ENVIRONMENTAL ASSESSMENT

WATER REALLOCATION PROJECT
AT HULAH LAKE
AND COPAN LAKE, OKLAHOMA

US Army Corps
Of Engineers
Tulsa District

ENVIRONMENTAL ASSESSMENT ORGANIZATION

This environmental assessment (EA) evaluates the environmental effects of the U.S. Army Corps of Engineers, Tulsa District's proposed action to reallocate water supply storage at Hulah Lake and Copan Lake, Oklahoma. This EA will facilitate the decision process regarding the proposed action and alternatives.

SECTION 1 *PURPOSE, NEED, AND SCOPE* summarizes the purpose of and need for the proposed action, provides relevant background information, and describes the scope of the EA.

SECTION 2 *ALTERNATIVES* examines the alternatives for implementing the proposed action.

SECTION 3 *PROPOSED ACTION* describes the recommended action.

SECTION 4 *AFFECTED ENVIRONMENT* describes the existing environmental and socioeconomic setting.

SECTION 5 *ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION* identifies the potential environmental and socioeconomic effects of implementing the proposed action and alternatives.

SECTION 6 *MITIGATION PLAN* summarizes mitigation actions required to enable a Finding of No Significant Impact for the proposed alternative.

SECTION 7 *FEDERAL, STATE, AND LOCAL AGENCY COORDINATION* provides a listing of individuals and agencies consulted during preparation of the EA.

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FINDING OF NO SIGNIFICANT IMPACT

WATER REALLOCATION PROJECT AT HULAH LAKE AND COPAN LAKE, OKLAHOMA

In accordance with the National Environmental Policy Act of 1969, the U.S. Army Corps of Engineers Tulsa District has assessed the environmental impacts of the reallocation of all available water quality storage at Hulah and Copan Lakes to the city of Bartlesville, Oklahoma. Available water is that which exceeds current usage and is not currently under contract. After considering dredging, changes in system operation, groundwater sources, and other reservoirs as possible alternative sources of water, reallocation of water from Hulah and Copan Lakes was deemed the only viable alternative to increase Bartlesville's available water supply, and the impacts of this action were analyzed. Several different reallocation scenarios were considered. The proposed action would ensure a dependable supply of at least 12 million gallons per day for the city of Bartlesville through 2035.

The enclosed environmental assessment was prepared in accordance with U.S. Army Corps of Engineers regulations, 33 *Code of Federal Regulations*, Part 230, *Policy and Procedures for Implementing the National Environmental Policy Act*. After analyzing the resources that could potentially be significantly impacted by the proposed action, it has been determined that there would be only minor adverse impacts on aquatic habitat and biological productivity as a result of the reallocation and distribution of reservoir water to the city of Bartlesville. Because the proposed action will have no significant adverse effect on the natural or human environment, an environmental impact statement will not be prepared.

26 APR 06
Date

MIROSLAV P. KURKA
Colonel, U.S. Army
District Engineer

Enclosure: Environmental Assessment

ENVIRONMENTAL ASSESSMENT OF THE WATER REALLOCATION PROJECT AT HULAH LAKE AND COPAN LAKE, OKLAHOMA

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Contract No.: 4600003237
Delivery Order No.: 03-69FC
e²M Project No.: 1050-007

MAY 2006

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ABBREVIATIONS AND ACRONYMS

°F	degrees Fahrenheit
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
DEQ	Department of Environmental Quality
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ER	Engineering Regulation
FONSI	Finding of No Significant Impact
mgd	million gallons per day
MSL	mean sea level
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
ODWC	Oklahoma Department of Wildlife Conservation
SUPER model	Southwestern Division Modeling System for the Simulation of the Regulation of a Multipurpose Reservoir System
USC	United States Code
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

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1. Purpose, Need, and Scope

1.1 Introduction

This environmental assessment (EA) presents potential impacts associated with reallocating water supply in Hulah and Copan lakes in northern Oklahoma. Hulah Lake is on the Caney River, a tributary of the Verdigris River, about 15 miles northwest of the city of Bartlesville in Osage County, Oklahoma. Hulah Lake receives water from the approximately 732-square-mile drainage area of the Caney River (USACE 1983, 1996a, 1996b, 1999). Hulah Lake has a flood control storage capacity of 257,900 acre-feet and a conservation storage capacity of 22,553 acre-feet, including 16,600 acre-feet for water supply, 5,953 acre-feet for water quality, and 12 acre-feet for sediment reserve (USACE 1999, 2005c).

Copan Lake is on the Little Caney River, a tributary of the Caney River, about 2 miles west of the town of Copan and about 9 miles north of the city of Bartlesville, in Washington County, Oklahoma (figure 1). Copan Lake receives drainage from approximately 505 square miles of the drainage area of the Little Caney River (USACE 1983, 1996a, 1996b, 1999). Copan Lake has a flood control storage capacity of 184,300 acre-feet and a conservation storage capacity of 33,887 acre-feet, including 7,500 acre-feet for water supply, 26,100 acre-feet for water quality, and 287 acre-feet for sediment reserve (based on a 2002 survey by the USACE).

1.2 Purpose of and Need for the Proposed Action

The U.S. Army Corps of Engineers (USACE) is proposing to reallocate water quality storage in Hulah and Copan Lakes to provide an adequate water supply for the city of Bartlesville, Oklahoma to meet future demands. The city of Bartlesville has estimated average future water demands to be 10 to 12 million gallons per day (mgd), and has constructed a new 26-mgd water treatment plant designed to handle a rate about double the anticipated average water demand. The city of Bartlesville currently has combined water supply contracts with Hulah Lake for 12.34 mgd. Hulah Lake has a current yield of 9.9 mgd; however, by 2035, it is predicted that siltation will reduce the available yield to 6.4 mgd. The city of Bartlesville will have a shortfall of 5.6 mgd of water through 2035. Subsequently, the city requested that the Tulsa District investigate alternatives for increasing water supply. The proposed action is needed to meet future water supply demand for the city of Bartlesville.

1.3 Regulatory Compliance

1.3.1 National Environmental Policy Act of 1969

The National Environmental Policy Act of 1969, commonly known as NEPA, is a federal statute requiring the identification and analysis of potential environmental impacts of proposed federal actions before those actions are taken. NEPA also established the Council on Environmental Quality (CEQ) that is charged with the development of implementing regulations and ensuring agency compliance with NEPA. CEQ regulations mandate that all federal agencies use a systematic interdisciplinary approach to environmental planning and the evaluation of actions that might affect the environment. This process evaluates potential environmental consequences associated with a proposed action and considers alternative courses of action. The intent of NEPA is to protect, restore, or enhance the environment through well-informed federal decisions.

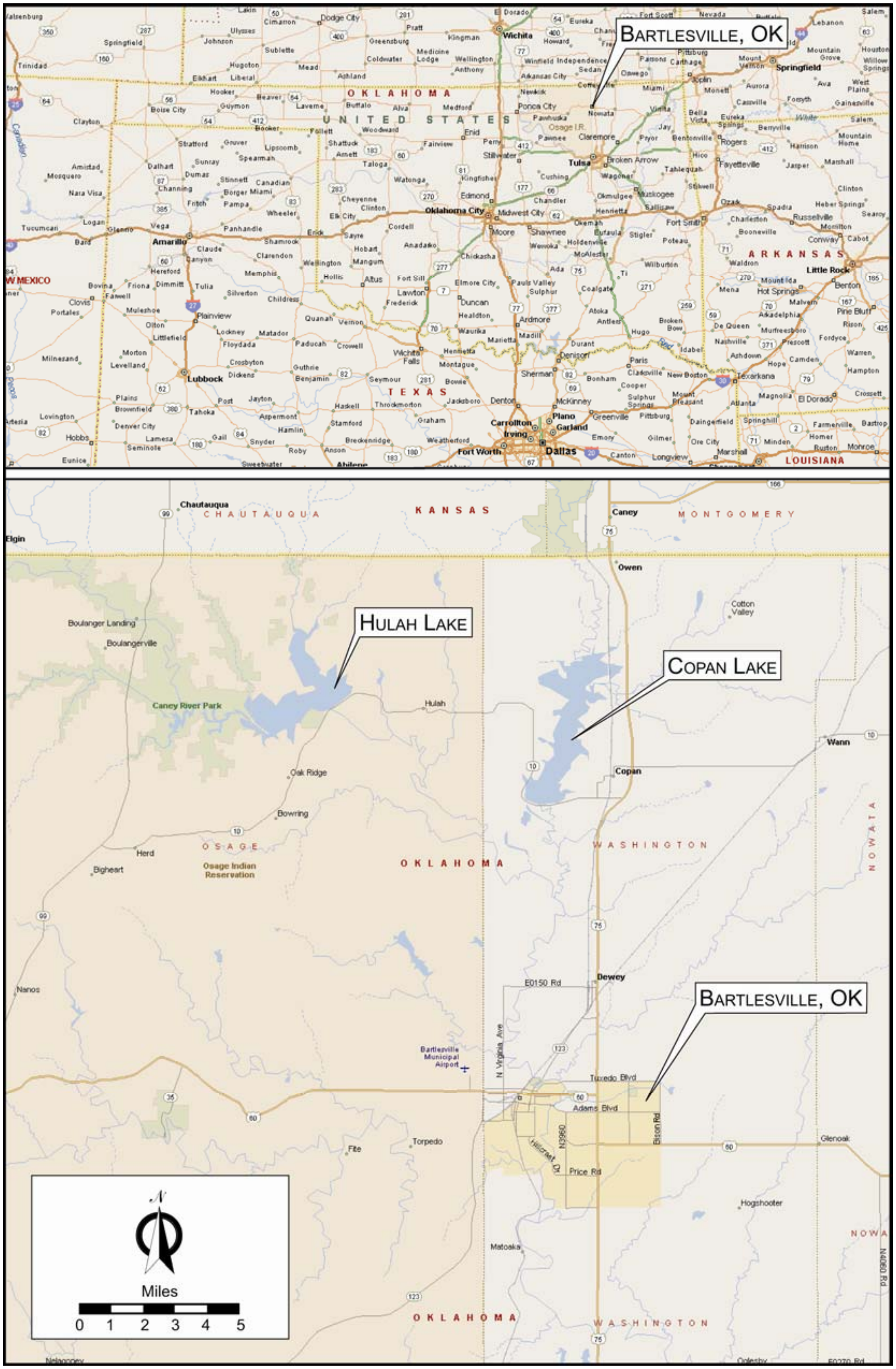

Figure 1. Vicinity Map, Hulah Lake and Copan Lake Water Reallocation Project

The process for implementing NEPA is codified in Title 40 of the *Code of Federal Regulations* (CFR) Parts 1500–1508, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*. The CEQ was established under NEPA to implement and oversee federal policy in this process. CEQ regulations specify that the following must be accomplished when preparing an EA:

- Briefly provide evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a Finding of No Significant Impact (FONSI).
- Aid in an agency's compliance with NEPA when an EIS is unnecessary.
- Facilitate preparation of an EIS when one is necessary.

This document has been prepared to comply with NEPA requirements, the CEQ regulations for implementing NEPA and Engineering Regulation (ER) 200-2-2, *Procedures for Implementing NEPA.*

1.3.2 Integration of Other Environmental Statutes and Regulations

To comply with NEPA, the planning and decision-making process for actions proposed by federal agencies involves a study of other relevant environmental statutes and regulations. The NEPA process, however, does not replace procedural or substantive requirements of other environmental statutes and regulations. It addresses them collectively in the form of an EA or EIS, which enables the decision maker to have a comprehensive view of major environmental issues and requirements associated with the proposed action. According to CEQ regulations, the requirements of NEPA must be integrated "with other planning and environmental review procedures required by law or by agency so that all such procedures run concurrently rather than consecutively." Resources that will be analyzed in the EA are those identified as being potentially affected by the proposed action, and include applicable critical elements of the human environment whose review is mandated by executive order (EO), regulation, or policy (see section 9).

1.4 Project Scoping

The Tulsa District issued a news release on August 4, 2003, announcing public information workshops for the Hulah Lake and Copan Lake water reallocation project. Paid display advertisements were published in the August 5, 17, and 19, 2003, editions of the *Bartlesville Examiner Enterprise*. The Tulsa District sent scoping and workshop announcements to state and federal resource agencies. Both the advertisement and the announcements initiated the NEPA scoping process by soliciting public input (appendix G).

The Tulsa District held a workshop on August 19, 2003 (5:00 p.m. to 8:00 p.m.), at the Bartlesville Community Center. Twenty-three persons attended the workshop, including representatives from local and state agencies, American Indian tribes, and private citizens. Several attendees suggested that not enough was being done about sedimentation in Hulah Lake, and that they were concerned about conservation storage and future dependable yield from the lake. Several attendees suggested that sediment should be dredged from Hulah Lake and transported offsite, including some that suggested it should have been dredged when it was dry. It was questioned whether or not it would be cheaper to just build a new lake. One attendee suggested that a combination of dredging and reallocation of flood control storage at Hulah Lake, coupled with the negotiation of a reasonably priced water supply storage agreement for Copan Lake (between the city of Bartlesville and the Tulsa District), could be an option. Another attendee suggested that sedimentation could be reduced by building a detention catch-pond close to Hulah Lake. The detention pond would capture floodwaters long enough for the sediment to settle out, and then the water could be discharged back to the lake.

As mentioned previously, several attendees suggested that building a new lake might be more reasonable than dredging, and some suggested that plans for constructing Sand Lake in Osage County be implemented. Other attendees suggested that an offsite storage facility be constructed to provide a 30- to 60-day water supply for the city of Bartlesville. A couple of attendees also suggested that Bardew Lake be retained and not sold because it holds a 30-day supply of water and could probably be enlarged. Finally, one attendee suggested increasing the height of the dam at Hulah Lake; several attendees suggested that the city of Bartlesville should receive more water from Copan Lake; and several attendees suggested that the city of Bartlesville should seek alternative water sources (besides Hulah Lake and Copan Lake), such as water available in the Verdigris River.

2. Alternatives

2.1 No-Action Alternative

CEQ regulations implementing the provisions of NEPA require federal agencies to consider a no-action alternative. These regulations define the no-action alternative as the continuation of existing conditions and their effects on the environment, without implementation of, or in lieu of, a proposed action. This alternative represents the existing condition and serves as the baseline against which to compare the effects of the other alternatives.

Under the no-action alternative, water reallocation in Hulah Lake and Copan Lake would not occur. With no action, existing water supply sources for the city of Bartlesville would be insufficient for meeting existing 2035 needs. The existing water supply yield for Hulah Lake is currently 9.9 mgd; however, the dependable yield for year 2035 is 6.4 mgd due to sedimentation. Hulah Lake currently has no additional water supply above what is under contract. With a 2035 water supply demand of 12 mgd, the city of Bartlesville needs additional contracts totaling approximately 5.6 mgd. The no-action alternative would be insufficient to meet future water supply demands of the city.

2.2 Action Alternatives

The USACE evaluated a number of possible scenarios to meet the purpose and needs of the proposed project while maintaining acceptable water quality and flood control storage levels (see appendix B). Requirements for the selected plan included technical soundness, economic feasibility, and environmental acceptance. The following alternatives were considered early in the planning process; however, all but one, were determined not to be viable and eliminated from further consideration.

2.2.1 Local Small Reservoir Water Sources Considered

Multiple available federal- and state-owned lakes in north-central and northeastern Oklahoma were reviewed to determine if the lakes had the capacity to meet the projected 2035 water demand. The following smaller lakes were considered to have insufficient potential for water supply yield:

- Birch Lake
- Shidler Lake
- Hudson Lake
- Big Creek Lake
- Chelsea Lake

Lakes in the Kansas region were not considered due to past difficulty in transferring water rights from one state to another.

2.2.2 Dredging Alternative

Hulah Lake has lost approximately 13,845 acre-feet of storage to sedimentation, based on 2002 storage data and is projected to lose 28,000 acre-feet of conservation storage by 2035. One option considered in the reallocation study was dredging Hulah Lake to recover storage lost to sedimentation during the life of the project.

A cost estimate for dredging Hulah Lake was prepared assuming 13,845 acre-feet of sediment would be dredged, the storage lost to date based on the 2002 sediment survey. This volume of storage equates to 22,336,600 cubic yards of material. At a cost of $4/cubic yard for dredging and transportation, dredging costs would total over $89 million dollars. Total costs could exceed this estimate if an offsite disposal option is chosen.

Dredging costs exceed the cost of constructing a reservoir with similar conservation storage. As a result, dredging was not considered as a viable alternative.

2.2.3 System Operation Alternatives

In many instances, lakes within the same drainage basin can be operated to optimize the storage and yield of downstream lakes. Hulah and Copan lakes are within the Caney River drainage basin, but Hulah Lake is on the main stem of the Caney River while Copan Lake is on the Little Caney River. Since the two lakes are on separate stems of the drainage basin, system operation to maximize storage and yield is not possible. Therefore, system operation was not considered a viable alternative.

2.2.4 Groundwater Alternative

There are no adequate groundwater sources in the Bartlesville area that could meet future water supply demands of the city. Therefore, groundwater sources were not considered a viable alternative.

2.2.5 Construction of a New Reservoir

The proposed Sand Lake reservoir was also eliminated from further consideration. The proposed Sand Lake reservoir was deauthorized in 1999 and would need new congressional approval to be considered again. The cost and time required to reauthorize the Sand Lake reservoir under the current U.S. Environmental Protection Agency (USEPA) regulations is a significant constraint. Selection of this option would require a long-term federal and local initiative to reauthorize the reservoir. There is no certainty that the reservoir would eventually be completed.

If Sand Lake was reauthorized, it would likely be a water supply lake with 100% of the costs reimbursable from the local sponsor. Reauthorization would also incur significant additional costs for ensuring adequate water quality. Other federal lake projects built in Osage County have encountered significant mineral rights mitigation requirements. It would also have to be redesigned to meet new 2005 federal environmental regulations. Existing environmental laws and Indian sovereign land rights issues would increase the cost of construction of Sand Lake. Because of these issues, the Sand Lake reservoir option was not considered a viable alternative.

2.2.6 Alternative Reservoir Water Sources

The USACE also considered five reservoirs as potential water sources. These reservoirs include

- Skiatook Lake, Osage County, Oklahoma (50 miles to reservoir)
- Grand Lake, Delaware County, Oklahoma (90 miles to reservoir)
- Kaw Lake, Kay County, Oklahoma (55 miles to reservoir)
- Oologah Lake, Rogers County, Oklahoma (50 miles to reservoir)
- Copan Lake, Washington County, Oklahoma (10 miles to reservoir)

Grand Lake was the farthest water supply source option considered. It has no water supply allocation in the conservation pool and has no provisions designed into its dam for the withdrawal of water. Using Grand Lake as a water supply source would require the construction of a water intake structure and reallocation of storage to water supply. Grand Lake was eliminated from further consideration.

Annual water costs were estimated for each of the five reservoirs. Pipeline construction cost estimates were made based on 5-mgd flow rates. The construction and annual costs for each new reservoir and pipeline were estimated and amortized over a 50-year period at 5.375%. An annual storage cost was also calculated for available water supply as well as potential reallocated water from water quality. The costs factored into developing the pipeline construction and annual costs for each reservoir alternative include

- land
- dams/intake structure
- pumping plants
- planning engineering and design
- construction management
- estimated contingencies (35%)
- available water supply
- reallocated water supply, if available

Oologah and Kaw lakes are not viable options because of high pipeline construction costs. These costs are estimated to be four and five times higher than construction pipeline costs to Copan Lake.

Skiatook Lake does not have sufficient water rights available to justify further consideration as a potential water supply source. It only has 1 mgd available for water supply and would be cost-prohibitive in addition to being insufficient to satisfy future water supply needs of the city of Bartlesville.

A pipeline from Copan Lake to Hulah Lake, if done with a reallocation of available water quality, is the most cost-effective option. Assuming the same water quality reallocation, a pipeline from Copan Lake to Lake Hudson also ranked high in the list of alternatives. Copan Lake water was not a viable option without a reallocation of the conservation pool. With only 1 mgd of available water supply, there would be insufficient water volume to justify the pipeline construction cost. Therefore, reallocation of available water in Copan and Hulah lakes was determined to be the only viable option and is the preferred action presented in sections 2.2.7 and 3.

2.2.7 Reallocation Scenarios for Hulah and Copan Lakes

Multiple reallocation scenarios for Hulah and Copan Lakes were evaluated using the Southwestern Division Modeling System for the Simulation of the Regulation of a Multipurpose Reservoir System (SUPER model) (see appendix B). Various scenarios were considered. The Report of the Water Supply Storage Reallocation Project at Hulah and Copan Lakes, Oklahoma, provides additional information on the reallocation and is included as appendix C.

Seasonal pool plan reallocations of the flood control pool, in conjunction with water quality reallocations, are considered in some of the alternatives below. Seasonal pool elevation changes were raised such that flood control reductions of 2.5%, 5.0%, and 7.5% would occur during the seasonal pool time period. Different seasonal pool plan time periods were selected to be analyzed. The time periods that were examined are

- June 1 to October 31
- May 1 to October 31
- June 1 to November 30
- May 1 to November 30

Reallocation Scenario 1

Alternative 1 would consist of reallocating all available water quality storage at Hulah and Copan lakes. This option would provide 7.20 mgd from Hulah Lake and an additional 5.54 after reallocation from Copan Lake. Total available yield for this alternative would provide 12.74 mgd of water supply.

Reallocation Scenario 2

Alternative 2 would provide for reallocation of all available water quality storage at Hulah Lake with seasonal pool raises from 733.0 feet to 734.75 feet during the May 1 to November 30 time period. This option would make no changes to the existing operation of Copan Lake. Under this alternative, 7.78 mgd would be available from Hulah Lake and an additional 0.97 mgd would be available from Copan Lake. Total available yield for this alternative would provide 8.75 mgd of water supply, which is slightly below the desired rate.

Reallocation Scenario 3

Alternative 3 would provide for reallocation of all available water quality storage at Copan Lake with seasonal pool increases of 710.0 feet to 711.0 feet from June 1 to November 30. This alternative would continue regular operation at Hulah Lake but would provide a 2.5% reduction of flood control from Copan Lake during the seasonal pool time period. This alternative would provide 6.38 mgd from Hulah Lake and 6.91 mgd from Copan Lake. This alternative would provide 13.29 mgd of water supply.

Reallocation Scenario 4

Alternative 4 would provide for reallocation of all available water quality storage plus 5% flood control reallocation from elevation 733.0 feet to 736.15 feet at Hulah Lake. There would be no changes to the Copan Lake operation. This alternative would provide 12.16 mgd from Hulah Lake and 0.97 mgd from Copan Lake. Total yield from both reservoirs from this alternative would be 13.13 mgd of water supply.

Reallocation Scenario 5

Alternative 5 would provide for reallocation of all available water quality storage at Hulah Lake with seasonal pool raises during the May 1st to November 30th time period. The conservation pool at Hulah Lake will be raised to 736.15 feet with a seasonal pool of 737.0. Hulah Lake would incur a 5% flood pool loss with the potential for an additional reduction of 1.5% during the seasonal pool time period. No reallocation is considered at Copan Lake under this alternative. This alternative would provide a combined total of 14.34 mgd of water supply.

3. Proposed Action

Reallocation of water supply in Copan and Hulah lakes under Reallocation Scenario 1 above is the most cost-effective plan. Reallocation Scenario 1 is the preferred alternative to best meet the purpose of and need for the proposed action. Therefore, the proposed action would consist of reallocating all available water quality storage at Hulah and Copan lakes. This option would provide 7.20 mgd from Hulah Lake and an additional 5.54 mgd after reallocation from Copan Lake. This option would provide 12.74 mgd of available yield and would provide sufficient water quality to continue to meet published Oklahoma Department of Environmental Quality (DEQ) guidelines, and satisfy published water quality release standards. This alternative would not alter pool management or pool elevations, both of which would increase the probability of flooding.

4. Affected Environment

Location

The Hulah Lake and Copan Lake project study area consists of the main body of the lakes as well as the lake and downstream shorelines that could be affected by the water reallocation. Hulah Lake is located on the Caney River, a tributary of the Verdigris River, about 15 miles northwest of the city of Bartlesville in Osage County, Oklahoma. Copan Lake is on the Little Caney River, a tributary of the Caney River, about 2 miles west of the town of Copan and about 9 miles north of the city of Bartlesville, in Washington County, Oklahoma (see figure 1). Hulah Lake receives runoff from the approximately 732-square-mile drainage area of the upper Caney River, while Copan Lake receives drainage from approximately 505 square miles of the drainage area of the upper Little Caney River (USACE 1983, 1996a, 1996b, 1999).

Climate

Climate data for Osage and Washington counties indicate that the climate in the project area is typified by long, hot summers and relatively moderate winters. The average summer temperature (June, July, and August) is 79.9 degrees Fahrenheit (°F). The average winter temperature (December, January, and February) is 38.1 °F. Average annual precipitation in these counties is about 39.4 inches, with an average of 27.6 inches usually falling during the period of April through October. Rainfall is usually the result of high intensity, short duration, local thunderstorms that occur in the late spring and early fall. Average seasonal snowfall is 9 to 12 inches (OCS 2002). The prevailing winds are from the south, with the greatest wind movements occurring in the spring months (USACE 1999).

4.1 Socioeconomics

4.1.1 Study Area

Hulah Lake and Copan Lake lie within Osage and Washington counties, respectively, and the proposed action would have the most direct impact on persons living in the city of Bartlesville. Therefore, these counties and the city of Bartlesville are considered the social area where project-related impacts could occur.

4.1.2 Population

The following table summarizes population data from the Census 2000 for the social area that could be affected by the proposed water reallocation project at Hulah and Copan lakes.

Table 1. Area Population of the Social Area

Locality	Census 1990 Population	Census 2000 Population	Estimated 2004 Population	Percent Growth (2000–2004)
City of Bartlesville	34,256	34,748	34,638	-0.3%
Osage County	41,645	44,437	45,181	1.7%
Washington County	48,066	48,996	49,027	0.1%
State of Oklahoma	3,145,585	3,450,654	3,523,553	2.1%

Sources: U.S. Census Bureau 2005

4.1.3 Employment and Income

In 2000, there were 128,181 people in the social area for the Hulah Lake and Copan Lake water reallocation project. The majority of the workers in the social area are employed in the educational, health and social services, manufacturing, and retail trade sectors (U.S. Census Bureau 2004). Table 2 presents employment and income information for the social area.

Table 2. Employment and Income of the Social Area

Locality	Census 2000 Per Capita Income [1]	Census 2000 Median Household Income [1]	February 2005 Unemployment Rate [2]
City of Bartlesville	$21,195	$35,827	5.1%
Osage County	$17,014	$34,477	5.6%
Washington County	$20,250	$35,816	4.8%
State of Oklahoma	$17,646	$33,400	4.8%

Sources: [1] U.S. Census Bureau 2004, [2] ORIGINS 2005

4.1.4 Environmental Justice

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that no groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the adverse environmental consequences as a result of federal, state, and local programs and policies. Consideration of environmental justice concerns includes race and poverty status where a proposed action would occur. Race and poverty status of the area surrounding the proposed action is given in the following table. Oklahoma has a large population of American Indians consisting of dozens of tribes. Osage County has the largest population of American Indians in the social area and nearly 20 times the population of American Indians as the United States as a whole (table 3). It also has the largest population of African Americans in the social area and Oklahoma. Poverty levels in the social area are less than the reported state level (table 3).

Table 3. Race and Poverty Characteristics of the Social Area

	City of Bartlesville	Osage County	Washington County	Oklahoma	United States
Percent White, 2000	87.4	73.4	87.1	80.3	77.1
Percent African American, 2000	3.8	11.6	3.0	8.3	12.9
Percent American Indian, Alaskan Native, 2000	11.8	20.7	13.9	11.4	1.5
Percent Asian, 2000	1.3	0.4	1.0	1.7	4.2
Percent Hawaiian or other Pacific Islander, 2000	0.1	0.1	0.0	0.1	0.3
Percent Other, 2000	1.5	0.9	1.3	3.0	6.6
Percent Living in Poverty, 1999	12.7	13.2	11.9	14.7	12.4

Source: U.S. Census Bureau 2005

4.1.5 Social Ecology

The social ecology of Osage and Washington counties and the city of Bartlesville is primarily rural, with large areas in agricultural production and scattered residences. There are several small communities with a mix of residential, industrial, commercial, and agricultural operations, the largest being the city of Bartlesville. This city of just under 35,000 people is a center for retail and service businesses in this part of northeast Oklahoma.

4.2 Natural Resources

4.2.1 Hulah Lake

4.2.1.1 Terrestrial

Hulah Lake is on the Caney River, a tributary of the Verdigris River, about 15 miles northwest of the city of Bartlesville in Osage County, Oklahoma. The project area, consisting of the lake and its immediately adjacent natural resources, was formed by impoundment of the Caney River. The topography surrounding Hulah Lake varies from hilly to relatively flat bottomlands. The terrain in the vicinity of the lake varies in elevation from about 700 feet above mean sea level (AMSL) on the hilltops to about 850 feet above AMSL near the base of the dam. The formation of the lake has influenced vegetation and habitat, creating shoreline environments that did not exist prior to filling the reservoir, and eliminating floodplain/riparian habitat that was supported along the Caney River in this area.

The project area is in the Prairie Parkland (Temperate) Province of the Prairie Division. Upland vegetation communities surrounding Hulah Lake include cross-timber forests and tallgrass prairie. A history of grazing at Hulah Lake is also evidenced by abandoned fields and active pasture (USACE 2004); in many places, the tallgrass prairie community is being invaded by grasses and forbs characteristic of overgrazed or disturbed sites.

The cross-timber forests are dominated by various oak (*Quercus* spp.) and hickory (*Carya* spp.) species, including post oak (*Q. stellata*), blackjack oak (*Q. marilandica*), bur oak (*Q. macrocarpa*), bitternut hickory (*C. canescens*), mockernut hickory (*C. tomentosa*), shagbark hickory (*C. cordiformis*), and pecan (*C. illinoensis*). The canopy of these wooded areas is mostly closed and understory vegetation is limited (USACE 2004).

Species commonly found in the tallgrass prairie of Hulah Lake include big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), and indiangrass (*Sorghastrum nutans*) (USACE 2004). Much of the grazing that occurs at Hulah Lake occurs in these prairie grasslands, and overgrazing has resulted in the establishment of more shortgrass prairie species, including native grasses such as grama (*Bouteloua* spp.), sheep fescue (*Festuca ovina*), and tall dropseed (*Sporobolus asper*). Introduced grasses such as Japanese brome (*Bromus japonicus*) are also found in areas of tallgrass prairie that have been overgrazed or used for pasture, as well as in abandoned fields. Other grasses and forbs indicative of overgrazed conditions found at Hulah Lake include johnsongrass (*Sorghum halepense*), three-awn (*Aristida* spp.), ironweed (*Vernonia* sp.), goldenrod (*Solidago* spp.), and false boneset (*Kuhnia eupatoriodes*) (USACE 2004).

In addition to these upland plant communities, bottomland forests and wetlands also occur in the project area. Bottomland forests border the lakeshore and are found in the riparian areas of the Caney River, as well as some of the other surface waters that feed Hulah Lake. These forests are dominated by eastern cottonwood (*Populus deltoides*) in the canopy and also support swamp oak (*Quercus bicolor*) and pecan (*Carya illinoensis*). The canopy of these forests are mostly closed and the understory vegetation is limited (USACE 2004).

4.2.1.2 Soils and Prime Farmland

Soils surrounding Hulah Lake are of the Verdigris-Mason-Wynona, Steedman-Coweta-Bates, and Darnell-Stephenville associations. Soils in the Verdigris-Mason-Wynona association are deep, nearly level and very gently sloping, well-drained to somewhat poorly drained, loamy soils found on wooded floodplains. Soils in the Steedman-Coweta-Bates association are deep and shallow, very gently sloping to steep, loamy soils over shale and sandstone. These soils are found on ridge crests and side slopes of prairie uplands. Soils of the Darnell-Stephenville association are shallow and moderately deep, very gently sloping to sloping, loamy soils over sandstone that are found on prairie uplands (USDA 1979).

Approximately 21 soil types occur in the project area associated with water reallocation at Hulah Lake. Table 4 provides a summary of the soil properties for each of these types.

Table 4. Soil Associations in the Vicinity of Hulah Lake

Soil Type	Description
Barnsdall very fine sandy loam	Barnsdall very fine sandy loam soils consist of deep, nearly level soils on floodplains. These soils formed in loamy sediments under a cover of trees and grasses, and are subject to flooding. In a representative profile, the surface layer is brown and dark brown, very fine sandy loam about 11-inches thick. The subsoil is approximately 40- to 60-inches deep. The upper 34 inches is a reddish brown silty clay loam. The next 13 inches is reddish brown clay loam, and the lower 14 inches is a brown fine sandy loam. Barnsdall soils are well-drained and have moderate permeability. Available water capacity is high.
Dennis silt loam, 3% to 5% slopes	Dennis silt loam soils consist of deep, very gently sloping to gently sloping soils on uplands. These soils formed in material weathered from shales interbedded with thin layers of sandstone under a cover of grasses. In a representative profile, the surface layer is very dark brown silt loam about 11-inches thick.. The upper part of the subsoil is very dark grayish brown and brown silty clay loam to a depth of 31 inches. The lower part of the subsoil is silty clay mottled in shades of red and brown to a depth of about 62 inches. Dennis soils are moderately well-drained and have slow permeability.
Dennis-Carytown complex, 1% to 5% slopes	This complex consists of small areas of Dennis and Carytown soils that are so intermingled they could not be separated at the scale selected for mapping. • Dennis soils make up about 30% of the mapped acreage. They consist of very gently sloping through gently sloping soils found on slightly higher, convex parts of the landscape. The surface layer is very dark grayish brown silt loam about 9-inches thick. The upper part of the subsoil is very dark grayish brown silty clay loam about 18 inches thick. The middle part is dark brown and brown silty clay about 38-inches thick. The lower part is silty clay mottled in shades of gray and brown about 72-inches thick. Dennis soils are moderately well-drained, have slow permeability, and available water capacity is high. • Carytown soils make up about 20% of the mapped acreage. These soils consist of deep soils on very gently sloping slopes on slightly lower, concave parts of the landscape. Typically the surface layer is very dark grayish brown silt loam about 9-inches thick. The upper part of the subsoil is very dark grayish brown, dark grayish brown, and dark brown silty clay about 38-inches thick. The lower parts is silty slay coarsely mottled in shades of gray and brown about 72-inches thick. • 25% of this mapping unit consists of soils that are similar to Dennis soils, except that the bedrock is less than 60-inches thick. • 10% of this mapping unit consists of soils that are similar to Carytown soils, except that the bedrock is less than 60-inches thick. • 10% of this mapping unit consists of Bates soils. • 5% of this mapping unit consists of Okemah soils.
Mason silt loam, 0% to 1% slopes	Mason silt loam soils are deep, nearly level soils on floodplains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. Typically, the surface layer and next layer are very dark grayish brown silt loam about 13-inches deep. The upper part of the subsoil is dark brown silty clay loam about 8-inches deep. The lower part of the subsoil is brown silty clay loam about 75-inches deep. Mason soils are well-drained to moderately well drained and have moderate permeability. Available water capacity is high.

Table 4. Soil Associations in the Vicinity of Hulah Lake (continued)

Soil Type	Description
Norge silt loam, 1% to 3% slopes	Norge silt loam soils are deep, very gently sloping soils found on uplands. These soils formed in loamy sediments under a cover of grasses. Typically, the surface layer is dark brown silt loam about 10-inches deep. The subsoil is about 64-inches thick. The upper part of the subsoil is dark reddish brown silty clay loam about 7-inches thick. The next layer is reddish brown silty clay loam about 32-inches thick, and the lower part of the subsoil is yellowish red silty clay about 25-inches thick. Norge soils are well-drained and have moderately slow permeability. Available water capacity is high.
Osage silty clay	Osage silty clay soils are deep, nearly level soils on floodplains. These soils formed in clayey sediments under a cover of trees with an understory of grasses, and are subject to flooding. In a representative soil profile, the surface layer is very dark gray silty clay about 8-inches thick. The next layer is black silty clay also about 8-inches thick. The upper part of the subsoil is dark gray silty clay about 22-inches thick. The lower part is dark grayish brown silty clay to about 34-inches deep. Osage soils are poorly drained and have very slow permeability. Available water capacity is medium.
Parsons silt loam, 1% to 3% slopes	Parsons silt loam soils consist of deep, nearly level through very gently sloping soils on uplands. These soils formed in material weathered from shales or clayey sediments under a cover of grasses. In a representative profile, the surface layer is a dark grayish brown and very dark grayish brown silt loam about 12-inches thick. The subsoil is approximately 58-inches thick. The upper 20 inches is a dark to very dark grayish brown silty clay. The next 8 inches is a coarsely mottled, dark brown, very dark gray, yellowish brown, and light brownish gray silty clay. The lower 30 inches is coarsely mottled light gray, yellowish brown, light brownish gray, very dark gray, and brown silty clay. Parsons soils are somewhat poorly drained and have very slow permeability. Available water capacity is medium.
Prue loam, 3% to 5% slopes	Prue loam soils consist of deep, gently sloping soils on uplands. These soils formed in material weathered from sandstones and shales under a cover of grass. In a representative profile, the surface layer is a very dark brown loam about 12 inches thick. The subsoil is more than 60 inches thick. The upper 6 inches is a very dark grayish brown loam. The next 12 inches is a yellowish brown, sandy clay loam. Underlying this layer is yellowish brown clay loam about 9 inches thick. The next 11 inches is a coarsely mottled, strong brown, grayish brown, and yellowish red silty clay loam, and the lower 22 inches is coarsely mottled strong brown, grayish brown, and very dark gray silty clay. Prue soils are moderately well-drained and have moderately slow permeability. Available water capacity is high.
Steedman silt loam, 1% to 3% and 3% to 5% slopes	Steedman silt loam soils consist of moderately deep, very gently sloping to steep soils on uplands. These soils formed from shales interbedded with thin layers of sandstone under a cover of grasses. The soils are generally 20- to 40-inches thick. The surface layer is a very dark grayish brown silt loam that is about 8-inches thick. The subsoil is about 20-inches thick. The upper 9 inches are a brown silty clay. The next 3 inches are a dark grayish brown silty clay, and the lower 5 inches are a coarsely mottled, dark gray, grayish brown, and yellowish brown silty clay. Steedman soils are well-drained to moderately well-drained and have slow permeability. Available water capacity is medium.

Table 4. Soil Associations in the Vicinity of Hulah Lake (continued)

Soil Type	Description
Stephenville-Darnell complex, 1% to 5% slopes	This complex consists of small areas of Stephenville and Darnell soils that are so intermingled they could not be separated at the scale selected for mapping. • Stephenville soil makes up about 45% of the mapped acreage. This soil consists of deep, very gently sloping through gently sloping soil. The surface layer is very dark brown fine sandy loam about 5-inches thick. The subsurface layer is dark grayish brown fine sandy loam about 14-inches thick. The subsoil is strong brown sandy clay loam about 30-inches thick. Stephenville soils are well drained and have moderate permeability. Available water capacity is medium. • Darnell soil makes up about 30% of the mapped acreage. This soil consists of shallow, very gently sloping through gently sloping soil. The surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is brown fine sandy loam about 15-inches thick. Darnell soil is well-drained to somewhat excessively drained and has moderately rapid permeability. • 15% of this mapping unit consists of Niotaze soils. • 5% of this mapping unit consists of Gasil soils. • 5% of this mapping unit consists of Steedman soils.
Verdigris silt loam	Verdigris silt loam soils consist of deep, nearly level to very gently sloping soils on floodplains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. In a representative profile, the surface layer is very dark grayish brown silt loam about 7-inches thick. The subsoil is about 65-inches deep. The upper 14 inches is very dark grayish brown silt loam. The next 21 inches is a very dark grayish brown silty clay loam, and the lower 30 inches is very dark grayish brown clay loam. Verdigris soils are moderately well-drained and have moderate permeability. Available water capacity is high.
Verdigris soils[1]	Verdigris soils are deep, nearly level to gently sloping soils found on floodplains. As with Verdigris silt loam soils, these soils formed in loamy sediments under a cover of trees with an understory of grasses. Typically, the surface layer is black silt loam about 12-inches deep. The next layer is very dark brown silt loam about 6-inches deep. The subsoil is about 42-inches thick and is dark grayish brown silty clay loam. Verdigris soils are moderately well-drained and have moderate permeability. Available water capacity is high.
Wynona silty clay loam	Wynona silty clay loam soils consist of deep, nearly level soils on floodplains. These soils formed in loamy sediments under a cover of trees with an understory of grasses. They are subject to flooding. These soils are more than 72-inches thick. The surface layer is a very dark gray silty clay loam that is about 8-inches thick. The next 15-inches is black silty clay loam. Below that is a layer of very dark gray silty clay loam about 24-inches thick. The lower 16 inches is dark gray silty clay. Wynona soils are somewhat poorly drained and have slow permeability. Available water capacity is high.
Coweta-Bates complex, 1% to 8% slopes	This complex consists of small areas of Coweta and Bates soils that are so intermingled they could not be separated at the scale selected for mapping. • Cowetta soils make up about 45% of the mapped acreage in this complex. They consist of shallow, gently sloping through steep soils on uplands. These soils formed in material weathered from sandstone under a cover of grasses. In a representative profile, the surface layer is very dark grayish brown loam about 9-inches thick. The subsoil is dark brown loam and is about 7-inches thick. Cowetta soils are well-drained to somewhat excessively drained and have moderate permeability. Available water capacity is low. • Bates soils make up about 20% of the mapped acreage in this complex. Please see previous entry for Bates soil description. • The remaining 35% of the mapped acreage in the Coweta-Bates complex includes minor soil types and exposed bedrock.

Table 4. Soil Associations in the Vicinity of Hulah Lake (continued)

Soil Type	Description
Darnell-Stephenville complex, 1% to 8% slopes	This complex consists of small areas of Darnell and Stephenville soils that are so intermingled they could not be separated at the scale selected for mapping. • Darnell soils make up about 50% of the acreage mapped in this complex. They are shallow, very gently sloping to sloping soils on uplands. Typically, the surface layer is very dark grayish brown fine sandy loam about 4-inches thick. The subsoil is dark brown fine sandy loam about 8-inches thick. Darnell soils are well-drained to somewhat excessively well-drained and have moderately rapid permeability. Available water capacity is low. • Stephenville soils make up about 20% of the acreage mapped in this complex. They are moderately deep, very gently sloping to sloping soils on uplands. Typically, the surface layer is very dark brown fine sandy loam about 3-inches thick. The next layer is brown fine sandy loam about 5-inches thick. The subsoil is approximately 18-inches thick. The upper part of the subsoil is strong brown sandy clay loam about 13-inches deep. The lower part is mottled in shades of brown and red sandy clay loam about 5-inches thick. Stephenville soils are well-drained and have moderate permeability. Available water capacity is medium. • The remaining 30% of the mapped acreage in the Darnell-Stephenville complex includes minor soil types.
Parsons-Carytown complex, 0% to 3% slopes	This complex consists of small areas of Parsons and Carytown soils that are so intermingled they could not be separated at the scale selected for mapping. • Parsons soils make up about 45% of the mapped acreage in this complex. Please see previous entry for Parsons soil description. • Carytown soils make up about 35% of mapped acreage in this complex. These are deep, nearly level or very gently sloping soils that formed on uplands. Typically, the surface layer is very dark grayish brown silt loam about 6-inches deep. The subsoil is approximately 40-inches thick. The upper part of the subsoil is very dark grayish brown about 21-inches thick. The lower part of the subsoil is silty clay coarsely mottled in shades of gray and brown and is about 19-inches thick. Carytown soils are poorly drained and have very slow permeability. Available water capacity is low. • The remaining 20% of the mapped acreage in the Parsons-Carytown complex includes minor soil types.
Niotaze-Darnell complex, 15% to 25% slopes	This complex consists of small areas of Niotaze and Darnell soils that are so intermingled they could not be separated at the scale selected for mapping. • Niotaze soils make up about 60% of the mapped acreage in this complex. These are moderately deep, moderately steep to steep soils. They formed in material weathered from shale interbedded with thin layers of sandstone and under a cover of trees with an understory of grasses. Typically, the surface layer is ver dark grayish brown loam about 2-inches thick. The subsurface layer is brown loam about 5-inches thick. The upper part of the subsoil is light olive brown silty clay about 11-inches thick, while the lower part of the subsoil is silty clay mottled in shades of olive, brown, and gray about 10-inches thick. Niotaze soils are somewhat poorly drained and have slow permeability. Available water capacity is low. • Darnell soils make up about 15% of the mapped acreage in this complex. Please see previous Darnell-Stephenville complex entry for a description of Darnell soils. • The remaining 25% of the mapped acreage in the Niotaze-Darnell complex are similar to Niotaze and Darnell soils, except in their depth to bedrock.

Table 4. Soil Associations in the Vicinity of Hulah Lake (continued)

Soil Type	Description
Norge, Dennis, and Prue soils, gullied [1]	This soil type consists of very gently sloping to sloping, gullied soils on uplands. It consists of primarily Norge (20%), Dennis (20%), and Prue (15%) soils in an irregular pattern between gullies. Please see the previous entries above for Norge, Dennis, and Prue soil descriptions. Ten percent of the acreage mapped in this soil type consist of gullies and soils that are similar to Norge, Dennis, or Prue soils except that the surface layer has been removed and the subsoil is exposed. The remaining 35% of the acreage mapped in the Norge, Dennis, and Prue soils include minor soil types.
Steedman-Coweta Complex, 3% to 15% slopes	This complex consists of small areas of Steedman and Coweta soils that are so intermingled they could not be separated at the scale selected for mapping. • Steedman soils make up about 65% of the mapped acreage in this complex. Please see previous entry for Steedman soil description. An additional 10% is included in areas of soil that are similar to Steedman soils except that the surface layer is thicker. • Coweta soils make up about 20% of the mapped acreage in this complex. Please see previous entry for Coweta-Bates complex for a description of Coweta soils. • The remaining 5% of mapped acreage in this complex consist of Bates soils. Please see previous entry for Bates soils description.
Steedman-Coweta Complex, 15% to 25% slopes	This complex consists of small areas of Steedman and Coweta soils that are so intermingled they could not be separated at the scale selected for mapping. • Steedman soils make up about 55% of the mapped acreage in this complex. Please see previous entry for Steedman soil description. An additional 10% is included in areas of soil that are similar to Steedman soils, except that the surface layer is thicker. Another 5% consists of soils also similar to Steedman soils except the depth to bedrock is shallower. • Coweta soils make up about 20% of the mapped acreage in this complex. Please see previous entry for Coweta-Bates complex for a description of Coweta soils. • The remaining 10% of mapped acreage in this complex consist of Bates soils. Please see previous entry for Bates soils description.
Stephenville-Darnell complex, 1% to 5% slopes	This complex consists of small areas of Stephenville and Darnell soils that are so intermingled they could not be separated at the scale selected for mapping. • Stephenville soils make up about 45% of the mapped acreage in this complex. Darnell soils make up about 30% of the mapped acreage in this complex. Please see the previous entry for the Darnell-Stephenville complex for a description of these soils. • The remaining 25% of the mapped acreage in the Stephenville-Darnell complex includes minor soil types.

Source: USDA 1979

Note: [1] Broadly defined types: the composition of these types is more variable than that of the others in the survey area, but has been controlled well enough to be interpreted for the expected use of the soils.

Soil that is prime or unique farmland as defined in the Farmland Protection Policy Act (7 *United States Code* [USC] 4201–4209) is classified as prime farmland. According to the U.S. Department of Agriculture, prime farmland soil is soil that is best suited for producing food, feed, forage, fiber, and oilseed crops. Soils in the vicinity of Hulah Lake that are classified as prime farmland include the following (USDA 2000):

- Barnsdall very fine sandy loam
- Norge silt loam, 1% to 3% slopes
- Osage silty clay

- Parsons silt loam, 1% to 3% slopes
- Prue loam, 3% to 5% slopes
- Steedman silt loam, 1% to 3% and 3% to 5% slopes
- Verdigris silt loam
- Wynona silty clay loam

4.2.1.3 Hydrology

Hulah Lake lies on the Caney River upstream of the town of Bartlesville, Oklahoma. The drainage area above Hulah Dam is approximately 732 square miles. The gradient of the river varies from as much as 20-feet per mile in the headwaters to 2.6-feet per mile through the reservoir area. The Caney River consists of one major channel with several major tributaries on both the left and right banks. The river is characterized by a well-defined channel with heavily vegetated overbanks that allow for very little bank erosion and result in relatively low sediment inflows into Hulah Lake. In addition, several Natural Resources Conservation Service (NRCS) sediment control structures are upstream of Hulah Lake, further reducing sediment inflows. The average annual sediment deposit is 281 acre-feet (USACE 1999).

At normal pool, Hulah Lake covers less than 3,200 surface acres, but increases to 13,000 acres at the top of the flood pool. The shoreline is approximately 54 miles (USACE 1999, 2004).

The channel capacity of the Caney River below Hulah Dam is approximately 12,600 cubic feet per second (cfs). The nondamaging flow on the Caney River downstream of the confluence with the Little Caney River is approximately 7,000 cfs. The channel capacity at Bartlesville is approximately 10,500 cfs.

Discharges from Hulah Lake are regulated primarily for flood control on the Caney River in conjunction with Copan Lake. When the flood control storage in the two lakes is unbalanced, the lake with the highest flood control storage would be given priority for discharge to the Caney River. In addition, Hulah Lake discharges are regulated for water supply and water quality. Hulah Lake has water supply storage of 16,600 acre-feet with a dependable yield of 9.9 mgd under current conditions. This yield is expected to decrease to 6.4 mgd by the year 2035 due to sedimentation (USACE 1999).

Water quality in the Caney River is considered generally good and requires minimal treatment to be suitable for municipal, agricultural, and industrial use. Hulah Lake has 5,953 acre-feet of storage allocated to water quality and yields an average of 2.3 mgd (3.6 cfs). Water quality discharges are regulated to maintain low flow requirements at Bartlesville. Table 5 shows the monthly water quality requirements for Bartlesville. The discharges are regulated from both Hulah and Copan lakes to provide the required flow to maintain water quality in the Caney River. Table 5 shows the monthly discharges required from both Hulah and Copan lakes to maintain the water quality requirements (USACE 1999).

There are no hydroelectric power units using Hulah Lake.

The U.S. Fish and Wildlife Service (USFWS) has not mapped wetlands in Osage County, Oklahoma, as part of the National Wetlands Inventory as of September 2005. Correspondence with the USACE Regulatory Branch has indicated that a Section 404 Permit under the Clean Water Act would not be required (appendix D).

Table 5. Minimum Low-Flow Releases for Hulah and Copan Lakes and Bartlesville Minimum Water Quality Requirements

Month	Hulah Release Rates (cfs)	Copan Release Rates (cfs)	Bartlesville Minimum Water Quality Requirements (cfs)
January–May	2	5	10
June	4	8	11
July–August	4	8	13
September–December	2	5	10
Annual Average	**2.50**	**5.75**	**10.58**

Source: USACE 1999

4.2.1.4 Wild and Scenic Rivers

The Caney River and its tributaries are not classified as wild and scenic pursuant to the Federal Wild and Scenic Rivers Act, Public Law 90-542.

4.2.1.5 Fish and Wildlife

The aquatic, wetlands, and upland habitats at Hulah Lake support a diversity of fish and wildlife. The Oklahoma Department of Wildlife Conservation (ODWC) has the responsibility to manage, regulate, and control fish and wildlife resources. Approximately 8,900 acres of project lands have been made available to the ODWC for wildlife management purposes. Two thousand acres of this have been set aside as a state waterfowl refuge; the remainder is managed for upland game and whitetail deer and is open to the public as a hunting area (USACE 2005a). The following sections describe the fish and wildlife resources at Hulah Lake.

Fish

Management of the fishery resources at Hulah Lake is the responsibility of the ODWC. Hulah Lake provides habitat for several species of fish. Those species popular for recreational fishing include channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), white crappie (*Pomoxis annularis*), spotted bass (*Micropterus punctulatus*), bluegill sunfish (*Lepomis macrochirus*), gizzard shad (*Dorosoma cepedianum*), thread fin shad (*Dorosoma petenense*), and shiners (*Notropis* sp.). Gizzard shad and threadfin shad are considered important forage species in the lake (USACE 2004).

Amphibians and Reptiles

Numerous amphibians and reptiles are known to occur at Hulah Lake. Species of amphibians and reptiles include tiger salamander (*Ambystoma tigrinus*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), Woodhouse's toad (*Bufo woodhousei*), northern cricket frog (*Acris crepitans*), snapping turtle (*Chelydra serpentine*), painted turtle (*Chrysemys picta*), eastern box turtle (*Terrapene carolina*), corn snake (*Elaphe guttata*), eastern hognose snake (*Heterodon platyrhinos*), prairie kingsnake (*Lampropeltis calligaster*), copperhead (*Agkistrodon contortrix*), cottonmouth (*Agkistrodon piscivorus*), and western diamondback rattlesnake (*Crotalus atrox*) (USACE 2004).

Birds

The variety of habitats at Hulah Lake supports numerous species of migratory waterfowl and wading birds, upland game birds, raptors, and songbirds. These include belted kingfisher (*Ceryle alcyon*), common golden eye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), great egret (*Casmerodius albus*), black-crowned heron (*Nycticorax nycticorax*), American bittern (*Botaurus lentiginosus*), green-winged teal (*Anas crecca*), ruddy duck (*Oxyura jamaicensis*), pintail (*Anas acuta*), American coot (*Fulica americana*), gadwall (*Anas strepera*), blue-winged teal (*Anas discors*), pied-billed grebe (*Podilymbus-podiceps*), common gallinule (*Gallinula chloropus*), common snipe (*Capella gallinago*), killdeer (*Charadrius vociferous*), mourning dove (*Zenaida macroura*), bobwhite quail (*Colinus virginianus*), great blue heron (*Ardea herodias*), mallard (*Anas platyrhynchos*), Canada goose (*Branta canadensis*), American kestrel (*Falco sparverius*), short-eared owl (*Asio flameus*), northern harrier (*Circus cyaneus*), common nighthawk (*Chordeiles minor*), barn owl (*Tyto alba*), long-eared owl (*Asio otus*), great horned owl (*Bubo virginianus*), screech owl (*Otus asio*), barred owl (*Strix varia*), Cooper's hawk (*Accipiter cooperil*), redtailed hawk (*Buteo jamaicensis*), turkey vulture (*Cathartes aura*), barn swallow (*Hirundo rustica*), rough-winged swallow (*Stelidopteryx ruficollis*), bank swallow (*Riparia riparia*), chimney swift (*Chaetura pelagica*), western meadowlark (*Sturnell neglecta*), flycatcher (*Muscivora forficate*), loggerhead shrike (*Lanius ludovicianus*), lark sparrow (*Chondestes grammacus*), field sparrow (*Spizela pusilla*), horned lark (*Eremophila alpestris*), common flicker (*Colaptes auratus*), American robin (*Turdus migratorius*), mockingbird (*Mimus polyglottos*), eastern bluebird (*Sialia sialis*), bluejay (*Cyanocitta cristata*), cardinal (*Cardinalis cardinalis*), house wren (*Troglodytes aedon*), brown thrasher (*Toxostome rufum*), house sparrow (*Passer domesticus*), song sparrow (*Melopiza melodia*), starling (*Sturnus vulgaris*), common grackle, (*Quiscalus quiscula*), red-winged blackbird (*Agelaius phoeniceus*), common crow (*Corvus brachyrhynchos*), whip-poor-will (*Caprimulgus vociferous*), downy woodpecker (*Picoides pubescens*), red-headed woodpecker (*Melanerpes erythrocephalus*), hairy woodpecker (*Picoides villosus*), brown creeper (*Certhia familiaris*), and red-eyed vireo (*Vireo olivaceus*) (USACE 2004).

Mammals

A variety of mammals occur at Hulah Lake including least shrew (*Cryptotis parva)*, eastern mole (*Scalopus aquaticus*), big brown bat (*Eptesicus fuscus*), Hoary bat (*Lasiurus cinereus*), woodchuck (*Marmota monax*), nine-banded armadillo (*Dasypus novemcinctus*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), southern flying squirrel (*Glaucomys volans*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), plains pocket gopher (*Geomys bursarius*), Texas mouse (*Peromyscus attwateri*), white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), Hispid cotton rat (*Sigmodon hispidus*), eastern woodrat (*Neotoma floridana*), prairie vole (*Microtus ochrogaster*), woodland vole (*Microtus pinetorum*), eastern cottontail rabbit (*Sylvilagus floidanus*), white-tailed deer (*Odocoileus virginianus*), American beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), American mink (*Mustela vison*), striped skunk (*Mephitis mephitis*), and eastern spotted skunk (*Spilogale putorius*) (ODWC 2005).

4.2.1.6 Threatened and Endangered Species

The USFWS has not performed an actual field survey of the proposed site due to time and personnel constraints. However, the USFWS provided a list of five species with the potential to occur in the project area for the water reallocation at Hulah Lake (see appendix E). A sixth species, American burying beetle (*Nicrophorus americanus*), was added to the endangered list for Osage County after the USFWS letter was received.

The interior least tern (*Sterna antillarum*), bald eagle (*Haliaeetus leucocephalus*), whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), and Arkansas River shiner (*Notropis girardi*), and American burying beetle (*Nicrophorus americanus*), are federally listed species that are known to occur in Osage County. The interior least tern (*Sterna antillarum*) and bald eagle (*Haliaeetus leucocephalus*) are endangered and threatened species, respectively, that are known to occur in the project area. Downstream of Hulah Lake, interior least terns may use sandbar habitats for nesting and the adjacent shallow water habitat for feeding on minnows. Bald eagles are common winter residents along the shores of Hulah Lake and are also known to nest in this area. They use tall trees near water for foraging, roosting, and nesting, and are also known to nest in cliffs. The whooping crane and piping plover are considered migrants in the vicinity of Hulah Lake. Whooping cranes, which are considered rare spring and fall migrants in this area, use emergent vegetation along the edges of marshes, prairie pothole wetlands, or lakes for resting sites; croplands for foraging; and riverine wetlands for roosting (ODWC 2004). The Arkansas River shiner inhabits the main channels of wide, shallow, sand-bottomed rivers. Adults are uncommon in quiet pools or backwaters, and almost never occur in tributaries having deep water and bottoms of mud or stone. Juvenile Arkansas River shiner is associated most strongly with current, conductivity and backwater and island habitat (USFWS 2005). The Neosho mucket (*Lampsilis rafinesqueana*) is a candidate species that has been recorded in Osage County (ODWC 2004). In Oklahoma, the American burying beetle has been found in habitats ranging from deciduous and coniferous forests to open pasture.

4.2.2 Copan Lake

4.2.2.1 Terrestrial

Copan Lake is located on Little Caney River in Washington County, Oklahoma, in the Claremore Cuesta Plains subdivision of the interior lowlands physiographic province. Washington County lies on the western flank of the Ozark Plateau, a mountain range prominent in northern Arkansas, southern Missouri, and extending into northeastern Oklahoma. From the western boundary of the Ozark Plateau (which coincides with the position of the Neosho River in Oklahoma), Pennsylvanian rocks dip gently westward, thickening from a feather edge along the Neosho River to about 2,000 feet in Washington County. These beds are predominantly shale interspersed at comparatively large intervals with thin, hard, more resistant beds of sandstone and limestone. Erosion has produced a topography characterized by low east-facing escarpments separated by broad valleys, gently rolling hills, and isolated buttes. Major drainage is by the Caney River, which flows in a south to southeast direction across the county. All of the larger tributaries except one enter the river from the east and follow a south to southwest course across dip slopes developed on the harder layers of rock.

Of the 21,305-acre watershed for Copan Lake, approximately 6,750 acres are cultivated, 2,300 acres are improved pasture, 3,200 acres are open pasture, 2,750 acres are upland woodland, 6,200 acres are bottomland woods, and 105 acres are commercial and home sites. The area's flora represent a transition zone of the oak-hickory forest, cross timbers forest, bluestem prairie, and bottomland communities.

The oak-hickory forest is characterized primarily by sandy soils and sandstone capped hills whose tops and upper slopes are forested with post oak (*Quercus stellata*), blackjack oak (*Quercus marilandica*), black oak (*Quercus velutina*), chinquapin oak (*Quercus prinoides),* burr oak (*Quercus macrocarpa),* bitternut hickory (*Carya cordiformis),* shagbark hickory (*Carya ovata),* American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), and hackberry (*Celtis occidentalis*).

The cross timber forests exist in continuous to scattered stands on sandstone throughout the area. The forests are situated over low, rolling uplands and prairie hilltops. In such areas, post oak, blackjack oak, and others grow on rocky land where water is received from sandstone surfaces and where snow lodges during the winter. These trees are situated well above the water table and withstand varying degrees of drought. In the understory of the upland woods, shrubs such as coral berry (*Symphoricarpos orbiculatus*), dwarf sumac (*Rhus coppallina*), smooth sumac, (*Rhus glabra),* blackberry (*Rhus allegheniensis),* black raspberry (*Rhus occidentalis*), and dewberry (*Rhus flagellaris*) grow beneath the trees along the margins of the woods.

The bottomland forests around Copan Lake are composed of a variety of large mature trees, including pecan (*Carya illinoensis*), black walnut (*Juglans nigra*), hackberry, American elm, red oak (*Quercus rubra*), and black oak.

Characteristic native species of the prairie/pasture areas include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi),* indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum),* along with more palatable herbaceous plants on the ungrazed or very lightly grazed areas. Other species characteristic of disturbed areas are sideoats grama (*Boteloua curtipendula*), fall panicum (*Panicum dichotomiflorum*), plains lovegrass (*Eragrostis intermedia*), chess (*Bromus scalinus*), Japanese chess (*Bromus japonicus*), flowering spurge (*Euphorbia corollata*), woolly verbena (*Verbena stricta*), tall goldenrod (*Solidago altissima*), blue sage (*Salvia azurea*), wild petunia (*Ruellia humilis*), lace grass (*Eragrostis capillaris*), stink grass (*Eragrostis cilianensis*), and windmill grass (*Chloris verticillata*).

4.2.2.2 Soils and Prime Farmland

According to a soil survey conducted in 1968, prior to the construction of Copan Lake, soils in the vicinity of Copan Lake are of the Dennis-Okemah-Parsons, Collinsville-Talihina-Bates, and Osage-Verdigris associations (USDA 1968). Soils of the Dennis-Okemah-Parsons association are nearly level and gently sloping, deep soils found on prairie uplands. Soils of the Collinsville-Talihina-Bates association are gently sloping to hilly, very shallow to deep soils also found on prairie uplands. Soils in the Osage-Verdigris association are nearly level, deep soils found in bottomlands (USDA 1968).

Soil type data for Washington County was recently updated by the U.S. Department of Agriculture, NRCS (NRCS 2004). Table 6 summarizes the properties of the approximately 15 soil types found in the vicinity of Copan Lake.

Table 6. Soil Associations in the Vicinity of Copan Lake

Soil Type	Description
Darnell stony sandy loam, 5% to 30% slopes	Darnell stony sandy loam soils are very shallow and shallow, gently sloping to steep soils on uplands. These soils developed in material weathered from coarse-grained sandstone, under a cover of tall native grasses. The surface layer is grayish brown, stony sandy loam about 5-inches thick. The subsurface layer is light yellowish brown fine sandy loam about 4- to 14-inches thick. Darnell soils are somewhat excessively drained and have moderately rapid permeability. Available water capacity is medium.
Dennis silt loam, 1% to 3%	Dennis silt loam soils are deep, very gently sloping to gently sloping soils on uplands. These soils developed under tall prairie grasses, largely from calcareous silty or sandy shale. Typically, the surface layer is dark grayish brown silt loam about 10-inches thick. The subsoil is approximately 42-inches thick The upper part is a dark grayish brown light clay loam about 5-inches thick. The lower part of the subsoil is a yellowish brown clay loam and heavy clay loam about 37-inches thick. Dennis soils are well-drained and have slow permeability. Available water capacity is low.

Table 6. Soil Associations in the Vicinity of Copan Lake (continued)

Soil Type	Description
Dennis silt loam, 3% to 5%	Dennis silt loam soils are deep, very gently sloping to gently sloping soils on uplands. These soils developed under tall prairie grasses, largely from calcareous silty or sandy shale. Typically, the surface layer is dark grayish brown silt loam about 10-inches thick. The subsoil is approximately 42-inches thick The upper part is a dark grayish brown light clay loam about 5-inches thick. The lower part of the subsoil is a yellowish brown clay loam and heavy clay loam about 37-inches thick. Dennis soils are well-drained and have slow permeability. Available water capacity is low.
Dennis silt loam, 3% to 5% slopes, eroded	This soil has a similar profile and characteristics of the Dennis silt loam soils, however, erosion has removed between 25% and 75% of the surface layer, and the surface layer is now about 6-inches thick. The subsoil is exposed in many rills, small gullies, and thin spots.
Eram clay loam, 3% to 5% slopes	Eram clay loam soils are moderately deep, gently sloping to moderately steep soils on uplands. These soils developed under tall prairie grasses, in material weathered from noncalcareous shale. In a representative profile, the surface layer is grayish brown clay loam about 9-inches deep. The subsoil is a grayish brown clay mottled with yellowish brown and pale brown about 13-inches thick. Eram clay loam soils with 3% to 5% slopes have thinner soil layers than the representative profile, and 1% to 5% of the surface is covered with stones and cobbles. Eram soils are well-drained and have slow permeability. Available water capacity is low.
Osage Clay	Osage clays are deep, dark-colored, clayey, nearly level soils on bottom lands. In a representative profile, the surface layer is slightly acidic clay about 22-inches thick. The subsoil is dark-gray, neutral clay mottled with strong brown about 28-inches thick. Osage clays are somewhat poorly drained and have slow permeability.
Okemah silt loam, 0% to 1% slopes	Okemah silt loam soils are deep, nearly level and very gently sloping soils on uplands. They developed in material weathered from noncalcareous shale, under a cover of tall prairie grasses. In a representative profile, the surface layer is about 16-inches thick. The upper 12 inches is dark gray silt loam, and the remaining 4 inches is gray heavy silt loam. The subsoil is approximately 44-inches thick. The upper part is dark, grayish brown silty clay loam with a few yellowish brown mottles. The lower part of the subsoil is grayish brown to light yellowish brown silty clay with dark grayish brown mottles. Okemah soils are moderately well-drained and have slow permeability. Available water capacity is low.
Parsons silt loam, 0% to 1% slopes	Parsons silt loam soils are deep, nearly level soils on uplands. These soils developed in material weathered from shale, under tall prairie grasses. In a representative profile, the surface layer is about 11 inches thick. The upper 9 inches of the surface layer is grayish brown silt loam, while the remaining surface layer is light brownish gray silt loam. The subsoil is about 39-inches thick. The top 13 inches are grayish brown clay and the next 14 inches are brown clay. The last 12 inches of the subsoil are mottled brown, yellowish brown, and gray clay. Parsons soils are somewhat poorly drained and have very slow permeability. Available water capacity is low.
Verdigris silt loam	Verdigris silt loam soils consist of deep, nearly level soils on floodplains. These soils developed in recent alluvium washed mainly from prairie soils. In a representative profile, the surface layer is dark grayish brown silt loam that is about 22-inches thick. The subsoil is 38 inches or more of dark grayish brown and grayish brown silt loam with a few yellowish brown mottles. Verdigris soils are moderately well-drained and have moderately slow permeability. Available water capacity is low.
Verdigris clay loam	These soils are similar to the Verdigris silt loam with the exception that the 22-inch surface layer is clay loam and the subsoil is 50 inches or more of clay loam.
Verdigris soils, broken	These soils are similar to the Verdigris silt loam. However, they occur only as narrow areas along major streams in Washington County and are frequently flooded.

Table 6. Soil Associations in the Vicinity of Copan Lake (continued)

Soil Type	Description
Bates-Collinsville complex, 2% to 6% slopes	This complex is made up of 70% to 80% Bates fine sandy loam, 15% to 25% of Collinsville sandy loam, and 5% Dennis silt loam. • Bates fine sandy loam soils are moderately deep and deep, gently sloping soils found on uplands. These soils developed in material weathered from noncalcareous sandstone under tall prairie grasses. The surface layer is dark grayish brown fine sandy loam about 12-inches thick. The subsoil is about 22-inches thick and the upper part is brown sandy clay loam. The lower part of the subsoil is yellowish brown to light yellowish brown and yellow mottles. Bates soils are well-drained and have moderate permeability. Available water capacity is low. • Collinsville soils are very shallow and shallow, gently sloping to moderately steep soils on uplands. These soils formed in material weathered from noncalcareous sandstone. The surface layer is dark grayish brown light loam about 6-inches deep. Below this is about 4 inches of brown sandy loam over sandstone. Collinsville soils are well-drained and somewhat excessively drained and have moderately rapid permeability. Available water capacity is low. • Please see previous entry for Dennis silt loam for a description of this soil type.
Breaks-Alluvial Land complex	This complex is found on the floors and sides of small valleys, along the upper reaches of intermittent streams, and is frequently flooded. The soils on the valley sides are grayish brown, dark brown, and reddish brown and have a loamy surface layer and a loamy to clayey subsoil. Soils on the valley floors are brown to grayish brown and loamy. Drainage is somewhat poor to somewhat excessive.
Collinsville-Talihina complex, 5% to 20% slopes	This complex is made up of 50% to 70% Collinsville soils, 20% to 30% of Talihina soils, and 5% to 10% Bates soils. • Please see the entry for the Bates-Collinsville complex for a description of Collinsville soils. • Talihina soils are very shallow and shallow, gently sloping to moderately steep soils found on uplands. These soils developed in material weathered from noncalacareous olive and gray shale, under a cover of tall grasses. In a representative profile, the surface layer is brown clay loam about 6-inches thick. The next layer is about 4-inches thick and about 50% consists of fragments of weathered shale. The soil in this layer is a light olive brown, light clay. Talihina soils are somewhat excessively drained and have slow permeability. Available water capacity is low. • Please see the entry for the Bates-Collinsville complex for a description of Bates soils.
Dwight-Parsons silt loam, 0% to 1% slopes	This complex consists of 50% to 70% Dwight silt loam, 20% to 40% Parsons silt loam, and 5% to 10% Okemah silt loam. • Dwight silt loam soils are deep, nearly level soils found on uplands. These soils developed under mixed prairie grasses in material weathered from shaley clay. The surface layer is gray silt loam about 5-inches thick. There is a claypan subsoil about 45-inches thick. The upper part is very dark grayish brown clay, while the lower part is dark grayish brown massive clay mottled with yellowish brown. Dwight soils are somewhat poorly drained and have very slow permeability. Available water capacity is low. • Please see the previous entry for Parsons silt loam for a description of this soil type. • Please see the previous entry for Okemah silt loam for a description of this soil type.

Sources: USDA 1968; NRCS 2004

Soils in the vicinity of Copan Lake that are classified as prime farmland include the following (NRCS 2004):

- Bates fine sandy loam, 3% to 5% slopes
- Dennis silt loam, 1% to 3% slopes
- Dennis silt loam, 3% to 5% slopes
- Eram clay loam, 3% to 5% slopes
- Okemah silt loam, 0% to 1% slopes
- Osage Clay (only considered prime farmland if drained)
- Parsons silt loam, 0% to 1% slopes (only considered prime farmland if drained)
- Verdigris clay loam
- Verdigris silt loam

4.2.2.3 Hydrology

Copan Lake is on the Little Caney River. The Little Caney River discharges into the Caney River downstream of Hulah Lake but upstream of the city of Bartlesville. The drainage area above Copan Dam is approximately 505 square miles. The gradient of the river and its tributaries range from approximately 2-feet per mile to approximately 150-feet per mile. The Little Caney River consists of one main channel and several major left bank tributaries. The drainage basin above Copan Lake contributes very little sediment because of good ground cover and a clay-type soil. In addition, the sediment inflow is further reduced by the 38 NRCS dams upstream (USACE 1983).

At normal pool, Copan Lake covers approximately 4,449 acres, which increases to approximately 13,380 acres at the top of the flood pool (USACE 2002).

The capacity of the Little Caney River channel below Copan Dam is approximately 3,000 cfs. Because the dam is near the confluence with the Caney River, backwater from large releases from Hulah Dam could reduce the channel capacity of the Little Caney River. As previously discussed, the channel capacity on the Caney River at Bartlesville, below the confluence with the Little Caney River, is approximately 12,600 cfs.

Discharges from Copan Lake are primarily for flood control in the Little Caney River and in conjunction with Hulah Lake for the Caney River. In addition, discharges also occur for water quality and water supply. As previously discussed, flood discharges are regulated in conjunction with Hulah Lake to maintain a balanced amount of flood control storage in each lake while ensuring that the capacity of the river channel at Bartlesville is not exceeded.

Copan Lake has water supply storage of 7,500 acre-feet with a dependable yield of 3 mgd (based on a 1973 survey by the USACE). The water in the Little Caney River is considered of excellent quality and requires minimal treatment to be suitable for municipal and industrial uses. In addition to the 3 mgd for water supply, the remaining conservation storage of 26,100 acre-feet supplies a maximum dependable yield of 16 mgd toward meeting the water quality needs of the area (based on a 1982 survey by the USACE). Required releases water quality from Copan Lake, as shown in table 5, are much less than the maximum dependable yield of 16 mgd.

The USFWS has not mapped wetlands in Washington County, Oklahoma, as part of the National Wetlands Inventory as of September 2005. Correspondence with the USACE Regulatory Branch has indicated that a Section 404 Permit under the Clean Water Act would not be required (appendix D).

4.2.2.4 Wild and Scenic Rivers

The Little Caney River and its tributaries are not classified as wild and scenic pursuant to the federal Wild and Scenic Rivers Act, Public Law 90-542.

4.2.2.5 Fish and Wildlife

The aquatic, wetland, and upland habitats at Copan Lake support a diversity of fish and wildlife. The ODWC has the responsibility to manage, regulate, and control fish and wildlife resources for Copan Lake. As the result of cooperative arrangements between the ODWC and the Tulsa District, several tracts (totaling 1,195 acres) adjacent to Copan Lake have been made available to Oklahoma sportsmen for restricted hunting (USACE 2005b). The following four subsections provide a brief overview of fish and wildlife species that could occur at Copan Lake.

Fish

The affected environment for fish at Copan Lake is essentially the same as that described under section 4.2.1.5 for Hulah Lake.

Amphibians and Reptiles

The affected environment for amphibians and reptiles at Copan Lake is essentially the same as that described under section 4.2.1.5 for Hulah Lake.

Birds

The affected environment for birds at Copan Lake is essentially the same as that described under section 4.2.1.5 for Hulah Lake.

Mammals

The affected environment for mammals at Copan Lake is essentially the same as that described under section 4.2.1.5 for Hulah Lake.

4.2.2.6 Threatened and Endangered Species

The USFWS has not performed an actual field survey of the proposed site due to time and personnel constraints. However, the USFWS has listed three species with the potential to occur in the project area for the water reallocation at Copan Lake (see appendix E).

The bald eagle (*Haliaeetus leucocephalus*), whooping crane (*Grus americana*), and American burying beetle (*Nicrophorus americanus*) are federally listed species that are known to occur in Washington County. The bald eagle (*Haliaeetus leucocephalus*) is an endangered and threatened species that is known to occur in the project area. Bald eagles are common winter residents along the shores of Copan Lake and are also known to nest in this area. They use tall trees near water for foraging, roosting, and nesting, and are also known to nest in cliffs. Whooping cranes, which are considered rare spring and fall migrants in this area, use emergent vegetation along the edges of marshes, prairie pothole wetlands, or lakes for resting sites; croplands for foraging; and riverine wetlands for roosting. The American burying beetle is known to occur in several counties along or near Copan Lake. In Oklahoma, it has been found in habitats ranging from deciduous and coniferous forests to open pasture. Surveys for the American burying beetle have not been conducted on Copan Lake. Since it is known to occur in the vicinity of the lake, and because it is a highly mobile species, it could occur in suitable habitat at Copan Lake. The Neosho mucket (*Lampsilis rafinesqueana*) is a federal candidate species that has been recorded in Washington County (ODWC 2004).

4.3 Cultural Resources

In accordance with section 106 of the National Historic Preservation Act of 1966 (as amended), the appropriate agencies and American Indian tribes were contacted via written correspondence (dated September 23, 2005) to discuss potential impacts on cultural resources. The Tulsa District mailed letters to the Oklahoma Historical Society State Historic Preservation Office and the Oklahoma Archeological Survey, as well as the Osage Nation of Oklahoma, Wichita and Affiliated Tribes of Oklahoma, and the Cherokee Nation of Oklahoma (appendix F). In these letters, the Tulsa District established the position that there would be “no effect” on cultural resources as a result of the Hulah and Copan lakes water reallocation project.

The Oklahoma Historical Society responded (October 13, 2005) with a determination of “no historic properties affected.” The Oklahoma Archeological Society responded (September 27, 2005) with no objection to the proposed plan. Agency responses are included in appendix F. None of the tribes contacted have provided comments on the project. section 106 coordination is therefore complete for this project.

4.4 Air Quality

The USEPA published the Conformity Rule on November 30, 1993, requiring all federal actions to conform to appropriate State Implementation Plans that were established to improve ambient air quality. National Ambient Air Quality Standards exist for six pollutants: carbon monoxide, ozone, particulate matter smaller than 10 microns, sulfur dioxide, nitrogen oxides, and lead. These “criteria pollutants” are the only ones for which standards have been established. USEPA assigns designations, based on an area’s meeting or “attaining” these standards. At this time, the Conformity Rule only applies to federal actions in nonattainment areas. A nonattainment area is an area that does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.

The project area is within the Oklahoma counties of Washington and Osage. According to maps in USEPA’s “Green Book” (for criteria pollutant nonattainment areas), all counties within Oklahoma have been designated as attainment areas for criteria pollutants and air toxins (USEPA 2004). Since the geographic region potentially affected by the Hulah and Copan lakes water reallocation project is in attainment and meets the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act, a conformity determination is not required.

4.5 Hazardous, Toxic, and Radiological Wastes

Potential pollution sources in the vicinity of Hulah and Copan lakes include agricultural practices, sewage disposal/treatment systems (septic tanks and other subsurface disposal systems, as well as municipal sewage treatment plants), private cabins and concession operations, boats, sanitary landfills, open dumps, water treatment plants, animal production facilities, and oil production facilities.

Concentrations of chlorides, sulfates, and the major cations are low in Hulah Lake. The pesticides chlordane and DDE (dichlorodiphenyldichloroethylene) have been identified in the water and fish tissue, but concentrations were below 1988 USEPA and state of Oklahoma alert levels. Toxic metals have not been detected. Iron and manganese occasionally exceed USEPA criteria for raw water sources but these metals are generally associated with the suspended solids and can be removed by conventional water treatment processes (USACE 1999).

A study conducted prior to Copan Lake becoming operational in 1983 determined that Copan Lake could have high values of calcium carbonate, chloride, iron, and manganese from the local soils. Nutrients such as phosphates and nitrogen could support algae blooms. Historical data revealed that some water quality criteria might be exceeded; however, with the exception of iron and manganese, all parameters would be below established criteria (USACE 1983).

4.6 Noise

Noise quality and natural sound exist in the absence of human-caused sound. The natural ambient sound is the aggregate of all the natural sounds that occur in area, together with the physical capacity for transmitting natural sounds. The frequencies, magnitudes, and duration of human-caused noise considered acceptable varies, being generally greater in developed areas and less in undeveloped areas. Noise sources at Hulah and Copan lakes are primarily affiliated with recreation activities and include motor boats, motor vehicles, hunting, and people at the marinas, campgrounds, and other recreational facilities surrounding the lakes.

4.7 Land and Recreational Use

Hulah Lake

Hulah Lake was constructed for flood control, water supply and recreation. Primary land use around Hulah Lake is for farming and ranching. Recreational opportunities include fishing and hunting. The principal species of fish in the lake include largemouth bass, white bass, crappie, channel catfish, flathead catfish, and bullhead catfish. Approximately 8,900 acres of project lands have been made available to the ODWC for wildlife management purposes. Two thousand acres of this have been set aside as a state waterfowl refuge; the remainder is managed for upland game and whitetail deer and is open to the public as a hunting area. Game species prevalent are deer (abundant), mourning dove (good), waterfowl (good), prairie chicken (low), wild turkey (fair), cottontail rabbit (good), and squirrel (good). Camping and picnicking facilities are also available at Hulah Lake and include boat launching ramps, camping and picnicking sites, beaches, and sanitary facilities in the developed park areas around the lake. Overnight accommodations, services, and supplies are also available on the lake.

Copan Lake

Copan Lake was constructed for flood control, water supply, and recreation. Primary land use around Copan Lake is for farming and ranching. Recreational opportunities include fishing and hunting. The principal species of fish in the lake include largemouth bass, white crappie, channel and flathead catfish, and various species of sunfish. The lake has also received an experimental stocking of the hybrid cross between the white bass and the striped bass, more commonly called the “wiper.” Approximately 1,200 acres of land managed by the ODWC or Tulsa District are open for hunting. There are also day-use areas beach areas, picnic sites, camping, and boat launching ramps.

5. Environmental Impacts of the Proposed Action

A summary of environmental impacts is presented in table 7.

Table 7. Impact Assessment Matrix

Name of Parameter	Magnitude of Probable Impact						
	Increasing Beneficial Impact			No Appreciable Effect	Increasing Adverse Impact		
	Significant	Substantial	Minor		Minor	Substantial	Significant
A. Social Effects							
1. Noise Levels				X			
2. Aesthetic Values				X			
3. Recreational Opportunities				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth and Development			X				
8. Business and Home Relocations			X				
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. Economic Effects							
1. Property Values				X			
2. Tax Revenues				X			
3. Public Facilities and Services			X				
4. Regional Growth			X				
5. Employment			X				
6. Business Activity			X				
7. Farmland/Food Supply				X			
8. Flooding Effects				X			

Table 7. Impact Assessment Matrix (continued)

Name of Parameter	Magnitude of Probable Impact						
	Increasing Beneficial Impact			No Appreciable Effect	Increasing Adverse Impact		
	Significant	Substantial	Minor		Minor	Substantial	Significant
C. Natural Resource Effects							
1. Air Quality				X			
2. Terrestrial Habitat				X			
3. Wetlands				X			
4. Aquatic Habitat					X		
5. Habitat Diversity and Interspersion				X			
6. Biological Productivity					X		
7. Surface Water Quality				X			
8. Water Supply		X					
9. Groundwater				X			
10. Soils				X			
11. Threatened and Endangered Species				X			
12. Hazardous, Toxic, Radioactive Materials				X			
D. Cultural Resources							
1. Historic Architectural Values				X			
2. Pre-Historic and Historic Archeological Values				X			

5.1 Socioeconomics

5.1.1 No-Action Alternative

Under the no-action alternative, water reallocation in Hulah Lake and Copan Lake would not occur. With no action, existing water supply sources for the city of Bartlesville would be insufficient for meeting projected 2035 needs. The existing water supply yield for Hulah Lake is currently 9.9 mgd; however, the dependable yield for year 2035 is 6.4 mgd due to sedimentation. The city's future demand of approximately 12 mgd would not be met by Hulah Lake's insufficient yield of roughly 6.4 mgd. If allowed to remain status quo, an insufficient yield of water would have indirect adverse impacts on the socioeconomic characteristics in the project area. Because the demand for water would remain the same, but with a smaller supply, it is not unreasonable to expect that the cost for water would rise in the social area. Following the rise in cost, industries and consumers could take one or more options. Industries could reduce their capacity of manufacturing (i.e., supplying their product), which would result in the loss of employment, or they could implement water conservation practices and technologies in order to sustain their productivity. Consumers could also implement water conserving practices and technologies in their homes.

5.1.1.1 Population

Under the no-action alternative, there would be long-term minor indirect adverse impacts on the population of the city of Bartlesville and surrounding area. Population trends of the past decade would continue. Population dynamics are influenced by economic and recreational opportunities in the counties of Osage and Washington, and the city of Bartlesville. However, economic opportunities (e.g., employment) would be hampered by the limited supply of water available to promote business growth in the social area which could result in stagnant to decreased population levels.

5.1.1.2 Employment and Income

Under the no-action alternative, there would long-term minor direct adverse impacts on the employment capabilities of Osage and Washington counties and the city of Bartlesville. Historically bodies of water have been a center for commerce and communities. If conditions were allowed to persist, the available dependable yield would be nearly half (6.4 mgd) of the anticipated demand by 2035. This would likely result in the displacement of jobs, especially in the manufacturing and retail industries and agriculture, which normally have large demands for water. This, of course, is dependent on whether water conservation practices and technologies were put in place. Conversely, employment levels could remain the same but employment growth could be encumbered by limited water supply. Under the no-action alternative, there would be long-term minor indirect adverse impacts on the income level of the counties and city. The income of the area would decrease as the number of employment opportunities decreased. Impacts on median household income could sharply decline if one or more household providers become unemployed.

5.1.1.3 Environmental Justice

Although the social area has a population with a very high percentage of American Indians, it is not expected that they would bear any disproportionate impacts. Minority populations would share adverse impacts equally with the rest of the social area.

5.1.1.4 Social Ecology

Under the no-action alternative, there would both long- and short-term direct and indirect adverse impacts on the social ecology in Osage and Washington counties and the city of Bartlesville. All areas of lifestyle would be disadvantaged. Manufacturing, commercial, industrial, and agriculture trades and industries that make up the area would be largely impacted, thereby damaging the population, employment, and income growth and sustainability of the area. The result would be a less diverse social ecology, as employment opportunities ceased or became fewer. On the other hand, industries and other consumers could invest in water-conserving technologies and implement practices to save water. This could be beneficial to companies supplying water conservation equipment.

5.1.2 Proposed Action

Under the proposed action, the future dependable water supply of at least 12 mgd would be secured and the water demands of Osage and Washington counties and the city of Bartlesville would be met through 2035.

5.1.2.1 Population

The proposed action would have a long-term minor indirect beneficial impact on the population of the social area. Population trends would continue as is, resulting in an added demand for water. Although it would not have an impact on overall population growth trends in Oklahoma, this water supply would ensure that the water would be available for new industrial, agricultural, and municipal users in this area. This could promote growth of business-related opportunities or residential development in the social area, which could cause small, local changes in population.

5.1.2.2 Employment and Income

The proposed action would have long-term minor direct beneficial impacts on the employment of the social area. Current employment trades and industries could continue to operate nominally or would have the availability for expansion as there would not be a limited supply of water. The growth in employment would perpetuate population and income growth and sustainability through at least 2035. The educational, health and social services, manufacturing, and retail trade sectors are expected to continue being an important part of the economy in this area. Under the proposed action, there would be long-term minor beneficial impacts on the income in the employment area. There would not likely be a surge in income level; however, per capita and median household incomes would be sustained through the employment opportunities present in the social area.

5.1.2.3 Environmental Justice

The proposed action would have no disproportional impacts on minority or low-income populations in the social area. These populations would continue to share the same privileges and opportunities as others.

5.1.2.4 Social Ecology

The proposed action would have no impacts on the area’s social ecology. The proposed action would allow for the continued way of life of the social area, including agriculture and manufacturing (a large employer). The reallocation of water would reinforce the social ecology of this area as primarily a mix of residential, agricultural, and business.

5.2 Natural Resources

5.2.1 No-Action Alternative

Under the no-action alternative, conditions at Hulah Lake and Copan Lake would remain status quo. There would be no impacts on natural resources.

5.2.2 Proposed Action

5.2.2.1 Terrestrial

The proposed action would have no impact on terrestrial resources. Construction and earth-moving activities would not be associated with the water reallocation project at Hulah Lake and Copan Lake. Reductions in elevation duration, elevation frequency, discharge duration, and discharge frequency would not be expected to have effects on terrestrial resources such as upland plant communities. Because the proposed action does not involve raising lake levels, additional flooding or backwater effects would not occur on terrestrial resources upstream of Hulah Lake or Copan Lake.

5.2.2.2 Soils and Prime Farmland

The proposed action would have no impact on soils or prime farmland. Although soils classified as prime farmland do exist in the project area, there would be no effects from the water reallocation at Hulah and Copan Lakes. None of these soils would be converted to different uses (i.e., taken out of agricultural production), nor would they be affected by the reductions in elevation duration, elevation frequency, discharge duration, or discharge frequency.

5.2.2.3 Hydrology

Reallocation of the available water quality storage in Hulah and Copan lakes would result in no changes to the flood control pool at either lake, and no changes to the flood control protection for the downstream reaches including the city of Bartlesville. As shown in the SUPER model analysis (see appendix B), the elevation duration, elevation frequency, discharge duration, and discharge frequency at Hulah and Copan lakes experience negligible change as a result of the implementation of the proposed action. The proposed action will require reallocating 2,122 ac-ft from water quality storage at Hulah Lake, and 11,790 ac-ft from water quality storage to water supply storage at Copan Lake. Tables 8 and 9 provide the pertinent data with and without the water supply reallocation.

The SUPER model calculated information for both reservoirs under the no-action alternative and the proposed action using the data available (1940 to 2000). The elevation frequency, or the percent of years in which a given lake elevation is equaled or exceeded, would not change perceptibly for either lake with implementation of the proposed action (see figures 1 and 3 in appendix B). The SUPER model also indicated that the elevation duration, or the percent of time for which a given lake elevation is exceeded, would not change when lake elevations are approximately 733 feet AMSL or higher for Hulah Lake (see figure 2 in appendix B) or approximately 710 feet AMSL or higher for Copan Lake (see figure 4 in appendix B). Elevation duration would decrease by approximately 2% to 5% under the proposed action. For example, under current conditions, elevations of approximately 707 feet at Copan Lake are exceeded approximately 95% of the time; under the proposed action, this elevation would be exceeded approximately 90% of the time.

Table 8 – Hulah Lake Pertinent Data					
Feature	**Elevation (ft)**	**Data from 1973 Survey (ac-ft)**	**Data from 2002 Survey (ac-ft)**	**2035 Conditions (ac-ft)**	**Data from 2002 Survey after Realloca-tion (ac-ft)**
Top of Dam	779.5				
Top of Flood Control Pool	765.0	289,000	289,000[a]		
Flood Control Storage	733.0-765.0	257,900	257,900[a]		
Spillway Crest	740.0	61,400	61,400		
Top of Conservation Pool	733.0	31,160	22565	13,074	
Active Conservation Storage	710.0-733.0	31,100	22553	13,074	
Water Supply		19,800	16,600	9,622	18,722[b]
Water Quality		7,100	5,953	3,452	3,831[b]
Sediment Storage		4,200	0	0	
Inactive Storage	710.0	0	12	0	

Notes:
[a] Flood pool was not resurveyed. No adjustment to flood control storage made.
[b] Water supply reallocation of 2122 ac-ft based on 2002 data

Table 9 – Copan Lake Pertinent					
Feature	**Elevation (ft)**	**Data from 1983 Survey (ac-ft)**	**Data from 2002 Survey (ac-ft)**	**2035 Conditions (ac-ft)**	**Data from 2002 Survey after Realloca-tion (ac-ft)**
Top of Dam	745.0	--	--	--	
Top of Flood Control Pool	732.0	227,700	227,700[a]	--	
Flood Control Storage	710.0 to 732.0	184,300	184,300[a]	--	
Top of Conservation Pool	710.0	43,400	34,634	30,060	
Active Conservation Storage	687.5 to 710.0	42,800	33,887	29,369	
Water Supply	--	7,500	7,500	6,555	19,290[b]
Water Quality	--	26,100	26,100	22,814	14,310[b]
Sediment Storage	--	9,200	287	0	
Inactive Storage	687.5	600	747	0	

Notes:
[a] Flood pool was not resurveyed. No adjustment to flood control storage made.
[b] Water supply reallocation of 2122 ac-ft based on 2002 data

Based on the results of the modeling discharge frequency, or the percent of years in which a given discharge would be equaled or exceeded, reservoir outflows would not change perceptibly for either lake (see figures 5 and 7 in appendix B). The model results also show that discharge duration, or the percent of time for which a given discharge would be equaled or exceeded, would also be only slightly reduced. This change would be the most pronounced, but still only slightly reduced for lower flow discharges between approximately 10 and 150 cfs for both reservoirs. For example, under current conditions, discharges of 60 cfs at Copan Lake are equaled or exceeded approximately 34% of the time. Under the proposed action, these discharges would be equaled or exceeded approximately 31% of the time. In addition, modeling of discharge duration and frequency at Bartlesville and Ramona, on the Caney River downstream of both lakes, indicate that the effects of the proposed action are reduced the further one travels below the lake (see figures 9 through 12 in appendix B).

The slight reduction in elevation duration and frequency at Hulah and Copan lakes is not expected to affect aquatic or wetlands habitat adversely. Although lake levels might be reduced slightly, this could result in the creation of wetlands in areas that were previously flooded. Backwater effects (e.g., flooding) on aquatic and wetlands habitat at and upstream of the lake are not anticipated.

The reduction in discharge duration and frequency would have negligible effects on aquatic and wetlands habitat downstream of both lakes since such reductions are negligible. The model results for Bartlesville and Ramona indicate the effects would be reduced as one travels further downstream from the lake. Additionally, regulation of water quality on the Caney and Little Caney rivers is an authorized project purpose for both lakes. Low-flow releases, as outlined in table 5, generally ensure the water quality of both rivers downstream of the lakes. Finally, during drought conditions, drought contingency plans would be implemented (see section 6, "Mitigation Plan") to ensure that adequate water is available for conservation purposes.

Because the proposed action does not involve raising lake levels, additional flooding or backwater effects would not occur on aquatic and wetland habitat upstream of Hulah Lake or Copan Lake. No wetlands or water quality permits under the Clean Water Act would be required for implementation of the proposed action (see appendix D).

5.2.2.4 Fish and Wildlife

Construction and earth-moving activities are not necessary to implement the water reallocation project at Hulah and Copan lakes; therefore, upland wildlife habitat and species would be unaffected. Reductions in elevation duration, elevation frequency, discharge duration, and discharge frequency (as discussed in section 5.2.2.3, "Hydrology") could have impacts on wildlife that use the aquatic and wetlands habitat available in the lakes and Caney and Little Caney rivers. A reduction in elevation duration and frequency could result in the formation of new wetlands, which would provide important wildlife habitat in areas that were previously inundated. Although this could result in the loss of shoreline aquatic habitat for wading birds and waterfowl and amphibians, the effects would be imperceptible given the extent of this habitat at Hulah and Copan lakes. In addition, the implementation of seasonal pool plans that benefit wildlife would continue to cause periodic inundation of these areas, temporarily restoring such habitat. Therefore, the proposed action is not anticipated to significantly affect wildlife or their habitat at Hulah or Copan lakes.

Under the proposed action, slight reductions in discharge duration and frequency from Hulah or Copan lakes are not expected to significantly affect wildlife or their habitat downstream. These reductions could, at times, cause pools that provide habitat for fish along the Caney or Little Caney rivers to be shallower; however, impacts would be negligible.

Because the proposed action does not involve raising lake levels, additional flooding or backwater effects would not occur on aquatic and wetland habitat upstream of Hulah Lake or Copan Lake.

5.2.2.5 Threatened and Endangered Species

Overall, the proposed action is not likely to adversely affect any of the federally listed species that occur at Hulah or Copan lakes.

American Burying Beetle

Although the American burying beetle has the potential to occur at Hulah Lake or Copan Lake, the proposed action would not affect the terrestrial environment in which this species is supported (upland plant communities). Therefore, the proposed action is not anticipated to have significant effects on this species.

Arkansas River Shiner

Impacts on the Arkansas River shiner are not anticipated under the proposed action because this species is not likely to occur in the project area. In addition, changes in discharge or elevation duration and frequency at Hulah Lake are not anticipated to alter the potential habitat for this species. There would be no changes in water quality that could affect the prey base of this species under this alternative. Therefore, the proposed action would have no effect on the Arkansas River shiner.

Bald Eagle

Reductions in elevation duration and frequency at Hulah and Copan lakes would not result in the loss of shoreline habitat (e.g., large trees near the water) that supports bald eagles. In addition, there would be no construction-related activities that could impact bald eagles (e.g., noise from heavy-equipment or tree removal). There would be no changes in water quality that could affect the prey base of the bald eagle under this alternative. Therefore, the proposed action would have no effect on bald eagles at Hulah or Copan lakes.

Interior Least Tern

Reductions in discharge duration and frequency are not anticipated to affect the hydrologic conditions that could create sandbar habitats potentially used by interior least terns downstream of Hulah Lake. Because there would be no construction-related activities that could impact interior least terns (e.g., heavy equipment noise or habitat loss) and because potential changes to downstream discharges would have no impacts, the proposed action would have no effect on potential interior least terns downstream of Hulah Lake.

Piping Plover

Although habitat for the piping plover is supported in the Hulah Lake project area, historical records indicate that it occurs primarily as migrants in the vicinity of the lakes. Regardless, reductions in discharge duration and frequency are not anticipated to affect the hydrologic conditions that create the wetland and mudflat areas downstream of the lake that might be used by this species. Because there would be no construction-related activities that could impact piping plovers (e.g., heavy equipment noise or habitat loss), because potential changes to discharge or elevation duration and frequency would have no impact on their habitat, and because there would be no changes in water quality that could affect the prey base, the proposed action would have no effect on this species.

Whooping Crane

Although habitat for the whooping crane is supported in the Hulah and Copan lakes project areas, historical records indicate that it occurs primarily as migrants in the vicinity of the lakes. Regardless, reductions in discharge duration and frequency are not anticipated to affect the hydrologic conditions that create the wetland and mudflat areas downstream of the lake that might be used by this species. Reductions in elevation duration and frequency at Hulah or Copan lakes would not significantly affect the shoreline habitat that might be used by whooping cranes. In fact, a reduction in elevation duration and frequency at the lake could result in the formation of new wetlands, which could provide additional rest areas for whooping cranes. Because there would be no construction-related activities that could impact whooping cranes (e.g., heavy equipment noise or habitat loss), because potential changes to discharge or elevation duration and frequency would have no impact on their habitat, and because there would be no changes in water quality that could affect the prey base, the proposed action would have no effect on this species.

5.3 Cultural Resources

5.3.1 No-Action Alternative

Under the no-action alternative, conditions at Hulah Lake and Copan Lake would remain status quo. There would be no impact on cultural resources.

5.3.2 Proposed Action

The proposed action does not involve construction or earth-moving activities or changes in pool elevation activities. Therefore, it is expected that the proposed action would have no effect on cultural resources. As discussed in section 4.3, section 106 coordination under the National Historic Preservation Act has been initiated (appendix F). No responses have been received to date.

5.4 Air Quality

5.4.1 No-Action Alternative

Under the no-action alternative, conditions at Hulah Lake and Copan Lake would remain status quo. There would be no impact on air quality.

5.4.2 Proposed Action

The proposed action would have no effect on air quality. No earth-moving, ground-disturbing, or other activities that emit air pollutants would occur.

5.5 Hazardous, Toxic, and Radiological Wastes

5.5.1 No-Action Alternative

Under the no-action alternative, conditions at Hulah Lake and Copan Lake would remain status quo. There would be no impact on hazardous, toxic, or radiological wastes.

5.5.2 Proposed Action

The proposed action would have no effect on hazardous, toxic, or radiological wastes. Reallocation of water supply at Hulah and Copan lakes would not change storage pool elevation levels, surface water runoff into the lakes, or disturb sediments on the lake bottoms.

5.6 Noise

5.6.1 No-Action Alternative

Under the no-action alternative, conditions at Hulah Lake and Copan Lake would remain status quo. There would be no impact on noise in the project area.

5.6.2 Proposed Action

The proposed action would have no effect on the noise environment. Reallocation of water supply would not result in or increase any activities that would produce noise.

5.7 Land and Recreational Use

5.7.1 No-Action Alternative

Under the no-action alternative, conditions at Hulah Lake and Copan Lake would remain status quo. There would be no impact on land and recreational use in the project area.

5.7.2 Proposed Action

The proposed action would have negligible effect on land use or recreational activities. Reallocation of water supply would not change storage pool elevation levels or current land use in or around the lakes. Over the long term, reallocation could allow for adequate water supply to encourage additional agricultural or industrial users, but these would most likely be closer to the city of Bartlesville.

5.8 Cumulative Impacts

No cumulative impacts are anticipated to occur as a result of the proposed project. However, if any future construction such as pipelines for water conveyance is found to be necessary, separate NEPA documents would be prepared to study the effects of the necessary construction and its impacts.

6. Mitigation Plan

Additional mitigation measures would not be necessary to implement the proposed action. However, existing measures are in place to reduce potentially adverse effects. Regulation of flows on the Caney and Little Caney rivers is an authorized project purpose for both lakes. During drought conditions, a Drought Contingency Plan is implemented at both lakes (USACE 1972, 1999). The Drought Contingency Plan establishes a USACE Drought Management Committee and an Interagency Drought Management Committee to conserve stored water and to identify surplus water available during drought conditions.

7. Federal, State, and Local Agency Coordination

The draft EA was coordinated with agencies having legislative and administrative responsibilities for environmental protection. Copies of the correspondence from those agencies that provided comments and planning assistance for preparation of the draft EA are in the appendices. Following is a list of officials from federal, state and local agencies, and tribes that were consulted as part of the EA process. The detailed mailing list, including federal, state, and local agencies; tribes; elected officials; and private citizens, is included in appendix G.

Bartlesville City Manager
Bartlesville Water Utilities
Cherokee Nation of Oklahoma
Delaware Nation of Oklahoma
Delaware Tribe of Indians, Oklahoma
Kaw Indian Tribe of Oklahoma
Oklahoma Archeological Survey
Oklahoma Department of Environmental Quality
Oklahoma Department of Wildlife Conservation
Oklahoma Historical Society State Historic Preservation Office
Oklahoma Water Resources Board
Osage Nation of Oklahoma
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Wichita and Affiliated Tribes of Oklahoma

8. References

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9. Applicable Environmental Laws and Regulations

Table 10 contains a list of environmental laws and regulations that might apply to the proposed action.

Table 10. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements

Federal Policies	Compliance
Archeological and Historic Preservation Act, 1974, as amended, 16 USC 469, *et seq.*	All plans in full compliance
Clean Air Act, as amended, 42 USC 7609, *et seq.*	All plans in full compliance
Clean Water Act, 1977, as amended, Federal Water Pollution Control Act, 33 USC 1251, *et seq.*	All plans in full compliance
Endangered Species Act, 1973, as amended, 16 USC 1531, *et seq.*	All plans in full compliance
Farmland Protection Policy Act, 7 USC 4201, *et seq.*	All plans in full compliance
Federal Water Project Recreation Act, as amended, 16 USC 460-1-12, *et seq.*	All plans in full compliance
Fish and Wildlife Coordination Act, as amended, 16 USC 661, *et seq.*	All plans in full compliance
Land and Water Conservation Fund Act, 1965, as amended, 16 USC 4601, *et seq.*	All plans in full compliance
National Environmental Policy Act, as amended, 42 USC 4321, *et seq.*	All plans in full compliance
National Historic Preservation Act, 1966, as amended, 16 USC 470a, *et seq.*	All plans in full compliance
Native American Graves Protection and Repatriation Act, 1990, 25 USC 3001–13, *et seq*.	All plans in full compliance
Rivers and Harbors Act, 33 USC 401, *et seq.*	N/A
Water Resources Development Act of 1986, Public Law 99-662	All plans in full compliance
Water Resources Planning Act, 1965	N/A
Watershed Protection and Flood Prevention Act, 16 USC 1001, *et seq*.	N/A
Wild and Scenic Rivers Act, as amended, 16 USC 1271, *et seq.*	N/A
Floodplain Management (EO 11988)	All plans in full compliance
Protection of Wetlands (EO 11990)	All plans in full compliance
Environmental Justice (EO 12898)	All plans in full compliance
Protection of Children From Environmental Health Risks and Safety Risks (EO 13045)	All plans in full compliance

Note: Full compliance means all requirements of the statutes, EOs, or other environmental requirements for the current stage of planning have been met.

10. List of Preparers

This EA has been prepared under the direction of Mr. Jerry Sturdy and Ms. Jan Hottubbee of USACE Tulsa District. Individuals from engineering-environmental Management, Inc. (e^2M) who contributed to the preparation of this document are listed below.

Jayne Aaron
M.A. Environmental Policy and Management
B.A. Architecture
Years of Experience: 12

Anne Baldrige – Project Manager
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B.A.A.S. Wildlife Biology
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M.S. Biology, Chemistry
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Years of Experience: 20

Mary Young
B.S. Environmental Science
Years of Experience: 3

APPENDIX A

SCOPING COORDINATION/CORRESPONDENCE

Attachment 3: Media Release

US Army Corps of Engineers®
Tulsa District

DRAFT NEWS RELEASE

For Immediate Release

To: News Directors, Assignment Editors, and Editors

Synopsis: The U.S. Army Corps of Engineers will host a public workshop to discuss the Hulah and Copan Lakes Reallocation Study.

Release No. 03
July 2003

Workshop to present the Hulah and Copan Lakes Reallocation Study

TULSA, Okla. -- The Tulsa District, U.S. Army Corps of Engineers will host a public information workshop, Tuesday, August 19, 2003, to provide information to the public and solicit comments and questions about the Hulah and Copan Lakes Reallocation Study.

The Corps of Engineers study will evaluate the water supply storage alternatives to address the increased demand in the area. The goal is to determine the best method to provide the necessary storage. The purpose of the study is to address the need in the area for additional water supply storage, formulate a variety of alternatives, and select a recommended plan of action or non-action.

The workshop will be held from 5:00 p.m. to 8:00 p.m. at the Bartlesville Community Center, 300 SE Adams Boulevard, Bartlesville, Oklahoma. The workshop will be an open house format with no set or formal presentations. Everyone is invited to attend, visit information tables and discuss the project with representatives from the Corps' Tulsa District.

The workshop and comment solicitation are part of the environmental documentation (scoping), conducted in compliance with the National Environmental Policy Act. Scoping is the process of identifying potential environmental impacts of proposed Federal actions by soliciting comments and questions from the public and government agencies.

For more information on this study, contact Mr. David Combs in the Tulsa office, 918-669-7660.

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Paid Advertisement

~ **Announcing** ~

PUBLIC INVOLVEMENT WORKSHOP AND SCOPING PROCESS

as related to the

Hulah and Copan Lakes Reallocation Study

in compliance with

The National Environmental Policy Act

On August 19th, the U.S. Army Corps of Engineers will host a public workshop to provide information about the Hulah and Copan Lakes Reallocation Study in Bartlesville, Oklahoma and to solicit comments and questions.

The workshop will be an open house format with no set or formal presentation. Interested persons may arrive anytime between 5:00 p.m. and 8:00 p.m., visit information tables, discuss the study with Corps personnel, make comments and ask questions. The workshop will be held at the following location and time:

August 19, 2003
5:00 p.m. to 8:00 p.m.

Bartlesville Community Center
300 SE Adams Boulevard
Bartlesville, Oklahoma
Phone 918-337-2787

Scoping Process

The workshop is part of an effort by the Corps to inform the public about the reallocation study in progress and to gather information from the public. The purpose of the study is to address the need in the area for additional water supply storage, formulate a variety of alternatives, and select a recommended plan of action or non-action. This public workshop is in compliance with the National Environmental Policy Act. As part of the scoping process, the Corps of Engineers requests that the public, interested parties, Federal, State and local agencies take part in the planning process by identifying issues related to the study and provide input in the development of alternatives to address the water supply issues. The Corps will include this input as it develops reallocation alternatives for Hulah and Copan Lakes. Comments and questions can be forwarded to:

Mr. David Combs
U.S. Army Corps of Engineers, Tulsa District
ATTN: CESWT-PE-E
1645 S. 101st East Avenue
Tulsa, OK 74128-4609
Phone: 918-669-7660
E-mail: David.L.Combs@usace.army.mil

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Announcing: COMMENT PERIOD
DRAFT ENVIRONMENTAL ASSESSMENT
as related to the
WATER REALLOCATION PROJECT AT HULAH LAKE AND COPAN LAKE, OKLAHOMA
In compliance with
The National Environmental Policy Act
FORMAL COMMENT PERIOD: December 30, 2005 through January 30, 2006

The Draft Environmental Assessment addresses the environmental and socioeconomic effects of the reallocation of water from Hulah and Copan Lakes to provide an adequate water supply for the City of Bartlesville. The comment period is a continuation of public involvement used to develop the Draft Environmental Assessment. The public is invited to review the Draft Environmental Assessment and make comments. A copy of the assessment is available at:

Bartlesville Public Library
600 S. Johnstone
Bartlesville, OK 74003

Written comments and questions will be addressed in the Final Environmental Assessment. To be included in the final assessment, comments and questions must be received prior to the close of the formal comment period. Comments and questions about the draft assessment or the comment process can be directed to:

Mr. Stephen L. Nolen
Chief, Environmental Analysis & Compliance Branch
U.S. Army Corps of Engineers, Tulsa District
1645 S. 101st East Avenue
Tulsa, Oklahoma 74128
Phone: 918-669-7660
e-mail: Steven.L.Nolen@SWT03.usace.army.mil

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

June 7, 2004

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Richard E. Greene
Federal Region VI Administrator
Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, TX 75202

Dear Mr. Greene:

This is to inform you that the Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake, Oklahoma. We are beginning the process of preparing an Environmental Assessment addressing the effects of water reallocation to provide additional water supply storage. The study is being conducted because the City of Bartlesville, which is dependant upon water supply from Hulah Lake, recently experienced a critical water shortage because of extreme drought conditions in the Caney River Basin. Consequently, the City of Bartlesville has requested that the Tulsa District look at alternatives for increasing water supply to the City. Additional water supply storage in Hulah Lake and Copan Lake is needed because sedimentation has reduced the existing storage capacity in Hulah Lake, and population growth in the City of Bartlesville has increased water demand.

The Tulsa District is working with the City of Bartlesville to develop a range of alternatives that would provide adequate water supply storage to meet current and future demands. The following are alternatives under consideration:

- **Reallocate Water Quality Storage in Hulah Lake and Copan Lake to Water Supply Storage**: This alternative does not require a change in lake levels.

- **Reallocate Water Quality Storage in Hulah Lake and Copan Lake and Implement Seasonal Pool Plans:** This alternative considers a variety of Seasonal Pool Plans and the reallocation of water quality storage to water supply storage. Seasonal pool plans under consideration could increase water levels in Hulah Lake by up to 4.55 feet and Copan Lake by up to 3 feet (a 7.5 and 8.1 percent increase, respectively). These plans would generally be implemented between May and November in any given year.

- **Reallocate Flood Control Storage and Water Quality Storage in Hulah Lake and Copan Lake:** This alternative considers permanently raising water levels in Hulah Lake and Copan Lake by up to 3.15 feet and 2 feet, respectively (a 5 percent increase in both cases), in addition to reallocating water quality storage to water supply storage.

- **Combination of Flood Control and Water Quality Storage Reallocations and Implementing Seasonal Pool Plans:** These alternatives consider permanently increasing water levels in Hulah Lake and Copan Lake by up to 3.15 and 2 feet, respectively (a 5 percent increase in both cases); implementing seasonal pool plans (generally between April and November) that could increase water levels in Hulah Lake by up to 4 feet and Copan Lake by up to 3 feet (a 6.5 and 8.1 percent increase, respectively); and reallocating water quality storage to water supply storage.

We are preparing documentation for compliance with the National Environmental Policy Act of 1969 and would appreciate comments from your agency concerning this proposed action.

If you have any questions or require additional information, please contact Mr. Jerry Sturdy at 918-669-4397.

Sincerely,

for Larry D. Hogue, P. E.
Chief, Planning, Environmental
and Regulatory Division

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

June 7, 2004

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Jerry Brabander
Field Supervisor
U.S. Fish & Wildlife Service
222 South Houston, Suite A
Tulsa, OK 74127

Dear Mr. Brabander:

This is to inform you that the Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake, Oklahoma. We are beginning the process of preparing an Environmental Assessment addressing the effects of water reallocation to provide additional water supply storage. The study is being conducted because the City of Bartlesville, which is dependant upon water supply from Hulah Lake, recently experienced a critical water shortage because of extreme drought conditions in the Caney River Basin. Consequently, the City of Bartlesville has requested that the Tulsa District look at alternatives for increasing water supply to the City. Additional water supply storage in Hulah Lake and Copan Lake is needed because sedimentation has reduced the existing storage capacity in Hulah Lake, and population growth in the City of Bartlesville has increased water demand.

The Tulsa District is working with the City of Bartlesville to develop a range of alternatives that would provide adequate water supply storage to meet current and future demands. The following are alternatives under consideration:

- **Reallocate Water Quality Storage in Hulah Lake and Copan Lake to Water Supply Storage**: This alternative does not require a change in lake levels.

- **Reallocate Water Quality Storage in Hulah Lake and Copan Lake and Implement Seasonal Pool Plans:** This alternative considers a variety of Seasonal Pool Plans and the reallocation of water quality storage to water supply storage. Seasonal pool plans under consideration could increase water levels in Hulah Lake by up to 4.55 feet and Copan Lake by up to 3 feet (a 7.5 and 8.1 percent increase, respectively). These plans would generally be implemented between May and November in any given year.

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- **Reallocate Flood Control Storage and Water Quality Storage in Hulah Lake and Copan Lake:** This alternative considers permanently raising water levels in Hulah Lake and Copan Lake by up to 3.15 feet and 2 feet, respectively (a 5 percent increase in both cases), in addition to reallocating water quality storage to water supply storage.

- **Combination of Flood Control and Water Quality Storage Reallocations and Implementing Seasonal Pool Plans:** These alternatives consider permanently increasing water levels in Hulah Lake and Copan Lake by up to 3.15 and 2 feet, respectively (a 5 percent increase in both cases); implementing seasonal pool plans (generally between April and November) that could increase water levels in Hulah Lake by up to 4 feet and Copan Lake by up to 3 feet (a 6.5 and 8.1 percent increase, respectively); and reallocating water quality storage to water supply storage.

Your comments are requested in accordance with the Fish and Wildlife Coordination Act and the Endangered Species Act. If you have any questions or require additional information, please contact Mr. Jerry Sturdy at 918-669-4397.

Sincerely,

Stephen L. Nolen

for Larry D. Hogue, P. E.
Chief, Planning, Environmental
and Regulatory Division

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DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

June 7, 2004

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Darrel Dominick
State Conservationist
USDA Agri-Center Bldg
100 USDA, Suite 206
Stillwater, OK 74074-2655

Dear Mr. Dominick:

This is to inform you that the Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake, Oklahoma. We are beginning the process of preparing an Environmental Assessment addressing the effects of water reallocation to provide additional water supply storage. The study is being conducted because the City of Bartlesville, which is dependant upon water supply from Hulah Lake, recently experienced a critical water shortage because of extreme drought conditions in the Caney River Basin. Consequently, the City of Bartlesville has requested that the Tulsa District look at alternatives for increasing water supply to the City. Additional water supply storage in Hulah Lake and Copan Lake is needed because sedimentation has reduced the existing storage capacity in Hulah Lake, and population growth in the City of Bartlesville has increased water demand.

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We are preparing documentation for compliance with the National Environmental Policy Act of 1969 and would appreciate comments from your agency concerning this Proposed Action.

If you have any questions or require additional information, please contact Mr. Jerry Sturdy at 918-669-4397.

Sincerely,

Stephen L. Nolen

for Larry D. Hogue, P. E.
Chief, Planning, Environmental
and Regulatory Division

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

June 7, 2004

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Steve Thompson
Executive Director
Oklahoma Department of Environmental Quality
P.O. Box 1677
Oklahoma City, OK 73101-1677

Dear Mr. Thompson:

This is to inform you that the Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake, Oklahoma. We are beginning the process of preparing an Environmental Assessment addressing the effects of water reallocation to provide additional water supply storage. The study is being conducted because the City of Bartlesville, which is dependant upon water supply from Hulah Lake, recently experienced a critical water shortage because of extreme drought conditions in the Caney River Basin. Consequently, the City of Bartlesville has requested that the Tulsa District look at alternatives for increasing water supply to the City. Additional water supply storage in Hulah Lake and Copan Lake is needed because sedimentation has reduced the existing storage capacity in Hulah Lake, and population growth in the City of Bartlesville has increased water demand.

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We are preparing documentation for compliance with the National Environmental Policy Act of 1969 and would appreciate comments from your agency concerning the Proposed Action..

If you have any questions or require additional information, please contact Mr. Jerry Sturdy at 918-669-4397.

Sincerely,

for Larry D. Hogue, P. E.
Chief, Planning, Environmental
and Regulatory Division

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

June 7, 2004

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Greg D. Duffy, Director
Oklahoma Department of Wildlife Conservation
P.O. Box 53465
Oklahoma City, OK 73105

Dear Mr. Duffy:

This is to inform you that the Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake, Oklahoma. We are beginning the process of preparing an Environmental Assessment addressing the effects of water reallocation to provide additional water supply storage. The study is being conducted because the City of Bartlesville, which is dependant upon water supply from Hulah Lake, recently experienced a critical water shortage because of extreme drought conditions in the Caney River Basin. Consequently, the City of Bartlesville has requested that the Tulsa District look at alternatives for increasing water supply to the City. Additional water supply storage in Hulah Lake and Copan Lake is needed because sedimentation has reduced the existing storage capacity in Hulah Lake, and population growth in the City of Bartlesville has increased water demand.

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We are preparing documentation for compliance with the National Environmental Policy Act of 1969 and would appreciate comments from your agency concerning fish and wildlife species of concern that might occur in the project area.

If you have any questions or require additional information, please contact Mr. Jerry Sturdy at 918-669-4397.

Sincerely,

Larry D. Hogue, P. E.
Chief, Planning, Environmental
1 and Regulatory Division

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

June 7, 2004

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Duane A. Smith
Executive Director
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118

Dear Mr. Smith:

This is to inform you that the Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake, Oklahoma. We are beginning the process of preparing an Environmental Assessment addressing the effects of water reallocation to provide additional water supply storage. The study is being conducted because the City of Bartlesville, which is dependant upon water supply from Hulah Lake, recently experienced a critical water shortage because of extreme drought conditions in the Caney River Basin. Consequently, the City of Bartlesville has requested that the Tulsa District look at alternatives for increasing water supply to the City. Additional water supply storage in Hulah Lake and Copan Lake is needed because sedimentation has reduced the existing storage capacity in Hulah Lake, and population growth in the City of Bartlesville has increased water demand.

The Tulsa District is working with the City of Bartlesville to develop a range of alternatives that would provide adequate water supply storage to meet current and future demands. The following are alternatives under consideration:

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We are preparing documentation for compliance with the National Environmental Policy Act of 1969 and would appreciate comments from your agency concerning this Proposed Action.

If you have any questions or require additional information, please contact Mr. Jerry Sturdy at 918-669-4397.

Sincerely,

Stephen L. Nolen
for Larry D. Hogue, P. E.
Chief, Planning, Environmental and Regulatory Division

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

December 30, 2005

Planning and Environmental Division
Environmental Analysis and Compliance Branch

Dear Interested Party:

The Tulsa District has prepared an Environmental Assessment to assess the environmental and socioeconomic effects of the reallocation of water from Hulah and Copan Lakes to provide an adequate water supply for the City of Bartlesville. The Environmental Assessment was developed in accordance with the National Environmental Policy Act, implementing regulations issued by the Council on Environmental Quality, and the U.S. Army Corps of Engineers Regulations, Part 230, Policy and Procedures for Implementing the National Environmental Policy Act. It was determined that this action will cause no significant adverse impacts on the natural or human environment.

A copy of the Draft Environmental Assessment and Finding of No Significant Impact is enclosed for your review and comments. Comments should be submitted within 30 days from the date of this letter to the U.S. Army Corps of Engineers, Tulsa District, ATTN: Environmental Analysis and Compliance Branch, 1645 South 101st East Avenue, Tulsa, Oklahoma 74128-4609.

Sincerely,

For

Stephen L. Nolen
Chief, Environmental Analysis
and Compliance Branch

Enclosure

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APPENDIX B

SUPER MODEL OUTPUTS

Hulah/Copan Water Supply Analysis for the City of Bartlesville Using SUPER Model

The City of Bartlesville experienced a critical shortage in available water supply at Hulah Lake beginning in the summer of 2001. The lake experienced a drawdown to 20 percent of the conservation pool by early April 2002. Fortunately inflows picked up, and the pool filled with a large, single event in early May 2002. The drought conditions convinced the city of the need to investigate and develop other possible sources of water supply to meet future water supply demands. The investigation was to include both Hulah and Copan lakes as well as other federal and state lakes in the vicinity.

Early in the study it was decided that sediment projections could be made 30 years into the future with some level of confidence. Sediment projections to the end of the project life in 2051 were considered too uncertain. Therefore, all yield projections and analyses for Hulah and Copan Reservoirs were done through the year 2035. These sediment projections were used to establish the elevation-area-capacity relationship of both projects for the year 2035. The City of Bartlesville then provided their projected water supply requirements through the year 2035, which is at least 12 million gallons per day (mgd) of dependable water supply yield. The city also seeks to minimize the loss of flood protection. Current yield projections show that without a reallocation the city will have 7.35 mgd of yield available at Hulah and Copan lakes by the year 2035 for contracting; however, this will not meet Bartlesville's future requirements. These pieces of information provided the basis for the study.

All modeling for this study was accomplished with the U.S. Army Corps of Engineers Southwest Division Modeling System for the Simulation of the Regulation of a Multipurpose Reservoir System, otherwise known as SUPER model. The SUPER model is a suite of computer programs used to model multipurpose reservoir system regulation.

Overview of SUPER Model

The SUPER model was developed over a 30-year period by Ronald L. Hula, primarily as a planning tool to perform period-of-record analysis to evaluate changes in operational scenarios. The model has the ability to simulate flood control operations, and conservation pool operations including hydropower, water supply, water quality, diversions, and returns. In addition to period-of-record analysis, it has the capability to perform conservation pool yield analysis, and firm energy analysis. It has the capability to develop unregulated conditions models, simulating systems with some or all reservoirs "dummied" out or nonexistent. Besides system modeling, SUPER can perform economic analyses of impacts between plans. It can also provide a wide variety of output from which to evaluate scenarios including tabular or graphical formats of hydrographs, duration plots, and frequency curves at all reservoirs and control points within the system model.

SUPER is a daily simulation model that assumes all reservoirs are in place for the entire period of record specified for each model, based on data availability. For each SUPER model, a complex set of intervening area flows is developed for the entire period of record. This is the culmination of the preprocessing of data, before any simulation is done. When simulation is begun, headwater reservoir inflows and subsequent derived releases based on current and future forecast conditions are then routed through the system on a daily basis. These routed flows are combined with intervening area flows at all control point locations. Reservoir releases are made for flood control, hydroelectric power generation, water supply requirements, and stream flow requirements (such as water quality and irrigation). Other regulating considerations include channel capacities and bank stability. All releases are analyzed to determine their impact on current and future forecasted conditions, and are adjusted as needed to meet predefined system constraints. In addition to the above requirements, SUPER works to achieve a target uniform balance between all competing reservoirs during the drawdown of system flood storage, and a target uniform balance in system conservation storage remaining during a conservation pool drawdown.

SUPER has evolved to meet the complex challenge of modeling system operations while meeting system and local constraints, and balancing requirements.

The Arkansas River SUPER model has a hydrologic period of record from January 1940 to December 2000, based on observed gage data. Therefore, all analyses using SUPER reflect actual hydrologic conditions that occurred throughout this period.

Yield Analysis

During the initial phase of the study, water supply yield analysis for 2035 conditions using SUPER was performed to determine how much yield would be available for the City of Bartlesville, for a number of possible alternatives including

- Reallocation of water quality storage at both projects beyond what is currently used. Table 1 shows current downstream water quality demands that are met throughout the simulation period.
- Developing seasonal pool plans at both projects to enhance water supply yield in conjunction with reallocating available water quality storage.
- Reallocating various percentages of flood control storage along with available water quality storage.
- A combination of the above alternatives including reallocating flood control storage, seasonal pool plans, plus available water quality storage.

Table 1. Current Water Quality Demands

Month	Below Hulah Lake (cfs)	Below Copan Lake (cfs)	At Bartlesville (cfs)
January	2	5	10
February	2	5	10
March	2	5	10
April	2	5	10
May	2	5	10
June	4	8	11
July	4	8	13
August	4	8	13
September	2	5	10
October	2	5	10
November	2	5	10
December	2	5	10

Note: cfs = cubic feet per second

Table 2 shows total water supply yields for the various alternatives under consideration, most of which are available to the City of Bartlesville, with the exception of 2 mgd from Copan, which is currently under contract.

Table 2. Water Supply Yields for Hulah and Copan Lakes for Various 2035 Conditions

Condition	Hulah Lake (mgd)	Copan Lake (mgd)
1. Existing Water Supply Storage.*	6.58	3.03
2. Reallocate all available Water Quality storage above current requirements plus water supply storage.	7.23	7.48
3. Additional Water Supply storage from seasonal pool plan with balanced rising from normal conservation pool beginning 1 May and reaching full seasonal pool elevation beginning 1 Jun through 31 Oct. Return to normal pool by 15 Nov. This also includes all available water quality storage above what is currently used, and designated water supply storage.		
Rising to 734.75 which is 2.5% of flood control storage	7.42	
Rising to 735.15 which is 5.0% of flood control storage	7.42	
Rising to 737.55 which is 7.5% of flood control storage	7.48	
Rising to 711.00 which is 2.5% of flood control storage		8.19
Rising to 712.00 which is 5.0% of flood control storage		8.19
Rising to 713.00 which is 7.5% of flood control storage		8.19
3. (Continued) Additional Water Supply storage from seasonal pool plan with balanced rising from normal conservation pool beginning 1 April and reaching full seasonal pool elevation beginning 1 May through 31 Oct. Return to normal pool by 15 Nov. This also includes all available water quality storage above what is currently used, and designated water supply storage.		
Rising to 734.75 which is 2.5% of flood control storage	7.48	
Rising to 735.15 which is 5.0% of flood control storage	7.48	
Rising to 737.55 which is 7.5% of flood control storage	7.48	
Rising to 711.00 which is 2.5% of flood control storage		8.19
Rising to 712.00 which is 5.0% of flood control storage		8.19
Rising to 713.00 which is 7.5% of flood control storage		8.19
3. (Continued) Additional Water Supply storage from seasonal pool plan with balanced rising from normal conservation pool beginning 1 May and reaching full seasonal pool elevation beginning 1 Jun through 30 Nov. Return to normal pool by 15 Dec. This also includes all available water quality storage above what is currently used, and designated water supply storage.		
Rising to 734.75 which is 2.5% of flood control storage	7.74	
Rising to 735.15 which is 5.0% of flood control storage	7.74	
Rising to 737.55 which is 7.5% of flood control storage	7.81	
Rising to 711.00 which is 2.5% of flood control storage		9.10
Rising to 712.00 which is 5.0% of flood control storage		9.10
Rising to 713.00 which is 7.5% of flood control storage		9.10

Table 2. Water Supply Yields for Hulah and Copan Lakes for Various 2035 Conditions

Condition	Hulah Lake (mgd)	Copan Lake (mgd)
3. (Continued) Additional Water Supply storage from seasonal pool plan with balanced rising from normal conservation pool beginning 1 April and reaching full seasonal pool elevation beginning 1 May through 30 Nov. Return to normal pool by 15 Dec. This also includes all available water quality storage above what is currently used, and designated water supply storage.		
Rising to 734.75 which is 2.5% of flood control storage	7.81	
Rising to 735.15 which is 5.0% of flood control storage	7.81	
Rising to 737.55 which is 7.5% of flood control storage	7.81	
Rising to 711.00 which is 2.5% of flood control storage		9.10
Rising to 712.00 which is 5.0% of flood control storage		9.10
Rising to 713.00 which is 7.5% of flood control storage		9.10
4. Reallocate a percentage of flood control pool plus available water supply storage above what is currently used plus available water supply storage.		
2.5% of flood control storage – Top of Conservation = 734.75	9.81	
5.0% of flood control storage – Top of Conservation = 736.15	12.19	
2.5% of flood control storage – Top of Conservation = 711.00		9.61
5.0% of flood control storage – Top of Conservation = 712.00		11.42
5. Reallocate a percentage of flood control pool plus additional water supply storage from seasonal pool plan with balanced rising from normal conservation pool beginning 1 April and reaching full seasonal pool elevation beginning 1 May through 30 Nov and returning to normal pool by 15 Dec, plus available water quality storage above what is currently used, plus available water supply storage.		
2.5% flood control reallocated, setting top of conservation to 734.75, with seasonal pool to 736	10.7	
5.0% flood control reallocated, setting top of conservation to 736.15, with seasonal pool to 737	13.4	
5. (Continued) Reallocate a percentage of flood control pool plus additional water supply storage from seasonal pool plan with balanced rising from normal conservation pool beginning 1 May and reaching full seasonal pool elevation beginning 1 Jun through 30 Nov and returning to normal pool by 15 Dec, plus available water quality storage above what is currently used, plus available water supply storage.		
2.5% flood control reallocated, setting top of conservation to 711.00, with seasonal pool to 712		11.4
5.0% flood control reallocated, setting top of conservation to 712.00, with seasonal pool to 713		13.2

* Based on existing conditions pertinent data, Hulah Lake 2035 water supply yield = 6.41 mgd, and Copan Lake 2035 water supply yield = 2.91 mgd.

Selected Alternatives for Period of Record Analysis

Upon review of the yield analysis, 5 alternatives were selected for further review. For these alternatives, a full period of record analysis was performed using SUPER to provide data for economic analysis and screening. These runs were all done with the 2035 elevation-area-capacity tables to model conditions in the future when storage at both reservoirs is more restrictive. Output developed for economic analysis included elevation and flow frequency data as well as elevation and flow duration data. The alternatives chosen for further analysis were

1. Reallocate all available water quality storage above what is currently being used at both Hulah and Copan lakes to water supply for Bartlesville, plus make available all water supply not currently under contract at both Hulah and Copan lakes. This provides a combined yield of 12.71 mgd. (SUPER Run A04X32)

2. Reallocate at Hulah Lake all available water quality storage above what is currently being used to water supply storage for Bartlesville, plus implement a seasonal pool at Hulah Lake with balanced rising from normal conservation pool beginning April 1 and reaching full seasonal pool elevation of 734.75 feet (2.5 percent flood control pool) beginning May 1 through November 30, returning to normal pool by December 15. This provides a combined yield of 8.84 mgd. (SUPER Run A04X36)

3. Reallocate at Copan Lake all available water quality storage above what is currently being used to water supply storage for Bartlesville, plus implement a seasonal pool at Copan Lake with balanced rising from normal conservation pool beginning May 1 and reaching full seasonal pool elevation of 711.0 feet (2.5 percent flood control pool) beginning June 1 through November 30, returning to normal pool by December 15. This provides a combined yield of 13.68 mgd. (SUPER Run A04X37)

4. Reallocate at Hulah Lake all available water quality storage above what is currently being used to water supply storage for Bartlesville, plus reallocate 5 percent of the flood control storage at Hulah Lake to water supply (raise Top of Conservation pool to elevation 736.15 feet). This provides a combined yield of 13.22 mgd. (SUPER Run A04X42)

5. Reallocate at Hulah Lake all available water quality storage above what is currently being used, to water supply storage for Bartlesville, plus reallocate 5 percent of the flood control storage at Hulah Lake to water supply (raise Top of Conservation pool to elevation 736.15 feet), plus implement a seasonal pool at Hulah Lake with balanced rising from normal conservation pool beginning April 1 and reaching full seasonal pool elevation of 737.0 feet (6.5 percent flood control pool) beginning May 1 through November 30, returning to normal pool by December 15. This provides a combined yield of 14.43 mgd. (SUPER Run A04X47)

The yields for alternatives 1 through 5 are based on the SUPER yields shown in Table 2. For screening purposes, these yields assume 2 mgd of water supply is under contract at Copan Lake, making 1.03 mgd available to the City of Bartlesville, and all water supply yield at Hulah Lake is available to the City of Bartlesville. In actuality, Copan Lake has a water supply yield of 2.91 mgd with 1.94 mgd currently under contract, leaving 0.97 mgd available to the City of Bartlesville. Hulah Lake has a water supply yield of 6.41 mgd with 0.03 mgd under contract to a user other than the City of Bartlesville.

Selected Alternative

Alternative 1 was selected after economic evaluation as the best alternative to meet the water supply needs of the City of Bartlesville to the year 2035. This alternative reallocates available water quality storage at both Hulah and Copan lakes to water supply storage. In the modeling, water quality requirements were met throughout the period of record. By reallocating within the conservation pool, this alternative does not impact the flood control protection of the city. It also provides at least 12 mgd of dependable water supply yield, and has the least overall impacts both at Hulah and Copan lakes, and also downstream. Results of the SUPER runs are provided in Figures 1 to 12. On the legend “A04X02” is the baseline condition, and “A04X32” is Alternative 1.

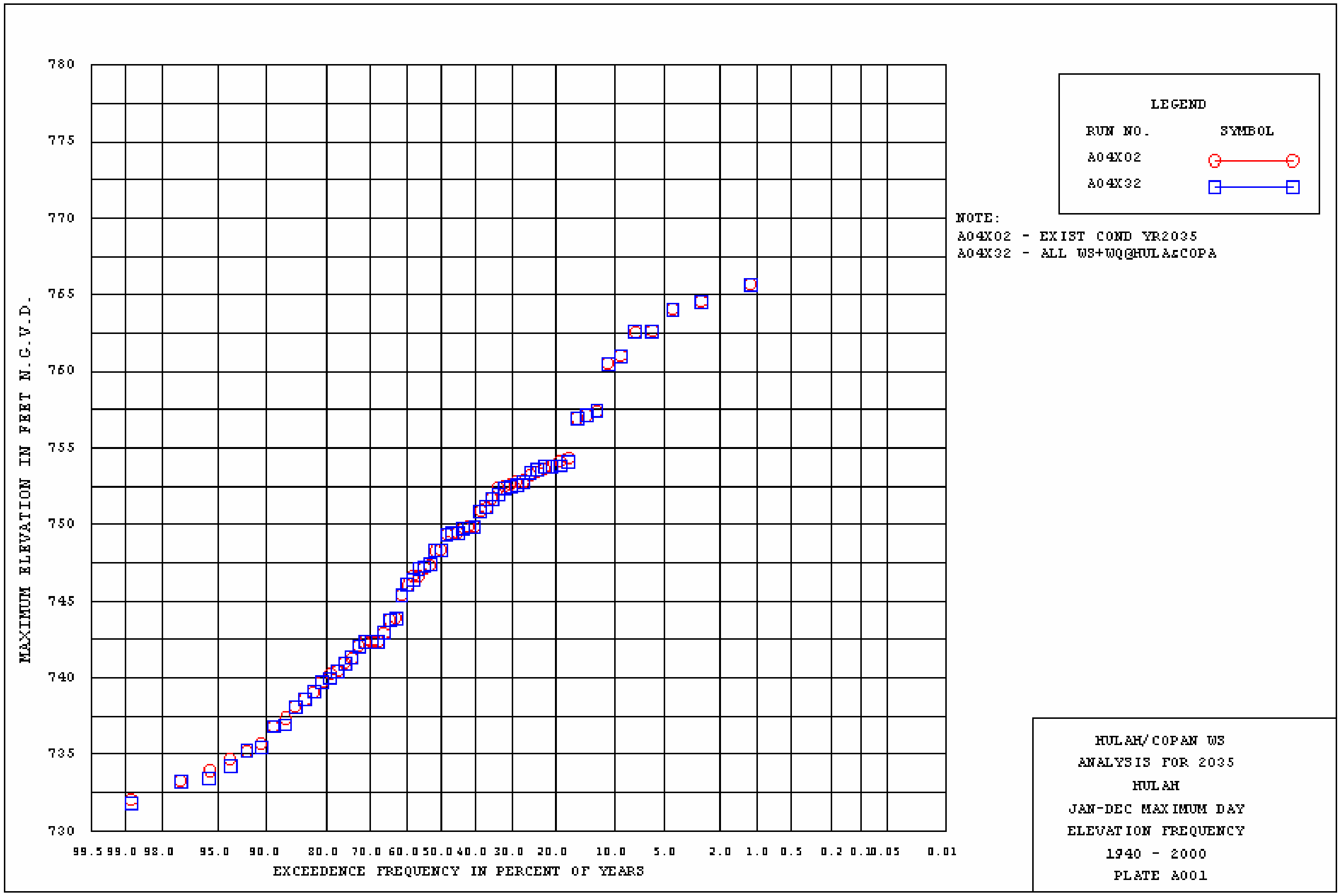

Figure 1. Hulah Comparative Average Annual Elevation-Frequency between Existing Conditions and Alternative 1

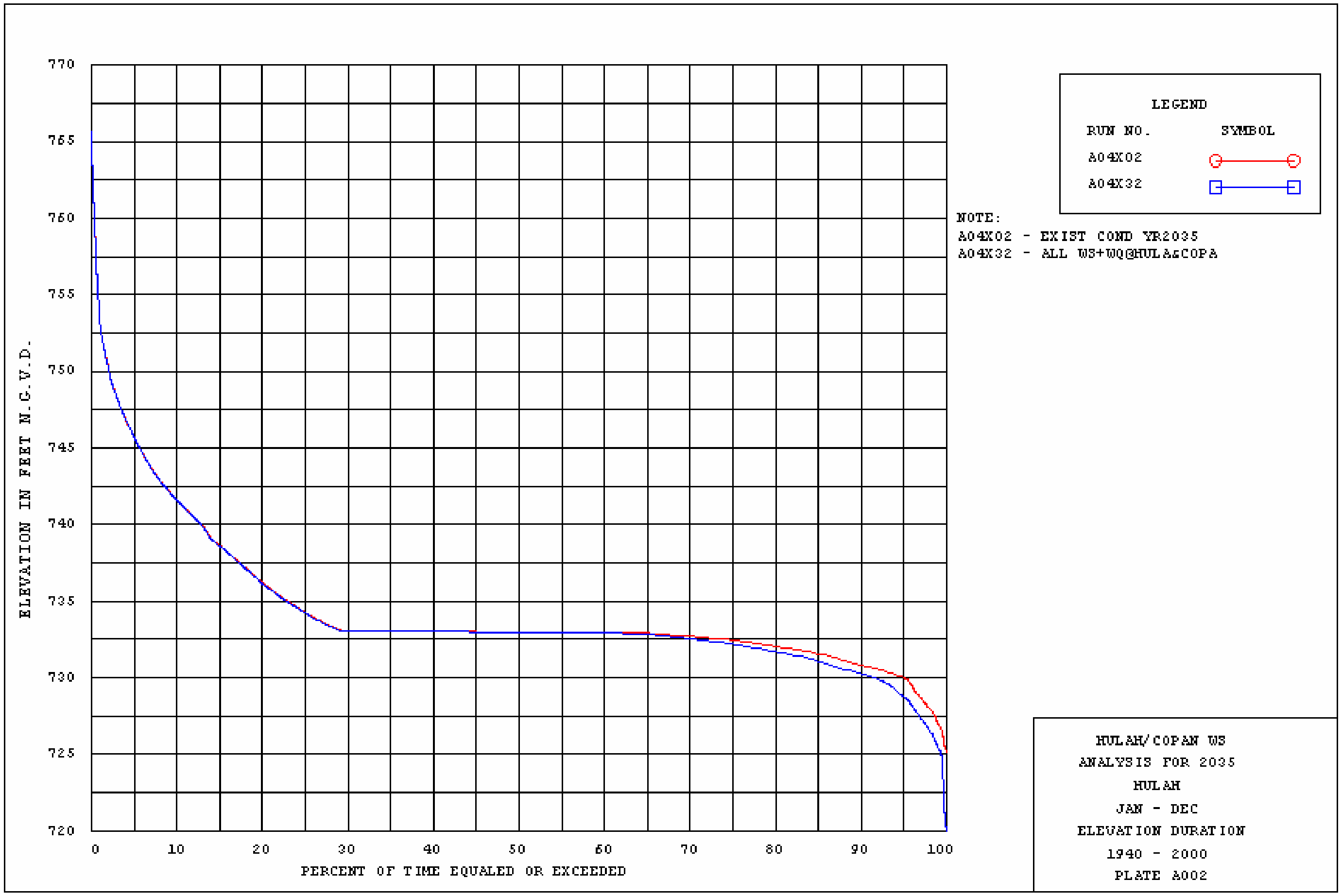

Figure 2. Hulah Comparative Average Annual Elevation-Duration between Existing Conditions and Alternative 1

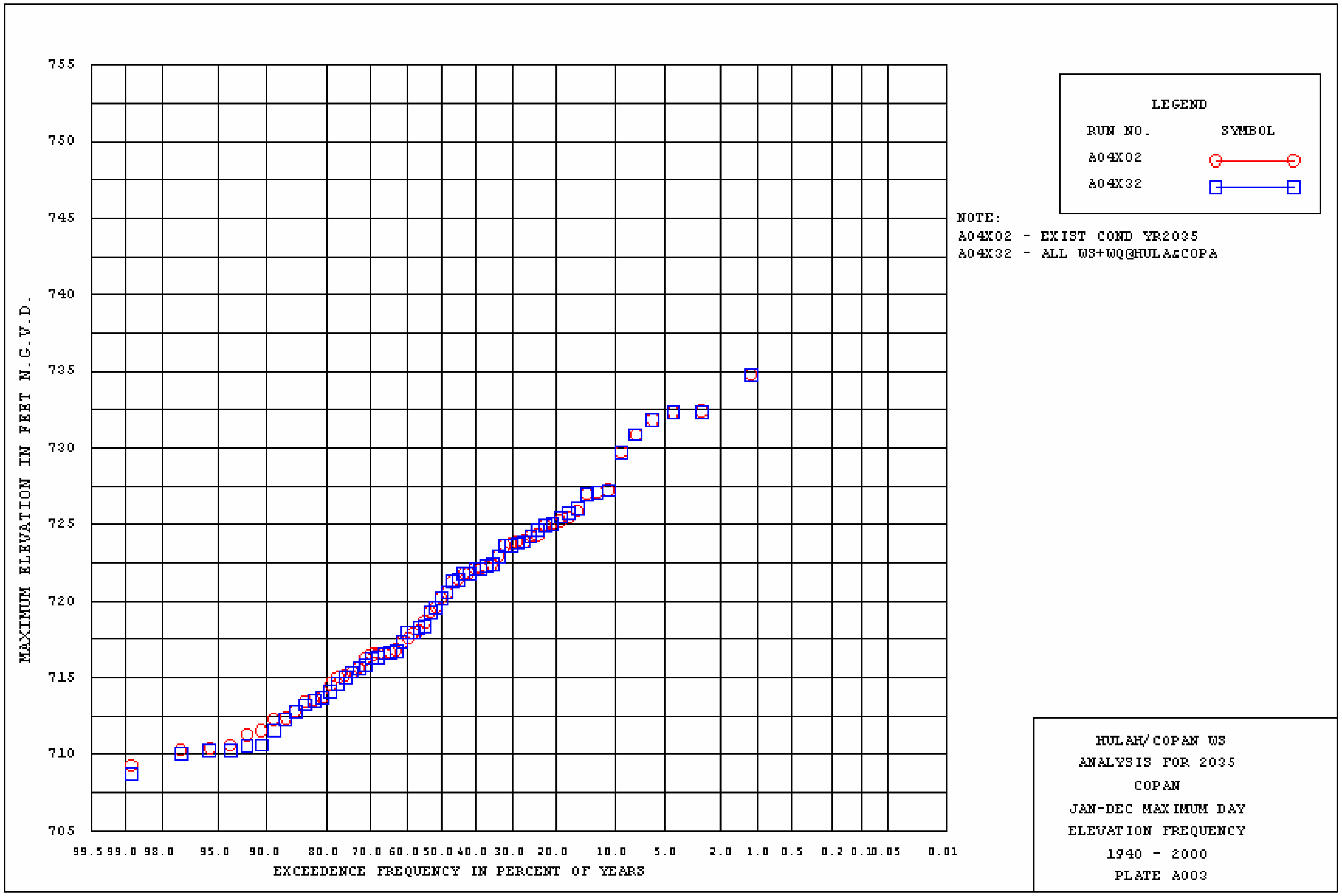

Figure 3. Copan Comparative Average Annual Elevation-Frequency between Existing Conditions and Alternative 1

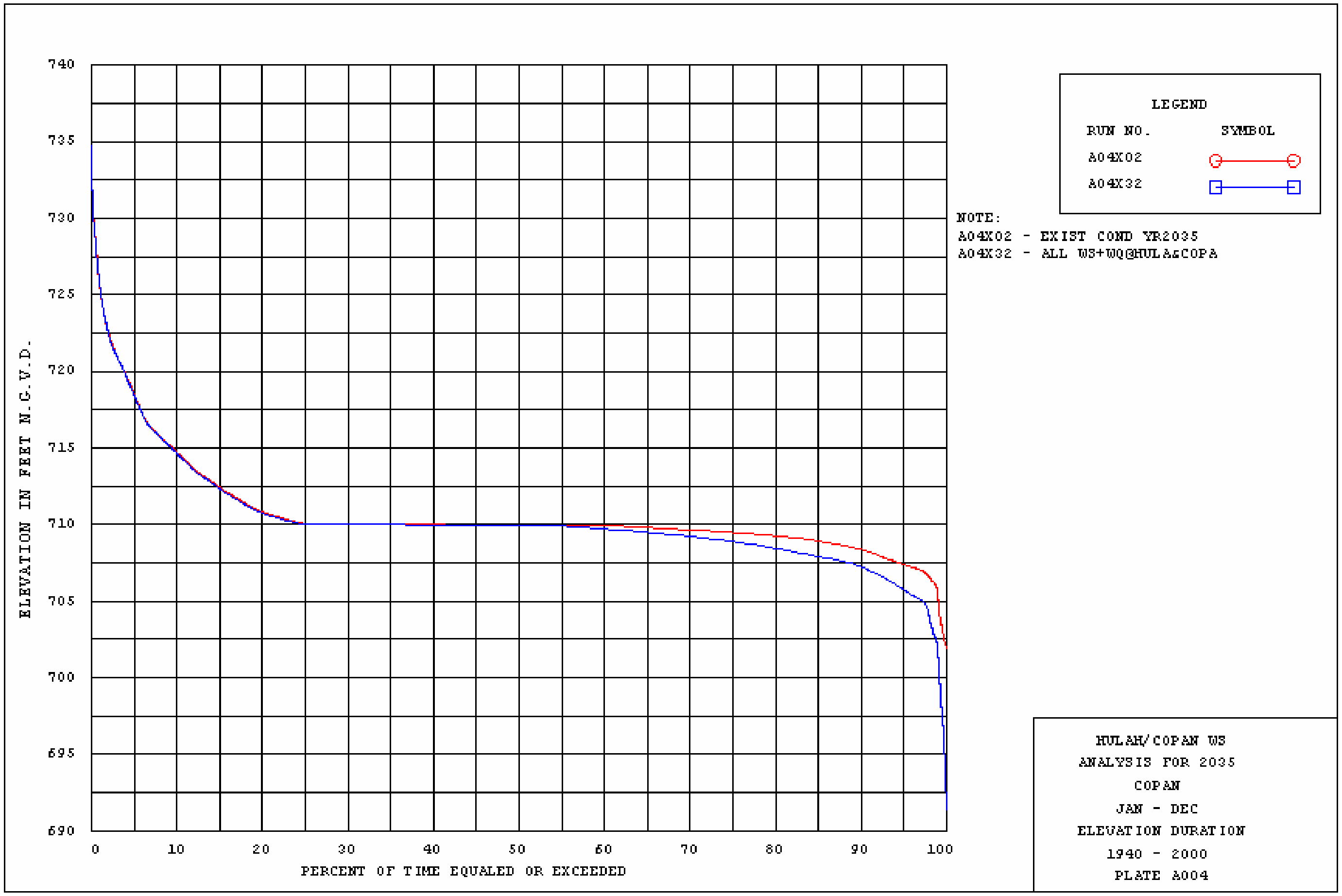

Figure 4. Copan Comparative Average Annual Elevation-Duration between Existing Conditions and Alternative 1

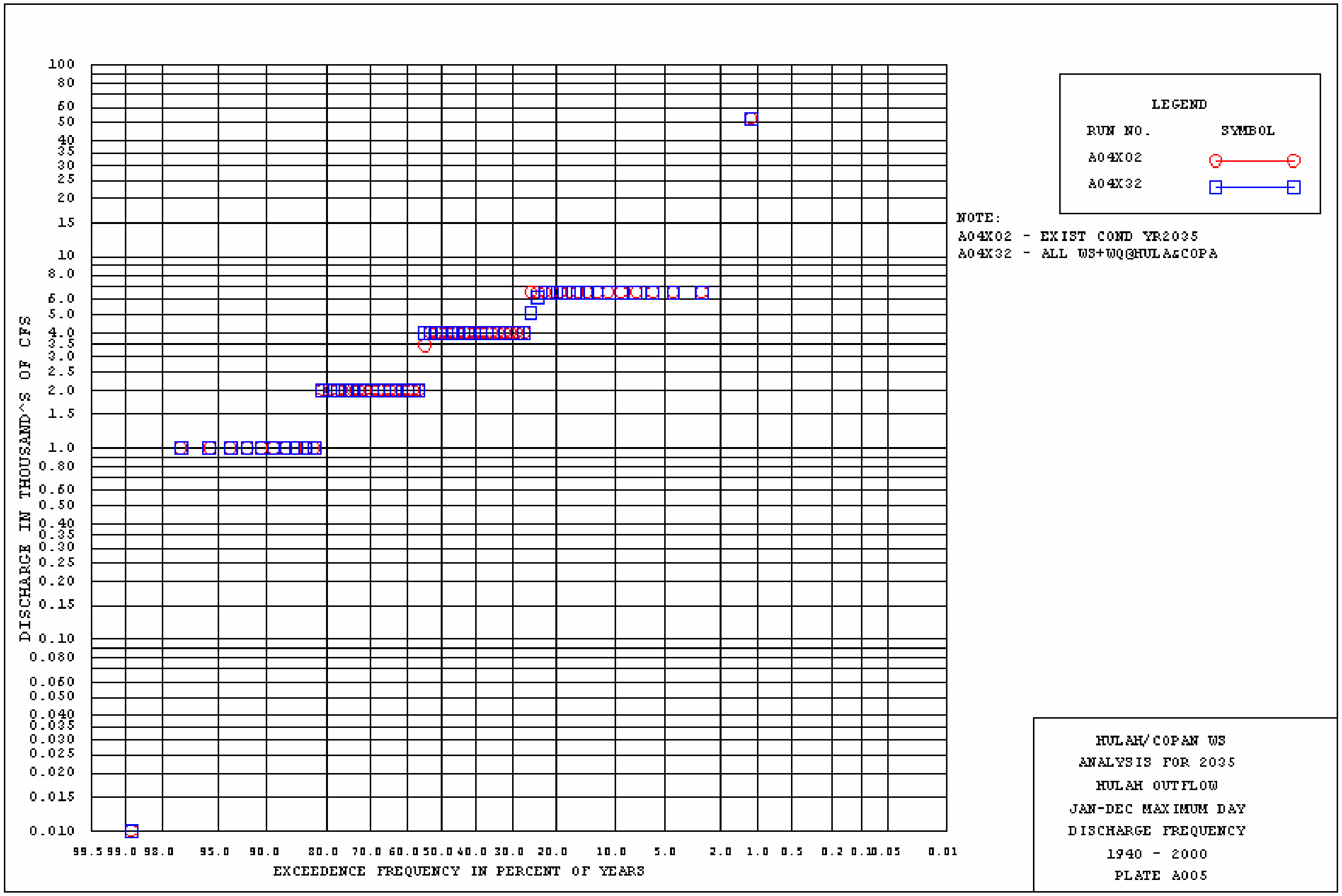

Figure 5. Hulah Outflow Comparative Average Annual Discharge-Frequency between Existing Conditions and Alternative 1

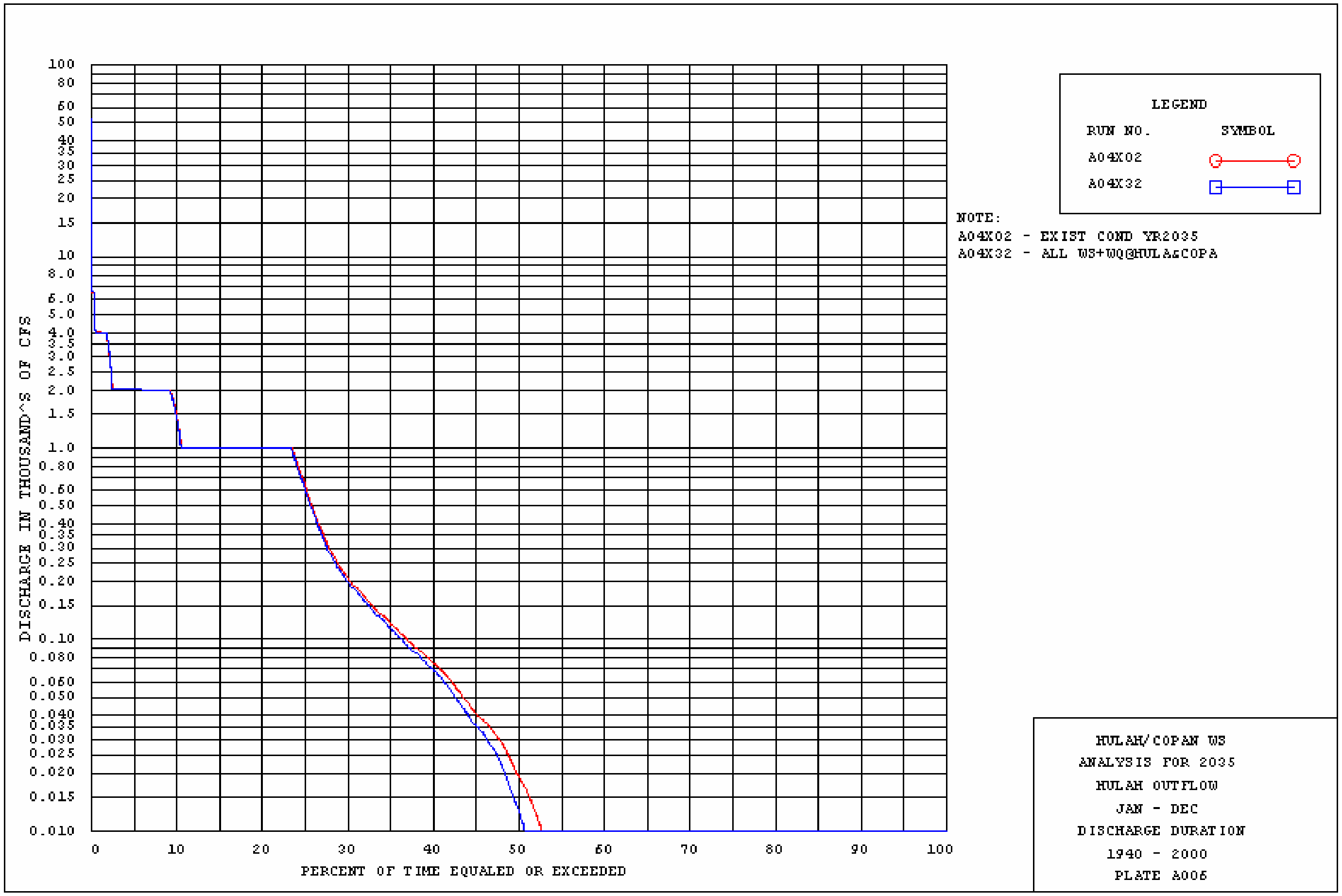

Figure 6. Hulah Outflow Comparative Average Annual Discharge-Duration between Existing Conditions and Alternative 1

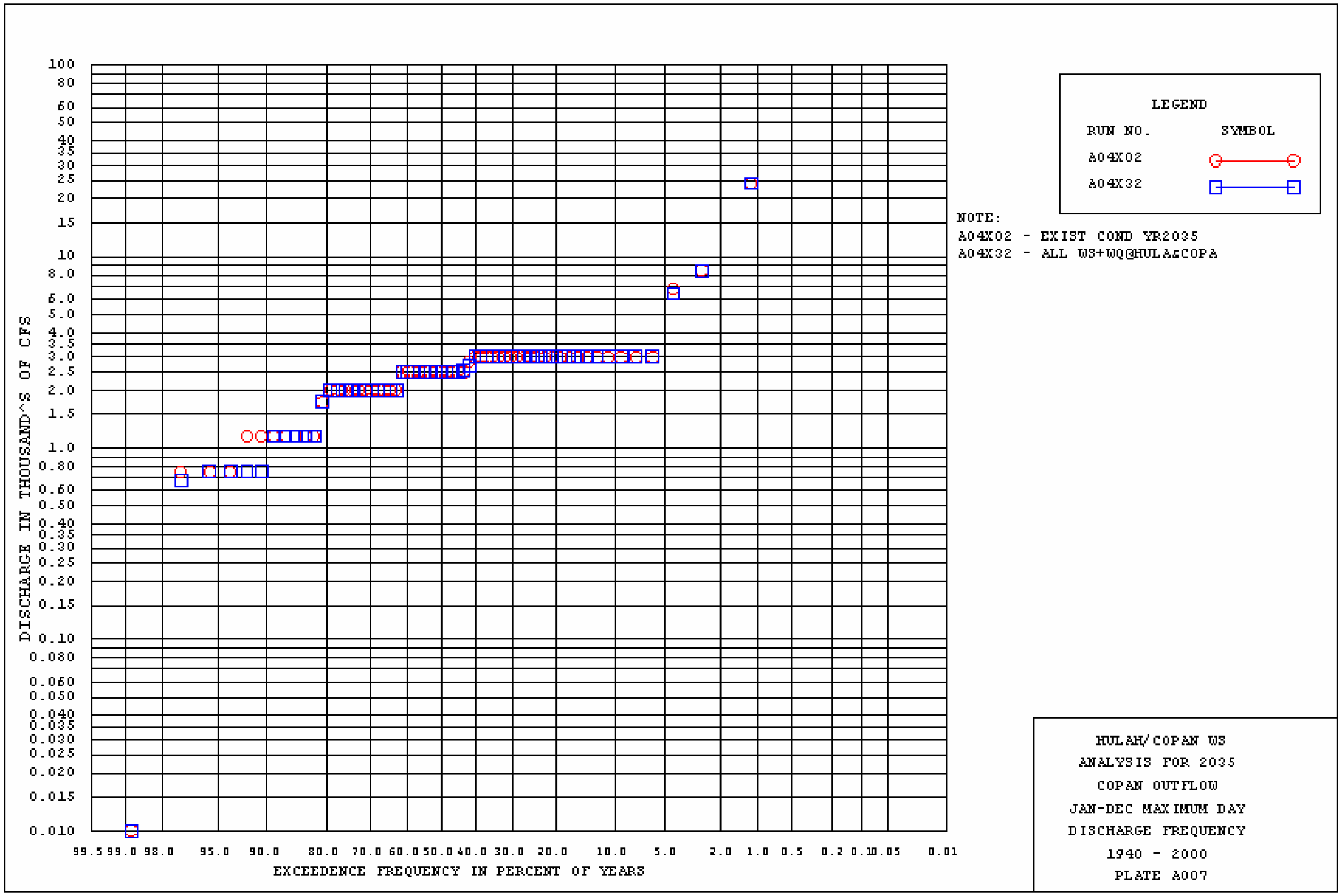

Figure 7. Copan Outflow Comparative Average Annual Discharge-Frequency between Existing Conditions and Alternative 1

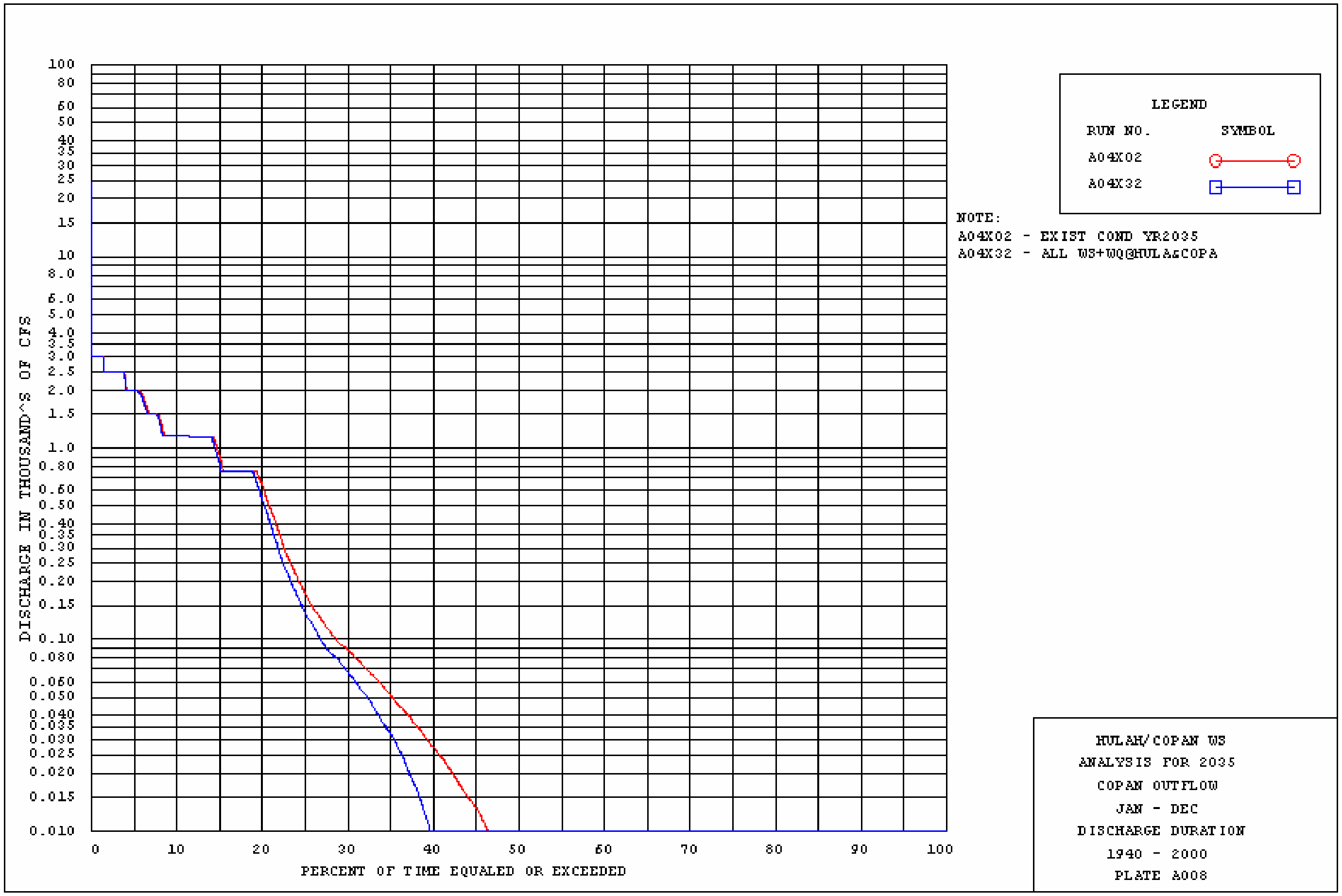

Figure 8. Copan Outflow Comparative Average Annual Discharge-Duration between Existing Conditions and Alternative 1

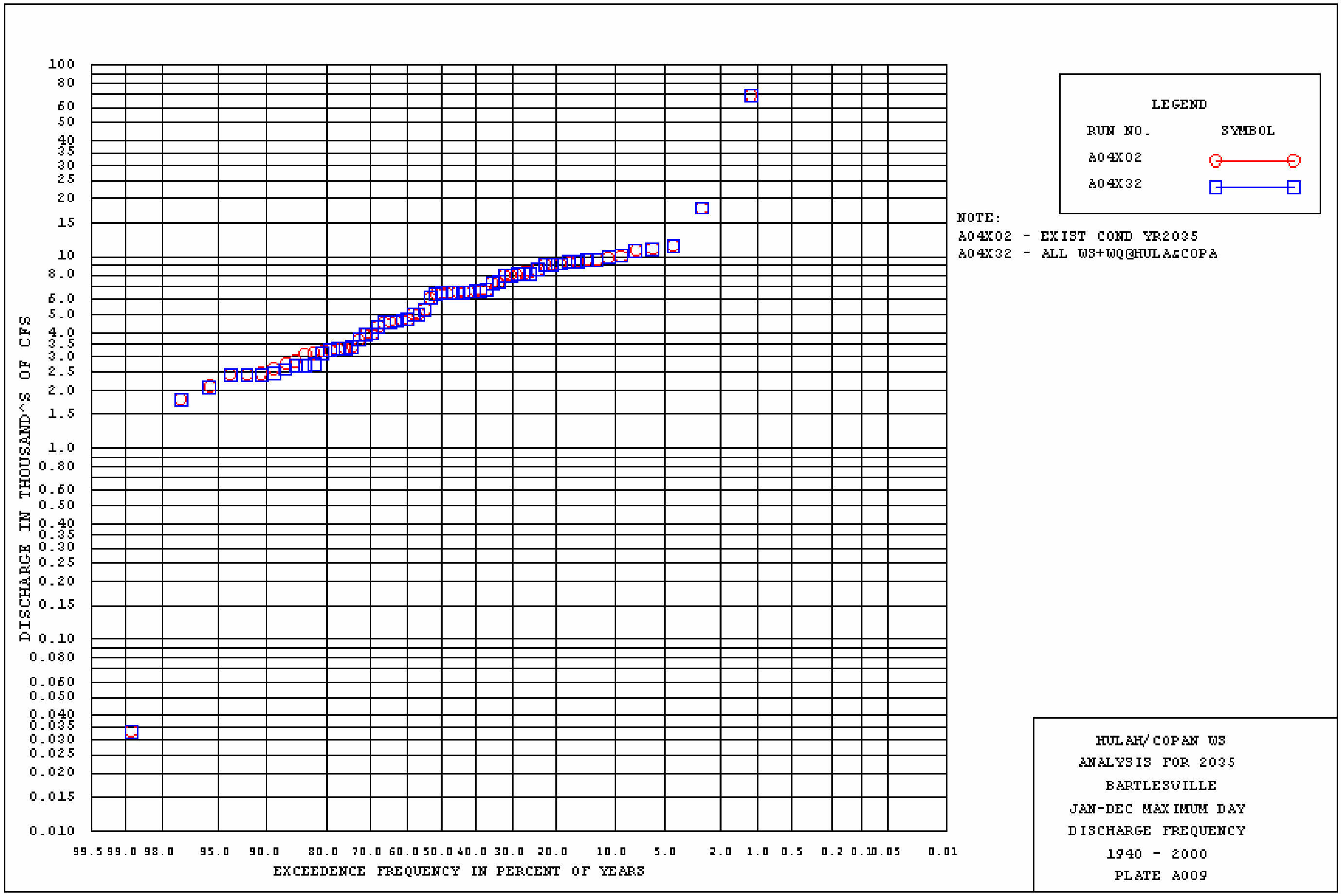

Figure 9. Bartlesville Comparative Average Annual Discharge-Frequency between Existing Conditions and Alternative 1

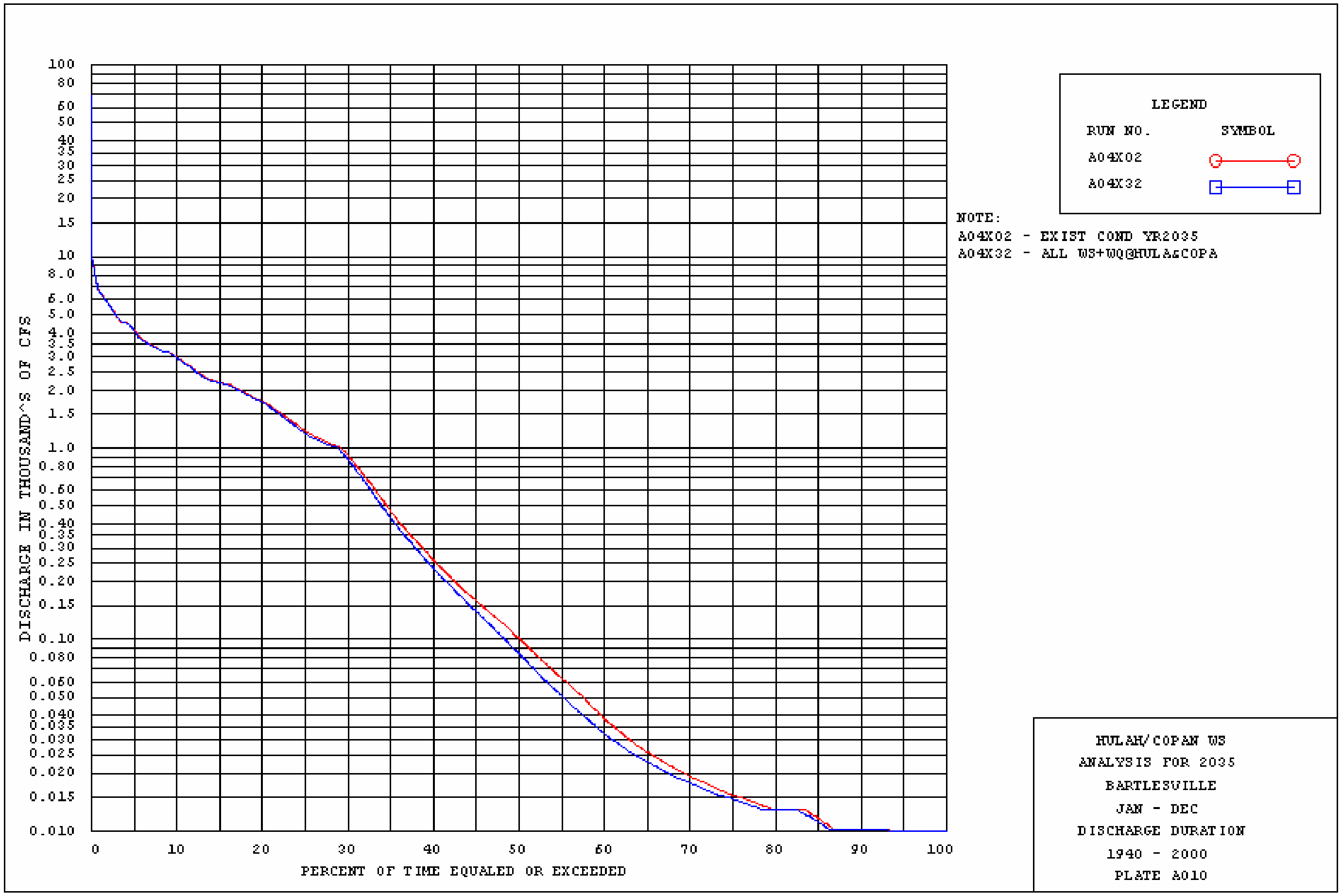

Figure 10. Bartlesville Comparative Average Annual Discharge-Duration between Existing Conditions and Alternative 1

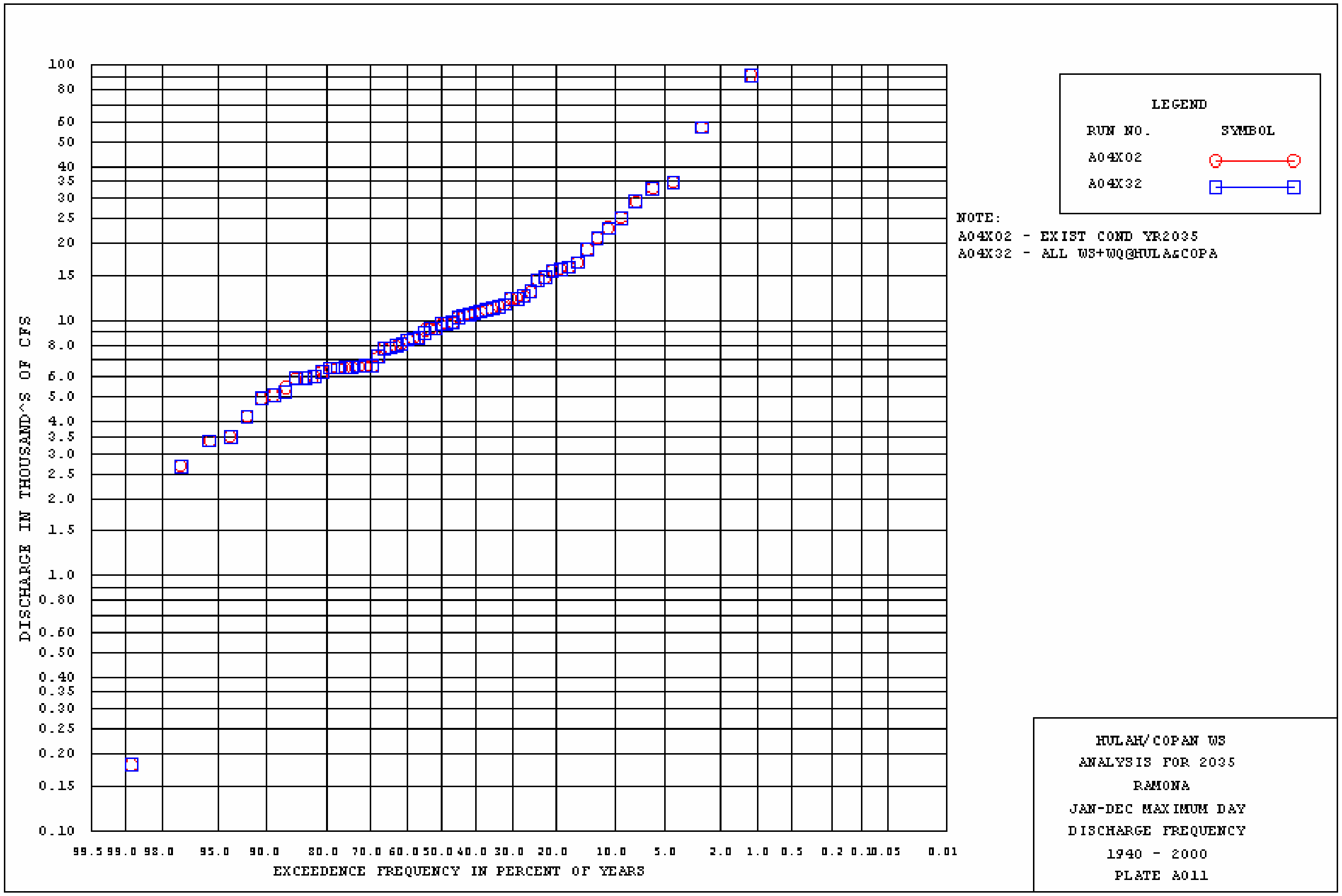

Figure 11. Ramona Comparative Average Annual Discharge-Frequency between Existing Conditions and Alternative 1

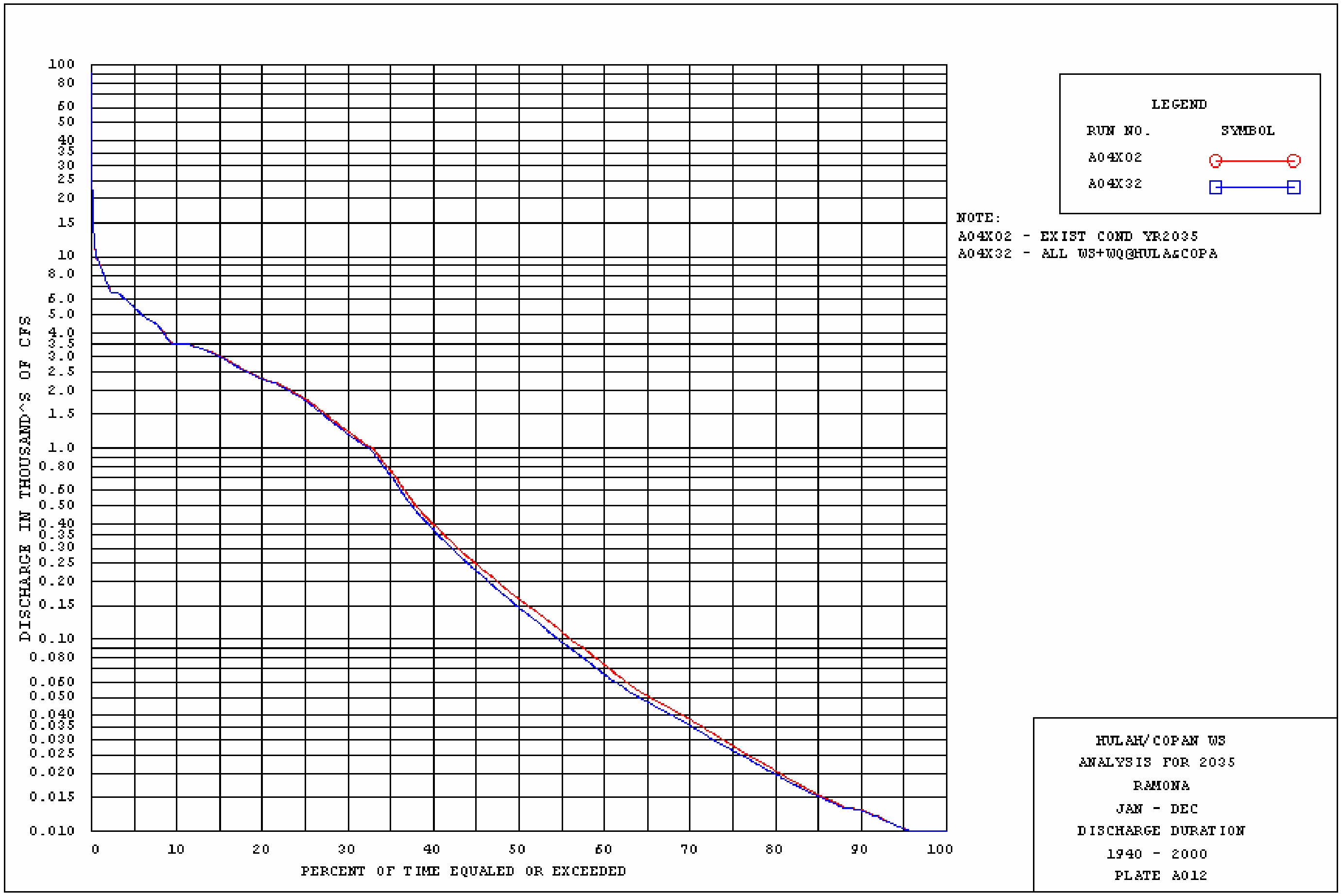

Figure 12. Ramona Comparative Average Annual Discharge-Duration between Existing Conditions and Alternative 1

APPENDIX C

REPORT OF THE WATER SUPPLY STORAGE REALLOCATION STUDY AT HULAH AND COPAN LAKES, OKLAHOMA

Report of the
WATER SUPPLY STORAGE REALLOCATION STUDY AT HULAH AND COPAN LAKES OKLAHOMA

APRIL 2006

US Army Corps
of Engineers ®
Tulsa District

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WATER SUPPLY STORAGE REALLOCATION STUDY AT HULAH AND COPAN LAKES, OKLAHOMA

EXECUTIVE SUMMARY

Hulah Lake is located on the Caney River and Copan Lake is located on the Little Caney River tributaries of the Verdigris River about 15 miles north of Bartlesville in Osage County, Oklahoma.

The reallocation study and subsequent report is in response to requests made by the City of Bartlesville to find alternative water supply sources to meet future municipal and industrial water demands. Storage available for water supply purposes in Hulah Lake through its 2035 project life will reduce the projected water supply yield to 6.4 million gallons per day (mgd) due to sedimentation, resulting in a water supply deficiency of 5.6 mgd of water through year 2035. The City of Bartlesville has three water supply contracts for water supply storage in Hulah Lake totaling 19,800 acre-feet with an original published available yield of 12.4 mgd through year 2035, based on 1973 sediment projections for Hulah and 1983 sediment projects for Copan. Based on the 2002 survey, the available yield has declined from 12.4 mgd to a current yield of 9.9 mgd.

Sediment removal at Hulah Lake, numerous small and large reservoir sources, and multiple reallocation scenarios were considered. Several smaller reservoirs were identified in north central and northeastern Oklahoma as potential water supply sources. These small water supply sources were eliminated due to insufficient yield to meet future demands and the pipeline costs to obtain the water. Analysis of sediment removal from Hulah Lake revealed that dredging costs would exceed the cost of constructing a reservoir. As a result, dredging was not considered as a viable alternative.

Five larger reservoir sources were considered as potential alternative water supply sources. Reservoirs considered were Skiatook, Grand, Kaw, Oologah, Sand and Copan Lakes. The City of Bartlesville wanted Sand Lake to be considered as an alternative, but the project was de-authorized in 1999. For Sand Lake to be considered it would have to go through a complete redesign/analysis, which is outside the scope of this study.

Each alternative water supply was ranked based on the projected annual storage and conveyance cost per mgd of water. The ranking revealed that reallocation of water quality at Copan Lake is the best option.

Multiple yield alternatives for Hulah and Copan Lakes were looked at using the Southwestern Division Modeling System suite of programs (SUPER). Various alternative reallocations were also analyzed to find the maximum available yield that would produce acceptable reductions of water quality and flood control storage.

Based on the evaluation of several alternatives, the recommended alternative is to reallocate storage used for water quality to water supply at Hulah and Copan Lakes. This option provides 7.2 mgd from Hulah and an additional 5.54 mgd after reallocation from Copan. This option will provide 12.74 mgd of available yield out to the year 2035 and will provide sufficient water quality to satisfy published water quality release standards.

No cumulative environmental impacts are anticipated to occur as a result of the proposed action. However, if any future construction such as pipelines for water conveyance is found to be necessary, separate NEPA documents would be prepared to study the effects of the necessary construction and its impacts.

Authority for the reallocation of storage is provided by Title III of Public Law 85-500, Water Supply Act of 1958. Engineering regulation guidance stipulates that Congressional approval would normally be needed for storage reallocation that would involve major structural or operational changes. However, 15% of total usable storage or 50,000 acre-feet, whichever is less, may be reallocated for water supply at the discretion of the Commander, United States Army Corps of Engineers (USACE). This reallocation report falls within the Chief's discretionary authority.

11. Purpose, Need, and Scope

The City of Bartlesville is investigating alternative water supply sources to meet future municipal and industrial water demands. The City has estimated its water demands in year 2035 to be 10 to 12 million gallons per day (mgd) and about 13.5 mgd by year 2040. Bartlesville has just constructed a new water treatment plant at the City owned; Hudson Lake. The treatment plant has a peak capacity of 26 mgd. Currently, the City of Bartlesville has three water supply contracts at Hulah Lake that provide an available yield of 12.4 mgd (19,800 acre-feet based on sediment through year 2035). Hulah Lake has a current water supply dependable yield of 9.9 mgd. The dependable yield of 9.9 mgd represents the dependable water supply yield based on the 2002 sediment resurvey. However, when sedimentation is projected out to the year 2035, using past rates of sedimentation, Hulah will only yield 6.4 mgd.

In order to meet future water demands, the City of Bartlesville has indicated it needs an additional water source for about 5.6 mgd of water through 2035. Multiple sources of water supply were investigated to determine a viable alternative. Analyses of these alternatives revealed that the best alternative for meeting future municipal and industrial water demand is to reallocate storage in both Hulah and Copan Lakes from water quality to water supply.

This study considers reallocation of storage under Engineer Regulation (ER) 1105-2-100. Authority for the reallocation of storage is provided by Title III of Public Law 85-500, Water Supply Act of 1958. ER guidance stipulates that Congressional approval would normally be needed for reallocation that would involve major structural or operational changes. However, 15% of total usable storage or 50,000 acre-feet, whichever is less, may be reallocated for water supply at the discretion of the Commander, United States Army Corps of Engineers (USACE). Since water quality storage to be reallocated is less than 50,000 acre-feet, the proposed reallocation can be approved by the USACE Commander.

12. Background

12.1 Project Authorization, Location, and Pertinent Data

Hulah Lake. Construction of Hulah Lake in Oklahoma and Kansas was authorized by the Flood Control Act of 1936, approved June 22, 1936, Project Document HD 308, 74th Congress, 1st Session, and Public Law 843, 84th Congress, 2d Session, approved July 30, 1956. Hulah Lake is located at river mile 96.2 on the Caney River, a tributary of the Verdigris River about 15 miles northwest of Bartlesville in Osage County, Oklahoma. Figure 1 shows the location of both Hulah and Copan Lakes in Oklahoma.

The dam is a rolled impervious, earth-filled embankment and concrete spillway that is 5,200 feet long. The maximum height of the embankment is 94 feet above the streambed. A dike 1,115 feet long with a maximum height of 30 feet is located in a saddle near the right abutment above the dam.

The spillway is a gate-controlled, concrete, gravity ogee weir that is 472 feet wide. Spillway discharge at maximum pool elevation of 771.4 feet is 266,200 cubic feet per second (cfs) and at the top of the flood control pool (elevation 765.0 feet) is 183,500 cubic feet per second cfs. The outlet works consist of nine 5- by 6-foot 6-inch rectangular sluices that pass through the spillway. Capacity of the sluices varies from 12,400 cfs at the top of the flood control pool (elevation 765.0 feet) to 7,950 cfs at the conservation pool (elevation 733.0 feet). Bank-full capacity below the dam is about 6,500 cfs.

Table 1 outlines pertinent data for Hulah Lake. Lake data is based on the 2002 sedimentation survey.

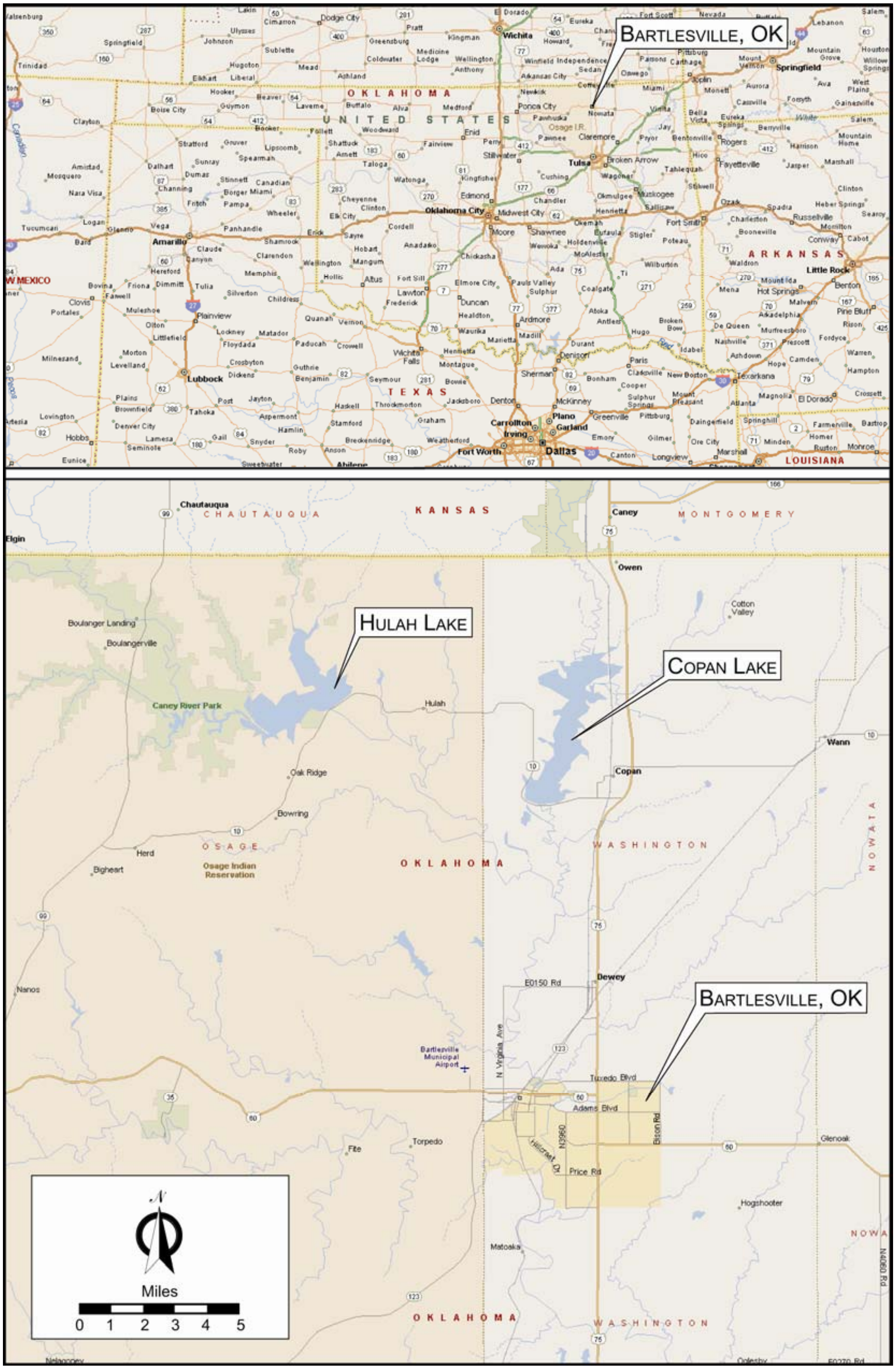

Figure 1. Vicinity Map, Hulah Lake and Copan Lake

Table 1. Hulah Lake Data

Feature	Elevation (feet)	Area (acres)	Capacity (acre-feet)	Equivalent Runoff [a] (inches)
Top of Dam	779.5	--	--	--
Top of Flood Control Pool	765	13,000	289,000	7.40
Flood Control Storage	733.0–765.0	--	257,900	6.61
Spillway Crest	740.0	5,160	61,400	1.57
Top of Conservation Pool	733.0	3,120	22,565 [b]	0.80
Conservation Storage	710.0–733.0	--	22,553	0.80
Top of Inactive Pool	710.0	0	12	--

Notes:

[a] From a 732-square-mile drainage area above the dam site.

[b] Includes 16,600 acre-feet for water supply, 5,953 acre-feet for water quality control, and 12 acre-feet for sediment reserve.

Copan Lake. The construction of Copan Lake in Oklahoma was authorized by the Flood Control Act approved October 23, 1962, and Project Document HD 563, 87th Congress, 2d Session. Copan Lake is located at river mile 7.4 on the Little Caney River. The Little Caney River is a tributary of the Caney River in the Verdigris River watershed. Copan Lake is located about 2 miles west of Copan and about 9 miles north of Bartlesville in Washington County, Oklahoma.

The lake was authorized for flood control, water supply, water quality control, recreation, and fish and wildlife purposes. The dam is a rolled earth-filled dam about 7,730 feet long, including the spillway. It rises about 73 feet above the streambed and has a top width of 32 feet. A 17,100-foot long levee provides flood protection for Caney, Kansas.

The spillway is a gate-controlled, concrete, gravity, ogee weir with four 50- by 35.5-foot tainter gates and a stilling basin. Total length of the spillway is 495 feet with a maximum discharge of 199,070 cfs. Concrete, non-overflow sections 263 feet long connect the spillway with the embankment. A 36-inch diameter low-flow pipe and a 12-inch diameter pipe for future water supply extend through the spillway.

Table 2 displays pertinent data for Copan Lake.

12.2 Operational History

Hulah Lake. Hulah Lake construction started in May 1946, and was completed in February 1951 for flood control, water supply, low flow regulation, and conservation purposes. Embankment closure began in February 1950 and was completed in June 1950. Impoundment of the conservation pool began on September 23, 1951, and was completed on September 24, 1951. The project was placed in full flood control operation in September 1951.

Copan Lake. Construction began in November 1972, and the project was placed in useful operation in April 1983.

Table 2 displays pertinent data for Copan Lake based on the 2002 sediment survey.

Table 2. Copan Lake Data

Feature	Elevation (feet)	Area (acres)	Capacity (acre-feet)	Equivalent Runoff [a] (inches)
Top of Dam	745.0	--	--	--
Maximum Pool	739.1	17,850	338,200	12.57
Top of Flood control Pool	732.0	13,380	227,700	8.45
Flood Control Storage	710.0–732.0		184,300	6.84
Top of Conservation Pool	710.0	4,449	34,634	1.61
Conservation Storage	687.5–710.0	--	33,887 [b]	1.59
Spillway Crest	696.5	1,080	4,700	0.17
Top of Inactive Pool	687.5	110	747	0.02

Notes:

[a] Drainage area is 505 square miles.

[b] Includes 7,500 acre-feet for water supply (3.0 mgd yield), 26,100 acre-feet for water quality control (16 mgd yield), and 9,200 acre-feet for sediment based on 2002 survey..(In year 2002, useable storage=34,634acre-feet less 747 acre-feet).

The operational history of Hulah and Copan Lakes have dealt with both extreme flooding and drought conditions and has directly impacted the City of Bartlesville and its surrounding communities. The flood of record for Hulah Lake occurred from September 29 to October 19, 1986, and had a volume of 408,000 acre-feet, equivalent to 10.46 inches of runnoff. Peak inflow to the lake was 133,000 cfs. For Copan Lake, the flood of record also occurred from September 29 to October 14, 1986 and had a volume of 369,000 acre-feet, equivalent to 13.71 inches of runoff with a peak inflow to the lake of 102,000 cfs.

Hulah Lake has prevented about $45.9 million of flood damages, and Copan Lake about $23.8 million during fiscal year 2005 (October 1st 2004 thru September 30th 2005). Cumulative flood damages prevented for these two projects are, $651.4 million for Hulah Lake, and $403.7 million for Copan Lake. Flood damages prevented are based on the date the flood occurred, as well as the holdouts made at those lakes for the flood events. Downstream reaches to the Oklahoma-Arkansas stateline may have benefited from those holdouts.

The top five historical floods on the Caney River at the Bartlesville gage, as recorded by the National Weather Service, are shown in Table 3 (Flood Stage is at 13.0 feet).

Table 3. Caney River, Historical Floods at the Bartlesville Gage

Date of Flood	Flood Stage (feet)
4-Oct-1986	27.7
3-Oct-1926	25.3
11-Apr-1944	24.71
19-May-1943	23.4
7-May-1917	23.3

Note: Designated major flood stage at 18.0 feet

Extreme flood conditions one year can be followed by drought conditions the next. Drought is a serious future concern. Beginning in the summer of 2001, the city of Bartlesville experienced a severe drought, and the City's primary source of water from Hulah Lake was in danger of running dry in May 2002. Although the City of Bartlesville does not have a water storage contract at Copan Lake, emergency releases from Copan Lake were implemented by officials and used to recharge Hudson Lake, the city-owned lake. The city's water intake structure is located on Hudson Lake.

12.3 Water Supply Storage Agreements

Table 4 below outlines existing water supply storage agreements for both Hulah and Copan Lakes.

Table 4. Water Supply Storage Agreements at Hulah and Copan Lakes (as of September 2005)

Lake	Approval Date	Percent of Water Supply to Usable Conservation Pool	Estimated User Storage (acre-feet)	Yield at End of Period of Analysis, Year 2035 (mgd)
Hulah Lake				
City of Bartlesville	6/12/57	57.249	15,400	9.644
City of Bartlesville	11/04/70	8.178	2,200	1.378
City of Bartlesville	11/12/80	7.807	2,100	1.315
Hulah Water District, Inc	11/04/70	0.372	100	0.063
Total		**73.610**	**19,800**	**12.40**
Copan Lake				
Copan Public Works Authority	10/23/62	14.881	5,000	2.0
Total		**14.881**	**5,000**	**2.0**

Note: Hulah Lake data based on 1973 sediment survey. Copan Lake data based on 1983 sediment survey

12.4 Sedimentation History

Sedimentation is a natural occurrence that is accounted for in all Corps of Engineers reservoir designs. Flood control, water supply, water quality, recreation, and wildlife habitat are all affected by sedimentation as the reservoir ages.

The Caney River basin consists of silts and clays with scattered outcroppings of sandstone and limestone rock. The well-defined stream with its heavily vegetated overbanks allow for very little bank erosion. The sediment inflow into the lake is low compared to other reservoirs in Tulsa District. The sediment inflow is further reduced due to several Natural Resource Conservation Service (NRCS), formerly the U.S. Soil Conservation Service (SCS), dams upstream of Hulah Lake.

The average annual sediment deposit in Hulah Lake is 281 acre-feet. The 50-year design sediment storage for Hulah Lake was 1,300 acre-feet. This storage has been depleted; however, the 1973 sediment resurvey resulted in an additional reallocation of 4,200 acre-feet of sediment storage in the conservation pool for sediment accumulation. The 1991 sediment survey revealed that all remaining sediment storage was filled and should have been impacting all project purposes. Sedimentation was depleting water supply and water quality storage as well as flood control storage. The 2002 sedimentation survey indicated that there were 22,565 acre-feet of total conservation storage remaining in Hulah Lake which includes approximately 16,600 acre-feet of water supply storage, 5,953 acre-feet for water quality storage, and 12 acre-feet of inactive storage.

The design sediment storage for Copan Lake was 9,200 acre-feet. Sedimentation surveys have been performed in 1993 and 2002. Based on the 2002 survey, Copan Lake has 34,634 acre-feet of conservation storage remaining with an average annual sedimentation rate of 219 acre-feet per year.

13. Economic Analysis

13.1 Water Supply Demand Analysis

Since water use fluctuates over time, a water system should be able to provide enough water to meet current and potential future water needs. Water demands are important to the long range planning, design, and operation of municipal water systems, such as annual average day and maximum day or peak water demands. The Bartlesville water supply system is the largest single water user in the Oklahoma portion of the Caney River Basin and in Washington County. The Bartlesville system serves the City of Bartlesville, the City of Dewey, rural communities, and rural water districts, with a total population exceeding 50,000. The 2000 Census of Population, April 1, 2000, shows a population of 34,748 for the City of Bartlesville, and 3,179 for the City of Dewey.

Population and employment for year 2000, and projections for Washington County are shown in Table 5.

Table 5. Population and Employment Washington County

Year	Population	Employment
2000	48,996	19,600
2010	49,700	20,800
2020	50,800	19,800
2030	51,300	18,800
2040	52,000	18,100
2050	52,700	18,200
2060	53,500	18,300

Source: Oklahoma State Data Center, Oklahoma Department of Commerce, 2002. U.S. Census Bureau, County and City Data Book, 2000.

The cities of Bartlesville and Dewey account for most of the county population. Population is important because there is generally a direct link between population and water use. The exception is when there is a major industrial or commercial entity that uses large quantities of water over time.

In a 1995 survey for the Oklahoma Water Resources Board, the following data was obtained for the city of Bartlesville, and other water districts and communities served by the City of Bartlesville. Table 6 shows this data.

Table 6. Water Districts Served by City of Bartlesville Year 1995

County/District	Population Served	Number of Meters–Residential	Avg Daily Use (1,000 GPD)	Maximum Daily Demand (1,000 GPD)	Per Capita Daily Use (GPD)	Water Lost (percent)
Washington County						
Washington County RWD No. 1	1,067	434	73	150	67	11
Washington County RWD No. 2	2,050	828	135	400	66	14
Washington County RWD No. 3	10,200	3,393	1,078	1,642	106	18
Washington County RWD No. 5	1,300	305	55	75	N.A.	12
Bar Dew Water Association	124	54	7	20	57	37
Dewey PWA	4,533	1,511	616	819	136	N.A.
Ramona PWA	500	295	295	N.A.	N.A.	N.A.
City of Bartlesville	34,256	13,595	7,600	72,300	216	13
Nowata County						
Nowata County RW&SD #1	478	207	33	50	69	24
(City of Dewey)						
Osage County						
Osage County RWD#1	844	356	50	110	59	17
Strike Axe Water Co.	800	308	49	64	61	N.A.

Source: Rural Water Systems in Oklahoma, Oklahoma Water Resources Board, January 1998

Notes:

N.A.–Not Available

GPD–gallons per day

PWA–Public Water Authority

RWD–Rural Water District

Total population served by the City of Bartlesville was over 56,000 at the time of the survey in 1995. Since the City provides water outside Washington County, the population served includes not only parts of Osage and Nowata Counties, but also Tulsa and Rogers County (Washington County RWD #3). The City of Dewey, which obtains its water from Bartlesville, also provides water to the Wann Water District and Rural Water Districts #1 and #5. The City of Bartlesville is a regional supplier outside the city limits itself.

Historical Water Use. The United States Geological Service (U.S.G.S.) estimates that total reported residential water use for Washington County in year 2000 was 4.1 mgd and 1.8 mgd for non-residential use that would include commercial, industrial, and public water use. In year 2000 total water deliveries were about 5.9 mgd or 6,600 acre-feet per year. The public sector and system losses account for the remaining water use, or about 778 acre-feet per year.

Reported water use (to the Oklahoma Water Resources Board) for the following cities is found in Table 7.

Table 7. Reported Water use by Community and Year (million's of gallons per day)

Year	City/District (County)			
	Bartlesville (Washington)	Bartlesville (Osage)	Copan (Washington)	Washington City RWD No. 3 (Washington, Rogers, and Tulsa)
1996	4.53	3.74	0.09	1.22
1997	2.57	4.04	0.09	1.13
1998	3.03	5.61	0.09	1.30
1999	3.58	5.01	0.07	1.31
2000	0.65	4.37	0.07	1.41
2001	5.27	4.34	0.10	1.60

Source: Oklahoma Water Resources Board, 2003.

Water pumped from Hudson Lake in Bartlesville, Hulah Lake and Caney River for the years 1999 through 2003 has been provided by the City of Bartlesville and is shown in Table 8. Also shown are the annual average day water use and the average water use for the month of August, typically the month with the greatest total water use.

Projected water use, as provided by the City of Bartlesville, is shown in Table 9.

Table 8. Summary of Water Pumped by Source and Year (Gallons)

Year	Raw Water (mgd)	Hudson Lake-(Bartlesville) (mgd)	Hulah Lake (mgd)	Caney River (mgd)	Plant Discharge (mgd)
1999	3,113,918,000	1,829,881,000	1,261,247,000	47,230,000	2,903,469,000
Annual Average Day	8.53				
August Average Day	10.18				
2000	3,307,181,000	1,346,649,200	1,992,065,000	73,000,000	3,131,317,000
Annual Average Day	9.07				
August Average Day	16.33				
2001	3,381,049,000	1,234,802,000	1,992,400,000	283,300,000	3,129,703,000
Annual Average Day	9.26				
August Average Day	14.79				
2002	2,895,727,000	527,144,000	2,356,079,000	501,200,000	2,536,075,000
Annual Average Day	7.93				
August Average Day	10.57				
2002	2,902,488,000	1,371,091,000	1,644,827,000	9,500,000	2,585,263,000
Annual Average Day	7.95				
August Average Day	11.40				

Table 9. Bartlesville Municipal Authority Projected Water Use (million gallons per day)

Year	Average Linear	Average ODOC	0.50 Percent Peak
2010	8.0	21.5	20.0
2020	9.5	24.0	21.0
2030	10.0	27.0	22.8
2040	10.5	29.6	24.3

Source: City of Bartlesville, 2004
Note: ODOC–Oklahoma Department of Commerce

13.2 Analysis of Water Supply Alternatives Considered Including the Proposed Action

13.2.1 No Action Alternative

With no action, existing water supply sources for the City of Bartlesville would be insufficient for meeting projected 2035 needs. The existing water supply yield for Hulah reservoir is currently 9.9 mgd; however, the dependable yield for year 2035 is 6.4 mgd due to sedimentation. Hulah reservoir currently has no additional water supply storage available above what is under agreement. With a 2035 water supply demand of 12 mgd, the City of Bartlesville needs additional storage that will yield a total of approximately 5.6 mgd. The proposed no action alternative will be not satisfy the future water supply demands of the city.

13.2.2 Preliminary Alternatives

Potential sources of water supply were identified in north central and northeastern Oklahoma. Alternative costs of conveying water from potential sources of water supply to the City of Bartlesville were developed by TetraTech, Inc., Tulsa, Oklahoma, and are described in a report, "Hulah-Copan Reallocation Study, Costs of Alternative Water Supply Sources", dated August 2004 and revised May 2005. Potential sources of water supply in Kansas were eliminated from further consideration due to legal issues and environmental issues in crossing state boundaries. In addition, there are no adequate groundwater sources of water supply that could meet the City of Bartlesville's future demands. Federal, State, and Natural Resources Conservation Service (NRCS) lakes, both existing and proposed, were considered.

- Skiatook Lake, Osage County (Federal)
- Kaw Lake, Kay County (Federal)
- Oologah Lake, Rogers County (Federal)
- Copan Lake, Washington County (Federal)
- Birch Lake, Osage County (Federal)
- Sand Lake (proposed), Osage County (Federal)
- Shidler (proposed), Osage County (Federal)
- Grand Lake, Delaware County (State)
- Hudson Lake, Mayes County (State)
- Big Creek Lake (proposed), Craig County (NRCS)
- Chelsea Lake (proposed), Mayes County (NRCS)

Initial screening of alternative sources of water supply considered the following lakes that were eliminated due to insufficient water supply yield. Those sources of water supply are Birch Lake, Shidler Lake, Hudson Lake, Big Creek Lake, and Chelsea Lake. Shidler Lake, a de-authorized project, was eliminated due to adverse environmental impacts and high costs associated with mineral acquisition. The remaining lakes considered as alternative sources of water supply are discussed below in the section of the report describing the costs of alternative sources of water supply.

Birch Lake

Birch Lake, at river mile 0.8 on Birch Creek, a tributary of Bird Creek, is about 1.5 miles south of Barnsdall in Osage County, and about 20 miles southwest of Bartlesville in Washington County. Project purposes are flood control, water supply, water quality control, recreation, and fish and wildlife. Construction began in 1973 and was completed in March 1977 for full flood control operation. The capacity of flood control storage is 39,805 acre-feet. Conservation storage is 15,808 acre-feet, of which 7,600 acre-feet (3.0 mgd yield) is for water supply; 7,600 acre-feet for water quality control (3.0 mgd); and 640 acre-feet for sediment storage.

Shidler Lake

The proposed Shidler Lake would be located at river mile 39.2 on Salt Creek, a tributary of the Arkansas River, about 1 mile east of Shidler in Osage County. This project was de-authorized as a Federal project on May 1, 1997. As proposed, the conservation storage pool of 58,200 acre-feet would yield 13.7 mgd for water supply and 1.3 mgd for low flow fish and wildlife mitigation. Other project purposes include flood control and recreation.

Hudson Lake

Hudson Lake (Markham Ferry Dam) is located on the Grand (Neosho) River at river mile 47.4, about 2 miles northeast of Locust Grove and about 8 miles southeast of Pryor in Mayes County Oklahoma. The purpose of Hudson Lake is hydroelectric power and flood control. This project was constructed by the Grand River Dam Authority (GRDA), an Oklahoma State agency. It was completed in April 1964. The U.S. Army Corps of Engineers operates the project for flood control. Flood control storage amounts to 244,200 acre-feet. Although power production is run of the river, power pool capacity is 200,300 acre-feet.

Big Creek Lake

The proposed NRCS Big Creek Lake is located in Craig County on Big Creek near the Nowata and Craig County line. Project purposes would be water supply and recreation. Actual storage requirements have not been developed; however, the water supply yield of 32,500 acre-feet per year, or about 29 mgd, is based on approximately 60% of the average annual stream flow in the drainage basin.

Chelsea Lake

The proposed NRCS Chelsea Lake on Pryor Creek in Mayes County would have a water supply storage of about 21,300 acre-feet per year, or a 19.2 mgd yield. Its purpose would be water supply and recreation. Actual storage requirements have not been developed; however, the water supply yields are based on approximately 60 % of the average annual stream flow in the drainage basin

Dredging Alternative

Hulah Lake has lost approximately 13,845 acre-feet of storage to sedimentation, based on 2002 volumetric survey data and is projected to lose a total of 28,000 acre-feet of conservation storage by 2035. One option considered in the reallocation study was dredging Hulah Lake to recover storage lost to sedimentation during the period of anlaysis.

As an example of the cost of dredging Hulah Lake, a cost estimate was prepared assuming 13,845 acre-feet of sediment would be dredged, the storage lost to date based on the 2002 volumetric survey. This volume of storage equates to 22,336,600 cubic yards of material. At a cost of $4/cubic yard for dredging and transportation, dredging costs would total over $89 million dollars. Total costs could exceed this estimate if an offsite disposal option is chosen.

Dredging costs exceed the cost of constructing a reservoir with similar conservation storage. As a result, dredging was not considered as a viable alternative.

System Operation Alternatives

In many instances, lakes within the same drainage basin can be operated to optimize the storage and yield of downstream lakes. Hulah and Copan Lakes are located within the Caney River drainage basin but Hulah Lake is located on the main stem of the Caney River, while Copan Lake is located on the Little Caney River. Since the two lakes are located on separate stems of the drainage basin, system operation to maximize storage and yield is not possible. Therefore, system operation was not considered a viable option.

Groundwater Alternative

There are no adequate groundwater sources in the Bartlesville area that could meet future water supply demands of the city for the quantities needed. Prior studies have looked at potential groundwater fields in Osage County. Therefore, groundwater sources were eliminated from further consideration.

Reservoir Water Sources Alternative

Potential existing and potential surface water sources evaluated include:

- Skiatook Lake, Osage County, OK (50 miles)
- Grand Lake,Delaware County, OK (90 miles)
- Kaw Lake, Kay County, OK (45 miles)
- Oologah Lake, Rogers County, OK (42 miles)
- Copan Lake, Washington County, OK (10 miles)
- Sand Lake, Osage County, OK (16 miles)

Skiatook Lake

Skiatook Lake is located at river mile 14.3 on Hominy Creek, a tributary of Bird Creek and the Verdigris River, about 5 miles west of Skiatook in Osage County, Oklahoma. Skiatook Lake was constructed for flood control, water supply, water quality control, recreation, and fish and wildlife. Construction began in January 1974 with impoundment in October 1984. Conservation storage, between elevations 657 and 714 feet national geodetic vertical datum, is 311,600 acre-feet decreasing to 295,900 acre-feet after 100 years of sediment. Water supply accounts for 62,900 acre-feet (14 mgd yield) of storage, and water quality storage of 233,000 acre-feet, yielding 62 mgd, with 15,700 acre-feet for sediment.

Skiatook Lake was screened from further consideration due to several issues. OWRB has over appropriated water rights on original water supply storage and have several water rights outstanding subject to reallocation. City of Tulsa has water quality fully utilized at their North Tulsa treatment plant. The availability of water rights and that reallocation of storage from water quality and/or flood storage would be required. Conveyance construction costs for 5 mgd of water from Skiatook Lake to Hudson Lake is estimated at $59.5 million and to Hulah Lake about $67.5 million. Annual conveyance costs are $3.8 million to Hudson Lake and $4.3 million to Hulah Lake for 5 mgd of water.

Grand Lake

Grand Lake, at river mile 77.0 on the Grand (Neosho) River, is located in Mayes and Delaware counties near Disney, Oklahoma, about 13 miles southeast of Vinita Oklahoma. The purpose of Grand Lake is hydroelectric power and flood control. This project was also constructed by the Grand River Dam Authority (GRDA). It became operational in 1941. The U.S. Army Corps of Engineers operates the project for flood control. The Grand River Dam Authority controls all the water rights and storage in the Grand (Neosho) River Basin and Grand Lake. The Grand River Dam Authority could contract with the City of Bartlesville for water supply storage.

Grand Lake was the furthest water supply source considered. The purpose of Grand Lake is hydropower and flood control. To use Grand Lake as a water supply source would require the construction of a water intake structure and Grand River Dam Authority's approval to contract for water supply. The conveyance construction cost for 5 mgd of water from Grand Lake to Hudson Lake is estimated to be $125.8 million and to Hulah Lake $138.8 million. These costs are considerably higher than other more viable alternatives.

Sand Lake

The proposed Sand Lake reservoir was de-authorized in 1999 and was eliminated from further consideration. If Sand Lake was reauthorized, it would most likely be a water supply lake with 100% of the costs reimbursable by the local sponsor. Downstream flood control would account for a small part of project benefits. Available yield and cost from Sand Lake is dependent on how the lake would be reauthorized and if it is sized for flood control, water supply and water quality. Prior studies indicate that flood control would be less than 10% of total benefits. Other Federal projects built in Osage County have encountered significant mineral rights mitigation requirements. The proposed Candy Lake in the nearby Bird Creek basin, for which land was acquired, has been de-authorized. Existing environmental laws and tribal sovereign mineral and land rights issues would increase the cost of construction of Sand Lake. Preliminary reconnaissance level studies by the Corps of Engineers in the Caney River Basin in 1984 indicated a benefit to cost ratio of 1.5 to 1.0; however, detailed cost studies would be required to reevaluate this project. Construction costs were estimated at a reconnaissance level in 1984 and updated to year 2004. These costs are estimated to be $40.0 million in 2004; however, construction costs would be significantly greater than those that were estimated due to when the actual construction would take place. Environmental constraints, tribal sovereign land rights, and the uncertainty of federal reauthorization, prevents an accurate analysis of the yield and cost of construction at Sand Lake.

Kaw Lake

Kaw Lake is located on the Arkansas River at river mile 653.7, about 8 miles east of Ponca City in Kay County, Oklahoma. Its purpose is flood control, water supply, water quality, hydropower, recreation, and fish and wildlife. Construction began in June 1966 and the project was place into operation in May 1977. Based on a 1986 sedimentation survey, the conservation storage is estimated at 330,180 acre-feet. Flood control storage is 867,310 acre-feet. The power and conservation storage has a capacity of 383,480 acre-feet, and includes 171,200 acre-feet for water supply (167 mgd yield), 31,800 acre-feet for water quality control (39 mgd yield), and 140,500 acre-feet for sediment reserve. Conveyance costs are shown in Table 11.

Oologah Lake

Oologah Lake, on the Verdigris River at river mile 90.2, is located about 2 miles southeast of Oologah in Rogers County, Oklahoma. It is about 27 miles northeast of Tulsa Oklahoma. Construction began in July 1950, resumed in December 1955 from standby status, and was completed in May 1963. Construction for ultimate development was completed in 1974. The conservation pool for navigation and municipal and industrial water supply contains 545,300 acre-feet of storage. Of this storage amount 342,600 acre-feet is for water supply that yields 154 mgd, 168,000 acre-feet is for navigation, and 34,700 acre-feet is for 50 years of sediment deposition. Conveyance costs are shown in Table 11.

Copan Lake

Copan Lake, at river mile 7.4 on the Little Caney River, is about 9 miles north of Bartlesville and 2 miles west of the town of Copan in Washington County. The purpose of Copan Lake is flood control, water supply, water quality control, recreation, and fish and wildlife enhancement. Construction began in November 1972 by the Corps of Engineers and the project was completed in April 1983. Prior to the reevaluation of storage in 2002, flood control storage amounted to 184,300 acre-feet and active conservation storage was 42,800 acre-feet of which 7,500 acre-feet was for water supply (17.52% of conservation storage) yielding 3.0 mgd; 26,100 acre-feet for water quality control (60.98% of storage) yielding 16 mgd; and sediment storage of 9,200 acre-feet (21.50% of storage). In year 2002, active usable conservation storage is reduced to 33,887 acre-feet, and 29,369 acre-feet by year 2035. Water supply storage remained at 7,500 acre-feet in year 2002, but is reduced to 6,555 acre-feet by year 2035. Likewise water quality storage remained at 26,100 acre-feet in 2002, and is reduced to 22,814 acre-feet by year 2035. By year 2002, sediment storage was reduced from 9,200 acre-feet to 287 acre-feet, and zero acre-feet by year 2035. By year 2035, based on existing conditions water supply would yield 2.91 mgd. Conveyance costs are shown in Table 11. Copan Lake was considered as the best and most likely alternative water supply source.

Water Rights and Water Availability

Water rights to existing sources of water supply are appropriated by the State of Oklahoma. Water rights obtained from the State of Oklahoma are given for municipal and industrial water supply needs and for other purposes. Water rights have been allocated in Hulah, Copan, Kaw, Skiatook, and Oologah lakes. The Grand River Dam Authority has control of all the water rights in Grand Lake. Water supply storage agreements can only be entered into with entities holding valid water rights from the proper State agency. Water rights are appropriated by the state so that the waters of the state are put to their most beneficial use.

Water Supply Storage Contracts

Existing and pending water supply storage contracts at Federal lakes, those operated by the U.S. Army Corps of Engineers, are shown in Table 10. These contracts show the amount of storage in acre-feet that is available from conservation storage for water supply, the yield in mgd, the amount presently stored and available for future storage in acre-feet and mgd, and the latest available amount the user has used and is expected to use in acre-feet per year. The date of the storage contract is also shown. The total water supply storage or yield and the total user storage and yield would indicate if there is any remaining storage available for water supply without relinquishment of storage or reallocation from other project purposes, such as reallocating flood control storage to water supply, or water quality storage to water supply. Currently there is 1 mgd of water supply storage that is not under agreement at Copan Lake and 78.24 mgd not under agreement at Kaw Reservoir. 100% of Hulah Lake’s water supply storage is under agreement.

Conveyance Costs

Construction costs and annual pipeline costs for water conveyance were estimated for each of the three existing reservoirs, Copan, Kaw, and Oologah Lakes, and are shown in Table 11. Sand Lake costs are also shown for comparative purposes. Two destination locations, Hulah Lake and Hudson Lake are also displayed in Table 11. Pipeline construction cost estimates were made based on 5 and 10 mgd flow rates. Likewise, conveyance costs for 15-, 20-, and 25-mgd flows were developed but are not shown. The construction and annual costs for each new reservoir and pipeline were estimated and amortized over a 50 year period at 5.375%.

Table 12 summarizes conveyance costs from sources of water supply, including Skiatook Lake and Grand Lake, to either Hudson Lake or Hulah Lake as destination points prior to treatment. These construction and pipeline costs were used in formulating and ranking water supply reallocation alternatives.

Table 10. Water Supply Storage Contracts by Project												
Authority Public Law	**Contract Number**	**User Name**	**Entity**	**Total Water Supply Storage**	**Total Yield**	**Present Storage**	**Present Yield**	**Future Storage**	**Future Yield**	**User Storage**	**User Yield**	**Contract Approved**
Birch Projects												
--	--	Not under Agreement	--	7,630	3.00	0	--	7,630	3.00	0	0	--
Copan Projects * a												
FCA 1962	81-C-0114	Copan PWA	C	7,500	3.00	250	0.10	4,750	1.90	5,000	2.00	15-Sep-81
--	--	Not under Agreement	--	7,500	3.00	0	0	2,500	1.00	2,500	1.00	--
Hulah Projects * b												
FCA 1936	71-C-0021	Hulah Water District, Inc.	C	19,800	12.40	100	0.06	0	0	100	0.06	4-Nov-70
FCA 1937	66-57-717	City of Bartlesville	C	19,800	12.40	2,200	1.38	0	0	2,200	1.38	4-Nov-70
FCA 1938	66-57-718	City of Bartlesville	C	19,800	12.40	15,400	9.64	0	0	15,400	9.64	12-Jun-57
FCA 1939	82-C-0101	City of Bartlesville	C	19,800	12.40	2,100	1.32	0	0	2,100	1.32	12-Nov-82
Kaw Projects												
FCA 1962	81-C-0026	Kaw Reservoir Authority	C	171,200	78.41	0	0	0	0	0	0	11-Mar-81
FCA 1963	80-C-0113	Stillwater Utility Authority	M	171,200	167.00	6,662	6.50	44,788	43.70	51,450	50.19	4-Mar-81
FCA 1964	78-C-0270	Okla Gas and Electric	C	171,200	167.00	9,150	8.93	30,200	29.46	39,350	38.39	22-Apr-80
FCA 1965	93-C-0052	Kaw Tribe of Oklahoma	Tr	171,200	167.00	6	0.01	0	0.00	2,100	1.32	28-Feb-98

Table 10. Water Supply Storage Contracts by Project (continued)												
Authority Public Law	**Contract Number**	**User Name**	**Entity**	**Total Water Supply Storage**	**Total Yield**	**Present Storage**	**Present Yield**	**Future Storage**	**Future Yield**	**User Storage**	**User Yield**	**Contract Approved**
--	--	Not Under Agreement	--	171,200	167.00	0	0	80,211	78.24	80,211	78.24	--
FCA 1962	93-C-0056	Otoe-Missouri Tribe	Tr	171,200	167.00	183	0.18	0	0	183	0.18	25-Aug-93
Oologah Projects												
PL 761	85-C-0093	Rogers County RWD #4	C	342,600	154.00	1,590	0.72	0	0	1,590	0.72	5-Jul-85
FCA 1938'	85-C-0085	Public Service Co of OK	C	342,600	154.00	20,990	9.44	0	0	20,990	9.44	8-May-85
FCA 1938'	85-C-0019	Rogers County RWD #3	C	342,600	154.00	5,960	2.68	0	0	5,960	2.68	8-Feb-85
FCA 1938'	85-C-0033	Nowata County RWD #1	C	342,600	154.00	200	0.09	0	0	200	0.09	7-Mar-85
FCA 1938'	85-C-0092	City of Collinsville	C	342,600	154.00	6,670	3.00	0	0	6,670	3.00	26-Jun-85
FCA 1938'	85-C-0019	Tulsa Metro Water Auth	M	342,600	154.00	285,450	128.31	0	0	285,450	128.31	8-Feb-85
FCA 1938'	85-C-0070	City of Claremore	M	342,600	154.00	445	0.20	0	0	445	0.20	19-Sep-88
FCA 1938'	85-C-0067	Washington Cty RWD #3	C	342,600	154.00	4,170	1.87	0	0	4,170	1.87	22-Jul-92
FCA 1938'	85-C-0058	Town of Chelsea	Tn	342,600	154.00	670	0.30	860	0.39	1,530	0.69	2-Apr-82

Table 10. Water Supply Storage Contracts by Project (continued)												
Authority Public Law	**Contract Number**	**User Name**	**Entity**	**Total Water Supply Storage**	**Total Yield**	**Present Storage**	**Present Yield**	**Future Storage**	**Future Yield**	**User Storage**	**User Yield**	**Contract Approved**
--	--	Not Under Agreement		342,600	154.00	0	0.00	9,365	4.21	9,365	4.21	
--	99-WS-0001	City of Claremore	M	0	0	6,230	2.80	0	0	6,230	2.80	18-Mar-99
Skiatook Projects												
--	83-C-0111	Osage County RWD #15	C	0	0	0	0	0	0	0	0	16-Jan-84
FCA 1962	88-C-0004	Sand Springs Municipal Authority	C	62,900	14.00	6,740	1.50	0	0	6,740	1.50	13-Mar-88
FCA 1962	88-C-0003	Sapulpa Municipal Authority	C	62,900	14.00	4,490	1.00	0	0	4,490	1.00	13-Mar-88
FCA 1962	87-C-0078	Skiatook Public Works Authority	C	62,900	14.00	2,018	0.45	0	0	2,018	0.45	13-Mar-88
FCA 1962	87-C-0061	Osage County RWD #15	C	62,900	14.00	0	0.00	2,000	0.45	2,000	0.45	29-May-87
--	--	--	--	62,900	14.00	--	--	35,909	7.99	35,909	7.99	--
--	98-WS-0003	Skiatook Public Works Authority	M	62,900	14.00	2,743	0.61	0	0	2,743	0.61	2-Jun-98
--	Pending	Sapulpa Municipal Authority	M	62,900	14.00	4,500	1.00	4,500	1.00	9,000	2.00	--

Note: a :Copan water supply storage agreements based on 1983 sediment survey data.
b. Hulah water supply storage agreements based on 1973 sediment survey data.

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Table 11. Hulah-Copan Reallocation Study Pipeline Costs of Alternative Water Supply Sources

		COPAN LAKE PIPELINE		KAW LAKE PIPELINE		OOLOGAH LAKE PIPELINE		SAND LAKE PIPELINE	
Length To Hudson Lake (Ft):		50,000		240,000		223,000		87,000	
Length To Hulah Lake (Ft):		45,300		285,300		268,300		132,300	
Amortization Rate:		5.375%		5.375%		5.375%		5.375%	
Amortization Period (Yrs):		50		50		50		50	
		To: Hudson Lake		*To: Hudson Lake*		*To: Hudson Lake*		*To: Hudson Lake*	
		5 MGD	**10 MGD**	**5 MGD**	**10 MGD**	**5 MGD**	**10 MGD**	**5 MGD**	**10 MGD**
		6,944 gpm	**13,889 gpm**	**6,944 gpm**	**13,889 gpm**	**6,944 gpm**	**13,889 gpm**	**6,944 gpm**	**13,889 gpm**
		24-in dia.	**30-in dia.**	**24-in dia.**	**30-in dia.**	**24-in dia.**	**30-in dia.**	**24-in dia.**	**30-in dia.**
CONSTRUCTION COSTS									
Acct No.	***Description***								
01	*Lands and Damages*	*$43,050*	*$43,050*	*$206,640*	*$206,640*	*$192,003*	*$192,003*	*$74,907*	*$74,907*
04	*Dams (1)*	*$0*	*$0*	*$620,000*	*$620,000*	*$620,000*	*$620,000*	*$0*	*$0*
13	*Pumping Plants (2)*	*$7,268,400*	*$9,765,600*	*$31,560,800*	*$40,198,600*	*$29,958,533*	*$38,519,167*	*$11,924,267*	*$15,558,433*
30	*Planning, Engr. & Design*	*$731,145*	*$980,865*	*$3,238,744*	*$4,102,524*	*$3,077,054*	*$3,933,117*	*$1,199,917*	*$1,563,334*
31	*Construction Management*	*$438,687*	*$588,519*	*$1,943,246*	*$2,461,514*	*$1,846,232*	*$2,359,870*	*$719,950*	*$938,000*
Contingency (35%) (3)		*$2,559,008*	*$3,433,028*	*$11,335,604*	*$14,358,834*	*$10,769,688*	*$13,765,909*	*$4,199,711*	*$5,471,669*
Total Construction Cost		**$11,040,290**	**$14,811,062**	**$48,905,034**	**$61,948,112**	**$46,463,510**	**$59,390,066**	**$18,118,752**	**$23,606,344**
ANNUAL COSTS									
Amortized Construction Cost:		$640,123	$858,754	$2,835,544	$3,591,790	$2,693,983	$3,443,473	$1,050,536	$1,368,710
Annual Power Cost (4):		$132,065	$262,968	$145,051	$288,940	$195,265	$398,372	$120,637	$244,787
Pump Replacement Cost (5):		$6,584	$13,159	$7,236	$14,463	$9,758	$19,960	$6,010	$12,246
Total Annual Cost		**$778,771**	**$1,134,881**	**$2,987,831**	**$3,895,193**	**$2,899,006**	**$3,861,805**	**$1,177,183**	**$1,625,743**

Table 11. Hulah-Copan Reallocation Study Pipeline Costs of Alternative Water Supply Sources (continued)

		COPAN LAKE PIPELINE		KAW LAKE PIPELINE		OOLOGAH LAKE PIPELINE		SAND LAKE PIPELINE	
		To: Hulah Lake		*To: Hulah Lake*		*To: Hulah Lake*		*To: Hulah Lake*	
		5 MGD	**10 MGD**	**5 MGD**	**10 MGD**	**5 MGD**	**10 MGD**	**5 MGD**	**10 MGD**
		6,944 gpm	**13,889 gpm**	**6,944 gpm**	**13,889 gpm**	**6,944 gpm**	**13,889 gpm**	**6,944 gpm**	**13,889 gpm**
		24-in dia.	**30-in dia.**	**24-in dia.**	**30-in dia.**	**24-in dia.**	**30-in dia.**	**24-in dia.**	**30-in dia.**
CONSTRUCTION COSTS									
Acct No.	***Description***								
01	*Lands and Damages*	*$39,003*	*$39,003*	*$245,643*	*$245,643*	*$231,006*	*$231,006*	*$113,910*	*$113,910*
04	*Dams (1)*	*$0*	*$0*	*$620,000*	*$620,000*	*$620,000*	*$620,000*	*$0*	*$0*
13	*Pumping Plants (2)*	*$6,506,560*	*$8,679,800*	*$6*	*$6*	*$35,767,893*	*$45,833,367*	*$17,703,627*	*$22,782,633*
30	*Planning, Engr. & Design*	*$654,556*	*$871,880*	*$3,820,580*	*$4,828,844*	*$3,661,890*	*$4,668,437*	*$1,781,754*	*$2,289,654*
31	*Construction Management*	*$392,734*	*$523,128*	*$2,292,348*	*$2,897,307*	*$2,197,134*	*$2,801,062*	*$1,069,052*	*$1,373,793*
Contingency (35%) (3)		*$2,290,947*	*$3,051,581*	*$302,977*	*$302,977*	*$12,816,615*	*$16,339,531*	*$6,236,138*	*$8,013,790*
Total Construction Cost		**$9,883,801**	**$13,165,393**	**$7,281,555**	**$8,894,777**	**$55,294,538**	**$70,493,403**	**$26,904,481**	**$34,573,781**
ANNUAL COSTS									
Amortized Construction Cost:		$573,069	$763,338	$3,344,946	$4,227,688	$3,206,011	$4,087,251	$1,559,938	$2,004,609
Annual Power Cost (4):		$105,919	$211,022	$145,051	$288,940	$199,594	$411,359	$120,637	$244,787
Pump Replacement Cost (5):		$5,270	$10,550	$7,236	$14,463	$9,976	$20,612	$6,010	$12,246
Total Annual Cost		**$684,258**	**$984,909**	**$3,497,233**	**$4,531,092**	**$3,415,581**	**$4,519,222**	**$1,686,585**	**$2,261,641**

Notes:

(1) Includes cost for new intake structure and outlet pipe to be constructed in existing lake. Zero cost indicates that existing intake and outlet pipe could be used instead of constructing a new intake structure.

(2) Includes cost of pipeline and pumping station.

(3) Calculated on Lands and Damages, Dams, and Pumping Plants.

(4) Assumes that annual power costs will escalate at 1.02% per year (average of CPI for past 3 years). Amount shown is average of Year 1 and Year 50 calculated power costs.

(5) Assumes pumps will be replaced one time during 50-year life.

Table 12. Summary of Alternative Plan Costs

Plan	Costs	Design Flows (mgd)	
		5.0	10.0
Skiatook Lake			
To Hudson Lake	Construction	$59,546,100	$77,940,500
	Annual	$3,846,600	$5,336,600
To Hulah Lake	Construction	$67,481,700	$87,454,700
	Annual	$4,323,900	$5,908,900
Grand Lake			
To Hudson Lake	Construction	$125,819,900	$169,336,400
	Annual	$7,756,900	$10,541,500
To Hulah Lake	Construction	$138,680,800	$187,223,600
	Annual	$8,515,800	$11,636,400
Kaw Lake			
To Hudson Lake	Construction	$74,049,700	$90,764,300
	Annual	$4,635,900	$5,903,000
To Hulah Lake	Construction	$87,198,900	$106,095,200
	Annual	$5,426,800	$6,825,100
Sand Lake			
To Hudson Lake	Construction	$24,283,200	$32,917,500
	Annual	$1,624,800	$2,369,000
To Hulah Lake	Construction	$35,250,600	$46,066,700
	Annual	$2,284,500	$3,159,400
Oologah Lake			
To Hudson Lake	Construction	$70,420,900	$87,109,000
	Annual	$4,445,600	$5,760,000
To Hulah Lake	Construction	$83,570,000	$102,439,900
	Annual	$5,249,500	$6,682,100
Copan Lake			
To Hudson Lake	Construction	$13,372,300	$20,093,100
	Annual	$992,600	$1,615,300
To Hulah Lake	Construction	$11,949,000	$17,910,100
	Annual	$879,700	$1,429,300

Notes:

Costs shown have been rounded to the nearest $100. The spreadsheet summaries contained in Appendix C were not rounded to clearly show how each number was calculated.

All costs shown are in 3rd Quarter 2004 dollars.

Water Supply Storage Cost for Plan Formulation

For plan formulation purposes an annual water supply storage cost was also calculated for available water supply as well as potential reallocated water from water quality.

The final two alternatives evaluated remaining available water supply and water supply reallocated from water quality storage at both Hulah and Copan Lakes. Table 13 displays annual storage and conveyance costs for the range of alternative projects considered in plan formulation. The estimated yield and total annual cost is shown with the cost ranked by mgd of water supply storage. It is evident that the least costly alternatives are to utilize both Hulah and Copan Lakes water supply and water quality storages for the amount of water needs at this time.

Table 13 shows that a pipeline from Copan to Hulah Lake with a reallocation of available water quality and obtaining remaining water supply storage appears to be the most cost effective option. Assuming the same water quality reallocation, a pipeline from Copan to Hudson Lake also ranks high in the list of alternatives. Copan water was not a viable option without a reallocation from water quality storage in the conservation pool. With only 1 mgd of available water supply, there would be insufficient water volume to justify the pipeline construction cost.

Oologah and Kaw Lakes are not viable options for the amount of water storage desired because of high pipeline construction costs. These costs are estimated to be 4 and 5 times higher than construction pipeline costs to Copan Lake.

Table 13. Annual Storage and Conveyance Cost Ranked by Cost per mgd by Alternative Project

Alternative Rank	Alternative	Annual Conveyance Cost	Annual Storage Cost	Total Annual Cost	Available Yield (mgd)	Cost per mgd	Major Environ mental Issues	Comment
1	Copan to Hulah Lake (with Water Quality reallocation and 1 mgd Water Supply)	$880,000	$1,440,403	$2,320,103	6.36	$364,796	No	Annual Cost declines after 6 years from $2,320,103 to $1,529,390.
2	Copan to Hudson Lake (with Water Quality reallocation and 1 mgd Water Supply)	$993,000	$1,440,403	$2,433,403	6.36	$382,610	No	Annual Cost declines after 6 years from $2,433,403 to $1,642,690.
3	Kaw to Hudson Lake	$4,636,000	$796,240	$5,432,140	5.0	$1,086,428	No	--
4	Oologah to Hudson Lake	$4,458,582	$141,256	$4,599,838	4.2	$1,095,200	No	No available water supply
5	Kaw to Hulah Lake	$5,427,000	$796,240	$6,223,240	5.0	$1,244,648	No	--
6	Oologah to Hulah Lake	$5,250,000	$141,256	$5,391,256	4.2	$1,283,632	No	No available water supply
7	Copan to Hulah Lake (available water supply)	$879,700	$820,713	$1,700,413	0.97	$1,753,003	No	Copan Available water supply costs
8	Copan to Hudson Lake (available water supply)	$992,600	$820,713	$1,813,313	0.97	$1,869,395	No	Copan Available water supply costs.

Table 13. Annual Storage and Conveyance Cost Ranked by Cost per mgd by Alternative Project

Alternative Rank	Alternative	Annual Conveyance Cost	Annual Storage Cost	Total Annual Cost	Available Yield (mgd)	Cost per mgd	Major Environmental Issues	Comment
9	Skiatook to Hudson Lake	$3,847,000	$190,100	$4,037,100	1.0	$4,037,100	No	No water supply available; Reallocation from water quality or flood pool required
10	Skiatook to Hulah Lake	$4,324,000	$190,100	$4,514,100	1.0	$4,514,100	No	No water supply available; Reallocation from water quality or flood pool required
11	Grand to Hudson Lake	$7,757,000	-	N/C	0.0	N/C	Not Investigated	Reallocation from hydropower or flood control would be required.
12	Grand to Hulah Lake	$8,516,000	-	N/C	0.0	N/C	Not Investigated	Reallocation from hydropower or flood control would be required.
13	Sand Lake to Hudson Lake (potential reservoir)	$1,625,000	Unknown	N/C	0.0	N/C	Yes	De-authorized site. Significant potential environmental concern, future reservoir construction costs uncertainty
14	Sand Lake to Hulah Lake (potential reservoir)	$2,285,000	Unknown	N/C	0.0	N/C	Yes	De-authorized site. Significant potential environmental concern, future reservoir construction costs uncertainty

Note: N/C–No Change

Reallocation Scenarios

From the ranked alternatives considered in Table 13, water supply reallocation of storage in both Hulah and Copan Lakes was selected for further analysis. These alternatives are described as scenarios in this section of the report.

Multiple yield alternatives for Hulah and Copan were looked at using the Southwestern Division Modeling System for the Simulation of the Regulation of a Multi-Purpose Reservoir System (SUPER). Various alternatives were considered to find the maximum available yield that would also produce acceptable reductions of water quality and flood control storage. Appendix B "Super Model Outputs" in the Environmental Assessment (EA) describes the evaluation process to develop the final alternatives that are described as scenarios in the following section.

Six scenario or alternative conditions including the "No Action" scenario were selected for further evaluation. For comparative purposes with those scenarios identified in the EA, the no action alternative is referred to as Scenario 0. Table 14 outlines a summary of yield analysis and other pertinent data of each alternative. Table 14 looked at the total available yield from both Hulah and Copan reservoirs for the best available combinations identified. The scenarios are:

Scenario 0

The "No Action", Existing Water Supply Condition.

This scenario has an available yield of 7.35 which is less than the minimum 12 mgd of water supply desired by year 2035.

Scenario 1

Reallocate all available water quality storage at Hulah Lake and Copan Lake plus purchase of available water supply (1mgd) at Copan Lake. This option provides 7.2 mgd from Hulah and an additional 5.54 after reallocation from Copan. This option will provide 12.74 mgd of available yield and will provide sufficient water quality to satisfy published water quality release standards.

Scenario 2

Reallocate all available water quality storage at Hulah with seasonal pool raises from 733.0 to 734.75 during the May 1st to November 30th time period. This option would make no changes to the existing operation of Copan reservoir. Under this option 7.78 mgd is available from Hulah and an additional 0.97 mgd would be available from Copan. Total available yield for this option provides 8.75 mgd, which is slightly below the desired rate. Mitigation costs for damages to cultural, natural and environmental resources would require additional mitigation cost assessment. Reallocation of water quality under scenario 1 eliminated the need to obtain detailed mitigation costs as this option would clearly have a higher cost.

Scenario 3

Reallocation of all available water quality storage at Copan with seasonal pool increases from June 1st to November 30th. This option would continue regular operations at Hulah reservoir. This option would provide a 2.5% reduction of flood control from Copan during the seasonal pool time period. Loss of flood control benefits at Copan are not significant. This option would provide 6.38 mgd from

Hulah reservoir and 6.91 mgd from Copan. This option provides 13.29 mgd of water supply. Mitigation costs for damages to cultural, natural and environmental resources would require additional mitigation cost assessment. Reallocation of water quality under scenario 1 eliminated the need to obtain detailed mitigation costs as this option would clearly have a higher cost.

Scenario 4

Reallocate all available water quality storage, plus 5% flood control reallocation from elevation 733.0 to 736.15 at Hulah reservoir. There would be no changes to the Copan reservoir operation. The reallocation of all available water quality storage to water supply and a 5% flood pool loss will result in additional flood damages downstream of Hulah Lake along the Caney River. A preliminary flood damage evaluation indicated that an estimated additional loss of about $12,000 to agricultural crop production and about a $19,000 to structures and contents over the current condition (without reallocation). The current condition (without reallocation) average annual flood damages are estimated to be about $272,000 to structures and contents and $283,000 to crops along the Caney River. This option provides 12.16 mgd from Hulah and 0.97 mgd from Copan. Total yield from both reservoirs from this scenario is 13.13 mgd. Mitigation costs for damages to cultural, natural and environmental resources would require additional mitigation cost assessment. Reallocation of water quality under scenario 1 eliminated the need to obtain detailed mitigation costs as this option would clearly have a higher cost.

Scenario 5

Reallocate all available water quality storage at Hulah reservoir with seasonal pool raises during the May 1st to November 30th time period. The conservation pool at Hulah will be raised to 736.15 with a seasonal pool of 737.0. Hulah reservoir will incur a 5% flood pool loss with the potential for an additional reduction of 1.5% during the seasonal pool time period. The reallocation of all available water quality storage to water supply with a seasonal pool raise during the May 1st to November 30th time period, and a 5% flood pool loss will result in additional flood damages downstream of Hulah Lake along the Caney River. A preliminary flood damage evaluation indicated that an estimated additional loss of about $1,000 to agricultural crop production and about a $4,000 to structures and contents over the current condition (without reallocation). No reallocation is considered at Copan reservoir under this option. This option provides a combined total of 14.34 mgd of water supply. Mitigation costs for damages to cultural, natural and environmental resources would require additional mitigation cost assessment. Reallocation of water quality under scenario 1 eliminated the need to obtain detailed mitigation costs as this option would clearly have a higher cost.

Preferred Alternative

Reallocation of water quality storage in the conservation pool in Copan and Hulah Lakes under Scenario 1 will increase the dependable yield, while maintaining the existing conservation storage and flood storage of the Lakes. Selection of scenario 1 achieved the desire to minimize the loss of flood control. Reallocation of flood control, with the public knowledge and rememberance of the 1986 flood made options 2,3,4,and 5 less desirable. Scenario 1 is the Preferred Alternative to meet the objectives of providing 12 to 14 mgd of water supply storage for the City of Bartlesville through year 2035. This will require reallocating 1,230 ac-ft from water quality storage at Hulah Lake, and 10,350 ac-ft from water quality storage to water supply storage at Copan Lake plus the consent to the remaining 2,185 ac-ft of originally authorized storage space from Copan Lake. The proposed reallocation will still satisfy published water quality release rates. No flood control storage loss will occur with this option and it will provide a yield of 12.74 mgd that satisfies future water demand needs of the community.

Table 14. Scenarios - Year 2035 Conditions

Scenario	Scenario Description	HULAH LAKE				COPAN LAKE				Total Yield Available (mgd)
		Conservation Pool Elevation (ft)	Yield (mgd)	Flood Control Reduction in (ac-ft)	Conservation Stage (ac-ft) at Normal Conservation Pool	Conservation Pool Elevation (ft)	Flood Control Reduction in (ac-ft)	Yield (mgd)	Conservation Storage (ac-ft) at Normal Conservation Pool	
0	2035 Conditions	733.00	6.38	0.00	13,074	710.00	0.00	2.91 with 0.97 available	29,369	7.35
1	Reallocate all available water quality storage at Hulah and Copan Plus 0.97mgd Water Supply at Copan	733.00	7.20	0.00	13,074	710.00	0.00	7.48 with 5.54 available	29,369	12.74
2	Reallocate all available water quality storage at Hulah with seasonal pool; Copan existing conditions	733.0 (seasonal pool May 1- Nov 30 - elevation 734.75)	7.78	6,324 ac-ft with 2.5% flood reduction	15,891	710.00	0.00	2.91 with 0.97 available	29,369	8.75
3	Reallocate all available water quality storage at Copan with seasonal pool / Hulah existing conditions	733.00	6.38	0.00	13,074	710.0 (seasonal pool June 1- Nov 30 - elevation 711.0)	4,526 ac-ft with 2.5% flood reduction	9.1 with 6.91 available	31,324	13.29

Table 14. Scenarios - Year 2035 Conditions (continued)

Scenario	Scenario Description	HULAH LAKE				COPAN LAKE				Total Yield Available (mgd)
		Conservation Pool Elevation (ft)	Yield (mgd)	Flood Control Reduction in (ac-ft)	Conservation Storage (ac-ft) at Normal Conservation Pool	Conservation Pool Elevation (ft)	Flood Control Reduction in (ac-ft)	Yield (mgd)	Conservation Storage (ac-ft) at Normal Conservation Pool	
4	Reallocate all available water quality storage plus 5% flood control reallocation at Hulah; Copan existing conditions	736.15	12.16	12,649 ac-ft with 5% flood reduction	25,752	710.00	0.00	2.91 with 0.97 available	29,369	13.13
5	Reallocate all available water quality storage with seasonal pool plus 5% flood control at Hulah ; Copan existing conditions	736.15 (seasonal pool plan May 1-Nov 30 - elevation 737.0)	13.37	16,443 ac-ft with 5% flood reduction (6.5% reduction with seasonal pool)	27,120	710.00	0.00	2.91 with 0.97 available	29,369	14.34

Table 15 – Hulah Lake Pertinent Data – Preferred Alternative					
Feature	Elevation (ft)	Data from 1973 Survey (ac-ft)	Data from 2002 Survey (ac-ft)	2035 Conditions (ac-ft)	Data from 2002 Survey after Reallocation (ac-ft)
Top of Dam	779.5				
Top of Flood Control Pool	765.0	289,000	289,000[a]		
Flood Control Storage	733.0-765.0	257,900	257,900[a]	252,976	
Spillway Crest	740.0	61,400	61,400		
Top of Conservation Pool	733.0	31,160	22565	13,074	
Active Conservation Storage	710.0-733.0	31,100	22553	13,074	
Water Supply		19,800	16,600	9,622	18,722[b]
Water Quality		7,100	5,953	3,452	3,831[b]
Sediment Storage		4,200	0	0	
Inactive Storage	710.0	0	12	0	

Notes:
[a] Flood pool was not resurveyed. No adjustment to flood control storage made.
[b] Water supply reallocation of 2122 ac-ft based on 2002 data (1,230 Ac-ft of usable storage in year 2035)

Table 16 – Copan Lake Pertinent Data - Preferred Alternative					
Feature	Elevation (ft)	Data from 1983 Survey (ac-ft)	Data from 2002 Survey (ac-ft)	2035 Conditions (ac-ft)	Data from 2002 Survey after Reallocation (ac-ft)
Top of Dam	745.0	--	--	--	
Top of Flood Control Pool	732.0	227,700	227,700[a]	--	
Flood Control Storage	710.0 to 732.0	184,300	184,300[a]	181,043	
Top of Conservation Pool	710.0	43,400	34,634	30,060	
Active Conservation Storage	687.5 to 710.0	42,800	33,887	29,369	
Water Supply	--	7,500	7,500	6,555	19,290[b]
Water Quality	--	26,100	26,100	22,814	14,310[b]
Sediment Storage	--	9,200	287	0	
Inactive Storage	687.5	600	747	0	

Notes:

[a] Flood pool was not resurveyed. No adjustment to flood control storage made.

[b] Water supply reallocation of 11,790 ac-ft based on 2002 data (10,305 ac-ft of usable storage in year 2035)

13.3 Economic Impact on Other Project Purposes

13.3.1 Economic Impacts—Hulah Lake

The economic impact of the Hulah Lake reallocation includes those impacts associated with project purposes of flood control, water supply, low flow regulation, and conservation. No other economic effects, such as employment and operational maintenance of the lake, was identified. No recreation impacts were identified. The preferred alternative would impact storage utilized for water quality; however, sufficient water quality would remain in the lake to meet published Oklahoma Department of Environmental Quality (DEQ) guidelines and satisfy published water quality release standards. This alternative would not alter pool management or pool elevations, both of which would increase the probability of flooding.

13.3.2 Economic Impacts—Copan Lake

The economic impact of the Copan Lake reallocation includes those impacts associated with the project purposes of flood control, water supply, water quality control, recreation, and fish and wildlife. No other economic effects, such as employment and operational maintenance of the lake, were identified. The preferred alternative would impact storage utilized for water quality; however, sufficient water quality would remain in the lake to meet published Oklahoma DEQ guidelines and satisfy published water quality release standards. This alternative would not alter pool management or pool elevations, both of which would increase the probability of flooding.

13.4 Approved Cost Allocation

There are approved cost allocations for both Hulah Lake and Copan Lake. The final cost allocation for Copan Lake was approved on October 29, 1981.

14. Derivation of User Cost

There is no change in the Users current water supply costs for storage already under agreement. The City of Bartlesville has not requested a water storage agreement for the reallocated storage.

14.1 Revenues Forgone and Cost Account Adjustments

There is no hydropower at either Hulah Lake or Copan Lake; therefore, there are no revenues forgone or cost account adjustments.

14.2 Cost of Storage Analysis

No cost of storage analysis has been completed since the City of Bartlesville has not requested a water storage agreement for the reallocated storage. Water quality storage from the conservation pool that can be reallocated to the water supply purpose has been identified in this report.

15. Other Considerations

15.1 Test of Financial Feasibility

As a test of financial feasibility, the annual cost of the reallocated storage is compared to the annual cost of the most likely, least costly, alternative that would provide an equivalent quality and quantity of water which the City of Bartlesville would undertake in the absence of utilizing the reallocated storage from Hulah and Copan Lakes. This alternative was identified in Table 13, which shows that Kaw Lake would most likely be the next least costly water supply alternative.

15.2 Cost Account Adjustments

There are no cost account adjustments because there is no hydropower at either Hulah Lake or Copan Lake.

15.3 Environmental Considerations

To comply with the National Environmental Policy Act (NEPA) of 1969, the United States Army Corps of Engineers (USACE) Tulsa District developed an Environmental Assessment (EA). The EA, through the NEPA process, provides a comprehensive review of major environmental issues and requirements associated with the Proposed Action, of project reallocation. The requirements of NEPA, according to Council of Environmental Quality (CEQ) regulations, must be integrated into the planning and other environmental review procedures and run concurrently with those. The EA is attached to this report to meet those requirements.

16. NEPA Documentation (Views of Public, State, Federal, and Local Interests)

The NEPA documentation for the Proposed Action is found in the attached EA. To initiate the NEPA process, the USACE Tulsa District solicited public input by issuing a news release on August 4, 2003 announcing public information workshops for scoping the proposed reallocation project. The first workshop was held on August 19, 2003 at the Bartlesville Community Center. Twenty-three persons attended the workshop, including representatives from local and state agencies, Native American tribes, and private citizens. Most comments dealt with sedimentation at Hulah Lake. Those are described in detail in the EA.

17. Conclusions and Recommendations

17.1 Summarization of Findings

Based on the evaluation of several alternatives, the recommended alternative is to reallocate storage used for water quality improvement to water supply. Congressional approval would normally be needed for storage reallocation that would involve major structural or operation changes. However, 15% of total usable storage or 50,000 acre-feet, whichever is less, may be reallocated for water supply at the discretion of the Commander, Headquarters (HQ) USACE. This reallocation falls within the Chief's discretionary authority.

With implementation of the proposed action, there would be no adverse impacts on the biological and cultural resources.

17.2 Recommendation of the District Engineer

Based on the findings in this study and the Environmental Assessment (EA), I recommend that the study identifying water quality storage that can be reallocated at Hulah and Copan Lakes to meet the current and future M&I water demands be approved.

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APPENDIX D

SECTION 404 PERMIT CORRESPONDENCE

CESWT-PE-E 22 August 2005

MEMORANDUM THRU Ch, CESWT-PER

FOR Ch, CESWT-PE-R

SUBJECT: 404 Permit Requirements for Hulah/Copan Water Reallocation

1. The Tulsa District has begun studying the reallocation of water storage at Hulah Lake and Copan Lake to meet water supply demands for the City of Bartlesville, Oklahoma. The City of Bartlesville recently experienced a critical water shortage because of extreme drought in the Caney River Basin. Authorization is in the Flood Control Acts of 1936 (Hulah Lake), and 1962 (Copan Lake).

2. Several alternatives have been considered and eliminated from further study. The alternative selected as the recommended plan is the simple reallocation of water quality storage at both Hulah Lake and Copan Lake to water supply storage. This alternative would not require a change in pool levels at either lake and would not include the placement of dredged or fill material.

3. A memo from your office is requested concerning the need for a Department of the Army permit pursuant to Section 404 of the Clean Water Act.

4. If you need further information please contact Mr. Jerry Sturdy, x4397.

STEPHEN L. NOLEN
Chief, Environmental Analysis
and Compliance Branch

CESWT-PE-R September 7, 2005

MEMORANDUM THRU Ch, CESWT-PER

FOR Ch, CESWT-PE-E

Subject: Hulah/Copan Water Reallocation

1. We have reviewed the submitted data relative to Section 404 of the Clean Water Act (CWA). The provided information does not indicate that a placement of dredged or fill material will be required, permanently or temporarily, into any "waters of the United States," including jurisdictional wetlands.

2. Therefore, this proposal is not subject to regulation pursuant to Section 404 of the CWA, and a Department of the Army (DA) permit will not be required. Should your method of construction necessitate such a discharge into Hulah or Copan Reserviors, we suggest that you resubmit that portion of your project so that we may determine whether an DA permit will be required.

3. Although DA authorization is not required, this does not preclude the possibility that other Federal, State, or local permits may be required.

4. Please reference this Identification Number 14855 in any future correspondence. If you have any questions about the Section 404 permit program, please contact Mr. Marcus Ware at 918-669-7403.

David A. Manning

DAVID A. MANNING
Chief, Regulatory Branch

APPENDIX E

FISH AND WILDLIFE COORDINATION

October 29 , 2004

Mr. Raul H. Reyes
Engineering-Environmental Management, Inc.
(210) 348-6000
(210) 348-6002 Fax
rreyes@e2m.net

Re: Request for File Review
Threatened and Endangered Species

Dear Mr. Reyes,

This is in response to your email of October 14, 2004 requesting information on threatened and endangered species or critical habitat that may occur in Lakes Hulah (Osage County) and Copan (Washington County).

Please understand that due to time and personnel constraints, we have not performed an actual field survey of the proposed site. However, we have reviewed maps and other information on which to base our conclusion. We can only respond to your direct request for occurrences of threatened and endangered species and Wildlife Management Areas (WMAs) because of the limited information provided to us. If you require further comments or recommendations that specifically relate to project impacts on fish and wildlife resources, please contact our office.

Several Threatened and Endangered species exist in Osage and Washington Counties. For your convenience, I have listed below Threatened (T), Endangered (E), and Candidate (C) species that have been known to occur in these Counties and their associated status.

Common Name	**Scientific Name**	**Status**	**County**
Interior Least Tern	*Sterna antillarum*	E	Osage
Whooping Crane	*Grus Americana*	E	Osage, Washington
Arkansas River Shiner	*Notropis girardi*	T, Designated Critical Habitat	Osage
Bald Eagle	*Haliaeetus leucocephalus*	T	Osage, Washington
Piping Plover	*Charadrius melodus*	T	Osage, Washington
Mountain Plover	*Cynomys ludovicianus*	Proposed as T	Osage, Washington
Neosho Mucket	*Lampsilis rafinesqueana*	C	Osage, Washington
American Burying Beetle	*Nicrophorus americanus*	E	Washington

Hulah and Copan Lakes also fall within or near twoWMAs. For more information on Hulah and Copan WMAs, please refer to the following links:

http://www.wildlifedepartment.com/copan2.htm

http://www.wildlifedepartment.com/hulah.htm

For additional information on state of Oklahoma threatened and endangered species, we recommend that you contact the Oklahoma Natural Heritage Inventory, 111 E. Chesapeake Street, Norman, Ok. 73019. For information on federally listed threatened or endangered species, contact the USFWS, Ecological Services, 222 South Houston, Suite A, Tulsa, Ok. 74127 or online http://ifw2es.fws.gov/Oklahoma/endsp.htm.

We appreciate the opportunity to review and provide comments on this project. If we can be of further assistance, please contact our Natural Resources Section at (405) 521-4663.

Sincerely,

Ferrella March
Natural Resources Biologist

January 12, 2005

Hello,
I'm sending this list of non-game wildlife at Hulah and Copan reservoirs on behalf of Ferrella March. To date, we have not conducted systematic non-game surveys at either reservoir, so the list below reflects species which are likely to occur on these areas based upon confirmed museum records in the vicinity and reliable observations made by biologists. Because of the close proximity of these two areas and their similar habitats, I have printed out a single list for both areas since the fauna should be very similar. Please note that we do not have information regarding the distributions of non-game fishes in this region at this time, so the list is restricted to mammals, birds, reptiles and amphibians. I have not separated the game from non-game species in this list, so that you would have a complete list to work from. I have printed the names of some species in bold type - these species are considered species of greatest conservation need in our draft Oklahoma Comprehensive Wildlife Conservation Strategy. For the mammals, reptiles and amphibians, you can assume that these are year-round residents. The birds are more complex - to help, I have placed an "M" after those birds that are present only during the spring and fall migration periods; and I've placed a "B" after those species which are likely to breed/nest on the area.

Please let me know if you have any questions,
Mark Howery
Natural Resources Biologist
OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION
1801 N. LINCOLN BLVD.
OKC, OK 73105
405-521-4663 OFC
mhowery@odwc.state.ok.us

Mammals, Birds, Reptile and Amphibians of the Hulah and Copan Reservoir Area.

Mammals
Opossum
Elliot's Short-tailed Shrew
Least Shrew
Eastern Mole
Eastern Pipistrel
Big Brown Bat
Red Bat
Hoary Bat
Nine-banded Armadillo
Swamp Rabbit
Eastern Cottontail
Woodchuck
Thirteen-lined Ground Squirrel
Fox Squirrel
Gray Squirrel
Southern Flying Squirrel
Plains Pocket Gopher
Hispid Pocket Mouse
Plains Harvest Mouse
Texas Mouse
White-footed Mouse
Deer Mouse
Hispid Cotton Rat
Eastern Woodrat

Prairie Vole
Woodland Vole
Muskrat
Beaver
Coyote
Red Fox
Gray Fox
Raccoon
Mink
Long-tailed Weasel
Striped Skunk
Eastern Spotted Skunk
Bobcat
White-tailed Deer

Birds
Common Loon - M
Pied-billed Grebe - B
Horned Grebe - M
Eared Grebe - M
American White Pelican - M
Double-crested Cormorant
American Bittern - M
Great Blue Heron - B
Great Egret - B
Snowy Egret - B
Little Blue Heron - B
Cattle Egret - B
Green Heron - B
Black-crowned Night-Heron - B
Yellow-crowned Night Heron - B
Turkey Vulture - B
Tundra Swan - M
Trumpeter Swan (rare)
Greater White-fronted Goose - M
Snow Goose - M
Canada Goose - B
Wood Duck - B
Green-winged Teal
Mallard
Northern Pintail
Blue-winged Teal
Northern Shoveler
Gadwall
American Wigeon
Canvasback
Redhead - M
Ring-necked Duck
Lesser Scaup
Common Goldeneye
Bufflehead
Hooded Merganser
Common Merganser
Ruddy Duck - M
Osprey - M
Mississippi Kite - B

Bald Eagle
Northern Harrier - B
Sharp-shinned Hawk
Cooper's Hawk - B
Red-shouldered Hawk - B
Broad-winged Hawk - B
Red-tailed Hawk - B
Rough-legged Hawk
American Kestrel - B
Merlin
Peregrine Falcon - M
Prairie Falcon
Ring-necked Pheasant - B
Greater Prairie Chicken - B
Wild Turkey - B
Northern Bobwhite - B
King Rail - B
Virginia Rail - M
Sora - M
American Coot
Black-bellied Plover - M
American Golden-Plover - M
Semipalmated Plover - M
Killdeer - B
American Avocet - M
Greater Yellowlegs - M
Lesser Yellowlegs - M
Solitary Sandpiper - M
Willet - M
Spotted Sandpiper - M
Upland Sandpiper - B
Hudsonian Godwit - M
Sanderling - M
Semipalmated Sandpiper - M
Western Sandpiper - M
Least Sandpiper - M
White-rumped Sandpiper - M
Baird's Sandpiper - M
Pectoral Sandpiper - M
Dunlin - M
Stilt Sandpiper - M
Buff-breasted Sandpiper - M
Long-billed Dowitcher - M
Wilson's Phalarope - M
Wilson's (Common) Snipe
American Woodcock - B
Franklin's Gull - M
Bonaparte's Gull
Ring-billed Gull
Herring Gull
Caspian Tern - M
Forster's Tern - M
Black Tern - M
Mourning Dove - B
Yellow-billed Cuckoo - B
Greater Roadrunner - B (rare)

Eastern Screech-Owl - B
Great Horned Owl - B
Barred Owl - B
Long-eared Ow - B (rare)l
Short-eared Owl
Common Nighthawk - B
Chuck-will's-Widow - B
Chimney Swift - B
Ruby-throated Hummingbird - B
Belted Kingfisher - B
Red-headed Woodpecker - B
Red-bellied Woodpecker - B
Yellow-bellied Sapsucker
Downy Woodpecker - B
Hairy Woodpecker - B
Northern Flicker - B
Pileated Woodpecker - B
Olive-sided Flycatcher - M
Eastern Wood-Pewee - B
Alder Flycatcher - M
Willow Flycatcher - rare
Least Flycatcher - M
Eastern Phoebe - B
Great Crested Flycatcher - B
Western Kingbird - B
Eastern Kingbird - B
Scissor-tailed Flycatcher - B
Horned Lark - B
Purple Martin - B
Tree Swallow - B
Northern Rough-winged Swallow - B
Cliff Swallow - B
Barn Swallow - B
Blue Jay - B
American Crow - B
Carolina Chickadee - B
Tufted Titmouse - B
Red-breasted Nuthatch
White-breasted Nuthatch - B
Brown Creeper
Carolina Wren - B
Bewick's Wren - B
Winter Wren
Sedge Wren
Marsh Wren
Golden-crowned Kinglet
Ruby-crowned Kinglet
Blue-gray Gnatcatcher - B
Eastern Bluebird - B
Swainson's Thrush - M
Hermit Thrush
American Robin - B
Gray Catbird - M
Northern Mockingbird - B
Brown Thrasher - B
American Pipit - M

Sprague's Pipit - M
Cedar Waxwing
Loggerhead Shrike - B
Bell's Vireo - B
Solitary Vireo - M
Warbling Vireo - B
Red-eyed Vireo - B
Tennessee Warbler - M
Orange-crowned Warbler - M
Nashville Warbler - M
Northern Parula - B
Yellow Warbler - B
Yellow-rumped Warbler
Blackpoll Warbler - M
Black-and-white Warbler - B
American Redstart - M
Prothonotary Warbler - B
Swainson's Warbler - hostorically occured
Louisiana Waterthrush - B
Kentucky Warbler - B
Common Yellowthroat - B
Wilson's Warbler - M
Summer Tanager - B
Northern Cardinal - B
Rose-breasted Grosbeak - M
Blue Grosbeak - B
Indigo Bunting - B
Painted Bunting - B
Dickcissel - B
Spotted Towhee
American Tree Sparrow
Chipping Sparrow
Clay-colored Sparrow - M
Field Sparrow - B
Vesper Sparrow - M
Lark Sparrow - B
Savannah Sparrow
Grasshopper Sparrow - B
Henslow's Sparrow - B
LeConte's Sparrow
Fox Sparrow
Song Sparrow
Lincoln's Sparrow
Swamp Sparrow
White-throated Sparrow
White-crowned Sparrow
Harris' Sparrow
Dark-eyed Junco
Lapland Longspur
Smith's Longspur
Red-winged Blackbird - B
Eastern Meadowlark - B
Yellow-headed Blackbird - M
Rusty Blackbird
Brewer's Blackbird
Great-tailed Grackle - M

Common Grackle - M
Brown-headed Cowbird - M
Orchard Oriole - M
Baltimore Oriole - M
Purple Finch
House Finch - M
Pine Siskin
American Goldfinch - M

Amphibians
Red River Mudpuppy (*Necturus maculosus louisianensis*)
Barred Tiger Salamander (*Ambystoma tigrinum*)
Smallmouth Salamander (*Ambystoma texanum*)
Dwarf American Toad (*Bufo americanus charlesmithi*)
Woodhouse's Toad (*Bufo woodhousii*)
Plains Spadefoot Toad (*Scaphiopus bombifrons*)
Hurter's Spadefoot Toad (*Scaphiopus holbrookii hurterii*)
Great Plains Narrowmouth Toad (*Gastrophryne olivacea*)
Cope's Gray Treefrog (*Hyla chrysoscelis*)
Gray Treefrog (*Hyla versicolor*)
Blanchard's Cricket Frog (*Acris crepitans blanchardi*)
Upland (Western) Chorus Frog (*Pseudacris triseriata*)
Spotted Chorus Frog (*Pseudacris clarkii*)
Strecker's Chorus Frog (*Pseudacris streckeri*)
Crawfish Frog (*Rana areolata*)
Plains Leopard Frog (*Rana blairi*)
Southern Leopard Frog (*Rana utricularia*)
Bullfrog (*Rana catesbeiana*)

Reptiles
Alligator Snapping Turtle (*Macroclemys temminckii*)
Common Snapping Turtle (*Chelydra serpentina*)
Yellow Mud Turtle (*Kinosternon flavescens*)
Mississippi Map Turtle (*Graptemys kohnii*)
Ouachita Map Turtle (*Graptemys pseudogeographica ouachitensis*)
Missouri River Cooter (*Pseudemys concinna*)
Red-eared Slider (*Trachemys scripta elegans*)
Three-toed Box Turtle (*Terrapene carolina*)
Ornate Box Turtle (*Terrapene ornata)*
Smooth Softshell Turtle (*Apalone mutica*)
Spiny Softshell Turtle (*Apalone spiniferus*)
Collared Lizard (*Crotaphytus collaris*)
Fence (Prairie) Lizard (*Sceloporus undulatus*)
Texas Horned Lizard (*Phrynosoma cornutum*) (possible)
Six-lined Racerunner (*Cnemidophorus sexlineatus*)
Ground Skink (*Scincella lateralis*)
Five-lined Skink (*Eumeces fasciatus*)
Great Plains Skink (*Eumeces obsoletus*)
Southern Prairie Skink (*Eumeces septentrionalis*)
Slender Glass Lizard (*Ophisaurus attenuatus*)
Western Hognose Snake (*Heterodon nasicus*)
Eastern Hognose Snake (*Heterodon platyrhinos*)
Ringneck Snake (*Diadophis punctatus*)
Flathead Snake (*Tantilla gracilis*)
Ground Snake (*Sonora semiannulata*)

Rough Green Snake (*Opheodrys aestivus*)
Coachwhip (*Masticophis flagellum*)
Yellowbelly Racer (*Coluber constrictor*)
Great Plains Rat Snake (*Elaphe guttata*)
Black Rat Snake (*Elaphe obsoleta*)
Prairie Kingsnake (*Lampropeltis calligaster*)
Speckled Kingsnake (*Lampropeltis getulus holbrooki*)
Red Milk Snake (*Lampropeltis triangulum*)
Bullsnake (*Pituophis melanoleucus sayi*)
Brown Snake (*Storeria dekayi)*
Rough Earth Snake (*Virginia striatula*)
Western Earth Snake (*Virginia valeriae elegans*)
Lined Snake (*Tropidoclonion lineatum*)
Western Ribbon Snake (*Thamnophis proximus*)
Red-sided Garter Snake (*Thamnophis sirtalis*)
Graham's Crayfish Snake (*Regina grahamii*)
Diamondback Water Snake (*Nerodia rhombifera*)
Plain-bellied Water Snake (*Nerodia erythrogaster*)
Midland Water Snake (*Nerodia sipedon*)
Copperhead (*Agkistrodon contortrix*)
Massasauga (*Sistrurus catenatus*)
Timber Rattlesnake (*Crotalus horridus*)

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APPENDIX F

CULTURAL RESOURCES COORDINATION

DEPARTMENT OF ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

September 23, 2005

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Anthony Whitehorn
Osage Nation of Oklahoma
627 Grandview Ave.
Pawhuska, OK 74056

Dear Mr. Whitehorn:

The purpose of this letter is to initiate consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, and to request your assistance in identifying cultural properties that may be of traditional religious or cultural significance to the Osage Nation regarding a proposal to reallocate all available water quality storage at Hulah and Copan Lakes to water supply for the City of Bartlesville, Oklahoma.

The City of Bartlesville seeks to find alternative water supply sources to meet anticipated water supply demands in 2035. In conjunction with the construction of a new 26 million gallons per day (mgd) water treatment plant, the City of Bartlesville has estimated average future water supply demands to be in the neighborhood of 10 to 12 mgd. Bartlesville has existing water contracts with the U.S. Army Corps of Engineers (Corps) that have combined water supply yields of 12.34 mgd from Hulah Lake. However, the dependable water supply yield at Hulah Lake is expected to decrease to 6.58 mgd by 2035, resulting in a need for a secondary water source with a dependable yield of approximately 5.5 mgd. As a result of this requirement, the Corps has received a request from Bartlesville to consider the reallocation of all available water quality storage to use as water supply (total of 7.53 mgd from Hulah Lake and 5.48 mgd from Copan Lake). If approved, the reallocation would not involve raising the existing lake level of either Lakes Hulah or Copan, but would simply reallocate storage space in the conservation pool of these lakes from one purpose to another.

Because the proposed water reallocations will not result in any changes in the existing lake levels of either Hulah or Copan Lake, we feel that the proposed reallocation of all available water quality storage to water supply will have "no effect" on cultural resources at Hulah or Copan Lake. We are requesting information that the Osage Nation is willing to share on any traditional religious or culturally significant properties located within the proposed project area so that we my adequately assess the effects of the proposed project on cultural resources.

Thank you for your help with this request. If you have any questions, please contact Mr. Louis Vogele, Archeologist, at 918-669-4934.

Sincerely,

Stephen L. Nolen
Chief, Environmental Analysis and
Compliance Branch

DEPARTMENT OF ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

September 23, 2005

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Dr. Bob Blackburn
State Historic Preservation Officer
Oklahoma Historical Society
2704 Villa Prom, Shepherd Mall
Oklahoma City, OK 73107

Dear Dr. Blackburn:

The purpose of this letter is to initiate consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, regarding a proposal to reallocate all available water quality storage at Hulah and Copan Lakes to water supply for the City of Bartlesville, Oklahoma.

The City of Bartlesville seeks to find alternative water supply sources to meet anticipated water supply demands in 2035. In conjunction with the construction of a new 26 million gallons per day (mgd) water treatment plant, the City of Bartlesville has estimated average future water supply demands to be in the neighborhood of 10 to 12 mgd. Bartlesville has existing water contracts with the U.S. Army Corps of Engineers (Corps) that have combined water supply yields of 12.34 mgd from Hulah Lake. However, the dependable water supply yield at Hulah Lake is expected to decrease to 6.58 mgd by 2035, resulting in a need for a secondary water source with a dependable yield of approximately 5.5 mgd. As a result of this requirement, the Corps has received a request from Bartlesville to consider the reallocation of all available water quality storage to use as water supply (total of 7.53 mgd from Hulah Lake and 5.48 mgd from Copan Lake). If approved, the reallocation would not involve raising the existing lake level of either Lakes Hulah or Copan, but would simply reallocate storage space in the conservation pool of these lakes from one purpose to another.

Because the proposed water reallocations will not result in any changes in the existing lake levels of either Hulah or Copan Lake, we feel that the proposed reallocation of all available water quality storage to water supply will have "no effect" on cultural resources at Hulah or Copan Lake. We request your comment on our opinion of effect regarding this project.

Thank you for your help with this request. If you have any questions, please contact Mr. Louis Vogele, Archeologist, at 918-669-4934.

Sincerely,

Stephen L. Nolen
Chief, Environmental Analysis and
Compliance Branch

DEPARTMENT OF ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

September 23, 2005

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Mr. Gary McAdams, President
Wichita and Affiliated Tribes of Oklahoma
P.O. Box 729
Anadarko, OK 73005

Dear President McAdams:

The purpose of this letter is to initiate consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, and to request your assistance in identifying cultural properties that may be of traditional religious or cultural significance to the Wichita and Affiliated Tribes regarding a proposal to reallocate all available water quality storage at Hulah and Copan Lakes to water supply for the City of Bartlesville, Oklahoma.

The City of Bartlesville seeks to find alternative water supply sources to meet anticipated water supply demands in 2035. In conjunction with the construction of a new 26 million gallons per day (mgd) water treatment plant, the City of Bartlesville has estimated average future water supply demands to be in the neighborhood of 10 to 12 mgd. Bartlesville has existing water contracts with the U.S. Army Corps of Engineers (Corps) that have combined water supply yields of 12.34 mgd from Hulah Lake. However, the dependable water supply yield at Hulah Lake is expected to decrease to 6.58 mgd by 2035, resulting in a need for a secondary water source with a dependable yield of approximately 5.5 mgd. As a result of this requirement, the Corps has received a request from Bartlesville to consider the reallocation of all available water quality storage to use as water supply (total of 7.53 mgd from Hulah Lake and 5.48 mgd from Copan Lake). If approved, the reallocation would not involve raising the existing lake level of either Lakes Hulah or Copan, but would simply reallocate storage space in the conservation pool of these lakes from one purpose to another.

Because the proposed water reallocations will not result in any changes in the existing lake levels of either Hulah or Copan Lake, we feel that the proposed reallocation of all available water quality storage to water supply will have "no effect" on cultural resources at Hulah or Copan Lake. We are requesting information that the Wichita and Affiliated Tribes are willing to share on any traditional religious or culturally significant properties located within the proposed project area so that we my adequately assess the effects of the proposed project on cultural resources.

Thank you for your help with this request. If you have any questions, please contact Mr. Louis Vogele, Archeologist, at 918-669-4934.

Sincerely,

Stephen L. Nolen

Stephen L. Nolen
Chief, Environmental Analysis and
Compliance Branch

DEPARTMENT OF ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

September 23, 2005

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Cherokee Nation of Oklahoma
P.O. Box 948
Tahlequah, OK 74465

Dear Sirs:

The purpose of this letter is to initiate consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, and to request your assistance in identifying cultural properties that may be of traditional religious or cultural significance to the Cherokee Nation regarding a proposal to reallocate all available water quality storage at Hulah and Copan Lakes to water supply for the City of Bartlesville, Oklahoma.

The City of Bartlesville seeks to find alternative water supply sources to meet anticipated water supply demands in 2035. In conjunction with the construction of a new 26 million gallons per day (mgd) water treatment plant, the City of Bartlesville has estimated average future water supply demands to be in the neighborhood of 10 to 12 mgd. Bartlesville has existing water contracts with the U.S. Army Corps of Engineers (Corps) that have combined water supply yields of 12.34 mgd from Hulah Lake. However, the dependable water supply yield at Hulah Lake is expected to decrease to 6.58 mgd by 2035, resulting in a need for a secondary water source with a dependable yield of approximately 5.5 mgd. As a result of this requirement, the Corps has received a request from Bartlesville to consider the reallocation of all available water quality storage to use as water supply (total of 7.53 mgd from Hulah Lake and 5.48 mgd from Copan Lake). If approved, the reallocation would not involve raising the existing lake level of either Lakes Hulah or Copan, but would simply reallocate storage space in the conservation pool of these lakes from one purpose to another.

Because the proposed water reallocations will not result in any changes in the existing lake levels of either Hulah or Copan Lake, we feel that the proposed reallocation of all available water quality storage to water supply will have "no effect" on cultural resources at Hulah or Copan Lake. We are requesting information that the Cherokee Nation is willing to share on any traditional religious or culturally significant properties located within the proposed project area so that we my adequately assess the effects of the proposed project on cultural resources.

Thank you for your help with this request. If you have any questions, please contact Mr. Louis Vogele, Archeologist, at 918-669-4934.

Sincerely,

Stephen L. Nolen
Chief, Environmental Analysis and
Compliance Branch

DEPARTMENT OF ARMY
CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

September 23, 2005

Planning, Environmental, and Regulatory Division
Environmental Analysis and Compliance Branch

Dr. Bob Brooks
State Archeologist
Oklahoma Archeological Survey
111 E. Chesapeake
Norman, OK 73019

Dear Dr. Brooks:

The purpose of this letter is to initiate consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, regarding a proposal to reallocate all available water quality storage at Hulah and Copan Lakes to water supply for the City of Bartlesville, Oklahoma.

The City of Bartlesville seeks to find alternative water supply sources to meet anticipated water supply demands in 2035. In conjunction with the construction of a new 26 million gallons per day (mgd) water treatment plant, the City of Bartlesville has estimated average future water supply demands to be in the neighborhood of 10 to 12 mgd. Bartlesville has existing water contracts with the U.S. Army Corps of Engineers (Corps) that have combined water supply yields of 12.34 mgd from Hulah Lake. However, the dependable water supply yield at Hulah Lake is expected to decrease to 6.58 mgd by 2035, resulting in a need for a secondary water source with a dependable yield of approximately 5.5 mgd. As a result of this requirement, the Corps received a request from Bartlesville to consider the reallocation of all available water quality storage to use as water supply (total of 7.53 mgd from Hulah Lake and 5.48 mgd from Copan Lake). If approved, the reallocation would not involve raising the existing lake level of either Lakes Hulah or Copan, but would simply reallocate storage space in the conservation pool of these lakes from one purpose to another.

Because the proposed water reallocations will not result in any changes in the existing lake levels of either Hulah or Copan Lake, we feel that the proposed reallocation of all available water quality storage to water supply will have "no effect" on cultural resources at Hulah or Copan Lake. We request your comment on our opinion of effect regarding this project.

Thank you for your help with this request. If you have any questions, please contact Mr. Louis Vogele, Archeologist, at 918-669-4934.

Sincerely,

Stephen L. Nolen
Chief, Environmental Analysis and
Compliance Branch

Oklahoma Historical Society *Founded May 27, 1893*

State Historic Preservation Office • 2704 Villa Prom • Shepherd Mall • Oklahoma City, OK 73107-2441
Telephone 405/521-6249 • Fax 405/947-2918

October 13, 2005

Mr. Stephen Nolen
Chief, Environmental Analysis
and Compliance Branch
U.S. Dept. of Army COE
1645 South 101st East Ave.
Tulsa, OK 74128-4609

RE: File #2365-05; Bartlesville Reallocation of Water at Hulah & Copan Lakes

Dear Mr. Nolen:

We have received and reviewed the documentation concerning the referenced project in Washington County. Additionally, we have examined the information contained in the Oklahoma Landmarks Inventory (OLI) files and other materials on historic resources available in our office. We find that there are no historic properties affected by the referenced project.

Thank you for the opportunity to comment on this project. We look forward to working with you in the future.

If you have any questions, please contact Charles Wallis, RPA, Historical Archaeologist, at 405/521-6381.

Should further correspondence pertaining to this project be necessary, the above underlined file number must be referenced. Thank you.

Sincerely,

Melvena Heisch

Melvena Heisch
Deputy State Historic
Preservation Officer

MH:bh

Oklahoma Archeological Survey
THE UNIVERSITY OF OKLAHOMA

September 27, 2005

Stephen L. Nolen
Chief, Environmental Analysis
and Compliance Branch
Department of the Army
Corps of Engineers, Tulsa District
1645 South 101st East Avenue
Tulsa, OK 74128-4609

Re: Proposed reallocation of water storage at Hulah and Copan lakes to water supply, City of Bartlesville, Oklahoma.

Dear Mr. Nolen:

The proposed action will reallocate all water storage at Lake Copan and Lake Hulah to water supply for the City of Barltesville, Washington County, Oklahoma. The reallocation of water resources will not result in an increase in the conservation pool or change seasonal fluctuations in the pool. As, lake levels with remain unchanged and consequently not result in new disturbance to archaeological resources, I have no objection to the proposed plan.

This review has been conducted in cooperation with the State Historic Preservation Office, Oklahoma Historical Society.

Sincerely,

Robert L. Brooks
State Archaeologist

Cc: SHPO

111 E. Chesapeake, Room 102, Norman, Oklahoma 73019-5111 PHONE: (405) 325-7211 FAX. (405) 325-7604
A UNIT OF ARTS AND SCIENCES SERVING THE PEOPLE OF OKLAHOMA

APPENDIX G

PUBLIC REVIEW OF THE DRAFT EA

Mailing List

Prefix	First Name	Last Name	Title	Agency or Organization	Add	City	State	Zip Code
Senator	James	Inhofe		US Senate	1924 S. Utica, Suite 530	Tulsa	OK	74104-6511
Senator	Tom	Coburn		US Senate	3310 Mid-Continent Tower, 401 South Boston	Tulsa	OK	74103
Representative	Frank	Lucas		US House of Representatives-District 3	720 South Husband, Suite 7	Stillwater	OK	74075
Representative	John	Sullivan		US House of Representatives-District 1	401 So. Johnstone #348	Bartlesville	OK	74003
Mr.	Jerry	Brabander	Field Supervisor	US Fish and Wildlife Service	222 S. Houston, Suite A	Tulsa	OK	74127-
Mr.	Richard	Green	Federal Region VI Administrator	U. S. Environmental Protection Agency	1445 Ross Ave. Suite 1200	Dallas	TX	75202-2733
Mr.	M. Darrel	Dominick	State Conservationist	Natural Resources Conservation Service	100 USDA, Suite 206	Stillwater	OK	74074
Mr.	Jim	Gray	Principal Chief	Osage Nation	P. O. Box 779	Pawhuska	OK	74056-
Mr.	Larry Joe	Brooks	Chief	Delaware Tribe of Indians	220 N.W. Virginia	Bartlesville	OK	74003-
Mr.	Guy	Munroe	Chairman	Kaw Indian Tribe of Oklahoma	Drawer 50	Kaw City	OK	74641
Mr.	Chad	Smith	Principal Chief	Cherokee Nation of Oklahoma	P.O. Box 948	Tahlequah	OK	74465
Mr.	Bruce	Gonzales	President	Delaware Nation of Oklahoma	P. O. Box 825	Anadarko	OK	73005
Mr.	Gary	McAdams	President	Wichita and Affiliated Tribes of Oklahoma	P.O. Box 729	Anadarko	OK	74005
Representative	Mike	Wilt	District 11	Oklahoma House of Representatives	1826 Southview Ave.	Bartlesville	OK	74003
Representative	Steve	Martin	District 10	Oklahoma House of Representatives	485 Hudson Lake Road	Bartlesville	OK	74003
Representative	Joe	Sweeden	District 36	Oklahoma House of Representatives	PO Box 473	Pawhuska	OK	74056
Senator	John	Ford	District 29	Oklahoma State Senate	748 Brookhollow Lane	Bartlesville	OK	74006
Senator	J. Berry	Harrison	District 10	Oklahoma State Senate	2300 N. Lincoln Blvd., Rm. 513-A	Oklahoma City	OK	73105-4808
Mr.	Tom	Clapper	Federal Action Monitor	Oklahoma State Senate	Room 310, State Capitol	Oklahoma City	OK	73105
Mr.	Steve	Thompson	Director	Oklahoma DEQ	1000 N.E. 10th St.	Oklahoma City	OK	73105
Mr.	Duane	Smith	Executive Director	Oklahoma Water Resources Board	3800 N. Clausen	Oklahoma City	TX	73118
Mr.	Greg D.	Duffy	Director	Oklahoma Department of Wildlife Conservation	1801 N. Lincoln	Oklahoma City	OK	73152
Mr.	Mike	Thralls	Executive Director	Oklahoma Conservation Commission	2800 N. Lincoln Blvd., Suite 160	Oklahoma City	OK	73105
Dr.	Robert L.	Brooks		University of Oklahoma Oklahoma Archeological Survey	111 E. Chesapeake	Norman	OK	73019-0575
Dr.	Bob	Blackburn	State Historic Preservation Officer	Oklahoma Historical Society	2704 Villa Prom, Shepherd Mall	Oklahoma City	OK	73107
Ms.	Margaret Ruff		Administrative	Oklahoma Wildlife Federation, Inc.	P.O. Box 60126	Oklahoma	OK	73146

Prefix	First Name	Last Name	Title	Agency or Organization	Add	City	State	Zip Code
			Director			City		
				Bartlesville Examiner-Enterprise	4125 Nowata Rd.	Bartlesville	OK	74006
Mr.	Steve	Brown	City Manager	City of Bartlesville	401 S. Johnstone	Bartlesville	OK	74003
Mr.	Mike	Hall	Director	Water Utilities	401 So. Johnstone Ave	Bartlesville	OK	74003
Mr.	Clark	Miller			1401 SE Meadow Lane	Bartlesville	OK	74006
Ms.	Julie	Daniels			2191 Kyle Rd.	Bartlesville	OK	74006
Ms.	Jerre	Jay			P. O. Box 219	Copan	OK	74022
Ms.	Louise	Brown			P. O. Box 215	Copan	OK	74022
Mr.	Bill	Barry			2200 N. Osage	Dewey	OK	74029
Mr.	Dennis	Artherton			220 NW. Virginia Ave	Bartlesville	OK	74006
Mr.	Bill	Wentroth			417 S. Silverdale Lane	Ponca City	OK	74604
Ms.	Kay	Martin			400 Moore Lane	Dewey	OK	74029
Mr.	Anthony	Austin			HC 73 Box 236	Pawhuska	OK	74056
Mr.	Jim	Orndorff			1821 SE Putnam Dr.	Bartlesville	OK	74006
Mr.	T. J.	Washer			Rt. 3, Box 4710	Bartlesville	OK	74003
Mr.	Robert	Bowen			Rt. 3, Box 5600	Bartlesville	OK	74003
Ms.	Sue	Armstrong			399431 W. 100 Rd.	Copan	OK	74022
Mr.	Bill	Autry			1824 So. Johnstone Ave	Bartlesville	OK	74003
Mr.	Larry P.	Williams			11810 US 75 Hwy	Dewey	OK	74029
Ms.	Dortha	Dunlap			328 Brookline Pl.	Bartlesville	OK	74006
Mr.	James	Randolph			905 W. Fredericksburg	Broken Arrow	OK	74011

AFFIDAVIT OF PUBLICATION

State of Oklahoma)
) SS
County of Washington)

Peggy Sanders

of lawful age, being duly sworn and authorized, says that she is the legal advertising representative of the Examiner-Enterprise, Bartlesville, Okla., 74006

a Daily newspaper printed in the City of Bartlesville, Washington County, Oklahoma, a newspaper qualified to publish legal notices, advertisements and publications as provided in Section 106 of Title 25, Oklahoma Statutes 1971 as amended, and complies with all other requirements of the laws of Oklahoma with reference to legal publications.

That said notice, a true copy of which is attached herto, was published in the regular edition of said newspaper during the period and time of publication and not in supplement, on the following dates:

December 30

________________, 2005

Notary Public Oklahoma
OFFICIAL SEAL
CHRISTY SUMMERS
WASHINGTON COUNTY
COMMISSION #02000565
COMM. EXP 02-14-2006

Peggy Sanders

Legal Advertising Representative

Subscribed and sworn to before me this 30

day of December, 05

Christy Summers

My Commission expires, Feb 14, 2006

Publisher's fee: $ 33.00

Examiner-Enterprise Number 333558

(Published in the Bartlesville, [Oklahoma] Examiner-Enterprise on December 30th, 2005).

Announcing: COMMENT PERIOD
DRAFT ENVIRONMENTAL ASSESSMENT
as related to the
WATER REALLOCATION PROJECT AT HULAH LAKE AND COPAN LAKE, OKLAHOMA
In compliance with
The National Environmental Policy Act
FORMAL COMMENT PERIOD: December 30, 2005 through January 30, 2006

The Draft Environmental Assessment addresses the environmental and socioeconomic effects of the reallocation of water from Hulah and Copan Lakes to provide an adequate water supply for the City of Bartlesville. The comment period is a continuation of public involvement used to develop the Draft Environmental Assessment. The public is invited to review the Draft Environmental Assessment and make comments. A copy of the assessment is available at:

Bartlesville Public Library
600 S. Johnstone
Bartlesville, OK 74003

Written comments and questions will be addressed in the Final Environmental Assessment. To be included in the final assessment, comments and questions must be received prior to the close of the formal comment period. Comments and questions about the draft assessment or the comment process can be directed to:

Mr. Stephen L. Nolen
Chief, Environmental Analysis & Compliance Branch
U.S. Army Corps of Engineers, Tulsa District
1645 S. 101st East Avenue
Tulsa, Oklahoma 74128
Phone: 918-669-7660
e-mail:
Steven.L.Nolen@SWT03.usace.army.mil

TULSA WORLD

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ENGINEERING-ENVIRONMENTAL
~~MANAGEMENT, INC~~ 9563 S. Kingston Ct.
ENGLEWOOD CO 80112 Englewood, CO 80112

PUBLISHED in the Tulsa World, December 30, 2005, Tulsa, OK.

Announcing:
COMMENT PERIOD
DRAFT ENVIRONMENTAL ASSESSMENT
as related to the
WATER REALLOCATION PROJECT AT HULAH LAKE AND COPAN LAKE, OKLAHOMA
In compliance with
The National Environmental Policy Act
FORMAL COMMENT PERIOD: December 30, 2005 through January 30, 2006

The Draft Environmental Assessment addresses the environmental and socio-economic effects of the reallocation of water from Hulah and Copan Lakes to provide an adequate water supply for the City of Bartlesville. The comment period is a continuation of public involvement used to develop the Draft Environmental Assessment. The public is invited to review the Draft Environmental Assessment and make comments. A copy of the assessment is available at:

Bartlesville Public Library
600 S. Johnstone
Bartlesville, OK 74003

Written comments and questions will be addressed in the Final Environmental Assessment. To be included in the final assessment, comments and questions must be received prior to the close of the formal comment period. Comments and questions about the draft assessment or the comment process can be directed to:

Mr. Stephen L. Nolen
Chief, Environmental Analysis & Compliance Branch
U.S. Army Corps of Engineers, Tulsa District
1645 S. 101st East Avenue
Tulsa, Oklahoma 74128
Phone: 918-669-7660
e-mail: Steven.L.Nolen@SWT03.usace.army.mil

PROOF OF PUBLICATION

TITLE ______ ENGINEERING-ENVIRONMENTAL ______________

STATE OF OKLAHOMA, }
COUNTY OF TULSA, } SS.

AFFIDAVIT:

I, Laura Carillas, of lawful age, being duly sworn, upon the oath deposes and says that he / she is the CLERK of TULSA WORLD, a daily newspaper printed in the City of Tulsa, County of Tulsa, State of Oklahoma, and a bonafide paid general circulation therein, printed in the English language, and that the notice by publication, a copy of which is here to attached, was published in said newspaper for

1 day(s), the first publication being on the 30th day of December , 2005 and the last day of publication being on the 30th day of December , 2005 ,

and that said newspaper has been continuously and uninterruptedly published in said county during the period of more than One Hundred and Four (104) weeks consecutively, prior to the first publication of said notice, or advertisement, as required by Section one, Chapter four, Title 25 Oklahoma Session Laws, 1943, as amended by House Bill No. 495, 22nd Legislature, and thereafter, and complies with all of the prescriptions and requirements of the laws of Oklahoma. (The advertisement above referred to is a true and printed copy. Said notice was published in all editions of said newspaper and not in a supplement thereof.)

==

The advertisement above referred to, a true and printed copy of which is hereto attached, was published in said NEWSPAPER on the following dates, to-wit: **December 30, 2005**

Said notice was published in the regular edition of said newspaper and not in a supplement thereof.

==

Publishing Fee	$	221.76
Notary Fee	$	
Affidavit	$	
TOTAL	$	221.76

Laura Carillas ______ (Signature)

Subscribed and sworn to before me this 3rd day of January, A.D., 2006

My commission expires 9-26-08

Judy Sole
Notary Public

NOTARY PUBLIC
JUDY SOLE
CREEK COUNTY
Notary Public in and for
State of Oklahoma
Commission # 00013635
Expires 09/26/08

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Phone: 918-669-7660
e-mail: Steven.L.Nolen@SWT03.usace.army.mil

attn: Matthew Smith

* ENGINEERING-ENVIRONMENTAL
ENGINEERING-ENVIRONMENTAL MNGMNT
9563 S KINGSTON CT SUITE 200
ENGLEWOOD, CO 80012

Ad Number: 3696268

PROOF OF PUBLICATION

TITLE: **ENGINEERING-ENVIRONMENTAL**

State of Oklahoma,}
County of Tulsa,)SS.

AFFIDAVIT:

I, Donna Jarboe of lawful age, being duly sworn, upon the oath deposes and says that he/she is the CLERK of TULSA WORLD, a daily newspaper printer in the City of Tulsa, County of Tulsa, State of Oklahoma, and a bonafide paid general circulation therein, printer in the English language, and that the notice by publication, a copy of which is hereto attached, was published in said newspaper for 1 days, the first publication being on the 30TH day of DECEMBER , 2005 and the last day of publication being on the 30TH day of DECEMBER ,2005, and that said newspaper has been continuously and uninterruptedly published in said county during the period of more than One Hundred and Four (104) weeks consecutively, prior to the first publication of said notice, or advertisement, as required by Section one, Chapter four, Title 25 Oklahoma Session Laws, 1943, as amended by House bill No. 495, 22nd Legislature, and thereafter, and complies with all of the prescriptions and requirements of the laws of Oklahoma. (The advertisement above is referred to is a true and printed copy. Said notice was published in all editions of said newspaper and not in a supplement thereof.)

The advertisement above referred to, a true and printed copy of which is hereto attached, was published in said NEWSPAPER on the following dates, to-wit:

12/30/2005

Said notice was published in the regular edition of said newspaper and not in a supplement thereof.

Publishing Fee	$	221.76
Notary Fee	$	
Affidavit	$	
Total	$	221.76

Donna Jarboe

Subscribed and sworn to before me this 17th day of January, A.D. 2006

My commission expires 9-26-08 Judy Sole

JUDY SOLE
CREEK COUNTY
Notary Public in and for
State of Oklahoma
Commission # 00013635
Expires 09/26/08

Response to
Comments on the

Draft Environmental Assessment of the Water Reallocation Project At Hulah and Copan Lake, Oklahoma And Report of the Water Supply Storage Reallocation Study

From Mayor Julie Daniels, City of Bartlesville, Oklahoma

By Mary Ann Duke
H&H Forecasting Section
2-8-06

- Bartlesville is seeking a *dependable* water supply of at least 12 mgd, yet the proposed action will provide only 12.71 mgd of *available* water supply. (See Draft Finding of No Significant Impact and B-1, 13-14).

The available water supply shown, is dependable.

- Reallocation of a small portion of water quality in Hulah, a lake in which sedimentation estimates have always lagged behind reality, does not result in dependable water supply.

This is a point well taken. The initial design sediment estimates of 1,300 ac-ft proved to be low, hence, an additional 4,200 ac-ft of storage was reallocated to inactive storage based on the 1973 resurvy. This additional storage has filled based on the 2002 resurvey. More sedimentation is expected over the next 30 years. There is certainly a degree of uncertainty to projecting sedimentation out 30 or more years into the future. Dallas Tomlinson may be able to further explain the process used by the Tulsa District in sediment projections. According to the Hulah Lake Water Control Manual, sediment is monitored at the Ramona gage on the Caney River every 6 weeks (1944-present). There are also 31 sedimentation ranges above Hulah Dam and 6 degradation ranges below Hulah Dam that are used for sedimentation measurements. These ranges are periodically surveyed for the purpose of computing sediment deposition, and to update lake area and capacity. It is done using valid engineering methods, and with the most current data available. Despite problems with sediment projections, the yields developed are still considered dependable.

- Bartlesville already contracts for 12.74 mgd from Hulah with a dependable yield of only 9.9 mgd.

Bartlesville's three water supply storage contracts are all based on providing the city a specified percent of the conservation storage, which totals to 73.234% of the conservation storage. Previously published yields and storages have all been based on the 1973 or earlier sediment surveys, as shown in Table 4 of the Water Supply Reallocation Report for Hulah Lake. The total yield of all Bartlesville water supply contracts was 12.337 mgd based on these older surveys, with a total estimated storage of 19,700 ac-ft. The dependable yield of 9.9 mgd represents the dependable water supply yield of Hulah Lake based on the 2002 sediment resurvey, or basically the current yield. However, when sedimentation is projected out to the year 2035, using past rates of sedimentation, Hulah will only yield 6.41 mgd, with Bartlesville contracts yielding 6.38 mgd, with an estimated total storage of 9,575 ac-ft. See the table below:

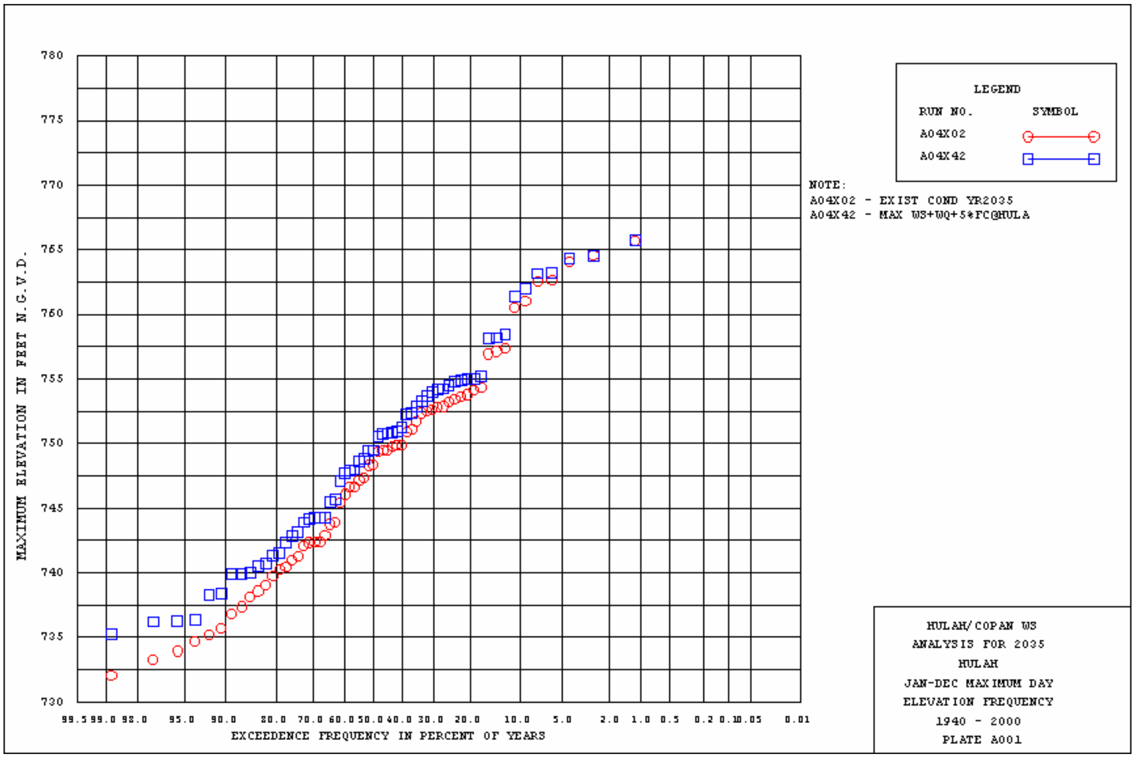
Hulah - Existing Conditions –if no changes are made				
	Elevation (ft)	Usable Storage 2035 Conditions (ac-ft)	Yield In 2035 (mgd)	Percent Usable Conservation Storage (%)
Flood Control	733-765	252,976		
Conservation	710-733	13,074	8.71	100.00
Water Supply		9,622	6.41	73.60
City of Bartlesville		7,485	**4.99**	57.249
City of Bartlesville, MOD		1,069	**0.71**	8.178
Hulah Water District, Inc		48	0.03	0.37
City of Bartlesville		1,021	**0.68**	7.807
Water Quality		3,452	2.30	26.40

- Reallocation scenarios #4 and #5 would reallocate some flood control at Hulah resulting in a more dependable yield, and the study states that the loss of flood control is "*not significant*". (See Report of the Water Supply Storage Reallocation Study, p. 26)

Based on the analysis done by the Corps, all scenarios presented in the Water Supply Reallocation Report provide dependable water supply yield. In Scenarios #4 and #5, the downstream impacts do not appear to be significant from a hydrologic standpoint. However, further economic analysis would be required. Both scenarios, will require a permanent pool raise of greater than 3 feet, which is significant. There would be additional costs in environmental analysis and mitigation, as well as costs due to any impacts on physical structures surrounding the lake. Both alternatives would require further analysis.

- While it is true that Bartlesville wants to minimize loss of flood control, Hulah was designed for both flood control and water supply. It would be instructive to know what "insignificant" means and how the USACE strikes a balance between flood control and water supply.

Hydrologic plots from the analysis of Scenario #4 (A04X42) and Scenario #5 (A04X47) are shown below. These plots show the hydrologic impacts both at Hulah Lake and at the downstream control points. The main impacts from these scenarios occur at the lake itself, where greater than a three foot permanent pool raise would occur. See response above. The downstream impacts for both scenarios appear to be hydrologically insignificant. The flow-frequency curves remain relatively unchanged. The frequency curve provides the statistical recurrence period of a particular flow or pool elevation. The duration curve shows the percent of time a particular flow or elevation occurs. The greatest change in the duration of flows occurs in the range below channel capacity, at the downstream control points. Thus, there would be little to no economic impact. The following plots show the impacts of Scenario #4 at the reservoir and at downstream control points.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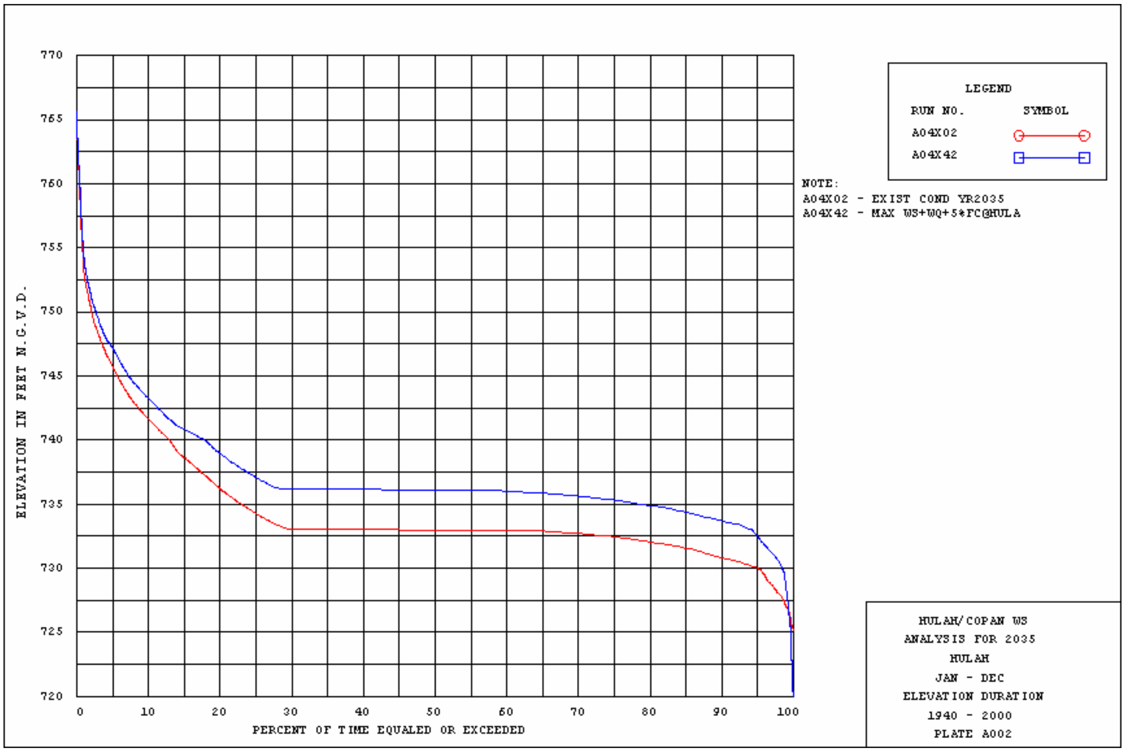
A04X42 - MAX WS+WQ+5%FC@HULA
HULAH/COPAN WS
ANALYSIS FOR 2035
HULAH
JAN-DEC MAXIMUM DAY
ELEVATION FREQUENCY
1940 - 2000
PLATE A001
MAXIMUM ELEVATION IN FEET N.G.V.D.
EXCEEDENCE FREQUENCY IN PERCENT OF YEARS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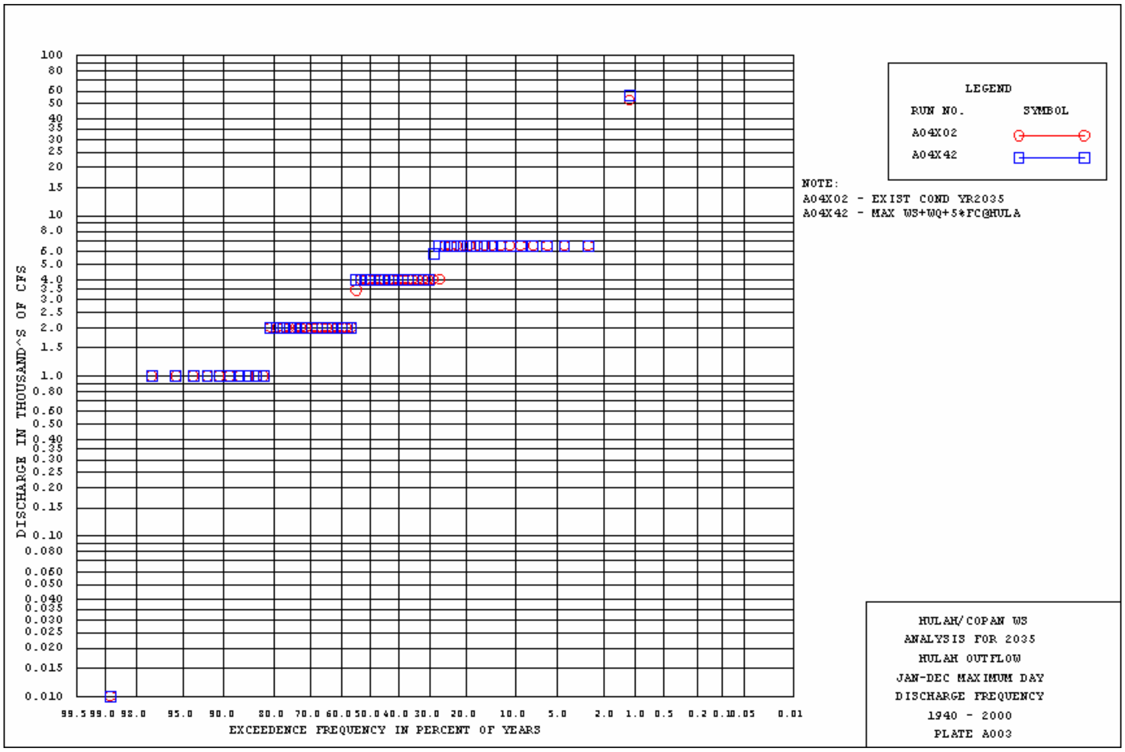
HULAH/COPAN WS
ANALYSIS FOR 2035
HULAH
JAN - DEC
ELEVATION DURATION
1940 - 2000
PLATE A002
ELEVATION IN FEET N.G.V.D.
PERCENT OF TIME EQUALED OR EXCEEDED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EXCEEDENCE FREQUENCY IN PERCENT OF YEARS
LEGEND
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NOTE:
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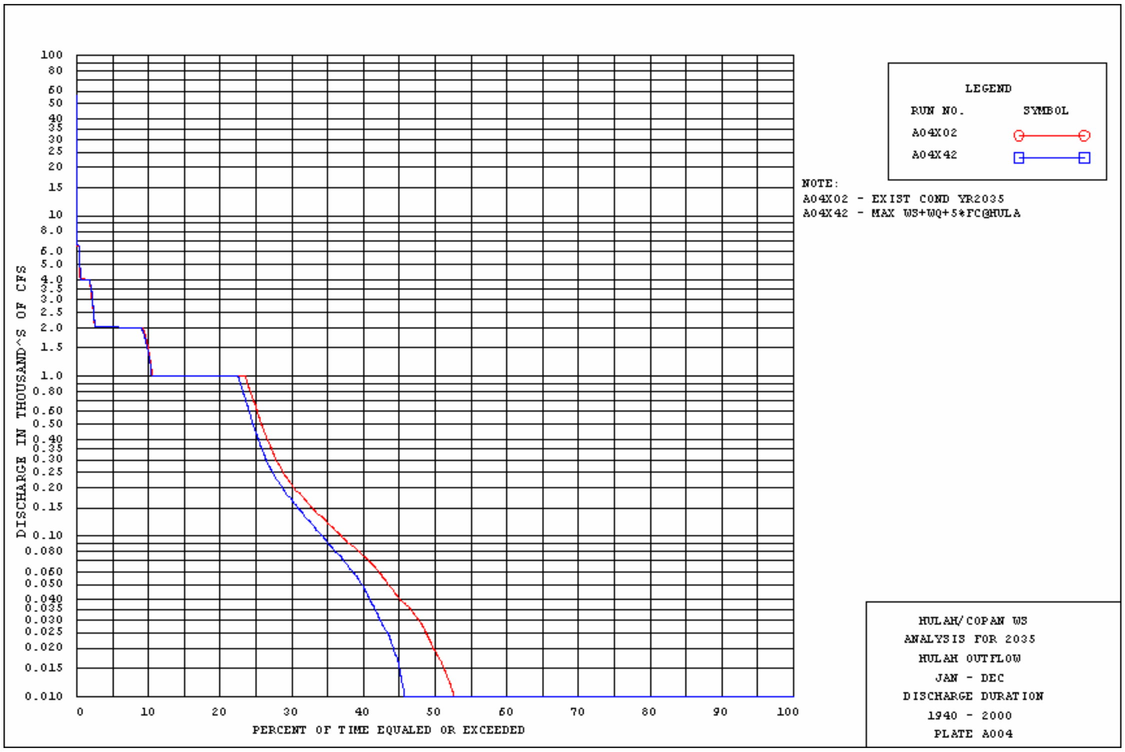
A04X42 - MAX WS+WQ+5*FC@HULA
HULAH/COPAN WS
ANALYSIS FOR 2035
HULAH OUTFLOW
JAN-DEC MAXIMUM DAY
DISCHARGE FREQUENCY
1940 - 2000
PLATE A003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PERCENT OF TIME EQUALED OR EXCEEDED
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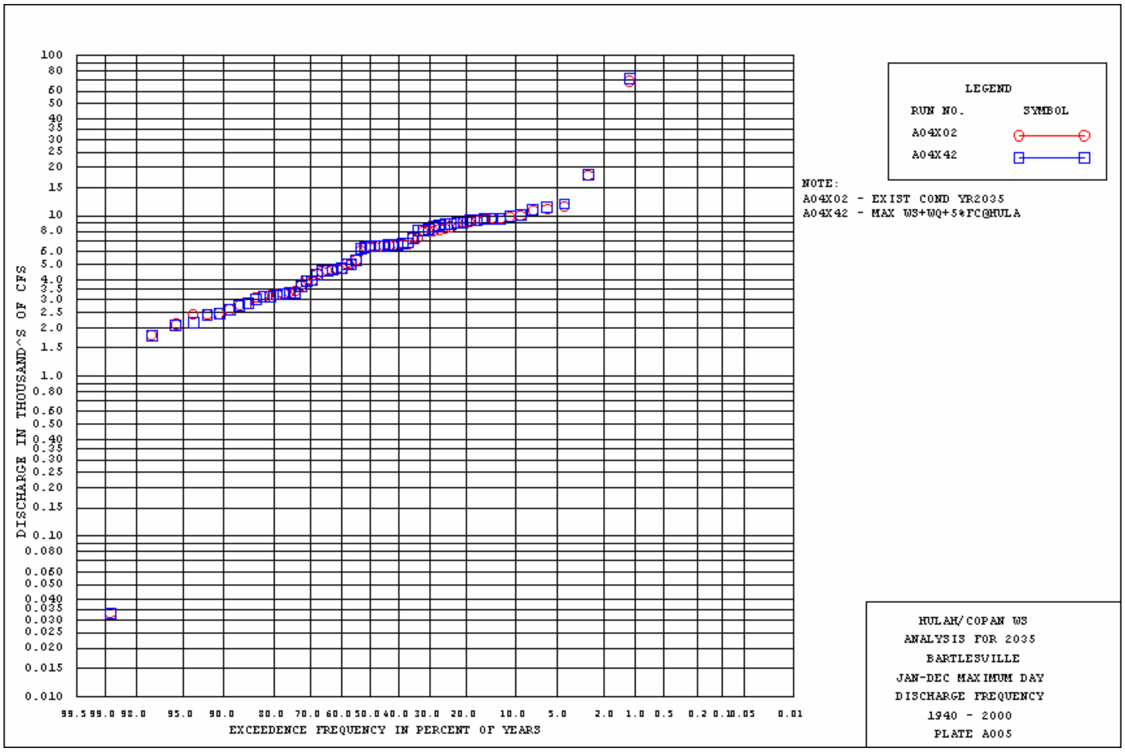
HULAH/COPAN WS
ANALYSIS FOR 2035
HULAH OUTFLOW
JAN - DEC
DISCHARGE DURATION
1940 - 2000
PLATE A004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LEGEND
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NOTE:
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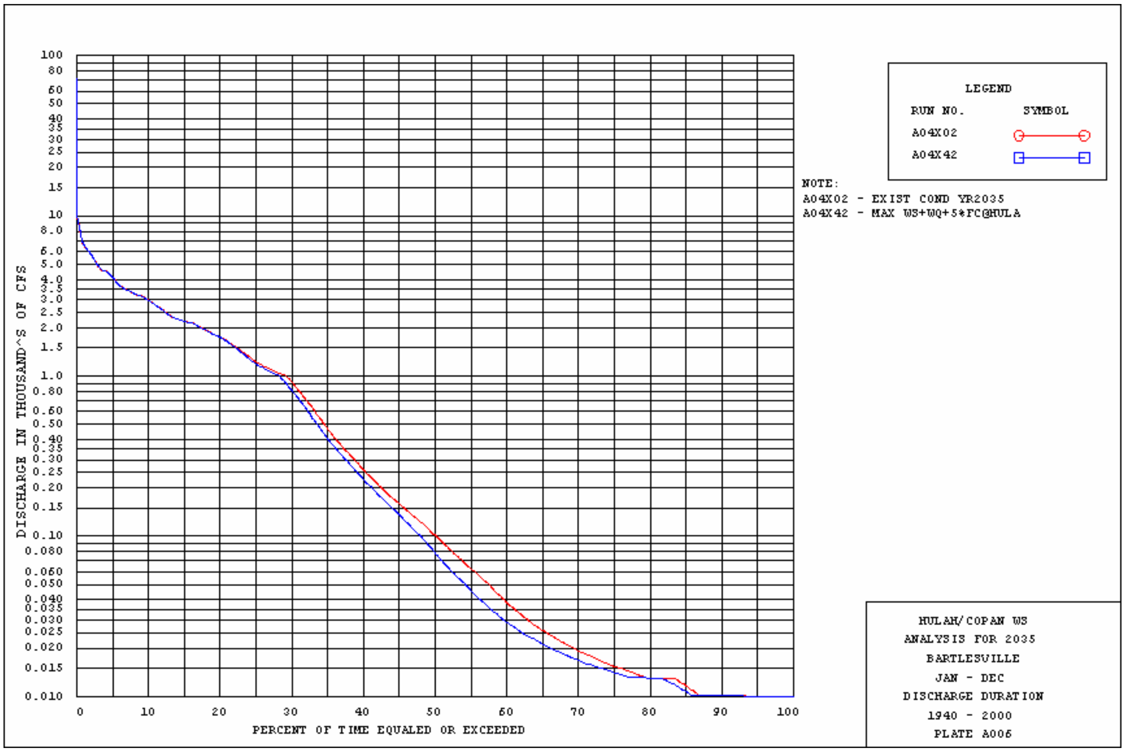
A04X42 - MAX WS+WQ+5*FC@HULA
HULAH/COPAN WS
ANALYSIS FOR 2035
BARTLESVILLE
JAN-DEC MAXIMUM DAY
DISCHARGE FREQUENCY
1940 - 2000
PLATE A005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PERCENT OF TIME EQUALED OR EXCEEDED
LEGEND
RUN NO. SYMBOL
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NOTE:
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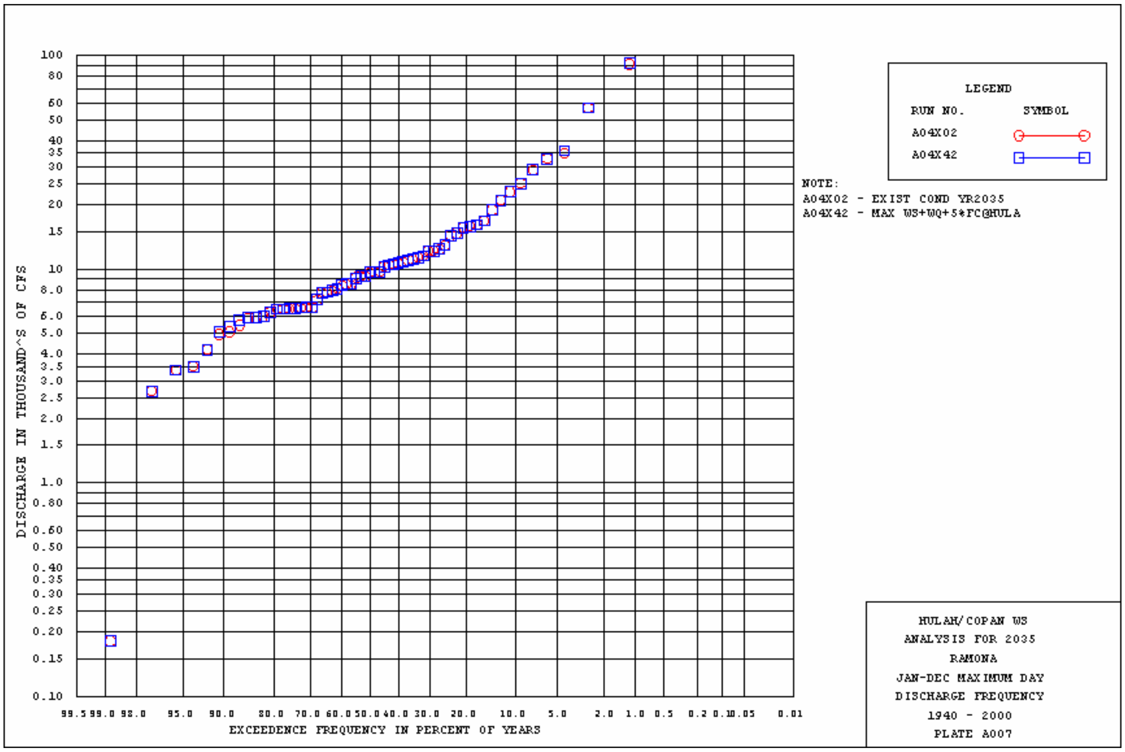
A04X42 - MAX WS+WQ+5*FC@HULA
HULAH/COPAN WS
ANALYSIS FOR 2035
BARTLESVILLE
JAN - DEC
DISCHARGE DURATION
1940 - 2000
PLATE A006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EXCEEDENCE FREQUENCY IN PERCENT OF YEARS
LEGEND
RUN NO. SYMBOL
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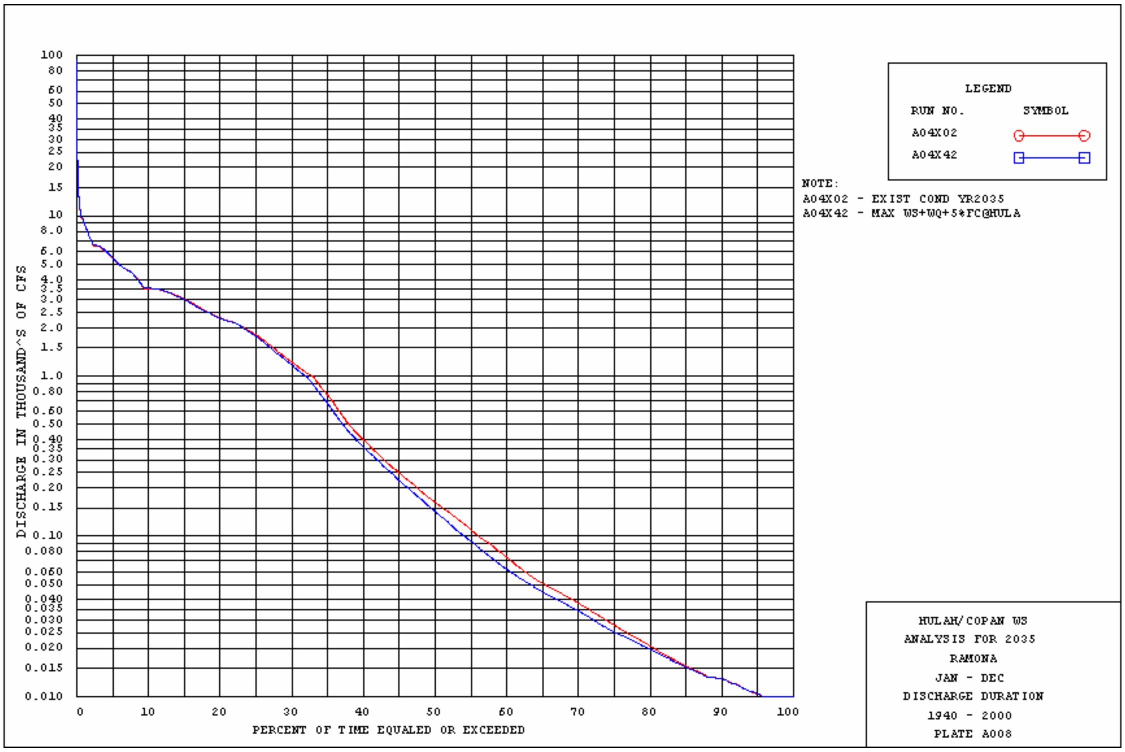
A04X42 - MAX WS+WQ+5*FC@HULA
HULAH/COPAN WS
ANALYSIS FOR 2035
RAMONA
JAN-DEC MAXIMUM DAY
DISCHARGE FREQUENCY
1940 - 2000
PLATE A007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PERCENT OF TIME EQUALED OR EXCEEDED
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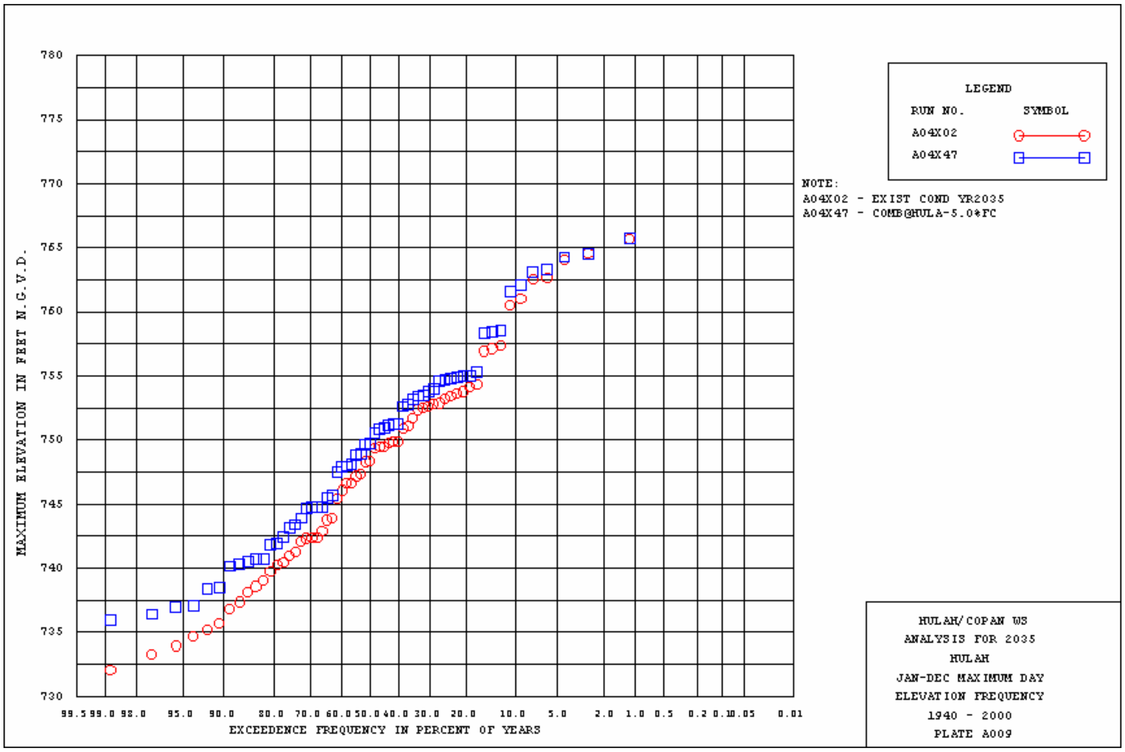
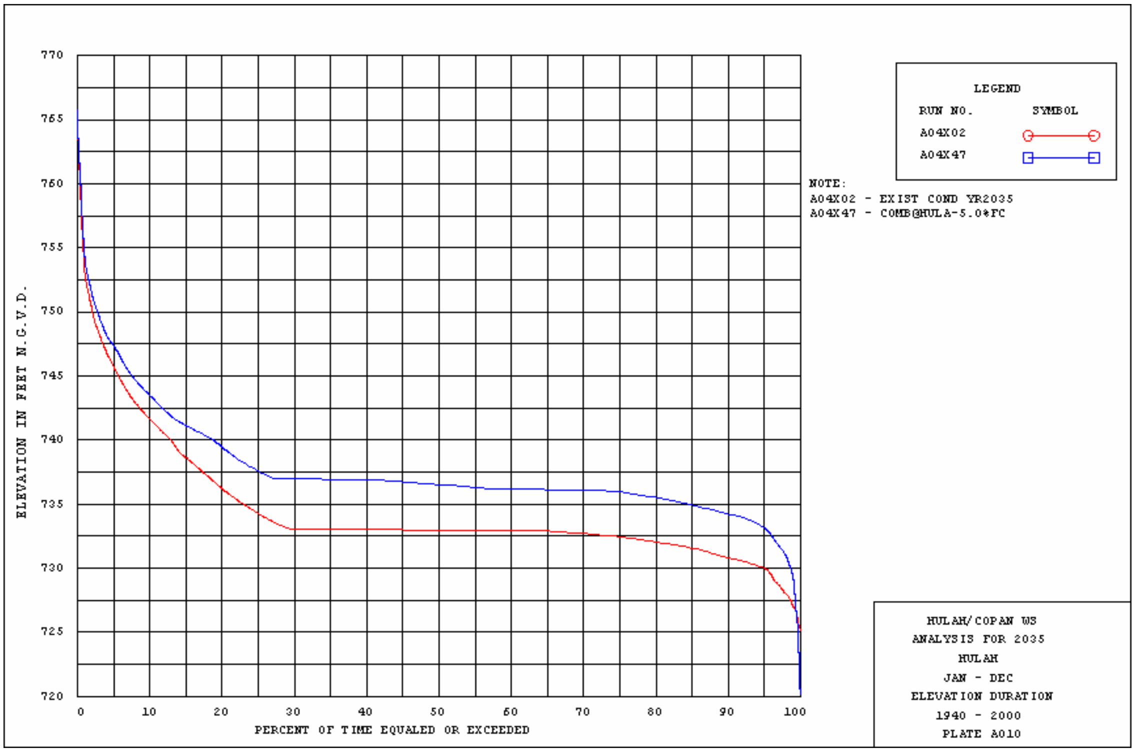
A04X42 - MAX WS+WQ+5*FC@HULA
HULAH/COPAN WS
ANALYSIS FOR 2035
RAMONA
JAN - DEC
DISCHARGE DURATION
1940 - 2000
PLATE A008


MAXIMUM ELEVATION IN FEET N.G.V.D.
EXCEEDENCE FREQUENCY IN PERCENT OF YEARS
LEGEND
RUN NO. SYMBOL
A04X02
A04X47
NOTE:
A04X02 - EXIST COND YR2035
A04X47 - COMB@HULA-5.0*FC
HULAH/COPAN WS
ANALYSIS FOR 2035
HULAH
JAN-DEC MAXIMUM DAY
ELEVATION FREQUENCY
1940 - 2000
PLATE A009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PERCENT OF TIME EQUALED OR EXCEEDED
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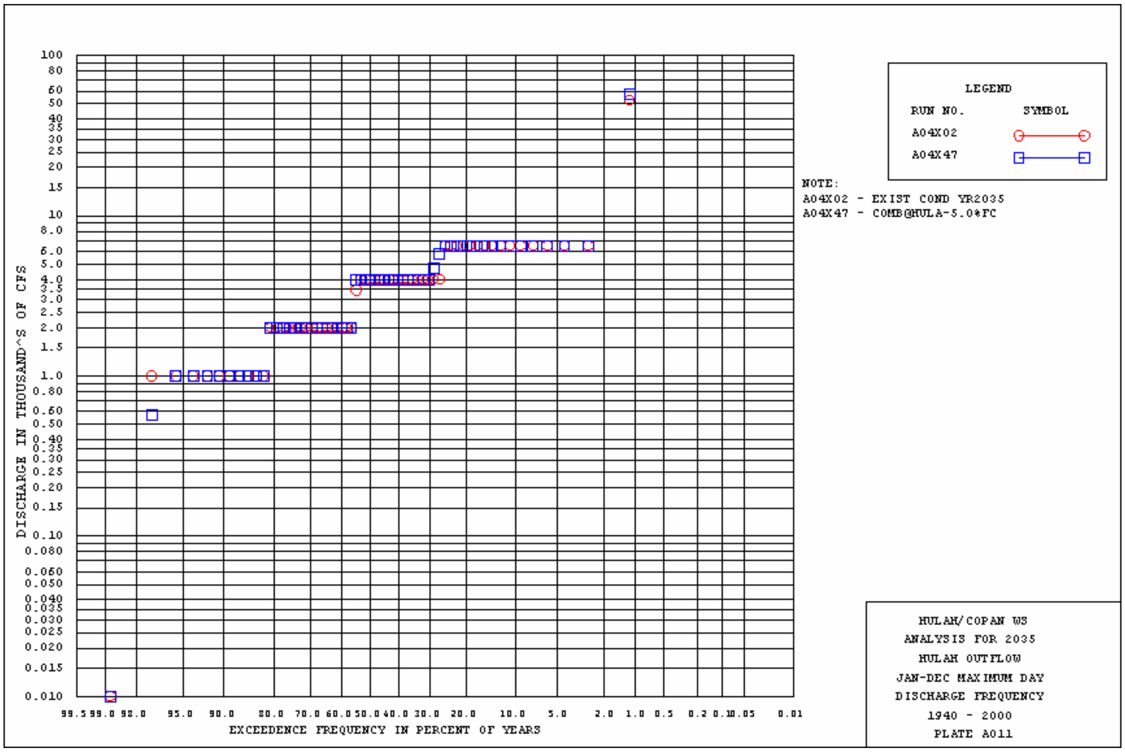
JAN - DEC
ELEVATION DURATION
1940 - 2000
PLATE A010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EXCEEDENCE FREQUENCY IN PERCENT OF YEARS
HULAH/COPAN WS
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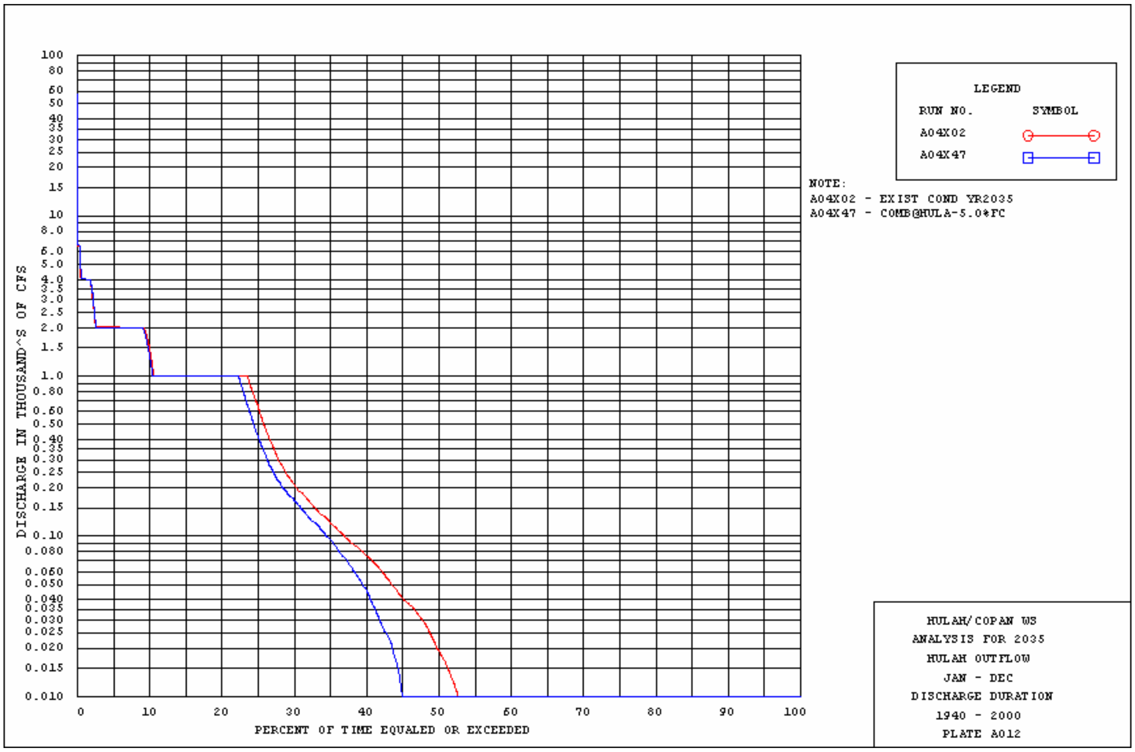
HULAH OUTFLOW
JAN-DEC MAXIMUM DAY
DISCHARGE FREQUENCY
1940 - 2000
PLATE A011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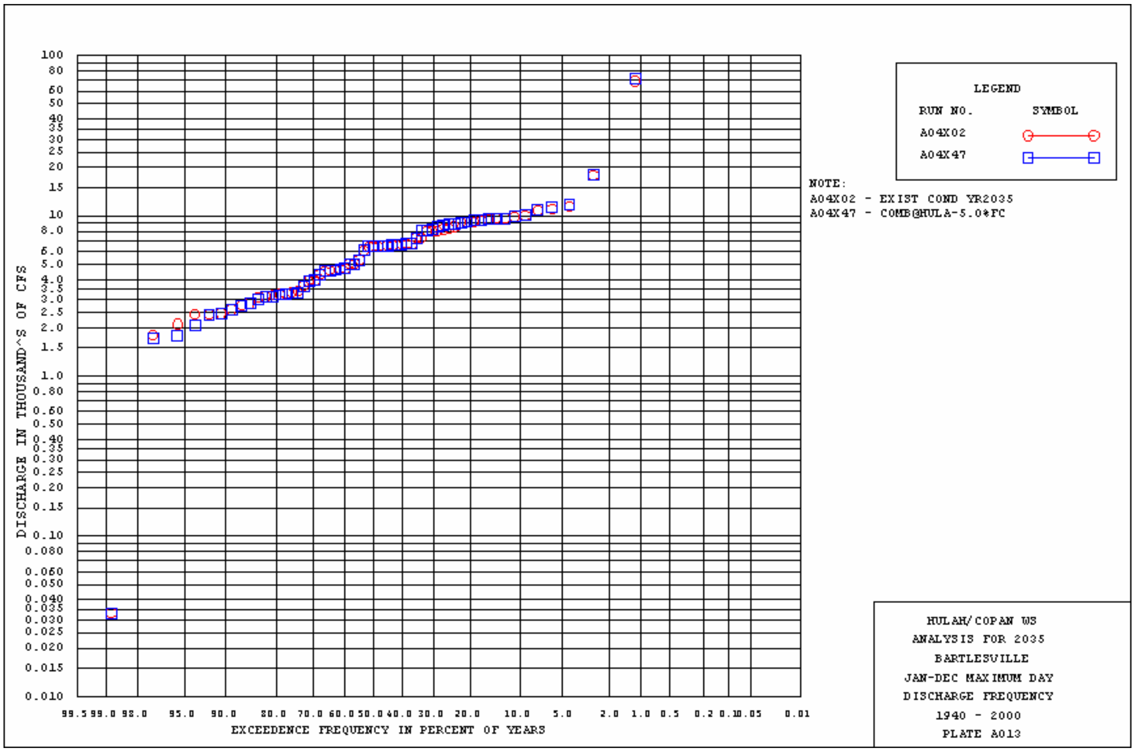
HULAH OUTFLOW
JAN - DEC
DISCHARGE DURATION
1940 - 2000
PLATE A012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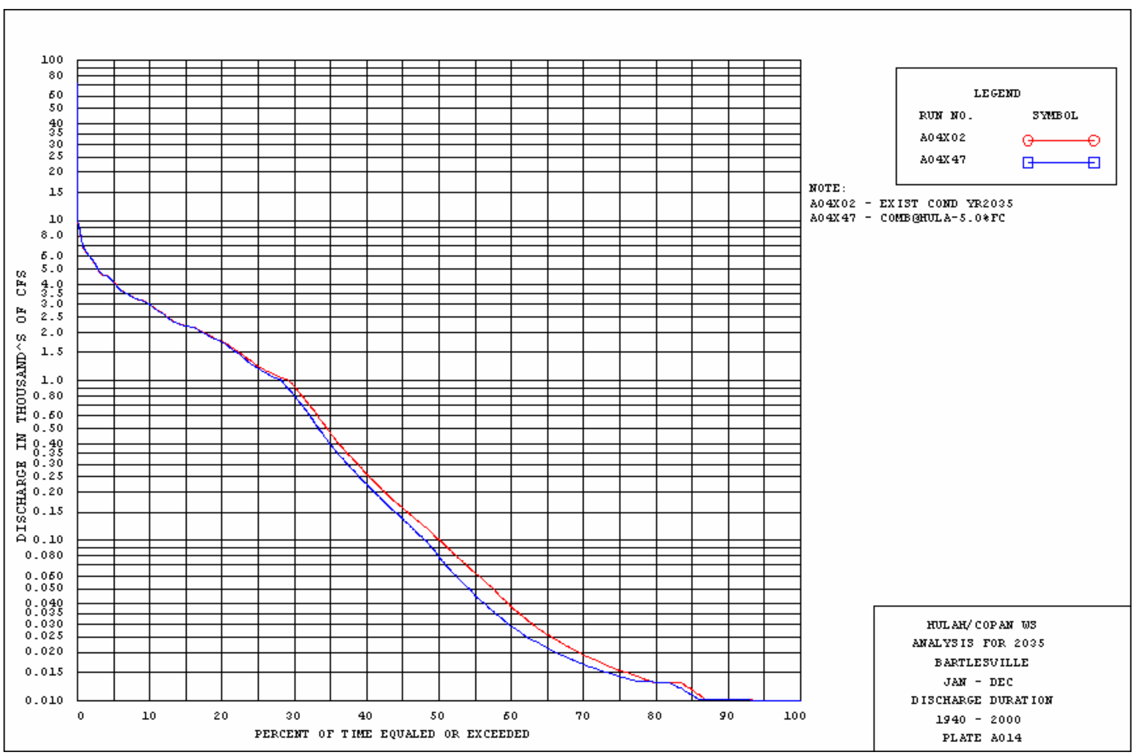
JAN-DEC MAXIMUM DAY
DISCHARGE FREQUENCY
1940 - 2000
PLATE A013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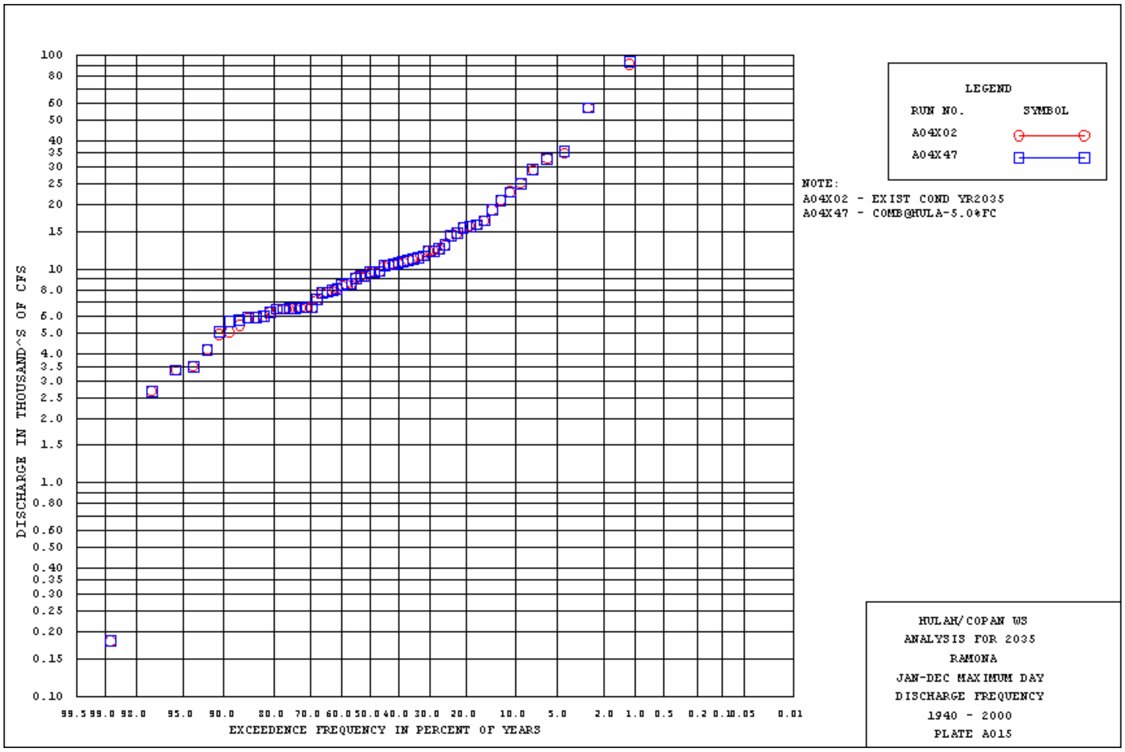
BARTLESVILLE
JAN - DEC
DISCHARGE DURATION
1940 - 2000
PLATE A014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DISCHARGE IN THOUSAND^S OF CFS
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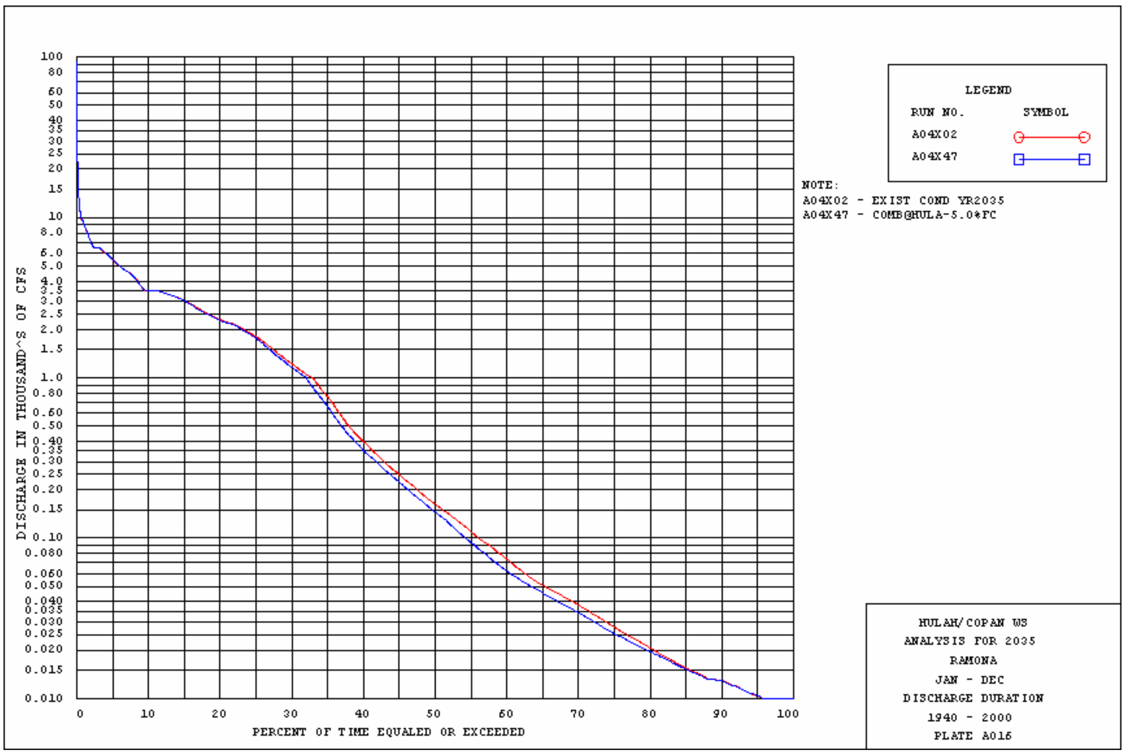
RAMONA
JAN-DEC MAXIMUM DAY
DISCHARGE FREQUENCY
1940 - 2000
PLATE A015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HULAH/COPAN WS
ANALYSIS FOR 2035
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JAN - DEC
DISCHARGE DURATION
1940 - 2000
PLATE A016

- A 2004 sedimentation study of Hulah revealed that the only way to increase yield at Hulah is to reallocate flood storage. (Presentation by Dallas Tomlinson to the Bartlesville Water Resources Committee 7/22/04)

The last sediment survey at Hulah Lake is dated September 2002. Yield is mainly impacted by the amount of storage available, and can be impacted to a lesser degree by hydrologic conditions which affect inflow. The impact due to hydrologic changes tends to be dampened by using a long period of record for analysis. For these analyses, a 60 year period of record was used, which is considered quite adequate. To increase the total yield of the conservation pool at Hulah Lake would require a pool raise, or a reallocation of storage from the flood control pool to the conservation pool. However, the City of Bartlesville would also be able to increase it's available water supply yield by reallocating some storage from water quality to water supply, or obtain it from flood control, or from another reservoir.

- Mitigation costs for damages to cultural, natural and environmental resources from reallocation of flood control were to be included in the reallocation study, but I do not find them. (according to the meeting of 7/22/04)

Scenario number 2, 3, 4, and 5 looked at obtaining additional water supply from reallocation of water from flood control. Scenario number 1 (the preferred option of reallocating all available water quality plus using existing available water supply from Copan Lake) achieved the City of Bartlesville anticipated demand in year 2035 of 10 to 12 million gallons per day. Reallocation from water quality eliminated the need to optain detailed mitigation costs as these options were clearly higher in cost. Water supply demands above 12 mgd would have required additional mitigation cost assessment.

- The scenarios for reallocation of flood control at Hulah should have been more thoroughly discussed. Hulah remains our most cost effective source of water supply as a pipeline is in place and the *yield per acre-foot* is greater than Copan.

It was the understanding of the Corps of Engineers, that the City of Bartlesville wanted to minimize the loss of flood control. Therefore, a decision was made, partly based on economics and partly on the environmental impacts, to reallocate water quality first, before considering reallocating flood control storage. Public knowledge and remembrance of the flood which occurred in 1986 in Bartlesville along the Caney River, would also make a flood control reallocation less desirable from a public relations point of view.

- It appears that *dependable* yield was not considered when comparing reallocation scenarios with the other options of Kaw Lake and Sand Lake. These were dismissed as being too costly.

All of the yields presented in the Hulah Water Supply Reallocation Report are dependable yields.

- No mention was made of the possible yields from Sand Lake although I have read estimates of some 8.0 mgd of dependable yield.

Sand Lake was not considered as a viable near term alternative since Sand Lake was deauthorized and would require reauthorization to be considered as an alternative. Available yield and cost from Sand

Lake is dependent on how the lake is authorized and if it is sized for flood control, water supply, and water quality. With all these uncertainties, it is difficult to include Sand Lake as a current viable alternative.

- The discussion of Sand Lake refers to possible difficulties with the Osage Nation, yet the Tribal Council adopted a resolution in January 2003, expressing an interest in the renewed study of Sand Lake, an interest in cooperating in such a study and asked to be included in developing a scope of work.

The discussion of Sand Lake referred to other past lake projects encountering significant mineral rights mitigation. Federal and sovereign, land rights and environmental issues may be difficult to resolve economically.

- Further discussion of Sand Lake refers to the cost and time to get the project reauthorized (assuming there were federal interest in doing so) as a *significant constraint.* However, in looking at long-term dependable supply, I am not sure that should be a deciding factor.

The proposed reallocation alternative meets the water demand objectives of 10-12 mgd in year 2035. Sand Lake could provide a higher long-term (beyond year 2035) dependable water supply. However Sand Lake as an alternative has significant constraints.

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