to maintain the hydropower water storage yield would result in only energy losses to the hydropower purpose and thus have less impact than any other form of storage reallocation.

Southwestern has several specific concerns with the draft report based on the portions of earlier versions that it was allowed to review. Southwestern does not agree with the Corps' method of computing the electrical capacity lost from the proposed reallocations. The Corps uses an average year method. Southwestern, which is by law responsible for marketing the electricity, determines the marketable capacity based on the critical drought period - in order to assure reliability. Most of the alternatives considered will cause severe capacity loss. The Corps also values the energy portion at a rate lower than Southwestern can purchase it for in the market. The Corps does not appear to distinguish between the more valuable on-peak energy and the less valuable off-peak energy in their study. Additionally, the Corps' downstream recreational benefits to be derived from the proposed reallocation appear to be considerably over-estimated based on Southwestern's review. It appears that most of the proposed alternatives would not be in accordance with PL 104-303, Section 304, that states, "recreation and fish and wildlife…purposes do not adversely affect flood control, power generation, or other authorized purposes of the project."