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ENVIRONMENTAL IMPACT STATEMENT, AUBREY LAKE, ELM FORK, TRINITY --ETC(U)
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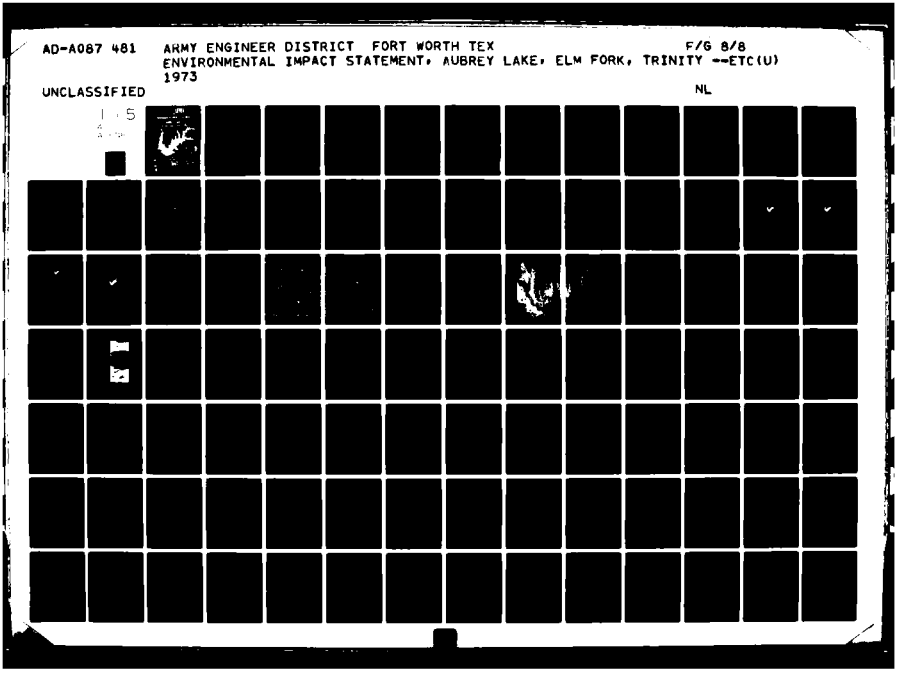

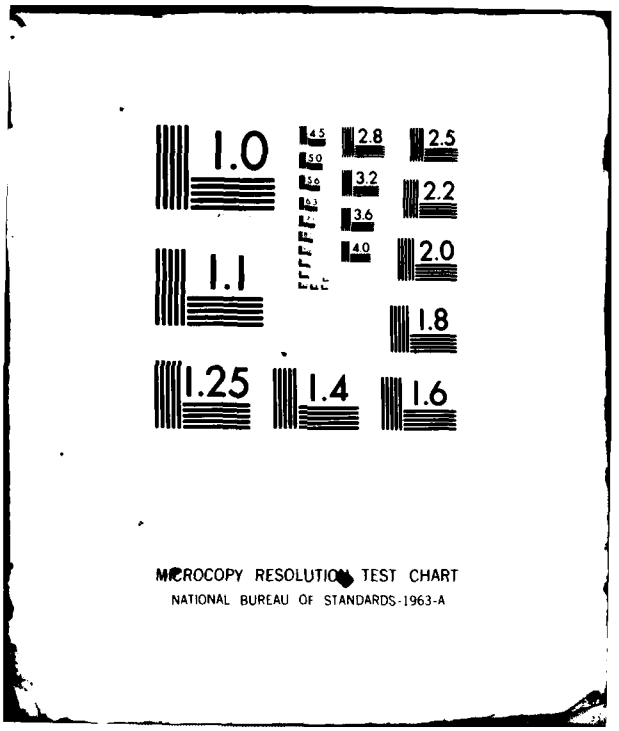
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ENVIRONMENTAL IMPACT STATEMENT

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ON FORK, TRINITY RIVER, TEXAS

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	6. PERFORMING ORG. REPORT NUMBER
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environmental Impact Statement
Aubrey Lake
Trinity River, Texas

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The proposed project will have the primary multiple purposes of water supply, recreation, and fish and wildlife conservation. Eighty-four million gallons per day of water will be available for municipal and industrial uses under initial conditions.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Aubrey Lake, Elm Fork, Trinity River, Texas

( ) Draft (X) Final Environmental Impact Statement

Responsible Office: U.S. Army Engineer District, Fort Worth, Texas.

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: Construct Aubrey Lake for water supply, recreation, and fish and wildlife.

3. a. Environmental Impacts: The proposed Aubrey Lake would dedicate about 25,200 acres of water surface area in the conservation pool. The project will have the primary multiple purposes of water supply, recreation, and fish and wildlife conservation. Eighty-four million gallons per day of water will be available for municipal and industrial uses under initial conditions. During the period 1924-1968, the net reduction in flows due to the addition of Aubrey Lake to the present system of lakes in the Trinity River Basin would have been 116 cfs, or 1.6 percent. Recreational opportunities will be provided for 6.24 million recreation user-days per year. The impoundment will increase both the quantity and diversity of area commercial and sport fish species. The multilevel withdrawal system of the lake will benefit the downstream fishery by allowing selection of the quality of water necessary for optimum production of desired species, and a more uniform streamflow. The proposed project will cause a decrease in available habitat for upland game and other animals, with an increase in waterfowl usage and wetland quality. Aquatic species should benefit from the increase in suitable habitat. Primary impacts from extensive land-use around the lake and related secondary social and economic impacts in the surrounding communities can be expected. At least 26 archeological sites could be affected by the project unless adequate and timely salvage operations are undertaken. There are no historical sites of Federal, State, or regional significance; however, the project will cause displacement of existing gravesites, and a unique architectural landmark in the area. There will be primary and secondary social, cultural, and economic impacts from relocations; disruption and dispersal of homes and neighborhood friends; loss of land; modified shopping patterns; changed distances to preferred churches and jobs; and alterations in social activities. The project also requires the relocation or modification of roads, a railroad, and several miles of communication and utility lines. The project is expected to increase the overall esthetic quality of the area. Water quality is expected to be good for all purposes.

b. Adverse Environmental Effects. At the conservation pool elevation, this project will inundate about 20 miles of the Elm Fork and 23 miles of Isle du Bois Creek; about 35 acres of ponds, stock tanks, and small impoundments; and about 25,200 acres of land used primarily for agriculture. Altogether, the project will require acquisition and subsequent change in land use of approximately 43,500 acres of land. Habitats for upland game and other animals will be lost due to inundation. There will be a loss of aquatic and terrestrial vegetation, and a portion of the unique East Cross Timbers physiographic province. The archeological resources of the project may be subjected to adverse impacts. Tax receipts of and income from lands to be acquired for project purposes will be lost for the life of the project. Relocating families, cemeteries, roads, railroads, and utility lines, and removal of landmarks will have some social and psychological impact on area residents, but should not cause extreme hardships.

4. Alternatives. Alternatives considered were: no action, those alternatives that will meet all of the authorized project purposes (alternate damsite locations, small upstream watershed projects, and excavation alternative); those alternatives that will meet one or more, but not all of the authorized project purposes (geothermal sources, weather modification, ground water supply, artificial aquifer recharge, reclamation and reuse of wastewater, interbasin and intrabasin transfer of water, access to existing streams with development, access to existing streams without development, provision of public hunting areas, open space greenbelt, Wild and Scenic River Act (23), low water retention dams, Water Bank Act (26), green tree reservoir, environmental corridor between Aubrey and Lewisville Lakes, and additional facilities at existing projects); and combinations of two or more single purpose alternatives that would meet all of the authorized project purposes.

5. Comments Received:

Environmental Protection Agency
U.S. Department of Agriculture:
    Soil Conservation Service
    Forest Service
U.S. Department of Commerce:
    National Weather Service
U.S. Department of Health, Education, and Welfare
U.S. Department of the Interior
U.S. Department of Transportation:
    Federal Railroad Commission
    Federal Highway Administration
Advisory Council on Historic Preservation
Federal Power Commission
Division of Planning Coordination, Office of the Governor,
    State of Texas
North Central Texas Council of Governments
Texoma Regional Planning Commission
City of Dallas, Texas

City of Denton, Texas
City of Fort Worth, Texas
Denton County, Texas
Texas Committee on Natural Resources
Texas Archeological Society
Sierra Club
League of Women Voters of Texas
League of Women Voters of Dallas
Department of Environmental Studies, University of Texas at San Antonio at the request of the National Wildlife Federation
Environmental Defense Fund
National Audubon Society
Dallas County Audubon Society
Trinity Improvement Association
Denton County Historical Survey Committee
Institute for Environmental Studies, North Texas State University
Archeology Research Program, Southern Methodist University.

6. Draft statement to CEQ 14 August 1973.
Final statement to CEQ _____.

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FINAL

ENVIRONMENTAL IMPACT STATEMENT
AUBREY LAKE, ELM FORK, TRINITY RIVER, TEXAS

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SECTION I

PROJECT DESCRIPTION

SECTION I - PROJECT DESCRIPTION

1. Specific Location. The proposed Aubrey Lake impoundment will be located in parts of Denton, Cooke, and Grayson Counties in north central Texas. The geographic grid location of the impoundment is between latitude 30°20'00" N. and latitude 33°32'30" N., and between longitude 96°52'30" W. and longitude 97°10'00" W. The major portions of the impoundment will be along the Elm Fork of the Trinity River and its tributaries, and along Isle du Bois Creek and its tributaries, in Denton County. The impoundment will extend into the southern part of Cooke County along the Elm Fork to the west, with the valleys of Isle du Bois, Indian, Buck, and Wolf Creeks to the east. Only the southwestern portion of Grayson County, along the valleys of Buck and Range Creeks, will be in the impoundment basin. The recommended Aubrey Lake damsite will be in Denton County at river mile 60.0 of the Elm Fork of the Trinity River, about 4 miles northwest of Aubrey, Texas. This damsite is about 30 river miles upstream from Lewisville Dam.

2. Physical Description. The selected project has been designed as an earthfill embankment consisting primarily of compacted medium to high plasticity clays. The embankment will have a maximum height of 136 feet above the streambed, will be about 14,700 feet long, and will have a crest width of 42 feet. A 100-foot long uncontrolled spillway will be constructed in the left abutment, and a 13-foot diameter outlet works conduit is planned for the right flood plain. The maximum design water surface area of the proposed project was determined to be 55,300 acres at elevation 655.8 feet msl. The expected operating elevations will be 636.0 feet msl for the flood-control pool which will inundate 32,600 acres, and 627.0 feet msl for the conservation pool which will cover 25,200 acres. The lake (plate II-1) will form a "V" shape as it backs water into the Elm Fork and Isle du Bois Creek valleys. At the conservation pool level, the lake will inundate about 20 miles of the Elm Fork channel and about 23 miles of Isle du Bois Creek channel, and will create a total shoreline of approximately 162 miles. At the flood control pool level, elevation 636.0 feet msl, 32,600 acres will be inundated at an average recurrence interval of about once every 46 years. A full flood control pool will inundate about 23 miles of the Elm Fork channel and about 25 miles of the Isle du Bois channel. At this water surface elevation the widest part of the lake would be about 6 miles across. A major alteration will result from increasing the water conservation pool at Lewisville Lake from 515 feet msl to 522 feet msl. This increase in the water surface area will inundate an additional 6,400 acres of existing project lands.

3. Purposes. The primary project purposes are water supply, recreation, and fish and wildlife. The flood control aspects of the Aubrey Lake project result from the transfer of a portion of the allocated flood control space in Lewisville Lake located immediately downstream from the Aubrey project. The resulting space in Lewisville Lake will be used for water conservation

storage. Therefore, flood control is not an added or increased purpose of Aubrey Lake, but merely a sharing of functions with Lewisville Lake.

4. Proposed Plan of Improvement.

a. Benefits To Be Provided by the Project.

(1) Water Supply. As a result of the critical drought situation experienced in the decade preceding the 1957 floods, the State of Texas indicated its desire that Corps of Engineers lakes in Texas be developed to their full potential for water conservation. In determining the conservation storage capacity which should be provided in Aubrey Lake, cognizance was taken of this desire on the part of the State, as well as the request of local interests, Corps of Engineers estimates of the probable future water requirements of the region, and the capability of refilling the conservation pool after the critical drought period. Before the accumulation of sediment, the 650,300 acre-feet of storage initially available in the conservation pool below elevation 627.0 feet msl would, under present conditions of watershed development, produce a dependable yield of 130 cubic feet per second. Of this water supply yield, 74 percent is for the city of Dallas, and 26 percent is for the city of Denton. These amounts are destined to supply a portion of the projected long range water needs of these two municipalities.

(2) Recreation. The proposed project is situated near the Dallas-Denton-Fort Worth metropolitan area, an area which has a projected growth rate above the national average. This location provides an excellent opportunity to develop, close to the people, a reservoir project with a variety of outdoor recreational opportunities. The demand for recreational outlets is demonstrated by the usage of recreational facilities at existing projects in the area. This project fits into the planning scheme for greenbelt areas and recreational corridors as proposed by the North Central Texas Council of Governments in their recently completed Open Space Plan. The project would provide opportunities for up to 6,240,000 recreation days annually. The principal recreation resources of Aubrey Lake will be the scenic beauty of the lake, the favorable climate, and the fish and wildlife resources of the project area. Tree cover, ease of access, topography, and suitable water depths for water-oriented recreation will be the factors determining the number of sites to be selected for recreational development. The development of 11 public-use areas at the proposed Aubrey Lake project will include approximately 2,800 acres above the conservation pool. Facilities provided at these sites will accommodate activities such as camping, picnicking, hiking, and water-based activities such as boating, fishing, swimming, and water skiing. Because of its proximity to the Dallas-Denton-Fort Worth metropolitan area, the

Aubrey Lake project has the potential to meet part of the large demand generated for outdoor recreation facilities. Park roads, parking areas, boat launching ramps, picnicking and camping facilities, sanitary facilities, potable water, and beautification aids are included in the facilities which will be provided at the project.

(3) Fish and Wildlife. Aubrey Lake will constitute a major change in the aquatic environment, i.e., alteration from several warmwater stream fisheries to a large impoundment-type fishery of good water quality. After the lake is filled, the productivity of fish should be high, but later this productivity will decrease. There should also be a significant increase in the benefit to waterfowl because of the upgrading of wetland quality in the area.

b. Land Requirements. The lands to be involved in the construction of Aubrey Lake consist of approximately 43,560 acres in 1,187 tracts and 945 ownerships. Approximately 945 relocation payments under the Uniform Relocation Assistance Act (28) will be required. This relocation assistance will consist mainly of payments and assistance to applicants who own farms or parts of farm units. The number of acres required for the project excluding approximately 42 acres to replace existing recreational resources to be inundated by the pool raise at Lewisville Lake is shown in table I-1.

Table I-1

Number of Acres To Be Acquired for Aubrey Lake

Homesite Tracts	12,000 acres
Undeveloped Acreage Suitable for Future Development	24,830 acres
Bottomland Farm Units	6,730 acres
Total	43,560 acres

5. Management of Project Resources.

a. Wildlife Management. The management of fish and wildlife resources is essentially the responsibility of the Texas Parks and Wildlife Department. Migratory bird management is primarily the responsibility of the Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior. Some specific recommendations from these organizations to facilitate proper management are included in section III. However, the Corps of Engineers will

supply all aid and assistance possible in order to secure an adequate management program for the project. The Texas Parks and Wildlife Department fishery management plan consists of establishing creel and size limits and seasons. Commercial fishermen and renovation methods could be used to control rough fish populations. Wildlife management for specific animals by habitat improvement will require standard mapping of vegetative species, classification of land use and wetlands, locating key habitats of each species of wildlife, and application of measures tailored to improve quality and quantity of populations. Application of good game management practices will aid in perpetuating and increasing the populations of most wildlife species at Aubrey Lake.

b. Forest and Vegetative Management. Although much forest cover exists on the areas recommended for purchase, many acres of land will require tree planting. All plantings should begin at the earliest possible time, especially tree plants, in order that reasonable growth can occur prior to development for public use. In the recreational areas, vegetation that can withstand overuse will be favored in order to preserve the beauty of the recreation areas. Selection of grasses and other plant materials will be coordinated with the district agronomist and the Soil Conservation Service. Construction contracts will contain statements to the effect that trees and other vegetation will not be subjected to unnecessary mechanical, chemical, or fire damage, with penalty clauses for violations. Labor forces will be instructed and supervised to protect critical sites and endangered resources. Before construction begins on recreational facilities, the contracting officer and district personnel will set the limits of the construction area. Any resources within this construction area will be protected.

c. Soil and Water Management. Soil is the basic factor used in determining the carrying capacity of the resource; therefore, protection and stabilization of the soil is the most important consideration of resource management. One of the best protections for these soils is a good vegetative cover. Areas of the lake will be zoned, and buoys and markers will be placed to control various activities and speeds of watercraft. During the peak recreation season, a boat patrol will be utilized to provide additional control to maintain water safety.

d. Health and Sanitation Management. The health and sanitation programs will be instituted in cooperation with the U.S. Public Health Service and the Texas State Health Department. These programs will include a limited entomological surveillance; insect and vector control (e.g. drainage, larviciding, aquatic plant control, and drift removal), adequate water supply and sewage disposal facilities in public recreation areas, and pollution control. The control of pollution would primarily be the responsibility of the State of Texas.

The Corps of Engineers will cooperate with the responsible State and Federal agencies in the prevention and control of pollution at the project.

e. Fire Protection. A fire control plan will be developed by the reservoir manager for the headquarters and project area. Agreements will be made with local fire departments to assist in suppressing fires.

f. Law Enforcement. Enforcement of civil and criminal law at the project on Government land and water remains the responsibility of duly constituted officers of Federal, State, and local agencies. Corps of Engineers personnel will cooperate fully with all officers responsible for the enforcement of laws relative to civil and criminal actions, game and fish conservation, public health and sanitation, water safety, and prevention of pollution.

6. Authorizing Document. Congressional authority for the construction of Aubrey Lake, a unit in the comprehensive plan of improvement for the Trinity River Basin, Texas, is contained in the River and Harbor Act approved 27 October 1965 (22) in accordance with the plan of improvement outlined in House Document No. 276 (89th Congress, 1st session). Authority to initiate advanced planning on Aubrey Lake is contained in the Public Works Appropriation Act of 1970 approved 11 December 1969 (24), and in Advice of Allotment C-57 dated 7 July 1970.

7. Status. The Aubrey Lake project is in the advanced engineering and design stage.

8. Benefit-Cost Ratio. Based on an interest rate of 3¼ percent, and using 1 November 1972 price levels and a 100-year amortization period, the benefit-cost ratio for this project is 2.6 to 1.0.

Table I-2

Summary of Benefit-Cost Data

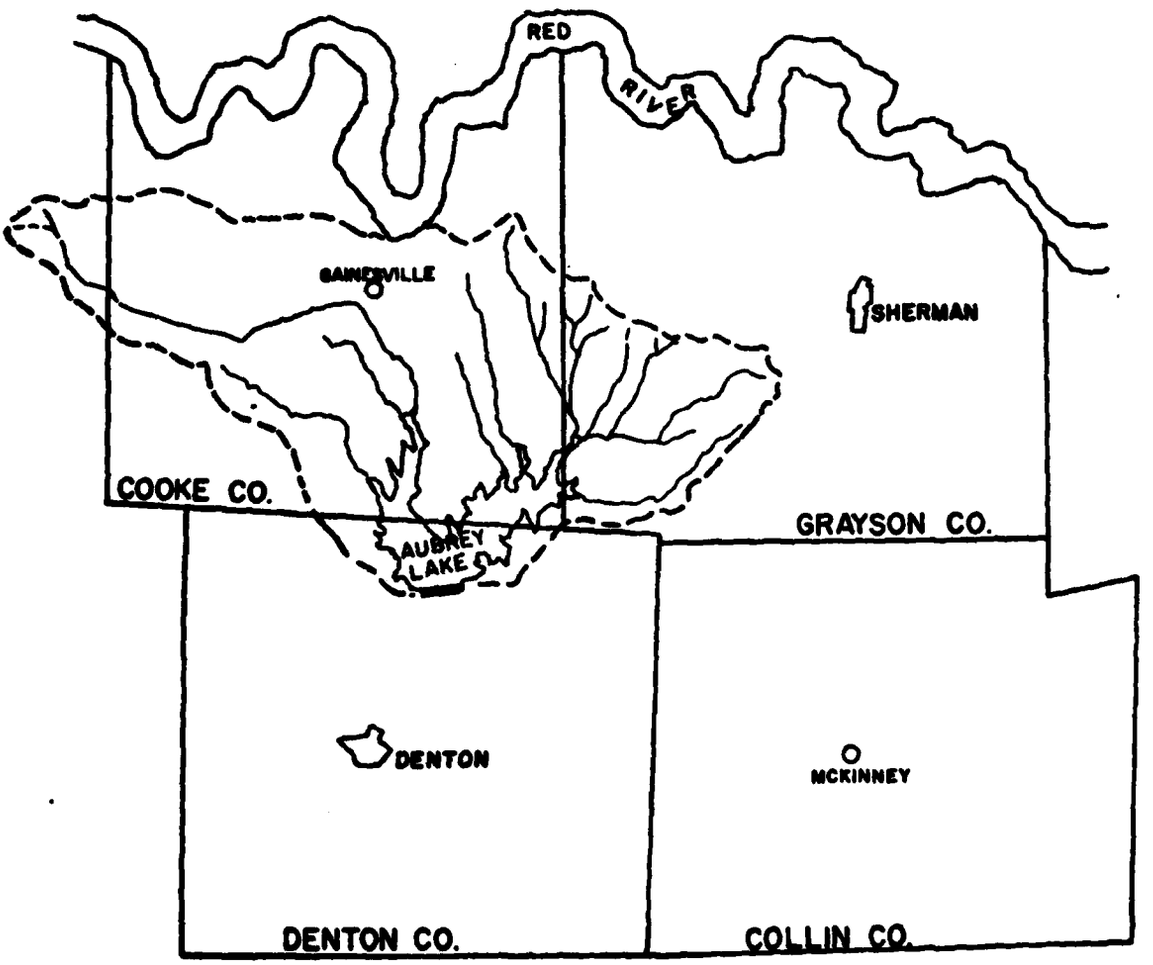
Total Project Cost	$101,000,000
Average Annual Charges (Includes O&M - $480,000)	$4,215,900
Average Annual Benefits:	
Water Supply	$4,546,300
General Recreation	$5,653,000
Fish and Wildlife	$741,600
Total	$10,940,900
Benefit-Cost Ratio:	2.6 to 1.0

$$(B/C = \frac{\$10,940,900}{\$\ 4,215,900} = 2.6)$$

Excess Annual Benefits Over Annual Costs	$6,725,000

SECTION II

ENVIRONMENTAL SETTING WITHOUT THE PROJECT



ELM FORK WATERSHED ABOVE AUBREY DAMSITE

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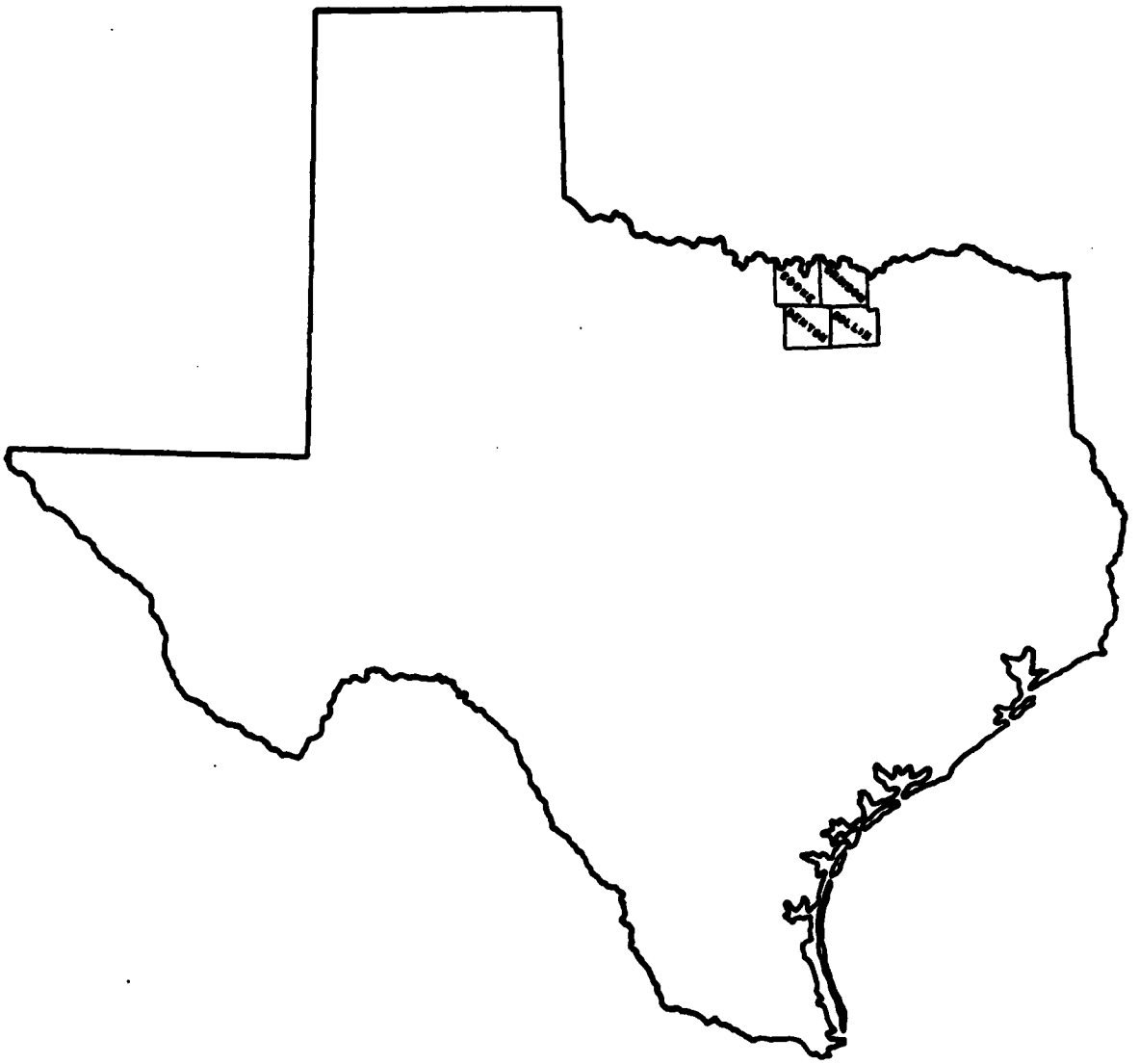
PLATE II-3



LOCATION MAP
AUBREY PROJECT AREA

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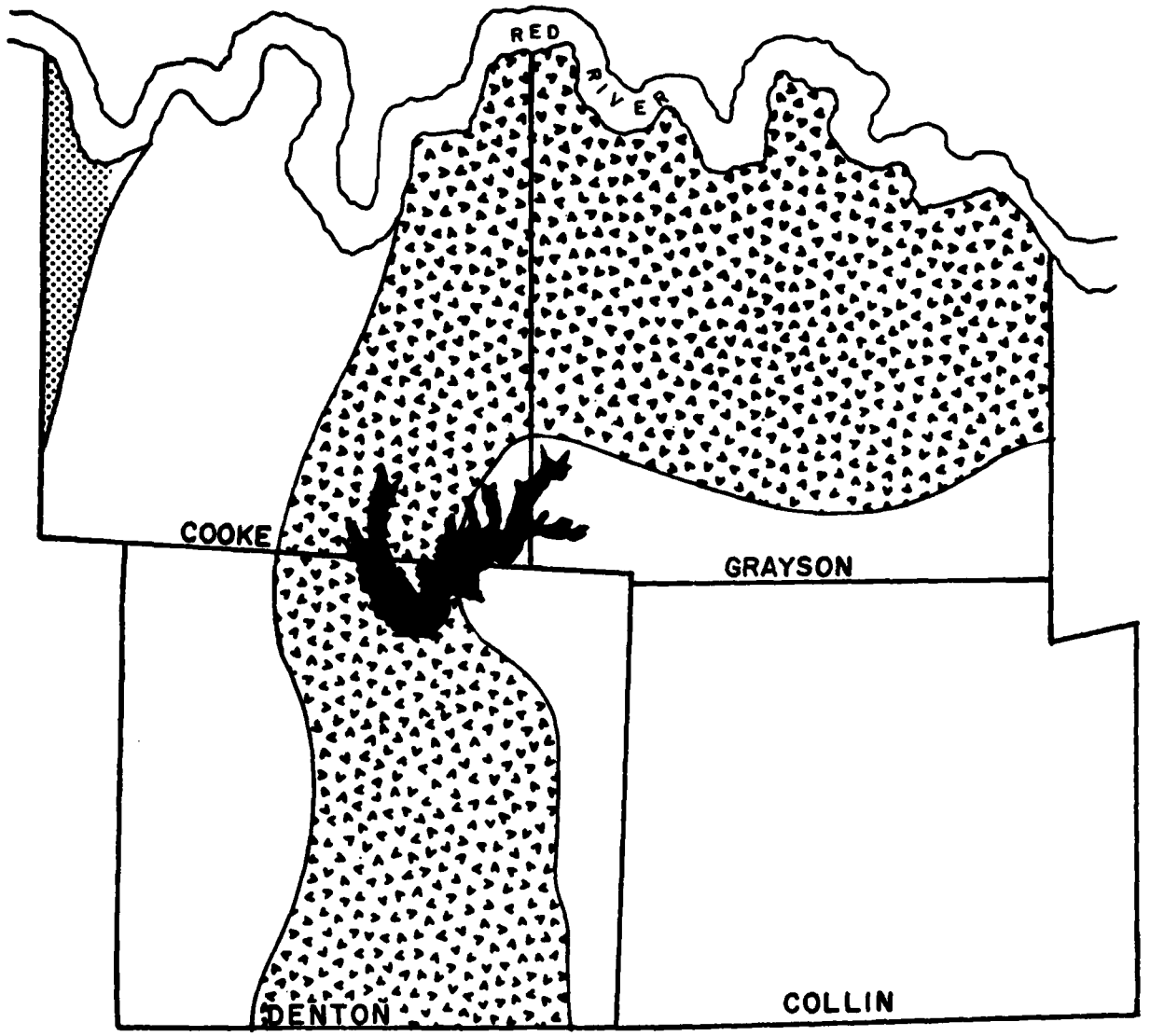
PLATE II-4



VEGETATION REGIONS

Oak Forest and Prairie
Post Oak, Blackjack Oak; some prairies.

Blackland Prairie
Bunch and Short Grasses.

Oak – Hickory Forest
Hickory, Post Oak, Blackjack Oak; some prairies.

Reference: ATLAS OF TEXAS, 1967

VEGETATION REGIONS OF AUBREY PROJECT AREA

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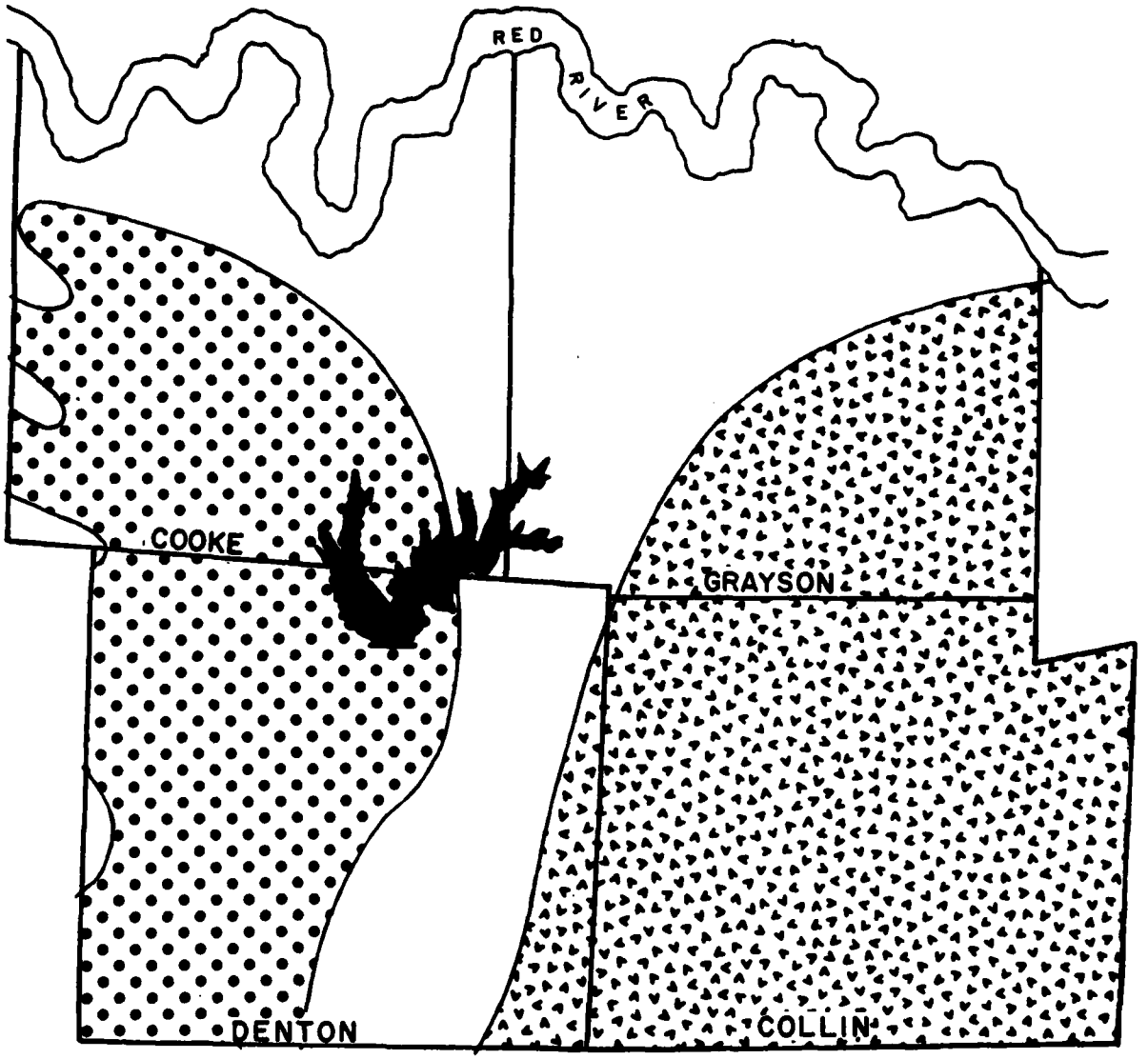
PLATE II-5



GEOGRAPHIC REGIONS

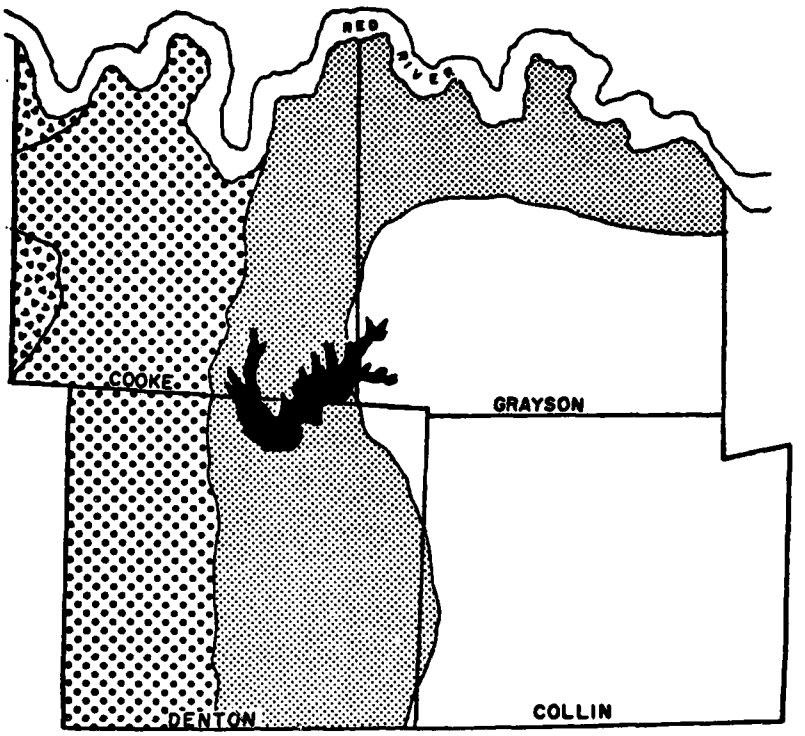
- Grand Prairie
- Cross Timbers
- Blackland Prairie

Reference: ATLAS OF TEXAS, 1967

GEOGRAPHIC REGIONS OF AUBREY PROJECT AREA

CORPS OF ENGINEERS

PLATE II-6



LAND RESOURCE AREAS
SOILS GENERALIZED

West Cross Timbers
Light-colored, slightly acid sandy loams, loamy sands and sands.

Blackland Prairie
Uplands - Dark-colored calcareous clays. Some grayish-brown, acid sandy loams and clay loams along eastern edge of the major prairie and interspersed in the minor prairies.

Bottomlands - Dark-grey to reddish-brown calcareous clay loam and clays.

East Cross Timbers
Light-colored, acid loamy sands and sandy loams.

Grand Prairie
Uplands - Dark-colored, deep-to-shallow and stony calcareous clays over limestone.

Bottomlands - Reddish-brown to dark-grey clay loams and clays.

Reference : ATLAS OF TEXAS, 1967

LAND RESOURCE ZONES OF AUBREY PROJECT AREA

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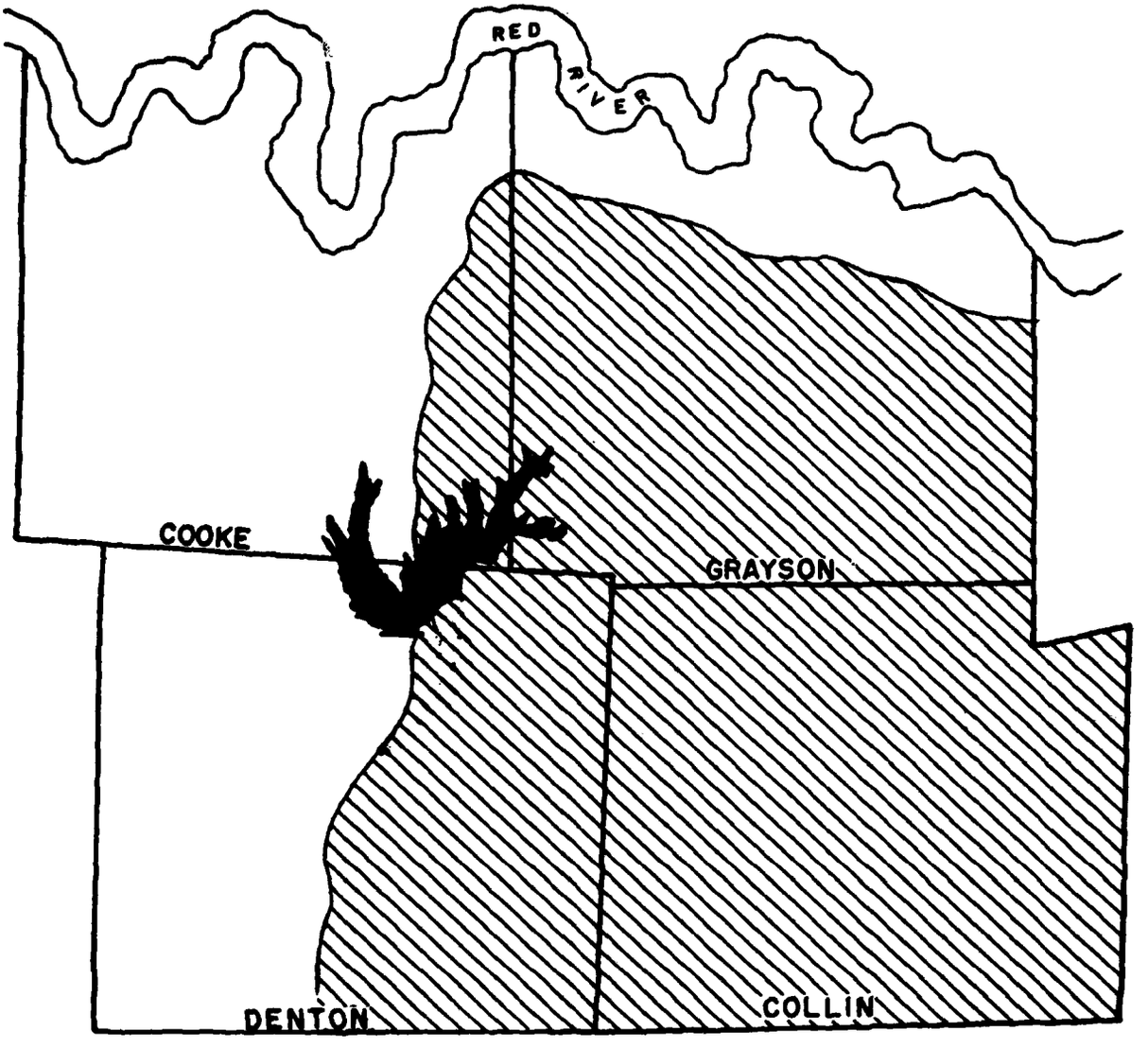
PLATE II-7



SURFACE GEOLOGY

GEOLOGIC AGES

Cretaceous
(Gulf Series)

Cretaceous
(Comanche Series)

Reference : ATLAS OF TEXAS, 1967

SURFACE GEOLOGY
OF AUBREY PROJECT AREA

CORPS OF ENGINEERS

PLATE II-8

SECTION II - ENVIRONMENTAL SETTING WITHOUT THE PROJECT

1. Physiographical Description of the Watershed.

a. Elm Fork Watershed. The Elm Fork of the Trinity River has its headwaters in the west central section of Montague County near the Cooke County line. From its headwaters, the stream and its tributaries flow in an easterly direction to central Cooke County where the principal drainage bends at a right angle to the south and southeast. This general course is maintained to the stream's confluence with the West Fork of the Trinity River near the city of Dallas. Isle du Bois Creek is the principal tributary of the Elm Fork above the Aubrey Lake damsite. It flows southwesterly, draining eastern Cooke County and the southwestern corner of Grayson County, and joins the Elm Fork just upstream from the proposed dam alinement. The drainage basins of the Red River to the north and of the Elm Fork of the Trinity River to the south are delineated by a well-defined divide extending in a northwesterly direction from a point just north of Gainesville. The elevation in the watershed ranges from a high of about 1,200 feet msl in the northwest region to a low of 530 feet msl at the damsite.

b. Damsite Location. The Aubrey Lake damsite is located on the Elm Fork of the Trinity River in north central Denton County about 5 miles south of the Cooke County-Denton County line and about 6 miles upstream from the upper reaches of Lewisville Lake. Except for a short projection of the Isle du Bois Creek into Grayson County, Aubrey Lake will be included entirely in Cooke and Denton Counties. The lake will have a two-arm configuration with one arm occupying the Elm Fork Valley and the other arm occupying the Isle du Bois Creek Valley (plate II-1). It will have a maximum width of about 5 miles, an average width of about 1 mile, and will extend about 11.5 miles upstream from the dam.

c. Geologic Setting. Aubrey Lake will lie within the Gulf Coastal Plain physiographic province - a broad belt of sands, clays, and limestones that borders the Gulf of Mexico. The strata supporting this area dip gently toward the Gulf of Mexico. Four main physiographic subdivisions of the West Gulf Coastal Plain physiographic division, based on the physical character of the underlying geologic formations, appear in this area. They are the West Cross Timbers, the Grand Prairie, the East Cross Timbers, and the Blackland Prairie.

(1) West Cross Timbers. The West Cross Timbers is the area covered by the outcrop of the Trinity sand formation. It is characterized by a rolling to hilly topography with a very sandy soil cover and a thick growth of primarily post oaks and blackjack oaks. This physiographic subdivision occurs in the western part of the Elm Fork watershed, but will not be inundated by Aubrey Lake.

(2) Grand Prairie. The Grand Prairie physiographic subdivision occupies the central part of Cooke and Denton Counties and is underlain by several hundred feet of alternating beds of shales and limestones situated stratigraphically between the Trinity sand formation at the base and the Woodbine sand formation at the top. Typically, it is a rolling upland prairie with small escarpments and benches formed by hard ledge-forming layers such as the Goodland limestone, lower Duck Creek limestone, Fort Worth limestone, "Quarry" limestone, and Main Street limestone.

(3) East Cross Timbers. The East Cross Timbers lies along the central and eastern boundary of the Elm Fork watershed. It is underlain by the Woodbine sand formation. The topographic expression is similar to that of the West Cross Timbers, except it is more rugged and hilly. The hills are due primarily to local strata that are well cemented with ferruginous materials. At one time a dense growth of timbers, consisting primarily of post oak and blackjack oak, covered the area.

(4) Blackland Prairie. The Blackland Prairie physiographic subdivision is not present in the lake area, but a small portion of it is present in the extreme eastern sector of the watershed east of Isle du Bois Creek. It is characterized by a flat to rolling surface developed on the Eagle Ford shale and Austin chalk formations. A prairie-type vegetation nearly void of trees grows from the brown waxy clay soil cover typical of the Blackland Prairie physiographic subdivision.

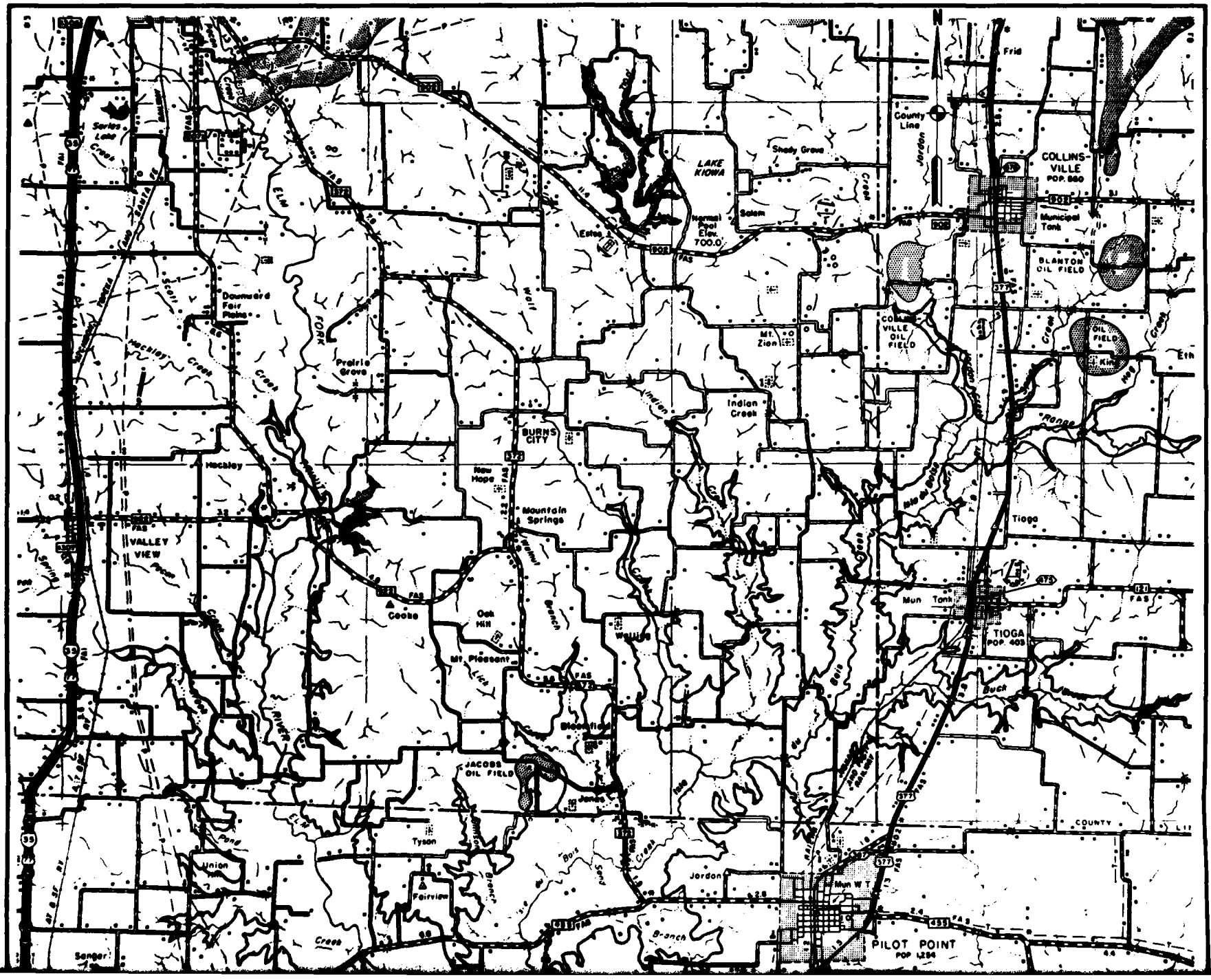
2. Geological Elements.

a. Geology of the Watershed.

(1) The rock strata supporting the project area consist of sands, clays, marls, and limestones that belong to the Cretaceous age. The Cretaceous system is subdivided as shown in table II-1.

(2) All of these strata dip gently toward the Gulf of Mexico. The regional dip of the bedrock is greater than the slope of the land surface, causing progressively younger formations to be exposed from the northwest to the southeast across the watershed.

(3) Flood-plain deposits of clay, silt, sand, and gravel are found along the bottomlands of the Elm Fork and its tributaries. These deposits are about 45 feet thick at the damsite. Terrace deposits, remnants of ancient flood-plain fills that were left standing high in relief after streams cut their paths successively deeper into rock, border the Elm Fork and Isle du Bois Creek over a portion of their course. These deposits probably reach a maximum thickness of about 35 feet.


LAKE KIOWA
Normal Pool Elev. 700.0
COLLINSVILLE POP. 880
Municipal Tank
BLANTON OIL FIELD
COLLINSVILLE OIL FIELD
OIL FIELD
BURNS CITY
Prairie Grove
Mt. Zion
New Hope
Mountain Springs
Indian Creek
Oak Hill
Mt. Pleasant
Cooke
VALLEY VIEW
Hackley
Downard Fair Plains
Tioga
Mun Tank
TIOGA POP. 403
JACOBS OIL FIELD
Tyson
Union
Fairview
Jordon
Mun W T
PILOT POINT POP 1256
Sanger
Shady Grove
County Line
Estes
Salem
Frid
ELM FORK
Scott Creek
Machlot Creek
Indian
Ridge
Buck
Bois
Sand
Branch
COUNTY

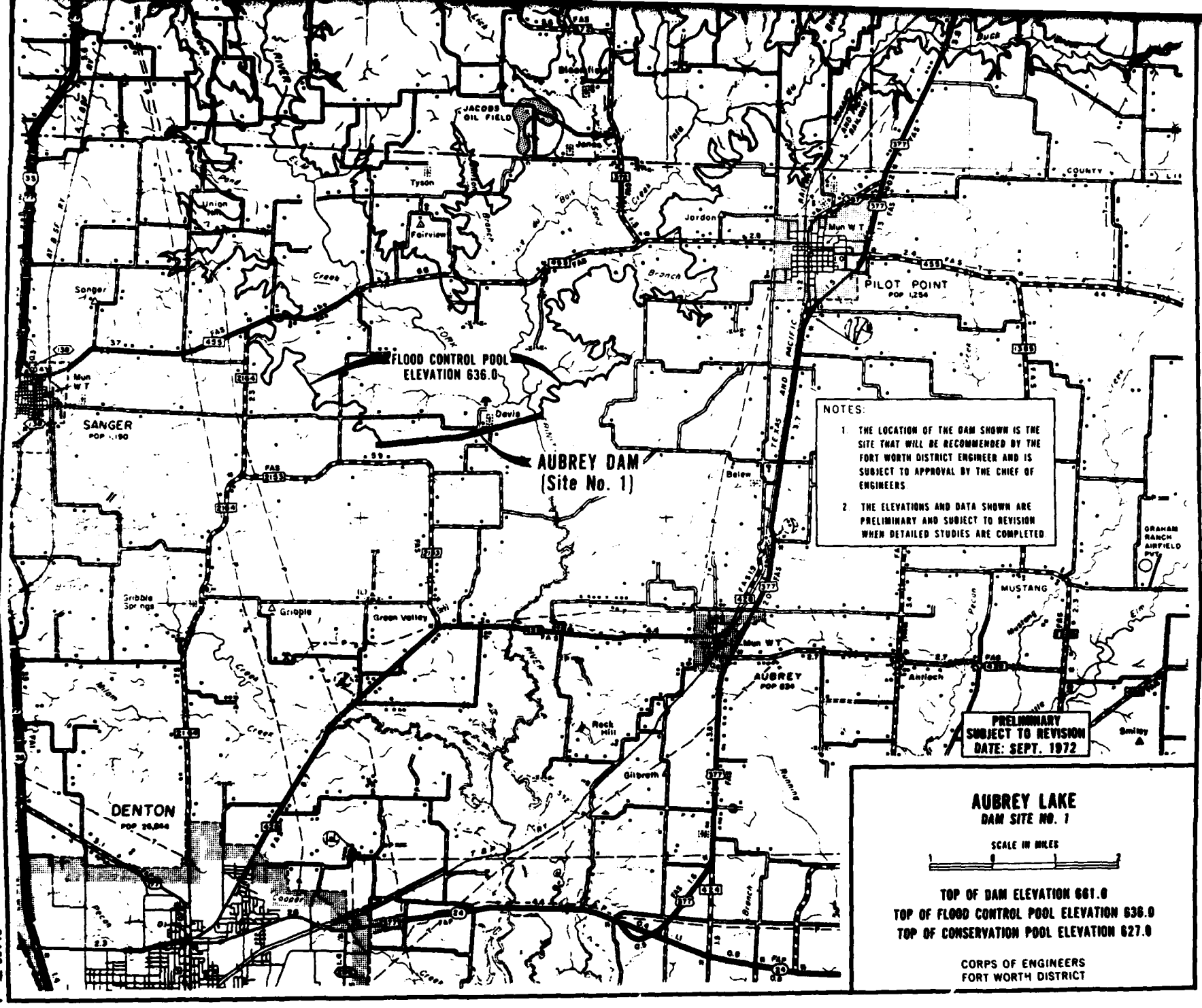


PLATE II-1

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Table II-1

Subdivisions of the Cretaceous System

Series	Groups	Formations
Gulf series		Eagle Ford shale
		Woodbine sand
Comanche series	Washita group	Grayson marl
		Main Street limestone
		Pawpaw sand
		Weno clay
		Denton clay
		Fort Worth limestone
		Duck Creek limestone
		Kiamichi clay
	Fredericksburg group	Goodland limestone
		Walnut clay
	Trinity group	Trinity sand

b. Lake Geology. Mappable groups of lithologically similar formations that crop out in the reservoir area are shown on plate II-2. They include, in descending stratigraphic sequence, Recent alluvium (Qal), Pleistocene terrace deposits (Qt), the Woodbine formation (Kwb), the Grayson marl and Main Street limestone (Kgy), the Pawpaw, Weno, and Denton formations (Kpwd), and the Fort Worth limestone (Kfw).

(1) Fort Worth Limestone. The Fort Worth limestone will come into contact with the Aubrey Lake project at only one location, and only when the lake is at maximum flood control pool. It crops out in the upper reaches of Pond Creek at the Cooke County-Denton County line (plate II-2). The formation typically consists of 6-inch to 1-foot thick limestone ledges alternating with marl beds of about the same thickness. The formation is abundant with echinoid and ammonite fossils. In Denton County the formation is only 25 to 35 feet thick, but it thickens to the north in Cooke County. No economic value has been realized for the Fort Worth limestone located in the project area. The soil cover is generally of poor quality and is suitable primarily for forage.

(2) Denton Clay. The Denton clay is included in a group of formations (Denton, Weno, and Pawpaw) that occurs between the Fort Worth limestone and the Main Street limestone. Except for certain well-marked fossil zones within the formations, they would be indistinguishable. The lowermost formation, the Denton clay, consists of from 45 to 60 feet of marly clay with numerous sandstone beds and lenses capped at the top with a plus or minus 1-foot thick bed of hard, fossiliferous limestone. Principal fossils in the Denton formation are pelecypods of the Gryphea and the Ostrea genera. The Denton formation, where not masked by alluvium and terrace deposits, will form a part of the confining reservoir rock on the west side of the Elm Fork in the middle and upper reaches of the lake. The rock has no known economic value.

(3) Weno Clay. The Weno clay is about 100 feet thick in the project area and consists of dark gray clayey shale with thin sandstone laminations and clay ironstone concretions. The formation is capped by a highly fossiliferous limestone ledge, varying in thickness from about 0.5 foot to 2.0 feet, that marks the boundary with the overlying Pawpaw formation. This bed has been called the "Quarry" limestone, probably in reference to its previous widespread use throughout the northern part of Texas as a building stone. The "Quarry" limestone is present everywhere in Cooke County, but has not been identified in southern Denton County. At the damsite, a 0.5-foot thick fossil bed occurs 50 feet below the top of the Pawpaw that has tentatively been labeled the "Quarry" limestone. Another hard, fossiliferous limestone bed, 4 feet thick, occurs 31 feet below the "Quarry" at the damsite. Both of these beds

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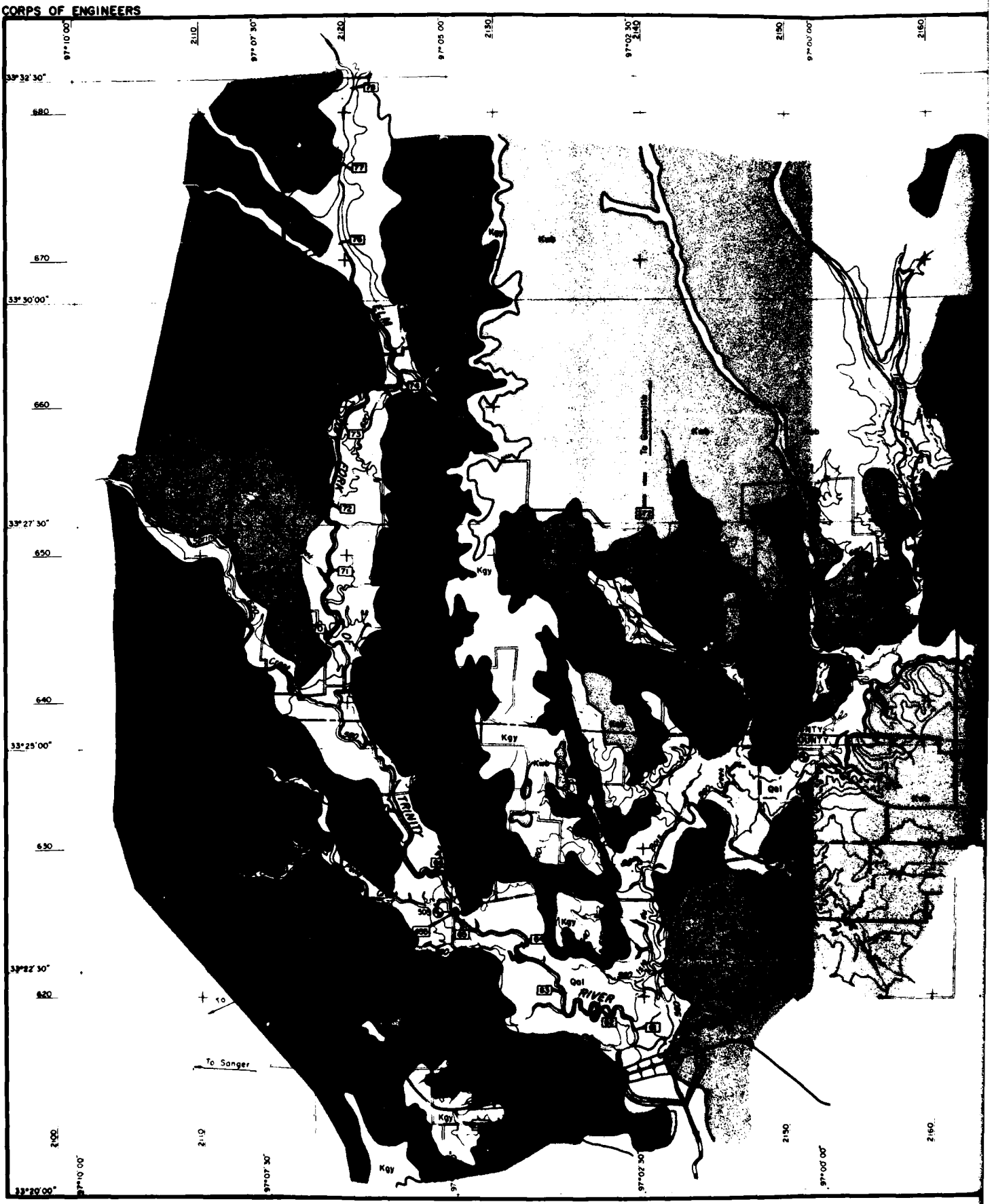

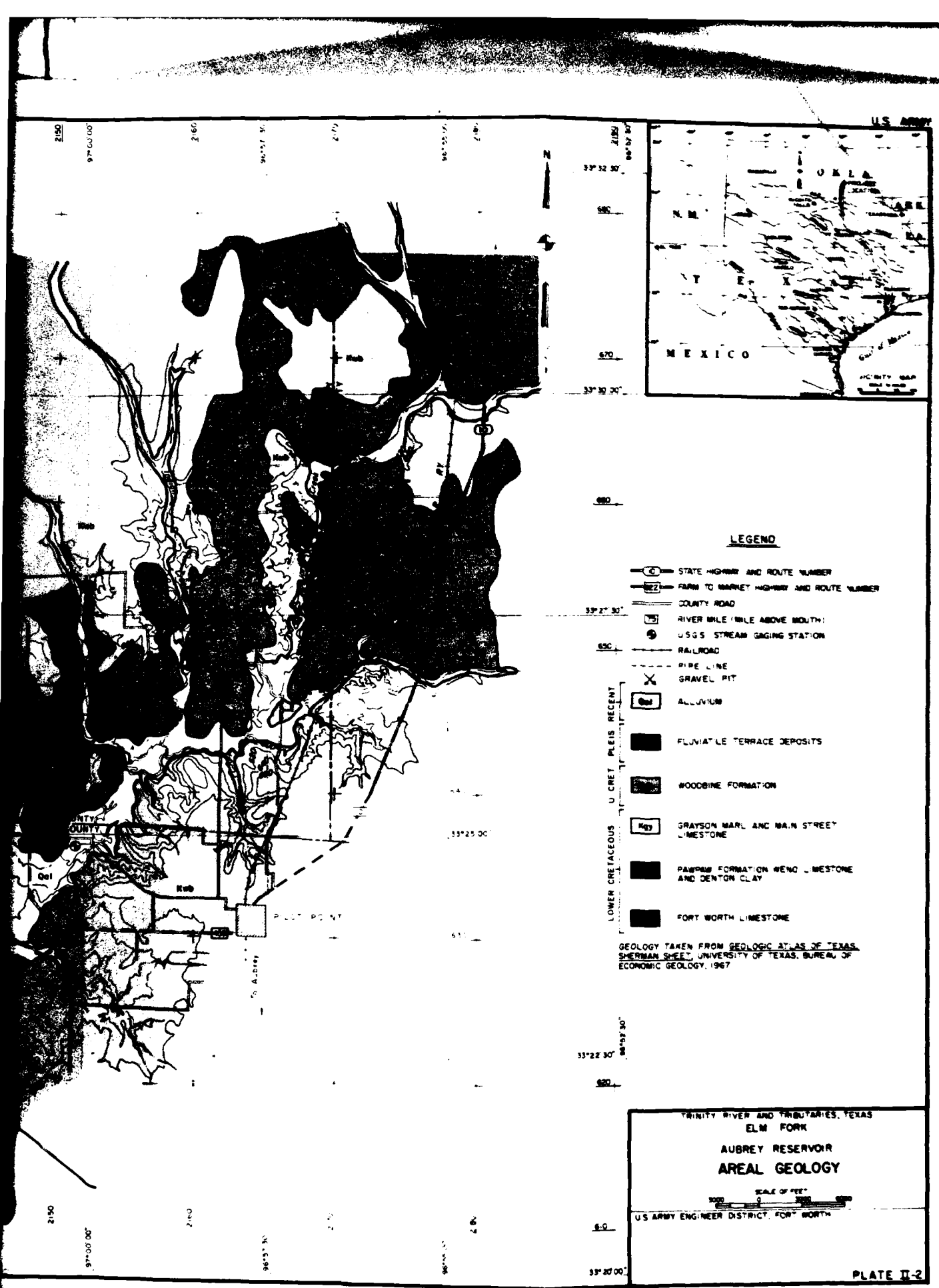
U.S. ARMY
OKLA.
N.M.
TEXAS
MEXICO
LEGEND
STATE HIGHWAY AND ROUTE NUMBER
FARM TO MARKET HIGHWAY AND ROUTE NUMBER
COUNTY ROAD
RIVER MILE (MILE ABOVE MOUTH)
USGS STREAM GAGING STATION
RAILROAD
PIPE LINE
GRAVEL PIT
ALLUVIUM
FLUVIATILE TERRACE DEPOSITS
WOODBINE FORMATION
GRAYSON MARL AND MAIN STREET LIMESTONE
PAWPAW FORMATION WENO LIMESTONE AND DENTON CLAY
FORT WORTH LIMESTONE
LOWER CRETACEOUS
U CRET
PLEIS
RECENT
GEOLOGY TAKEN FROM GEOLOGIC ATLAS OF TEXAS, SHERMAN SHEET, UNIVERSITY OF TEXAS, BUREAU OF ECONOMIC GEOLOGY, 1967
TRINITY RIVER AND TRIBUTARIES, TEXAS
ELM FORK
AUBREY RESERVOIR
AREAL GEOLOGY
SCALE OF FEET
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
PLATE II-2

serve as excellent stratigraphic markers. Because of the weathering characteristics of the Weno clay, well-exposed outcrops of the formation are rare. However, a few exposures occur in the north-south belt parallel to and just east of the Elm Fork. The formation will confine a large portion of the lake that will occupy the Elm Fork Valley. The formation has very little economic importance. The "Quarry" limestone has not been utilized from any location in the reservoir area, and its commercial exploitation in the future is considered unlikely. Clays from the Weno have, in the past, been used successfully for brickmaking. The industry is no longer active in the area.

(4) Pawpaw Sand. Situated between the "Quarry" limestone of the Weno clay and the Main Street limestone are approximately 50 feet of irregularly bedded clay shales and thin sandstone layers designated as the Pawpaw formation. The shales are gray to black, ranging from slight to noncalcareous. The sandstone layers have an average thickness of about 0.2 foot, and are soft, friable, and sometimes ferruginous. North of the damsite the Pawpaw becomes more sandy and can be easily mistaken for the Woodbine sand because of the similarity in their physical properties and the thick growth of blackjack and scrub oak that has developed. The formation contains an abundant fossil assemblage of ammonites, clams, and oysters similar to that in the underlying Weno. The Pawpaw forms the primary material underlying the flood-plain alluvium and terrace deposits at the damsite. It will confine a portion of the reservoir east of the Elm Fork immediately upstream from the dam. The rocks that comprise the formation have no known economic value in the reservoir area.

(5) Main Street Limestone. The Main Street limestone conformably overlies the Pawpaw formation. It consists of 10 to 15 feet of thick-bedded, gray, highly fossiliferous limestone with shaly or marly layers. The limestone is relatively pure and massive at the base, becoming more marly as it grades upward into the overlying Grayson. This gradational contact at the top makes it difficult to determine the formation's exact thickness. At the damsite, core borings show about 7 feet of massive limestone overlain by 2 to 4 feet of material that could be classified as either a highly calcareous shale or shaly limestone. Typical fossils found in the formation include brachiopods of the Exogyra genera and pelecypods of the Kingena genera. The Main Street crops out as a narrow band that strikes north-south across northern Denton County into and through Cooke County. It forms a portion of the right abutment at the damsite and will have only limited contact with the lake. This contact will occur near the Denton County-Cooke County line on the west side of Isle du Bois Creek. The limestone has not been commercially exploited although the lowermost part appears suitable for crushed aggregate or possibly riprap.

(6) Grayson Marl. The Grayson is the uppermost formation in the project area. It overlies the Main Street and underlies the Woodbine formation with both contacts very difficult to distinguish. The formation consists of a gray, fossiliferous, calcareous clay shale with scattered limestone nodules. The thickness has been reported to be 75 feet in Denton County and 25 feet in Cooke County. From an examination of the cores taken for foundation studies at the damsite, it would appear that the Grayson is about 25 feet thick. The cores show a sandy, often carbonaceous shale changing to a calcareous, massive-bedded shale with a 2-foot thick shaly limestone at the top. This shaly limestone is believed to be the top of the Grayson formation. The Grayson and Main Street formations have been mapped as one unit and will, for all practical purposes, play no part in confining Aubrey Lake.

(7) Woodbine Sand. The Woodbine sand formation is the basal member of the Gulf series in this area. It nonconformably overlies the Grayson marl and underlies the Eagle Ford shale. The formation is composed chiefly of ferruginous, clayey sands and weakly cemented sandstones and lignitic sandy shales that have an estimated thickness of 300 to 400 feet. At the damsite, the lowermost 75 feet of Woodbine was penetrated with core borings. These cores show 51 feet of gray to black, noncalcareous sandy shale with lignitic zones, overlain by thin-bedded sand and soft sandstones with numerous iron oxide laminae. The Woodbine crops out as outliers between the Elm Fork and Isle du Bois Creek in northern Denton County and southern Cooke County and as a wide belt extending north-south through Cooke County. It will confine the arm of the reservoir that extends northeasterly up Isle du Bois Creek. A loose, sandy soil, typically covered with a dense growth of post oak and blackjack oak, mantles the Woodbine formation at most locations. Generally, the rocks of the Woodbine have no economic value; however, locally the clays may be sufficiently pure for making stoneware.

(8) Fluviatile Terrace Deposits. Pleistocene terrace deposits consisting of sandy clays, sands, and gravels occur along both the Elm Fork and Isle du Bois Creek. Along the Elm Fork the deposits cover the right flood-plain area in an almost continuous belt that averages 1 mile in width and extends approximately 10 miles above the damsite. The deposits cover an even greater area along Isle du Bois Creek, masking the primary strata in a 1- to 2-mile wide belt that extends northeasterly across Cooke County into western Grayson County. The terrace deposits probably reach a thickness of 35 feet, as evidenced from core borings on the right abutment at the damsite. The extent of the deposits, along with the wide stream valley, would indicate that in late Pleistocene time the Elm Fork was much larger than at present. The terrace deposits are a source of sand and gravel in the area. The fact that they have been excavated

and processed from several locations is apparent from the piles and rows of waste material left by the operations. The industry continues to be active today in much the same manner, leaving unproductive, unsightly land in its wake.

(9) Flood-Plain Alluvium. Recent alluvium fills the valleys of the Elm Fork and its tributaries. At the damsite the alluvium consists of clay and sandy clays overlying about 3 to 6 feet of sand and gravel that rest directly on primary strata. The valley fill reaches a depth of about 45 feet. The flood plain is a highly productive area for agricultural activity but is subject to frequent flooding. Generally, the alluvium is not worked for the small quantity of sand and gravel it contains.

c. Geologic Structural Features. Cretaceous sedimentary rocks in the watershed area form a gently dipping monocline with a slope to the south and east varying from 30 to 50 feet per mile. The strike of the strata varies from north-south to about N35°E. At the damsite, using the contact between the Main Street limestone and Pawpaw formation as the reference datum, the strata strike N25°E and dip 43 feet per mile to the southeast. Only minor, almost imperceptible undulations occur in the Cretaceous sediments of north central Texas. These minor folds are a reflection of the folded, eroded, and peneplained surface of the Palezoic rocks that the Cretaceous sediments were deposited upon. No faulting or significant folding has been observed in the proposed site.

d. Soils.

(1) Soil associations, or landscapes that have a distinctive proportional pattern of soils, have been mapped in Denton, Cooke, and Grayson Counties by the U.S. Soil Conservation Service. The major soils associations that occur within the Aubrey Lake area include, from west to east, the Crockett-Wilson and Heiden-Purves, the Trinity, and the Galey-Crockett and Galey-Freestone-Truce. These soils associations define areas that are suitable for a certain kind of farming or other land use. They do not provide the necessary data for planning the management of a farm or field, or for choosing the site for manmade structures. The soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other physical characteristics.

(2) The Crockett-Wilson soils will be partially flooded by the western arm of the proposed Aubrey Lake at two locations - upstream from the right abutment of the dam and in southern Cooke County. The level to gently sloping areas are dominated by deep, loamy soils with tight clayey subsoils that are well drained to somewhat poorly drained, medium acid to neutral, and have high shrink-swell properties. The soils of the association are used mainly for pastureland and cropland. The Heiden-Purves soils will border the

western portion of the reservoir in northern Denton County. The area is characterized by gently sloping, well-drained, calcareous clayey soils used mainly for rangeland and cropland. They do not have the high shrink-swell characteristics of the Crockett-Wilson soils.

(3) The Trinity soils are the nearly level bottomland soils that occupy the flood plains of the Elm Fork and Isle du Bois Creek. The calcareous, clayey, somewhat poorly to moderately drained soils were formed in deep-textured alluvium washed from the higher-lying uplands. Flooding occurs one or more times each year unless the area is protected. The soils are used primarily for pastureland and wildlife.

(4) The areas between the Elm Fork and the Isle du Bois Creek and east of Isle du Bois Creek are characterized by soils of the Galey-Crockett and Galey-Freestone-Truce Associations. These are areas of gently sloping, well to moderately well-drained, slightly acid, sandy loam soils that occupy rolling hills on outcrops of sandy numbers of the Upper Cretaceous formations - primarily the Woodbine formation. These soils are used mainly for pasture and urban land. They generally support a heavy growth of oak timber and brush.

e. Economic Geology. Mineral resources currently being worked in the proposed Aubrey Lake area are limited to sand, gravel, and petroleum. Available data have revealed that during 1970 mineral deposits in Denton County yielded sand and gravel, clay, petroleum, and natural gas valued at about $1.7 million; deposits in Cooke County yielded petroleum, natural gas liquids, and natural gas valued at $30 million; and deposits in Grayson County yielded natural gas, petroleum, natural gas liquids, stone, and sand and gravel valued at about $34.8 million. Clays and shales from the Woodbine and Weno formations have been used in the past to manufacture bricks and pottery, but these industries have not been active for many years. Locally, the top of the Weno formation, which is comprised of the "Quarry" limestone, has been used as a building stone. The courthouse at Denton is built of "Quarry" limestone. The constituents for the manufacturing of cement, clay or shale, and limestone are present at several places within the project area, especially in areas that include the Main Street limestone-Pawpaw shale contact. The lower part of the Main Street appears to be suitable for crushed aggregate and/or riprap.

(1) Sand and Gravel Developments.

(a) Sand and gravel deposits, in sufficient quantity to be of commercial value, are found at selected locations in the valleys of

the Elm Fork and Isle du Bois Creek above the Aubrey Lake damsite. The material occurs almost exclusively in the fluviatile terrace deposits that border the alluvial flood plain. As these deposits contain predominantly sand-size particles, a very large amount of material must be processed to extract gravel-size material suitable for use as concrete aggregate. Ordinarily, commercial operators make extensive subsurface investigations to determine if a sufficient number of gravel-size particles exists to make the mining and processing profitable. A study of aerial photos and U.S. Geological Survey topographic maps that cover the Aubrey Lake site shows that during the past, small operators have mined gravel from as many as 14 locations in the reservoir - 12 of which were along the Elm Fork. Probably more locations exist from which the commodity has been recovered. No estimate is available on the quantity of material removed and processed.

(b) Presently, only one mining operation is in progress in the project area. This operation is located approximately 2,000 feet south of the dam axis and 5,000 feet west of the Elm Fork. Information obtained from Mr. Dale Schleinat, owner and operator, revealed that the area typically has 6 to 17 feet of clayey overburden overlying 7 to 12 feet of sand and gravel. Draglines are used to extract the materials from below the water table. Mr. Schleinat states that only about 4 percent of the processed sand and gravel is wasted from this particular pit.

(c) Another pit, not active at this time, is located about 500 feet north of the dam axis on an approximate north-south line with the active pit described above. There are no other recent mining operations in the Aubrey Lake area. Photos of the open-pit mining operation in the Aubrey Lake damsite area are shown in figures II-1 and II-2.

(2) Petroleum Developments.

(a) The search for oil and gas in north central Texas began in the early 1920's and continues today on a very small scale. Several minor oil fields were discovered in Cooke and Grayson Counties during the early years of exploration.

(b) A review was made of the Texas Railroad Commission maps and records in Austin to determine the locations of dry holes, abandoned wells, and producing wells that occur within, or very near, the proposed Aubrey Lake. General well construction details were obtained, and plugging procedures were discussed with both the local operators and Texas Railroad Commission officials. These data were obtained to examine the danger of polluting freshwater aquifers, and the lake waters and its shoreline.

Figure II-1

View of scarred land left after alluvium has been worked for sand and gravel.

Figure II-2

Waste land created by dredging and processing of sand and gravel. Note mounds of waste material.

(c) Texas Railroad Commission records show that a total of 114 oil test holes have been drilled in or very near the area to be inundated by Aubrey Lake. Forty-one of these holes are concentrated in a 2 square mile area near the Cooke County-Denton County line (Jacobs Oil Field). The remainder are scattered throughout the reservoir area. The holes, varying in depth from 1,000 to 4,000 feet, were drilled to test the oil possibilities in the sands, shales, and sandy shales within the Pennsylvanian system. Typically, a producing well is constructed with 4-inch to 7-inch diameter casing cemented through the Trinity group to the top of the producing horizon. The producing zone may be either open or cased with perforated casing. Prior to 1963, when the Railroad Commission revised its plugging procedures and started strict enforcement, dry holes and abandoned wells were filled with heavy drilling mud and capped with a cement plug at the ground surface. At present, an abandoned hole is pressure cemented within and for 100 feet above the producing zone. All freshwater aquifers are protected by a 50-foot cement plug placed above and below the water-yielding zone. The top is plugged and capped with cement.

(d) The only known producing oil wells that will be inundated are located in the Jacobs Oil Field. A total of 12 wells are pumped at present, but the yields are very low. Ten of the wells are pumped two days per week, producing only 2 to 3 barrels per day. The remaining two wells are pumped continuously, but large quantities of salt water are extracted with the oil. The salt water is pumped back into the producing zone through two disposal wells under pressure of approximately 300 pounds per square inch. Four other producing oil wells are located 2¼ miles west of the town of Tioga, but are believed to be above the proposed flood control pool elevation of 636.0 feet msl. Surveys will be made to determine the exact location of the wells in relation to the maximum lake level. All of the wells that will be covered with water will be capped and plugged in accordance with the regulations of the Texas Railroad Commission.

(e) Locating dry and abandoned holes drilled prior to 1963 would be impractical and probably impossible. In most instances the casing was removed, leaving no trace of the hole. The chances of any of the holes ever becoming instruments of pollution to the lake water or contributing to the pollution of freshwater aquifers are very remote. No wells in the area ever exhibited any high pressure that could cause eventual surface rupture. Sometimes secondary recovery methods, i.e., pressure flooding, can cause old wells to start flowing, but this apparently has not occurred in the one active field in the Aubrey Lake area. It is highly unlikely that any oil seepage will occur, but in the event it does, the wells can be located by divers and the holes plugged. This control method has been practiced with success in the large Toledo Bend Reservoir located on the Sabine River in East Texas.

f. Ground-Water Geology. Ground-water supplies in the area are obtained from the sands of the Trinity group, the Woodbine formation, and from the alluvial flood-plain and terrace deposits that border the Elm Fork and its tributaries.

(1) Trinity Group. The Trinity sands in Cooke County are typically composed of massive beds of fine sand, 40 to 50 feet thick, separated by clay seams and beds that vary in thickness from a few inches to 20 to 30 feet. The total thickness is estimated to be between 800 and 900 feet. Farther to the south, the middle portion of the Trinity group becomes limy and has been separated, in ascending order, into the Basal Trinity sands, the Lower and Upper Glen Rose limestone, and the Paluxy sands. This division has not been recognized in the project area. There is, however, evidence that two separate water-bearing zones occur. In this discussion these separate zones will be referred to as the Upper Trinity and Lower Trinity.

(a) Upper Trinity. Wells in the Upper Trinity sands vary in depth from approximately 500 to 600 feet in the western portion of the reservoir area to 800 to 900 feet in the eastern sector. They are generally drilled for individual domestic use, although a few small villages may use the Upper Trinity for a community supply. The wells are cased and cemented to the top of the producing formation. Promising sand beds are screened and gravel packed. The water in the formation is under artesian pressure, presently rising approximately to elevation 470.0 feet msl datum, in the area. In the early 1900's, wells drilled into the Upper Trinity reportedly flowed from as high as elevation 600.0 feet msl. This piezometric water level continues to drop as more wells are completed in the producing interval.

(b) Lower Trinity. Wells requiring high yield and good quality water are completed in the Lower Trinity beds some 600 feet below the first Trinity sands. Most cities and towns are supplied from this source. Properly constructed wells, cased, cemented, and screened to modern standards, will yield 250 to 350 gpm. The water is under artesian pressure, with piezometric surface occurring a few feet higher than that from the Upper Trinity sands. Flowing wells no longer exist in the area although there were many when the aquifer was first developed 30 or more years ago. Many small farms that once had their own individual water supply wells are now supplied from rural water corporations such as the Green Springs Water Supply Corporation near Sanger and the Black Rock Water Supply Corporation near Aubrey. This practice will ultimately put higher demands on the Lower Trinity, causing a further lowering of the water table.

(2) Woodbine Formation. The sands of the Woodbine formation that crop out in the eastern portion of the reservoir area yield variable quantities of poor quality water for irrigation and to a

lesser degree for domestic purposes. These wells vary from 100 to 300 feet in depth, depending on the water quantities desired. The water occurs under water table conditions, although locally the water may be slightly artesian. The depth to the water table is dependent on geologic and hydrologic conditions in the immediate area. It is generally encountered within 100 feet of the ground surface. Those wells in the Woodbine drilled and constructed for domestic supplies have sanitary surface seals that extend from the ground surface to a minimum depth of about 10 feet. Those drilled solely for irrigation probably do not have cement surface seals because contamination is not of prime importance.

(3) Flood-Plain and Terrace Deposit Alluvium. A very few wells are located in the valleys of the Elm Fork and Isle du Bois Creek. They produce from the alluvium that overlies the bedrock. These wells are typically hand dug to depths of 40 feet or less and are presently used only for stock watering, if they are used at all. It is probable that these old structures once supplied the needs of local farmers before modern drilling techniques became available. As would be expected, the water level fluctuates considerably from season to season depending on the rainfall and the level of the stream.

g. Ground-Water Recharge.

(1) Recharge to the water-bearing formations in the area is derived from three principal sources: (a) Precipitation that falls on the outcrop area of the aquifer and permeates into the formation before being lost to runoff, evaporation, or transpiration; (b) seepage from lakes that are contained wholly or in part by permeable, water-yielding beds; and (c) seepage from those streams that flow across the aquifer outcrop area that are not receiving base flow from the aquifer. Recharge figures are unavailable for Denton and Cooke Counties.

(2) The creation of the Aubrey Lake will in no way affect the water table in the Upper and Lower Trinity aquifers. The recharge area for these aquifers will not be in contact with the lake, and impermeable beds that mask the Trinity group will prevent downward seepage to these deep water-bearing sands. The water levels in the Woodbine formation east of Aubrey Lake will be affected to some degree. Preliminary investigations indicate that the Woodbine formation is a contributing aquifer, i.e., the water table is higher than the base flow of the Elm Fork. The Woodbine will receive some recharge from the Aubrey Lake, causing the water table to rise slightly. However, aquifer characteristics have not been defined sufficiently to permit a calculation as to the amount the water table will rise. Based on experience gained from the operation of Grapevine Lake, which has similar geologic and hydrologic conditions, the effects will probably be minimal.

(3) Obviously, the terrace alluvials in contact with the lake will accept recharge, causing at least temporary bank storage. Water levels in these deposits will fluctuate with the lake level.

h. Ground-Water Quality. Water from the Trinity sands has been sampled and analyzed from several locations in the area because of its extensive use by cities and industries. The water from the Woodbine sands, used primarily for irrigation, has not been tested in the immediate vicinity, but analyses are available from wells in neighboring Collin County. No analysis has been made on water from the alluvium because of its limited use. A general comparison of the water chemistry is shown in table II-2. As noted in table II-2, water from the Trinity sands taken at different elevations shows similar chemical composition. Both water samples are very soft and meet the Federal drinking water standards set by the Environmental Protection Agency. Water from the Woodbine sands shows considerable variation from location to location. Generally, however, the water from the Woodbine sands is of poor quality, exceeding Federal drinking water standards in total solids, sodium chlorides, sulfates, and iron. It should be noted that any recharge to the Woodbine formation from the Aubrey Lake will obviously improve the quality of the water locally.

3. Hydrological Elements.

a. General. The purposes of the Aubrey Lake project are to provide water supply, recreation, fish and wildlife habitat, water quality, and sedimentation control. The flood control aspects of Aubrey Lake result from the transfer of a portion of the allocated flood control space in Lewisville Lake located immediately downstream.

(1) Aubrey Lake will have an initial design net capacity of 252,800 acre-feet for flood control, 600,700 acre-feet for conservation, and 54,600 acre-feet for 100-year sediment deposition. Of the 54,600 acre-feet reserved for sedimentation, 49,600 acre-feet will be below elevation 627.0 feet msl, and 5,000 acre-feet will be between elevations 627.0 and 636.0 feet msl.

(2) At full flood control pool elevation (636.0 feet msl), approximately 32,600 acres will be inundated, an average of about once every 46 years. Also, a full flood control pool would inundate about 23 miles of the Elm Fork channel and about 25 miles of the Isle du Bois Creek channel. The total amount of land which will be required will be approximately 44,000 acres, of which 39,089 acres will be aquired in fee.

(3) At the top of the conservation storage pool, elevation 627.0 feet msl, approximately 25,200 acres of land will be

Table II-2

Chemical Analyses of Ground Water

	City of Aubrey Upper Trinity	City of Aubrey Lower Trinity	Lakeland Resort-Collin County Woodbine Formation
pH	-	9.2	8.3
Total Dissolved Solids (ppm)	920	710	1,756
Calcium (ppm)	1	2	9.5
Magnesium (ppm)	1	1	0.25
Sodium (ppm)	266	211	785
Potassium (ppm)	-	-	3.4
Total Iron (ppm)	<0.02	<0.02	0.5
Chlorides (ppm)	20	17	420
Sulfates (ppm)	108	124	444
Nitrates (ppm)	<0.4	<0.4	0.4
Fluorides (ppm)	0.9	0.4	2.6
Carbonates (ppm)	30	28	60
Total Alkalinity (ppm)	458	319	-
Total Hardness (ppm)	4	9	24

covered by water an average of about once every 3 years. A full conservation pool will inundate about 20 miles of the Elm Fork channel and about 23 miles of Isle du Bois Creek channel, and will create a total shoreline of approximately 162 miles. Under initial conditions, the planned conservation storage will provide 84.0 million gallons daily for municipal and industrial uses.

(4) The existing Lewisville Lake, located downstream from the Aubrey Lake site, is under the jurisdiction of the Corps of Engineers and is one of six multiple-purpose projects now in operation in the Trinity River Basin. A portion of the flood control storage in Lewisville Lake will be reallocated to conservation storage upon completion of the Aubrey project. The combined system, operated for flood control, will include the Benbrook, Grapevine, Lewisville, modified Lavon, Navarro Mills, and Bardwell Lakes.

(5) Table II-3 presents a summary of pertinent data regarding Aubrey Lake.

b. Trinity River Basin. The Trinity River watershed, of which the Elm Fork is a major tributary stream, lies in the eastern half of the State of Texas, approximately between latitude 29°46'N. and latitude 33°44'N., and longitude 94°40'W. and longitude 98°43'W. It is bounded on the north by the Red River Basin; on the east by the Sabine and Neches River Basins; and on the west and south by the Brazos and San Jacinto River Basins. The Trinity River Basin is relatively long and narrow, with a maximum length of about 360 miles and a maximum width of about 100 miles. The Trinity River Basin has a combined total drainage area of 17,969 square miles and embraces all or portions of 38 counties. It lies within two physiographic provinces of the United States - the northwestern portion of the basin is situated in the central lowland province of the Interior Plains, and the remainder of the basin is in the Western Gulf Coastal Plain. The Coastal Plain section, which extends nearly to Fort Worth on the main stem of the Trinity River and includes all of the East Fork watershed, has a generally flat or undulating to gently rolling topography on the interstream divides. In the vicinity of the large streams the topography is more rolling and broken, but nowhere does it present a rugged appearance. The central lowland province, which includes the watersheds of the West Fork and the Elm Fork, has considerable areas of flat to undulating land on the interstream divides, but the topography is generally more rolling and broken. Approaching the headwaters of the West Fork, the topography becomes quite rugged, especially near the stream. The general land elevation of the Trinity River Basin rises gradually from 1 to 2 feet above sea level at Galveston Bay to about 550 feet msl on the interstream divides in the vicinity of Dallas, then to 800 to 950 feet msl on the divides at the headwaters of

Table II-3

Aubrey Lake: Pertinent Data

Feature	Elevation (ft. msl)	Area (acres)	Capacity * Acre-Feet	Capacity * Equivalent Runoff (inches)
Top of dam	661.0	-	-	-
Maximum design water surface	655.8	55,300	1,759,800	47.68
Spillway crest (top of flood-control pool)	636.0	32,600	908,100	24.61
Top of conservation pool	627.0	25,200	650,300	17.62
Maximum tailwater	560.2	-	-	-
Streambed	524.0	-	-	-

*Includes 54,600 acre-feet of storage for estimated 100-year sediment deposition, with 49,600 acre-feet below elevation 627.0 and 5,000 acre-feet between elevation 627.0 and 636.0.

Richland Creek and the East Fork. To the west and north of Dallas, the slope of the terrain increases, rising to about 1,250 feet msl on the stream divides in the northwest corner of the basin. Table II-4 summarily presents recorded annual flows into Trinity and Galveston Bays and water resource development projects initial impoundment data in the Trinity River Basin.

c. Elm Fork Watershed. The hydrological and climatological characteristics of the Elm Fork watershed (plate II-3) are described as follows.

(1) Stream Characteristics. The Elm Fork of the Trinity River rises in eastern Montague County in north central Texas and flows in a generally southeasterly to southerly direction to its confluence with the West Fork at Dallas, Texas, at river mile 505.5 to form the Trinity River. The Elm Fork drains a total area of 2,577 square miles and its basin is relatively wide in proportion to its length. The maximum width is about 60 miles, and the length along the general axis of drainage is about 80 miles. The watershed lies within parts of Montague, Wise, Cooke, Denton, Grayson, Collin, Tarrant, and Dallas Counties. The total thalweg is about 110 miles in length, with a total fall of about 715 feet vertically, giving an average slope of 6.5 feet per mile. The principal tributaries of the Elm Fork are Clear Creek with a drainage area of 372 square miles, Isle du Bois Creek with a drainage area of 266 square miles, Little Elm Creek with a drainage area of 256 square miles, Denton Creek with a drainage area of 712 square miles, and Hickory Creek with a drainage area of 163 square miles. Clear Creek rises in eastern Montague County and flows in a generally southeasterly direction. The average slope of Clear Creek is about 11.5 feet per mile. Isle du Bois Creek rises in western Grayson County and flows southwesterly. The average stream slope is about 2.5 feet per mile. Little Elm Creek rises in southwestern Grayson County and flows generally in a southerly direction. It has an average stream slope of about 8.5 feet per mile. Denton Creek rises in central Montague County and flows generally in a southeasterly direction with an average stream slope of 6.9 feet per mile. Hickory Creek rises in northeastern Wise County and flows in a southeasterly direction with an average stream slope of about 6.0 feet per mile. The topography throughout the basin is predominantly gently rolling, varying from broken prairie in the northern and northwestern portions to level, to rolling with some rough land along the lower reaches. Four major physiographic subdivisions lie within the Elm Fork watershed. Almost all of that portion of Montague County lying within the watershed is covered by West Cross Timbers soils, a highly erodible reddish-brown and yellow sandy soil with thin vegetal cover and with post and blackjack oaks as the predominant timber growth. The Grand Prairie physiographic subdivision traverses the central one-third of the basin in a roughly north-south direction. The soil group of the Grand Prairie is characterized by a black to brown friable soil with native grass cover. A north-south belt of the East Cross Timbers extends from the eastern portion of Cooke County through the central areas of Denton County. The soil group of the East Cross Timbers

TABLE II-4

SUMMARY OF AVERAGE ANNUAL FLOWS, TRINITY RIVER BASIN

Water Year	Lake Constructed	Impoundment Date	Average Flow (cfs) 1/
1925			913
1926			9,790
1927			8,130
1928	Lake Dallas	February 16	4,540
1929			9,570
1930			6,780
1931			5,480
1932	Bridgeport Lake	April 1	11,780
1933			5,300
1934	Eagle Mountain Lake	February 28	4,730
1935			11,060
1936			4,174
1937	Mountain Creek Lake	January 1	5,388
1938			9,328
1939			2,991
1940			4,553
1941			16,930
1942			13,680
1943			5,937
1944			10,450
1945			16,860
1946			11,590
1947			9,681
1948			6,167
1949			5,566
1950			11,070
1951			2,387
1952	Benbrook and Grapevine Lakes	September 29	2,779
1953	Lavon Lake	September 14	5,511
1954	Lake Houston (San Jacinto)	April 9	1,694
1955	Garza-Little Elm (Lewisville)	November 1	2,935
1956	Lake Amon G. Carter	May 1	1,211
1957	Weatherford Lake	March 1	12,690
1958	Lake Arlington	March 31	11,690
1959			4,909
1960			6,621
1961			10,440
1962			4,469
1963	Navarro Mills Lake	March 15	3,495
1964			1,612
1965	Bardwell Lake	November 20	7,333
1966			8,946
1967	Ray Hubbard Lake	August 15	1,771
1968			11,520
1969	Joe B. Hogsett Lake	December 23	10,390
1970			4,657
1971			730
1972			5,377

1/ Total at Romayor of 17,192 square miles - Trinity River

is composed of reddish, light brown, and gray moderately pervious materials that are covered with a fairly heavy growth of native timber composed principally of cottonwood, elm, ash, pecan, and various species of oak. The eastern edge of the watershed is covered by the Blackland Prairie soils that are dark gray to black in color, friable to hard in texture, and generally very productive. The northwestern section of the basin is mostly rangeland, while the remaining areas are devoted mainly to the cultivation of cotton, corn, peanuts, feed crops, truck produce, and fruit. The steep slopes in the upper portion of the basin, the relative width of the basin compared to its length, the fan-like arrangement of the tributary streams, and the generally thin soils and lack of vegetal cover on most of the watershed all result in the rapid concentration of flood runoff in the lower reaches. The runoff from Elm Fork is affected by two existing Corps of Engineers lakes, Lewisville Lake and Grapevine Lake.

(2) Climatic Conditions. The Elm Fork watershed is located in a region where seasons of moderate to mild winters and comparatively long, hot summers prevail.

(a) Rainfall. The mean annual precipitation over the Elm Fork watershed for the period from 1891 to 1969 was about 34.4 inches. There are several U. S. Weather Bureau precipitation stations in the Elm Fork watershed with long-term records. Three of these stations with data relative to annual precipitation are listed in table II-5.

(b) Winds. Winds in the Elm Fork watershed are generally from a southerly or southeasterly direction. The average wind velocity at Dallas is 11 miles per hour, and the maximum ever recorded there is 77 miles per hour. These data can be considered applicable to the Elm Fork watershed.

(c) Droughts. Droughts in the watershed occur frequently and range from moderate to severe. The most severe drought of recent times occurred during the period from 1950 through 1956.

(d) Storms. The storms that cause precipitation on the Trinity River Basin, of which the Elm Fork watershed is a part, are of three general types: cyclonic or tropical storms originating in the Gulf of Mexico; thunderstorms, culminating in devastating cloudbursts; and frontal storms. A major part of the time precipitation in the watershed results from disturbances of the last two types, although tropical storms do occur rather frequently, primarily during the period from June through September. A few of the major flood-producing storms that have occurred over the Trinity River Basin were from 5 April to 30 April 1942, from 28 March to 2 April 1945, and from April to June 1957.

Table II-5

Annual Precipitation Data

Station	Years of Complete Record*	Annual Precipitation (inches) Minimum	Maximum	U.S.W.S.O. Normal**
Dallas	89	18.81	59.53	34.55
Gainesville	79	16.19	52.79	34.54
Denton 2SE	55	17.48	56.42	31.56

* Through December 1969.

** Weather Service Office normals based on period 1931-1960.

(e) Evaporation.

1 The evaporation loss at the Aubrey project site for the period from January 1924 through December 1969 was determined using evaporation records at the Texas Agricultural Experiment Station at Denton, located about 11 miles southwest of the damsite, and at Grapevine Dam, located about 25 miles south of the damsite. The observed monthly pan evaporation at Denton for the period from 1924 to 1953 and at Grapevine Dam for the period from 1953 through 1970 were first converted to gross evaporation from a reservoir surface by the application of the applicable pan coefficients of 0.94 and 0.69, respectively, (Young pan at Denton; U.S. Weather Bureau pan at Grapevine Dam). The observed monthly rainfall at Denton and at Grapevine Dam during the same periods was then adjusted for natural runoff from the land area occupied by the reservoir and subtracted from the gross reservoir evaporation previously determined. This difference, the net reservoir evaporation loss (in feet) for a given month, when multiplied by the average reservoir area (in acres) for that month will give the net change in storage (acre-feet) attributable to rainfall on and evaporation from the reservoir area during the month. Table II-6 shows the average monthly pan evaporation, the estimated average monthly evaporation from the reservoir surface, and the average monthly observed precipitation for the evaporation stations at Denton and at Grapevine Dam.

2 The estimated average net annual evaporation loss from the proposed Aubrey Lake would have amounted to 28.68 inches for the period from 1924 to 1969. During the critical period of storage (October 1950 through February 1957), the net annual evaporation would have been 38.26 inches. The maximum net annual evaporation loss was 58.56 inches in 1956.

(3) Flow Data. Stages and runoff observations have been made and recorded by the U.S. Geological Survey on the Elm Fork of the Trinity River near Carrollton from November 1923 to the present. Records of the reservoir levels at Lewisville Lake (formerly Garza-Little Elm Lake or Lake Dallas) on the Elm Fork of the Trinity River are available from 1 January 1929 to 28 October 1957 when Garza Dam was breached. Records of the reservoir levels at the existing Lewisville Dam are available from June 1957 to the present. Stages and runoff observations have been made by the U.S. Geological Survey on the Elm Fork at a gage near Sanger, Texas, and on Isle du Bois Creek at a gage near Pilot Point, Texas, since April 1949.

(4) Flood Data. The topography of the upper Elm Fork watershed, the character of the soils, and the nature of the rainfall in the area are all conducive to rapid runoff and to sharp-crested flood hydrographs. Such floods can and do occur frequently and at

Table II-6

Average Monthly Evaporation Data
Denton, Texas and Grapevine Dam, Texas

Month	Denton, Texas - 1917-1969 Pan Coefficient = 0.94			Grapevine Dam, Texas - 1953-1970 Pan coefficient = 0.69		
	Observed pan evaporation (inches)	Evaporation from reservoir surface (inches)	Observed precipitation (inches)	Observed pan evaporation (inches)	Evaporation from reservoir surface (inches)	Observed precipitation (inches)
January	1.95	1.83	1.85	2.88	1.99	1.78
February	2.40	2.26	2.07	3.74	2.58	1.96
March	3.97	3.73	2.39	6.25	4.31	2.26
April	4.69	4.41	3.87	7.52	5.19	4.90
May	5.47	5.14	4.67	8.88	6.13	4.32
June	6.63	6.28	3.17	10.06	6.94	2.71
July	7.56	7.11	2.05	12.47	8.60	2.45
August	7.70	7.24	2.09	11.95	8.25	1.95
September	5.72	5.38	2.78	8.64	5.96	4.36
October	4.35	4.09	2.88	6.49	4.48	2.88
November	3.04	2.86	2.17	4.25	2.93	2.10
December	2.17	2.04	2.23	2.99	2.06	1.73
Annual	55.65	52.37	32.22	86.12	59.42	33.40

almost any time of the year. The maximum observed discharge on the Elm Fork at the Sanger gage occurred in May 1958 with a peak discharge of 27,500 cubic feet per second. Based on historical flood marks, a maximum stage of 30.7 feet was reached at this same gage location in 1908. Peak stages and discharges for the major floods that have occurred during the period of gage records on the Elm Fork watershed are given in table II-7.

(a) Channel Capacity. The channel capacities of the Elm Fork of the Trinity River are as follows: Lewisville Dam to Carrollton gage - 8,000 cubic feet per second; Carollton gage to the mouth of the Elm Fork - 8,000 cubic feet per second; and Grapevine Dam to the mouth of Denton Creek - 6,000 cubic feet per second. A complete survey to obtain cross sections of the reach above Lewisville Lake has not been made. Therefore, a detailed analysis of the channel capacity between the Aubrey damsite and the head of Lewisville Lake cannot be made at the present time. The channel capacities of the main stem of the Trinity River and its major tributaries vary from a low of 500 to 1,200 cubic feet per second on the East Fork below Forney Dam, to 24,000 cubic feet per second at the Oakwood gage.

(b) Flood Frequency. As stated previously, floods occur frequently on the upper Elm Fork watershed. Floods estimated to exceed the existing channel would probably occur on an average of more than once a year. Table II-8 shows various frequency floods and estimated natural peak discharges at the Aubrey damsite.

Table II-8

Flood Frequency and Estimated Natural Peak Discharges at the Aubrey Damsite

Flood Frequency (Average recurrence in years)	Peak Discharge (Cubic feet per second)
5	28,000
10	41,500
50	87,000

d. Existing Water Quality.

(1) Intermittent water quality records from 1969 on are available from the U.S. Geological Survey and the Texas Water Quality Board for the Elm Fork of the Trinity River near Sanger, Texas. The Sanger site is at the bridge on Farm Road 455, approximately 6 miles from the Aubrey Lake damsite. Results of these samples are shown in tables II-9 and II-10. Other records are available for the upper Trinity River Basin near Muenster, Texas,

Table II-7

Major Floods During Period of
Gage Records on Elm Fork Watershed

Date	Isle du Bois Creek near Pilot Point DA = 264 sq. mi. Gage 0 = 555.48 ft. msl* Stage	Isle du Bois Creek near Pilot Point DA = 264 sq. mi. Gage 0 = 555.48 ft. msl* Discharge cfs	Elm Fork near Sanger DA = 381 sq. mi. Gage 0 = 555.48 ft. msl Stage	Elm Fork near Sanger DA = 381 sq. mi. Gage 0 = 555.48 ft. msl Discharge cfs	Elm Fork near Carrollton DA = 2536 sq. mi. Gage 0 = 432.39 ft. msl Stage	Elm Fork near Carrollton DA = 2536 sq. mi. Gage 0 = 432.39 ft. msl Discharge cfs**
May 1908	29.3	-	-	-	28.0+	-
May 1935	-	-	29.70	-	13.00	82,100
June 1941	-	-	-	-	20.53	76,400
April 1942	-	-	-	-	21.05	90,700
April 1957	28.20	22,700	27.40	20,800	7.50	10,100
May 1958	27.30	16,000	29.10	27,500	5.17	4,840
September 1964	-	-	-	-	10.95	33,000
April 1966	26.09	11,100	26.92	20,400	7.40	9,810
May 1967	27.79	19,000	26.08	12,600	5.65	5,590
May 1969	25.17	9,170	26.34	13,500	7.50	10,100

*Gage datum as of 1969
**Flows modified by Lake Dallas from 1928 to 1954, by Lake Dallas and Grapevine Lake, July 1952 to 1954, and by Grapevine and Lewisville Lake subsequent to November 1954.

Table II-9

Analysis of Water Samples by USGS*
Elm Fork, Trinity River near Sanger, Texas

Constituent	Chemical Analysis in mg/l		
	Max	Min	Avg
Silica (SiO_2)	16	1.6	8.1
Calcium (Ca)	120	40	85
Magnesium (Mg)	9.8	2.0	6.7
Sodium plus Potassium (Na + K)	120	16	69
Bicarbonate (HCO_3)	464	126	310
Carbonate (CO_3)	0	0	0
Sulfate (SO_4)	66	14	41
Chloride (Cl)	90	14	63
Fluoride (F)	.5	.1	.3
Nitrate Nitrogen (NO_3)	7.1	.5	1.5
Nitrite Nitrogen (NO_2)	.10	.01	.05
Ammonia Nitrogen (NH_4)	5.3	.02	.56
Total Phosphorus (PO_4)	2.8	.12	.71
Dissolved Solids	574	162	432
Hardness as $CaCO_3$	330	110	239
Noncarbonate Hardness	46	0	9
Specific Conductance (micromhos)	976	269	724
pH (hydrogen ion concentration scale of 1-14)	8.1	7.4	7.8

*USGS samples December 1969 through January 1972.

Table II-10

Analysis of Water Samples (TWQB)*
Elm Fork, Trinity River near Sanger, Texas

	Max	Min	Avg
Sulfate (SO_4) (mg/l)	59	10	38
Chloride (Cl) (mg/l)	128	28	72
Specific Conductance (micromhos)	888	204	580
pH (hydrogen ion concentration scale of 1-14)	7.9	7.1	7.7

*Texas Water Quality Board samples September 1969 through September 1971.

for water years 1967 and 1970. The Muenster station data were not used in this analysis of present water quality at the Aubrey project because of its distance upstream from the project. The Institute for Environmental Studies of North Texas State University conducted an intensive sampling program in March, April, May, and June 1972 in conjunction with their report (10). Flows during this sampling period were low to moderate and reflect high concentrations of some chemical constituents. Results of their sampling program are shown in table II-11.

(2) Present water quality in the proposed project area is good. The available water quality data indicate that concentration of various chemical constituents during normal flows are within criteria set by the U.S. Public Health Service in their "Standards for Surface Water Sources of Public Water Supply." Concentrations of ammonia in some individual samples and the arithmetic mean of all samples are above the standard. However, the weighted mean concentration of 0.22 ppm falls well within the Public Health Service standards. The high ammonia concentrations result from extremely low flows providing little dilution for sewage effluents.

(3) The present water quality is good and could be used for municipal water supply with proper treatment. The city of Gainesville, Texas, is planning to expand and improve their wastewater treatment facilities which should reduce ammonia concentrations and improve the overall chemical quality of water in the immediate area.

4. Biological Elements.

a. Botanical. Natural vegetation within a defined area may be characterized by the major or dominant, externally distinguishable communities present. Each of these communities possesses its own boundaries, internal structure, and specific components.

(1) Area Aquatic Vegetation. Aquatic communities are those whose species are adapted to habitats of, relating to, or containing excessive moisture (e.g., swamps, ponds, impoundments, streams, and seeps). Without Aubrey Lake, there are approximately 465 acres that could be classified as wetlands. These include some 116 small farm impoundments and the marshes of abandoned gravel operations. Very few of these areas possess a permanent water level, and most have low aquatic plant productivity. For the most part, this aquatic vegetation has limited benefits for waterfowl and migrant bird usage, provides poor hunting, and has practically no waterfowl production. The acreages of aquatic vegetation in the Isle du Bois and Elm Fork streambeds are categorized as having from zero to very low productivity.

Table II-11

Analysis of Water Samples (NTSU)*
Elm Fork, Trinity River near Sanger, Texas

Constituent	Chemical Analysis in mg/l	
	Max	Min
Iron	.32	.04
Calcium	96.3	58.4
Total Phosphorus (PO_4)	1.18	.23
Ammonia Nitrogen (NH_4)	1.49	.04
Nitrate Nitrogen (NO_3)	1.78	.90
Nitrite Nitrogen (NO_2)	.36	.02
Total Carbon	81	54
Inorganic Carbon	69	33
Organic Carbon	21	10
Total Solids	607	455
Specific Conductance (micromhos)	781	485
pH (hydrogen ion concentration scale of 1-14)	8.0	7.9
Dissolved Oxygen	8.0	6.4

*North Texas State University samples March through June 1972.

(2) Area Terrestrial Vegetation. Terrestrial communities possess their characteristic species, boundaries, and internal structures and are excluded from those habitats which are adapted to, related to, or contain excessive moisture.

(a) Certain controls, resulting from or influenced by the soil rather than the climate, are very important to the vegetation within the area required for the Aubrey project. These vegetative types are distinct and natural, externally distinguishable communities, each characterized by an assemblage of predominant species controlling the community. Therefore, recognition is given to the edaphic types present which influence the types of vegetation that they support (plate II-5).

(b) The selected site for Aubrey Lake is located mainly in the physiographic subdivision of the East Cross Timbers and the Grand Prairie (plates II-6 and II-7). The East Cross Timbers is underlain by a mixture of slightly acid sands, clays, and sandstone of the Woodbine formation. These reddish, sandy soils support an oak-hickory forest in which the principal aborescent dominants are post oak (Quercus stellata), blackjack oak (Quercus marilandica), Texas hickory (Carya texana), and winged elm (Ulmus alata). The chief understory in this sandy soil is little bluestem (Schizachyrium scoparium), although its abundance has suffered from the extreme grazing pressure in the area. Species of weedy assemblages, dominated mostly by herbs, include purple three-awn (Aristida purpurea), ragweed (Ambrosia artemesifolia), coralberry (Symphoricarpos orbiculatus), and elderberry (Sambucus).

(c) The Grand Prairie, which supports the major areas of tall grass, is underlain by dark calcareous clays over limestone beds. The predominant grass in this region is little bluestem (Schizachyrium scoparium). Other species include big bluestem (Andropogon gerardi), Indiangrass (Sorghastrum nutans), switchgrass (Panicum virgatum), tall dropseed (Sporobolus asper), and Texas wintergrass (Stipa leucotricha). The weedy annual and perennial grasses include Texas grama (Bouteloua rigidiseta), red grama (Bouteloua trifida), tumblegrass (Schedonnardus paniculatus), tumble windmillgrass (Chloris verticillata), and some perennial weeds.

(d) The bottomland vegetation along the Elm Fork consists primarily of a mesophytic forest of hardwoods. This plant community, which requires a high humidity microenvironment, is typified by a rich variety of tree species, i.e., cedar elm, hackberry, Bumelia, boxelder, ash, hickory, hawthorne, osage-orange, cottonwood and ash willow, Lippia, and creeper. The understory is dominated by broadleaf uniola, greenbrier, fleabane, tumblegrass, buffalobur, and croton.

(3) Unusual or Unique Elements. The term unusual or unique denotes elements or resources that are uncommon, single in kind or excellence, or without an equal. A unique biological element in the project area is a portion of the East Cross Timbers. This vegetative region represents a finger of forest jutting into a prairie ecosystem as a result of edaphic variations. Much of the East Cross Timbers has been destroyed by cutting, burning, and construction activities.

(4) Rare and Endangered Species. Rare and endangered species include those that are uncommon or rare, and those which, because of a restricted distribution or other circumstances, are in danger of extinction. All aquatic plant species at the proposed site for Aubrey Lake are common, with no species known to be considered rare or endangered. However, in the category of terrestrial species, two plants (both of the family Gramineae) can be considered rare or endangered. These grasses are broadleaf uniola (Uniola latifolia), which is rare in Texas, and Canadian wildrye (Elymus canadensis), which is considered endangered by the Soil Conservation Service of the U.S. Department of Agriculture in Temple, Texas, in their list dated February 1972 (10).

b. Zoological.

(1) Area Commercial Fisheries.

(a) Freshwater fish production has made a substantial contribution to human nutrition and to commerce over the years. Although commercial fishing in inland waters is of much less significance in Texas than sport fishing, the annual catch of freshwater fish by contract commercial fishermen amounts to approximately 930,000 pounds per year, with an estimated value of $111,600. In addition, it is estimated that fishermen holding a $3 commercial fisherman's license catch a total amount that would equal the annual catch of the contract fishermen. In comparison, the contract fishermen market only buffalofish, gar, drum, and other rough fish, while the commercial fishermen are allowed to market catfish in addition to the rough fish.

(b) Of the total 25,200 acres required for the conservation pool of Aubrey Lake, approximately 71 acres is occupied by streams, principally the Elm Fork (33 acres), Isle du Bois Creek (20 acres), Buck Creek (5 acres), Spring Creek (4 acres), and six other creeks of less than 3 total acres. Stock tanks and small reservoirs within the site presently occupy another 35 acres.

(c) Seine hauls were made from the Elm Fork of the Trinity River between the city of Gainesville and the confluence of the Elm Fork and Clear Creek. Data from these collections indicated that the two most abundant fishes were red shiners (Notropis lutrensis) and bullhead minnows (Pimephales vigilax). The most

important commercial species present were carp (Cyprinus carpio), carpsuckers (Corpiodes carpio), and long-nosed gar (Lepisosteus osseus).

(d) From collections made in the smaller tributary streams of the reservoir site, the most abundant species were shiners (several species of Notropis), mosquito fish (Gambusia affinis), and green sunfish (Lepomis cyanellus). The commercial species present were black bullhead (Ictalurus melas), and spotted sucker (Minytrema melanops).

(2) Commercial Fishery in Galveston and Trinity Bays. Even though this renewable resource is not in the proposed project area, it is a very important element in the economy of the State which should be recognized and considered because it is directly associated with the water resources of the Trinity River Basin. In this report, attention is confined to the fishery of Galveston and Trinity Bays into which the Trinity River eventually flows. This examination was limited to four main categories: shrimp, oysters, crabs, and finfish. Table II-12 was based on data compiled by the National Marine Fisheries Service, U.S. Department of Commerce (42, 43, and 45). The 3-year average for Galveston and Trinity Bays was over 11 million pounds and was valued at approximately 4 million dollars.

(3) Area Sport Fisheries.

(a) Sport fish are an important renewable resource in Texas. In 1969, approximately 1,300,000 persons bought a Texas sport fisherman's license. This number does not include those persons that may fish without a license in their home county with certain types of gear.

(b) The upstream drainage area of the proposed reservoir will include approximately 407,830 acres. About 0.28 percent of this total area, or 1,145 acres, is covered by streams. Approximately 0.14 percent of this total upstream drainage area, or 574 acres, is covered by ponds, stock tanks, and reservoirs. It is estimated that these bodies of water provide 1,000 man-days of fishing annually.

(c) Seine hauls made in the Elm Fork of the Trinity River between the city of Gainesville and the confluence of Elm Fork and Clear Creek indicated that the two most abundant fishes present were red shiners and bullhead minnows. The most important sport fishes present were channel catfish (Ictalurus punctatus), flathead catfish (Pylodictus olivaris), white bass (Morone chysops), sunfish (several species of Lepomis), and largemouth bass (Micropterus salmoides). From collections made in the smaller tributary streams of the reservoir site, the most abundant species present were shiners, mosquito fish, and green sunfish. The most important sport fishes present were channel catfish, sunfish,

Table II-12

Texas Landings Galveston and Trinity Bays

Species	1969 Pounds	1969 Dollars	1970 Pounds	1970 Dollars	1971 Pounds	1971 Dollars
Fish (total)	556,700	49,120	332,000	44,019	212,200	33,778
Oyster Meat	3,447,200	1,385,136	3,850,200	1,700,547	4,021,700	2,054,624
Crabs	1,705,700	157,538	2,622,000	244,798	2,160,800	213,240
Shrimp	4,285,100	1,899,118	5,625,500	1,974,357	5,013,900	2,054,941
Total	9,994,700	3,490,912	12,429,700	3,963,721	11,408,600	4,356,583

largemouth bass, spotted bass (Micropterus punctulatus), and white crappie (Pomoxis annularis).

(d) In a farm pond, largely due to the stocking practices of the owner, the species present were sunfish, channel catfish, largemouth bass, white crappie, and golden shiner (Notemigonus crysoleucas), a popular bait minnow in the area.

(4) Area Wildlife.

(a) Amphibians and Reptiles. Data on population densities of amphibians and reptiles are extremely difficult to gather because of their secretive behavior and avoidance of traps. The lists of amphibians and reptiles which are or should be in the proposed Aubrey Lake area were compiled by the North Texas State University (N.T.S.U.) investigating team from direct field observations and from literature. Field observations were made during several canoe trips on the Elm Fork and also at three different types of natural habitats: at farm ponds and stock tanks, along roads, and in and along the banks of streams. The lists of amphibians and reptiles are found in appendixes B and C, respectively.

(b) Mammals.

1 To assess the mammalian fauna of the Aubrey Lake site, the N.T.S.U. investigating team selected eight collecting sites which included the major natural habitats for mammals of the area. A list of 26 mammals which were either present during the study period or previously reported for the area by Davis (8) is found in appendix D.

2 Few mammals on the site can be considered to be of economic importance. Large carnivores are rarely sighted. Those species of interest to the hunter include gray fox, fox squirrel, and white-tailed deer, and these species provide only a limited source of hunting pleasure because of their relatively small numbers in the area.

(c) Birds.

1 Upland Game Birds. Upland game birds provide recreation in the form of hunting and, in most cases, are a food source for man. The only game birds occurring on the proposed Aubrey Lake site are quail and mourning doves, both present only in small numbers. Texas Parks and Wildlife Department officials report hunter success to be poor, with no more than 25 percent of the total bird population harvested. Available habitat is lacking due to grazing, and only 25 percent of the total area is suitable habitat for upland game birds.

2 Waterfowl.

a Migration Routes. The Central Flyway covers over 1,000,000 square miles, and is one-third larger in area than all the other flyways combined. Within the Central Flyway, approximately 185,000 acres would qualify as suitable habitat for waterfowl. This habitat is included in portions of Montana, North Dakota, South Dakota, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, New Mexico, and Texas(46). The proposed Aubrey Lake impoundment would be situated along the eastern edge of the flyway. The birds may stop over here during their migrations to the Gulf Coast.

b Waterfowl Species. The current wetland quality is poor and receives only limited use by waterfowl. Waterfowl which could be expected to occur in significant numbers on the proposed site are gadwall, pintail, green-winged and blue-winged teals, American widgeon, redhead duck, and woodduck.

3 Wild Birds. The presence of wild birds adds a positive esthetic value to an area and enhances the enjoyment of an area by visitors and local inhabitants. A summary of the birds present as residents or migrants during the study period, based on on-site observations by an N.T.S.U. investigating team and observations previously made in the area by Rylander (32), is presented in appendix E. There are some 36 species that are residents of the area, and some 47 species that are migrants to the area. In general, the proposed reservoir site has fewer birds than would be expected, possibly due to loss of habitat as a result of grazing.

(5) Unusual or Unique Elements. At present, there are no unusual or unique zoological elements which are known to occur in the proposed Aubrey Lake area.

(6) Rare and Endangered Species. Animals most sensitive to environmental change are usually those that are low in occurrence. After a general survey of the animals in the proposed reservoir area, it was determined that no known rare or endangered species were present.

5. Esthetic Elements. In an individual evaluation of a natural landscape, the esthetic value assigned to a certain environmental element is relative to the observer's previous sensory perceptions, education, and sensitivity. The need to maintain esthetically pleasing "natural" environments is generally agreed upon. With increasing urbanization, pressures of overcrowding, and a reduced workweek, people will make greater demands on "natural" environments. Esthetically pleasing environments offer an escape from the tensions of modern urban living.

a. Land. The topography of the land on which water resource projects are constructed plays a major role in determining the impact of the project on esthetics.

(1) Geological Surface Materials. The esthetic quality of land is enhanced by unusual coloration and diversity in type and texture of component materials. If the Aubrey Lake site is compared to such places as the Grand Canyon, the Painted Desert, or White Sands, it might be considered inferior. However, if it is compared to a flat coastal marsh, perhaps it would be considered more pleasing esthetically. The western portion of the reservoir site is situated on Lower Cretaceous age sedimentary rocks composed chiefly of impure limestone and thin-bedded sandstones. The eastern portion, along Isle du Bois Creek and its tributaries, is underlain by materials of the Upper Cretaceous Woodbine sandstone. Large quantities of sediments that were deposited during the Pleistocene are exposed along the sides of the valleys as terraces. The lower flood plains, composed of silts and sediment of Recent alluvium, form mud flats when covered during high water.

(2) Relief and Topographic Character. The proposed Aubrey Lake site is located in an area with limited relief and topographic character when compared with mountains and hills, but still to some individuals it could have a higher esthetic value than the flat coastal plains of Texas. The esthetic value of an area is often determined by comparison with surrounding areas.

(a) The proposed site is located mainly in the physiographic subdivisions known as the Grand Prairie and the East Cross Timbers. A small section in the extreme eastern portion of the impoundment site at the headwaters of Range and Buck Creeks is located in the Blackland Prairie physiographic subdivision. The Grand Prairie dips seaward with a main scarp located at its junction with the West Cross Timbers. Many minor scarps occur within this rolling midgrass prairie.

(b) The East Cross Timbers is a band of predominantly post and blackjack oaks which appears to stretch across a region of high and rolling knolls when viewed from the Grand Prairie. Erosion in this subdivision has produced deeper and steeper-sided valleys than those found on the Grand Prairie.

b. Air. Esthetics relating to air are based in part upon the quality of sounds and odors carried by the air, and its clearness.

(1) Odor and Visual Quality. The project is located in an area removed from major sources of air pollution. Therefore, the atmosphere in the project area contributes to the esthetic pleasantness of the region. Overall, it can be said that the current visual quality is clear with no pollution or high degree of odor.

(2) Sounds. The esthetic sounds factor for the area is currently considered to be occasionally pleasant. The sound quality on the proposed site is currently enhanced by bird songs, frog calls, insect noises, and an overall quietness. The operation of a few motor vehicles and farm implements sometimes detracts from the existing good sound quality.

c. Water. The esthetic quality of the water resource project itself must be considered as an important environmental component.

(1) Appearance of Water. The esthetic appeal of water in a landscape is largely visual. This appeal is heightened by clean water and decreased by turbid, off-color water. Turbidity in natural waters results from suspended materials in the water, which usually include silt, clay, pollutants, and algal cells. Moving water is usually more appealing to the eye than still or sluggish water. The combination of these two factors accounts for most of the visual esthetic appeal of a body of water. Since the mean turbidity of these area streams is usually between 100 and 200 JTU (Jackson Turbidity Units), they are considered to be slightly more than moderately turbid. Their current speed normally ranges between 0.25 and 2.25 feet per second. Overall, the esthetic evaluation of stream water quality rates rather low because of turbidity and sluggishness.

(2) Odor and Floating Materials. Investigations have revealed that there is a moderate amount of floating debris on the Elm Fork and Isle du Bois Creek. Normally some odor may be detected but it is not considered objectionable. One exception is an area where the treated sewage effluent from Gainesville, Texas, enters the Elm Fork and continues for 2 to 3 miles below the town. However, natural self purification is nearly completed in the next 5 to 6 miles before the effluent effects reach the proposed lake site. Upon completion of treatment plant improvements by Gainesville, scheduled for January 1974, this situation is expected to noticeably improve. A second exception is the algae blooms which result in soupy-green water occurring between the proposed damsite and the upper end of Lewisville Lake. In the summer, this may cause an offensive odor. Algae blooms of this nature most generally result from abundant nutrients in the water. Based on the premise that these abundant nutrients stem primarily from sewage effluent entering the Elm Fork and Isle du Bois Creek, it is anticipated that their wide dispersal in the main body of Aubrey Lake will significantly reduce their concentration downstream of the damsite and thereby reduce these algae blooms and consequent odors. Overall, the floating materials entering Aubrey Lake from its tributaries will be within tolerable limits.

(3) Water Surface Area. Streams associated with this project are less than 50 feet wide during normal flows, but will swell to hundreds of feet in width during floods. Because of the relative narrowness of the normal stream widths, their esthetic quality is relatively low.

(4) Wooded and Geologic Shoreline. Visitors to lakes look at the shoreline and its appearance, the kinds and ruggedness of rock formations, the sandy beaches, and the surrounding vegetation. Each person has his own preference as to the type of shoreline which gives him pleasure.

(a) The eastern two-thirds of the project site is in a region that is underlain by deposits of the Woodbine sand formation. This formation consists of ferruginous, clayey sands and weakly cemented sandstones and lignitic sandy shales. Considering the sandy character of the Woodbine and its residual overburden, sandy beach areas should develop at certain locations along the shore over a period of time. Additionally, the Woodbine supports a dense growth of hardwood forest as its natural vegetation. Much of the region was cleared as the land was developed agriculturally, but with the establishment of the lake the vegetation may reestablish itself.

(b) The western third of the project site is adjacent to the Elm Fork of the Trinity River and is underlain by thin-bedded limestone, marl, marly clay, and sandstone belonging to the Denton, Weno, Pawpaw, Main Street, and Grayson formations. The stream valleys are underlain by alluvial fill and some dissected Pleistocene deposits.

(c) An estimate of the forest covering revealed that the forest covers from 30 percent to 60 percent of the land up to 500 feet on either side of the stream. Farther than 500 feet from the stream, the forests cover less than 30 percent of the land.

d. Biota. The esthetic value of biota is concerned with the sensory pleasure people derive from the presence of certain plants and animals.

(1) Animals. Since the project area is used fairly intensively for production of livestock, the most readily noticeable animals are domesticated types, raised primarily for meat. Wild animals in the area such as small mammals and birds are considered to be common but not numerous. The wild mammals, consisting primarily of rodents, are mostly nocturnal and not easily observed. The widest variety of birds are present during spring and fall migrations. Reptiles and amphibians are rarely seen during the day, but are easily observed at night during rainy periods. Aquatic forms, such as fish and aquatic insects, are not prevalent, but can be observed with some effort. The only large wild mammal known in the area is the white-tailed deer, and these are rarely seen.

(2) Vegetation. Because of the demand for wood for fuel and construction, and the need for cleared areas for cultivation, the extensive blackjack oak "forest" of the early 1800's has been converted to today's "abandoned Old Field" vegetation type. The project area has a very uniform vegetation type. The uniformity of vegetation type is a result of competition being so severe that post oak ends up with all of the biomass, number of individuals, and a good distribution in the layer occupied by trees. The lower layers are severely uniform because of extreme overgrazing. The vegetation of the lower layer is about 72 percent abandoned Old Field type, with more than 62 weed species distributed uniformly because of their low palatability to cattle. At present, the project area contains the following vegetation types:

Types	Acres	Percent
Forest	4,500	13
Abandoned Old Field	26,600	76
Bare Cultivation	3,800	11
Total (approximate)	35,000	100

e. Manmade Objects. The manmade objects within the Aubrey Lake project area include such features as buildings, roads, railroads, bridges, fences, electric lines, telephone lines, pipelines, farm ponds and reservoirs, construction and mining scars, and oil well pumps and storage tanks. The area also contains discarded waste objects such as cans, household appliances, and automobiles and parts, especially along the roads at stream crossings. Buildings include houses and storage structures, none of which are clustered into a housing development or town, but which are of a moderate rural density. Roads are of moderate density with irregular patterns of spacing. They are not in long straight lines, but wind across the landscape. The roads are narrow and covered with local earth materials of sand and gravel which blend into the mineral soils and rock materials of their natural environment. The bridges associated with these roads are constructed of concrete pillars supporting wood and steel, and are decked with narrow, unpainted, rough plank floors. Many are considered picturesque in their setting across narrow stream channels with crowns of trees arching over them. Several farm ponds and two reservoirs, all with earthen dams covered with grass vegetation, create a pleasing landscape. With utilities such as pipelines being buried and the absence of major transmission lines, there is very little to distract from the natural skyline of the area. Scattered throughout the area are abandoned houses and storage buildings, some unkept house sites, farmsteads, and deteriorated fences. This neglect may be an indication that man is allowing portions of the area to return to natural settings. Another reminder of man's utilization of the resources of this area is the mounds of overburden left from sand and gravel mining operations.

6. Archeological and Historical Elements.

a. Historical Elements.

(1) Architecture and Styles. Structures, sites, and objects often serve as unusual examples of certain periods, styles, or methods of construction, and thus have considerable historical value. Although the project area contains the remains of the old Bloomfield community, founded in 1875, and some structures which are examples of a style of ranch-farm architecture which is worthy of preservation, the overall value significance of sites or objects in the reservoir area is low.

(a) Unusual or Unique Elements. At the second public meeting concerning the Aubrey Lake project, held on 27 October 1972 in Denton, Texas, Mr. Tom Miller, speaking as a representative of the Denton County Historical Survey Committee, submitted a written and oral statement concerning a unique element within the project area. This element is an unoccupied, somewhat deteriorated house, one of three built by members of the Hammons family. A description of the house, taken from Mr. Miller's written statement (which is inclosed in section VIII) follows. The house was built in the 1850's and is architecturally unique in this area and quite unusual in the entire State. It is considerably older than the other two houses built by members of the Hammons family, and is much more interesting and valuable architecturally. Its "uniqueness" is a result of an architectural style, common in the southeastern United States in the early 1800's, but not often seen in Texas. There is only one existing example of this architectural style in Early Texas Homes (5), and none in Texas Homes of the Nineteenth Century (1). This architectural style is characterized by a long low porch which extends the complete length of the front of the house. Above the porch is a row of low, square windows, under an eave line which provides headroom of only 5 feet at the sides of the second floor rooms. In contrast, the architectural styles of most houses during this period are one-story with a continuous roof from ridge to porch eaves, or two story with tall upper windows and entirely different proportion. In addition, the house has a cluster of auxiliary structures - a small tenant house, a barn which incorporates an earlier log structure, and a large barn. This house and its auxiliary structures are considered in Mr. Miller's statement as a cultural survivor of the nineteenth century westward migration from the old southeastern settlements, a physical witness to a period from which very few witnesses remain, and sound enough structurally to merit restoration.

(b) Other Historical Considerations in the Project Area.

1 Of 140 structures in the affected area, only one appears to have been built before 1890, and its distinction has been previously discussed.

2 Twenty structures appear to have been built between 1890 and 1910. Half of these are unoccupied, and several are badly dilapidated.

3 There are no State historical markers in the reservoir area, and none are presently planned.

4 Generally, the structures in the site area are in a greatly deteriorated condition.

5 A review of the National Register of Historic Places indicates there are no sites of National significance located in the project area.

(2) Events. Certain sites, structures, and objects depict or are associated with significant events in the history of the United States. Examples of historical elements related to events are battlefields, birthplaces, gravesites associated with communities, and locations of significant discoveries. The value significance for events in the site area is very low because:

(a) No events, discoveries, or developments occurred within the proposed project area that are of National, State, or regional significance.

(b) Events or developments which have occurred within the proposed project area that are of significance as local historical elements are not especially peculiar or unique, i.e., similar developments occurred in the areas that will not be affected by the project.

(c) No State historical markers are presently placed in the area, and as far as can be determined, none are officially or unofficially planned.

(d) Many other events occurred within the affected area, but have significance only to people who live in the area now or once lived there and return occasionally to visit.

(3) Persons. There are many persons who are considered to have been of importance in the history of the United States. There are significant sites, structures, and objects associated with the lives, careers, and activities of such people. The selected reservoir site includes the gravesite of Dr. John S. Riley, uncle of the noted poet James Whitcomb Riley. Dr. Riley settled at Bloomfield in 1871 after serving as an officer in the Confederate army. His medical practice, personality, and distinguished background made him widely known in the north Texas region. He died in 1915 and is buried in Jones Cemetery. The proposed project area also includes the sites of the graves and residences of Mr. and Mrs. John Strickland, early settlers in this area.

b. Archeological Elements. Archeological elements include anything which demonstrates or indicates mainly the prehistoric past in the life and cultural activities of a people. Examples include prehistoric villages, dwellings, and objects used in everyday activities.

(1) Recorded Sites. Bousman and Verrett (4) describe 26 archeological sites within the limits of the reservoir which were located, recorded, and evaluated. All sites are located below elevation 655 feet msl, maximum design water surface elevation. A large variety of artifacts are present in the Aubrey area, and these have been divided into five groups: (a) chipped stone, (b) pecked and ground stone, (c) ceramics, (d) fire-cracked rock, and (e) faunal remains. On the basis of surface artifacts and information provided by amateur archeologists, there is evidence of occupation in this area during the Late Archaic, Neo-American, and Historic periods. Although evidence of occupation in the area during the Paleo-Indian stage and Norteno Focus was not found, detailed studies are expected to uncover remains attributable to these periods. The 26 sites range in size from small concentrations of lithic debris, marking the location of intermittently used tool manufacturing locales, to large village sites which were occupied repeatedly during the Archaic and Neo-American periods. The types of activity sites recorded included quarry sites, mussel shell gathering sites, and hunting camps. Although gathering sites were not recorded, they are expected to occur in the upland areas above the flood pool level of the lake. These evaluations and data are not intended to represent an indepth comprehensive survey but to recognize the existence of recorded and possible archeological material in the region to aid in answering questions about the prehistoric past. The Aubrey reservoir area archeological materials can be a means of extending the knowledge of aboriginal cultures to fill the many gaps in the prehistoric record of the area. This information can be utilized to estimate the degree and nature of archeological survey that will be necessary to prepare an adequate inventory and properly evaluate the historic and prehistoric resources of the area.

(2) Possible Sites. During construction of Lewisville Dam (formerly Garza-Little Elm Dam) an archeological site of controversial origin and value was exposed after 21 feet of earth had been removed in bulldozing operations. This site yielded 21 seemingly manmade hearths containing disarticulated bone of Pleistocene fauna, hackberry seeds, logs, and six flint and quartzite tools. The two log samples have yielded radiocarbon dates of more than 37,000 years B.P. (before present). The large Clovis point found with the hearth material has an accepted date

of about 9500-9000 B.C. The activities between 37,000 B.P. (35,000 B.C.) and 9,000 B.C. are still a mystery and could be filled in by information contained in other sites which may exist under several feet of alluvial material. Because of the significant archeological finds uncovered during excavation activities connected with the construction of Lewisville Dam, and the possibility of uncovering similar finds in the proposed Aubrey Dam area, care will be exercised during excavation operations at Aubrey Lake to bring any material suspected of being of archeological value to the attention of qualified archeologists for evaluation and salvage.

7. Social, Cultural, and Economic Elements.

a. Population.

(1) The water supply and recreation implications of the proposed Aubrey project affect the entire Upper Trinity River Basin. Census returns place the 1970 population of this region at 2,636,000, an increase of 33.8 percent, or about 700,000 people in the 10 years since 1960. This region's share of the total state population increased from 20.6 percent in 1960 to 23.5 percent in 1970. Projections indicate that this remarkable growth rate will be slightly higher than the State of Texas as a whole. The region's population growth history, together with current projections, underscores the salient need for water resource development planning for this area.

(2) Cooke and Denton Counties, in which the proposed Aubrey Lake site and its drainage area are located, have experienced a significant growth in population during the last 10 to 15 years. This trend is expected to continue because the area is within the sphere of influence of the rapidly expanding Dallas-Fort Worth metropolitan area. According to U.S. Census Bureau data, the population of Cooke and Denton Counties increased at an average annual rate of 3.54 percent during the period from 1960 to 1970. The average annual increase for Texas was 1.57 percent. The rural population of these two counties increased 2.35 percent, while the urban population increased 4.0 percent. Urbanization in these two counties is expected to continue at a fairly rapid rate. Table II-13 shows the distribution of the population of the two counties between urban and rural classifications. It also shows the population of the two principal cities within the study area.

b. Land Use.

(1) Land in the Aubrey Lake area is used for agricultural, mining, services, commerce, and manufacturing industries, and for

Table II-13

Population Distribution

	Counties			Principal Cities	
	Cooke	Denton	Total	Gainesville	Denton
1960:					
Urban	14,273	33,244	47,517	13,083	26,844
Rural	8,287	14,188	22,475	-	-
Total	22,560	47,432	63,992		
1970:					
Urban	15,241	55,523	70,764	13,830	39,874
Rural	8,230	20,110	28,340	-	-
Total	23,471	75,633	99,104		
Percent Change (+ or -) 1960 to 1970:					
Urban	+6.8	+67.0	+48.9	+5.7	+48.5
Rural	-0.7	+41.7	+26.1		
Total	+4.0	+59.5	+41.6		

roads, utilities, residences, and farmsteads. Each use of the land has been mismanaged to some extent, contributing to environmental degradation.

(2) In the eastern portion of the project area, classified as East Cross Timbers, there is evidence of misused land. Most of these lands are abandoned and are in the "Old Field" stage of ecological succession. In the past, some areas in the flood plains were farmed, but the recurrence of flooding hampered these efforts. Evidence of improper cultivation practices is also apparent in this area.

(3) Within the project area, man has inconsiderably used areas for solid waste disposal, especially along the streams at road crossings. Automobile salvage yards are scattered across the fields, clashing with the landscape.

(4) Mining operations have also changed the landscape in the area. The biggest offenders are sand and gravel pit mining operators. The soil profile has been destroyed by overburden being left in piles instead of being leveled upon completion of mining operations. This type of land alteration limits the usability of the area.

(5) The lands required for the Aubrey Lake project are rural, with most of them being devoted primarily to pastureland, and, to a lesser extent, to cropland. Other minor uses include mining of sand and gravel, automotive repair garages, and a housing and recreational development project known as Pioneer Valley on Persimmon Creek, a tributary of the Elm Fork.

(6) It is estimated that about 93 percent of the land required for Aubrey Lake is developed for agricultural, mining, manufacturing, service, and commerce related industrial uses, and for roads, residences, and farmsteads. The density of development in the reservoir area is low.

c. General Economy. The general economy of the proposed Aubrey Lake area and its watershed is comprised of the usual wholesale and retail business activities, a number of industrial enterprises, and several large educational institutions. Livestock and crop production amounts to over $30 million annually. Due to the proximity of Lake Texoma and Lewisville and Grapevine Lakes, income in the project area derived from supporting recreational activities at these lakes is increasing. Job opportunities in the Dallas-Fort Worth metropolitan area are also available as sources of income for residents in this area.

d. Employment. The rate of employment in these two counties continues to be high. The unemployment rate for these two counties

was reported in April 1972 to be only 2.3 percent of the total work force. Table II-14 shows the distribution of the work force as of April 1972 based on Texas Employment Commission data.

Table II-14

Work Force Distribution

Category	Number of Workers in Cooke County	Number of Workers in Denton County	Area Total
Manufacturing	1,900	3,500	5,400
Nonmanufacturing	5,700	16,300	22,000
Agriculture	800	1,600	2,400
Unemployed	300	400	700
Total	8,700	21,800	30,500

e. Employment Opportunities.

(1) Employment opportunities in the proposed Aubrey Lake area can be grouped into these categories: agriculture and related enterprises, mining, contract construction, commerce, service, and manufacturing.

(2) The major groups within the plant and animal industries include only agriculture and forestry. Agricultural employment consists of the production of crops or plants, and trees (excluding forestry operations), and the keeping, grazing, and feeding of domesticated animals. Forestry operations offer employment opportunities in cutting of firewood, removal of native trees for landscaping, and harvesting of native pecans.

(3) The mining industry involves the economically feasible extraction of minerals which occur in the area. These extraction operations include quarrying and water well operations. Within the proposed project area, a small producing oil field, some sand and gravel quarries, and some stripping of topsoil are present.

(4) The contract construction category refers to the new construction work, additions, alterations, and repair of immobile structures. This includes construction of houses, farm buildings, roads, bridges, railroads, farm ponds, drilling of wells, and placement of telephone lines, transmission lines, and pipelines.

(5) The commerce category includes those industries which are primarily engaged in facilitating the transfer of the ownership of property. A salvage yard and an antique shop are located in the reservoir area.

(6) The service category includes those industries which are primarily engaged in providing benefits that are directed toward the buyer's person or property. Within the proposed reservoir site are one automobile repair shop, one welding shop, one American Legion hut, one church, a baseball camp for boys, and a retreat area for recreation and relaxation.

(7) A survey conducted by an N.T.S.U. investigating team on employment data in the reservoir site indicates that only 33 percent of the people living in the proposed reservoir site have full employment in the area, while less than 33 percent receive only a part of their income within the reservoir site, and more than 33 percent derive no income from within the reservoir site. Observations upstream, downstream, and adjacent to the proposed reservoir site reveal the existence of a similar employment pattern throughout the area near the proposed reservoir.

(8) This is an area where agriculture is practiced extensively; this development of farmsteads supplements incomes. There are three dairy operations in the reservoir site. Some additional income is derived through gas and oil leases, and the sale of sand and gravel, firewood, and native pecans.

(9) A part of this land is owned and operated by persons living in communities at a distance from the reservoir site. These owner-operators live in such places as Pilot Point, Denton, and Dallas. Many of them gain only part of their income from lands in the reservoir site.

f. Housing.

(1) Housing includes the site of residence. This may be a single house, or it may be a farmstead with a house, a yard, and all the buildings surrounding the house. Also included are the other buildings in the project area. This is a rural area with no cluster of houses which can be considered to be a hamlet, village, town, or city.

(2) The existing housing in the reservoir site is of about average density for a rural area in this region. There are approximately 280 buildings in the project boundaries. Of these, 63 are inhabited houses, 6 are mobile homes, 14 are vacant houses, and 21 are abandoned houses. In addition, there is an American Legion building and a baseball camp with three buildings.

g. Social Interactions. Social interactions are the activities of the area which are a part of people's lives. These include interrelationships created by churches, clubs, schools, camps and retreats, entertainment, recreational activites, and travel and shopping patterns. The following social activities which are

an important part of people's lives exist in the project area:

(1) A baseball camp for boys, which provides an opportunity to learn the sport of baseball, enjoy recreation, and develop friendships.

(2) A retreat area located northwest of Pilot Point which provides facilities for recreation and relaxation.

(3) The St. James Baptist Church, used for regular meetings and social functions.

(4) The Bloomfield Cemetery and church building, where people gather annually to clear the cemetery of undesirable vegetation. At this event, the social value occurs as the people work and visit together, some people seeing each other only this one time each year. People bring food and eat together. This is the only time the church building is used.

(5) Bodies of water which provide sites for recreation and use of leisure time. Many people fish in the streams and some swim there. There is also some picnicking, hunting, and target practice.

(6) Several families have lived at their present homesites more than 50 years, and two families for 68 years. Some farms have been owned by the same family since the middle and late 1800's. This has resulted in longstanding friendships with rural neighbors and with townspeople where these people shop.

(7) In the project area, there are 46 children attending school in the school districts of Sanger, Valley View, Pilot Point, and Tioga.

h. Economic Conditions and Trends.

(1) Land Values. Because of the proximity of the Dallas-Fort Worth metropolitan area and excellent water-based recreational areas, along with the population and income growth in the study area, land values have been increasing. Competition for the available land resources is expected to push land values even higher. The latest available figures on agricultural land prices are from the 1969 agricultural census and indicate a 66 percent average increase in the value of land for agricultural purposes from 1964 to 1969. Table II-15 shows the land values and the percentage of increase in value during that period of time. It is estimated that the 1973 values are considerably higher than those values shown in the table.

Table II-15

Average Value of Agricultural Land Per Acre

County	From 1964 Agricultural Census	From 1969 Agricultural Census	Percent Increase 1964 to 1969
Cooke	$144	$207	44
Denton	$274	$508	85
Grayson	$173	$267	54

(2) Taxation. County and city tax rates on real property are important indicators of economic stability within the area. Low tax rates are a good indication that conditions are favorable for future growth. The highest county tax rate shown for any county in Texas in 1970 was $2.55, and the lowest was $0.70. Table II-16 shows the tax rates for the study area.

Table II-16

Tax Rate Per $100 Assessed Valuation

	1969	1970
Cooke County	$0.82	$0.82
Denton County	$0.95	$0.95
City of Gainesville	$1.20	$1.20
City of Denton	$1.50	$1.50

i. Agricultural Trends.

(1) A study of the significant trends in agriculture shows that farm units are becoming larger, involving a much larger investment. The size of the average farm unit increased about 13 percent from 1959 to 1964, while average farm values increased almost 70 percent.

(2) Major land-use changes during the period from 1958 to 1967 include significant decreases in cropland acreage and increases in land used for permanent pasture.

(3) Agricultural income in the area increased from a total of about $20,000,000 in 1964, to about $31,000,000 in 1970, a 55 percent increase. These trends are expected to continue. Table II-17 shows major land-use changes from 1958 to 1967 according to the Conservation Needs Inventory of the Soil Conservation Service. Table II-18 shows changes in size and average value of farms from 1959 to 1964 according to the latest available agricultural census.

Table II-17

General Land Use (Acres) - Study Area

Land Use	Area Total 1958	Area Total 1967	Acreage Change 1958 to 1967
Cropland	456,600	354,298	-102,302
Pasture	137,400	287,737	+150,337
Range	318,600	304,525	-14,075
Forest	104,600	83,260	-21,340
Urban	51,000	53,597	+2,597
Federal	64,800	64,800	-
Other 1/	47,200	13,831	-33,369

1/ Does not include large bodies of water.

Table II-18

Average Size and Value of Farms

	Cooke County	Denton County
Size:		
Average per farm 1959 (acres)	332.2	263.6
Average per farm 1964 (acres)	358.8	308.7
Change 1959 to 1974 (percent)	+8	+17
Value:		
Average per farm 1959	$31,950	$45,906
Average per farm 1964	$52,262	$83,804
Change 1959 to 1964 (percent)	+64	+83

j. Communication, Transportation, and Utility Networks. The following communication, transportation, and utility elements are located within the proposed project area.

(1) U.S. Highway 377
(2) F.M. Roads 372, 455, and 922
(3) County roads
(4) Texas and Pacific Railroad
(5) Telephone facilities (Valley View, General, and Central Telephone Companies)
(6) Electric power facilities (Community Public Service Company, Denton County, and Cooke County Cooperatives)
(7) Pipelines (Atlantic Richfield Co., Lone Star Gas, Green Springs, and Mountain Springs Water Corporations).

8. Water Supply and Recreational Needs.

a. Water Supply. The urban and industrial areas of the Trinity River Basin are in a period of rapid economic expansion at a rate almost 1½ times the national average. An anticipated continued increase in population and economic growth throughout the basin requires maintenance of adequate water supply facilities and development of the surface and ground-water resources of the basin to meet future demands.

b. Recreational Needs. The increasing urban population has severely strained the capability of the existing lake facilities to meet the recreation demand. With the increasing rate of demand, there will not be enough surface water to meet the future population's recreation needs. The projected unmet recreational needs for the Aubrey market area are as follows:

1980	1990	2000	2010	2020
3,432,551	5,105,540	7,158,338	9,645,353	12,593,418

Indications are that water-oriented recreation needs will continue to exceed the increasing number of facilities being provided. The demand for recreational outlets is demonstrated by the usage of recreational facilities at existing projects in the area. This project fits into the planning scheme for greenbelt areas and recreational corridors as proposed by the North Central Texas Council of Governments in their recently completed Open Space Plan(19). The project would provide opportunities for up to 6,240,000 recreation days annually. The principal recreation resources of Aubrey Lake will be the scenic beauty of the lake, a favorable climate, and fish and wildlife resources of the project area. It has been estimated that streams of the project area provide about 5,000 man-days of fishing annually and the ponds and reservoirs provide about 1,000 man-days of fishing annually. Additionally, the area provides an estimated 4,400 man-days of upland-game

hunting, 400 man-days of waterfowl hunting and 9,000 man-days of non-consumptive wildlife-oriented recreation. Tree cover, ease of access, topography, and suitable water depths for water-oriented recreation will be the factors determining the number of sites to be selected for recreational development. The scope of development will be based upon the visitation demand in the day-use market area and the optimum capacity of the project. The estimates of recreational use at Aubrey Lake are based primarily upon the anticipated recreational activities of the people within the day-use market area of the project, their need for outdoor water-oriented recreational experiences, and the resources available to meet this need. This area was determined to be the area within 50 miles of the project. Tables II-19 and II-20 show the population projections and projected recreational needs for this area. Based on the population projections and recreational needs projections of the day-use market area, the optimum capacity of 6,240,000 recreation days annually would be reached by 1995. This project will help to meet the recreational needs estimated in the "Statewide Comprehensive Outdoor Recreation Plan" prepared by the Texas Parks and Wildlife Department (37). There also is an indication that water-oriented recreation needs will continue to exceed the increasing number of facilities being provided. Projects like Aubrey Lake will help to reduce the deficit in needed recreational outlets.

Table II-19

Area Population Projection

1980	1990	2000	2010	2020
2,837,177	3,569,460	4,349,701	5,225,821	6,181,788

Table II-20

Projected Recreational Needs
(Visitors Annually)

1980	1990	2000	2010	2020
3,432,551	5,105,540	7,158,338	9,645,353	12,593,418

9. Programs of Other Agencies.

a. Soil Conservation Service.

(1) Presently the Soil Conservation Service of the U.S. Department of Agriculture has a work plan in operation for the Elm Fork watershed of the Trinity River watershed. In general, this area is in proximity to Gainesville, Texas, which is also in the watershed of the proposed Aubrey Lake project.

(2) This Soil Conservation Service plan combines land treatment practices with flood prevention measures which contribute directly to soil and water conservation and flood prevention. This flood prevention plan covers that portion of the Elm Fork above its confluence with Clear Creek, excluding the drainage area of Isle du Bois Creek, under the Flood Control Act of 1944.

(3) Of 105 floodwater retarding structures planned, 92 have been constructed. Six of these structures have been constructed in the lower Elm Fork watershed at a cost to the Federal Government of approximately $260,000. Spring, Wheeler, Pecan, Dry Elm, and Brushy Creeks are the major tributaries in this watershed (41).

b. Environmental Protection Agency. The municipalities listed in table II-21 are the towns in the Aubrey Lake area which have wastewater treatment facility projects in which the Environmental Protection Agency is currently participating.

c. Agricultural Stabilization and Conservation Service. Correspondence with the Executive Directors for the Agricultural Stabilization and Conservation Service of Denton, Grayson, and Collin Counties advises us that they are not participating in any programs in the general area of the Aubrey Lake project.

d. Bureau of Sport Fisheries and Wildlife. The Bureau of Sport Fisheries and Wildlife, in cooperation with the Texas Parks and Wildlife Department is carrying out various fishery and wildlife programs in the watershed.

e. Texas Water Quality Board. The Texas Water Quality Board reports that the following municipalities are participating in the "Self Reporting System" and are discharging effluents from their sewage treatment plants into the tributary streams of the drainage basin for the proposed Aubrey Lake: Aubrey, Collinsville, Gainesville, Gunter, Lindsay, Muenster, Pilot Point, Sanger, Tioga, and Valley View.

f. North Central Texas Council of Governments.

(1) The North Central Texas Council of Governemnts has initiated a plan, Open Space for North Central Texas: A Policies Plan, which should serve as a point of departure for more detailed individual

Table II-21

Environmental Protection Agency Projects
in the Aubrey Lake Area

Applicant	Receiving Stream
Argyle, Texas	Hickory Creek
Corinth (Denton S.T.P.)	Pecan Creek to Lewisville Lake
Flower Mound	Denton Creek
Frisco	Stewart Creek to Lewisville Lake
Gainesville	
Haslet	Henrietta, Harriet, and Denton Creeks
Lewisville	Prairie Creek, Timber Creek
Ponder	Denton Creek
Sanger	Clear Creek

county open space plans in which the county governments would have greater involvement. This plan should be a significant step toward identifying and realizing an optimal open space system for North Central Texas (19).

(2) This plan advocates the necessity for provision and development of outdoor recreation, in the form of green open spaces, as a vital part of the urban growth process. "Open space serves five basic functions: (a) resource production; (b) resource preservation; (c) protection of social, cultural, and natural amenities which contribute to the public good; (d) environmental protection and public safety; and multiple use of intraregional "corridors" (19).

(3) Some of the main objectives outlined in the program include: development and maintenance of both initial and long-range comprehensive open space plans; determination of existing open space deficiencies; encouragement of State and local governments to remedy existing deficiencies and to acquire open space in advance of intended development; seeking local and State legislation to set aside marginal land in urban areas for open space; and encouragement and development of methods for joint planning, development, and financing of open space and recreational areas (19).

g. Other Agencies. Other Federal and State agencies involved with roads and health, education, and welfare programs are carrying out and coordinating a variety of programs within the watershed.

10. Lewisville Lake Component.

a. Flood Control Reallocation. As envisioned in the comprehensive Trinity River plan of improvement, Aubrey Lake and Lewisville Lake will work in combination to provide flood control and water conservation on the Elm Fork of the Trinity River. As a result of the Aubrey project, there will be a transfer of a portion of the flood control storage from Lewisville Lake to Aubrey Lake. Also, the water conservation pool elevation of Lewisville Lake will be increased from 515 feet msl to 522 feet msl.

b. Area Vegetation. This rise in elevation of the conservation pool will inundate an additional 6,400 acres, of which approximately 33 percent is sparsely timbered. This 33 percent is located primarily in the southern and eastern sections of the project. The remaining 67 percent of the additional acreage to be inundated contains brush, brushy grassland, and grassland. The aquatic vegetation on the Lewisville project is limited primarily to algae and water tolerant trees such as willows and cottonwoods. The absence of smaller aquatic vascular plants is the result of lake level fluctuations and turbidity caused by the wind and powerboat created wave washing.

c. Area Wildlife. The timbered areas around Lewisville Lake are suitable mainly for squirrels, birds, and other small animals which can adapt to the presence of human populations. The brushy and grassy areas are more suitable for mourning doves, rabbits, bobwhites, and foxes. Many waterfowl such as green-winged and blue-winged teals, pintails, shovelers, scaups, baldpates, canvasbacks, redheads, blue geese, snow geese, and Canada geese are typical residents in or migrants to the area. About 300 mallards are reported to winter on Lewisville Lake, which provides about 2,350 man-days of waterfowl hunting at this existing lake.

d. Area Fishery. Lewisville Lake is usually murky and the fish habitat is generally of poor quality. The lake is over-populated with gizzard shad, smallmouth buffalofish, gar, and carp. Species taken by sport fishermen include white crappie, white bass, largemouth bass, carp, bluegill, and catfish. There are about 650,000 man-days of fisherman use on the project.

11. Basin Future Without the Project.

a. Physiography. Although the general physiography of the watershed is not expected to change dramatically over the next 100 years (the expected life of the project); if the project is not constructed a certain amount of change is to be expected. This change could result from continued sand and gravel mining operations or from the subdivision of farms for suburban development. Some small farm units could be combined to create larger farm units.

b. Geology. Ground-water reserves will continue to be tapped by residents of the watershed, and this will further lower the local water table.

c. Hydrology. The quality of surface water in this section of the Elm Fork of the Trinity River should remain good. This conclusion is based on the premise that soil and water conservation techniques will continue to be improved and implemented, and that sewage treatment plants will continue to be upgraded to the point that all effluent will meet desirable standards. These improvements may be offset to some extent by runoff from homesites and farms where agricultural chemicals are used.

d. Biology. Many natural areas will be converted to planned use areas which will entail the changing of botanical communities in both terrestrial and aquatic settings. Broadleaf uniola (Uniola latifolia) and Canadian wildrye (Elymus canadensis) are locally classified as threatened species (10), respectively, and could cease to exist here if their habitats are disrupted. Area fisheries will continue on their present precarious course, except in farm ponds and stock tanks where they can receive intensive management. Area wildlife may also receive management attention on private land

holdings. Such management could maintain or slightly increase productivity, but would decrease diversity of species. Unique or exotic species may be introduced. No fish or wildlife species now inhabiting the area are expected to become a threatened species.

e. Esthetics. The esthetic appeal of the area may become enhanced by landscaping of homesites and grounds. However, this may be offset by some residents who will not try to beautify their property and who will use their property as storage areas for inoperable machinery. Industry could move into this area and affect the esthetic quality of air, land, and water.

f. Archeological and Historical Elements. Archeological and historical sites could be destroyed inadvertently by normal activities or when discovered, could be restored or preserved by residents, historians, or scholars.

g. Social, Cultural, and Economic Elements. Social, cultural, and economic trends in the area will be dictated by the development and growth of the Dallas-Denton-Fort Worth metroplex where most employment will continue to be located. Small communities in the watershed will continue to grow, and will eventually become part of the ever-increasing Dallas-Fort Worth metroplex.

h. Water, Recreation, and Flood Control Needs.

(1) Water Supply.

(a) At the present time, the city of Dallas supplies water to 17 customer cities in the Dallas-Fort Worth market area and is studying the possibility of supplying water to an additional five customer cities located within the Trinity River watershed. Since the city of Dallas must anticipate the water supply demands of this rapidly expanding area of the Southwest, a study entitled "Dallas Long Range Water Supply" was initiated. An interim report of this study(11) indicated that the Elm Fork area north of Dallas would have a water supply deficit of 134 mgd by the year 2000. Table II-22 depicts the reservoirs considered in the report to determine if they would be able to prevent the 134 mgd deficit forecast for the year 2000.

(b) Although the data in table II-22 are based on an interim report and may, therefore, be subject to some final modification, they reveal the following pertinent facts:

1 Sulphur Bluff 1 and Sulphur Bluff 2 will not provide water by the year 2000.

2 Without Aubrey Lake, the Roanoke, Cooper, and Lakeview Lakes will provide only 61.6 mgd of the required 134 mgd.

Table II-22

Reservoirs Studied to Prevent Anticipated Deficit

Reservoir	Water Available (mgd)	Cost Per 1,000 Gallons	Earliest Year Available
Aubrey	62.8	$0.0811	1983
Roanoke	13.0	$0.3027	1983
Cooper	39.5	$0.1323	1985
Sulphur Bluff 1	53.7	$0.2044	2010
Sulphur Bluff 2	60.0	$0.1262	2010
Lakeview	9.1	$0.3250	1983

3 The weighted average cost of water, not including the cost of piping the water to treatment plants, from Roanoke, Cooper, and Lakeview Lakes is $0.1967 per 1,000 gallons for 61.6 mgd.

4 If the water from Aubrey Lake is not available to Dallas, alternate sources must be found. Water from these sources, which would probably be more remotely located, can be expected to cost at least as much as the $0.1967 average cited above.

5 Replacement of the Aubrey Lake source of 62.8 mgd at $0.0811 per 1,000 gallons with water at $0.1967 per 1,000 gallons will cost the city of Dallas an additional $2,649,800 per year.

(c) Previous studies conducted by the Corps of Engineers for the Aubrey Lake project indicate a variation from the preliminary study results prepared by Forrest and Cotton, Inc. for the city of Dallas. An annual cost of $2,129,100 has been allocated to Dallas for an average of 63.66 mgd, or $0.0915 per 1,000 gallons. On this basis, the additional cost to Dallas to replace the Aubrey Lake source is $2,411,400, or $238,400 less than indicated from interpretation of the Forrest and Cotton, Inc. study (11).

(d) These observations indicate the critical need by the city of Dallas for the Aubrey Lake project from both the standpoint of time and money.

(2) The Recreation Demand and Recreation Needs.

(a) Recreation Demand.

1 The Outdoor Recreation Review Commission, the Bureau of Outdoor Recreation, and the Texas Parks and Wildlife Department have concluded from past trends that outdoor recreation participation can be expected to increase significantly in future years. This will be particularly true in highly urbanized areas such as the Dallas-Denton-Fort Worth metroplex. The following factors contribute to the increased demand for outdoor recreation:

a A rapid population growth in this area of the State;

b An increase, larger than the national average, in the number of older people, retired or otherwise, with time for outdoor recreation;

c An increase, larger than the national average, in the number of young people not yet in the labor force;

d Steady growth in the per capita real income;

e Improved travel facilities; and

f Increased amounts of leisure time.

2 A reasonably accurate picture of the increasing demand for water-based outdoor recreation can be gathered from examination of recreation visitation data for the four Corps of Engineers lakes in the area. These four lakes have 45,510 surface acres in their normal conservation pools, and they attracted a total of 9,783,500 visitors in 1972. Visitation has increased from 3,927,000 visitors in 1954 to 9,783,500 visitors in 1972. These lakes, although heavily used for recreation, were constructed with flood control as the primary purpose. For recreation purposes, there are not enough access areas, picnic areas, swimming beaches, and almost no camping or rental services. The increasing urban population has put a severe strain on the existing lake facilities to meet the recreation demand. With the severe crowding at present, and the increasing rate of demand, there is not enough surface water to meet the future population's recreation needs.

(b) Recreation Needs.

1 Determination of recreation needs is based on the demand and supply characteristics of the counties that comprise the Dallas-Denton-Fort Worth metropolitan area. Need arises when the demand for recreational opportunities exceeds the supply of recreational opportunities, and conversely, idle recreational capacities exist when the supply of recreational opportunities exceeds the demand for them.

2 The total projected unmet recreational needs are as follows:

1980	1990	2000	2010	2020
3,432,551	5,105,540	7,158,338	9,645,353	12,593,418

(c) The Importance of Meeting Identified Needs. There are millions of people using the existing lakes and facilities in the Dallas-Denton-Fort Worth area. If additional water resource projects are not available to meet the increasing demand for outdoor recreational opportunities, the environment of existing projects will suffer from the increased amount of visitation, the quality of the recreational experience for each person will be reduced, and the recreational needs of this area will not be met.

(3) Flood Control Needs. Without adequate facilities to regulate runoff from the major portion of the watershed, flooding can be expected on and along the Elm Fork at almost any time of the

year. Lewisville Lake would continue to be the sole source of flood control for the Elm Fork, and damages resulting from floods will likely increase if unrestricted urban development in flood plain areas continues.

i. Other Agencies. Other agencies with authority to implement various programs will continue to try to provide the necessary help to satisfy the social, cultural, economic, water supply, and recreation needs which will develop in the watershed.

SECTION III

THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

PLATE III - 2

Net Effects of Aubrey Lake on Downstream Discharges in Cubic Feet Per Second
(Flood Control Spills and Water Supply Conservation Yields Return Flow)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Average Annual Total	Return Flow Percentage (1)
1924	58	58	- 394	- 184	- 10	58	58	58	58	58	58	58	- 6	63
1925	46	46	46	46	46	46	46	46	46	46	46	46	46	50
1926	57	57	57	57	57	57	- 735	- 175	57	56	57	- 118	- 43	61
1927	- 219	- 964	-1775	- 715	- 265	48	- 152	55	55	55	55	- 281	- 342	59
1928	55	55	55	- 16	- 287	- 493	55	55	55	55	55	55	- 25	59
1929	61	2	61	61	-1848	3	61	61	61	61	61	61	- 108	66
1930	61	61	61	61	- 174	61	61	61	61	61	61	- 107	27	66
1931	50	- 398	- 580	- 131	50	50	50	50	50	50	50	50	- 55	54
1932	-2531	-1151	- 78	68	- 71	68	- 375	68	68	68	68	68	- 311	73
1933	55	55	- 800	- 21	- 584	55	55	55	55	55	55	55	- 76	59
1934	51	51	51	51	51	51	51	51	51	51	51	51	51	55
1935	62	62	62	62	-3630	- 690	62	62	62	62	62	- 621	- 365	67
1936	54	54	54	54	54	54	54	54	- 568	- 831	54	15	- 75	58
1937	- 356	54	- 67	54	54	54	54	54	54	54	54	54	10	58
1938	7	-1962	-1297	- 146	67	67	67	67	67	67	67	67	- 239	72
1939	49	49	49	49	49	49	49	49	49	49	49	49	49	53
1940	58	58	58	58	58	- 266	- 657	58	58	58	- 287	-1591	- 195	63
1941	- 3	- 893	- 86	- 823	- 225	-2648	71	71	71	- 202	- 134	6	- 400	76
1942	74	74	74	-1256	- 177	- 137	74	74	74	74	74	74	- 75	80
1943	58	58	- 750	- 170	- 568	- 73	58	58	58	58	58	58	- 91	62
1944	64	- 236	- 476	- 326	-1014	64	64	64	64	64	64	64	- 128	69
1945	76	-1637	3	- 96	76	- 480	- 147	76	- 99	- 412	74	76	- 207	82
1946	- 254	- 58	- 119	- 125	- 13	- 315	71	71	71	71	- 915	6	- 126	76
1947	- 7	- 58	25	- 292	- 302	- 150	58	58	58	58	5?	- 196	- 48	62
1948	- 607	- 527	- 145	58	- 435	54	- 37	58	58	58	5[illegible]	58	- 112	63
1949	58	58	58	58	-1287	- 208	58	58	58	- 421	58	58	- 116	63
1950	- 483	- 793	65	46	- 531	- 151	- 25	- 215	- 75	65	65	65	- 164	70
1951	48	48	48	48	48	- 427	48	48	48	48	48	48	8	52
1952	49	49	49	49	49	49	49	49	49	49	49	49	49	53
1953	54	54	54	54	54	54	54	54	54	54	54	54	54	58
1954	46	46	46	46	46	46	46	46	46	46	46	46	46	50
1955	46	46	46	46	46	46	46	46	46	46	46	46	46	50
1956	46	46	46	46	46	46	46	46	46	46	46	46	46	49
1957	70	70	70	-2453	-7349	- 679	70	70	70	- 100	-1681	- 39	- 990	75
1958	- 381	18	- 461	- 496	- 452	- 152	- 127	64	64	64	64	64	- 144	69
1959	58	58	58	58	58	58	58	58	58	- 381	58	- 494	- 24	63
1960	- 677	- 81	- 62	58	- 116	58	- 129	- 17	58	58	58	58	- 61	62
1961	7	- 302	- 328	61	61	50	61	61	61	61	61	61	- 7	66
1962	53	53	53	- 188	53	- 771	- 253	53	-2349	53	- 549	- 109	- 325	57
1963	46	46	46	- 143	- 296	46	46	46	46	46	46	46	2	50
1964	49	49	49	49	49	49	49	49	-1581	49	-1772	- 126	- 253	53
1965	- 202	- 432	- 8	58	- 431	- 194	58	58	- 40	58	58	58	- 80	62
1966	64	-1113	- 94	-1125	- 175	- 2	64	64	- 40	64	64	64	- 180	69
1967	52	52	52	52	- 626	- 953	52	52	52	52	52	52	- 88	56
1968	70	70	-1899	- 145	- 255	- 193	53	70	32	12	- 11	70	- 186	75

1924-1968 Net reduction for this period - 116

Romayor stream gage average flow 1924-1968 +7155

Percent Reduction at Romayor Due to Aubrey
(7155 - 116) ÷ 7155 = .984 or 1.6% Reduction

(1) Based on 2085 Conditions as a Percentage of the Difference in Water Supply Dependable Yields for 2 Conditions (1. Lewisville Lake only and 2. Lewisville - Aubrey Lakes System).

SECTION III - THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

1. Introduction of Environmental Evaluation System (EES).

a. Need for an Environmental Evaluation System.

(1) Traditionally, most final decisions bearing on the feasibility of water resource projects such as Aubrey Lake were based primarily on benefit-cost analyses that considered cost versus National and regional economic benefits. These costs and benefits were readily comparable in commensurate monetary terms. However, the mandate of the National Environmental Policy Act of 1969 now requires that a greatly widened range of effects must be considered in addition to costs and benefits during the earliest project planning stages. Central to these effects are the impacts of a proposed project on the natural and human environment, on ecosystems, on the social environment, on esthetics, and on archeological and historical sites. In most cases these impacts are not measurable at present in monetary terms or in other commensurate units.

(2) In order to effectively analyze the wide and varied range of these impacts and their interactions, and to evaluate their relative impact, a systematic and reproducible method of impact measurement in commensurate units is necessary. Toward this end, the Bureau of Reclamation commissioned Battelle-Columbus Laboratories to develop a system and procedures for such evaluations for water resource projects.

(3) The system produced by Battelle-Columbus Laboratories, known as the Environmental Evaluation System (51), was reviewed by the District Engineer for its applicability to water resource projects planned in the Fort Worth District. In the case of the proposed Aubrey Lake project, it was determined that use of the Battelle-Columbus Environmental Evaluation System (EES) would provide a sound basis for evaluation of the environmental impacts of the proposed reservoir. As a result, North Texas State University was commissioned to conduct an evaluation of the proposed Aubrey Lake site employing the EES (10).

b. Description of the Basic Principles Employed in the EES.

Since data from this North Texas State University evaluation form the central core of the impact material presented in this statement, a brief description of the basic principles employed in the EES is included in this environmental impact statement in order to provide an insight into its central premise and method of application. A more complete description of the evaluation procedures with mathematical formulas and their application is included in appendix A.

(1) By reducing nature's complex environmental system with its many considerations and interactions to a relatively few systematic

measurements and indicators, the EES provides a useful, effective, and practical tool for conducting an evaluation of the impact of a proposed action on the environment. Essentially, the EES measures the environmental setting with and without the proposed action. The results, representing the sum measurements of individual environmental considerations in common units of measurement, indicate the relative desirability or undesirability of the proposed action from an environmental viewpoint. However, since the results of an EES evaluation are only one among several facets considered in final evaluation of a proposed project, a negative environmental viewpoint does not in itself preclude action on a given project.

(2) The EES divides the total environment into 4 main categories, 18 components (subcategories), and 78 parameters (sub-subcategories). Each of the 78 parameters represents a unit of environmental significance worthy of separate consideration and is assigned a number of Parameter Importance Units (PIU). The number of PIU's assigned to each parameter reflects the relative importance of the particular parameter in the total environmental picture (plate III-1).

(3) To determine the significance that the proposed action has on each of the 78 parameters, the project setting is evaluated to determine the quality of each parameter at the site before commencing and after completion of the project. This quality is rated on a scale from zero to one, with zero representing extremely low quality and one representing extremely high quality. Each "before" and "after" quality rating (EQ) is then multiplied by its respective assigned parametric units (PIU) to obtain an Environmental Importance Unit (EIU) value before and after the proposed action. The impact of the proposed action (project impact) for each parameter is determined by subtracting the before project EIU value from the after project EIU value.

(4) Since the project may have an adverse or a beneficial effect on the various parameters considered, the project impact for a particular parameter may be preceded by a minus (-) or a plus (+) sign. A minus sign indicates an adverse environmental impact for a parameter, and a plus sign indicates a beneficial environmental impact. The algebraic sum of the project impacts for all 78 parameters indicates the positive or negative environmental impact of the proposed action.

(5) Potential problem areas arising from significant adverse (-) project impact changes or from data gaps are keyed by "red flags." Red flags, therefore, indicate parameters which require further detailed study and/or which should be given special consideration during planning and modification of the proposed action. A mathematical summary of each of the four main categories is given in tables III-1, III-2, III-3, and III-4. Table III-5 presents an overall summary of the four categories.

AD-A087 481 ARMY ENGINEER DISTRICT FORT WORTH TEX F/G 8/8
ENVIRONMENTAL IMPACT STATEMENT, AUBREY LAKE, ELM FORK, TRINITY --ETC(U)
1973

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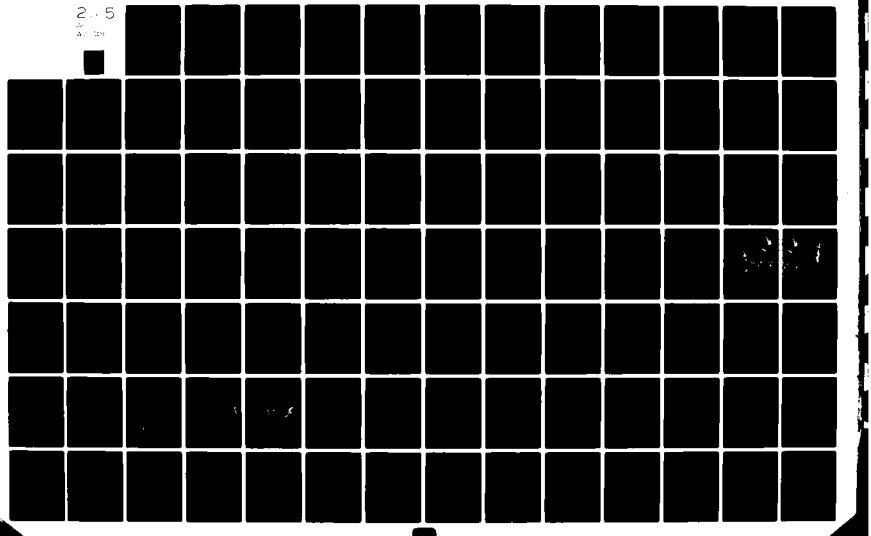

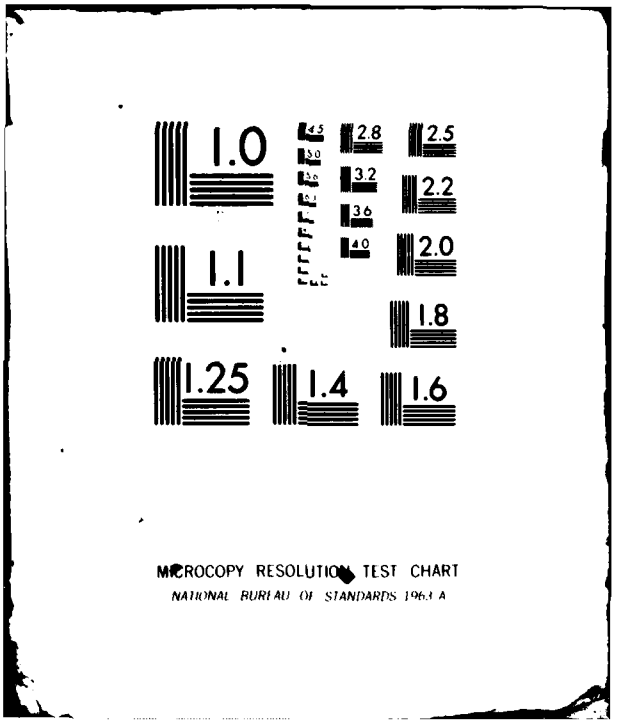
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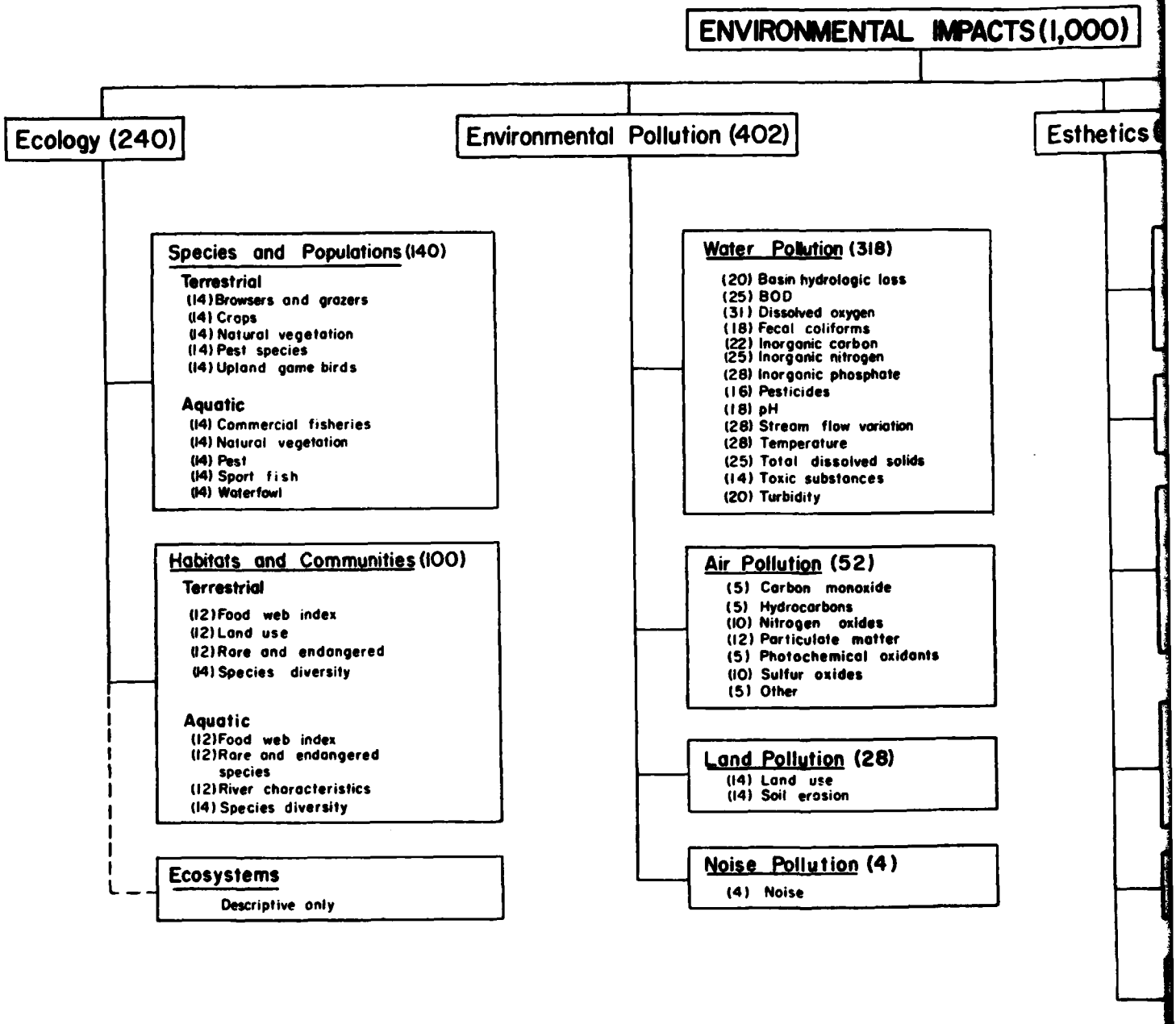

ENVIRONMENTAL IMPACTS (1,000)
Ecology (240)
Environmental Pollution (402)
Esthetics
Species and Populations (140)
Terrestrial
(14) Browsers and grazers
(14) Crops
(14) Natural vegetation
(14) Pest species
(14) Upland game birds
Aquatic
(14) Commercial fisheries
(14) Natural vegetation
(14) Pest
(14) Sport fish
(14) Waterfowl
Habitats and Communities (100)
Terrestrial
(12) Food web index
(12) Land use
(12) Rare and endangered
(14) Species diversity
Aquatic
(12) Food web index
(12) Rare and endangered species
(12) River characteristics
(14) Species diversity
Ecosystems
Descriptive only
Water Pollution (318)
(20) Basin hydrologic loss
(25) BOD
(31) Dissolved oxygen
(18) Fecal coliforms
(22) Inorganic carbon
(25) Inorganic nitrogen
(28) Inorganic phosphate
(16) Pesticides
(18) pH
(28) Stream flow variation
(28) Temperature
(25) Total dissolved solids
(14) Toxic substances
(20) Turbidity
Air Pollution (52)
(5) Carbon monoxide
(5) Hydrocarbons
(10) Nitrogen oxides
(12) Particulate matter
(5) Photochemical oxidants
(10) Sulfur oxides
(5) Other
Land Pollution (28)
(14) Land use
(14) Soil erosion
Noise Pollution (4)
(4) Noise

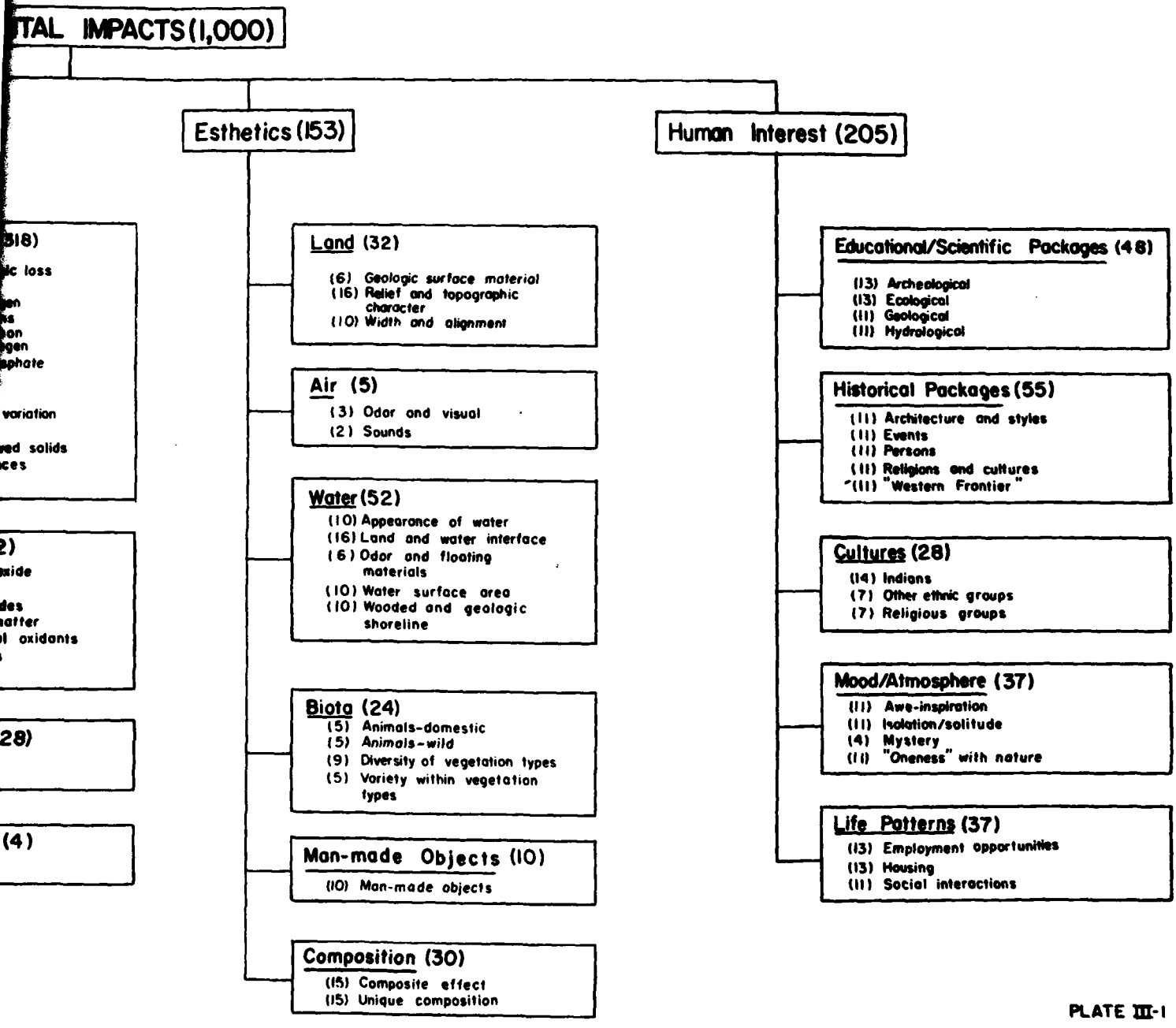

TAL IMPACTS (1,000)
Esthetics (153)
Human Interest (205)
Land (32)
(6) Geologic surface material
(16) Relief and topographic character
(10) Width and alignment
Air (5)
(3) Odor and visual
(2) Sounds
Water (52)
(10) Appearance of water
(16) Land and water interface
(6) Odor and floating materials
(10) Water surface area
(10) Wooded and geologic shoreline
Biota (24)
(5) Animals-domestic
(5) Animals-wild
(9) Diversity of vegetation types
(5) Variety within vegetation types
Man-made Objects (10)
(10) Man-made objects
Composition (30)
(15) Composite effect
(15) Unique composition
Educational/Scientific Packages (48)
(13) Archeological
(13) Ecological
(11) Geological
(11) Hydrological
Historical Packages (55)
(11) Architecture and styles
(11) Events
(11) Persons
(11) Religions and cultures
(11) "Western Frontier"
Cultures (28)
(14) Indians
(7) Other ethnic groups
(7) Religious groups
Mood/Atmosphere (37)
(11) Awe-inspiration
(11) Isolation/solitude
(4) Mystery
(11) "Oneness" with nature
Life Patterns (37)
(13) Employment opportunities
(13) Housing
(11) Social interactions

PLATE III-1

Table III-1

Summary of the EES Evaluation of the Environmental Impact of the Aubrey Reservoir Project on Ecology

Environmental Parameter	Weight (PIU)	With Project (EIU)	Without Project (EIU)	Net Change (EIU)	Red Flags Minor	Red Flags Major
Species and Populations						
(Terrestrial)						
Browsers and Grazers	14	2.80	11.76	-8.96		X
Crops	14	0.00	5.70	-5.70		X
Natural Vegetation	14	0.00	4.34	-4.34		X
Pest Species	14	10.50	5.88	+4.62		
Upland Game Birds	14	0.21	0.87	-0.66		X
(Aquatic)						
Commercial Fish Species	14	4.54	0.003	+4.537		
Natural Vegetation	14	1.12	0.08	+1.04		
Pest Species	14	7.00	8.40	-1.40		X
Sport Fish	14	6.06	0.04	+6.02		
Waterfowl	14	8.82	4.62	+4.20		
Habitats and Communities						
(Terrestrial)						
Food Web Index	12	0.84	7.92	-7.08		X
Land Use	12	5.52	3.96	+1.56		
Rare and Endangered Species	12	6.00	12.00	-6.00		X
Species Diversity	14	0.00	0.91	-0.91		X
(Aquatic)						
Food Web Index	12	6.72	6.96	-0.24		
Rare and Endangered Species	12	12.00	12.00	0.00		
River Characteristics	12	6.36	7.80	-1.44		X
Species Diversity	14	7.56	8.82	-1.26		X
Total	240	86.05	102.06	-16.01	0	10

Table III-2

Summary of the EES Evaluation of the Environmental Impact of the Aubrey Reservoir Project on Environmental Pollution

Environmental Parameter	Weight (PIU)	With Project (EIU)	Without Project (EIU)	Net Change (EIU)	Red Flags Minor	Red Flags Major
Water Pollution						
Basin Hydrological Loss	20	19.60	19.60	0.00		
BOD	25	20.00	12.50	+7.50		
Dissolved Oxygen	31	27.90	29.45	-1.55		
Fecal Coliforms	18	9.00	9.00	0.00		
Inorganic Carbon	22	22.00	22.00	0.00		
Inorganic Nitrogen	25	24.25	20.00	+4.25		
Inorganic Phosphate	28	0.00	0.00	0.00		
Pesticides	16	6.40	8.00	-1.60	X	
pH	18	16.20	16.20	0.00		
Stream Flow Variation	28	28.00	28.00	0.00		
Temperature	28	26.60	28.00	-1.40		
Total Dissolved Solids	25	23.75	23.75	0.00		
Toxic Substances	14	14.00	14.00	0.00		
Turbidity	20	3.00	2.00	+1.00		
Air Pollution						
Carbon Monoxice	5	5.00	5.00	0.00		
Hydrocarbons	5	5.00	5.00	0.00		
Nitrogen Oxides	10	10.00	10.00	0.00		
Particulate Matter	12	12.00	12.00	0.00		
Photochemical Oxidants	5	5.00	5.00	0.00		
Sulfur Oxides	10	10.00	10.00	0.00		
Other	5	5.00	5.00	0.00		
Land Pollution						
Land Use	14	5.60	11.48	-5.88		X
Soil Erosion	14	9.94	8.12	+1.82		
Noise Pollution						
Noise	4	0.87	2.40	-1.53		X
Total	02	309.11	306.50	+2.61	1	2

Table III-3

Summary of the EES Evaluation of the Environmental Impact of the Aubrey Reservoir Project on Esthetics

Environmental Parameter	Weight (PIU)	With Project (EIU)	Without Project (EIU)	Net Change (EIU)	Red Flags Minor	Red Flags Major
Land						
Geologic Surface Material	6	1.20	0.84	+0.36		
Relief and Topographic Character	16	0.32	0.32	0.00		
Width and Alignment	10	3.14	1.90	+1.24		
Air						
Odor and Visual	3	2.70	2.70	0.00		
Sounds	2	0.20	1.10	-0.90		X
Water						
Appearance of Water	10	4.32	4.00	+0.32		
Land and Water Interface	16	4.03	4.80	-0.77		
Odor and Floating Materials	6	3.24	2.40	+0.84		
Water Surface Area	10	7.24	1.25	+5.99		
Wooded and Geologic Shoreline	10	9.08	3.66	+5.42		
Biota						
Animals - Domestic	5	2.00	4.50	-2.50		X
Animals - Wild	5	2.65	2.75	-0.10		
Diversity of Vegetation Types	9	3.60	3.15	+0.45		
Variety Within Vegetation Types	5	1.60	1.30	+0.30		
Man-Made Objects						
Man-Made Objects	10	3.60	3.90	-0.30		
Composition						
Composite Effect	15	6.60	6.00	+0.60		
Unique Composition	15	0.00	0.00	0.00		
Total	153	55.52	44.57	+10.95	0	2

Table III-4

Summary of the EES Evaluation of the Environmental Impact of the Aubrey Reservoir Project on Human Interest

Environmental Parameter	Weight (PIU)	With Project (EIU)	Without Project (EIU)	Net Change (EIU)	Red Flags Minor	Red Flags Major
Educational/Scientific Packages						
Archeological	13	3.12	7.80	-4.68		X
Ecological	13	10.40	7.80	+2.60		
Geological	11	6.60	2.20	+4.40		
Hydrological	11	8.88	6.66	+2.22		
Historical Packages						
Architecture and Styles	11	0.22	2.20	-1,98		X
Events	11	2.86	2.20	+0.66		
Persons	11	2.20	1.10	+1.10		
Religions and Cultures	11	1.76	3.30	-1.54		X
"Western Frontier"	11	0.00	0.00	0.00		
Cultures						
Indians	14	0.00	0.00	0.00		
Other Ethnic Groups	7	0.00	0.00	0.00		
Religious Groups	7	4.20	4.20	0.00		
Mood/Atmosphere						
Awe-Inspiration	11	1.32	1.10	+0.22		
Isolation/Solitude	11	2.20	4.40	-2.20		X
Mystery	4	1.60	1.40	+0.20		
"Oneness" with Nature	11	2.20	1.10	+1.10		
Life Patterns						
Employment Opportunities	13	10.66	9.10	+1.56		
Housing	13	9.49	9.10	+0.39		
Social Interactions	11	7.84	7.70	+0.14		
Total	205	75.55	71.36	+4.19	0	4

Table III-5

Summary of the EES Evaluation of the Environmental Impact of the Aubrey Reservoir Project on Ecology, Environmental Pollution, Esthetics and Human Interest

Environmental Category	Weight (PIU)	With Project (EIU)	Without Project (EIU)	Net Change (EIU)	Red Flags Minor	Red Flags Major
Ecology	240	86.05	102.06	-16.01	0	10
Environmental Pollution	402	309.11	306.50	+2.61	1	2
Esthetics	153	55.52	44.57	+10.95	0	2
Human Interest	205	75.55	71.35	+4.19	0	4
Total	1,000	526.33	524.49	+1.74*	1	18

*Environmental Impact Index of the Aubrey Reservoir Project on four environmental categories.

2. Hydrological Elements.

a. Water Quality.

(1) In the Project Area.

(a) General.

1 The water impounded by Aubrey Dam will be of similar quality to that presently experienced at the proposed damsite. Chemical and biological constituents of natural waters are dependent on several factors including soil types, physical channel characteristics, streamflow characteristics, climatic characteristics, and the activities of man. Impoundment of Aubrey Lake will change both channel and flow characteristics in the lake area. The activities of man will change. New and improved domestic wastewater facilities planned for the Elm Fork Basin above Aubrey Dam will substantially reduce stream pollution. All of these factors will have an effect on the quality of water in Aubrey Lake.

2 The Trinity River Authority has conducted an additional water quality study on the project. The results of this study were presented to the Fort Worth District, Corps of Engineers, in a report entitled "Aubrey Reservoir Effect on Water Quality" (40).

(b) Short-Term Effects.

1 The short-term effects on chemical parameters are difficult to predict. They depend to a great extent on the chemical and organic content of the inundated soils. Initially, after impoundment, leaching of the mineral and organic constituents of the soils causes increases in color, potassium, forms of nitrogen, and biochemical oxygen demand (BOD), with corresponding decreases in dissolved oxygen concentrations and pH.

2 Impoundment will have its greatest effect on biochemical oxygen demand. Inundating standing trees, grasses, and organic soils will cause an immediate increase in BOD. The largest increases will occur in heavily forested areas not cleared before inundation. The total effect and the time required to completely neutralize the problem is dependent on so many physical and climatological factors that it defies definition. However, with median flow conditions and normal variations in lake elevations, the effect should diminish rapidly after the conservation pool is filled.

3 Dissolved oxygen concentrations in the lake will be low initially, reflecting the high BOD, but will still be ample to support aquatic life. Dissolved oxygen will recover rapidly as the BOD

concentrations decrease. Algae growth will increase due to the inflow and leaching of nutrients. Initial growth in some areas will be heavy, but as domestic waste loads of nutrients are reduced and bed nutrients are leached out, substantial reductions in algae will occur. Algae blooms should not be heavy enough to affect the taste or odor of water withdrawn near the dam for domestic use.

(c) Long-Term Effects. The long-term effects of impoundments on the water quality are not as great as the initial effects shown above. Water temperature will be more constant. Turbidity will decrease, especially near the dam. It has been shown that certain constituents, such as inorganic carbon, ammonia, and coliform, will decrease in an impoundment; therefore, these should cause no adverse effect on the Aubrey Lake project. Improved waste treatment facilities will also substantially reduce the concentration of phosphorus, suspended solids, ammonia, nitrites, nitrates, BOD, and coliform entering the lake. Hardness of the water will show a slight increase but will not be a problem. Total dissolved solids concentrations will decrease slightly during impoundment due to dilution. The pH may undergo a slight depression following impoundment because of organic acids formed by leaching, but this change will be very slight and will not adversely affect water quality. However, recreational activities at the 11 public use areas will have the potential for lowering the quality of impounded water. By implementing a sound vegetation management program, the polluting products of erosion should not enter the lake in great abundance. Also, by utilizing the latest techniques for treating and disposing of domestic and solid wastes generated at the public use areas and aboard the boats, the good water quality should be maintained.

(d) Summary. The overall quality of the water impounded by Aubrey Lake should be well within U.S. Public Health Service criteria for surface water sources of public water supply. New and improved waste treatment facilities within the upper Elm Fork Basin should substantially increase the quality of inflow. The water in Aubrey Lake will be of better quality than that presently impounded in Lewisville Lake.

(2) Downstream to the Gulf of Mexico.

(a) General. When the attention is placed strictly on effects on water quality, the source of the water supply becomes insignificant. An expanding population will require a dependable source of water, and the water quality issue will be dependent mainly on the use-consumption rate and adequate treatment in the Dallas-Denton-Fort Worth metroplex.

(b) Above Dallas. The main project related benefit to water quality would take place between Aubrey Lake and Dallas, where the

more constant flows from the lake would aid in maintaining the high quality water in the Elm Fork.

(c) From Dallas to the Gulf of Mexico. With Aubrey Lake situated on the Elm Fork, the water impounded by the selected damsite would be of high quality. However, after this water served the populations in the Dallas area, the return flows reentering the Trinity River below Dallas would be of an understandable lower quality. Nevertheless, the water originally impounded at Aubrey Lake, after serving the Dallas area and being returned to the Trinity, then flowing the entire distance to the Gulf of Mexico with many more use-consumption and treatment factors entering along the way, would lose its identity completely as "Aubrey water", but should maintain adequate water quality.

b. Water Supply.

(1) Above Dallas. After construction of the dam, water not released for water supply to the cities of Dallas and Denton will be held and accumulated until the conservation pool of the lake is attained. A dependable water supply of 84 mgd initially will be available to the cities of Dallas and Denton after deliberate impoundment is initiated, and the conservation pool is regulated for water supply purposes.

(2) From Dallas to the Gulf of Mexico. Placing a dam containing flood control and conservation storage such as Aubrey Lake on a river or stream will certainly alter the natural rate of flow. Very generally, the dam will reduce the portion of high flows normally recorded during flood periods and increase the low flows normally recorded during drought periods. The result will be a more uniform flow recorded on the river or stream, with a reduction in the very large fluctuations between high and low flows. However, while aiding the "leveling out" of the peak high and low flows, the dam serves as a water retention structure with releases being made at rates different from the inflow rates. The average annual flow in the river or stream below the dam will be slightly reduced because of evaporation and consumption losses. In order to assess the previously described probable effects that Aubrey Dam and Lake would have on the existing Trinity River from Dallas to the Gulf of Mexico, flow data was researched and accumulated on the Trinity River for the period of 1924 to 1968. The net effects that Aubrey Lake would have had on reductions and increases in flows in the Trinity River are shown in plate III-2. The sum of these net effects for those years is represented by an average annual loss of 116 cfs in the rate of flow in the Trinity River below Dallas. To further compare this reduction to the flows into Trinity Bay, the deficit of 116 cfs was subtracted from the average annual flow recorded at Romayor stream gage for the same study period, 1924-1968. This amount would be a reduction of 1.6 percent in the average annual flow into Trinity Bay at this point.

During this study period the critical drought of record occurred from 1952 to 1957. Due to the constant releases from the water supply storages at Aubrey and the additional storage at Lewisville, the flows on the Elm Fork would have been increased during this critical drought period. This increase would have also been registered by an increase in the return flows from wastewater treatment facilities by the city of Dallas. Overall, during this 1952-1957 period, the Aubrey Lake additional water supply and return flow would have increased the average rate by 48 cfs below Dallas.

c. Thermal Stratification.

(1) General. According to Hanson (13), thermal stratification is the condition of a body of water in which the successive horizontal layers have different temperatures, each layer more or less sharply differentiated from the adjacent ones, the warmest at the top. The epilimnion, or uppermost layer of the lake, has essentially uniform temperature. The thermocline, or middle layer, is the area in which there is a phenomenal drop in temperature per unit of depth. The lowermost layer, or hypolimnion, also has a relatively uniform temperature from its upper limit to the bottom (figure III-1).

(2) Chemical Parameters. Thermal stratification also affects other quality parameters. Dissolved oxygen concentrations decrease with depth, the most pronounced change being at the thermocline. Concentration of dissolved solids should be greater in the hypolimnion during stratification.

(3) Environmental Effects. The outlet works at Aubrey Dam will have the capability of releasing water from the epilimnion, the hypolimnion, or combining releases from both layers. Therefore, the thermal stratification of Aubrey Lake is not expected to cause adverse environmental effects downstream.

3. Biological Elements.

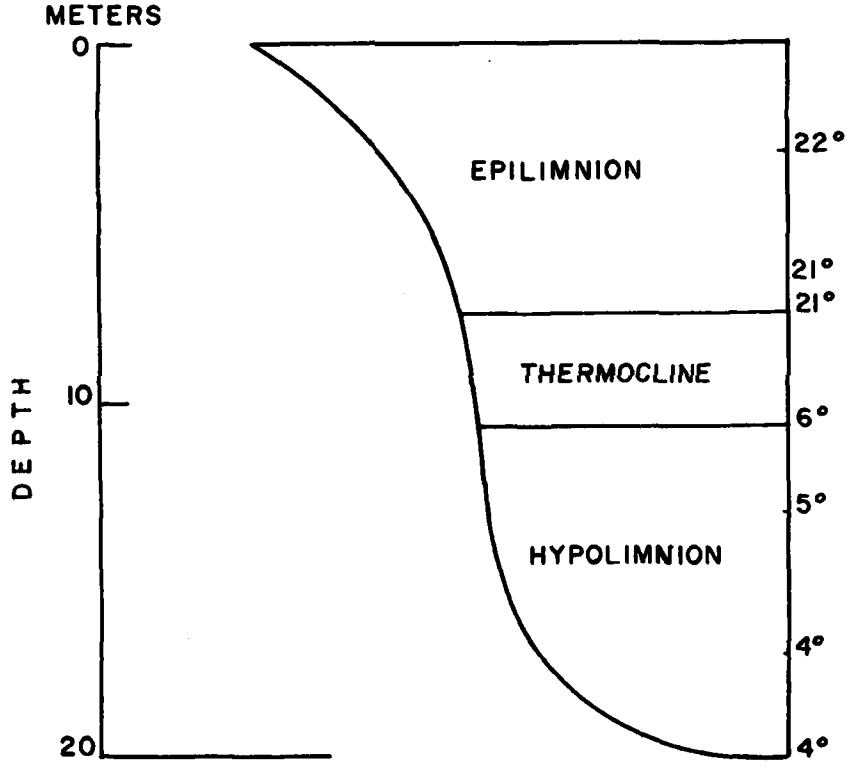
a. Vegetation.

(1) History of the Area Vegetation. Until settlers arrived in the early 1800's, forests covered all of the proposed reservoir site. Slowly, settlers cleared portions of the East Cross Timbers for cultivation and domestic use. Today, the remaining forests are found mainly along the streambeds.

(2) General Impacts of the Project. Most of the land at the selected Aubrey Lake site could support a post oak or streamside forest. Man's actions have reduced the actual forests to less than 5,000 acres. The best possible situation, ecologically, would be to let the entire site return to natural forests. However, even if the reservoir is not constructed, demographic, economic, and other factors would preclude the area's return to climax vegetation. Construction of the reservoir represents a conversion of the present terrestrial disclimaxes to aquatic ones. Also, a portion of the

Figure III-1

Summer Thermal Stratification



Numbers at right represent the temperature conditions from the surface to bottom, expressed in degrees Centigrade. Various detailed values used, such as depths, temperature decline in the thermocline, and temperature distribution, differ in different lakes, but the essential features in this seasonal cycle remain the same (50).

Note: 4.0° Centigrade = 39.2° Fahrenheit
22.0° Centigrade = 71.6° Fahrenheit

East Cross Timbers, a unique geographic and vegetative region, will be lost with construction of the project and subsequent inundation. Although the impact of the reservoir on natural terrestrial vegetation will be adverse or negative, establishment of areas around the reservoir which are restricted from certain uses such as grazing, indiscriminant cutting, and vehicular traffic will permit restoration and preservation of some of the unique forests of this area, and will make them available to more people in the future.

(3) Specific Impacts of the Project.

(a) Natural Terrestrial Vegetation. The calculations made according to the Battelle-Columbus Environmental Evaluation System yielded a total impact index for the Aubrey Lake project of -4.34 EIU on natural terrestrial vegetation. The "percent EQ change" equaled -100 percent, numerically the most critical adverse impact possible. In evaluation of this parameter, considering the heavy pressure, the "without" EQ is 0.31, which is relatively low. However, the "with" project EQ is 0 since inundated land has no terrestrial vegetation, resulting in a -100 percent impact.

(b) Natural Aquatic Vegetation. For natural aquatic vegetation, the environmental impact was calculated to be +1.04 EIU for the obvious reason that there will be an increase in suitable aquatic habitat.

(c) Summary. In conclusion, the EES reveals that construction of the proposed project will slightly benefit the aquatic vegetation and will adversely affect terrestrial vegetation in the inundated area.

b. Area Fisheries.

(1) Physical or Chemical Factors of Manmade Lakes That Affect the Fishery.

(a) Short-Term Impacts.

1 High fertility, caused by leaching of the nutrients from the soil, is established in the early stages of the impoundment. This condition can result in extensive plankton blooms and rapid growth of aquatic vegetation and other aquatic organisms.

2 The initial high fertility level of the impounded water will cause a fish population explosion, with fish attaining large sizes in a short period of time -- 2 to 3 years after impoundment. After about 3 years, the water nutrient level will become static at a level consistent with nutrient input from the watershed, and the nutrient cycles in the impoundment and the fishery will attain its natural population level.

(b) Long-Term Impacts.

1 Drawdown periods inhibit growth of aquatic vegetation, and rapid drawdowns may expose areas used for spawning, killing eggs and fry. Drawdowns are also used as a management technique to reduce stocks of undesirable fish, weeds, or over-abundant vegetation.

2 Heavy deposits of silt can smother and inhibit growth of eggs in spawning areas, prevent construction of nests on hard substrata, fill up reservoir areas, and can go far toward ruining the most productive of fisheries. Normal silt loads may be beneficial to a very large impoundment that is situated in a very rocky area. These silt loads settling on an otherwise stony and unproductive substrata will improve the productivity of the otherwise infertile area.

3 Overgrazing by livestock destroys emergent aquatic vegetation during low-water periods and prevents its use for food production and cover by recently spawned fish when water is at the higher level again.

(2) Commercial Fisheries. The commercial fishing industry in Texas, which is subject to article 4050c, Vernon's Annotated Civil Statutes, is small, but it provides, for those who engage in it, an independent and satisfying life-style which is in itself probably as important as the economic worth of the catch. Any effect of the project on commercial fish species will affect commercial fishermen directly and will also serve as an indicator of potential changes in other aspects of the environment.

(a) Specific Impacts of the Project.

1 Input data in the worksheet matrix and calculations from the Battelle-Columbus EES yielded an impact index of +4.54 EIU (a marked beneficial impact on commercial fish species).

2 From a commercial standpoint, as it pertains to the removal of rough fish from public fresh waters, the Parks and Wildlife Department will have discretionary authority over Aubrey Lake on matters pertaining to commercial fishing. Separate contracts shall be let for each body of public fresh water or portion thereof when the Department finds that rough fish or turtles exist in any such waters in numbers detrimental to the propagation and preservation of game fish. Vernon's Annotated Civil Statutes, Article 4050c, section 6, gives the statutory definition for rough fish as follows:

> "Rough fish as used in this Act shall include those freshwater fishes having no sporting value, the predatory, bony or rough-fleshed species, or any species of fish whose numbers should be controlled in order to protect and encourage game fish; provided, however, that the term 'rough fish' shall not include

black bass, white bass, crappie, bream, sunfish, channel catfish or yellow catfish, which are, for the purposes of this Act, 'game fish.'"

Vernon's Annotated Civil Statutes, article 4050c, section 5, states that rough fish removed in accordance with the above State law may be sold.

3 While the harvest of fish from the upstream and downstream areas will remain nearly the same following construction of the proposed project, the harvest of fish from the inundated reservoir site will, of course, increase significantly (table III-6).

(b) General Impact of the Project. In the next two decades, the human population of the United States will continue to grow, and the demand for animal protein may increase the relative value of freshwater fish products. With or without an increased demand for fish in the future, there is little doubt that the beneficial impact of Aubrey Lake on the area's commercial fisheries would be very substantial.

(3) Sport Fisheries.

(a) The Sport Fishing Industry. The avid sport fisherman in Texas may spend hundreds of dollars per year for gear, motors, travel, and lodging. Sport fishermen can be expected to be extremely sensitive to any impact of the proposed Aubrey Lake on sport fishery resources in the area.

(b) Present Sport Fishery Characteristics. In general, streams are more productive for fish populations than lakes, reservoirs, or ponds because of the relatively large energy inputs to stream ecosystems from the surrounding terrestrial ecosystems. All three areas, i.e., upstream, reservoir site, and downstream, are considered to have moderate-to-high productivity without the project because most of the existing aquatic surface area is made up of ponds and somewhat less productive warmwater streams.

(c) Fishery Characteristics During Construction of the Project. During construction of the project, it is assumed that alteration of the stream channel, draining of ponds, increasing turbidities and runoff, and decreasing dissolved oxygen content will decrease productivity.

(d) Impact of the Completed Project on Sport Fisheries. The data entered on the worksheet-matrix for sport fish in the Battelle-Columbus EES and the resulting calculations yielded an environmental impact of +6.02 EIU, a substantial beneficial impact. The negative impact (loss of 1,000 man-days annually) on the small stream and pond fisheries of the reservoir basin during the construction period will be

Table III-6

Maximum Potential Harvest of Commercial Fish Species from the Upstream, Reservoir Site, and Downstream Areas of the Proposed Aubrey Lake
(In Pounds Per Year and Dollar Value of the Harvest)

	Upstream	Site	Downstream
Without Project			
Annual Harvest	27,489 lbs.	1,968 lbs.	457 lbs.
Cash Value	$3,299	$304	$55
With Project			
Annual Harvest	27,489 lbs.	303,600 lbs.	457 lbs.
Cash Value	$3,299	$36,432	$55

offset by the beneficial effects (increase of 500,000 man-days annually) of the project on sport fisheries after construction. The proposed reservoir, when completed, should exhibit moderate-to-high productivity, some fluctuation in water supply and quality, and a large fish population to satisfy the interests and demands of the most avid sport fisherman.

c. Estuarine Organisms in Galveston and Trinity Bays.

(1) Summary.

(a) Most streams and creeks find their ways to rivers, which in turn eventually flow into the sea. Where a river meets the sea, a special and distinctive aquatic environment called an estuary is formed. This peculiar environment acts as a buffer zone in which the river water mixes with, and measurably dilutes, the sea water. Certain physical and chemical factors are typical of the estuary and are not encountered in lakes and streams. One such factor is the system of two opposing currents which meet in the estuary and together exert considerable and complicated effects on the biota. Another factor is the mixing of saltwater and freshwater which produces a chemical environment quite unlike that of the typical river or the sea. The organisms that inhabit the estuary are confronted with chemical and physical factors such as salinity, temperature, and currents which essentially regulate their number and distribution. The extent to which these factors serve to limit a population depends upon the tolerance of the organisms to a single factor or combination of factors. Salinity is an example of an environmental factor which limits organisms. Essentially, it is this specific factor, and the various biological adaptations to it, that distinguish marine and freshwater organisms (31).

(b) The tide is another critical factor which directly affects the organisms in the estuary. Many mobile species come in and go out, or at least move downstream from the head of the estuary, with the tide. In general, the penetration of estuaries by marine and freshwater organisms is dependent more on the rate and magnitude of tidal changes than on the actual salinity gradient. In addition to the many adult species that invade the estuary in pursuit of food, there are also seasonal migrants. These migrants include those species which enter the estuary to spawn, those species which pass through on their way to the river or the sea to spawn, and those species which migrate as young into an estuary to feed (14).

(c) The volume of freshwater reaching the estuary is also a critical factor which influences the inhabiting organisms. Some of the effects of inflows of fresh water may be harmful, others may be beneficial. The amount is obiously affected by many natural conditions, e.g., precipitation, topography, climate, soils, and vegetation. In addition, man also alters freshwater inflows in many ways, i.e., different water resource projects. Construction of dams within a

basin affects timing of inflows to the estuary, and could reduce annual inflows by aiding or increasing consumptive uses, reuse of renovated wastewater, evaporation, transpiration, and seepage. Even this brief list of natural and manmade factors which affect the presence of freshwater in estuaries demonstrates that the answers to many questions are concealed by those complex interrelationships among a multitude of actions and phenomena. Predicting the effects of water resource projects upon the presence of freshwater in estuaries is an exceedingly difficult undertaking, because these important relationships of freshwater inflows to estuarine life are incredibly complex and not fully understood (16).

(2) Conclusion. It is concluded from the hydrological data previously presented on net flows into Trinity Bay (section III, paragraph 2b) and these excerpts from Reid (31), Hedgpeth (14), and Johnson (16) that no adverse impacts on estuarine organisms could be connected directly to the selected Aubrey Lake project being included in the Trinity River system.

d. Birds.

(1) Upland Game Birds. It is estimated that the construction activities and inundation processes of Aubrey Lake will permanently destroy approximately 25 percent of the upland game bird habitat in the area. However, in the project area between the top of the conservation pool (elevation 627.0 msl) and the top of the flood control pool (elevation (636.0 msl) there will be about 7,400 acres. Of this area, some portion will be available each year for habitat needs except during those periods when the lake surface elevation reaches 636.0 feet msl. This elevation is expected to be reached on an average of once every 46 years, with a duration of only a few days. As calculated in the North Texas State University report, the Battelle-Columbus EES yielded a -0.66 EIU on upland game birds.

(2) Upland Wild Birds. Although Battelle-Columbus EES was not used specifically to assess an impact on wild birds, the mathematical evaluation derived for upland game birds should closely parallel the missing estimate. There will be an estimated increase of 3,000 man-days annually of nonconsumptive wildlife oriented recreation.

(3) Waterfowl.

(a) The proposed Aubrey Lake should significantly add to the existing wetlands suitable for waterfowl in north central Texas. This is because woodlands, rivers, streams, lakes, ponds, and reservoirs that occur along migratory routes are of significant value to migrating waterfowl. From these wetland areas, suitable habitat, which in many cases has been created through construction

programs of Federal and State agencies, is used for resting and feeding areas by waterfowl. Aubrey Lake should increase the availability of suitable wetland habitat for these important species of wildlife.

(b) It is expected that Aubrey Lake will be used as a rest area and will "shortstop" a percentage of the waterfowl during both north and south migrations. However, agricultural land around the project is mostly in pasture with very little of it planted in grains or crops suitable for waterfowl feeding. Therefore, it is doubtful that migrating waterfowl would stay in the reservoir area for any length of time. It is estimated that an additional 400 man-days annually of waterfowl hunting will develop because of the project.

(c) Data entered in the Battelle-Columbus EES yielded an environmental impact of +4.2 EIU, a substantial beneficial impact, on waterfowl.

e. Mammals. To estimate the impact on the mammals within the proposed Aubrey Lake site, two separate viewpoints are employed. First, an intangible impact involving the human aspect of esthetics; and second, a more measurable impact involving the mammals' indispensable, interacting niche within an ecological community.

(1) Intangible Impact on Esthetics. The presence of wild animals, which includes the mammals, adds to the local color of an area. Observance of wild animals by amateur naturalists is increasing as an awareness of the "out-of-doors" becomes more prevalent. No effect on wild animals is anticipated upstream from the site. The effect on wild animals' habitat in the project area would be adverse if one considers the land area to be inundated and dedicated to possible inundation in the flood control pool. Also, the concentrated recreational use of the remaining habitat in the project area will add to the adverse effects. The data entered in the Battelle-Columbus EES yielded an environmental impact of -0.10 EIU on wild animals.

(2) Measurable Impact on the Ecological Community in General.

(a) Generally, a habitat is the sum total of environmental conditions of a specific place that is occupied by an organism, population, or community. A community is composed of many species of organisms interacting in a manner which connects each to all others. Biotic communities are extremely complex levels of ecological organization, possessing a most important functional structure, i.e., food web structure. This structure represents pathways among individuals within the community along which energy is transferred. The mammals in the proposed Aubrey Lake area, as well as all mammals living in their natural surroundings, are a necessary link in the complex terrestrial energy transfer structure (food web).

(b) No adverse impact is anticipated on the terrestrial food web upstream or downstream from the proposed reservoir. It is expected that a 10 percent reduction in the overall food web index will result from construction related disturbances. With inundation and destruction of the habitat, all terrestrial organisms will be displaced, reducing the index nearly to zero.

(c) The data collected and entered into the Battelle-Columbus EES yielded an environmental impact on the terrestrial food chain index of -7.08 EIU (a substantial adverse impact). A certain portion of this adverse impact would directly affect the mammals which occupy a specific niche or role in the ecological community.

f. Amphibians and Reptiles.

(1) Overall, the Aubrey Lake impoundment will have a slightly negative effect on the population of certain amphibians and reptiles.

(2) The majority of amphibians, such as frogs and toads, and some reptiles, such as turtles and water snakes, should benefit from the increase in standing water. Lizards and snakes will be displaced by removal of a significant portion of their habitat. However, in zones around the reservoir that are permitted to "return to nature," populations of the amphibians and reptiles could be expected to increase in number.

(3) The environmental impact calculated from the Battelle-Columbus EES on wild animals, which includes the amphibians and reptiles, was -0.10 EIU (a slightly adverse impact).

g. Wildlife Management Areas.

(1) Recommendations of Bureau of Sport Fisheries and Wildlife. Implementation of this plan is being considered in response to a recommendation from the Bureau of Sport Fisheries and Wildlife. The Bureau suggests that the game management area include approximately 1,000 acres to help offset the loss of habitat to be inundated by the lake. This plan would improve the habitat and cover for small game and aid in retaining migratory mourning doves. This area would serve as a nature area for sightseeing, nature hiking, wildlife photography, bird watching, and public hunting. This plan would not require any additional land. Nearby residents could be exposed to an increase in the noise level during hunting season. The costs for the development and operation and maintenance of this small game management area for one year would total approximately $12,000. The further development, specific location, and boundaries of this proposed game management area will be included in the master plan for development and operation of the natural resources of Aubrey Lake.

(2) Recommendations of the Texas Parks and Wildlife Department.

(a) Project funds in the amount of $13,200 annually be made available to the Bureau of Sport Fisheries and Wildlife for funding of a fishery study of five years duration to be conducted by the Texas Parks and Wildlife Department in cooperation with the Corps of Engineers and other interested State and Federal agencies, beginning one year prior to the impoundment of Aubrey Lake.

(b) When project lands are acquired, the Texas Parks and Wildlife Department be notified so that farm ponds and floodwater retarding structures located at or within the conservation pool elevation may be conclusively examined for suitability as fish rearing coves or other fishery uses.

(c) Four fish nursery coves be developed at existing floodwater retarding structures suitable for this purpose.

(d) Four seining areas be constructed within the conservation pool of Aubrey Lake.

(e) Impoundment of Aubrey Lake be initiated in the fall of the year to permit early spring stocking with gamefishes.

(f) To increase sport fishing use at Aubrey Lake, 12 access areas of three acres each, providing parking space, boat launching ramps, and sanitary and drinking water facilities, be developed around the middle and upper portions of the reservoir.

(g) A zoning plan to minimize conflicts and promote safety for water oriented recreationists be developed for both Lewisville and Aubrey Lakes by the Corps of Engineers in cooperation with the Texas Parks and Wildlife Department, the Bureau of Sport Fisheries and Wildlife, and other interested agencies.

(h) The Aubrey Lake stilling basin and discharge channel be designed to prevent ponding of water and consequent entrapment of fishes during periods of zero release from Aubrey Dam, or

(i) As an alternate to recommendation (h), the operation of Aubrey Lake be coordinated with that of Lewisville Lake to permit continuous or near-continuous streamflows below Aubrey Lake or at least a daily release of sufficient quantity to recharge the entire reach of stream to Lewisville Lake.

(j) Two access areas having facilities similar to those listed in recommendation (f), except for boat launching ramps, be provided below the dam; one to be located at the side of the stilling basin and the other positioned along the mid-portion of the discharge channel.

(k) Access facilities to be inundated at Lewisville Lake be fully replaced above the new conservation pool elevation.

(l) To mitigate wildlife losses, approximately 1,000 acres of project lands to be acquired in fee title be developed as a management unit, at a cost to the project of $7,000, and made available to the Texas Parks and Wildlife Department under terms of a General Plan as provided for in Section 3 of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

4. Esthetics.

a. General. Since water resource projects modify the environment, they have an impact on elements which are generally pleasing to people's senses. With increasing urbanization, pressures of overcrowding, and a reduced work week, people will make greater demands on "natural" environments. Thus, the importance of maintaining esthetically pleasing "natural" environments is obvious. An esthetically pleasing environment offers an escape from tensions of modern living. Since the proposed Aubrey project site is located close to the large metropolitan areas of Dallas, Fort Worth, and Denton, the esthetic qualities of the area are very important and must be accorded due consideration in the planning, construction, and utilization of the impoundment.

b. Land. The land on which water resource projects are constructed plays an important role in determining the impact of a project on esthetics.

(1) Geological Surface Materials. During the construction period there will be little change in the geologic surface materials at the reservoir site. In 20 years there should be no change in the surface materials, either upstream or downstream, but there would be definite changes within the reservoir. The following changes would result from waves striking the shoreline: The revealing of geological formations; the cutting of landforms such as wave-cut cliffs and terraces; the production of wave-built terraces; and the formation of deltas and lacustrine plains in the upper areas of the lake that would be exposed during periods of low water. Input of these considerations into a worksheet-matrix and calculations yielded a total impact index of +0.36 EIU for the Aubrey project on the geological surface material.

(2) Width and Alinement.

(a) The proportion of the width of a canyon or gorge to its depth and the deviation of a watercourse from a straight line have a direct bearing on the esthetic quality of a valley or stream. The esthetic value diminishes when the valley width increases and its depth decreases. However, there is still esthetic value in wide, shallow valleys. The proposed site for Aubrey Lake is in a region of rolling plains where

the streams seldom cut a valley more than 50 feet below the flood plain. Most of the valleys in the project area are 10 or more times greater in width than depth.

(b) As the Aubrey Lake basin fills with water, the valleys will appear more shallow and their alinement will change. When formed, the lake will have several arms due to the filling of numerous stream valleys that converge just above the damsite. During the 5-year impounding period, an increase in esthetic value will occur. During the use phase, the lake will have a varied alinement, adding to the esthetic value. Input of these considerations into a worksheet-matrix and calculations yielded a total impact index of +1.24 EIU on width and alinement.

c. Air. Esthetics related to the air are based, in part, upon the quality of sounds, odors, and clearness.

(1) Odor and Visual Quality. The areas upstream and downstream from the proposed reservoir site will be affected slightly by construction and use of Aubrey Lake. Admittedly there will be an increase in the exhaust gases and particulate matter in the area atmosphere resulting from an influx of vehicles and recreation machines. However, they are expected to be neutralized by green plants or diluted by wind currents common to the area. Therefore, only insignificant changes in the odor and visual qualities are expected with construction and use of the lake. Inversion layers and smog are not expected to become a significant problem for many years. Therefore, as calculated, the net change on odor and visual quality as a result of the project is 0.0 EIU.

(2) Sounds. The areas upstream and downstream from the proposed project site will be affected very little by construction or use of the Aubrey project. Sound quality on the proposed site is currently enhanced by bird songs, frog calls, insect noises, and an overall quietness. Occasionally a few motor vehicles and farm implements detract from the quietness. During construction, sound quality will decrease. During the use period, increased utilization of the reservoir for recreational purposes will create sounds which are somewhat unpleasant. Input of these considerations into a worksheet-matrix and calculations yielded -0.90 EIU on sound, a significant adverse impact.

d. Water. The esthetic quality of the water resource project itself must be considered as an important environmental component.

(1) Appearance of Water. The visual appeal and esthetic value of water will be increased if it is clean and clear in appearance, and decreased if it is turbid, off-color, or opaque. During construction of the dam, the turbidity of streams in the upstream area will remain

the same, but there will be an increase in turbidity at the impoundment site and in the downstream area. The water should become clearer during the use period. Input of these considerations into a worksheet-matrix and calculations yielded +0.32 EIU on the appearance of water at the project.

(2) Land and Water Interface.

(a) The land and water interface of multiple-purpose impoundments often presents significant esthetic problems. When the water level of an impoundment fluctuates severely, it will result in the exposure of unsightly mud flats, which may dry, crack, and give rise to rank growths of obnoxious weeds before being flooded again. Also, access to the water may become difficult if boat ramps, piers, and walkways are stranded above the waterline.

(b) In the area of the proposed reservoir, the water level of most streams fluctuates markedly with the seasons. In late winter and spring water levels are up, but during the summer months water levels recede gradually. Unsightly mud banks are exposed as a result of the recession. Consequently, without the project, the present influence of water level fluctuation on the esthetics of the area is moderately severe.

(c) Construction activities may cause some minor fluctuations in the water level of Elm Fork, but no major effect on the land and water interface is anticipated. During the use phase of the impoundment water level fluctuations could be severe, and it is expected that mud flats will be exposed to view from time to time. The installation and operation of Aubrey Dam is expected to result in a stabilized flow of water downstream. This flow, coupled with the expected increase in water quality below the dam, will likely allow exposure and accumulation of a more permanent substrata in the bed of the downstream portion of the Elm Fork. Thus, a substrata of sand and gravel will replace much of the silt in the existing streambed. Input of these considerations into a worksheet-matrix and calculations yielded an environmental impact index of -0.77 EIU for the land and water interface.

(3) Odor and Floating Materials.

(a) Many people feel that the inclusion of still or running water increases the esthetic value of an outdoor scene. However, this appeal can sometimes be reduced if the observer, approaching the shore, encounters a variety of obnoxious odors and unpleasant floating materials.

(b) It is expected that the odor and debris present will not change in the upstream area during the construction period. In the reservoir basin and downstream from the dam during construction, the

amount of floating debris will increase. During the use period, the odors are expected to remain noticeable but not objectionable. Based on similar experiences at existing projects, floating materials will probably not be a problem. Furthermore, the large open-water areas will present to the eye a broad expanse of clear water. The Elm Fork below Aubrey Dam should be cleaner, clearer, and less odoriferous after construction, enhancing the environmental quality of this area. Input of these considerations into a worksheet-matrix and calculations yielded an impact of +0.84 EIU on odor and floating materials.

(4) Water Surface Area.

(a) People have a natural attraction to water and its surface appearance. The movement of waves, the reflection of objects on its surface, and the movement of sail boats or motor boats on the water all emphasize the esthetic quality of the water's surface.

(b) All of the streams in the reservoir area are less than 50 feet wide during normal flows, but during floods they may become several hundred feet wide. The portion of the proposed lake immediately behind the dam will have a surface several miles in width. The areas upstream and downstream of the proposed reservoir will not be modified by construction activities. There will be considerable increase in the water surface area during the 5-year construction period. Input of these considerations into a worksheet-matrix and calculations yielded a total impact index of +5.99 EIU on water surface area for the Aubrey project.

(5) Wooded and Geological Shoreline. The areas upstream and downstream from the project site will not be affected by shoreline changes during the construction phase. The mixed lowland forest which is found only near the streams will be lost because of the project. However, the forest will become reestablished on properly managed project lands. Exposure of the more resistant materials by wave action and runoff as well as establishment of beaches is expected. Correspondingly, the shoreline and forest will increase about 30 to 60 percent in the area as a result of the Aubrey project. Input of these considerations into a worksheet-matrix and calculations yielded a total impact index of +5.42 EIU on the wooded and geologic shoreline.

e. Biota. This component concerns the esthetic value of biota in the ecosystems within the reservoir site.

(1) Animals - Domestic. Inundation of pastureland by the Aubrey project will exclude domestic animals from the immediate reservoir basin. Likewise, recreational development will reduce or eliminate populations of these animals from public-use areas and smaller tracts bordering the reservoir. However, larger tracts of adjacent, less fertile upland areas should sustain moderate and generally pleasing levels of domestic cattle and horses. Areas upstream and downstream

from the project should remain unaffected. Transitional effects are considered to occur immediately upon the onset of construction, since few stockmen would leave animals on the construction site due to the hazard of physical injury, reduced forage, downed fences, and other potential accidents. The EES yielded a -2.5 EIU impact on domestic animals.

(2) Animals - Wild. The proposed project is expected to have no effect on wild animals whose territory is located upstream from the site. Construction will cause permanent reduction in habitat that is located in the immediate area of activity. There will be a temporary reduction in the desirability of habitat in those areas immediately adjacent to the construction site. Inundated areas will not be decreased in overall fauna richness because of the influence of an increase in aquatic organisms adjacent to and downstream from the reservoir. Wild animal species and populations in the project area should undergo insignificant change if one considers that the area between the desired operating lake level and the upper guide contour level would not be constantly inundated and therefore should be available to these animals. This area will provide 3,000 additional man-days annually of nonconsumptive wildlife oriented recreation. Input of these considerations into the worksheet-matrix and calculations yielded a total impact index of -0.10 EIU on wild animals for Aubrey Lake.

(3) Diversity of Vegetational Types. The construction phase will not change vegetational uniformity but merely the amount of vegetation. This effect should be confined to the project area. During the use phase of the project, a diversification will be encouraged by a stabilized downstream water table. In time, new types of wetland and marsh vegetation will occur in the upper third of the lake and around the shoreline. The wetland and marsh area will eventually exhibit more diversification. The new plain to be formed by the lake will first support grasses, then many perennials, and finally a pioneer flood-plain forest of willow and cottonwood. Input of these considerations into the worksheet-matrix and calculations yielded a total impact index of +0.5 EIU on diversity of vegetational types at the project.

(4) Variety of Vegetational Types. There is very little variety in vegetational types within the project area. Some species diversification will occur as the project lands are removed from cultivation and the process of natural sucession is permitted to proceed with little interference from man's activities (i.e., clearing and cultivation). Additional species diversification will occur as aquatic and water-tolerant plants become established in those areas of the newly formed lake which provide the necessary ingredients for their proliferation. Input of these considerations into the worksheet-matrix and calculations yielded a total impact index of +0.3 EIU on variety

in vegetation types for the Aubrey project.

f. Manmade Objects.

(1) Most of the manmade objects in the project area will either be moved or dismantled when residents are forced to move out. These objects have been determined to be generally incompatible with the natural surroundings of the area. Based on removal of the offensive objects and construction of compatible objects on Corps of Engineers administrated lands, the impact on manmade objects was determined to be +5.1 EIU as a result of project construction. There will also be development on a band of land about 0.5 mile wide around the project which will be easily visible. It has been assumed that this private development will not take design compatibility into consideration and will result in an impact of -0.30 EIU. This negative impact is impossible to prevent.

(2) It is believed that after construction of the project those manmade elements which are allowed to remain will be a nostalgic reminder of days gone by. Sometime in the future these objects will meld into their surroundings and become a compatible part of the scenery. Input of these considerations into a worksheet-matrix and calculations yielded an impact of +0.6 EIU on the overall esthetic "picture" for the Aubrey project.

5. Geological Elements. A thorough investigation, including both research and field work, has been made to determine the adverse and beneficial effects that the construction of Aubrey Dam and creation of Aubrey Lake will have on the geological elements in the area. Discussion of these effects follows.

a. Adverse Impacts.

(1) An unknown quantity of sand and gravel that occurs in the flood-plain and terrace deposits will be inundated and thus lost for commercial development.

(2) Some producing oil wells in the Jacobs Oil Well Field will be flooded. These wells will be plugged and taken out of production.

(3) Because the predominant soil type is highly erodible in the 11 recreation sites, a vegetative management plan, careful selection of facility sites, and planned development will help to limit the possible degradation of the fragile vegetative cover which reduces loss of topsoil through erosion.

b. Beneficial Impacts.

(1) Aubrey Lake will cover some open gravel pits and spoil piles that detract from the beauty of the countryside.

(2) The nature of the geologic formations that will surround the reservoir are such that, in time, sandy beaches will develop at many locations. These areas, especially along the eastern sector of the lakeshore, could become recreation sites.

(3) Recharge, in the form of seepage from the lake, will ultimately improve the quality of the water in the Woodbine formation.

(4) The sands of the Trinity group - the principal ground-water source in the area - will not be affected.

(5) It is not expected that there will be any pollution of the lake by oil seepage from old abandoned oil test holes that will be covered.

(6) There are no types of geologic outcrops of special academic interest in the reservoir area.

(7) There are no areas of unique or special paleontological interest that will be inundated.

c. Measured Impact of the Project. The Battelle-Columbus EES total impact index of the Aubrey Lake project on geological elements is +4.4 EIU.

6. Archeological Elements.

a. Inventory Request to National Park Service. In a letter dated 4 August 1972, the Fort Worth District, Corps of Engineers, requested assistance of the National Park Service, U.S. Department of Interior, in preparing archeological inventories for certain Corps of Engineers projects, including the proposed Aubrey Lake project. Their reply, dated 4 October 1972, stated that they had received funding authorization for the Archeological Investigations and Salvage Program for FY 73, and that no study funds were included for projects listed in the Corps of Engineers letter of 4 August 1972; therefore, they would not be able to provide data for the Aubrey environmental impact statement.

b. Reconnaissance Report. Under contract DACW 63-73-W-0576, the Archeology Research Program, Department of Anthropology, Southern Methodist University, conducted an archeological reconnaissance of the Aubrey Lake project area. The reconnaissance report prepared by Britt Bousman and Linda Verrett (4) indicated that in the area of the proposed project 26 archeological sites had been located and recorded; that no attempt had been made to locate all of the sites in the area, only a sampling. A majority of the sites exhibit evidence of prehistoric occupation. Appendix F contains an excerpt from the report which provides some details pertinent to all the known sites. Sites designated as 41DN4 through 41DN15 in this appendix are not to be confused with the sites in appendix G carrying identical designations.

c. Impact on Recorded Sites. Twenty-six archeological sites have been cataloged which will be situated within the limits of the impoundment. Because these sites are all located below elevation 655.0 feet msl (maximum design water surface), they will be impacted in any of three ways. Those sites that are covered by silt during the life of the project could be relatively protected from further destruction. Others may be located on the sloping shore or beach areas around the impoundment which will be directly affected by water level fluctuations. This is the area of maximum, unscheduled destruction by wave action erosion, rapid bone and shell leaching caused by repeated inundation, and pilferage by casual relic collectors. Other sites will be affected by construction of the dam. Because of the significant archeological finds uncovered during excavation activities connected with construction of Lewisville Dam and the possibility of uncovering similar finds in the proposed Aubrey Dam area, care will be exercised during excavation operations at Aubrey Lake to bring any material suspected of being of archeological value to the attention of qualified archeologists for evaluation and salvage.

7. Historical Elements.

a. Architecture and Styles. The people who presently live in the area, and those who may occasionally visit their one-time home community, will be adversely affected by the loss of landmark homes in the proposed project area. The Corps of Engineers will work in cooperation with interested agencies, communities, and individuals with the objective of restoring, preserving, or relocating any site that is historically significant or unique. Presently, further study is being conducted on protecting and restoring the oldest of the three houses built by members of the Hammons family, as discussed in section II. Input of these considerations into worksheet-matrix and calculations in the Battelle-Columbus EES yielded a total impact index of -1.98 EIU for the Aubrey Lake project on the "architecture and styles" of the historical elements.

b. Events. Although not all of the events associated with this area are historically significant, the sites where they occurred cannot be inundated without having a psychological or social impact on the people who live in the area or once lived in it and return occasionally to visit. Input of these considerations into worksheet-matrix and calculations of the Battelle-Columbus EES yielded a total impact index of +0.66 on the "events" of the historical elements.

c. Persons. The gravesite of Dr. John S. Riley, located in Jones Cemetery, will be inundated by the proposed Aubrey Lake. As discussed

in section II, Dr. Riley was an uncle of the noted poet James Whitcomb Riley. Also, the sites of the graves and residences of Mr. and Mrs. John Strickland, also discussed in section II, will be inundated. Input of these considerations into worksheet-matrix and calculations of the Battelle-Columbus EES yielded a total impact index of the Aubrey Lake project on the "persons" of the historical elements of +1.1 EIU since additional publicity may promote interest in the historical relationship of these people to this region.

8. Social and Cultural Elements. With the proposed project the social interaction will be slightly disrupted but not destroyed, and in some cases improvement is expected.

a. Such social programs as those associated with the baseball camp, retreat, and church would continue even though they will be relocated to another site outside the reservoir area. In fact, if the baseball camp and retreat were located adjacent to the reservoir project, their value in social interactions could possibly be enhanced. Certainly, their setting could be more attractive than at the present sites.

b. The leaders of the St. James Baptist Church have indicated that they would like to have the church nearer the members' dwellings. Presently, all members except one live in Pilot Point. If the church were moved to where the people live, the building could be used more.

c. The relocation of the Bloomfield Cemetery and church building would cause a disruption and social impact to those families who have family members or friends interred in this cemetery.

d. Relocation of residents in the area will cause a social impact by disrupting group relations among neighbors and children of school age. With the relocation of approximately 90 families, there will be some disruption of their shopping patterns, routes to churches they attend, and distance traveled to work and to social activities of schools and other establishments. A road travel pattern and shopping habits for those living between the arm of the Elm Fork of the Trinity River and that of Isle du Bois Creek will be disrupted.

e. One major highway (U.S. Highway No. 377), three F.M. roads (F.M. Roads Nos. 372, 455, and 922), and numerous county roads are located within the project area.

(1) U.S. Highway No. 377. About 2 miles would be altered and raised in place as a replacement for the existing highway affected by the project.

(2) F.M. Road No. 372. There is no proposed remedial work for this road section. The traffic currently utilizing this road will be

served primarily by proposed F.M. Road "A" (see paragraph (5) below).

(3) F.M. Road No. 455. The traffic currently utilizing this road will be served by relocation "B", which is proposed to be routed over the Aubrey Dam and extends from Sanger to U.S. Highway No. 377, intersecting at a point approximately 3.5 miles south of Pilot Point. Relocation "B" would be about 3 miles south of the existing F.M. Road No. 455 and about 13 miles in length.

(4) F.M. Road No. 922. Approximately 1.6 miles of F.M. Road No. 922 would be constructed as replacements for the existing segments affected by the project.

(5) F.M. Road "A". F.M. Road "A" is proposed to cross the central area of the project. It is proposed to begin 5 miles north of Sanger at an intersection with U.S. Highway No. 77, then extend in an easterly direction to Tioga.

(6) County Roads. Approximately 45 miles of county roads in Denton, Cooke, and Grayson Counties are within the project area. This proposed plan includes abandoning approximately 44 miles of road, obtaining flowage easements over approximately 1.5 miles of road, and relocating or raising in place about 10 miles of road at 18 separate locations.

f. A new railroad, with a total length of approximately 14,000 linear feet of track, would be built one mile east of the existing Texas and Pacific track. A total of 6 structures are proposed to be constructed at Range and Duck Creeks and Pierce Spring Branch.

g. Approximately 38 miles of telephone facilities owned by 3 companies (Valley View, General, and Central Telephone) would be abandoned and/or removed as they are affected by the project.

h. It is estimated that about 46 miles of electric distribution line owned by three companies (Community Public Service Company, Denton County Co-op, and Cooke County Co-op) would be abandoned and/or removed as they are affected by the project. It is proposed to construct approximately 22 miles of electric distribution line in order to maintain service.

i. Four pipeline systems would be affected by the project, i.e, Atlantic Richfield Company, Lone Star Gas Company, and Green Springs and Mountain Springs Water Corporations. Alterations to the 8-inch petroleum products line of Atlantic Richfield Company would include anchoring portions of the existing pipe and installing new pipe. It is proposed to construct approximately 1.3 miles of 16-inch gas lines and 1 mile of 3-inch gas lines of the Lone Star Gas Company. The 4-inch and smaller water lines which lie within the project limits will be abandoned in place. The water lines that interfere with construction of F.M. Road No. 455 will be altered in place.

j. A total of 604 graves at four cemeteries would be relocated.

k. The Battelle-Columbus EES total impact index of the Aubrey Lake project on social interactions is +0.14 EIU.

9. Recreational Elements. Presently, the bodies of water in the area provide sites for recreation, use of leisure time, and picnicking for a limited number of local residents only. However, the provision of recreation, park and open space along with the recognized existing and projected needs for water supply, is a major feature of the proposed plan. The project would provide water-based recreational opportunities of up to 6,240,000 recreation-days annually as optimum development is achieved. Aubrey Lake will help to reduce the deficit in needed recreational outlets. As the lake and associated recreation facilities contribute to satisfying these recreational needs, local towns and communities will benefit economically through additional sales of supplies, equipment, food, and services to the visitors to the lake. Concurrently, these visitors will have the opportunity to relax, recreate, and refresh mind and body. Some environmental degradation is expected to occur from the estimated 6,240,000 annual visits to the project. The detrimental impacts would include soil compaction from vehicular and foot traffic, damage to vegetation, possible soil erosion, increased lake sedimentation, and from recreational vehicles and/or equipment.

10. Land-Use Changes.

a. Within the land area required for the proposed Aubrey Lake site, unutilized portions of commercial fertilizers, pesticides, herbicides, and defoliants applied to these lands may adversely affect the natural food chain and life.

b. During construction, the land use will remain much the same as at present. But after the lake is impounded, the percentage of land used is expected to increase slightly and the density of use will rise to medium value. There should be a growth in housing and recreation close to the reservoir site. It can be anticipated that several hundred houses will be constructed, small retail establishments will be operated, and boat storage facilities will be provided. Land-use development in the project vicinity is estimated to be 95 percent for the use period of the reservoir.

c. Calculations of input data and considerations into the worksheet-matrix of the Battelle-Columbus EES yielded a total impact index of the Aubrey Lake project of -5.88 EIU on land pollution due to use.

11. Housing.

a. With the project there would be a high degree of disruption

to about 90 families who live within the proposed impoundment area. During construction of the project there will be a gradual and hopefully smooth resettlement of these residents. The first removal of buildings will be in the damsite area, but by the time embankment construction is completed all buildings will be removed. The project will cause 100 percent disruption within the project boundary of the reservoir.

b. The impact on the housing at the periphery of the project area was also considered. With construction of the project there would be a high degree of disruption in the project site, since all of the buildings will be removed and all families relocated, but outside the project boundary buildings and families would not be relocated. Following construction and during the use period of the project, portions of the area within 0.5 mile of the project boundary will experience an intensive buildup of houses for permanent use, weekend and vacation cottages, and some retail and service establishments. This buildup is predicted to total several hundred buildings - many more than presently exist in the proposed reservoir area. The increase in number of buildings will result from the presence of the reservoir. Upstream and downstream areas will probably have some slight increase in housing.

c. Input of these considerations into the worksheet-matrix and calculations in the Battelle-Columbus EES for the upstream area, downstream area, reservoir proper, and to 0.5 mile beyond the project boundary yielded a total impact of +0.39 EIU on housing in the Aubrey Lake project.

12. Employment Opportunities.

a. During early construction stages of the project, existing employment in the reservoir site upstream from the dam will continue. Therefore, with the construction of the dam and reservoir bringing in a large number of employees plus a portion of the present employment continuing, employment opportunities during the construction phase will greatly increase. As construction is completed, these employment opportunities will decrease.

b. Upon completion of the project, fewer employment opportunities will exist within the project area. There will be the possibility of employment related to concessions and upkeep of roads and parks. The existing plant and animal, service, commerce, manufacturing, and construction industries would be disrupted.

c. Upstream, a small amount of construction and commerce should develop. This could result in employment in construction of houses and retail buildings, and in commerce in the operation of retail establishments selling food, fishing supplies, and automobile supplies and services. Cafes, motels, and boat sale and service enterprises

could be developed in the area.

d. Similar employment opportunities can develop in the downstream area, and an increase in employment opportunities can result indirectly from the supplying of water to the cities of Denton and Dallas. Also, the incidental flood control provided by the project will allow increased assurance of successful cropping below the dam.

e. Because of the reservoir, employment opportunities will develop adjacent to or surrounding the project boundary for at least 0.5 mile. Within this additional area along the periphery of the project, where sites are available and suitable, there will be employment in the construction of housing, service buildings, and roads. Also, there will be employment in operating the commerce and service establishments, and in the maintenance of roads, utility lines, and buildings.

f. Based on observed trends associated with other reservoir projects in the area, houses will be constructed by individuals on single plots and in areas created by land development companies. Within the land company areas, several tens or even a few hundreds of houses will be constructed. This necessitates the construction of roads and the provision of utilities. The actual construction of houses gives employment to such craftsmen as foundation workers, carpenters, plumbers, electricians, roofers, bricklayers, painters, and cabinetmakers. This will require the provision of water and proper sewage disposal facilities. Normally, within the area there will develop such retail establishments as those which provide groceries, fuels, fishing equipment and supplies, wearing apparel, and picnic supplies. Other employment opportunities can be found in businesses such as cafes, motels, and boat sales, service, and storage. The development in this area will create at least as many employment opportunities as exist in the proposed reservoir area at the present time.

g. Input of data and considerations into a worksheet-matrix and calculations in the Battelle-Columbus EES yielded a total index of +1.56 on employment opportunities.

13. State and Federal Agency Programs.

a. Soil Conservation Service. Six structures for retarding floodwater have been constructed in the project area by the Soil Conservation Service at a cost to the Federal Government of approximately $260,000. Of the four alternate project damsites considered, damsites 1 and 4 would cause the greatest adverse impact on these structures as a result of their being inundated.

b. Programs of Other Agencies. Impacts on programs of other agencies as a result of construction of the Aubrey Lake project are not foreseen at this time.

14. Impacts of Lewisville Lake.

a. Summary.

(1) Land Requirements. The plan of operation with Aubrey and Lewisville Lakes working in combination will change the current operating procedures of Lewisville Lake. A major alteration will result from increasing the water conservation pool elevation from 515 feet msl to 522 feet msl. This increase in the conservation pool will inundate an additional 6,400 acres of project lands, of which about 2,200 acres is sparsely timbered, and the remainder is in brush, brushy grassland, and grasslands. This land area is not particularly productive for wildlife. Of the 45,548 acres of fee-owned land on the project, about 29,680 acres will be covered by water most of the time. There are 4,471 acres dedicated for use by the general public (recreation areas). Other project-oriented land uses have reduced the upland game habitat of the project to a total of about 11,000 acres. With the Aubrey Lake project, the removal of this additional 6,400 acres will result in a further reduction in the upland habitat area.

(2) Recreational Elements. Concurrent with the reduction in habitat acreage, the increased water surface area at Lewisville Lake will provide for an additional 400,000 recreation-days annually. The enlarged project is expected to provide opportunities, initially, for 3,000,000 recreation-days annually, and eventually would provide opportunities for about 7,500,000 recreation-days annually. Human activity of this magnitude will have an impact on both the plant and animal resources of the project. The increased water surface area will require acquisition of an additional 42 acres to replace existing recreational resources to be inundated along the periphery of the lake.

(3) Social, Cultural, and Economic Elements. Project visitors can be expected to contribute to the growth of the local economy by purchasing such items as picnic and fishing supplies, and fuels. Also, those businesses which provide public services, such as restaurants, lodges, and workshops for equipment service and repair should share in the growth of the economy. A growing economy can be expected to cause an increase in local employment, which can increase the local, permanent population and create a need for more homesites and construction activities. An increase in the local permanent population can cause a change in the lifestyle and social structure which now exists in the area. This change is expected to convert the rural mode of life to that of a more suburban interaction.

(4) Biological Elements. The enlarged lake area will provide additional room for those fish which are overpopulated in the existing impoundment. The newly inundated land will provide an increased food supply and spawning area. Since operating procedures are to keep Lewisville Lake at a constant water surface elevation of 522 feet msl, fish reproduction should remain stable year to year. This situation, without some form of fishery management, will result in the continuation of overpopulations and stunted fishes. With constant water levels, an increase can be expected in the populations of insects which spend part of their life cycle in still water. These are mainly certain species of mosquitoes and midges, both of which can become a nuisance to man and domesticated and wild animals.

(5) Archeological Elements. Under contract DACW63-73-M-0669, Dr. Parker Nunley directed the Richland Archeological Society through an assessment (20) of the historical and archeological resources located on Lewisville Lake project lands. Some of these lands will be inundated (between 515 feet msl and 522 feet msl) because of modified operating procedures needed to compliment the Aubrey Lake project operating procedures. Dr. Nunley's report describes 60 archeological sites in the vicinity of Lewisville Lake. Fifty-five of them are in areas which will be affected either directly or indirectly by the raising of the reservoir elevation. There are 20 sites located above elevation 532 feet msl (maximum design water surface), 33 sites below elevation 532 feet msl, and 2 sites which extend from below to above this elevation. The 20 sites will be endangered primarily by construction activities, while the 33 sites will be endangered by water level fluctuations. An indepth exploration and salvage of the archeological resources endangered by the pool raise will be conducted when the construction of Aubrey is guaranteed. An excerpt from the report which provides some details pertinent to all the known sites is presented in appendix G. Sites designated as 41DN4 through 41DN15 in this appendix are not the same sites carrying identical designations in appendix F.

b. Conclusion. The previously discussed impacts expected to result from raising the pool level of Lewisville Lake are believed to have been adequately evaluated and; therefore, negates the need for a separate environmental impact statement covering the Lewisville component.

SECTION IV

ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

SECTION IV - ANY ADVERSE EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

1. Stream Reaches Inundated. Construction of the proposed reservoir would inundate approximately 71 acres of stream and 35 acres of pond surface, and would replace it with approximately 25,200 acres of reservoir surface at the conservation pool level. About 20 miles of the Elm Fork, 23 miles of Isle du Bois Creek, and several miles of smaller tributary streams will be inundated.

2. Lands and Areas Required for Project Purposes. Construction of the proposed Aubrey Lake impoundment will require acquisition of approximately 39,000 acres in fee area, 1,500 acres of which are for recreational areas, and approximately 4,500 acres in flowage easement lands. Thus, land acquisition for project purposes will total approximately 44,000 acres.

3. Fish and Wildlife Resources.

a. Area Fisheries. The energy input from the contributing watershed will be diluted in the larger aquatic ecosystem, causing an alteration or modification of population diversity and density in the lake fishery. Some of these species will be of the less desirable or nonsport category. Initially, there will be a reduction in fishery production, resulting from alterations of stream channels, draining of ponds, increased turbidity and sediments, and decreased dissolved oxygen content during the construction period. However, this adverse impact should have only a short-term effect on the area fishery. An estimated loss of 1,500 man-days annually of pond fishing will result from construction of the proposed project.

b. Amphibians and Reptiles. The Aubrey Lake impoundment will have an adverse effect on lizards and snakes, which could eventually be reduced in number by removal of a significant portion of their habitat and subsequent crowding of species in the remaining habitat.

c. Mammals. Inundation of the proposed reservoir site will have an adverse effect on those mammals which will be forced to seek suitable habitats outside the periphery of the lake. It is believed that suitable habitats outside the pool area are now carrying their optimum number of mammals and that any increase will cause crowding which may lead to starvation, epidemics, and competition for suitable living areas. It is expected that with the rising water level, the land-water relationship will cause some new habitat type to become available.

d. Upland Wild and Game Birds. Construction of Aubrey Lake will have an adverse effect on upland birds due to the destruction of approximately 25 percent of the watershed's upland bird habitat. Also, inundation of the required project area will completely remove

approximately 25,000 acres of existing bird habitat below the conservation pool level. An estimated loss of 3,700 man-days annually of hunting will result from construction of the proposed project.

e. Food Web Structure. The fish and wildlife native to the proposed Aubrey Lake area are a necessary link in the complex aquatic and terrestrial energy transfer structures. It is expected that a 10 percent reduction in the food web structure will occur from construction-related disturbances. The most significant adverse effect on the food web structure will result from inundation and destruction of the habitat, which will displace all the terrestrial organisms, reducing the energy transfer structure in the project area nearly to zero.

4. Vegetation. Construction of Aubrey Lake and subsequent inundation will have an adverse effect on approximately 25,000 acres of terrestrial vegetation within the project area. Additionally, pedestrian and vehicular traffic in the 11 public use areas will cause loss of vegetation through physical injury to the plants and by compaction of the soil in which they grow. Furthermore, loss of this vegetation can lead to soil erosion which will cause some degradation of the lake water quality.

5. Historical Resources. The National Register of Historic Places does not list any sites of National historical interest in the project area. Adverse effects will result from inundation of the following sites within the proposed reservoir area:

a. The remains of the abandoned Old Bloomfield Community, founded in 1875.

b. The gravesite of Dr. John S. Riley in Jones Cemetery.

c. The sites of the graves and residence of Mr. and Mrs. John Strickland.

d. The three houses and ancillary structures built by the Hammons brothers in the mid- and late 1800's. However, the Fort Worth District is working with the Denton County Historical Survey Committee to formulate a plan which will provide for preserving and possibly restoring the main house and some of the more significant ancillary structures associated with the oldest of the three homesites. Preservation alternatives being considered include (1) a ring levee system to exclude water from Aubrey Lake, (2) relocation to an area not to be inundated, and (3) raise the home and ancillary buildings to elevation 641.0 feet msl and set on earthen fill. Cost estimates for the basic work required in alternatives (1) and (3) are $156,250 and $439,000, respectively.

6. Archeological Resources. The Bousman and Verett archeological report (4) concerning the Aubrey reservoir area suggests that there are at least 26 prehistoric and historic sites which will be inundated when the lake is impounded, or be endangered by construction of facilities, houses, etc. adjacent to the lake. Mitigation of the impacts on these resources can best be accomplished by conducting a systematic survey of the reservoir area to provide an adequate assessment of the resources present. Concurrently, controlled collection of surface artifacts and test pitting of subsurface deposits should be accomplished.

7. Social, Cultural, and Economic Resources. The relocation of the Bloomfield Cemetery would cause a slight adverse psychological effect to those families who have family members or friends interred there. Relocation of residents in the area will cause an adverse social effect by disrupting neighborhood friendships among adults and among children of school age. There will be adverse effects on the residents of the area from disruption of their shopping patterns, routes to churches they attend, and distances traveled to work, school, and activities. In certain situations, some adverse economic impacts could affect those persons who must relocate and/or lose all or part of their established holdings. For example, sentimental values are not considered when an appraisal is made on a home or personal property. In addition, the present market value paid on the land does not reflect its future value, which sometimes appreciates significantly each year. An economic loss could also be suffered by relocating to an area with a higher tax rate.

8. Recreational Resources. The expected 6,240,000 annual visits at Aubrey Lake will have an adverse impact on the environment of the area. The impacts would include soil compaction from vehicular and foot traffic, damage to vegetation, possible soil erosion and increased lake sedimentation. However, a vegetative management plan and careful selection of recreation sites are actions which will be taken to limit possible degradation of vegetation and loss of topsoil through erosion. All possible efforts will be made to prevent pollution of the lake water from recreational activities and facilities. Pollution will be discouraged by (1) education of the public through advertisements and distribution of published regulations, (2) provision of conveniently located trash receptacles, (3) availability of litter bags for boats, and (4) presence of custodial patrols. A wildlife and fisheries management plan will assure the availability of fish and wildlife habitat.

9. Agricultural Resources. There will be adverse impacts from the loss of approximately 31,000 acres of agricultural lands due to the project. Of this total, about 87 percent is pastureland and the remaining 13 percent is being used mainly for dryland crops such as sorghum, peanuts, and cotton.

10. Adverse Impacts on the Lewisville Lake Project.

a. Raising the conservation pool elevation at Lewisville Lake by 7 feet will reduce the available terrestrial wildlife habitat at that project by about 6,400 acres. About one-third of this acreage is sparsely timbered, and the remaining two-thirds is covered with brush, brushy grassland, and grassland. Although these areas are not highly productive for wildlife, any loss of existing habitat will create a hardship on those species which currently inhabit the area because there is a sparsity of suitable habitat nearby to which they could move.

b. At first the fishery will benefit from having the extra space available to alleviate the existing overpopulated condition. However, with continuously favorable conditions for reproduction and without an adequate fishery management program, the fishery will become overpopulated again in just a few years.

c. A continuous water surface elevation will be extremely conducive to propagation of nuisance insects which spend a part of their life cycle in an aquatic environment. These aquatic stages of insects form an important part of many fishes' diets. Fish may provide a degree of pest control but are not expected to be able to reduce insect populations below nuisance levels.

d. Approximately 55 archeological sites will be adversely affected, either directly or indirectly, by the raising of the reservoir elevation. Mitigation measures include an indepth exploration and salvage expedition of the archeological resources endangered by the pool raise when the construction of Aubrey Lake is assured (20).

e. Vehicular and foot traffic related to or resulting from the recreational opportunities available at Lewisville Lake will have much the same adverse impacts on both plant and animal resources as those discussed for Aubrey Lake in section III, paragraph 9.

SECTION V

ALTERNATIVES TO THE PROPOSED ACTION

SECTION V - ALTERNATIVES TO THE PROPOSED ACTION

1. No Action. The passive or negative approach to development of additional resources on the Elm Fork of the Trinity River is to take no action and to accept the consequences. Dallas is already the eighth largest city in the Nation and is expected to become even larger. If the no-action alternative were selected, the Dallas-Denton-Fort Worth metropolitan area would have to continue to depend on the water sources and recreational opportunities that are now available, which are considered inadequate.

a. Water Quality and Supply.

(1) Beneficial Aspects. There are no water quality and supply benefits in the no-action alternative.

(2) Detrimental Aspects. The adverse effects of adopting the no-action alternative would primarily be the forgoing of development and use of the most efficient surface water source remaining to the Dallas-Denton-Fort Worth metropolitan area. Not only would the no-action alternative deny this metropolitan area a means of satisfying a portion of its projected water needs, but it would also deny water needed for other developments such as Flower Mound New Town and the Dallas-Fort Worth Regional Airport.

(a) Flower Mound New Town. Flower Mound New Town, with an expected population in excess of 60,000, is the fourth Federally designated new town project in the Nation.

(b) Dallas-Fort Worth Regional Airport. The Dallas-Fort Worth Regional Airport, covering 18,000 acres with all of its supporting systems, including water treatment and waste disposal plants, and transportation and communication systems, will be an almost self-supporting city. The airport will employ 23,000 persons initially, and its daily population of customers and employees will be over 100,000. By 1980, it is projected that an additional 12,000 airport workers will be needed.

(c) Regional Growth. The area's projected total population, based on OBERS data from the U.S. Census (series C projections) is 2,837,177 in 1980, and will increase to 6,181,788 in the year 2020. The city of Dallas also projects that water demands will increase from 259 mgd in 1980 to 475 mgd in the year 2000. Acceptance of the no-action alternative would cancel the selected impoundment project and reject what has been an anticipated element of the Dallas Water Plan for many years.

(3) Economic Aspects. By implementing this alternative and forgoing the selected plan, an estimated 84 mgd will not be available to meet the projected needs of the area. This amount of municipal and industrial water has an estimated annual benefit of $2,191,900.

(4) Factors Contributing to Rejection of this Alternative. The no-action alternative would not develop, upstream from Denton, Dallas, and Fort Worth, and their contiguous municipalities, a dependable water supply in the amount of 84 mgd which would be of good quality and gravity flow to treatment plants. Since the projected water demands of the area are expected to increase 91 percent between 1980 and the year 2000, the no-action alternative was felt to be unresponsive to the area's needs for water quality and supply.

b. Fish and Wildlife.

(1) Beneficial Aspects. Adoption of the no-action alternative would prevent the inundation of approximately 25,200 acres at the conservation pool elevation (about 100 acres of which are streams, tanks, and ponds), most of which can be considered as possible wildlife habitat. It would also prohibit the possible inundation of approximately 7,400 additional acres of wildlife habitat between the conservation pool elevation and the top of the flood-control pool. In addition, implementation of the no-action alternative would check any possible disruption of approximately 1,450 acres of wildlife habitat by its being acquired and developed for recreational purposes by the Government. Thus, without the project, the approximate acreage of either directly or indirectly unaffected wildlife habitat would be approximately 35,000 acres. Acceptance of the no-action alternative would leave the proposed project area with its 100 acres of existing area fisheries, which are rated moderate-to-high in productivity. It would also suspend the adverse effects to amphibians, reptiles, birds, and mammals that would eventually be displaced by removal of a significant portion of their habitat by construction activities or inundation. Furthermore, if this alternative is adopted, 3,700 man-days annually of hunting will not be forgone.

(2) Detrimental Aspects. The area's present wetland quality and waterfowl use is poor, and would remain basically the same without the selected project. Since only 25 percent of the total area is available as habitat for upland game birds, consisting primarily of small numbers of quail and mourning doves, rejection of the project would have little effect on their populations. Although the stream fishery is classified as being moderate-to-high in productivity, an enlarged area for fish production will be forgone with the no-action alternative.

(3) Economic Aspects. By implementing the no-action alternative, an estimated 400 man-days of waterfowl hunting and 500,000 man-days of sport fishing would be forgone. These forfeited uses have an estimated annual benefit of $741,600. If the no-action alternative were adopted by the Federal Government, local interests could undertake the project, but they would be required to finance all of the cost of the project construction without financial support for costs allocated to recreation.

(4) Factors Contributing to Rejection of this Alternative. The no-action alternative would continue the low-productive status of existing wildlife habitat in the area, would not allow for an expanded fishery in area waters, and would forgo $741,600 in annual benefits which the proposed project would provide.

c. Social, Cultural, and Economic Elements.

(1) Beneficial Aspects. If the no-action alternative were implemented, the following elements of social and economic importance would not have to be abandoned, altered, or relocated.

(a) A total of approximately 1.86 miles of U.S. Highway 377 and bridges in the vicinity of Buck, Range, and Spring Creeks.

(b) Approximately 30.8 miles of farm to market roads in Denton, Cooke, and Grayson Counties.

(c) Approximately 3.3 miles of railroad owned and operated by the Texas & Pacific Railway Company.

(d) A total of 9.2 miles of cable (nearly all of which is buried) belonging to the Valley View Telephone Company; a total of 12.5 miles of telephone line (9.5 miles of buried cable and 3 miles of aerial line) belonging to the General Telephone Company; and a total of 15.8 miles of telephone line (8.8 miles of buried cable and 7.0 miles of aerial line) belonging to the Central Telephone Company.

(e) Approximately 2.2 miles of electrical distribution line belonging to the Community Public Service Company, approximately 37.0 miles of electrical distribution line belonging to the Denton County Cooperative, and approximately 6.1 miles of electrical distribution line belonging to the Cooke County Cooperative.

(f) Approximately 0.68 mile of 8-inch petroleum products pipeline owned by the Atlantic Richfield Company, about 1.3 miles of 16-inch high pressure gas line, 1.0 mile of 3-inch feeder line owned by the Lone Star Gas Company, and an undetermined length of 4-inch and smaller water distribution pipelines belonging to the Green and Mountain Springs Water Supply Corporation.

(g) Approximately 604 graves located in three public cemeteries (Davis, Jones, and Bloomfield), and in one private cemetery (Maxwell and Tevault).

(h) The Jacobs Oil Field.

(i) None of the trends in social, cultural, or economic patterns which have been evolving since people first settled this area would be disrupted.

(2) Detrimental Aspects. Implementation of the no-action alternative would cause the project area not to realize the increase in employment opportunities which would result from construction of a structural project. Additionally, there would be no significant change in developments of houses, hotels, motels, retail stores, restaurants, and land.

(3) Economic Aspects. Overall benefits which the area inhabitants and governments would fail to realize would probably amount to about $11,000,000 annually.

(4) Factors Contributing to Rejection of this Alternative. The annual benefits to be shared by a large area and population would far outweigh the anticipated disruptions of established social, cultural, and economic trends.

d. Archeological and Historical Elements.

(1) Beneficial Aspects. The no-action alternative would be beneficial for the archeological and historical elements of the area because they would not be disrupted by relocation, inundation, or construction activities. No known historical sites of National or State significance exist in the area. There are sites in this area which are of local significance, such as the old Hammons houses. Archeological resources of the watershed have been surveyed to determine the number, location, and value of sites in this area.

(2) Detrimental Aspects. If the sites are not explored and the resources salvaged, a portion of the story of man's early occupation of this area could be lost by inadvertent destruction caused by agricultural practices or construction, as well as by artifact hunters. The historical sites are believed to be of little significance, and their eventual destruction may hardly be noticed.

(3) Economic Aspects. It is nearly impossible to apply a dollar value to historical and archeological resources. They are usually described as being invaluable and irreplaceable. However, it is estimated that a sum of $50,000 will be needed for surveying and salvaging of archeological resources in the area to be affected by the selected impoundment project. This amount has been programed for this work, but will not be allocated until it is certain that the project will be constructed.

(4) Factors Contributing to Rejection of this Alternative. It is believed that the archeological resources should be salvaged before any more are lost to deliberate or inadvertent destruction. The historical resources are believed to be of little significance and would have little effect on the rejection or selection of this alternative.

e. Recreational Elements.

(1) Beneficial Aspects. There would be no additional benefits for recreation if the no-action alternative were selected.

(2) Detrimental Aspects. Recreational elements of the watershed would remain static should the no-action alternative be selected. This would mean that most water-oriented recreational needs would have to continue to be satisfied outside the basin. Furthermore, land-oriented recreational needs would continue to be met in the basin only by landowners permitting a selected few to utilize their privately-owned resources.

(3) Economic Aspects. It is estimated that the selected plan will provide $6,394,600 annually in recreational benefits. This amount includes $741,600 for benefits to be derived from fish and wildlife oriented recreation.

(4) Factors Contributing to Rejection of this Alternative. The no-action plan would forgo these monetary benefits, as well as the advantage of having a nearby area with facilities which would satisfy many of the area's recognized recreational needs.

2. Alternatives That Will Meet All of the Authorized Project Purposes. The project purposes of Aubrey Lake for which alternatives were explored are water supply, recreation, and fish and wildlife. Flood control is not an added or increased purpose of Aubrey Lake. The Aubrey Lake project at river mile 60.0 of the Elm Fork of the Trinity River has been planned, on an exchange of storage basis with existing Lewisville Lake at river mile 30.0, to provide the same degree of flood protection in combination as that provided by Lewisville Lake alone. Flood-control storage in Lewisville Lake will control floods of up to 35-year frequency when regulating releases in proportion to existing downstream channel capacities. However, the project as originally planned would control floods of about 50-year frequency when operated in conjunction with the authorized improved channels. This would be in consonance with the regional statistical analysis conducted for House Document No. 276, which found that each project in the Trinity River system should be planned to regulate 50-year floods to nondamaging proportions. Sufficient flood-control storage would be retained in Lewisville Lake to regulate flood runoff from the 968 square miles of drainage area between the two lakes, and sufficient flood-control storage would be provided in Aubrey Lake for its 692-square-mile drainage area. Flood-control storage allocated to Aubrey Lake would take into consideration that the rainfall rates on the smaller drainage area controlled by Aubrey Lake are from a relatively greater areal distribution of higher rainfall intensities. As a consequence, although the total volume of flood-control storage is slightly increased, the degree of

flood-control protection is not altered by the projects in combination. Flood control, therefore, is not an added or increased purpose of Aubrey Lake.

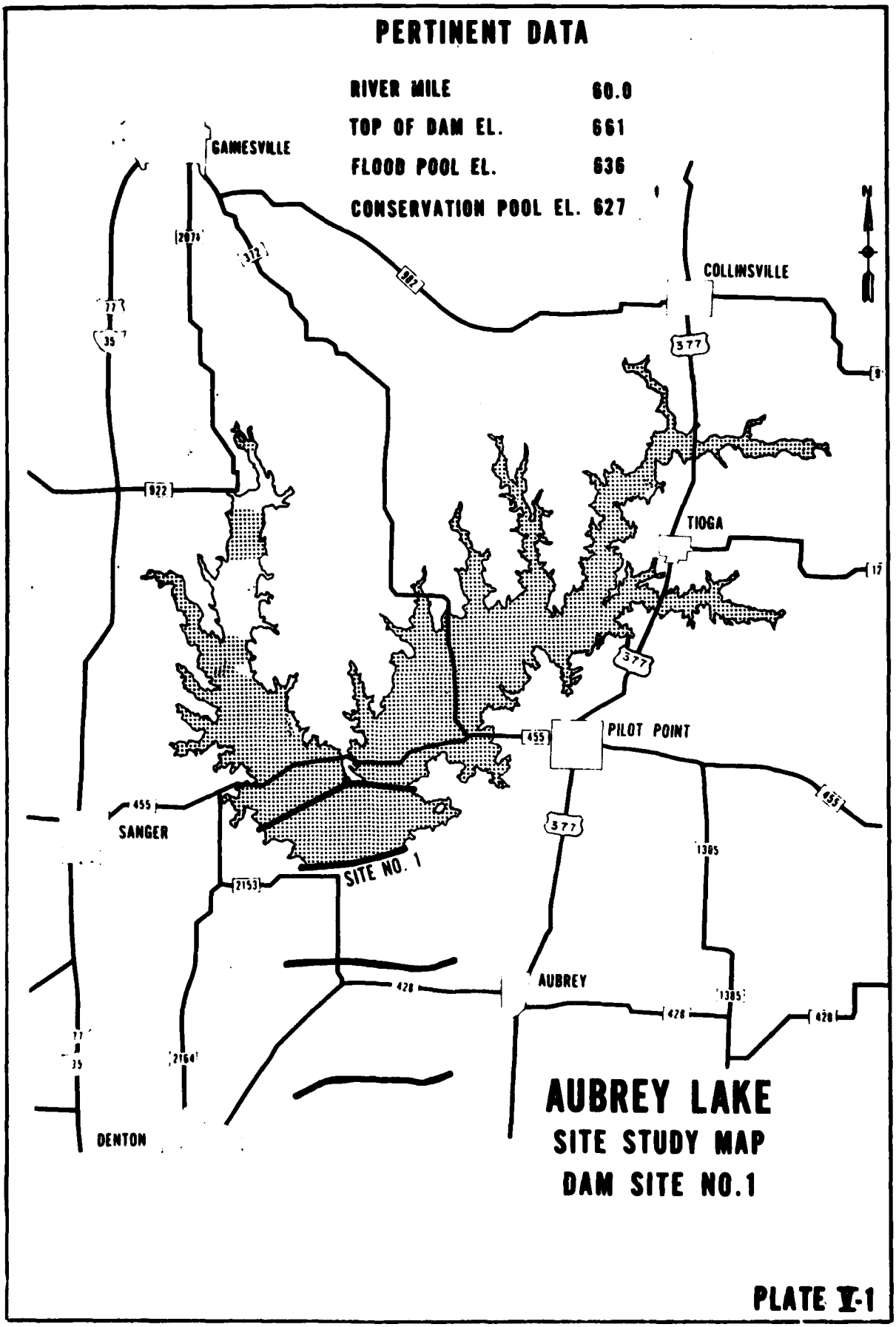
a. Alternate Damsite Locations. The selected project is located at one of the four damsites considered for the project. Site 1 (plate V-1) is at river mile 60.0 and is the project document site. Site 2 (plate V-2) is located at river mile 55.9, site 3 (plate V-3) at river mile 51.2, and site 4 (plate V-4) at river mile 64.0. Site 4 would require an embankment on both the Elm Fork of the Trinity River and Isle du Bois Creek, and would, in effect, form two lakes. Investigations included an appraisal of the natural, physical, historical, cultural, economic, and social impacts to be expected at each site. A cost comparison for each of the sites, including the project document site, site 1, is shown in the following table. It should be noted that this cost comparison was based on preliminary design data for the alternate damsites which have been modified and refined to show present cost figures.

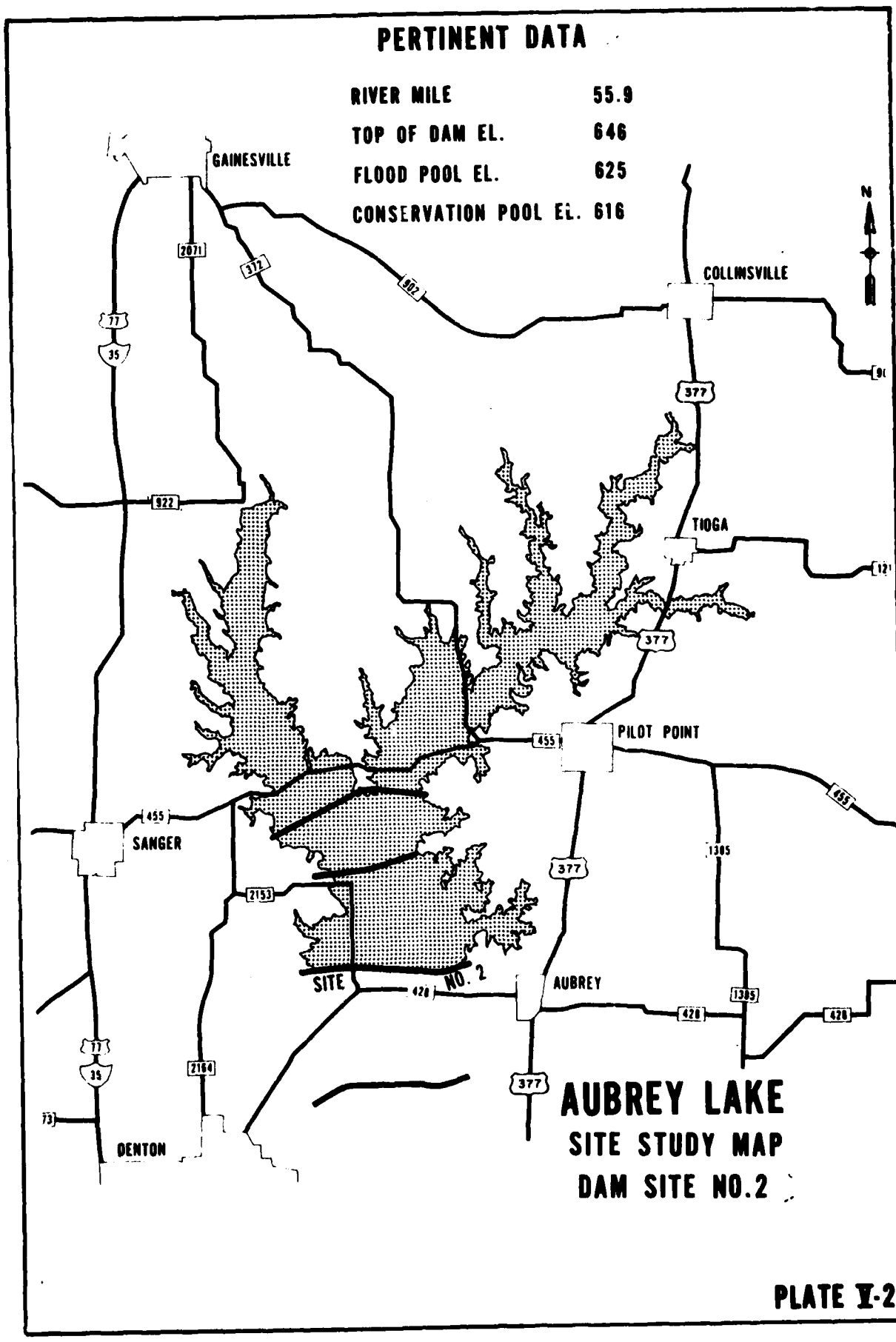
Table V-1

Total Project Costs of Development for the Alternate Sites

Site :	Estimates in Thousands of Dollars
Site 1	$101,000
Site 2	117,924
Site 3	118,791
Site 4	127,036

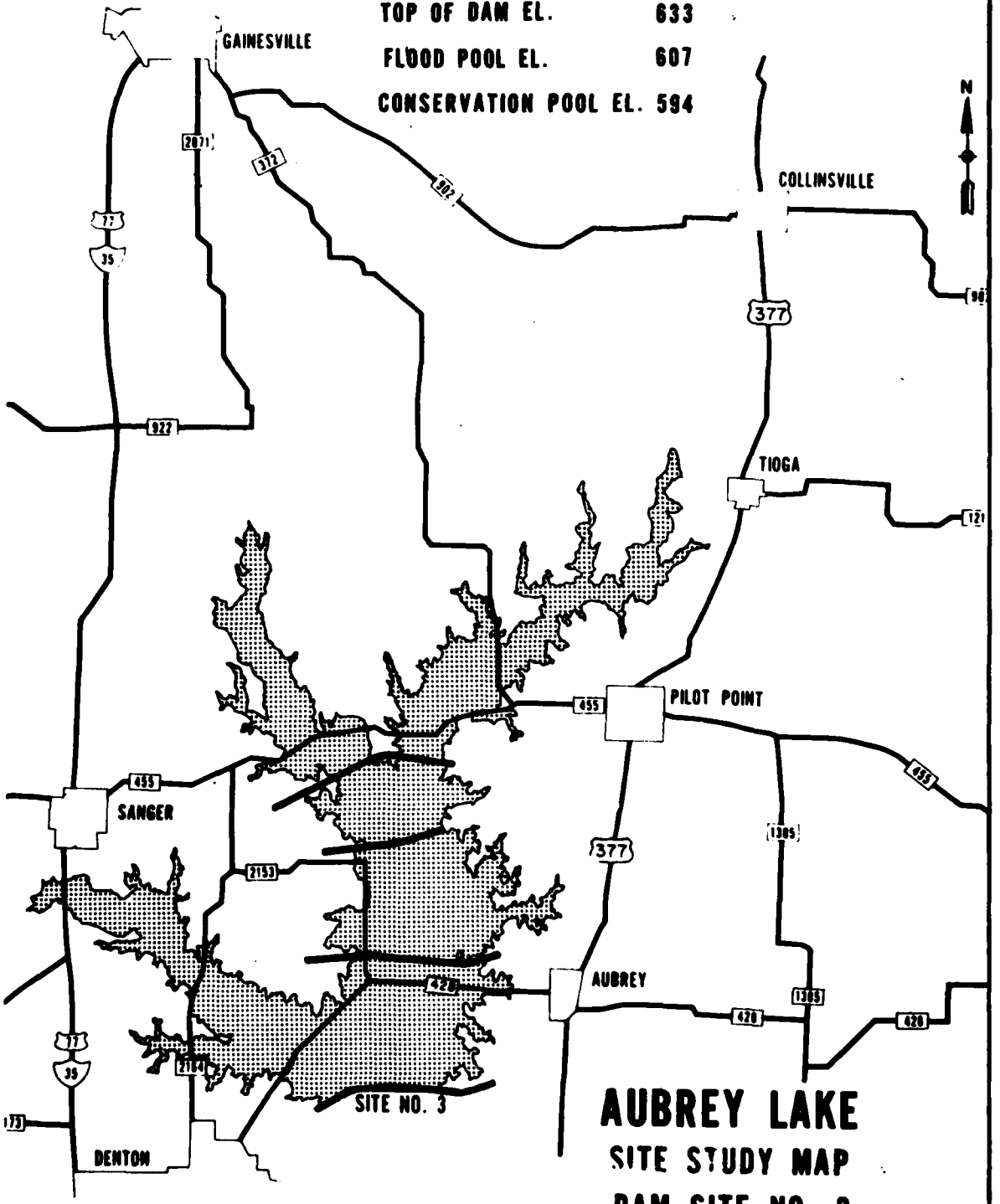
Since there are only about 13 river miles separating the four sites, it was not surprising that several elements of impact among the four were indistinguishable. Among them are historical elements, foundation conditions, fishery, water quality, and water supply. An investigation to determine the existence of historical sites within Denton, Cooke, and Grayson Counties indicated that a few sites of local significance would be inundated. With respect to the area fishery, it was found that species productivity is directly proportional to the water quality. Since water quality was found to be almost identical, all sites will be equally suitable for fish life. In terms of water supply, each of the four sites working in conjunction with Lewisville Lake will develop all of the watershed's water resources, and again are considered to be equal. These four sites exhibit similar foundation conditions. No faulting or other structural anomalies are known to exist in the vicinity of the sites. Consequently, the damsite selection was influenced by prevailing hydrological, economic, and other environmental conditions.


PERTINENT DATA
RIVER MILE 60.0
TOP OF DAM EL. 661
FLOOD POOL EL. 636
CONSERVATION POOL EL. 627
GAINESVILLE
COLLINSVILLE
TIOGA
PILOT POINT
SANGER
AUBREY
DENTON
SITE NO. 1
AUBREY LAKE
SITE STUDY MAP
DAM SITE NO.1
PLATE V-1


PERTINENT DATA
RIVER MILE 55.9
TOP OF DAM EL. 646
FLOOD POOL EL. 625
CONSERVATION POOL EL. 616
GAINESVILLE
COLLINSVILLE
TIOGA
PILOT POINT
SANGER
AUBREY
DENTON
SITE NO. 2
2071
372
902
77
35
377
922
455
2153
1385
2164
73
428
AUBREY LAKE
SITE STUDY MAP
DAM SITE NO.2
PLATE X-2

PERTINENT DATA

RIVER MILE	51.2
TOP OF DAM EL.	633
FLOOD POOL EL.	607
CONSERVATION POOL EL.	594



AUBREY LAKE

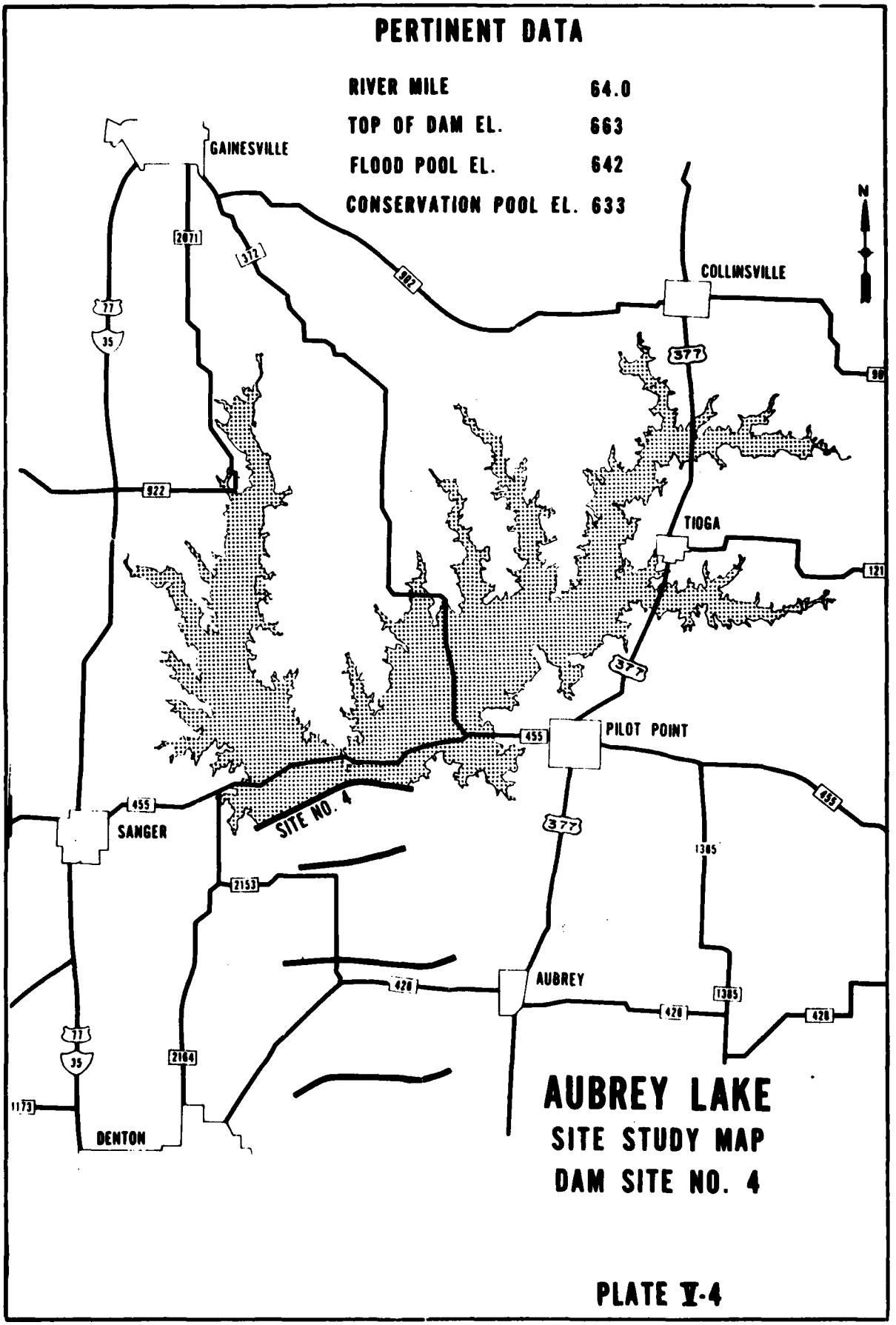
SITE STUDY MAP

DAM SITE NO. 3

PLATE V-3

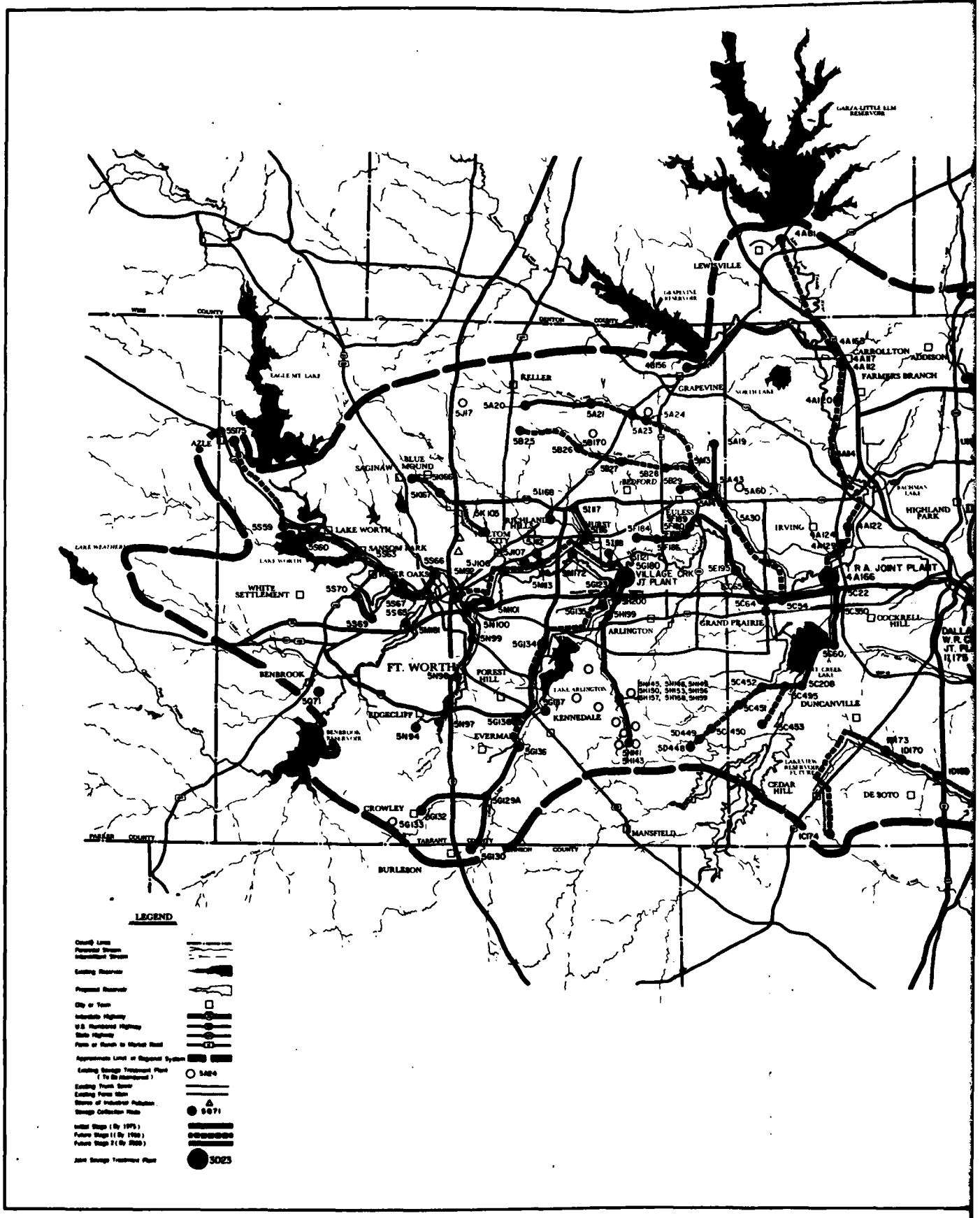
PERTINENT DATA

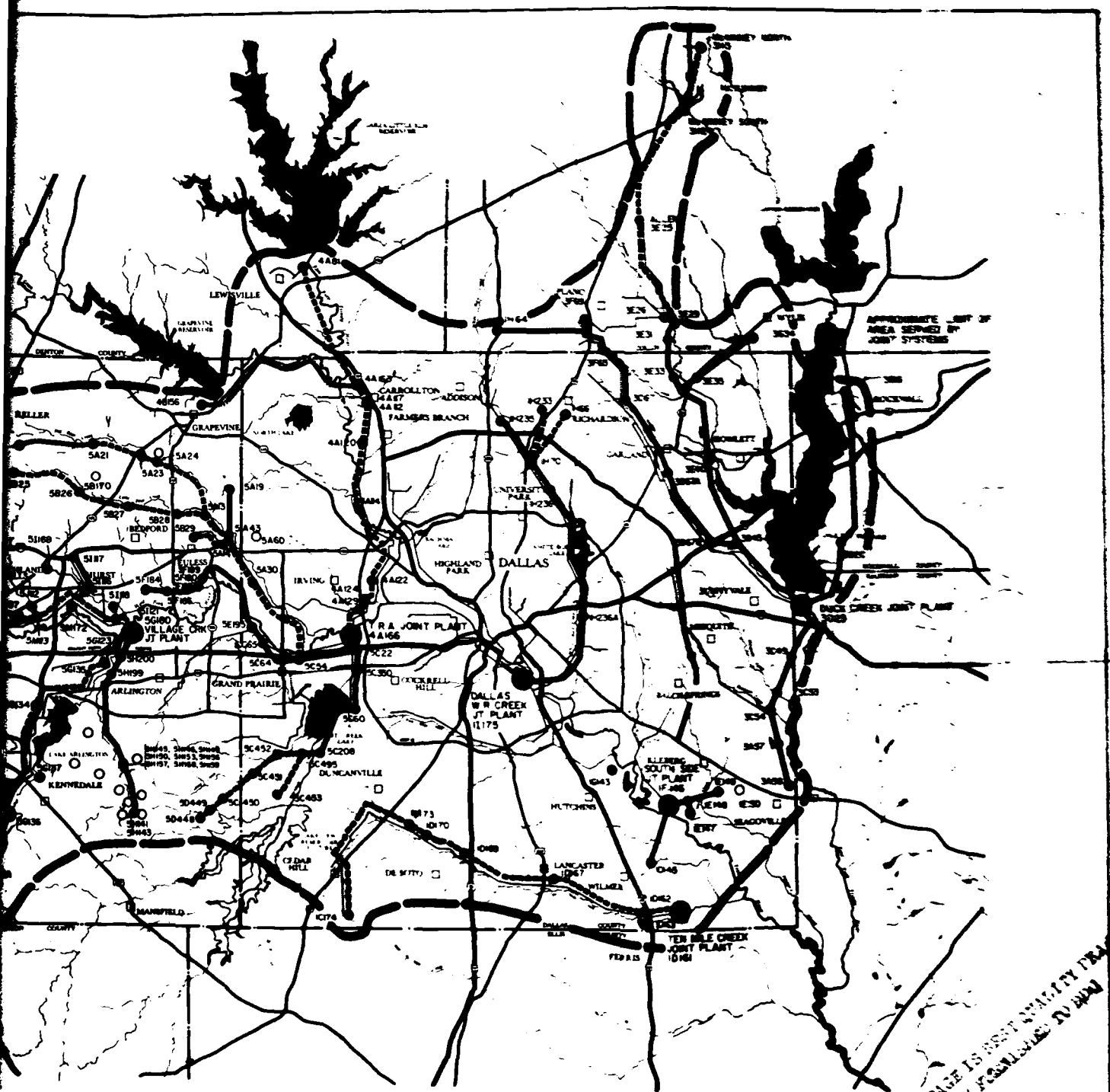
RIVER MILE	64.0
TOP OF DAM EL.	663
FLOOD POOL EL.	642
CONSERVATION POOL EL.	633



AUBREY LAKE
SITE STUDY MAP
DAM SITE NO. 4

PLATE V-4


LEWISVILLE
GRAPEVINE RESERVOIR
GARZA-LITTLE ELM RESERVOIR
LAKE MT. LAKE
KELLER
GRAPEVINE
CARROLLTON
ADDISON
FARMERS BRANCH
AZLE
SAGINAW
BLUE MOUND
BEDFORD
EULESS
HURST
IRVING
HIGHLAND PARK
LAKE WORTH
LAKE WEATHERFORD
RIVER OAKS
WHITE SETTLEMENT
VILLAGE CRK JT PLANT
T R A JOINT PLANT
GRAND PRAIRIE
ARLINGTON
COCKRELL HILL
FT. WORTH
FOREST HILL
BENBROOK
EDGECLIFF
EVERMAN
KENNEDALE
LAKE ARLINGTON
DUNCANVILLE
CEDAR HILL
DE SOTO
CROWLEY
MANSFIELD
BURLESON
TARRANT COUNTY
JOHNSON COUNTY
DENTON COUNTY
WISE COUNTY
LEGEND



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Upper Trinity Regional Water District
UPPER TRINITY RIVER BASIN
COMPREHENSIVE SEWERAGE PLAN

RECOMMENDED SANITARY SEWERAGE FACILITIES

CAMP, DRESSER AND MCKEE Board Consultants
FORREST AND COTTON, INC. Associate Consultants
FREESE, NICHOLS AND ENDRESS Associate Consultants

JULY 1970

PLATE 2-5

2

(1) Site 1. Site 1 is the project document site. The selected plan has been designed as an earthfill embankment consisting primarily of compacted medium to high plasticity clays. The embankment will have a maximum height of 136 feet above the streambed, will be about 14,690 feet long, and will have a crest width of 42 feet. A 100-foot long uncontrolled spillway will be constructed in the left abutment, and a 13-foot diameter outlet works conduit is planned for the right flood plain. The impoundment to be created behind the embankment will have a maximum design water surface area of 54,600 acres at elevation 655.2 feet msl. The normally expected operating elevations will be 636.0 feet msl for the flood-control pool which will inundate 32,600 acres, and 627.0 feet msl for the conservation pool which will cover 25,200 acres. The benefit-cost ratio is 2.6 to 1.0, and the annual benefits in excess of the annual costs are $6,725,000. This impoundment will provide for water conservation, flood control, recreation, fish and wildlife conservation, and sediment control. The flood control aspects of the Aubrey project result from the transfer of a portion of the allocated flood-control space in Lewisville Lake, located immediately downstream from the Aubrey project. With this transfer, sufficient flood-control storage would be retained in Lewisville Lake to regulate flood runoff from the 968 square miles of intervening drainage area, and sufficient flood-control storage would be provided in Aubrey Lake for its 692 square miles of drainage area. This will result in the total volume of flood-control storage being slightly increased, but the degree of flood-control protection would not be altered by the projects in combination. Therefore, flood control is not an added or increased purpose of Aubrey Lake. The water conservation aspects of the selected project were developed in response to the State of Texas requesting the Corps of Engineers to develop its lakes to their full potential for water conservation. This request resulted from the critical drought situation which was experienced in the decade preceding the 1957 floods. The State's desire was taken into consideration when the determination of the conservation storage capacity was made. The desires of local interests, the Corps of Engineers estimates of probable future regional water requirements, and the capability of refilling the conservation pool after the critical drought period were also considered. The resulting conservation storage space of 600,700 acre-feet in the selected project is comparable to the 603,800 acre-feet authorized by House Document No. 276. Studies to determine the water yield were based on the critical period, October 1950 through February 1957, when the average annual inflow to Aubrey Lake under present conditions of watershed development would have been 44,900 acre-feet, and the estimated average annual net evaporation would have been 45.03 inches. Before the accumulation of sediment (54,600 acre-feet in 100 years), the 650,300 acre-feet of storage initially available in the conservation pool of Aubrey Lake below elevation 627.0 would, under 1985 conditions of watershed development and initial area and capacity, produce a dependable yield of 130 cubic feet per second (cfs), which amounts

to about 84.0 mgd. A conservation storage-yield study at the selected project, after 100 years of watershed development and sediment deposition (54,600 acre-feet), indicates that the ultimate conservation storage of 600,700 acre-feet would produce a yield of 117 cfs which amounts to about 75.6 mgd. In summary, the selected site will necessitate 32,600 acres of land at the flood pool level, requiring less land than any of the other sites. At the water supply pool level, 25,200 acres are required, less than site 4 but more than the other sites. Principal roads through the area, U.S. Highway 377 and Farm-to-Market Roads 372, 455, and 922, would require relocation or modification as will county roads and utilities at 18 other locations. The traffic currently utilizing FM Road 455 will be served by the relocated route over the Aubrey Dam. Approximately 3.5 miles of railroad would also require relocation and alteration. In terms of wildlife, the site will disturb less cover for game species than sites 2 or 3 but more than site 4. Site 1 will do less by inundation to affect existing mineral resources than the other sites. This damsite will affect, to differing degrees, all 26 archeological sites referenced in the Bousman and Verrett report (4). It will affect 3 sites less than site 2, 11 sites less than site 3, and 3 sites more than site 4. In dealing with recreation, the rationale was adopted that proximity to people would be the positive deciding factor. Sites 1, 2, and 4 are located farther from the centers of population and were; therefore, considered to be equal and slightly less desirable than site 3. With respect to the Soil Conservation Service floodwater retarding structures within the proposed Aubrey Lake site 1, it is estimated that approximately 4,480 acres of land benefited by these structures would be inundated with a resulting loss of approximately $98,500 in attributable annual benefits. Cost data in table V-1 show site 1 to be less expensive, with either an uncontrolled or gated spillway than the other sites.

(2) Site 2. Site 2, located 4.1 river miles downstream from site 1, will require 31,580 acres of land at the flood pool level, which is more than site 1 but less than sites 3 or 4. The conservation pool level requires 25,280 acres, which is less than sites 1 or 4 but more than site 3. The site should require relocation or modification of U.S. Highway 377 and Farm-to-Market Roads 372, 2153, 922, and 455. In addition, there would be 16 other relocations of county roads and utility lines, and approximately 3.3 miles of railroad associated with this site. Ground cover for game species would be disturbed more by this site than by sites 1 or 4 but less than site 3. The existing mineral resources would be more adversely affected by inundation at site 2 than at sites 1 or 4 but less than site 3. This damsite will affect 3 archeological sites more than site 1, 8 sites less than site 3, and 6 sites more than site 4. Considering recreation, sites 1, 2, and 4, located farther from population centers, were considered about equal and slightly less desirable than site 3. Aubrey Lake at site 2 would

inundate an estimated area of 3,500 acres of flood plain protected by floodwater retarding structures, at a loss in annual benefits of approximately $80,850. Table V-1 shows site 2 to be more expensive than site 1 but less expensive than sites 3 or 4.

(3) Site 3. This site is the farthest downstream of the four sites, and is located 8.8 river miles downstream from site 1 and 12.8 miles below site 4. An area of 32,130 acres at the flood pool level is the largest required of any of the sites, and 22,730 acres at the water supply pool level is the smallest. It would require relocation or modification of Farm-to-Market Roads 455, 428, 372, 2153, and 2164. Alteration of Interstate Highway 35 would also be required. Relocation of utilities would be required, as well as relocation and alteration of approximately 3.5 miles of railroad and county roads at 20 locations. Site 3 is the least expensive regarding relocations, but will disturb more cover for wildlife than the other sites. Site 3 would inundate more of the existing mineral resources than any of the other alternate sites considered. This site will affect 11 archeological sites more than site 1, 8 sites more than site 2, and 14 sites more than site 4. From the standpoint of accessibility to people, this site is regarded as being the most desirable for recreation. Aubrey Lake at site 3 would affect both Elm Fork and Clear Creek floodwater detention projects. It is estimated that 2,800 acres of flood-plain lands in the Elm Fork watershed, and 2,320 acres in Clear Creek watershed would be inundated. This would amount to a total of $114,400 of average annual benefits lost. Site 3 is more expensive than sites 1 or 2 and less expensive than site 4, as shown in table V-1. This site would not adversely affect Bloomfield Cemetery and Townsite, Jones Cemetery, the Hammons' house, and most of the Jacob's Oil Field.

(4) Site 4. Site 4, located at river mile 64.0, is upstream from the other sites. With 31,700 acres required at the flood pool level, it is the next largest in size after site 3, and is the largest in area at the conservation pool level, with 25,500 acres. This site would require relocation or modification of U.S. Highway 377 and Farm-to-Market Roads 372, 455, 922, and 2164. There are 28 county road relocations and many utility relocation requirements. Approximately 3.6 miles of railroad would also require relocation and alteration. Site 4 is the most expensive in terms of relocations. This site floods less wildlife cover than the other sites. In terms of existing mineral resources, its impact is more favorable than sites 2 or 3 and slightly less favorable than site 1. This damsite will affect 3 archeological sites less than site 1, 6 sites less than site 2, and 14 sites less than site 3. At the site 4 location, approximately $102,700 in annual benefits would be lost to the Elm Fork watershed floodwater retardation project, with an estimated area of 4,670 acres of flood-plain land being covered by Aubrey Lake. As shown on table V-1, the site 4 location was found to be the most expensive site location studied. For recreation, site 4 is equal to sites 1 and 2, but less desirable than site 3.

(5) Summary. An evaluation table (table V-2) is presented to facilitate understanding of the complex relationships of the impact elements discussed. Numbers 1 through 4 are used as an index to indicate a range of desirability, with 1 representing the most desirable and 4 the least desirable. Blank spaces represent an equal rating at each damsite location. Although this represents a ranking approach, and the index numbers are not weighted, it is considered to have value in comparing the more obvious elements. In this way, the four sites may be considered generally in relation to the same types of conditions studied by North Texas State University in its use of the Battelle-Columbus Environmental Evaluation System, except that a cost factor has been included in table V-2. Site 1 was indicated as the preferred or most desirable site after summation.

b. Small Upstream Watershed Projects.

(1) General. This alternative was developed to determine if several smaller impoundments would develop a water conservation yield similar to the authorized project with less environmental impact to the watershed and less cost. To make a definite determination, it was necessary to hypothetically locate an adequate number of feasible damsites which would create impoundments developing nearly 130 cfs initially, and 117 cfs after 100 years of sedimentation and watershed development. The first damsite was located on Isle du Bois Creek almost 1 mile due west of Tioga, the second was located on Mustang Creek about 3.5 miles southeast of Aubrey, the third on Clear Creek about 7 miles north of Sanger, and the fourth on Spring Creek about 8 miles southwest of Gainesville. Pertinent data developed on each of the four sites is presented in tables V-3, V-4, V-5, and V-6, respectively.

(2) Beneficial Aspects: By constructing four separate projects, it would be possible to distribute recreational facilities over more area and thereby possibly prevent the crowding and overtaxing of natural resources in the recreation areas which would be developed at the Aubrey project. The overall water quality in all of the impoundments would be better because there would be less land used for agriculture, industry, and municipalities which usually contribute the bulk of pollutants to streams in the drainage area. Furthermore, the fishery in each impoundment would be of extremely high quality, not only because of the good quality water, but also because there will be a larger littoral zone for fish to find food and to spawn. Reestablishment of native vegetation around these impoundments would increase the diversity and total number of wildlife species in the area. Since some of the impoundments would be in the prairie and some in the East Cross Timbers, a large variety of organisms would benefit. The water conservation storage of the four projects is estimated to be approximately 110.5 cfs initially, or about 71.4 mgd. After 100 years of sediment deposition and watershed development, the impoundments are expected

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Table V-2

Effects of Damsite Locations on Various Elements

Elements	Damsites 1	2	3	4
Lands Flooded (Flood Control)	*1	2	4	3
Lands Flooded (Water Supply)	3	2	1	4
Relocations	2	3	1	4
Historical	3	3	1	3
Archeological	2	3	4	1
Wildlife	2	3	4	1
Fishery	**-	-	-	-
Mineral Resources	1	3	4	2
Foundations	-	-	-	-
Water Quality	-	-	-	-
Water Supply	-	-	-	-
Recreation	3	3	1	3
Floodwater Detention Program	2	1	4	3
Cost	1	2	3	4
Total	20	25	27	28

*1 represents most desirable; 4 represents least desirable.
**A dash or no numerical rating means that the effects on the element would be equal at each damsite.

Table V-3

Preliminary Pertinent Data - Tioga Site

Stream: Isle Du Bois Creek
Drainage Area (Contributing): 158.7 square miles
Initial Conservation Storage: 126,900 acre-feet; yield 21 cfs
Ultimate Conservation Storage: 103,500 acre-feet; yield 15 cfs
Purpose (Use): Conservation only
Type of Dam: Earthen Fill

	Flow into full pool
Spillway Design Flood:	
Peak inflow, cfs	222,500
Volume, acre-feet	261,500
Volume, inches	30.9
Outflow:	
Total routed peak, cfs	26,900*

Spillway:
Type and location: Broadcrested Weir
Length in feet at crest (net): 100
Control: None

Outlet Works:
Type (and dimensions): One 8-foot diameter gated conduit
Control: Two 4X8 slide gates
Elevation of invert at intake, feet msl: 610.0

Reservoir Data:

Item	Elevation (feet msl)	Area (acres)	Capacity** (acre-feet)	Spillway Discharge (cfs)
Top of conservation pool***	654.0	6,630	129,900	0
Guide taking line	659.0	7,670	165,900	
Max. design (water surface)	677.5	11,200	339,900	26,900
Top of dam	683.0			

* Includes 0 cfs discharge through the outlet works.
** Includes allowance for 100-year sedimentation of 23,400 acre-feet; 23,400 acre-feet of sediment at top of conservation pool, el. 654.0 ft. msl.
*** Also top of uncontrolled spillway crest.

Table V-4

Preliminary Pertinent Data - Mustang Creek

Stream: Mustang Creek
Drainage Area (Contributing): 144 square miles
Initial Conservation Storage: 178,500 acre-feet; yield 29 cfs
Ultimate Conservation Storage: 159,000 acre-feet; yield 21 cfs
Purpose (Use): Conservation only
Type of Dam: Earthen Fill

	Flow into full pool
Spillway Design Flood:	
Peak inflow, cfs	169,600
Volume, acre-feet cfs	241,100
Volume, inches	31.4
Outflow:	
Total routed peak, cfs	16,600*

Spillway:
Type and location: Broadcrested Weir
Length in feet at crest (net): 100
Control: None

Outlet Works:
Type (and dimensions): One 8-foot diameter gated conduit
Control: Two 4X8 slide gates
Elevation of invert at intake, feet cfs: 528.0

Reservoir Data:

Item	Elevation (feet msl)	Area (acres)	Capacity** (acre-feet)	Spillway Discharge (cfs)
Top of conservation pool***	581.0	8,850	178,500	0
Guide taking line	586.0	10,650	227,300	
Max. design (water surface)	597.6	15,170	379,500	16,600
Top of dam	603.0			

* Includes 0 cfs discharge through the outlet works.
** Includes allowance for 100-year sedimentation of 19,500 acre-feet; 19,500 acre-feet of sediment top of conservation pool, el. 581.0 ft. msl.
*** Also top of uncontrolled spillway crest

Table V-5

Preliminary Pertinent Data - Clear Creek

Stream: Clear Creek
Drainage Area (Contributing): 228 square miles
Initial Conservation Storage: 275,900 acre-feet; yield 52 cfs
Ultimate Conservation Storage: 285,900 acre-feet; yield 49 cfs
Purpose (Use): Conservation only
Type of Dam: Earthen Fill

	Flow into full pool
Spillway Design Flood:	
Peak inflow, cfs	238,900
Volume, acre-feet	431,700
Volume, inches	28.1
Outflow:	
Total routed peak, cfs	21,500*

Spillway:
Type and location: Broadcrested Weir
Control: Two 4X8 slide gates
Elevation of invert at intake, feet msl: 690.0

Reservoir Data:

Item	Elevation (feet msl)	Area (acres)	Capacity ** (acre-feet)	Spillway Discharge (cfs)
Top of conservation pool***	782.0	8,170	275,900	0
Guide taking line	787.0	10,060	279,700	
Max. design (water surface)	799.4	68,840	639,900	21,500
Top of dam	805.0			

* Includes 0 cfs discharge through the outlet works.

** Includes allowance for 100-year sedimentation of 20,000 acre-feet; 20,000 acre-feet of sediment top of conservation pool, el. 782.0 ft. msl.

*** Also top of uncontrolled spillway crest.

Table V-6

Preliminary Pertinent Data - Spring Creek

Stream: Spring Creek
Drainage Area (Contributing): 41.8 square miles
Initial Conservation Storage: 49,050 acre-feet; yield 8.5 cfs
Ultimate Conservation Storage: 46,850 acre-feet; yield 7.5 cfs
Purpose (Use): Conservation only
Type of Dam: Earthen Fill

	Flow into full pool
Spillway Design Flood:	
Peak inflow, cfs	119,300
Volume, acre-feet	60,200
Volume, inches	27.0
Outflow:	
Total routed peak, cfs	14,400*

Spillway:
Type and location: Broadcrested Weir
Length in feet at crest (net): 100
Control: None

Outlet Works:
Type (and dimensions): One 8-foot diameter gated conduit
Control: Two 4X8 slide gates
Elevation of invert at intake, feet msl: 695.0

Reservoir Data:

Item	Elevation (feet msl)	Area (acres)	Capacity** (acre-feet)	Spillway Discharge (cfs)
Top of conservation pool***	748.0	2,010	49,050	0
Guide taking line	753.0	2,350	60,410	
Max. design (water surface)	765.8	3,480	97,150	14,400
Top of dam	771.0			

* Includes 0 cfs discharge through the outlet works.
** Includes allowance for 100-year sedimentation of 2,200 acre-feet; 2,200 acre-feet of sediment at top of conservation pool, el. 748.0 ft. msl.
*** Also top of uncontrolled spillway crest.

to develop approximately 92.5 cfs, or about 59.8 mgd. A comparison of social elements in table V-7 indicates that the "four small impoundments" alternative would require more miles of road and utility alterations or relocations than the proposed Aubrey Lake project.

Table V-7

Required Alterations or Relocations

Elements	Aubrey Lake	Four Small Impoundments
State and/or Federal highways	1.9 miles	0
Farm-to-Market roads	30.8 miles	5.5 miles
County roads	9.3 miles	41.8 miles
Railroads	3.3 miles	1.0 mile
Utility lines	37.0 miles	50.0 miles
Cemeteries	4	0
Oil fields	1	1

(3) Detrimental Aspects. By constructing four separate projects, the cost of construction will be $16,400,000 more than the single authorized project. Furthermore, these four lakes will cover a total of 25,660 acres at the top of the conservation pool compared to 25,200 acres to be covered by the authorized project. In spite of this additional acreage, it is estimated that the combined yield from these reservoirs would be 12.6 mgd less initially, and 15.8 mgd less after 100 years of sediment deposition and watershed development. A primary detrimental effect would be the elimination of approximately 130 miles of streams and related streamside flora and fauna. Furthermore, the flora and fauna restricted to stream-type habitats will be replaced by lacustrine types. There will be a conversion of the existing stream-oriented recreation to slack-water-oriented recreation. Current trends in recreation indicate that stream-oriented recreation areas are at a premium, and that stream channelization and dam building are reducing good stream-type recreation areas and affecting their quality. The Aubrey project will inundate only 43 miles of stream reaches, compared with 130 miles which would be inundated with the four small watershed projects alternative.

(4) Economic Aspects. The total first costs of the four small watershed projects is $117,400,000.

(5) Reason for Rejection. This alternative was rejected primarily because both the monetary and environmental cost would be excessive when compared to the cost of the selected project. These projects will produce less water, will require more land, and will entail greater costs to operate and maintain four separate structures, all of which will significantly raise the cost of water to the consumer.

c. Excavation Alternative.

(1) General. This alternative was investigated pursuant to the statement made by Dr. J. K. G. Silvey at the Aubrey Lake public meeting held in Denton, Texas, on 30 April 1971. His statement concerned the feasibility of excavating to deepen the proposed impoundment, thereby reducing the amount of land required, and extending the effective life of the project. In order to determine the economic and environmental feasibility of such an alternative, the total water storage volume remained 650,300 acre-feet at the conservation pool elevation. Table V-8 shows the differences in the selected project and the excavation alternative(figure V-1).

Table V-8

Land Requirements in Acres

Elevation	Selected Project	Excavation Alternative	Reduced Amount of Lands	
			Acres	Percent
Top of conservation pool	25,200	11,020	14,180	56
Top of flood control pool	32,600	18,900	13,700	42
Guide taking line	37,300	23,100	14,200	38
Maximum design water surface	54,800	42,200	12,600	23
Top of dam	62,700	48,700	14,000	22

(2) Beneficial Aspects. With the smaller amount of land required, this alternative will reduce by about 14,200 acres the amount of land inundated, which, in turn, will reduce the adverse impacts and

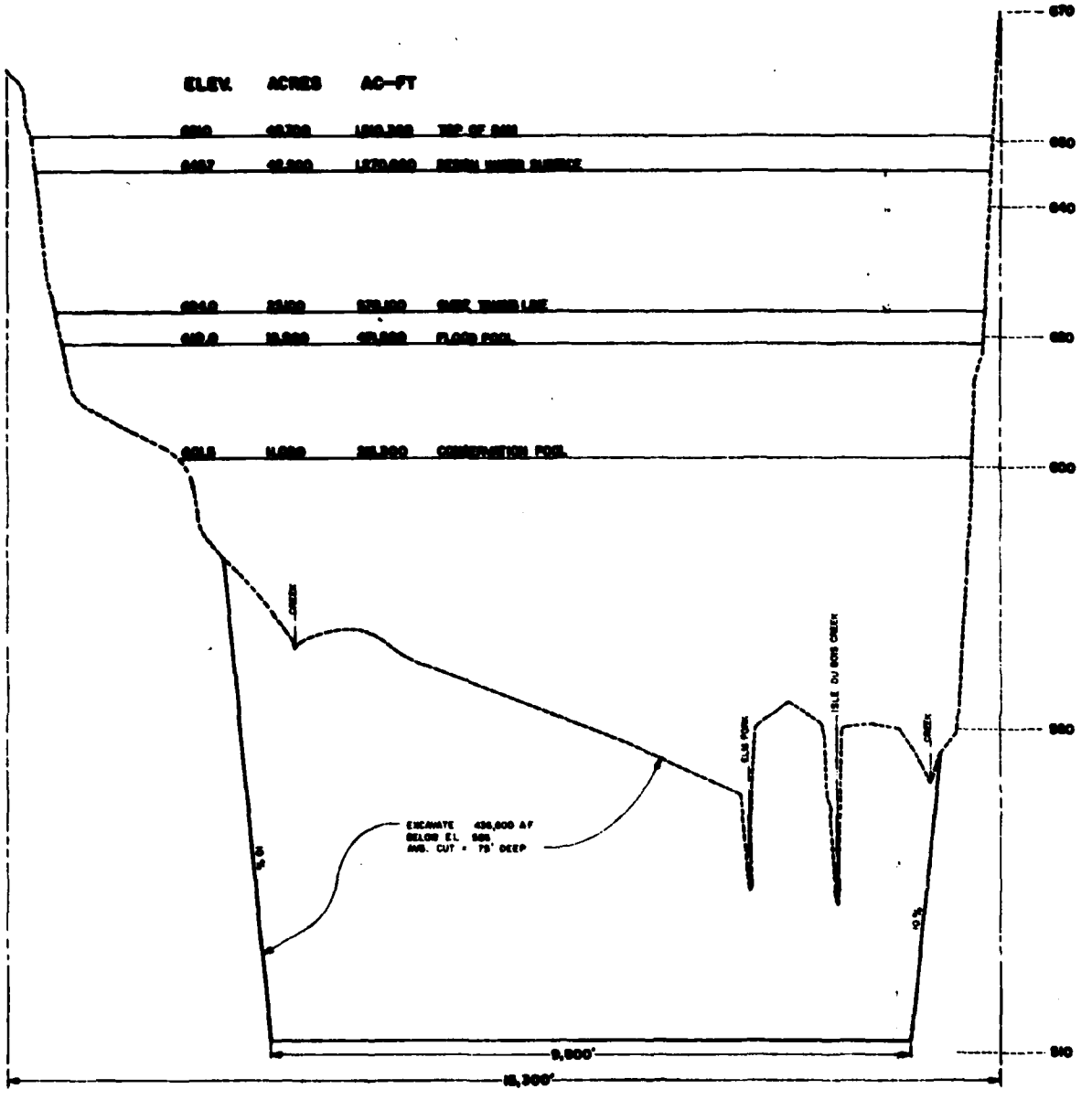


FIGURE X-1

TYPICAL CROSS-SECTION OF EXCAVATION ALTERNATIVE

effects on the area wildlife resulting from the filling of the conservation pool. The costs of lands, damages, and relocations for this alternative will be about $34 million, which is a reduction of $25 million from the cost of the selected project.

(3) Detrimental Effects. This alternative, by the nature of its design, will create a huge amount of surplus excavated material, requiring some type of disposal or distribution. This surplus would total about 704 million cubic yards of material, which would cover about 21,800 acres of land to an average height of 20 feet. It would require 14,500 acres if it were filled to an average height of 30 feet. Therefore, the excavated lake, plus the spoil area 30 feet deep, would require 25,520 acres, which is 320 acres more than the land requirements of the selected project. This alternative will reduce the average annual recreational benefits from $5,653,000 to $2,603,800, and the average annual fish and wildlife benefits from $741,600 to $188,100. This design of the reservoir would reduce the littoral zone of the lake which is used by many fish species for feeding and spawning, and by wildlife species for feeding and nesting.

(4) Economic Aspects. A comparison of the estimated costs of this alternative with the selected project reveals that the excavation alternative is three times more expensive. The majority of the extra expense comes from the actual excavation of the pool area, which is estimated at over $211 million, as shown in table V-9. The cost of available water per acre-foot from the selected project is about $0.09/1,000 gallons, while the cost per 1,000 gallons for the excavation alternative would be about $0.27.

(5) Factors Contributing to Rejection of this Alternative. There would be a 56 percent reduction in land requirements for this alternative at the conservation pool level, which would reduce the adverse impacts and their primary and secondary effects on the human and natural environment resulting from land acquisition, inundation, and relocations. However, the additional estimated excavation expense makes this alternative economically infeasible.

3. Alternatives That Will Meet One or More, But Not All, of the Authorized Project Purposes.

a. Structural Alternatives. The following alternatives involve the use of structures to satisfy one or more, but not all, of the purposes for which Congress authorized the Aubrey project.

(1) Water Supply.

(a) Ground Water Supply.

1 General.

a Ground water and its movement form an integral part of the total hydrologic cycle through which the earth's moisture moves

Table V-9

Cost Comparison
(in thousands of dollars)

Criterion	Selected Plan	Alternative Plan - Pool Excavation	
Lands and Damages	$ 41,447	$ 25,100	
Relocations	17,562	8,724	
Reservoir	3,002	1,789	$211,314
Embankment	16,714	13,103	
Spillway	3,809	4,738	
Outlet Works	2,935	2,787	
Access Roads	59	59	
Recreation	6,957	5,460	
Buildings, Grounds and Utilities	337	337	
Operating Equipment	251	251	
Engineering and Design	4,342	3,487	10,566
Supervision and Administration	4,125	2,906	8,453
Subtotal	$101,000	$ 68,741	$230,333
Total Project Cost	$101,000	$299,074	

from the sea, through the atmosphere, onto the land, and eventually back to the sea. All water in the Trinity River Basin, whether ground or surface water, is derived from the precipitation portion of this cycle. The major portion of this precipitation results from water vapor being carried inland from the Gulf of Mexico. A generalized hydrologic cycle for the Trinity River Basin appears in figure V-2.

b A portion of the precipitation in the Trinity River Basin percolates into outcroppings of geologic strata. This water, together with seepage from streams crossing these outcroppings, flows downward by gravity through these strata. The amount of ground-water flow depends on the porosity of the water-bearing strata and on the permeability, or ability to transmit water, of the strata. The downward percolating water eventually reaches an underground zone in which the strata are saturated. The top level of this zone of saturation becomes the ground water table. A geologic formation with a saturated zone capable of yielding water in sufficient quanity to constitute a usable water supply is referred to as an aquifer.

c In Texas, aquifers have been classified as either major or minor, depending on their ability to supply water. A major aquifer may yield large quantities of water over a comparatively wide area of the State. A minor aquifer is capable of supplying large quantities of water over a small area or of supplying small quantities of water over large areas. Figure V-3 depicts a geologic section through Dallas and Tarrant Counties and shows the relative positions of the Trinity group aquifer and the Woodbine group aquifer. These two aquifers comprise the significant major and minor aquifers, respectively, that underlie the general locale of the proposed Aubrey project. Figures V-4 and V-5 show the areal distribution of these aquifers.

d The Trinity group aquifer is generally subdivided into the Trinity group, undifferentiated, and the Travis Peak, Glen Rose, and Paluxy formations. The Trinity group, undifferentiated, lies north of the northern limit of the Glen Rose limestone formation. This northern limit of the Glen Rose limestone formation is presently ill-defined, and, from a water availability standpoint in the Aubrey project area, the geologic and hydraulic interrelationships of the various formations permit consideration of these formations as a single, combined aquifer.

e As shown in figure V-3, the Woodbine group aquifer lies above the Trinity group aquifer and is separated from it by the Fredericksburg and Washita group formations. In the Aubrey project area, these aquifers overlap as shown in figures V-4 and V-5.

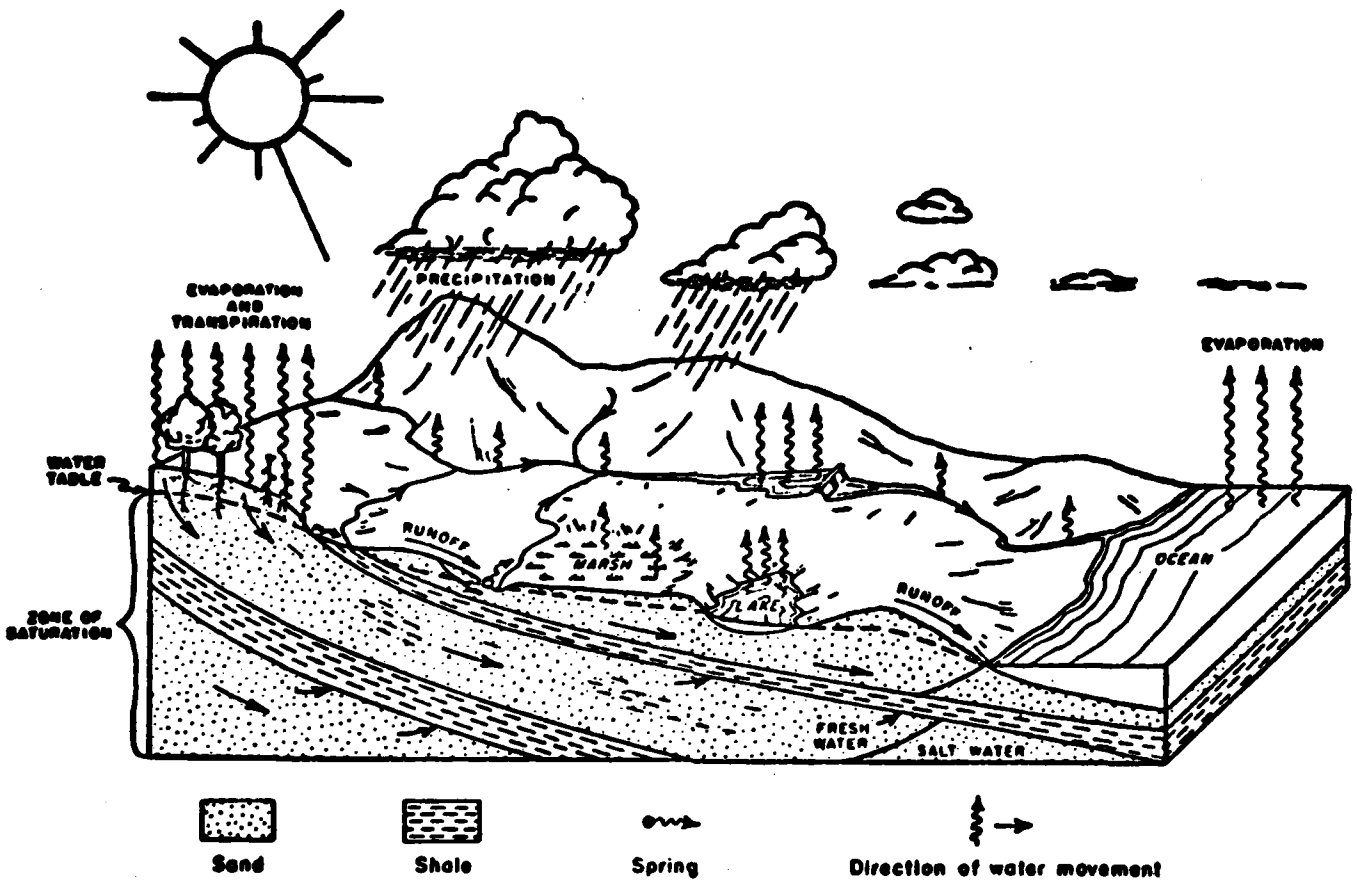


Figure V-2

The Hydrologic Cycle

From Texas Water Commission Bulletin 6309

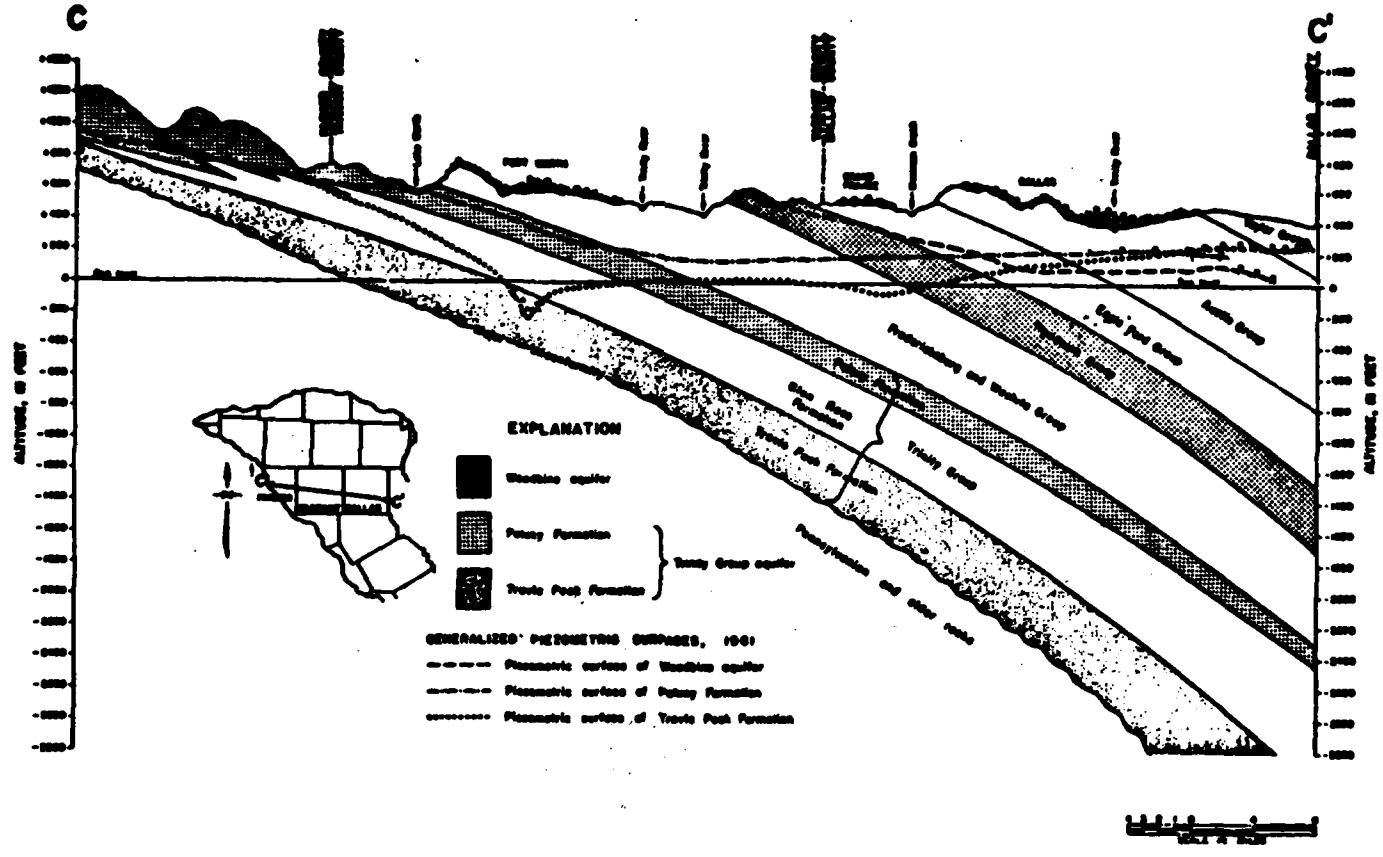


Figure V-3

Generalized Geologic Section C-C', Region I, Trinity River Basin

From Texas Water Commission Bulletin 6309

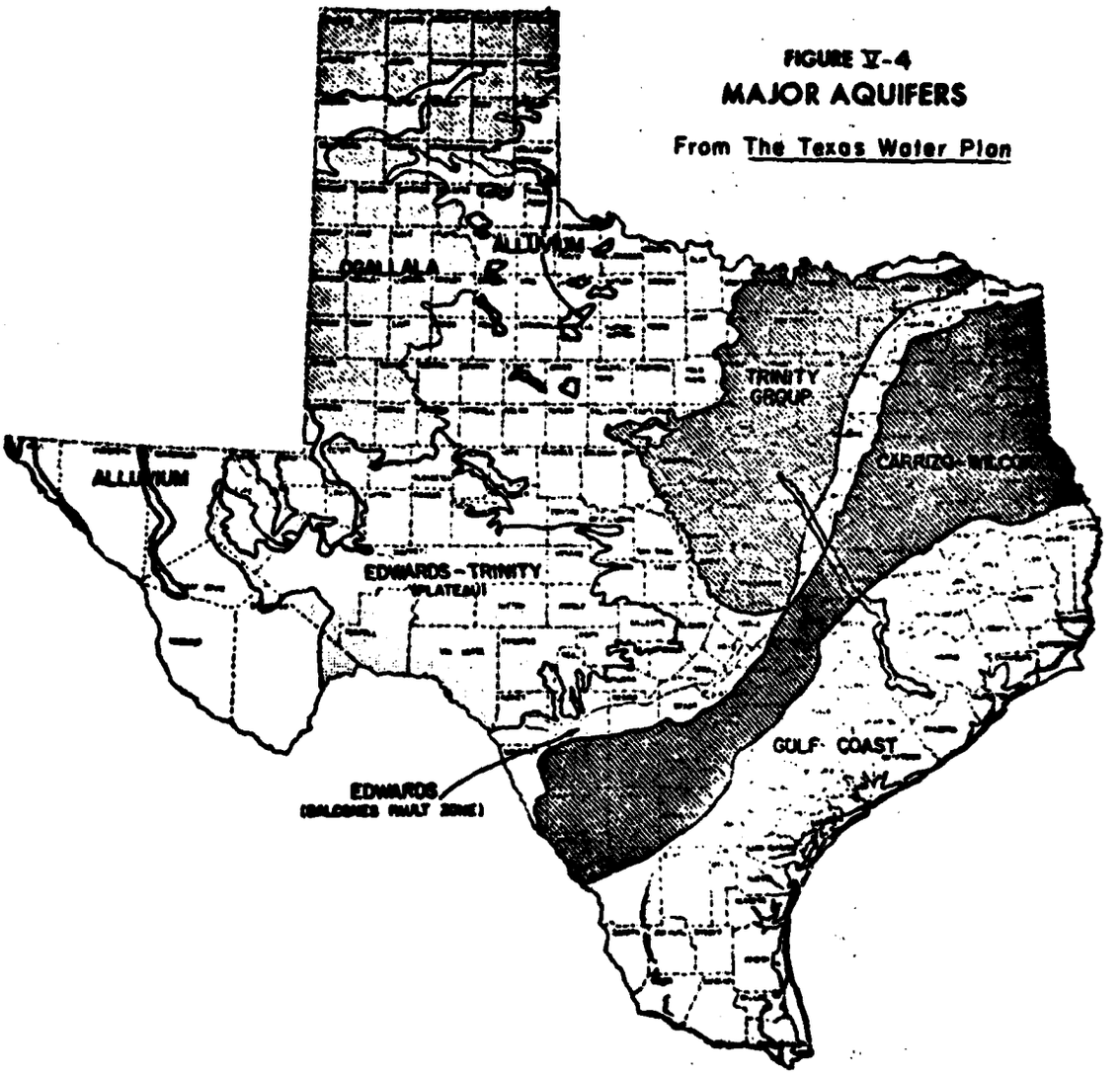
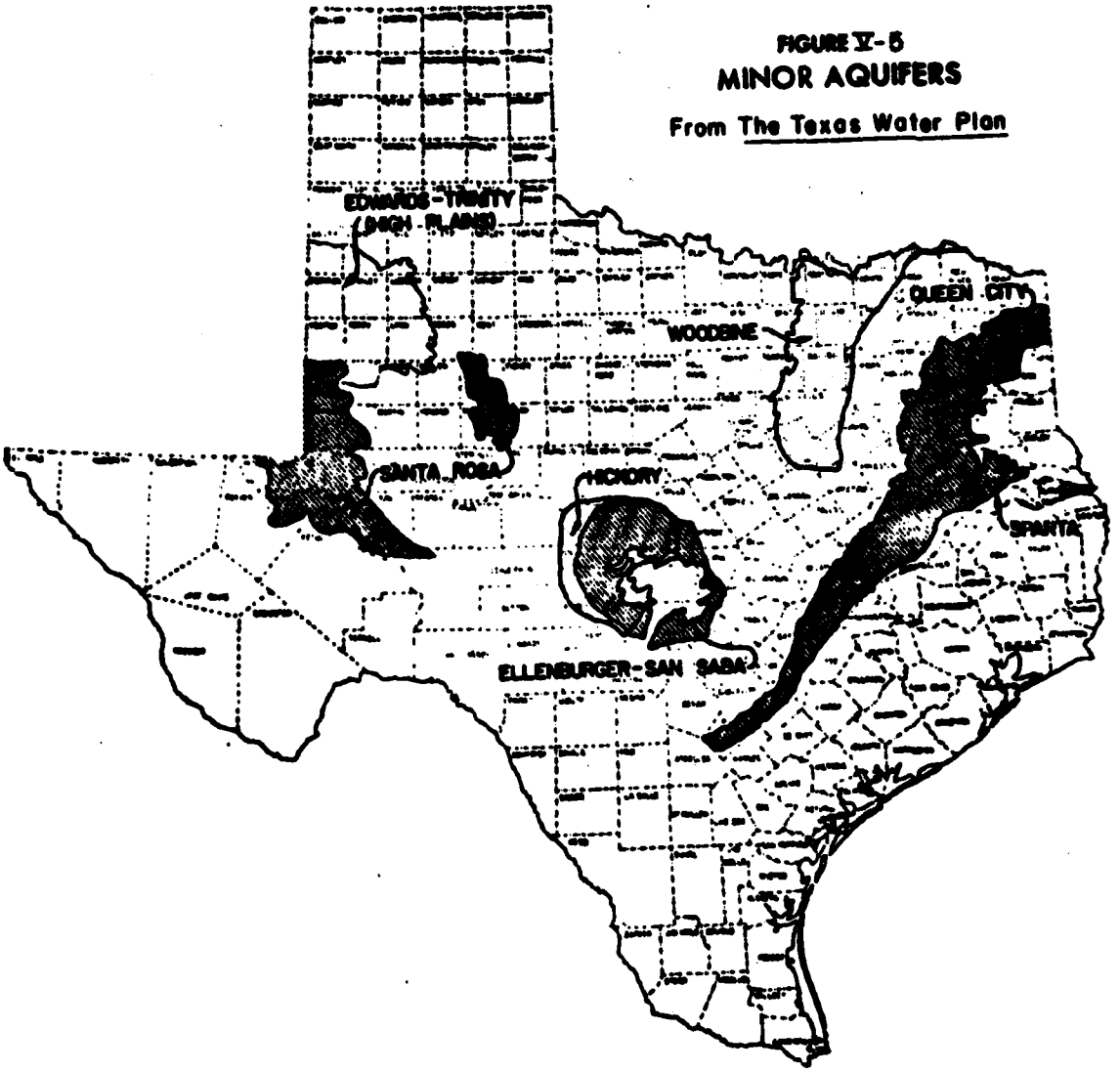


FIGURE V-4
MAJOR AQUIFERS

From The Texas Water Plan

FIGURE V-5
MINOR AQUIFERS
From The Texas Water Plan



2 Beneficial Aspects.

a The installation of a well with its accompanying surface pump and ancillary facilities requires a relatively small ground area. It is estimated that less than 100 acres of surface area would be required to install a sufficient number of pump stations and wells to fully develop the available water resources of both aquifers. Small additional land acquisition might also be required for necessary pipelines, but, for the most part, pipelines might be laid along already developed highway and road rights-of-way.

b In addition, the necessary land would be required in small, less than acre size, parcels over a rather widely dispersed area. Environmental disruption on these parcels would be minor and these isolated, minor disruptions would not be expected to significantly affect either the community environment or endemic ecosystems.

c The quality of water from the Trinity group aquifer is considered generally good. Dissolved solids range from 700 to 900 ppm, and, other than chlorination, this water is acceptable for public water supplies and industrial uses. The water from the Woodbine group aquifer is of poorer quality, being a sodium bicarbonate type with dissolved solids ranging over 1,500 ppm in several samples. In addition, sulfate, fluoride, and in some places, chloride and iron are generally high. However, its general quality would permit its use to augment a total water supply by dilution with a higher quality water. Water from either aquifer would not be exposed to the conventional hazards associated with surface runoff into reservoirs.

3 Detrimental Aspects.

a The quantities of water available for development from both the Trinity group and the Woodbine group aquifers were studied during preparation of the "Reconnaissance Investigation of the Ground-Water Resources of the Trinity River Basin, Texas" (38). This groundwater availability study was conducted on the basis of pumpage under assumed conditions and was related primarily to the ability of the aquifer to transmit water to the pumping areas. Although the study was conducted prior to publication in 1963, it constitutes the most comprehensive study and presents the most reliable data presently available. There appear to be no subsequent changes in withdrawal patterns or known supplies of ground water that modify its findings.

b Under conditions of assumed development of the Trinity group aquifer, approximately 50,000 to 55,000 acre-feet of water annually would be transmitted from the recharge area to pumpage areas. For example, in 1956 about 50,000 acre-feet were pumped from this aquifer. The wells were not located properly to optimize

withdrawals. This resulted in a serious decline in water levels, and, as a result, withdrawals continually decreased, until by 1960 pumpage was reduced to approximately 34,000 acre-feet. Thus, with proper well locations, an additional 15,000 to 20,000 acre-feet annually might be obtained on a sustained basis. Of this additional quantity, about 75 percent, or 11,000 to 15,000 acre-feet, is available north of Dallas and Tarrant Counties. The localized overproduction during 1956 demonstrated that adequate well spacing would be required to achieve a sustained yield of the 50,000 to 55,000 acre-feet possible.

c As a minor, more accessible aquifer, the Woodbine group has been more widely tapped by housing developments, small towns, and industries that do not require large volumes of water. Withdrawals from this aquifer probably peaked at about 6,000 acre-feet during the drought of 1956 and have decreased slightly to about 5,700 acre-feet in 1960. Under assumed study conditions, approximately 12,000 acre-feet were found to be available annually from the aquifer. Thus, if fully developed, an additional 6,000 acre-feet would be available.

d The low transmissibility of the Woodbine group aquifer requires large drawdowns in order to obtain large amounts of water. This condition dictates that full development would require a large number of wells. The large number of wells required for full development, with attendant site acquisition, maintenance, and piping costs places an additional economic burden over the drilling and pumping costs, making this alternative impractical from an economical viewpoint. As indicated in table V-11, page V-34, the projected 2020 water deficit for the Dallas area is 119,200 acre-feet annually. The Texas Water Plan which is currently in the planning stage and, as yet, unauthorized, includes a Trans-Texas Canal from East Texas across the northern part of the state to the High Plains and New Mexico. Under this plan, water from the Trans-Texas Canal will be used to relieve this projected 119,200 annual acre-feet deficit. The Aubrey project is scheduled in this table to provide 64,900 acre-feet annually. The alternative of full development of ground-water resources would supply, at best estimate, about 21,000 acre-feet annually, thus contributing an additional deficit of 43,900 acre-feet, or 36 percent, to the already projected 119,200 acre-feet deficit. Although final costs for water via the Trans-Texas Canal System have not been determined, it is considered quite likely that water supplied from this source will be significantly more costly than water from the Aubrey project.

4 Economic Aspects. Cost estimates for production of water as dictated by well dispersal necessitated by drawdown data indicate that

pretreatment water costs for the Trinity group aquifer would be in the range of $0.22 to $0.29 per 1,000 gallons. For the Woodbine group aquifer, this range is estimated at $0.13 to $0.18 per 1,000 gallons. The weighted average cost for water from both aquifers based on these estimates would be in the range of $0.20 to $0.25 per 1,000 gallons. The estimated pretreatment cost range for water from the Aubrey project is $0.03 to $0.04 per 1,000 gallons.

5 Reasons for Rejection. Based on costs, ground water as an alternative to the Aubrey project water supply is not considered an attractive possibility. The factor of long-term dependability of these ground-water sources in view of past drought experience in this area is open to speculation. Most important, however, is the relatively small and potentially limited quantities of water available in relation to long-term area needs. Full exploitation of area ground-water sources could be expected at best to defer the ultimate necessity for Aubrey Lake or a similar project only a short while. Meanwhile, a present standby reserve for possible emergencies would not exist. For these reasons, utilization of ground water as an alternative to the Aubrey Lake project was rejected.

(b) Artificial Aquifer Recharge.

1 General. Approximately 36 mgd of subsurface water is now being pumped from the aquifers underlying the upper Trinity River Basin. The principal source of natural recharge for the aquifers is precipitation falling on the aquifer outcrop. Seepage from streams and lakes located on the outcrop and interformational leakage are minor sources of ground-water recharge. Artificial aquifer recharge would augment natural aquifer recharge by pumping water of acceptable quality into the aquifers by means of a series of pressurized injection wells situated on or adjacent to the recharge zone. Artificial aquifer recharge, when considered as a valid alternative to the selected Aubrey project, must develop an equivalent resource of yield contribution while maintaining current ground-water development. The Texas Water Commission (38) reports that an estimated total of 60 mgd are available in the primary and secondary aquifers of the upper Trinity River Basin. This amount is based on pumpage, under idealized conditions, related to the ability of aquifers to transmit water and the availability of recharge in outcrop areas. Since at the present time 36 mgd is being utilized, this means that under natural conditions only an additional 24 mgd would be available for development. This available but undeveloped resource would satisfy only a fraction of the anticipated water needs of the area, as estimated by the Texas Water Development Board in their report entitled "The Texas Water Plan" dated November 1968 (39).

2 Beneficial Aspects. A primary benefit to be realized from implementation of this alternative is the socioeconomic gain to individuals who would be employed in the myriad functions which would be necessary to operate the recharge system. Some recreation benefits would be available at the catchment basins used to retain water to be used for recharge purposes. Fish and wildlife may receive some benefit from these catchment basins.

3 Detrimental Aspects. The Trinity group and the Woodbine group aquifers are composed principally of fine-grained sands, and both have relatively low coefficients of transmissibility. Because of the low transmissibility coefficient under conditions of maximum ground-water development, water received for recharging will be greater than the amount that can be transmitted to supply withdrawals. This could be described simply as a "pipeline" problem. Any water not admitted to the aquifers at the recharge point is contributed to the flow of Clear Creek, Denton Creek, and the Elm and West Forks of the Trinity River, and is lost for natural recharging of the aquifers. Thus, it seems that ground-water development, including artificial recharge, is limited by the lack of transmissibility and storage. To overcome this deficiency for recharge, the project would require a systematic location of many injection wells, control structures, collecting systems, and withdrawal wells. Furthermore, water to be injected would require treatment to remove solids and turbidity, and chlorination to prevent growth of bacteria in order to prevent clogging of wells. Temperature control might also be an environmental factor necessary for successful recharging of aquifers. This alternative does not forgo the need for impoundments because they would be needed for catching and storing water prior to treating and injecting operations. An indirect detrimental effect will be the tremendous consumption of energy necessary for pumping, treating, injecting, and finally lifting of the water. The energy must be generated somewhere with consumption of another form of energy, usually resulting with one or more environmentally damaging byproducts.

4 Economic Aspects. In addition to the costs of pumping ground water, as explained in the ground-water alternative, there will be a tremendous cost for treating, cooling, and injecting the water. The estimated cost per 1,000 gallons of water is shown in table V-10.

5 Reason for Rejection. This alternative was rejected for several reasons. The primary reason is that this alternative could not be developed to the point where it would produce an amount equivalent to the selected Aubrey project. Secondly, the ultimate cost of the water delivered to the consumer would be enormous. In essence, this alternative would have all the detrimental effects of the selected Aubrey project plus an astronomical cost of treating the water, injecting it into the aquifers, pumping it out again, and retreating the water. In summary, the study of this alternative

Table V-10

Estimated Annual Costs for Injecting 20,000 Acre-Feet Into the Trinity Group and Woodbine Group Aquifers

Item	Units Involved	Annual Cost
Pretreatment	20,000 acre-feet at $0.10 per 1,000 gallons	$652,000
Treatment Plants	20-mgd plant - $10,000,000 at 6 percent over 40 years	664,000
Injection Wells	25 wells - 38,800 feet at $15 per foot plus equipment - $250,000 at 6 percent over 40 years	56,000
Piping Cost	144 miles at $10 per foot at 6 percent over 40 years	505,000
Injection Costs (17)	At $0.20 per 1,000 gallons	1,303,000
Other Costs	Pumping, operation, and maintenance	250,000
Total		$3,430,000

Cost per 1,000 gallons: $0.54

revealed that the physical limitations, results to be achieved, and economic outlay required would render the project infeasible.

(c) Reclamation and Reuse of Wastewater.

1 General.

a As existing natural water sources are fully exploited and return flows of wastewater consequently mount, continued increase in the magnitude of water requirements will demand that wastewater reuse be recognized as an integral component of overall water supply. In addition, the increased value of wastewater imposed by treatment costs required to meet increasingly stringent effluent standards will provide an economic incentive for wastewater reclamation and reuse.

b Some reuse of municipal and industrial wastewater has been a reality for many years. Wastewater discharged into rivers and streams in many instances makes up a significant portion of the water supplies of downstream municipalities. Usually, dilution and natural purification have been sufficient to permit reuse after conventional purification treatment. This reuse of wastewater might be described as indirect reuse, since the wastewater has lost its original identity through dilution, blending, and natural recovery. Other indirect reuse occurs through ground-water recharge from septic tank seepage and wastewater discharges upon land.

c The concept of direct wastewater reuse was introduced by the U.S. Public Health Service in 1962, when it was reported that such a concept was technologically attainable. However, previous instances of such direct reuse on an emergency basis do exist. In Chanute, Kansas, during October 1956 and March 1957, direct reuse was accomplished by chlorination of a secondary effluent, flow of the chlorinated effluent onto a dried riverbed with a 17-day detention time prior to water intake, two-stage flocculation, and rapid sand filtration. This process was primitive by today's standards, and the reclaimed water was objectionable in turbidity, color, taste, and foaming. However, it contained no pathogens when tested by the most efficient methods available at that time.

d Research in wastewater treatment has significantly expanded with the inception of Federal water pollution control programs. Pilot plant studies have been initiated at Lebanon, Ohio; Santee, Panama; Tahoe, California; and Washington, D.C. In 1968, Stephan and Weinburger (36) concluded, "Wastewater reuse arrived a long time ago. We are just getting the message that it is here."

e Indeed, direct reuse of industrial wastewater by recycling is a current practice in Texas, particularly for cooling water in power plants. Direct reuse by industry of municipal

wastewater has also found application in several areas of the State. A large petrochemical complex near Odessa has been using secondary treated municipal wastewater from Odessa for a number of years. Extensive additional treatment is necessary, however, to reduce phosphates, suspended solids, hardness, silica, and alkalinity.

f Irrigation of cropland using municipal wastewater effluent is accepted and widely practiced in Texas, particularly in the western part of the State. A 1965 survey indicated that 135 towns and cities in the State used all or part of their effluent for irrigation of cropland. In addition, eight other towns used municipal wastewater for irrigation of parks, golf courses, and cemeteries. Others were considering some type of irrigation.

g Augmentation may be viewed as an intermediate step between indirect reuse and direct wastewater reuse by recycling. After extensive treatment, reclaimed water is mixed directly into municipal water supply lines and thereby the total municipal water supply is increased.

h In areas that are generally water-short and which have rapidly developing metropolitan complexes, the availability of large return flows as water supply sources cannot presently be ignored. A full-scale effluent treatment plant which is supplying reclaimed water to satisfy one-third of the water demand in the city of Windhoek, South Africa, was put into operation in November 1968 (35). A schematic of this plant appears in figure V-6. Noteworthy features include the maturation ponds and the flocculation/flotation process. Since commission, this plant has exceeded expectations in every respect, and most importantly, the public has accepted it without reservation. The plant effluent has continually met the drinking water standards set by the World Health Organization. These standards have been met in spite of a severe drought that limited the available quantities of fresh water, resulting in a relatively high, but still acceptable, level of dissolved solids caused by the use of mineralized well water.

2 Beneficial Aspects.

a The indirect form of water reuse is expected to increase in magnitude as more pristine sources are depleted. In this regard, The Texas Water Plan (39) has incorporated reused water into its overall plans and regards its future potential as a significant factor. Table V-11, from the Texas Water Plan, depicts that portion of the Texas Water Plan's existing, under construction, and proposed water supply system planned to meet projected municipal and industrial water requirements for the Dallas system in the year 2020. Table V-12 from a recent study by Forrest and Cotton, Inc. (12) summarizes water supplies available from existing sources and the projected demand for the year 2020.

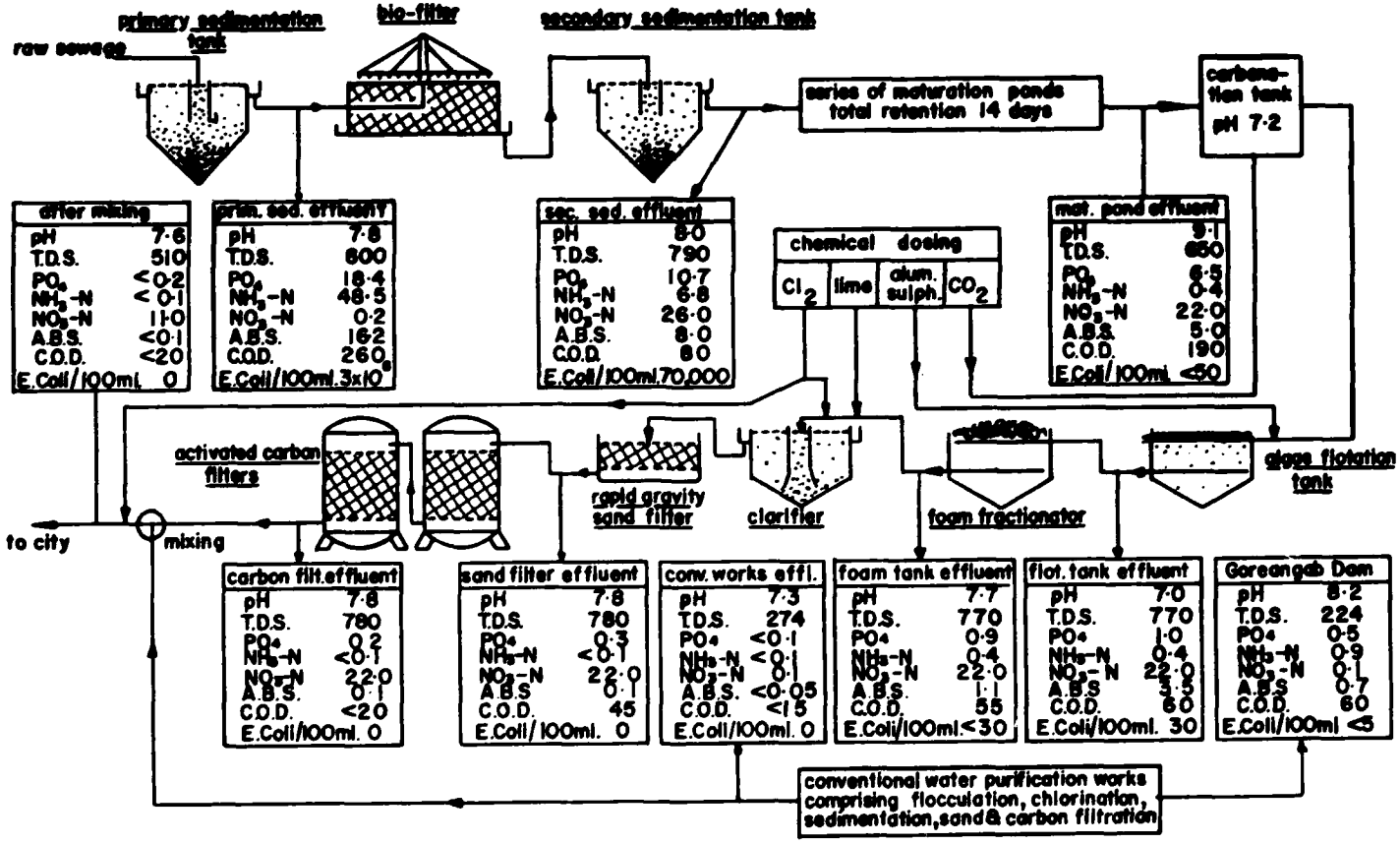


FIGURE V-6 Diagram of Windhoek Sewage Purification and Water Reclamation Plant

(From 'Municipal Reuse of Water,' National Institute for Water Research, Pretoria, South Africa

Table V-11

Dallas System Reservoirs and Imports

Reservoir	Projected 2020 Supply (1,000 acre-feet annually)
Lewisville	102.4
Grapevine	26.2
North Lake	0.4
White Rock	4.0
Lavon Enlargement	97.1
Ray Hubbard	72.1
Lakeview	34.0
Aubrey	64.9
Total Yield	401.1
Usable Return Flows	55.4
Imports	
Tawakoni (Sabine River Basin)	190.0
Cooper (Sulphur River Basin)	97.8
Total Yield, Return Flows, Imports	744.3
Total Requirements	863.5
Total Shortage	119.2

Table V-12

Water Supply Available from Existing Sources and Total Projected Demand[1]

Source	Available in 2020 (MGD)
Grapevine	10.0
Lewisville*	86.8
Ray Hubbard	55.4
Tawakoni	100.0
Lavon (NTMWD)	10.0
Return Flows	41.3
Subtotal	303.5
Additional Permitted Supply:	
Tawakoni	62.8
Palestine	102.0
Total	468.3
Total Projected Demand	708.9

*Includes both Dallas' and Denton's Rights

[1]URS/Forrest & Cotton, Inc. Semi-Final Report Summary: Long Range Water Supply Study to Meet Anticipated Requirements To The Year 2050 For The City of Dallas, Texas, 12 July 1973, Tables 4-5 and 5-1 modified.

b Both table V-11 and table V-12 contain significant return flow factors. These return flows will augment waters impounded in various reservoirs and thus constitute water reuse for beneficial purposes.

c There can be no doubt that augmentation programs will become more widespread, particularly in areas such as South Africa which are already moving along a critical path with respect to available water resources. Technological breakthroughs in processes such as reverse osmosis, ion exchange, or electrodialysis will accelerate the use of augmentation programs.

d The Texas Water Quality Act of 1969 established water quality standards for all waters in the State. In order to meet the standards set for the Trinity River, reliable biological secondary treatment will be required for effluent to the Trinity River.

e In July 1970, a report was prepared for the North Central Texas Council of Governments on an Upper Trinity River Basin Comprehensive Sewage Plan by a team of consulting engineers. The plan recommended an area-wide comprehensive sewerage system in the North Central Texas region, and suggested a plan for implementation. The study encompassed an area of about 11,000 square miles located in North Central Texas and covered all of 10 counties, including Dallas and Tarrant Counties, and parts of 11 other counties. The purpose for development and implementation of a comprehensive sewerage system was to protect lakes used for water supply and recreation from contamination and eutrophication, and to enhance the quality of the upper Trinity River and its tributaries to permit its optimum use. Construction and operation of the sewage and treatment facilities, and implementation of the plan's policies, are to help insure that surface waters within the North Central Texas region meet the requirements of the Texas Water Quality Act.

f The recommended plan, as shown in plate V-5, consists of a combination of separate treatment plants with interceptors carrying flows to joint treatment plants. The minimum degree of treatment will be secondary, as now required by the Texas Water Quality Board. In order to achieve water quality objectives within a reasonable time, the plan projects that tertiary treatment will be provided at all plants by 1990.

3 Detrimental Aspects.

a Now that direct reuse of municipal wastewater appears to be technically feasible, the concept of combined treatment to eliminate the dual system of wastewater treatment and domestic water purification becomes an attractive possibility, particularly in arid

or semiarid regions. However, aside from the public acceptance aspect, there are two primary deterrents to direct wastewater reuse at the present time. These are the health aspects of renovated water for domestic use and the costs involved.

b Currently, developments indicate that the degree of treatment presently under investigation at pilot installations does not remove a variety of questionable organic and inorganic constituents of the wastewater. Lack of removal of these constituents, even though they may be inocuous or tolerable in treated effluent, may cause a buildup to unacceptable levels through the recycle process. Among these constituents are heavy metals, inorganic salts, and organic compounds that are not readily biodegradable.

c Difficulty has also been encountered in the identification and enumeration of the soluble organic constituents of secondary effluent. Studies have left 60 to 70 percent of these compounds unidentified. As a result, practical methods for purifying treated sewage for domestic use must now be of such a nature as to remove a wide variety of organic material of unknown constitution. Approaches to this problem have for the most part been empirical and provide little applicable information on removal efficiencies and selectivity or costs of operations. Until many of these impurities are identified and their composition studied to determine their physiological effects, drinking water standards for renovated water cannot be suitably defined. It, therefore, becomes clear that much additional information is needed in order to provide a satisfactory wastewater renovation process for all conditions and times to insure that consumers are protected. As a minimum, it will be important to assess the health aspects of direct wastewater reuse in terms of viral infections, chronic toxicity, carcinogenic effects, sex hormone effects, and possible radiological effects.

d Because the final treatment processes required to achieve complete renovation of wastewater for domestic reuse are at present unknown, determination of the total unit treatment costs involved will, barring a technological breakthrough, certainly be higher than present advanced treatment processes. The operation, processes, and costs developed at the Lake Tahoe treatment plant in California have been widely cited in literature. This plant is considered significant, not only for its advanced treatment processes, but also for the volume of effluent treated. Its effluent is reputedly drinkable; however, the physiological effects of sustained consumption are at present unknown and questionable in view of the current imponderables previously cited.

e An undated cost breakdown, by process, for the South Lake Tahoe plant are shown in table V-13. Table V-13 indicates that the capital and operating costs for the advanced treatment phase are

Table V-13

Summary of Total Costs Experienced at South Lake Tahoe
(In Dollars Per Million Gallons of Influent)

Process	Total Operating Costs	Capital Costs	Total Cost
Primary	12	19.50	31.50
Activated Sludge	34	33.60	67.60
Organic Sludge	55	14.10	60.10
Chlorination	2	0.30	2.30
Lime Treatment	31	9.70	40.70
Lime Recycling	40	13.50	53.50
Ammonia Stripping	10	8.00	18.50
Recarbonation	4	4.00	8.00
Filtrations	28	17.80	45.80
Carbon Adsorption	3	16.30	19.30
Carbon Regeneration	27	5.20	32.20
Total Conventional Treatment	103	67.50	170.50
Total Advance Wastewater Treatment	143	74.50	217.50
Total	246	142.00	388.00

greater than the conventional treatment phase. On this basis, it is not unlikely that the cost of upgrading and operating present treatment plants to attain effluent of the quality of the Lake Tahoe plant would double the present cost of a conventional secondary plant. This interpolation does not include additional costs involved for the more advanced renovation that may be required to overcome the presently undefined health aspects. This additional cost may well double the present advance treatment cost cited in table V-13, which in effect would triple the capital and operating costs of a complete renovation plant over a conventional secondary treatment plant. In addition, wastewater treatment plants are usually situated in low-lying areas next to effluent receiving streams, while water supply reservoirs are situated at the highest hydraulic gradient available. Therefore, whether the renovated water is injected directly into existing municipal supply lines or pumped to reservoirs, pumping costs are maximized for this water.

4 Economic Aspects.

a The Texas Water Plan views water reuse by industry as a potentially significant factor in long-range industrial water requirements. At present, the extent of industrial water reuse is dictated by the cost of reuse water versus the cost of alternative supplies, except in water-short areas. As the cost of alternative sources of water increases with demand, wastewater reuse by industry will increase substantially.

b Analysis by the Texas Water Plan places the total industrial return flow in Texas at 1.3 million acre-feet annually, of which 0.5 million acre-feet is saline water discharged into the Gulf Coast waters. Of the remaining 0.8 million acre-feet, 4 percent, or 32,000 acre-feet annually, is discharged into the Trinity River Basin, principally from the Dallas-Fort Worth area. When compared to projected requirements (tables V-11 and V-12), it is evident that even total recycle-reuse by industry of its return flow would not significantly alter the projected 2020 water requirements of the Dallas system. At best, it might reduce the deficit to be supplied from the Trans-Texas Canal System and other sources. If such a complete recycle requirement for industry were legally attainable, it would certainly be economically untenable for the affected industries. A more likely approach may be the future location of planned industrial complexes so that treated municipal effluent may be piped directly to industries.

c Preliminary cost estimates were prepared for construction, operation, and maintenance of proposed sewerage facilities for the Upper Trinity River Basin Comprehensive Sewage Plan. Costs shown in table V-14 have been multiplied by the ratio of the July 1972 Dallas ENR Construction Cost Index (1726) to the Dallas Index used for the Comprehensive Plan Report (1100). Land costs are included.

Table V-14

Estimated Cost for Joint System, Comprehensive Sewage Plan (Costs in Thousands of Dollars

Area	Construction Costs							1st Year Average	Average	Average
		Future Stage 1				Future Stage 2	Grand Total			
	1975	1980	1985	1990	Total	2020		1975	1975-1990	1990-2020
Dallas-White Rock	70,070	2,870	-	-	2,870	46,270	119,210	9,030	10,970	14,760
South Side	36,340	-	-	-	-	33,820	70,160	2,980	3,820	6,290
Ten Mile Creek	-	28,970	-	-	28,970	26,910	55,880	310	1,520	3,470
Duck Creek	117,120	6,910	-	-	6,910	59,770	183,800	3,580	6,700	12,530
TRA Central	99,520	39,360	4,330	-	44,290	101,820	245,630	4,490	7,730	16,360
Village Creek	98,770	35,430	3,520	2,030	40,980	90,950	230,700	7,770	11,260	19,470
Total	421,820	114,140	7,850	2,030	124,020	359,540	905,380	28,160	42,000	72,880

Ratio = 1.57

Portions of the Comprehensive Plan not needed before 1975 but needed before 1990 are shown as Future Stage 1. Portions not needed before 1990 but needed before 2020 are shown as Future Stage 2. Costs shown do not include construction for plants beyond the area served by the joint systems. Shown in table V-15 are estimates of future population to be served, average sewage flow, and cost per 1,000 gallons for the joint system. The Comprehensive Sewerage Plan Report acknowledges that costs developed were generalized. Specific sites and plant layouts were not considered in detail. Additional studies would be required for each proposed plant.

5 Reasons for Rejection. These considerations led to the following conclusion, stated in the Texas Water Plan:

> Renovation of municipal and industrial wastewaters for direct municipal reuse presently is technically feasible, and may be economically practical in the future. A high degree of removal of presently known water-borne viruses can be attained by conventional waste-treatment processes followed by chlorination, and extensive studies of the effectiveness of virus removal by advanced treatment processes are underway. However, much additional investigation of the potential health hazard from direct reuse of wastewaters for municipal purposes is needed. In Texas, as elsewhere throughout the nation, extensive reuse for such purposes is improbable in the near future (39).

Therefore, direct wastewater renovation and reuse is not considered as a presently practical alternative to the Aubrey project.

(d) Interbasin and Intrabasin Transfer of Water.

1 General.

a The surface water resources of the upper Trinity River Basin are approaching full development. The Aubrey Lake site is one of the few sites remaining in the upper Trinity River Basin which has good potential for development. Therefore, the only potentially viable alternative sources of intrabasin water supply would be the middle and lower portions of the Trinity River Basin.

b Interbasin transfer is already being utilized, with the city of Dallas presently importing water from Lake Tawakoni in the upper Sabine River Basin, to which it has contractural rights. Dallas also has plans for importing water from Lake Palestine in the upper

Table V-15

Estimated Population To Be Served, Average Flows, And Cost Per Thousand Gallons, Comprehensive Sewage Plan

	Year		
	1975	1990	2020
Dallas-White Rock			
Population To Be Served	878,100	1,123,500	1,311,000
Average Sewage Flow, mgd	95.20	139.71	200.00
South Side			
Population To Be Served	238,000	348,170	526,100
Average Sewage Flow, mgd	25.73	43.18	80.51
Ten Mile Creek			
Population To Be Served	58,910	133,100	289,600
Average Sewage Flow, mgd	6.32	16.45	44.19
Duck Creek			
Population To Be Served	274,160	773,800	1,075,000
Average Sewage Flow, mgd	28.83	91.23	154.70
TRA Central			
Population To Be Served	375,290	904,180	1,677,500
Average Sewage Flow, mgd	40.54	111.88	256.04
Village Creek			
Population To Be Served	737,160	1,304,040	1,957,600
Average Sewage Flow, mgd	79.55	165.58	298.84
Total Population	2,561,620	4,586,790	6,836,800
Total Average Flow, mgd	276.17	568.03	1,034.28
Cost Per 1,000 Gallons, $	0.279	0.202	0.193

Neches River Basin, and has expressed interest in importing water from the projected Tennessee Colony Lake in the middle Trinity River Basin. In addition, Mineola, Lake Fork, and Big Sandy Lakes in the Sabine River Basin, which have been authorized by Congress, will make an additional 200,000 acre-feet, or 178.5 mgd available annually to the Dallas-Fort Worth metroplex by the year 2020.

c Based on projections of increasing water needs, the question is now whether the option of forgoing construction of the Aubrey project in favor of increasing importations at an earlier date is desirable. The city of Dallas has a present surface supply of 270 mgd, and demands, including those of connected cities, are projected to increase from 275 mgd in 1980 to 514 mgd in the year 2000. Contributions by Lake Palestine (102 mgd) and Aubrey Lake or an alternative will be needed.

d The proposed Mineola, Lake Fork, and Big Sandy Lakes in the upper Sabine River Basin were examined as alternative interbasin sources of supply. These projects were authorized by Public Law 91-611 as presented in House Document No. 91-429. The Sabine River Authority and the Texas Water Development Board have been designated as cosponsors by the Texas Water Rights Commission. In addition, Tennessee Colony Lake authorized by Public Law 89-298 in accordance with House Document 89-276, was examined as a possible intrabasin supply source. Lake Fork and Big Sandy Lakes are to be situated on Lake Fork and Big Sandy Creeks respectively, downstream tributaries of the Sabine River. The Tennessee Colony damsite is to be situated at approximately river mile 340 of the Trinity River, about 16 miles west of Palestine, Texas and 7 miles southwest of Tennessee Colony. The impounded waters will extend upstream to about river mile 410 of the Trinity River. Although these projects have been previously authorized for purposes other than alternate water supply sources to the Aubrey Lake project, the planning and study accomplished to date on them provided basic data on which an analysis of the alternative of interbasin or intrabasin water transfer could be based. Of these several possibilities, Mineola Lake was selected as the example for an indepth feasibility study of such an alternative because it is characteristic of the type and location necessary as a viable alternative. Its size is sufficient, it is located 72 miles from Dallas (plate V-6), as opposed to 79 miles, 96 miles, and about 110 miles to Lake Fork, Big Sandy, and Tennessee Colony Lakes respectively, and its pool level is 97 feet higher than the projected pool level at Tennessee Colony Lake.

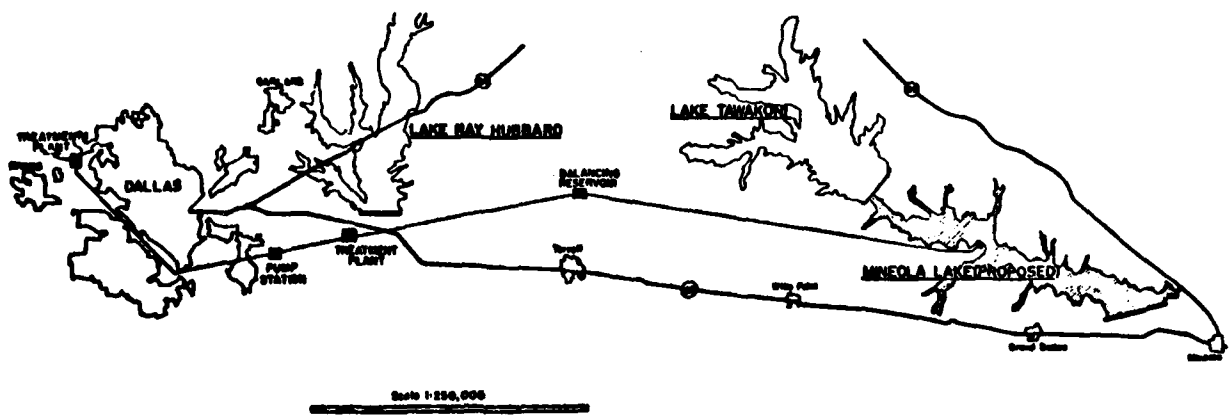
e The proposed Aubrey Lake would develop an estimated dependable yield of 84.0 mgd under 1985 conditions, and 75.6 mgd at year 2085 conditions. A transmission facility was investigated to move 71 mgd (110 cfs) from Mineola Lake to Dallas' Bachman treatment plant on the lower Elm Fork of the Trinity River. This point of delivery would be comparable to that provided by the Aubrey

project. The facility investigated consisted of a 60-inch diameter pipeline extending 68 miles from Mineola to Dallas, pumping plants, rights-of-way, and enlargement of a balancing reservoir. Estimated costs for the transmission facility are based on July 1972 price levels. Annual charges include amortization of the investment at an interest rate of 5.5 percent for a 40-year period, plus annual operation and maintenance charges including the annual equivalent cost of replacements, and the cost of power at $0.01 per kilowatt hour. Annual charges were converted to a 100-year equivalent to make them compatible with values for Mineola and Aubrey Lakes, and were found to be $2,619,000 per year.

2 Beneficial Aspects. The primary benefit to be realized from this alternative is the esthetics resulting from situating an impoundment in an area with a considerable amount of timber adjacent to it. A long-range benefit could be the reserving of the Aubrey site until such time as the need for water exceeds in-basin and out-of-basin supplies.

3 Detrimental Aspects. The most obvious adverse impact to be caused by implementing this alternative would be the consumption of additional electrical power to provide energy needed to pump 71 mgd of water through a 68-mile-long, 60-inch-diameter pipeline. Electrical power generation causes consumption of valuable natural resources and contributes to air and water pollution. Furthermore, this plan would necessitate trenching and other involvement with manmade culture. The selected Aubrey project would gravity feed water to Dallas and Denton. From a recreational use standpoint, Mineola project would be substantially more distant from the large population centers than would the Aubrey project. There are 91 archeological sites known to exist in the Mineola project area and 26 in the Aubrey project area. These would need to be salvaged prior to inundation of the area. The conservation pool would cover 23,900 acres, which is 1,300 acres less than that required for Aubrey Lake. (Because species diversity and abundance is probably greater per acre in the Mineola project area than in the Aubrey project area, implementation of the alternative could be considered detrimental.) One of the more far-reaching adverse impacts could be the modifying of the quality of the existing marshes and estuaries associated not only with that of the Sabine River, but also with those associated with the rivers of the importing basin.

4 Economic Aspects. The cost of developing 71 mgd in Mineola Lake was obtained through updating the cost allocated to water supply storage in Project Document 91-429. Price levels of January 1970 were adjusted to July 1972 levels, and the interest rate used was 5.5 percent. On this basis, the cost allocated to water supply storage amounts to $2,606,000. The 71 mgd investigated for movement from



INTERBASIN TRANSFER
ALTERNATIVE PLAN

U.S. ARMY ENGINEER DISTRICT, FORT WORTH

PLATE IV-6

Table V-16

Pertinent Data for Mineola Lake

	Elevation (ft. msl)	Area (acres)	Capacity (acre-feet) Accumulative	Capacity (acre-feet) Incremental
Top of Dam	410.5			
Maximum Design Water Surface	404.7	50,290	1,603,000	
Flood Control Pool	400.0	46,900	1,375,000	984,500
Conservation Pool	372.5	23,900	386,000	370,100
Sediment				20,400*

* Distribution: 15,900 acre-feet below elevation 372.5 feet msl; 4,500 acre-feet between elevation 372.5 and 400.0 feet msl.

Mineola Lake represents approximately 85 percent of the project's 83.4 mgd yield. The pro-rata share of storage cost allocated to the water transmission project would thus be $2,215,000. Annual transmission and storage costs combined amount to $4,834,000, or $0.186 per 1,000 gallons. The cost allocated to water supply storage in Aubrey Lake has been found to be $1,103,000, or $0.035 per 1,000 gallons. Annual water supply benefits amount to $2,191,900. Aubrey Lake is obviously the least costly alternative, having the advantage of a location which provides gravity flow and streambed and streambank delivery. With benefits for the transmission project limited to water supply benefits developed for Aubrey, the transmission project is not economically justified at this time. When surface supplies are fully developed, including that of Aubrey Lake, and imports must be increased, then benefits to be realized will of necessity cover the cost. Estimated construction costs, annual charges, and a benefit-cost comparison involving the conveyance system and Aubrey Lake are shown in table V-17.

5 Reasons for Rejection.

a One of the primary reasons for rejecting interbasin water transfer as an alternative is the relative cost of such water. In the Mineola example, which represented one of the nearer transmission sites, the cost of water delivered to Dallas is $0.186 per thousand gallons. The comparative figure for Aubrey is $0.0916 per thousand gallons.

b From an environmental standpoint, significant environmental impacts may be expected whether a reservoir is situated in the Trinity River Basin or some other basin such as the Sabine or Neches. While the Battelle-Columbus environmental evaluation method reveals a slightly positive total impact (+1.74), there is no assurance that a reservoir project in another basin designed to provide water to replace Aubrey water would rate as well. Aubrey water will flow by gravity, while interbasin water would require considerable quantities of electrical energy. Energy is projected to be in short supply, and its production results in varying forms and degrees of environmental degradation. It is, therefore, reasonable to project that the overall environmental impact produced by interbasin water transfer would be more severe than the impact of the Aubrey project.

c In addition, recreation benefits are viewed as dependent on the recreation area's proximity to population which uses the area. Since the existence, extent, and location of truly surplus waters in adjacent river basins are presently unknown, it is impossible to relate recreational benefits from an adjacent basin reservoir project to the approximate $5.6 million annual recreation benefits attributable to the Aubrey project. It is reasonable to anticipate,

Table V-17

Estimated First Cost and Annual Charges of 71 MGD Conveyance System

Mineola Lake to Dallas

Transmission Facility

Construction, Incl. 25% Cont.	$32,215,000
Investment Cost (2-year period)	$33,987,000
Annual Charges, 40-years @ 5 1/2%	
Interest and Amortization	$2,118,000
OM&R	510,000
Power Cost @ $0.01 per kwh	326,000
TOTAL	$2,954,000
100-year Equivalent	$2,619,000

Storage, Mineola Lake

Annual Charges	
Pro-rata share allocated to water supply	$2,215,000

Total Conveyance System

Annual Charges	$4,834,000
Benefits	$2,192,000
Benefit-Cost Ratio	0.37
Cost of water per 1,000 gallons	$0.186

AD-A087 481 ARMY ENGINEER DISTRICT FORT WORTH TEX F/G 8/8
ENVIRONMENTAL IMPACT STATEMENT, AUBREY LAKE, ELM FORK, TRINITY --ETC(U)
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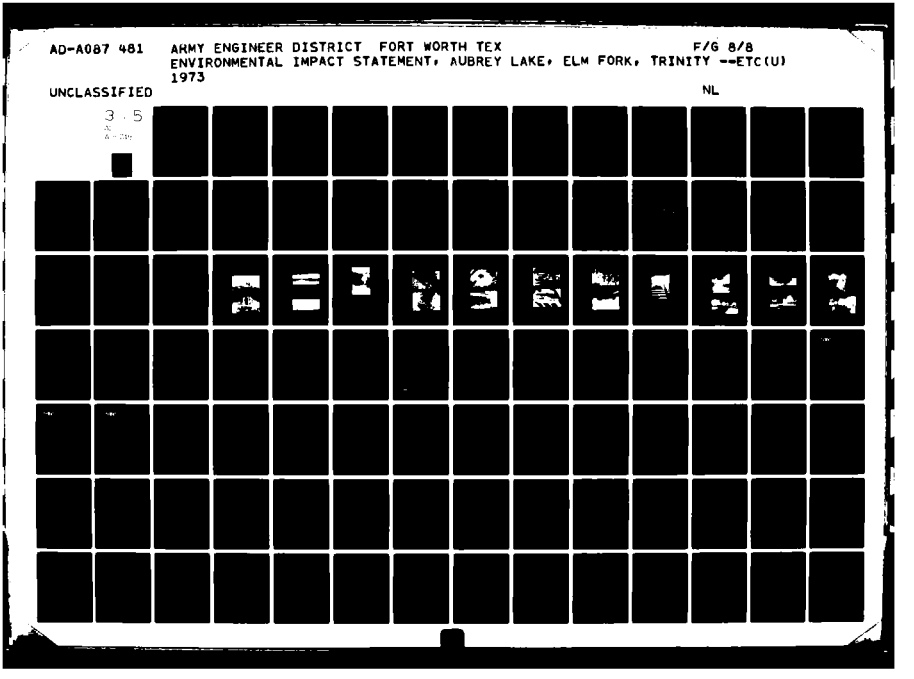

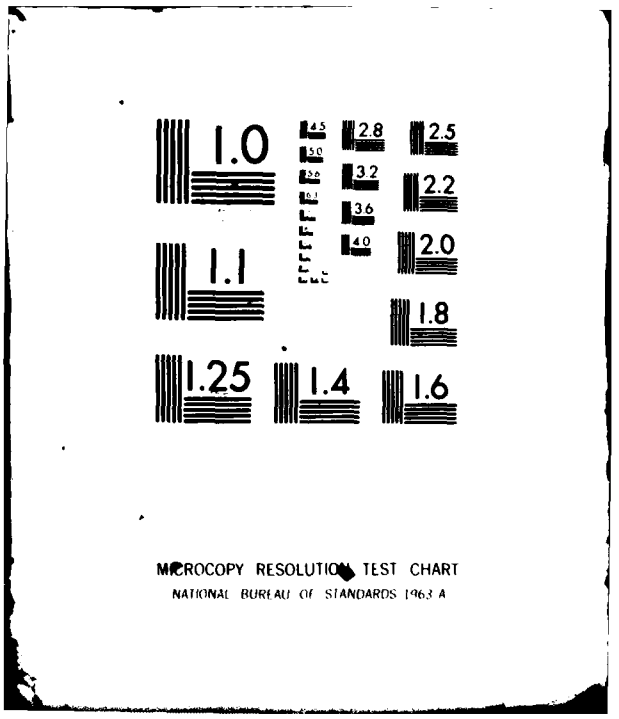
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however, that the relative distances from the Dallas-Fort Worth metroplex would significantly reduce this amount.

d For these reasons, interbasin transfer of water does not present an economically feasible or environmentally sound alternative to the Aubrey project at this time.

(2) Recreation Alternatives. The 1965 Texas State Comprehensive Outdoor Recreation Plan (37) indicated the existence of a deficiency of land- and water-based recreation opportunities in Planning Region II. There is a shortage in picnicking and camping facilities, and the available public grounds are taxed beyond their capacity, especially on weekends and holidays. There are virtually no bicycle or walking paths in the area. The lakes located in this region receive tremendous use in boating, water-skiing, and swimming activities. This heavy demand indicates that more water surface acreage is needed in the region. The proposed Aubrey Lake project would be located in Planning Region II. The following are alternatives which would meet the authorized purpose of recreation to some extent.

(a) Providing Additional Facilities at Existing Nearby Water Resource Projects.

1 General. Under this alternative, recreation facilities such as roads, boat ramps, parking areas, sanitary facilities, picnicking and camping units, and trails would be provided, in addition to those already proposed in the various project master plans, at existing nearby water resource projects.

2 Beneficial Aspects. This alternative provides the same benefits as the Aubrey project, but not to as great a degree.

3 Detrimental Aspects. The detriments of this alternative would include the following:

a Other Corps of Engineers water resource projects in this region are already receiving a great amount of use and the natural environment has suffered as a consequence.

b If more facilities are provided, in addition to those already planned for optimum development of the existing projects, the environment will suffer from the increased amount of traffic, the quality of the recreational experience for each person will be reduced, and the recreational needs of this area will still not be met.

4 Economic Aspects. The cost of the alternative would be higher because the cost of maintaining the natural resources and

setting in the public-use areas of existing projects will be higher than that which would be necessary at public-use areas in the Aubrey Lake project. There would be additional costs if additional lands were needed to expand existing public-use areas.

5 Reason for Rejection. Although Aubrey Lake will be able to satisfy only a portion of the heavy demand for recreational outlets anticipated for this area, it is believed that this alternative is preferable to overcrowding the nearby water resource projects and thus lowering the quality of the recreational experience.

(b) Minimum Recreational Development With Construction of Aubrey Lake.

1 General. With this alternative, Aubrey Lake would be constructed, but only minimum recreation facilities would be developed. These minimum facilities would include those required for health and safety purposes. The minimum facilities would consist of guardrails, turnarounds on existing road ends, and minimum safety facilities. With the construction of the dam, construction roads would be developed which could later be used for access to the lake. Even without full recreational development, the public may be expected to force undeveloped and damaging land accesses to the lake. The lack of shoreline access or launching ramps will not deter the desire for use of the lake, and the public would form their own access roads and launching areas. This forced access would cause a loss of existing plant materials and much erosion would occur.

2 Beneficial Aspects. The benefits of this alternative would include minimum recreation facilities which would serve basic needs at little cost to the Federal Government. Full recreation development, with the lake being provided, could be undertaken at a later date.

3 Detrimental Aspects. The detriments of this alternative would include uncontrolled vehicular traffic which would result in a loss of plant materials, soil erosion, and increased lake sedimentation. Whether adequate facilities are constructed or not, the Aubrey project will draw a considerable number of people annually, and the lack of facilities would provide hazards to the visitors' health and welfare.

4 Economic Aspects. Minimum recreational development with construction of Aubrey Lake has been estimated to cost approximately $190,000.

5 Reason for Rejection. This alternative has been rejected as the most desirable alternative because it does not meet the recreational needs of the area; and it does not provide for the

protection of the natural resources, or the health, safety, and well-being of the visitors to the project.

(c) Low-Water Retention Dams.

1 General. This alternative would require channel work for modification or improvement but not a complete channelization of the streambed, with constructional objectives to include several small impoundments which would catch only the flow that is not of flood capacity.

2 Beneficial Aspects. With developed public-use areas in coordination with the small impoundments, this alternative would provide for a more passive form of recreation. The nature of these lakes would provide many of the benefits of recreation, including fish and wildlife which the larger lake would provide.

3 Detrimental Aspects. This alternative would not permit those recreational activities requiring a large expanse of water such as skiing or large-scale sailing. The land requirements would be similar, but a longer stretch of the river area would be involved.

4 Economic Aspects . The cost of this alternative would be approximately the same as the cost of constructing Aubrey Lake because the amount and type of development would be almost the same.

5 Reasons for Rejection. This alternative would not meet the needs for water- and land-based recreation, and the existing flora and fauna likely would be significantly adversely affected by foot and vehicular traffic. In conclusion, it would not provide a well-balanced development of the watershed's resources.

b. Nonstructural Alternatives.

(1) Water Supply.

(a) Geothermal Sources.

1 General. Scientists are looking more and more to geothermal sources to alleviate the widespread chronic power deficit and the water shortage which is most evident in the southwestern United States (48). To date, very few explorations for heat deposits have been initiated. Furthermore, the techniques of prospecting in this field are not yet refined.

a Methodology. Heat deposits result from geologically recent intrusions of magma from the earth's mantle. When ground water comes into contact with magma, natural deposits of steam or hot water are produced. At sufficient depths, magma can be found anywhere, with temperatures of 300 degrees C. expected to occur

within 6,000 meters of the surface in the western United States. In several areas in the United States, the most notable of which is in Yellowstone Park in Wyoming, this heated water or steam is vented to ground surface under pressure through naturally occurring vents or fissures (47). In most cases for commercial application, however, natural steam or heated water would have to be tapped by drilling, and in some instances, the heated water might have to be pumped.

b Test Areas. So far, proven sources of geothermal water have been located in California, Nevada, New Mexico, Oregon, and Idaho, with potential sites having been located in all of the western states. Congress has enacted the Geothermal Steam Act of 1970 (27), which defines the authority and responsibility to classify lands as valuable for the geothermal steam and associated geothermal resources.

2 Beneficial Aspects. A beneficial effect of a highly mineralized water being heated is that desalting by distillation may be relatively inexpensive. Site development of this type source would have very little effect on the social interactions of the area because a large land area would not be needed for the facilities. Wildlife would not be expected to be adversely affected for the same reason. Likewise, the historical and archeological resources could remain undisturbed. Relocation of people, transportation arteries, and utility distribution facilities would not be necessary. Some economic benefits would be realized from construction activities, from wages demanded by technicians operating the recovery equipment, and from local economic activities quickened by the increased availability of water.

3 Detrimental Aspects. Some of the problems associated with development and use of geothermal sources include an abundance of waste heat, land subsidence, harmful gases and disagreeable odors, and highly mineralized water which often requires intensive treatment before it can be discharged to surface waters. Because of nearly continuous air currents in the area, waste heat would not likely have a measurable impact on the climate. However, if odor were a problem, the air currents could create an uncomfortable condition for people living in the area. Stream fisheries could be reduced in quality if minerals removed from the hot water were allowed to enter the waterways in concentrations which would be injurious to organisms making up the aquatic ecosystem food web. Recreational needs of the area would not be satisfied by implementing this plan.

4 Economic Aspects. One of the unknown factors in geothermal use is how soon the steam supply from any well will be exhausted. At this time, data accumulated on the economics of this alternative are insufficient to make a valid assessment.

5 Reason for Rejection. Because this type plan is in the early stages of technical development, and because of the uncertainty of the availability of this type resource in the area, it was determined that this alternative would be undesirable at this time.

(b) Weather Modification.

1 General. Studies and experiments conducted over the last 25 years have proved that deliberate modification of clouds to produce precipitation is possible. However, there has been disagreement on how results from the experiments and the data from the operational projects should be interpreted; there have been contradictory claims; and there have even been lawsuits filed to recover damages or to prevent cloud seeding efforts. Seven rainmaking projects are currently in progress in West Texas and the Panhandle, but State officials and meteorologists report it may be another 10 years before they can determine if their experiments are successful. This is because normal year-to-year rainfall variations, especially in West Texas, can exceed the average amount by 50 percent. However, State water development officials do believe that rainmaking projects will have their place in the future.

2 Beneficial Aspects. Weather modification is intended primarily to normalize the rainfall rather than to change the climate of any region of Texas by increasing the average rainfall. The technology to prevent rainfall in areas already flooded may soon be developed. Furthermore, controlled modification of weather would not have the disruptive effects on the social, cultural, and economic elements of a watershed that an impoundment project would have. If landowners could be assured that the uncertainties of weather could be removed, they could expand their agricultural production. Also, if an adequate water supply could be assured, other economic conditions would be enhanced. The local historical and archeological resources would only be disturbed by time and weather, just as they are at present.

3 Detrimental Aspects. If agricultural production were expanded because of assured weather conditions, fish and wildlife could suffer if lands now suitable for wildlife habitat were cleared of natural vegetation and converted to cropland or pastureland, and if stream quality was reduced by siltation and agriculture chemicals. Other detrimental aspects are summarized fairly well by the National Academy of Sciences (18). They report:

> The technical reasons for the long-continued controversy over cloud-seeding, despite some notable advances, are that (a) we do not have a complete and accurate understanding

of how clouds create raindrops and snowflakes, (b) field observations usually have been inadequate to describe accurately the specific changes resulting from cloud-seeding efforts, and (c) the effects of individual seeding experiments, even when successful, usually fall well within the natural variability of clouds and cloud systems.

The progress made on the scientific and technical problems of weather modification has brought the subject to the point where certain significant effects can be identified and programs can be designed for examining systematically the potential value of large-scale weather modification efforts. However, as the technical problems are overcome, another group of problems looms larger. These are problems of public policy associated with weather modification. Examples of these problems include the economic value of cloud seeding as opposed to alternative means of increasing water supply or agricultural production, determination of responsibility for damages from cloud seeding, definition of the roles and responsibilities of government and private industry, criteria for deciding what operations are in the public interest, ensuring that long-range aspects are fully considered, and providing a mechanism to cope with international ramifications. The science and technology of weather modification are responsible for determining what is possible, for suggesting effective means for modifying weather, and for anticipating possible deleterious effects of inadvertent modification before they occur. The crucial question of what weather modification efforts are in the public interest cannot be settled by atmospheric scientists alone. This question involves economic, legal, political, and administrative, as well as scientific and technical considerations. Involved also is the whole complex of environmental issues to which the nation will have to respond in the coming decades: issues of land usage, of the degree of freedom to use and affect the atmosphere, procedures needed to reach equitable decisions in cases of conflicting interests, and methods needed to safeguard the future ecology and climate.

4 Economic Aspects. The state of the art of weather modification is such that a cost per acre-foot of precipitation cannot be determined. Therefore, no valid comparison of the economics of this alternative against those of the selected project was possible.

5 Reason for Rejection. This alternative was rejected primarily because weather modification is in its infancy, and is therefore not viewed as a substitute for surface water control and

development projects at this time. Furthermore, for the amount of water expected to be needed, some method must be devised to catch the precipitation runoff and hold it until it is needed. Although this alternative is rejected now, in the future it may be used as a possible procedure through which the operation of existing impoundment projects may be enhanced.

(2) Recreation.

(a) Designation as Wild, Scenic, and Recreational River Area.

1 General. The Wild and Scenic Rivers Act (23) reveals that the Elm Fork of the Trinity River and its tributaries would not fulfill the requirements necessary to be classified as a "Wild River Area" because they are not "generally inaccessible except by trail." Likewise, the Elm Fork and its tributaries would not meet the requirements necessary to be classified as a "Scenic River Area" because their shorelines are not "still largely primitive and largely undeveloped." However, the Elm Fork and its tributaries could possibly meet the requirements for consideration as a "Recreational River Area" by possessing characteristics of being a free-flowing stream that is readily accessible by road or railroad, that may have some development along its shorelines, and that has undergone impoundment or diversion in the past. Under this concept, a corridor or strip of land would be purchased on either side of the river.

2 Beneficial Aspects. This alternative would provide a higher degree of protection to the streamside flora and fauna, as well as provide areas to be used by hikers, canoeists, and boaters.

3 Detrimental Aspects. Minor adverse environmental impacts would occur at access points, including soil compaction from foot traffic, damage to vegetation, and possible soil erosion. There would be no large body of water to provide the visitors with the opportunity to participate in water-based activities such as water skiing, pleasure boating, and sailing.

4 Economic Aspects. The cost of facilities and land for the "Recreational River Area" would be approximately $3,200,000.

5 Reason for Rejection. Although the Elm Fork and its tributaries could possibly meet the requirements for consideration as a "Recreational River Area," this alternative would not serve the recreational demand to the extent that a large body of water with developed public-use areas would serve.

(b) Access to Existing Streams Without Development.

1 General. This alternative to recreation development would provide no improvements along the creeks in the project area. It would utilize the existing access but would not provide additional

access. The lands would be retained in their present uses, and the existing conservation or lack of conservation practices would continue. There would be little recreation development under this alternative because of the lack of a developed attraction. The possibility of private development is doubtful because the types of activities which attract private development, such as boating, skiing, sailing, and fishing on a large scale, will not be present.

2 Beneficial Aspects. Two benefits of this alternative would be the reduced impact on the environment due to only recreational development, and that little Federal expense would be incurred.

3 Detrimental Aspects. Some of the detrimental aspects of this alternative would be that the demands for water-based recreation would not be met and that the loss of this tourist attraction will detract from the area's economic potential.

4 Economic Aspects. This alternative would entail no Federal expense and few benefits would be gained.

5 Reason for Rejection. This alternative is not considered desirable because it would not even begin to satisfy the needs for water-based recreation in this region.

(c) Access to Existing Streams with Development.

1 General. This alternative in lieu of Aubrey Lake would provide public access to streams, streambeds, and stream pools for water- and land-based recreation. The lands purchased along the streambeds would be developed with camping and picnicking facilities and access roads. This development of the river bottoms would be popular with local residents and some transients; however, it would not provide for large numbers of the visiting public. Limited area for facility development would meet only a fraction of the demand which would be met by the proposed Aubrey project.

2 Beneficial Aspects. The benefits of this alternative would include providing access to streams allowing use of the streambeds by the public to a much greater degree than that provided under restricted private ownership. The present environmental setting would remain virtually unchanged except in the vicinity of the access points.

3 Detrimental Aspects. The detriments of this alternative would include plant material damage and soil erosion which would occur at points of access; no large water-based attraction to meet demands of the public for water-based recreation activities such as water skiing, boating, and sailing, and encroachment upon private land by the public from the streambeds would create conflict between private landowners and the general public.

4 Economic Aspects. Construction of access roads and acquisition of lands would cost approximately $440,000. Facility development would entail some additional expense.

5 Reason for Rejection. The cost of providing access to the streams is not justified in view of the limited uses and space expected to be available.

(d) Provide Public Hunting Areas.

1 General. Under this alternative, public hunting lands would be provided or developed to accommodate the needs for this activity. Access would be provided, but some control over the use of vehicles would be required to maintain their usability. Without control, a loss of vegetation, soil erosion, and eventually an impact on game populations would result. Due to the low flow and often intermittent nature of the streams in the area, fishing would be limited. The wildlife habitat in the area is limited, and therefore sport hunting is somewhat limited.

2 Beneficial Aspects. The benefits of this alternative would include the following:

a This alternative could result in an enhancement of the existing land use of the area if a wildlife conservation program and public-use control were established.

b No major impacts upon the flora and fauna would occur with control of vehicle access and use in the management area.

c Additional man days of hunting could be accommodated in an area where lands available for public hunting are scarce.

3 Detrimental Aspects. The detriments of this alternative would include the following:

a Only limited types of recreational pursuits would be made available.

b The demand for water-based recreation would not be met.

4 Economic Aspects. The cost for land acquisition and access is estimated to be approximately $500,000. Additional expenses would be incurred annually for habitat management. Also, there is already a plan for a 1,000 acre wildlife management area to be developed in conjunction with the authorized Aubrey Lake project.

5 Reason for Rejection. This alternative provides only limited recreation provisions and does not satisfy the many other recreation needs of the area.

(e) Open-Space Greenbelt.

1 General. This alternative consists of acquiring a linear

strip of right-of-way and other fee-owned lands adjacent to the channels. An extensive network of trails, green areas, playgrounds, and picnic and camping areas would help to partially meet the recreational and leisure needs of the area.

2 Beneficial Aspects. The benefits of this alternative would include the following:

a Only minor adverse environmental impacts would occur.

b This type of development would provide facilities for a portion of the demand for picnicking and camping.

3 Detrimental Aspects. The detriments of this alternative would include the following:

a Minor adverse environmental impacts which might occur include soil compaction from foot traffic, damage to vegetation, and possible soil erosion.

b There would be no large body of water to provide the visitors with the opportunity to participate in water-based activities such as water skiing, pleasure boating, and sailing. This alternative would not serve the recreational demand to the extent that a large body of water, with developed public-use parks would serve.

4 Economic Aspect. Providing an open-space greenbelt would include the cost of most of the facilities that would be included under full development of the proposed project. The cost of facilities and land is approximately $5,800,000.

5 Reason for Rejection. This alternative would not meet recreational demands for water-based activities. However, a similar type of development could be developed along the Elm Fork between the proposed Aubrey Dam and the headwaters of Lewisville Lake [Sec. V, para 3b(3)(c)].

(3) Fish and Wildlife.

(a) Water Bank Act.

1 General. The "Water Bank Act" (26) authorizes the Secretary of Agriculture to enter into agreements with owners of wetlands located in important migratory waterfowl nesting and breeding areas for the conservation of water on specified farm, ranch, or other wetlands. These agreements are entered into for a period of 10 years, with provision for renewal for additional 10-year periods. The landowner is forbidden to undertake any activity which would destroy the wetland character of the area for which the agreement was adopted.

2 Beneficial Aspects. Agreements entered into under this act would provide for preserving and improving the existing migratory

waterfowl and other species habitat located along the Elm Fork and Isle du Bois Creek.

3 Detrimental Aspects. There are no known detrimental aspects associated with the implementation of this act in the study area; however, the authorized project purposes of water supply and recreation, except that portion associated with fish and wildlife, would not be fulfilled.

4 Economic Aspects. The cost of implementing the Water Bank Act as an alternative to the Fish and Wildlife benefits to be derived from the proposed Aubrey project is based on the following information. There is approximately 500 acres of low-quality wetlands in the project area. This wetland could be suitable primarily for wood duck habitat. Based on payments made to owners of land suitable for this usage in Louisiana and Mississippi, the annual cost of bringing all of these 500 acres under an agreement would be about $4,500. These agreements are for a minimum period of 10 years. This would put the cost of the program for a minimum number of years at about $45,000.

5 Reason for Rejection. Currently this program is being administered by the Rural Environmental Assistance Program of the Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture. The guideline used by this agency in preparing agreements is that the area must be suitable for the intended use and must not be smaller than 10 acres. However, it is believed that an optimum size area should be single parcels containing from 100 to 200 acres. There are no parcels of wetlands of suitable quality or size in the area, except perhaps the area adjacent to Isle du Bois Creek and the Elm Fork. Most of the area wetlands are small ponds, and therefore would not be considered suitable. Additionally, recent decisions by the President regarding budget expenditure reductions has cast doubts on whether this program will continue to be implemented. Although the existing wildlife habitat would be preserved by implementing this alternative, no consideration is given to water supply, recreational elements, or flood control needed in the Dallas-Denton-Fort Worth metropolitan complex.

(b) Green Tree Reservoir.

1 General.

a Even though, by design, this alternative is limited in scope to waterfowl, it is included as a single purpose alternative under the more general category of fish and wildlife conservation.

b Green tree reservoirs can promote the distribution, utilization, and preservation of wintering woodland ducks. At first, green

tree reservoirs were unique to eastern Arkansas, but their successful development soon spread to other states.

c The success of a green tree area depends on four basic components: mast-producing trees, suitable terrain and soils, water, and ducks. The resulting green tree reservoir can be small or large, expensive or cheap, bad or good, depending on the quality and quantity of these four components and how they are combined.

d Oaks head the list of desirable mast-producers. However, areas considered for development usually contain a mixed stand of these and other species. The herbaceous plants on the forest floor could act as a supplemental food source.

e The topography of the site should be relatively flat so a large area can be flooded to a shallow depth at a reasonable cost.

f The impoundment structures could be any type that would hold the water at the desired level, and allow complete draining of the area (such as dikes and levees).

g Different methods can be used to flood the area. Below a reservoir, the lake could supply the water by gravity flow into the green tree area, or if the area chosen were located at some distance from the lake the water could be transferred by pumping. Ideally, the water should be about 18 inches deep. Mast in deeper water would not be easily accessible to puddle ducks, which would make up the greatest percentage of ducks present. Keeping the green tree reservoir area flooded during the growing season would kill the desirable mast-producers; therefore, the area must be drained before, and kept unflooded during the growing season.

2 Beneficial Aspects. Green tree reservoirs generally provide outstanding waterfowl hunting opportunities. Private landowners use them for recreation and a source of income through hunting leases. In some areas, these reservoirs offer methods for timber companies to increase production, develop multiple uses, and provide recreational benefits. They are very valuable as quality wintering habitat for migratory waterfowl.

3 Detrimental Aspects. There would be a loss of understory plant material due to the inundation process. Also, landowners would lose landholdings required for the reservoir. A concurrent loss of county tax revenue on these lands would occur.

4 Economic Aspects. Specific costs for land, levee construction, water diversion works, and other project related requirements would depend on the size and location of the selected site.

5 Reason for Rejection. An aerial photo survey of the lands in proximity to the proposed Aubrey Lake disclosed no suitable site for

a green tree reservoir, primarily because of a lack of desirable mast producers in the area.

(c) Environmental Corridor Between Aubrey and Lewisville Lakes.

1 General. The primary purpose of this plan is to create and maintain a high quality stream fishery. All other uses of this area would be secondary benefits. Therefore, this plan is included as a fish and wildlife conservation alternative.

2 Beneficial Aspects. The social and recreational opportunities of this project would be almost limitless. Opportunities for fishing, hunting, backpacking, hiking, picnicking, and camping could be provided. A regulated release producing a continuous current would provide the opportunity for individual and family "float trips" down the stream. If an adequate amount of flow for "white water" type canoeing could be provided the stream would draw avid canoeists from all over the state. The decrease in quantity and quality of streams has produced greater demands for esthetically pleasing stream environments. Ideally situated between two lakes, this area could be developed into a harmonious stream environment for both man and nature.

3 Detrimental Aspects. The primary requirement of this plan, besides the land itself, is that there be a continuous regulated release of water from Aubrey Lake to maintain the high quality stream fishery. The Corps of Engineers only has jurisdiction over water releases from its projects when the impounded water is above the conservation pool level. The water is then released, usually at the maximum rate that the downstream channel can carry, until the conservation pool is attained. The continuous flow required for this environmental corridor is dependent upon agreement and cooperation with the local interests which hold the water rights (authority over use and manipulation of the impounded water within the conservation pool) of the project.

4 Economic Aspects. A detailed study of the economic aspects of this project has not been undertaken at the time of preparation of this report.

5 Discussion. This proposed plan is not a true alternative because it is completely dependent upon construction of Aubrey Lake. However, it is worthy of recognition since it could be developed with the lake to create a high quality stream fishery and stream-type recreation opportunities.

4. Combinations of Two or More Alternatives Considered That Will Meet All of the Authorized Project Purposes.

a. General. Since many of the alternatives studied serve only a single purpose, it is necessary to consider combinations which together would fulfill all the authorized purposes of the proposed Aubrey project. These combinations of single-purpose alternatives must not only satisfy all the project purposes but must also be compatible while remaining comparable in overall benefit-cost ratios and environmental considerations.

b. Possible Combinations.

(1) The three main purposes that combinations of alternatives must serve are water supply, recreation, and conservation of fish and wildlife environment. Since flood control was viewed as an indirect benefit achieved in combination with Lewisville Lake, it was not considered a purpose within the context of this study.

(2) When the total of various single-purpose alternatives discussed were grouped according to the project purpose served, it was found that there were six alternatives to serve the water supply purpose, eight alternatives to serve the recreation purpose, and two alternatives to serve the purpose of conservation of fish and wildlife environment. Obviously, selecting and discussing separately all possible combinations of these single-purpose alternatives grouped to serve project purposes would result in a lengthy discourse, much of which would be redundant and consequently tend to cloud or veil the pertinent issues.

(3) It was, therefore, decided that a combination of the best single-purpose alternatives which serve each project purpose should be selected. This combination would represent the best alternative to the proposed Aubrey project. If this combination of best single-purpose alternatives was rejected in favor of the proposed Aubrey project, then all other combinations of single-purpose objectives would be rejected since each would be inferior to the combination considered.

(4) In order to select the best single-purpose alternative for each project purpose, single, ranking evaluation tables were employed. Since it was considered necessary only to rank the single-purpose alternatives rather than evaluate the relative impact of each alternative in commensurate units, it was determined that more involved matrices would not be necessary.

c. Single-Purpose Alternative Selection.

(1) Water Supply. In order to select the best single-purpose alternative for water supply, the evaluation table shown in table V-18 was employed. Each alternative was ranked in order of

Table V-18

Water Supply Evaluation Table

Criterion	Ground Water	Aquifer Recharge	Rec. and Reuse Wastewater	Inter/Intra basin Transfer	Geothermal Source	Weather Modification
Optimum dependable yield (pristine)	4	2	3	1	5	6
Unit cost, mgd	1	4	4	2	4	6
Environmental effects	1	5	3	5	2	5
Total	6	11	10	8	11	17

*1 is most desirable, 6 is least desirable.

desirability on a scale from 1 to 6 (1 the most desirable and 6 the least desirable) for each of the three criteria. Thus, the alternative with the lowest number of total points was considered to be the best alternative. To serve the project purpose of water supply, the alternative of "ground water" with 6 total points was considered the best.

(2) Recreation. Based on the evaluation table shown in table V-19 for recreation, the alternative of "additional sites at existing projects" was selected. Each alternative was ranked in order of desirability on a scale from 1 to 8 (1 the most desirable and 8 the least desirable). Since recreation demands are so complex and interdependent, each alternative was evaluated on its ability to satisfy the greatest number of demands for the greatest variety of land- and water-based types of recreation; therefore, only one criterion was used in the recreation alternative evaluation table.

(3) Fish and Wildlife Environment. In the evaluation table for fish and wildlife environment (table V-20), only two alternatives (no action and the Water Bank Act) were considered, but 10 criteria were used. The other two alternatives were not considered because they were analyzed as being dependent upon the proposed reservoir. Based on the utilization of this evaluation table, the "Water Bank Act" was found to be more desirable than "no action."

d. Combination Selected. Through this evaluation table selection system, it was determined that the best combination of single-purpose alternatives could be defined as the alternative of using ground-water sources for water supply, providing additional facilities at existing sites for recreation, and utilizing the Water Bank Act for conservation of fish and wildlife environment. If the components of this combination were compatible, comparable in benefit-cost ratios, and fulfilled the project purposes to an equal or greater extent than the proposed Aubrey project, they would constitute a viable alternative to the Aubrey project.

e. Comparison to Proposed Project.

(1) As previously concluded in the rejection of the ground-water alternative, the use of ground water as a supply source would not provide a sufficient quantity of water to be considered a dependable, long-range alternative for the purpose of water supply. Thus, this combination alternative was rejected as not fulfilling all the purposes of the proposed project.

(2) Review of the water supply evaluation table (table V-18) indicated that the second choice single-purpose water supply alternative, interbasin or intrabasin transfer of water might provide

Table V- I9

Recreation Evaluation Table

Single Purpose Alternatives	Criterion Satisfies the Demand for Land and Water-Based Rec.
Access to existing streams with development	5
Provide public hunting areas	7
Additional facilities at existing projects	1
Open-space greenbelt	2
Low water retention dams	3
Access to existing streams without development	6
Proposed project with minimal recreation	4
Wild and scenic river act	8

Table V-20

Fish and Wildlife Evaluation Table

Elements	Alternatives	
	No Action	Water Bank Act
1. Fishery:	1.5	1.5
a. Commercial	1.5	1.5
b. Sport	1.5	1.5
2. Vegetation:		
a. Terrestrial	2	1
b. Aquatic	2	1
3. Available Habitats	2	1
4. Upland Game Birds	2	1
5. Waterfowl and Wetland	2	1
6. Amphibians and Reptiles	2	1
7. Mammals	2	1
8. Domestic Animals	1	2
9. Rare or Endangered	2	1
10. Unusual or Unique	1	2
Total	21	15

the quantities of water needed to fit the Aubrey project's purposes. However, as previously discussed, developing transferable water from even the closest possible source, Lake Mineola, is at least double the cost of developing a comparable water supply at the Aubrey site. In addition, present development of interbasin or intrabasin transfer facilities could quite possibly conflict with the routing of future long-term transfers, such as those proposed in the Texas Water Plan. For these reasons, it was concluded that substitution of the interbasin or intrabasin transfer of water for the ground water single-purpose alternative in the best combination was not economically justifiable and would tend to narrow the field of choice for additional water sources in the future. This possible combination was therefore rejected.

(3) By this procedure, it was concluded that neither the first nor second best combinations of single-purpose alternatives constitute viable alternatives to the proposed Aubrey project, and therefore, all combinations, by definitition inferior, [Sec V, para 4b(3)] were rejected.

(4) The following table (table V-21) provides a comparison of pertinent data on each of the alternative plans studied.

TYPE OF ALTERNATIVE	NO ACTION	GREEN TREE RESERVOIR	ENVIR. CORRIDOR; AUBREY & LEWISVILLE	WATER BANK ACT	SITE NO 1 (SELECTED)	SITE NO 2	SITE NO 3	SITE NO 4	SMALL WATERSHED PROJECTS (TOTAL)
PROJECT PURPOSES	F&W	F&W	F&W	F&W	WS, FC, R, F&W	WS, FC, R, F&W	WS, FC, R, F&W	WS, FC, R, F&W	WS, FC, R, F&W
LOCATION									
Stream	-	-	EFTR	-	EFTR, I du B	EFTR, I du B	EFTR, I du B	EFTR, I du B	-
Drainage Area	-	-	-	-	692	716	1,076	-	572.5
River Mile	-	-	-	-	60.0	55.9	51.2	64.0	-
NUMBER OF RESERVOIRS	-	1	1	0	1	1	1	2	4
STORAGE CAPACITY, AC-FT									
Top Flood Control Pool	-	-	-	-	908,100	950,600	947,500	910,000	-
Top Conservation Pool	-	-	-	-	650,300	695,700	593,500	-	630,350
Sediment	-	-	-	-	54,600	-	-	-	65,100
DEPENDABLE WATER SUPPLY (Initially)									
cfs	-	-	-	-	130	116	116	-	100.5
Mgd	-	-	-	-	84	74	74	-	71
AF/Year	-	-	-	-	94,203	84,058	84,058	-	80,072
SURFACE AREA, ACRES									
Top Water Supply Pool	-	-	-	-	25,200	25,280	22,730	25,500	25,660
Top Flood Control Pool	-	-	-	-	32,600	31,580	32,130	31,700	-
FIRST COST, $	-	-	-	-	99,430,000	108,700,000	109,500,000	117,100,000	117,400,000
ANNUAL COST, $	-	-	-	-	4,215,900	4,466,500	4,320,900	4,574,700	-
ANNUAL BENEFITS, $									
Fish & Wildlife	-	-	-	-	371,100	371,100	371,100	371,100	-
Water Supply	-	-	-	-	4,546,300	4,546,300	4,546,300	4,546,300	-
Recreation	-	-	-	-	5,900,000	5,900,000	5,900,000	5,900,000	-
BENEFIT/COST RATIO	-	-	-	-	2.6	2.4	2.5	2.4	-
LAND REQUIREMENTS, ACRES									
Conservation Pool Level	-	-	-	-	25,200	25,280	22,730	25,500	-
Flood Pool Level	-	-	-	-	32,600	31,580	32,130	31,700	-
Public Use and/or Facilities	-	-	-	-	2,800	-	-	-	-
ANNUAL VISITATION (Optimum)	-	-	-	-	6,240,000	6,240,000	6,240,000	6,240,000	6,240,000

TABLE V-21

PERTINENT DATA: ALTERNATIVE PLANS

AUBREY LAKE

	SMALL WATERSHED PROJECTS (TOTAL)	EXCAVATION ALTERNATIVE	GROUND-WATER SUPPLY	GEOTHERMAL SOURCES	WEATHER MODIFICATION	RECLAMATION AND REUSE OF WASTE WATER	AQUIFER RECHARGE	INTER- AND INTRA-BASIN TRANSFER	ACCESS TO EXISTING STREAMS WITHOUT DEVELOPMENT	MINIMAL RECREATION DEVELOPMENT WITH THE PROJECT	ACCESS TO EXISTING STREAMS WITH DEVELOPMENT
B, F&W	WS, FC, R, F&W	WS, FC, R, F&W	WS	WS	WS	WS	WS	WS	R	R	R
I du B	-	EFTR, I du B	-	-	-	-	-	-	-	-	-
-	572.5	692	-	-	-	-	-	-	-	-	-
.0	-	60.0	-	-	-	-	-	-	-	-	-
	4	1	0	0	0	0	0	0	0	1	0
00	-	908,100	-	-	-	-	-	-	-	-	-
	630,350	650,300	-	-	-	-	-	-	-	-	-
	65,100	54,600	-	-	-	-	-	-	-	-	-
	100.5	130	-	-	-	-	-	-	-	130	-
	71	84	-	-	-	-	-	-	-	84	-
	80,072	94,203	-	-	-	-	-	-	-	94,203	-
00	25,660	11,020	-	-	-	-	-	-	-	25,200	-
00	-	18,900	-	-	-	-	-	-	-	32,600	-
00	117,400,000	299,074,000	-	-	-	-	-	-	-	76,175,000	-
00	-	-	-	-	-	-	-	-	-	3,299,800	-
00	-	186,100	-	-	-	-	-	-	-	1,400,000	-
00	-	4,755,400	-	-	-	-	-	-	-	2,191,000	-
00	-	2,603,800	-	-	-	-	-	-	-	44,470	-
4	-	-	-	-	-	-	-	-	-	-	-
00	-	11,020	-	-	-	-	-	-	-	25,200	-
00	-	18,900	-	-	-	-	-	-	-	32,600	-
-	-	2,700	-	-	-	-	-	-	-	-	-
00	6,240,000	2,730,000	-	-	-	-	-	3,000,000	10,000	185,000	40,000

TER-/INTRA-BASIN SFER	ACCESS TO EXISTING STREAMS WITHOUT DEVELOPMENT	MINIMAL RECREATION DEVELOPMENT WITH THE PROJECT	ACCESS TO EXISTING STREAMS WITH DEVELOPMENT	PROVIDE PUBLIC HUNTING AREAS	OPEN-SPACE GREENBELT	WILD AND SCENIC RIVERS	LOW WATER RETENTION DAMS	ADDITIONAL FACILITIES AT EXISTING PROJECTS
NS	R	R	R	R	R	R	R	R
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
0	0	1	0	0	0	0	1	0
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	130	-	-	-	-	-	-
-	-	84	-	-	-	-	-	-
-	-	94,203	-	-	-	-	-	-
-	-	25,200	-	-	-	-	-	-
-	-	32,600	-	-	-	-	-	-
-	-	76,175,000	-	-	-	-	-	-
-	-	3,299,800	-	-	-	-	-	-
-	-	1,400,000	-	-	-	-	-	-
-	-	2,191,000	-	-	-	-	-	-
-	-	44,470	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	25,200	-	-	-	-	-	-
-	-	32,600	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
,000,000	10,000	185,000	40,000	3,000	3,000,000	-	2,000,000	-

SECTION VI

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Table VI-1

Possible Short-Term and Long-Term Impacts With the Project

Elements Affected	Short-Term Impacts With Project	Long-Term Impacts With Project
1. Biological Elements		
a. Vegetation		
(1) Aquatic	Upstream from the reservoir, no significant change. In the project area, a loss of species due to construction or inundation. Initially, high fertility will increase plankton blooms and aquatic vegetation. Downstream, no significant change except when water releases from the lake cause alteration or modification of habitat due to changes in temperature, nutrients, and flow.	Upstream from the reservoir, no significant change. In the reservoir area, when conservation pool is filled and relatively stable, an increase in species should evolve with the development of new shorelines and available littoral habitats. Drawdown periods and heavy silting inhibit growth of vegetation. Downstream, no displacement of species during periods of water releases from the lake. Future developments will contribute to a loss or reduction in existing species in the area.
(2) Terrestrial	Upstream, no significant change. In the reservoir area, a significant loss of species due to construction or inundation. Loss of species from clearing procedures before inundation is complete. Overgrazing, if uncontrolled, destroys vegetation.	Upstream, no significant change. In the project area, vehicular traffic and general misuse or abuse by visitors will have some impact, but strict regulations and enforcement can aid in reducing damages to project lands. A conservation program established to mitigate the impact and sustain species on project land would be initiated to meet long-range as well as short-range objectives. Future public and private developments in the reservoir area and downstream will cause a reduction in existing species.
b. Wildlife Population		
(1) Area Fishery	The upstream fishery will benefit from the repopulation capabilities of the lake. In the lake area, there will be an impact to species that are usually confined to small streams of moderate streamflow such as red shiner, Notropis lutrensis. Most other species should survive the transition to the lacustrine environment satisfactorily. Initially, with standard stocking and management programs, game species should be dominant, and peak productivity should be reached 3 to 5 years after attaining the desired water conservation level. Multilevel water releases from the lake will increase quality and quantity of the downstream fishery. The dam will constitute a blockage of migrations.	Good fishery management techniques can keep a population well balanced indefinitely. The good-quality water and rather large littoral zone should make the lake very productive. Many factors (e.g., pollutants, drawdowns, silting, or overgrazing) can reduce the quality of the existing lacustrine fishery which could eventually result in the less desirable bottom-feeders becoming the dominant species. Future public and private development on the periphery of the project can contribute to pollutant runoffs and increased turbidity from erosion.
(2) Amphibians and Reptiles	Upstream, no significant change. Amphibians in the reservoir area will generally not be affected, and many turtles, toads, and frogs should increase in population density after construction. There will be significant displacement of lizard and snake species due to the irregular water levels during inundation. Water releases which contribute to additional or more suitable habitats could increase species.	Restabilization or increase in populations can be accomplished in suitable habitats available along the periphery of the impoundment due to developmental restrictions on private land. However, future public and private developments in proximity to the project will continue to cause displacements of species, as well as a further reduction in available habitat.
(3) Birds	Upstream, no significant change. In the construction and reservoir area there will be an impact on those species that inhabit, primarily, the heavily wooded stream bottom lands or floodplain bottom land hardwood forest. The impoundment would increase the favorable habitat for water, shore, and marsh-dwelling species, and will serve as an additional resting and feeding area for migrating waterfowl using the Central Flyway. Downstream, wetland quantity and quality and waterfowl usage could increase as a result of continuous water releases.	In the project area, a significant increase in wetland quantity and quality and waterfowl usage. A restabilization of population densities and productivity in suitable habitats along the periphery of the impoundment. As trees and shrubs are introduced into public-use areas, as volunteer native vegetation reestablishes itself, and as areas are improved for wildlife use, greater carrying capacity and species diversity can be expected. Future public and private developments in the area will contribute to the reduction of natural habitats; however, many species are adaptable to suitable urban-type developments which would aid in reducing an additional displacement of species.
(4) Mammals	Upstream, no significant change. In the project area there will be a significant displacement of species that usually inhabit the streamside habitat or wooded flood plains, due to the pool filling or inundation process. Downstream, the periodic water releases will displace some species. Reduction in flooding downstream from the dam could result in habitat stabilization unless developed for man's use.	Future public and private development in the project area will continue to reduce available habitats and displace those species that are unable to adapt to an environment where the effects of human populations are present.
c. Environmental Pollution		
(1) Water	Upstream, no significant change. Downstream, during the construction phase there will be an increase in pollution. After construction, and when the desired conservation pool is attained, there should be a continual decrease in pollution. Also downstream, periodic multilevel water releases will result in more uniform biotic conditions which should contribute to a decrease in pollution.	Future developments within the watershed that utilize septic tank facilities may contribute to increased pollution of the lake. Additional agricultural or chemical pollutants will be carried into the reservoir by runoffs from the watershed assuming there are no changes in usage regulations or applications. Also, future industrial plants could indirectly discharge effluents into the lake.
(2) Air	During the construction phase there will be an increase in noxious gases and particulate matter pollution in the project area and downstream.	Future developments and recreational activities in the area could significantly contribute to an increase in pollution.
(3) Noise	Upstream and downstream there should be little change. In the reservoir area there will be an increase in pollution due to construction and recreational activities.	Future recreational pursuits and additional public or private developments in the vicinity of the project could contribute to an increase in pollution.
d. Unusual or Unique Elements	Construction and subsequent inundation will result in the loss of a portion of the East Cross Timbers, which represents a unique geographic and vegetative region in north central Texas.	Consideration will be given to a conservation program to sustain as much of the East Cross Timbers as possible and to designate a portion of the project area containing this unique vegetation as a natural preserve and field study site. Future public and private developments in non-Federal areas will contribute to the elimination of of this unique geographic region.

(1) Animals	Presently, there are no known species, terrestrial or aquatic, in the project area that are classified as either rare or endangered.	A large water body with large trees nearby could beco a nesting area for rare and endangered species such as the eagle or peregrine falcon. Waterfowl such as the endangered Tule White-Fronted Goose may visit the proje during migrations.
(2) Plants	1. Uniola latifolia: broadleaf uniola is rare in Texas. 2. Elymus canadensis: Canadian wildrye is considered endangered by the USDA, Soil Conservation Service, Temple, Texas. Due to construction or inundation, these species will be reduced but not completely eradicated from the area.	Consideration will be given to a conservation program o project land to aid in sustaining these species. Other wise, future developments in the area will also contrib to a decrease or further reduction of existing species.
2. Hydrological Elements		
a. Water Supply	Supplying water needs downstream would be delayed until the water reaches the minimum discharge level (elev. 565.0 ft. msl) during deliberate impoundment, which would take 1 to 3 months under normal conditions. Additionally, downstream flows would not be fully restored until the Aubrey Lake level reached a full conservation pool, which under average conditions would take 2 to 4 years.	The impoundment would be an additional source for projected municipal and industrial water requirements. Continuous releases from Aubrey Lake into Lewisville Lake would provide a continuous water supply from Lewisville Lake.
b. Water Quality	Immediately after impoundment, leaching of the mineral and organic constituents of the soils will cause an increase in turbidity, color, potassium, nitrogen, and biological oxygen demand (BOD), with a corresponding decrease in dissolved oxygen (DO) and hydrogen-ion concentration (pH).	Because of the reservoir, a more constant flow, with mor uniform water quality and temperature, will result. How ever, future public and private industrial or municipal plants with effluents that have been inadequately treate entering the reservoir directly or indirectly, will degrade the water quality.
c. Flood Control	The project will control flood damages on the stream reach below the dam.	Continuation of short-term impact.
3. Archeological Elements	There are many prehistoric and historic sites which will be inundated when the lake is built, or be endangered by construction of facilities, houses, etc., adjacent to the lake.	Continuation of short-term impact.
4. Historical Elements	Upstream and downstream, no change. There will be eliminations, relocations, or modifications of those sites that are within the impoundment or project area.	Certain sites could gain recognition as having Federal or State significance. Future public and private developments could contribute to a loss or reduction of existing sites in the area.
5. Recreational Elements	The Aubrey Lake project will help to meet the immediate land and water-based recreational needs of an area which is deficient in recreational opportunities by providing recreational opportunities for approximately 3,500,000 persons initially. The Aubrey project will provide an incentive for tourists to lengthen their stay in the area which in turn should contribute to the area's economy. The high numbers of people expected to visit the project could create adverse impacts on the area's vegetation, land, and esthetic quality.	A continuation of short-term impacts, with the project ultimately providing recreational opportunities for approximately 6,240,000 persons.
6. Social, Cultural, and Economic Elements		
a. Land-Use Changes	Loss of production and taxes on land inundated by the lake. Use adjustments for farm units reduced in size. Improved market potential for sale of land for residential and recreational use.	Increased economic activity--capital expenditures in new homes and businesses near the lake. New tax sources for local government. Increased land values. Loss of production and taxes from land inundated by the lake. Elimination of size adjustment in affected farm units.
b. Community Life	Employment opportunities in project operation and maintenance and in new services and retail businesses. Stimulus to area population growth. Adjustment period for displaced farm operators, road networks, and development patterns of existing communities.	Job opportunities for local residents in project maintenance and in existing and new services and supply businesses. Improved road systems and utilities. Higher standard of living with economic and population growth. Disruption of existing community development, Relocation of existing cemeteries, a church, and some roads to nearby trade centers.
c. Education	Possible realinement of existing school districts and school bus routes. Inventory of real properties within the school district boundaries to include new listings and transfers between districts.	Additional tax revenue for improved public school facilities and administration. Some realinement of existing school districts (possibly not detrimental).
d. Flood Protection	Improved efficiency in downstream protection. Increased sense of security for floodplain landowners.	Continuation of short-term impacts.

SECTION VI - THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

1. Natural Environment Trusteeship. In the past, project designers have made a thorough study of the short-term beneficial and adverse effects of proposed projects only to find out many years after project completion and use that the project had caused many long-term impacts that were not expected or considered. Therefore, it is necessary to consider every possible short-term or long-term impact that will be caused by the project. In this examination, "short term" refers to the period of time from the initiation of construction of the project to about 5 years later. "Long term" refers to the period of time from about 5 years after initiation of construction to at least the designed life of the project, which, in this instance, is approximately 100 years. Table VI-1 presents possible short-term and long-term impacts which were considered in an effort to more validly assess the proposed action in relation to safeguarding the environment for succeeding generations.

2. Human Environment Trusteeship.

a. Implicit in the requirement that all environmental impacts and their effects be studied for a proposed project is the recognition that each generation is the trustee of the environment for succeeding generations. This environmental trusteeship includes relating the maintenance and enhancement of the natural environment to the long-term productivity of these succeeding generations.

b. Among the facets central to long-term productivity of succeeding generations is a sense of socioeconomic well-being "achieved by a balance between population and resources use which will permit high standards of living and a wide sharing of life's amenities." (25) This is widely demonstrated today by this generation's many beautification programs in parks and scenic sites, improved working conditions in production plants, and constant striving for better living conditions and conveniences. Still, there exist today ample demonstrations of productivity losses in our society occasioned by instances of unfavorable socioeconomic environment. Therefore, failure of this generation to strive for enhancement of the human environment for succeeding generations, while maintaining the natural environment for short-term uses, demonstrates an insensitivity to this important responsibility envisioned in the National Environmental Policy Act of 1969.

c. Toward consideration of this responsibility, implications of the Aubrey Lake project which may affect the human environment of succeeding generations were studied and forecast based on present trends and goals. As previously indicated, the enhancement of long-term productivity implies a human environment that produces

socioeconomic well-being of people. Although economic well-being has in the past been frequently viewed as analogous to social well-being, younger generations increasingly tend to draw a finite distinction between the two. For many young people today, economic well-being in itself does not automatically produce social well-being. Without desirable amenities and adequate recreational facilities, more monetary affluence appears useless at best, and at worst, provides a means for incurring social ill-being and unrest.

d. As noted in section II and section V of this report, study groups have forecast a future shortage of recreational facilities and areas in the north central Texas area. The additional recreational facilities authorized as a purpose of the Aubrey Lake project will aid in alleviating this shortage. These additional facilities are expected to contribute to the social well-being of people in the area and thereby enhance long-term productivity.

e. As little as two or three generations ago, indoor plumbing, now available as a result of a dependable, adequate, and inexpensive water supply, was considered a restricted amenity of life. Today such facilities, accepted as commonplace and expected as necessary, might be considered a widely shared amenity. Chronic or even occasional future water shortages might again place these common, expected facilities in the category of an amenity with restricted or curtailed availability. Additionally, water shortages or supply interruptions might be expected to have profound effects on industrial and agricultural operations and productivity. These developments would most certainly be considered a detriment to social well-being and thereby adversely affect long-term productivity. A primary purpose of the Aubrey project is to provide an adequate, reliable, and economical water supply to meet the widely recognized and growing needs of future generations in this area. While it is not the only possible source of this supply, it is the best alternative now available to fulfill all authorized purposes. The Aubrey project is, therefore, considered to contribute to long-term productivity by enhancing the potential social well-being of succeeding generations.

f. While construction of the Aubrey project commits present resources both in terms of land and money, the undertaking of this project will significantly contribute to man's long-term productivity by enhancing man's environment. Although the short-term usage of the natural environment will be altered, it is considered that these alterations are consistent with the Federal goal of employing "all practical means and measures . . . in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans"(25).

Therefore, to neglect or postpone the Aubrey Lake project may be viewed by future generations as an abdication by this generation of its responsibilities implicit in the National Environmental Policy Act of 1969.

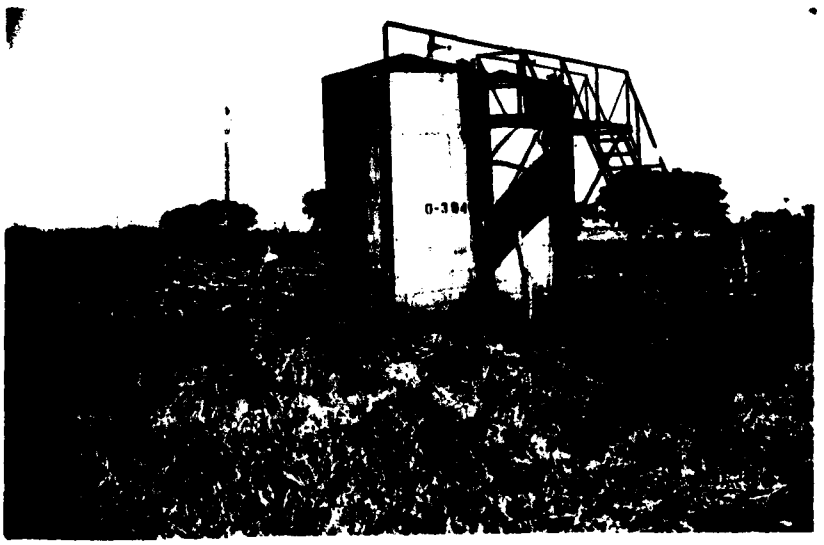
SECTION VII

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

SECTION VII - ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

1. The commitment of the following lands and related resources in the project area is classified as both irreversible and irretrievable due to the construction of the proposed project.

a. Existing oil field facilities:



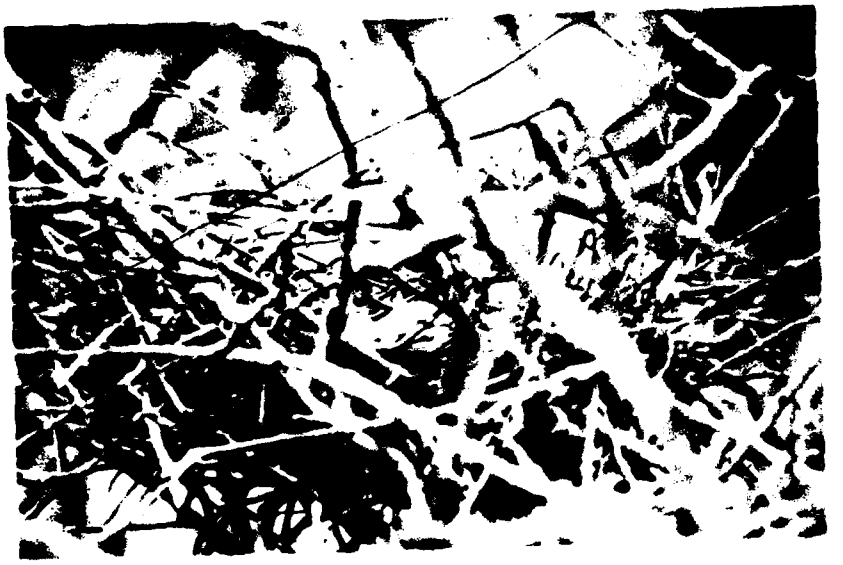
b. Mining activities:

c. Pastureland and cattle production:

d. Agricultural lands and products:

2. The commitment of the following resources in the area is classified as irretrievable due to the construction of the proposed project.

a. Wildlife populations and habitats:



b. Archeological Resources*:

*Pictures courtesy of Mr. R. King Harris

c. Construction materials, manpower, and funds:

d. Loss of income derived from the land:

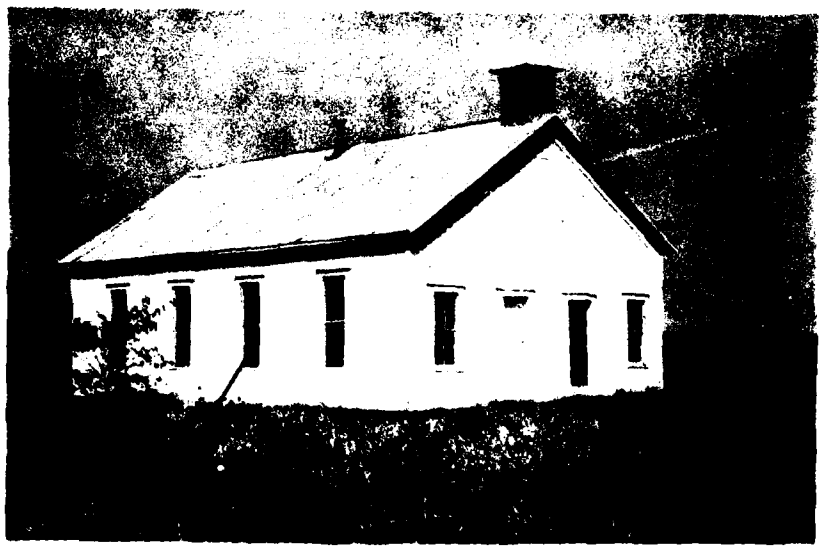
3. The commitment of the following elements in the area is classified as irreversible due to their required relocation, alteration, or modification during the construction phase of the proposed project.

a. A portion of a railroad:

b. Utility lines:

c. Homesites:

d. A Church:



e. A Retreat:

f. Roadways:

g. Cemeteries:

SECTION VIII

COORDINATION WITH OTHERS

INTRODUCTION

The National Environmental Policy Act of 1969 (25) requires that the expertise and views of a broad range of knowledgeable people be utilized in the preparation of environmental impact statements. Section VIII contains a complete history of the coordination effort and the comments of those who have reviewed the draft environmental statement prepared for Aubrey Lake, Elm Fork, Trinity River, Texas. To facilitate finding certain comments of particular agencies, organizations, or individuals, and the responses of the Corps of Engineers to those comments, the following cross index is included.

Commentor	COMMENT Synopsis and Response	COMMENT Full Text
U.S. Department of Agriculture		
Soil Conservation Service	VIII-18	VIII-59
Forest Service	VIII-18-20	VIII-60-61
U.S. Department of Health, Education, and Welfare	VIII-20	VIII-62
U.S. Department of Commerce		
National Weather Service (NOAA)	VIII-20	VIII-63
Federal Power Commission	VIII-20	VIII-64
Environmental Protection Agency	VIII-21-24	VIII-65-69
U.S. Department of Transportation		
Federal Highway Administration	VIII-31	VIII-102
U.S. Department of the Interior	VIII-31-42	VIII-103-109
State of Texas		
Soil and Water Conservation Board	VIII-25	VIII-83
Water Rights Commission	VIII-25-28	VIII-84-96
Water Quality Board	VIII-28-31	VIII-97-98
Department of Agriculture	VIII-42	VIII-79
General Land Office	VIII-42	VIII-80
Parks and Wildlife Department	VIII-42-44	VIII-99-101
North Central Texas Council of Governments	VIII-24	VIII-70
Texoma Regional Planning Commission	VIII-24	VIII-71-72
City of Denton, Texas	VIII-25	VIII-73
City of Fort Worth, Texas	VIII-25	VIII-74
City of Dallas, Texas		
Dallas Water Utilities	VIII-25	VIII-75
Trinity Improvement Association	VIII-45	VIII-113-114
Sierra Club, Lone Star Chapter	VIII-44-45	VIII-6-8 VIII-112
Southern Methodist University		
Department of Anthropology	VIII-45	VIII-115
North Texas State University		
Institute for Environmental Studies	VIII-45	VIII-116-121

Commentor	Comment: Synopsis and Response	Comment: Full Text
Denton County Historical Survey Committee	VIII-45	VIII-122
Texas Archeological Society	VIII-45-46	VIII-123
League of Women Voters, Dallas	VIII-46	VIII-124-126
League of Women Voters of Texas	VIII-54-57	VIII-142-143
Texas Committee on Natural Resources	VIII-46-50	VIII-127-132
Advisory Council on Historical Preservation	VIII-57-58	VIII-144-145
National Wildlife Federation	VIII-50-53	VIII-133-141
Environmental Defense Fund		VIII-147
National Audubon Society		VIII-148
Dallas County Audubon Society		VIII-146
Mr. Tom Miller, Mount Miller, Architects		VIII-4-5

SECTION VIII - COORDINATION WITH OTHERS

1. History of Project Coordination Prior to Developing the Environmental Impact Statement.

a. During 1956 and 1957, the Trinity River Authority held public hearings in each of the 17 counties within its jurisdiction. The public expressed desires for improvements in flood control, water conservation and quality, fish and wildlife, and recreation. In this plan, adopted in 1958 and modified slightly in 1960, the Trinity River Authority proposed the construction of Aubrey Lake.

b. The U.S. Study Commission of Texas made an inventory of the land and water resources in all of the major river basins of Texas to formulate a plan to meet the water needs in the year 2020. In 1960, public hearings were held in Corsicana and Huntsville to obtain the public's views on the proposed plan of improvement. In 1962, the U.S. Study Commission of Texas submitted a report regarding the construction of Aubrey Lake.

c. In December 1961, the Corps of Engineers, Fort Worth District, held a public hearing to present its preliminary plan and to obtain the public's views and desires. This plan, which was submitted in 1962 and authorized in 1965, provided for the construction of Aubrey Lake.

d. In July 1966, the Texas Water Development Board held a public meeting in Arlington, Texas, concerning the Trinity plan. As a part of their comprehensive development of the state, they proposed the construction of a lake in the same vicinity as Aubrey.

e. On 30 April 1971, the Corps of Engineers, Fort Worth District, held a public meeting in Denton, Texas, to obtain the public's views and desires for the purpose of gathering data to make a final decision on the site location for the dam at Aubrey Lake.

2. Summary of Project Coordination Since the Initiation of the Environmental Impact Statement.

a. On 18 August 1972, a coordination meeting was held in Denton, Texas, for the purpose of discussing the location of the proposed public-use areas and the cost-sharing requirements under Public Law 89-72 (21). Representatives of the Corps of Engineers, the Texas Parks and Wildlife Department, and the cities of Denton and Dallas were present.

b. On 27 October 1972, a public meeting was held by the Corps of Engineers, Fort Worth District, in the Civic Center Community Building in Denton, Texas. The meeting was held to inform the nearly 400 attendees of the latest details concerning the Aubrey project, to

present results of environmental studies, and to explain the alternative actions studied. The meeting also served as an opportunity to obtain information from, and ascertain the attitudes of, interested individuals and organizations. Mr. Tom Polk Miller, representing the Denton County Historical Survey Committee, stated that the oldest of the three houses built by members of the Hammons family is considered to merit restoration because of the uniqueness of its architectural style. Environmentally oriented opposition to the proposed project was expressed by Mrs. Franklyn Wright, Conservation Chairman, Lone Star Chapter, Sierra Club. Copies of Mr. Miller's and Mrs. Wright's statements follow.

c. Preparation, Review, Approval of Environmental Impact Statement for Aubrey Lake.

Document or Event	Date Submitted	Submitted To
Precoordination Letter	28 Aug 72	Federal, State, local agencies
Summary of Environmental Considerations Attached to Notice of Public Meeting	25 Aug 72	Federal, State, local agencies, public groups & others
Environmental Public Meeting	27 Oct 72 (Held)	Public
Preliminary Draft	27 Dec 72 15 Jan 73 (Replies)	All elements, District Engineer, Fort Worth
Reviewed Draft	27 Mar 73 14 Jun 73 (Replies)	Division Engineer, Southwestern
Draft	20 Jul 73	Division Engineer, Southwestern Chief of Engineers
Draft	23 Jul 73	Federal, State, local agencies Public groups & interested individuals
Draft	16 Aug 73 (Received)	Council on Environmental Quality
Draft	4 Sep 73 (Notice)	Notice published in Federal Reporter, Vol 38, No. 170-Tues, 4 Sep 73, page 23821
Draft of Final	29 Oct 73 13 Dec 73 (Replies)	Division Engineer, Southwestern Chief of Engineers

d. Preliminary Coordination with Other Agencies. In the early stages of preparation of the draft environmental impact statement, information was requested from agencies having expertise in certain areas. Copies of their responses follow.

MOUNT - MILLER architects
711 WEST SYCAMORE DENTON, TEXAS 76201 TELEPHONE (817) 387-1659

26 October 1972

Colonel Floyd H. Henk, District Engineer
Fort Worth District, Corps of Engineers
Post Office Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

This is in response to your announcement dated 25 September 1972 of a Public Meeting to present plans for Aubrey Lake on the Elm Fork of the Trinity River, to be held in Denton on 27 October 1972.

Our concern is for the preservation of a house built in the 1850's, architecturally unique in this area and quite unusual in the entire state. The house, one of the three built by members of the Hammons family, is about 1½ miles north of state road 455, just east of the Elm Fork of the Trinity. It sits about one-quarter mile inside the proposed flood-control pool, and according to the large contour map of the project it seems to be at approximately the level of the conservation pool.

This house, the easterly one of the two Hammons houses that are only a few hundred yards apart, is considerably earlier than either of the other houses built by this family, and much the most interesting and valuable architecturally. It is of a style that was widespread in the southeastern states in the early nineteenth century (the Hammons family came to Texas from Tennessee), but is not often seen in Texas. In fact, only one extant example appears in Early Texas Homes (Bracken and Redway, Southern Methodist University Press, 1956) and none in Texas Homes of the Nineteenth Century (D. B. Alexander, University of Texas Press, 1966).

A long low porch extends the complete width of the front of the house; above this is a row of low square windows, under an eave line which provides only five-foot headroom at the sides of the second-floor rooms. The result is a very long horizontal feeling, of a charm unique in this area. Most houses of this period in North Texas were generally like the other two Hammons houses: either one-story, with the roof continuous from ridge to porch eaves, or of full two-story height, with tall upper windows and an entirely different proportion. This house is a cultural survival, of great interest to any student of the nineteenth-century westward migration from the old southeastern settlements.

ISABEL MOUNT MILLER
TOM POLK MILLER A.I.A.

The house is additionally interesting in that it still has a cluster of ancillary structures--a small tenant house, a barn which incorporates an earlier log structure, and a large later barn.

The house appears to have been abandoned for some time, and is somewhat deteriorated. However, it is still sound enough structurally to merit restoration, especially in view of the uniqueness of its style. The cluster is a physical witness to a period from which very few witnesses remain; if called to the attention of an interested person or organization, it could be restored as a unique cultural asset and put to use as, for example, a lakeside conference center.

What we wish to urge at this time is that the house and its attendant structures be saved from the lake. A low levee or berm extending the approximately quarter-mile from the edge of the flood-control pool would be a way of doing this. Of course if the level of the lake were revised downward a few feet, the problem would disappear.

Sincerely yours,

Mount-Miller, Architects

Tom Polk Miller, AIA

PS: Our name appears in the Systems Evaluation of the Environmental Impact of the Aubrey Lake as sources of "ideas". This refers to a consultation in very general terms with one of the participants in the study. At that time we were not aware of the existence of the Harmons houses; we discovered them only within the past three weeks.

TPM

Statement of Mrs. Franklyn Wright
Conservation Chairman, The Sierra Club--Lone Star Chapter
9720 Wisterwood Dallas, Texas 75238
Before the Public Meeting, Aubrey Lake Elm Fork Trinity River
October 27, 1972

Aubrey Lake is described in the Announcement as being needed for water supply, recreation, fish and wildlife. For a number of reasons I question its value at the present time.

A League of Women Voter's Study stated that Dallas has a pristine water supply for the projected population through 1995. This study was based on the University of Texas Bureau of Business Research, 1965. The BBR predicted a Texas population of 18,million by 1990 (needing 6 million acre feet of water) and a population of 30 million by 2020 (needing 12 million acre feet of water). This projection was the basis of the Texas Water Plan. However recent forecasts of the University of Texas Research Center, estimate a Texas population by 1990 of 15,474,000 if there is a slight increase in the fertility rate of child-bearing, and of 14,358,000 if Texas women decide to make a slight decrease . -- depending on how the population goes, 2,284,380 or 3,400,380 less people in 1990 than predicted in 1965.

These new projections will require the Texas Water Development Board to convert their old water demand figures to reflect new growth patterns.

Although the new patterns indicate fewer people than predicted, they show a speeding up of the migration from rural areas to the cities. This trend is a very real problem for Texas--destroying our little towns, and creating a few monster cities, with all the unpleasantness, financial havoc, and ugly, unhealthy environment already apparent in many large cities. We should be concentrating on a reversal of this trend. If we build projects that actually encourage growth in already large urban areas, or, if we build projects before they are absolutely necessary, we may be compounding the water problem instead of solving it.

Livestock and crop production in the Aubrey area amounts to over $30 million a year. Excluding the recreational benefits, I wonder how much of this income will be lost per year through flooding 35,000 acres. The Environmental Study shows that the lake would probably produce good fishing. This is usually true in new lakes, but, as a reservoir ages, trash fish will thke over. The Study prepared by North Texas State University may have estimated this period, but it was not included in the Announcement.

The Study contains some rather weird figures--things like PIU (Parameter Importance Units, and EIU (Environmental Impact Units. Under Human Interest, Mood/Atmosphere there is a rating for Awe-inspiration. The PIU weight is 11, and the net change (if

the canal is built) is plus 0.22. It also includes a rating for Isolation/solitude, "oneness" with nature, and would you believe "Mystery" The Mystery PIU weight is 4 and the lake would increase Mystery by 0.20. I may be unfair, since I have not read the study, but this sounds like a lot of "biological double-talk".

Under Ecology, Species & Populations, I guess natural vegetation includes trees— anyway it has a PIU factor of 14, and an EIU net change of minus 4.34. I would be interested in knowing how many trees would be lost, how old they are, and their actual value. A tree is expensive when purchased, but for some reason, has no value in Corps projects— the true cost of lost trees, and other forms of natural beauty are not included in cost/benefit ratios.

In addition to including true environmental damage costs in cost/benefit ratios, I believe the planners should study the combined results of projects. For, even minimum destruction from each project could lead to overall maximum destruction; An overview is needed of all projects, considering their relationship to each other. That is, their relationship to each other on environmental factors. I have a feeling they are already being so considered on other factors. We know that the Texas Water Plan is based on inter basin transfer. In a summary of the plan for proposed water resources development in the Trinity River Basin done by the Texas Water Development Board in June, 1966, it suggests using the Trinity River basin to provide integral parts of the transbasin diversion system to transmitt water south and southwestward through the Trinity River and planned conveyance facilities. It also mentions exporting more than 1 million acre-feet for uses in the San Jacinto River basin, the Neches Trinity Coastal basin, and the Trinity-San Jacinto Coastal basin— and importing 646,600 acre feet annually from other Texas basins. It mentions Aubrey Lake as a means of conversion of flood control storage capacity in Garza-Little Elm Reservoir to conservation storage—it does not mention water supply, recreation, fish and wildlife. It does mention that the proposed plan provides for the construction of six new reservoirs (including Aubrey) and three others scheduled for construction—adding to existing reservoir acreage 195,430 surface acres of water . Here it does mention recfeation " thus providing additional water-recreation opportunities". But, one of the most important mentions is " <u>Reserving water needed for future navigation on the Trinity River.</u>"

As to the two archelogical sites mentioned , a member of the Dallas Archelogical Society told me that there are probably 100 to 150 sites in the Aubrey area.—some dating back as far as 10,000 B.C. (carbon 14 samples found in the Lewisville area— now under water, were dated 37,000 B.C.

My friend told me that the North Texas Study does suggest that a survey be done. They had no archelogist on their team. The National Parks Service has the authority to conduct surveys, but doesn't have enough funds . But, the Corps districts can fund archelogical studies up to $10,000—So far as I know, the Fort Worth District has not directly funded any such studies. Without a study much evidence of early man could be lost.

We are concerned, not just about archelogical and other environmental destruction, but about the very integrity of our colleges and universities. With no prejudice to North Texas, since many other schools are involved—even the layman knows that a proper biological study involves at least one total year's cycle. But, addording to the Dallas Times Herald, July, 1972,"The team of researchers concluded after three months study the proposed Aubrey Reservoir will have a slightly positive effect on the environment of North Texas. I would ask this question," Is grant money more important than objective study?"

Also, in these inflationary times, we are spending billions on what we consider, unnecessary projects, which increase the national debt, flood prime farmlands, degrade the environment, and invite catastrophe through development of the flood plain. If the unnecessary projects could be halted, billions of dollars could be saved. An economist at the University of Wisconsin says, " If all projects were subjected to rigorous economic analysis, I would not be surprised to find that only about 25 % would be justified, and, further, that half of this 25 % would have to be eliminated if the environmental damages could be added to the cost side." (Prof. Robert H. Haveman) As an article in the July Readers Digets suggests, the vast majority of the dams we are now building should not be built.

I doubt if Aubrey Lake is necessary. Our area already has at least 16 reservoirs, and as these age, we may badly need the remaining sites for water supply. Why use up sites that might be needed for the future? Why destroy our rivers? We are already doing research on desalination, weather modification and recycling, and other new technology may be eminent. We can also wait a few years and see how the growth projections are leaning, and also see how well our present reservoirs are holding up. If we build the lake before it is absolutely necessary we will be wasting the reservoirs youth, the good years of fishing and water supply.

The Sierra Club, Lone Star Chapter suggests that Aubrey Lake not be built at the prestnt time..

We also request that this statement be included in the Draft Environmental Impact Statement.

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

September 15, 1972

Mr. D. L. Orendorff
Chief, Engineering Division
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Orendorff:

In response to your letter of August 28, 1972, the attached list shows the projects we are now participating in.

We suggest you contact the Texas Water Quality Board for a complete list of treatment facilities planned for this area, and for the quality of effluents.

If we can be of further service, please contact me.

Sincerely yours,

Kenton Kirkpatrick
Grants Coordinator

Enclosure

Applicant	Receiving Stream	Design Data Flow(mgd)	Design Data BOD lbs/day Effluent
Argyle, Texas	Hickory Creek	0.21	24
Corinth (Denton S.T.P.)	Pecan Creek to Garza Little Elm Res.	6	1500
Flower Mound	Denton Creek	0.7	58
Frisco	Stewart Creek to Garza Little Elm Res.	0.1	17
Gainsville		2.0	340
Haslet	Henrietta Creek Harriet Creek Denton Creek	.05	10
Lewisville	Prairie Creek Timber Creek	3.0 3.0	250 250
Ponder	Denton Creek	0.12	17
Sanger	Clear Creek	0.3	51

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE
Collin County ASC Committee
214 Federal Building
McKinney, Texas 75069

August 31, 1972

Mr. D. L. Orendorff
Chief, Engineering Division
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Orendorff:

In reply to your letter of August 28, 1972, this is to advise that we have no programs going or planned on the tributary streams of the Aubrey Lake project.

We assist farmers in the area with conservation work under the Rural Environmental Assistance Program, but this would be on individually owned farms not affected by your project.

Sincerely,

Fred L. Cook
County Executive Director

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE
Denton County ASCS Office
Box 130, 201 E Oak
Denton, Tx. 76201

September 5, 1972

Mr. D. L. Orendorff
Chief, Engineering Division
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Tx. 76102

Dear Mr. Orendorff:

The Denton County ASCS office does not have any planned nor are we participating in any programs in the Elm Fork Watershed. The only programs operated at all in this area is land improvement on a year to year program.

Sincerely yours,

Thomas J.Hutchins,
County Executive Director,
Denton County ASCS.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE
Grayson County
Sherman, TX 75090

September 8, 1972

Mr. D. L. Orendorff
Chief, Engineering Division
P. O. Box 17300
Fort Worth, TX 76102

Dear Mr. Orendorff:

Our office currently has no specific program operating in the area you described in Grayson County. We do have a county wide program, the Rural Environmental Assistance Program, whereby individual farms carry out conservation and pollution control practices. On this basis, some individuals may perform certain practices in the area you described but it would only be on a small scale, such as stockwater ponds, or establishing permanent grass pastures.

I hope this is the information you need. However, please let me know if I can be of further assistance.

Sincerely. yours,

J. T. Key, Jr.
County Executive Director

JTK/pl

GORDON FULCHER
CHAIRMAN

LESTER CLARK
VICE-CHAIRMAN

J. DOUG TOOLE

HARRY P. BURLEIGH

TEXAS WATER QUALITY BOARD

CLAYTON T GARRIS

J. E. PEAVY, MD

BYRON TUNNELL

HUGH C. YANTIS, JR.
EXECUTIVE DIRECTOR

PH. 475-2651
A.C. 512

314 WEST 11TH STREET 78701
P.O BOX 13246 CAPITOL STATION 78711
AUSTIN, TEXAS

September 19, 1972

Mr. Joe Swick
Environmental Resources Section
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Swick,

Attached is the information which you requested (Telecon 9-6-72), regarding municipal sewerage systems located in the drainage basin of the proposed Aubrey Reservoir. Should you desire additional information please advise.

Very truly yours,

Charles D. Gill
District Supervisor

CDG:dc

	Sewage Treatment Plant	WCO No.	Self Reporting Submitted	Compliance with WCO
Aubrey	yes	10064	yes	yes
Collinsville	yes	10151	yes	no
Gainesville	yes	10726	yes	marginal
Gunter	yes	10569	yes	yes
Lindsay	yes	10923	yes	yes
Muenster	yes	10341	yes	yes
Myra	no	none	not applicable	not applicable
Pilot Point	yes	10361	yes	yes
Sanger	yes	10271	yes	no
Tioga	yes	10615	yes	no
Valley View	yes	11164	yes	yes

SOUTHERN METHODIST UNIVERSITY

DEPARTMENT OF ANTHROPOLOGY
DALLAS, TEXAS 75222
Archaeology Research Program

October 24, 1972

Colonel Floyd H. Henk, District
Engineer
Department of the Army
Fort Worth District, Corps of
Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

Since receipt of the public meeting announcement concerning Aubrey Lake, several amateur archaeologists in the Dallas-Denton area have asked about the content of the section (pg. 2) on archeological and historical elements. These people advised me of archaeological sites in the lake area and of the many sites that have been affected by Lake Dallas. I assured them that there no doubt were more than two sites within the proposed reservoir flood pool and that the study prepared by North Texas State University points out that an archaeological reconnaissance will have to be completed before an acceptable Environmental Impact Statement is prepared. "Let us know when you start the survey," they said, "and we will be happy to help."

At present I understand that submission of an EIS is planned for this Fiscal Year so I checked with the National Park Service about the availability of funds. They advised me that funds for a survey will not be available during the present Fiscal Year. Therefore, I suggest that the Fort Worth District consider contracting with Southern Methodist University to conduct this study within the next several months. The office of the Archaeology Research Program at S.M.U. is near Aubrey Lake, has contact with many local amateur archaeologists, and has expertise in carrying out archaeological evaluations of Corps of Engineers' reservoirs. In the past

two years we have conducted archaeological site surveys at Coop[illegible] Lake, Lake Whitney, Big Pine Lake (Red River) ar[illegible]quilla Lake. With the direction of trained students and the support of amateur archaeologists, we are able to provide a deeper knowledge of the local prehistory than is possible by a short term visit to a reservoir area.

By working together we should be able to record and evaluate the archaeological resources at Aubrey Lake. Please feel free to call upon me at any time.

Sincerely,

S. Alan Skinner

S. Alan Skinner
Director

3. Final Coordination of Draft Environmental Impact Statement. The draft environmental impact statement was submitted to 25 governmental agencies and 18 nongovernmental entities for review and comment. Their review comments and the Corps of Engineers responses to them are presented in the following paragraphs.

a. Governmental Agencies. Pursuant to the coordination requirements set forth in Public Law 91-190 (25), copies of the draft environmental impact statement were sent to Federal, State, and local agencies authorized to develop and enforce environmental standards. They were asked to comment on the accuracy and adequacy of the information contained in this statement. The comments received have been reviewed and evaluated and, where applicable, incorporated in this document. The comments of the governmental entities are incorporated below, and copies of their letters are included at the end of this section.

(1) U.S. Department of Agriculture, Soil Conservation Service.

Comment: "The environmental statement very adequately describes the environmental impact of the proposed project as well as containing measures to minimize adverse effects."

(2) U.S. Department of Agriculture, Forest Service.

Comment: "On pages II-46 through 49 are references to expected changes in land use due to development of the lake. We strongly recommend the sponsors consider land use planning and zoning to guide the developments."

Response: These cities, or incorporated communities, which will be situated adjacent to the proposed project have the authority over zoning. The county has approval authority over development plats but none over zoning. At the present time, the state of Texas is working on a proposal to give the counties some authority to enforce a more stringent housing code. The ultimate fate of the esthetic values displayed in areas along the periphery of the lake will rest primarily with the individual landowners. However, the state of Texas does have a law which requires the siting of septic tanks and leaching fields a distance away from a water supply impoundment. The distance is determined by the percolative qualities of the soils into which the tank and field are to be constructed. Through enforcement of this regulation, the degradation of the good quality Aubrey Lake water would be minimized.

In addition, all point source discharges, including industrial, public, and private discharges, that may exist in the watershed will be controlled by interim permit from the Environmental Protection Agency through the National Pollutant Discharge Elimination System (NPDES) instituted pursuant to sections 402 and 405 of PL 92-500 (29).

If findings by the Texas Water Quality Board indicate that private sewage facilities such as septic tanks cause, or may cause, pollution, the Texas Water Quality Board may delegate regulating power over these types of facilities to the concerned counties under sections 21.083 and 21.084 of the Texas Water Quality Act. Solid waste disposal activities at sites such as garbage dumps, landfills, and auto junkyards are under the individual or joint control of the Texas Water Quality Board, Texas State Department of Health, and the affected counties, pursuant to the Texas Solid Waste Disposal Act of 1969, as amended.

Comment: "We are aware that other large dams and lakes are planned for this region. These may satisfy the recreation needs for large bodies of water. If so, then the scenic river/greenbelt alternatives may be a more viable alternative."

Response: Other large dams and lakes are planned for this region. However, there is no guarantee that these projects will ever be developed. For this reason, it is necessary to develop the optimum recreation resources while the project is being planned. A "scenic river/greenbelt" plan was proposed in conjunction with the selected project. Because of the short distance between Aubrey Dam and the headwaters of Lewisville Lake, about 4 miles, State or Federal parks and recreation agencies could develop a prime "environmental corridor" recreation area in conjunction with the Aubrey Lake project. We agree that such additional fish and wildlife and recreational development would be desirable.

Comment: "What are the regional needs for large bodies of water? What part of the recreational demand for large bodies of water can be supplied by the other reservoirs scheduled for construction in this region?"

Response: Long range studies have been made to determine the regional needs for water resources projects in the Trinity River Basin. These studies were based on current and proposed water resources development through the year 2020. Determination of recreation needs was based on current and projected participation rates. From our studies it appears that approximately 50 percent of the current participation occurs at larger lakes. The following table (VIII-1) presents data on regional recreation needs at large lakes in the Trinity River Basin by year 2020. These projections will be updated when the State of Texas updates its State Comprehensive Outdoor Recreation Plan (37).

Table VIII-1

LARGE LAKE RECREATION NEEDS OF THE TRINITY RIVER BASIN

Total Basin Needs 1/	Output of Existing Supply	Remaining Needs
261,036,250 2/	89,651,600 3/	171,384,650

1/ Total basin needs = basin resident needs (257,890,300) + non-resident needs (3,146,100).

2/ Expressed in recreation days.

3/ Existing supply = 38 percent provided by Corps plus 12 percent provided by others.

If all the projects in the Texas Water Plan were developed by 2020, they would provide an additional 23,302,200 recreation days annually.

(3) U.S. Department of Health, Education, and Welfare.

Comment: "Our review of the draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations. We, therefore, have no objection to the authorization of this project. . ."

(4) U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Comment: "The draft environmental impact statement, Aubrey Lake, demonstrates that a very considerable degree of thought and effort has been directed toward a thorough and comprehensive evaluation of the project as proposed, and of the alternatives that offer a reasonable approach to practicability, including that of no action. In the balance, the proposal appears well conceived and we have no additional comments concerning the draft environmental impact statement."

(5) Federal Power Commission.

Comment: "We have reviewed the report to determine the possible effect of the planned improvements on the construction and operation of bulk electric power facilities, including existing and potential hydroelectric developments, and on natural gas pipelines. It does not appear that the proposed improvements would adversely affect the construction or operation of such facilities; therefore, we have no comments on the draft statement."

(6) Environmental Protection Agency.

Comment: "We are classifying your Draft Environmental Impact Statement as Category 3, Inadequate. Our reason for categorizing it Inadequate is the segmented approach of evaluating this project exclusive of the total Trinity River system."

Response: Additional pertinent data concerning the proposed project as related to the total Trinity River system was incorporated in section III, paragraph 2, Hydrological Elements.

Comment:

"Item 2b(3), page III-12, discusses the multi-level water release capability of the dam. However, we could find no mention of specific elevations of the releases nor the projected release volumes or schedule. We believe both these issues are significant in terms of regulating water quality downstream from the reservoir.

"With regard to release volumes, will there be a continuous minimum release or will there be periods of no release? Hopefully, the watershed yield will permit continuous releases, as this would eliminate entrapment of fish and their possible suffocation due to low oxygen levels."

Response: The elevations of the four intake ports of the low flow outlet works have been tentatively set at 617.0, 607.0, 597.0, and 587.0 feet msl. These port elevations may be modified if mathematical model studies of the probable thermal characteristics of Aubrey Lake indicate that better quality water could be obtained by locating them at other elevations. As for the releases from Aubrey Lake, we agree that a continuous release would be most advantageous for the downstream fishery even though intermittent releases would be more natural to this reach of the stream. However, the Corps of Engineers has no authority over the water contained within the conservation pool. Therefore, the volume and schedule of releases from the conservation pool portion of the impoundment will be dependent upon the local interests which hold the water rights to the project.

Comment: "Item 3a(2), page III-14, mentions that man's activity in the project area has reduced the actual forested area to less than 5,000 acres. We assume that most, if not all, of this timber will be cleared prior to operation of the lake. However, we could find no mention of the estimated acreage to be cleared nor the method to be used in the clearing operation. We believe the inclusion of this data would strengthen the statement. Although open burning is permitted under certain circumstances, we strongly suggest that consideration be given to shredding, chipping, or burying non-marketable residue, as the environment should gain more from its decomposition than from it being burned."

Response: The North Texas State University's environmental study of the project area revealed that less than 5,000 acres of native forest remain. A determination has not been made as to how many acres are situated above and below the guide elevation for clearing. However, the exact amount of acres or the specific method of disposal will not be known until the feature design memorandum is prepared. This document will be prepared when project lands have been acquired and the necessary survey completed. Because of the recognized uniqueness of this timbered area, clearing will be limited to that necessary for protection of health and safety.

Comment: "Location of Borrow Areas - We could find no mention of the location of borrow areas nor the estimated volume of material required for construction of the earthen dams. If the borrow areas are located outside the impounding area of the lake, they could have significant impact on the land area around the reservoir."

Response: All of the material to be used in the embankment, estimated to be 14,000,000 cubic yards, will be from borrow areas, estimated to contain 30,000,000 cubic yards of suitable material, located in the flood plain immediately upstream from the damsite and within the area to be inundated. Therefore, there should be no impacts on land around the reservoir from borrow areas, nor should any unsightly areas be created. These borrow areas will increase the volume of the lake.

Comment:

"The impacts of the project as presented in the statement appear to be directed primarily at the effects of the water area and its inundated land area as a separate independent unit. We believe that there are two other specific impact areas which should be related to the project. These are: (1) effects of the project on peripheral development and the effects of this peripheral development on the project, and (2) the cumulative effect of this project on the total Trinity River System.

"Implementation of the proposed project should trigger commercial, residential, and possibly some industrial development around the periphery of this lake. This growth could produce numerous secondary effects, such as increased volume of solid waste, increased number of septic tanks, loss of vegetation, increased runoff, the need for additional highways, and numerous other impacts - both beneficial and adverse - to the environment. In essence, the land area directly and indirectly involved by the proposed project may be two or three times that actually required for construction of the project. We believe the inclusion of these secondary effects is necessary to evaluate total effects of the project on the environment."

Response: Section III, paragraph 4f(1), describes the anticipated adverse effect on the esthetics of a 0.5 mile wide band of land on the periphery of the lake. Paragraph 6c indicates that some destruction of archeological sites could result from development on lands adjacent to the project. Paragraph 8a contains a suggestion for benefiting the baseball camp and retreat should it be relocated adjacent to the lake. Paragraph 9 predicts that nearby towns and communities will economically benefit from the influx of recreationers. Paragraph 10b explains developments that can be expected to take place close to the project. Paragraph 11b explains expected development adjacent to the project. All of paragraph 12 in section III covers several activities and needs expected to arise in the region associated directly and indirectly with the project.

Comment: "The presentation in Section I - Project Description, paragraphs 1-5, would lead the reader to believe that the proposed project plus Lewisville Lake constitutes an individual unit, separate from any other river system or complex. However, paragraph 6, Authorizing Document, page I-8, states that Aubrey Lake is a unit of the comprehensive plan of improvement for the Trinity River Basin, Texas. Therefore, we believe the statement must address the cumulative effects (inter-relationship) of this project to the total Trinity River System."

Response: Aubrey and Lewisville Lakes are designed to operate as an individual unit to provide a very sophisticated system whereby the water resources of the upper Elm Fork of the Trinity River can be captured and manipulated in an efficient and beneficial manner. The Elm Fork is one of many contributors which collectively compose the extensive Trinity River Basin, and only a small portion of the total system. The scope of the Aubrey Lake environmental impact statement does not include evaluating the impact of every individual water resource development project in the Trinity River basin. However, the effects of the existing dams and reservoirs on the annual flows into Trinity and Galveston Bays have been included in Section II, table 4. The net effects of the proposed Aubrey Lake project on water quality and supply in the Trinity River system and the marine organisms which inhabit Galveston and Trinity Bays have been included in Section III. (The effects on water quality of the Trinity River system are included in paragraph 2a(2). The effects on water supply of the Trinity River system are included in paragraph 2b(2). The effects on marine organisms inhabiting Galveston and Trinity Bays are included in paragraph 3c).

Comment: "The proposed Aubrey Lake, in combination with the existing Lewisville Lake, forms a significant water supply system. At similar lakes throughout the region, peripheral development has not been controlled. In some cases (Canyon Lake as an example), the use of septic tanks as wastewater treatment facilities plus other effects of developments has led to water quality deterioration. Therefore, we believe it is of utmost importance for the Corps of

Engineers to encourage local county officials to exclude septic tank construction and use around the peripheral area of the lake."

Response: We have recognized the possibility of the aforementioned developments and their detrimental effects on the quality of water to be impounded. Furthermore, we have grappled with the problem of wastewater and its treatment and disposal for several years at our projects already in operation. Because we know that the quality of impounded water can be degraded by septic tanks located some distance from the project, we will encourage local authorities to continue to take measures and enforce regulations which will help to maintain the continuous high quality of water impounded in Aubrey Lake.

(7) North Central Texas Council of Governments.

Comment: ". . . our staff has reviewed the draft environmental statement for Aubrey Lake, Elm Fork, Trinity River, Texas, and we have no comments on this subject."

(8) Texoma Regional Planning Commission.

Comment: "The primary area of concern which may have a negative environmental impact with relation to the proposed reservoir would be the location of the sewage treatment plant of the City of Tioga, in Grayson County. It is possible that the sewage treatment plant may become inundated during high flood water periods. According to the Environmental Impact Statement, this condition may exist on a once in forty-six year frequency. Adequate information was not available to determine precisely the elevation of the sewage treatment plant. The proposed elevation of the flood control pool of 636.0 above MSL will definitely affect any future sewage treatment plant improvements for Tioga, should the population of the City increase as expected as a result of the close proximity of the proposed reservoir to the City. Special consideration to the quality of effluent discharged from the existing or from a future sewage treatment plant will be necessary in order to prevent any adverse environmental effect when the lake is constructed."

Response: Mr. E. M. Busby, Professional Engineer, Sherman, Texas, who is the consulting engineer for the city of Tioga, Texas, reported that the Tioga wastewater plant is situated at about elevation 650.0 feet msl, with the outfall works located at about elevation 645.0 feet msl. These elevations would not be reached by the lake at full flood control pool, which would be at elevation 636.0 feet msl. It is agreed that future expansion of the plant may be limited because of its being situated on a narrow strip of land between U.S. Highway 377, the Texas and Pacific Railway tracks, and a backwater bay of a tributary to Buck Creek.

(9) City of Denton.

Comment: "We agree with your conclusions that the benefits to be gained from this project will by far outweigh any detrimental effect to the area."

(10) City of Fort Worth.

Comment: "It has been determined that the proposed action will have no negative effects on the City of Fort Worth. The water supply, flood control, recreation, and fish and wildlife conservation resulting from the construction of Aubrey Lake should have a positive effect on the immediate and surrounding areas."

(11) City of Dallas, Dallas Water Utilities.

Comment: "We have reviewed the draft 'Environmental Impact Statement--Aubrey Lake.' It is an excellent report and very comprehensive. The only substantive suggestion we would have is to consider expanding on paragraph 4A(1), Water Supply, page I-3. As you know, the primary interest of the City of Dallas in Aubrey Lake is the increased dependable yield of water for domestic use of the City of Dallas and its twenty-one customer cities which will be generated by construction of Aubrey Lake and its operation in conjunction with Lewisville Reservoir."

Response: The referenced paragraph has been expanded to include the interests of the cities of Dallas and Denton in the Aubrey Lake project, as related to future water supply.

(12) Texas State Soil and Water Conservation Board.

Comment: "We did note one possible oversite in Table V-11, Dallas System Reservoirs and Imports, page V-48. The table indicates that the Dallas Area will have a 119,200 acre-feet deficit in their projected year 2020 annual supply. According to our information, the City of Dallas has contracted with the Upper Neches River Municipal River Authority for a dependable annual yield of 114,335 acre-feet from Lake Palestine. This import is not included in the table. If our information, as reported in the April 1972 issue of 'Water for Texas,' a Texas Water Development Board publication, remains pertinent to the status of the Dallas area water supply, the table should be corrected."

Response: Comment noted. Table V-12 added, and text modified in section V, paragraph 3a(1)(b)2.

(13) Texas Water Rights Commission.

Comment: "The Battelle-Columbus Environmental Evaluation

System (EES), used as a basis for the referenced report, demonstrates without question, the complexity of comprehensive environmental impact analysis, as envisaged by NEPA of 1969 (25). It is evident that the large number of economic, political, social, technical, and environmental parameters used in the EES are susceptible of being weighted differently when reviewed from various competing public needs and interests. The DEIS would be enhanced by including some evidence that the report is not an experimental, one-time simulation or application of an evaluation model. A brief review of results of applying the Battelle-Columbus EES to other projects would help to substantiate the appropriateness of the EES for the Aubrey Lake project."

Response: It is agreed that the requirements of NEPA present a unique problem in that evaluations required are extremely complex and not at present susceptible to reduction to customary monetary units of measurement. The question of subjectivity on the part of evaluators employing the EES was significant to the Battelle-Columbus team that devised the EES and was one of several paramount questions encountered by the Corps of Engineers in its determination of the applicability of the EES to the proposed Aubrey project. This question of subjectivity was also raised by the Texas League of Women Voters and is discussed in detail in the response to their question. The reader is, therefore, referred to that response for a more detailed discussion of subjectivity in the EES.

The question of validation of the EES through previous usage bears directly upon its current developmental status. Since its conception dates only from June 1971, it is implicitly recognized that its present form and methodology cannot at this time be considered the ultimate tool in answer to the broad spectrum of environmental analysis. It is only through knowledge gained from the system's application to real circumstances that this evaluation and refinement will take place. This process may require years or even decades to complete, and this point was clearly recognized by the Battelle-Columbus developmental team in its first report to the Bureau of Reclamation dated 30 June 1971 (51). This report dealt with the conceptual design of the EES, cited several areas of research needs, the most obvious of which was field testing, and contained the following remark in its conclusion: "The art of environmental evaluation is in its infancy and will surely develop in significant steps over the next decade. The EES recommended in this report gives the Bureau of Reclamation a tool with which to apply this art as it exists today." Responding to this need for field testing of the EES, the Bureau of Reclamation commissioned Battelle-Columbus to undertake actual field tests. The results of this field testing are contained in the second Battelle-Columbus report dated 31 January 1972 (9). Two sites were selected for field tests. The following description of these two sites is contained in this second report:

"The Oneida Narrows segment (Bear River Basin in Southeast Idaho) would provide a 435,000 acre-feet reservoir formed by a 315 foot dam. The proposed reservoir would extend 32 river miles upstream from the dam, inundating an existing hydroelectric dam (30,000 kw) and about 1,400 acres of irrigated land in the Gentile and Gem Valleys. The stored water would be distributed by gravity flow through a 75-mile canal to the Cache and Malad Valleys for irrigation and other uses. Additional irrigation service from this water amounts to 88,600 acres.

"The Oneida Narrows Reservoir would also be used to improve the fish, wildlife, and recreation resources of the area. Coulam National Wildlife Refuge would be established in Franklin County, Idaho, on 4,693 acres of land, and the Candie, Twin Lakes, and Newton Reservoirs which are currently being used for irrigation would become potential fishery pools. A trout fishery is also expected below the Oneida Narrows Dam.

"The Honeyville segment (Bear River Basin in Northeast Utah) would have a reservoir with a capacity of 120,000 acre-feet (105,000 acre-feet active) formed by a 76-foot dam. The proposed reservoir would extend 25 miles upstream to the Cutler Power Plant inundating about 3,800 acres of land. The reservoir water would be used primarily to manage the Bear River flow into the Bear River Migratory Bird Refuge. About 68,000 acre-feet would be used on an annual basis in the regulation of the river.

"The reservoir would be used to provide readily accessible water based recreation for the area. Also, a firm supply of 30,000 acre-feet of water annually would be available to satisfy municipal and industrial needs in southern Box Elder County, Utah."

The following conclusions were reached by the Battelle-Columbus team concerning the EES output:

"The results of the Oneida and Honeyville evaluations provide clear insight into the possible trade-offs between beneficial and adverse environmental impacts. This is indicated primarily by whether the difference in Environmental Impact Units between the 'with' and 'without' evaluations is negative (adverse impact) or positive (beneficial impact).

"The EES performed very well in indicating the environmentally sensitive areas in the Oneida and Honeyville segments. This was done through the system of 'major' and 'minor' red flags incorporated in the EES. In the judgment of the research team, no environmentally sensitive areas failed to be keyed out by 'red flags' nor did a 'red flag' appear in any area judged not to be environmentally sensitive.

"The EES performed satisfactorily in indicating data gaps to the research team and to potential decision makers."

The conclusion that the EES would be a useful tool to augment the overall environmental impact evaluation process undertaken for the proposed Aubrey Lake project was based primarily on the similarities of the Aubrey project to the field test projects in both purposes and general physical configurations and on the satisfactory results obtained by the Battelle-Columbus field test team.

Because of the relative newness of this system, published results concerning the experiences with the EES by other users are not readily available. It can only be assumed that the system is presently being employed by others and that their published results will be forthcoming.

Comment: "The DEIS and the project itself would be enhanced if special emphasis were given to the pressing demands generated by the phenomenal population growth and migration trends in the North Central Texas region."

Response: Section II, paragraph 7a, amended to reflect suggested inclusion.

(14) *Texas Water Quality Board*.

Comment: "The discussion of water quality conditions (presented on page II-54) is not acceptable, and it should be broadened to assess . . . :

1. That the algae bloom . . . might result from natural problems . . .

2. . . . the potential of algae bloom in Aubrey Lake;

3. . . . improvements and corresponding quality effects of effluent impounded by the proposed lake should be correlated to the water quality objectives of the FWPCA amendments of 1972 and the construction schedule of the dam."

Response: The referenced discussion in question is limited to a review of existing odors and floating debris within the context of section II of the draft environmental impact statement, which is a description of the environmental setting without the Aubrey project. While it is agreed that algae blooms may result from phosphates and nitrates contained in runoff from agricultural lands or from natural causes, primary reference is made to effluents from sewage treatment plants because, as may be noted in table II-16, cropland, and thus the expected use of fertilizers in the study area, has decreased markedly in recent years and, although the rate may vary, this trend is expected to continue.

While it is agreed that the dispersal of nutrients into Aubrey Lake does not abrogate the potential for algae blooms in the lake, this dispersal will reduce their potential by reducing nutrient concentration. This does not infer the transfer of an algae problem to the lake but, rather, that a reduction of the algae problem downstream from the damsite is anticipated. This premise is within the scope of the environmental impact statement, which is to assess the impacts of the proposed action on the environment. Section III of the environmental impact statement discusses the environmental impacts of the proposed action, and paragraph 2 relates to the impact of the proposed action on water quality. As may be noted in table III-2, the assessment of the impact of Aubrey Lake on water pollution, as made by the North Texas State University employing the EES, reveals a net positive change of 8.20. The summary concludes that water impounded in Aubrey Lake should be well within the U.S. Public Health Service criteria for surface water sources of public water supply. This conclusion is supported by an essentially identical statement contained on page 38 of the Trinity River Authority report (40).

Dam construction is presently estimated to require three years. The actual construction start date depends on Congressional appropriations and therefore cannot be definitely stated at this time. However, if the fiscal year 1975 is assumed to be the earliest feasible construction start date, the earliest completion date would be 1978. For publicly owned treatment works, section 301(b)(1)(B) of the FWPCA amendments of *1972 (PL 92-500)* sets 1 July 1977 as the date by which these plants achieve effluent limitations based on secondary treatment as defined by the Administrator, Environmental Protection Agency, pursuant to section 304(d)(1) of this act. Thus, the primary responsibility for control of sewage effluent pollution in Aubrey Lake lies with the Environmental Protection Agency and the Texas Water Quality Board. The Corps of Engineers will cooperate with responsible Federal, State, and local agencies in the abatement and prevention of all types of pollution at the proposed project. Based on Texas Water Quality Board data, at the present time Collinsville, Gainesville, Lindsay, Muenster, Pilot Point, Tioga, and Valley View may discharge sewage treatment plant effluents into tributary streams of Aubrey Lake under waste control orders. These municipalities are participating in a "self reporting system" by which they report to the Texas Water Quality Board on a periodic basis the concentrations of BOD, suspended solids, chlorine residual, and other parameters as may be required to evaluate treated effluents. Table VIII-2 summarizes the Texas Water Quality Board effluent standards and compliance for these municipal waste discharges during the 12-month period from April 1972 through March 1973.

Table VIII-2

TWELVE-MONTH EFFLUENT COMPLIANCE RECORD FOR MUNICIPALITIES IN AUBREY LAKE WATERSHED

County	Population 1972	TWQB Requirements (Monthly Averages) Max Flow mgd	BOD ppm	SS ppm	Number of Months Requirement Exceeded Flow	BOD	SS
Collinsville	768	0.09	55	60	0	3	6
Gainesville	13,830	1.23	20	20	0	3	4
Lindsay	435	0.08	20	-	0	8	-
Muenster	1,411	0.207	20	-	5	6	-
Pilot Point	1,663	0.09	20	-	0	2	-
Tioga	456	0.09	56	95	0	4	0
Valley View	805	0.04	Currently reporting no discharge				

Both Collinsville and Tioga completed expansion and renovation of their treatment plants in May 1973. Amendments to waste control orders are being processed, and significant improvements are expected. The city of Gainesville is expanding its treatment plant to a capacity of 2 mgd. Completion is planned for January 1974, with improved results anticipated. Lindsay, Muenster, and Pilot Point employ oxidation ponds. The algae growth produced by these ponds makes it impractical for the Texas Water Quality Board to set meaningful standards for suspended solids concentrations. In addition, this algae contributes to widely varying BOD test results. A recently passed industrial discharge ordinance has significantly affected plant effluent at Muenster. While Muenster exceeded its flow allowance for the last five months of the year ending March 1973, the BOD concentration was within required limits in each of these five months. Pilot Point employs land irrigation for a portion of its effluent. It reported no discharge in the third and fourth quarters of 1972, exceeded its BOD allowance in April and May 1972, and was in conformance with its waste control order in January, February, and March 1973. It is, therefore, anticipated that Collinsville, Gainesville, and Tioga, with a total population of 15,054, or 77 percent of the total population of 19,368 in the municipalities discussed, will report significantly improved effluent in 1974 and that the Texas Water Quality Board will continue its efforts to insure that discharges will meet the quality standards required by PL 92-500 (29).

In addition, all point source discharges, including industrial, public, and private discharges, that may exist in the watershed will be controlled by interim permit from the Environmental Protection Agency through the National Pollutant Discharge Elimination System (NPDES) instituted pursuant to sections 402 and 405 of PL 92-500 (29). If findings by the Texas Water Quality Board indicate that private

sewage facilities such as septic tanks cause, or may cause, pollution, the Texas Water Quality Board may delegate regulating power over these types of facilities to the concerned counties under sections 21.083 and 21.084 of the Texas Water Quality Act. Solid waste disposal activities at sites such as garbage dumps, landfills, and auto junkyards are under the individual or joint control of the Texas Water Quality Board, Texas State Department of Health, and the affected counties, pursuant to the Texas Solid Waste Disposal Act of 1969, as amended.

(15) U.S. Department of Transportation, Federal Highway Administration.

Comment: "We suggest that the final environmental impact statement include a comprehensive discussion on what effects the proposed reservoir will have on both the existing and planned highway systems."

Response: Project related effects on existing highways and roads, utility and communication lines, a railroad, and a cemetery were included in section III. Future development of highway systems were not available.

(16) United States Department of the Interior.

Comment: ". . . nowhere in the statement is there a full explanation of anticipated water releases from Aubrey Dam and resultant changes in downstream flow regimen. Land use, fish and wildlife habitat, and recreational activities would be affected. We suggest that comparative flow data be presented and consideration be given to the probable impacts."

Response: We agree that downstream releases would affect many existing environmental elements. The volume and schedule of releases from the conservation pool will be dependent upon the local interests, who hold the water rights to the project.

Comment: "The potential for increased recreational use of the channel between Aubrey Dam and the head of Lewisville Lake after construction of Aubrey Reservoir and the impact on the area should be discussed."

Response: A discussion of this topic has been included as a single purpose fish and wildlife alternative in section V, paragraph 3b(3), Environmental Corridor Between Aubrey and Lewisville Lakes.

Comment: "Recognition also should be given to the reduction in . . . inflow to Trinity Bay . . ."

Response: A discussion of the project related effects on water supply and quality downstream to the Gulf of Mexico is included in section III, paragraph 2, Impacts on Hydrological Elements.

Comment: "It is not clear whether the Environmental Evaluation System (EES) used to evaluate the project included Lewisville Lake or was limited to Aubrey Lake."

Response: The environmental impacts of the proposed project are evaluated for both the proposed Aubrey Lake area and existing Lewisville Lake within the environmental impact statement. However, the Battelle-Columbus EES methodology was incorporated only on the Aubrey Lake area.

Comment: "On page 2 the total land to be acquired is given as 43,500 acres. However, on page III-14 it is indicated that 35,050 acres of land would be required for the site."

Response: The land to be acquired for the proposed project totals 43,500 acres. The number on page III-14 was removed to clarify this apparent discrepancy.

Comment: "The project would provide opportunities for up to 6,240,000 recreation days annually. How was this use determined, and how will it be distributed in point of time and location? . . . further explanation of location, size, facilities provided, and public use capacity of each site would seem warranted."

Response: The estimates of recreational use have been developed using standard Corps procedures for developing such estimates. The method used is contained in Technical Report No. 2 prepared for the Office, Chief of Engineers, by the U. S. Army Engineer District, Sacramento. This method takes into account existing and proposed recreational opportunities, needs based on past and current participation rates, and trends in recreational pursuits.

Optimum visitation is a measure of project capability. It is based on many of the physical and environmental resource factors affecting the project, but must also consider population in the market area, access to the project, and user needs and preferences. Standards for maximum crowding in the project must then be determined to conform with optimum visitation criteria which have been established. For lakes, these standards are keyed to a maximum boat density desirable for the project. A standard of 5.0 acres per boat was chosen as the overall space requirement needed to accommodate a mix of boating activity at the desired density standard. Additional variables are as follows:

Persons per boat - 3

0.5 boat active at one time

Calculations:

25,200 water acres ÷ 5.0 acres/boat = 5,040 boats on lake at one time

5,040 x 2 (0.5 boat active) = 10,080 boats (total boats)

10,080 x 3 persons per boat = 30,240 persons on lake at one time

30,240 x 2 (2:1 ratio of the number of land users compared to the number of water users) = 60,480 design day load

60,480 x 26 weekend days = 1,572,480 summer weekend users ÷ .42 summer weekend visitation rate = 3,744,000 summer visitation ÷ .60 summer visitation rate = 6,240,000 optimum visitation

Many features of a lake site can also affect recreation potential. This figure (6,240,000) is a reflection of the aspect of size, location, sustained ecological balance, and other characteristics of the project, including, but not limited to, topography, soil, vegetation, accessibility, climate, selection of recreation areas, and water quality. A brief summary of these features, except size, which is discussed above, is as follows:

Project location. Aubrey Lake is situated near the densely populated Denton-Dallas-Fort Worth metropolitan area, a region of heavy industrial and commercial development, which has a projected growth rate above the national average. This location provides an excellent opportunity to develop, close to the people, a lake project with a variety of outdoor recreational opportunities.

Sustained ecological balance. Man's influence on the ecosystems of the Aubrey project area constantly changes the balance which exists between components. The presence of wildlife in their natural habitats adds to the local color of the area. The types, amounts, and diversity of vegetation add to or detract from the esthetic quality of the site. It is very important to have an acceptable plant and animal balance. Appendix I to Design Memorandum No. 2, General, sets concepts and policies, which will be expanded during the master plan, regarding the management of both created and natural project resources to provide continued enjoyment and maximum sustained use of lands, waters, and associated recreational resources by the public, consistent with their carrying capacity and esthetic and biological values.

Topography. The Aubrey Lake site is desirable for recreation because its topography will allow recreationists to be at the water's edge. The lake will have sufficient depth for recreational activities, and no large mud flats will be created during periods of drawdown.

Soil. Soil is the basic factor used for determination of land use planning and land carrying capacity. Certain soil characteristics impose slight to severe limitations on recreational development, engineering, and land management. The soil conditions at Aubrey lend themselves to a variety of uses, and it does not appear that any severe limitations exist. The lake should be, for the most part, clear, and the shoreline should not be sticky and muddy.

Vegetation. Vegetation has an influence on the general esthetics of the lake, and the presence of shade producing trees is very important. The Isle du Bois arm of the lake is characterized by medium to dense vegetative cover. The Elm Fork arm has sparse vegetative cover. The heavy vegetation will serve as a natural screening between camp or picnic sites and thus allow for more development without apparent crowding.

Accessibility. Access to the lake is exceptionally good because of the abundance of roads in the area. The recreational potential of the lake is increased because people can easily get to the lake.

Climate. Aubrey Lake is situated in a region characterized by a relatively mild climate. Warm temperatures during the long summer days are favorable for water oriented recreation, particularly water contact recreation. The longer the warm season, the longer the recreation season will be.

Selection of recreation areas. Several variables were analyzed in the selection of the areas for recreation development. These variables include, but are not limited to, the following:

Widest possible distribution of use around the lake.

Maximum accessibility to the water surface at all pool levels.

Potential for multiplicity of activities.

Access to existing roads.

Topography of the area.

Existing vegetation.

Existence of scenic areas.

Degree of shelter for boats, water depths for swimming beaches and boat ramps.

Water quality. Water in Aubrey Lake should be of good quality. The project will support a water environment suitable for a variety of outdoor recreational activities.

Comment: "No evidence is given to support the contention that the initial productivity of the reservoir for fish would be reduced but would subsequently increase. New reservoirs typically are highly productive . . . Later this productivity decreases."

Response: This conclusion was agreed upon and changed as indicated in the comment.

Comment: ". . . give the Bureau of Sport Fisheries and Wildlife credit for having primary responsibility for the management of migratory birds."

Response: Section I, paragraph 5a, was modified accordingly.

Comment: "The sections concerning 'Wildlife Management' and 'Forest and Vegetation Management' appear too general . . . Planning for these management programs should be coordinated with appropriate Federal, State, and local interests."

Response: A Fish and Wildlife Management Plan and a Vegetative Management Plan will be prepared and presented in the master plan for Aubrey Lake. The purpose of the Vegetative Management Plan is to increase the value of project lands for recreation and wildlife, and to promote natural vegetative conditions by providing a protection, development, and management program which is in accordance with accepted conservation and land management practices. The objectives of this plan include, but are not limited to, establishment of vegegation control of erosion, provision of wildlife habitat, screening of unsightly areas, and provision of shade and protection from the sun and wind. The basic objective underlying the development of a fish and wildlife management plan for the project is to provide for the conservation, maintenance, and management of fish and wildlife habitat. This plan would include, but not be limited to, species being managed, short and long range management objectives, and wildlife habitat maintenance and enhancement plans. Specific recommendations from the Texas Parks and Wildlife Department and Bureau of Sport Fisheries and Wildlife were included in section III under Wildlife Management Areas.

Comment: "The statement does not explain the effect of the proposal on two active sand and gravel operations just above and below the damsite."

Response: Both of these sites will be within the boundary of land to be acquired for the proposed project, and therefore will be adversely affected.

Comment: "Does the wetland acreage include areas of this type in the bottomlands downstream of the Aubrey damsite and around the periphery of Lewisville Lake?"

Response: The acreage in the bottomlands downstream of the proposed Aubrey damsite is included in the discussion in section II, paragraph 4a(1). The aquatic vegetation around the periphery of Lewisville Lake is discussed in section II, paragraph 10.

Comment: "A separate discussion of bottomland vegetation is needed."

Response: A discussion of the bottomland vegetation has been included in section II, paragraph 4a(2)(d).

Comment: "The meaning of the hunting estimate of 2,350 man-days is not clear. It seems to indicate waterfowl hunting; however, a figure of 3,000 man-days of waterfowl hunting is given on page III-28."

Response: The figure on page III-28 has been changed to 400 man-days of waterfowl hunting annually, agreeing with the Bureau of Sport Fisheries and Wildlife estimate. The 2,350 man-days of waterfowl hunting is being provided annually at Lewisville Lake, and is not to be confused with the Aubrey Lake estimate.

Comment: "The source of data on commercial fishing at Lewisville Lake should be given. We were not aware that commercial fishing has occurred in this lake within the last several years."

Response: The source of data relating to commercial fishing at Lewisville Lake is the 18 January 1963 fish and wildlife report related to developments proposed by the Corps in its comprehensive review report on the Trinity River and tributaries, Texas. However, the 1973 report regarding Aubrey and Lewisville projects indicates that there is no commercial fishing in the project area, and none is expected during the period of analysis. Therefore, the data on commercial fishing at Lewisville has been deleted from the report.

Comment: "What is meant by the 'present precarious course' of the area fisheries?"

Response: Lewisville Lake supports a fair to poor quality fishery, and since its future condition is dependent upon many different factors or circumstances which for the most part are uncertain, the fishery was described as following a "precarious course."

Comment: "The final statement should contain evidence of contact with the Texas Historic Preservation Officer and include his comments concerning the effect of the undertaking upon historical and archeological resources."

Response: The results of coordination with the Texas State Historical Survey Committee have been included in the environmental impact statement.

Comment: "Page III-5, Table III-1. The basis for specific EIU values in this and succeeding tables is not explained so that interpretation is difficult. The evaluation of aquatic vegetation, for instance, is open to question. We wonder whether the detrimental aspects of aquatic vegetation in a reservoir have been considered. Such vegetation tends to bind nutrients, thus reducing fertility, increases BOD in winter die-off, provides escape cover for fish, reduces fishing area and success, and often is a factor in the overabundance of nongame fishes."

Response: Because the EES developed by Battelle-Columbus is essentially a new tool designed to deal as effectively as possible with many complexities of an ecosystem, it is recognized that the EES may be approached with various degrees of apprehension on first encounter. For this reason, an abbreviated discussion of the mechanics of the EES was included in appendix A. A discussion of the method employed to derive Environmental Impact Units (EIU) begins at the bottom of page A-3. As may be noted in this discussion, each parameter evaluated, including aquatic vegetation, is opened to question and dealt with by means of assigning values for Environmental Quality (EQ) to each parameter evaluated. The assignment of EQ values, although admittedly subjective, results from an onsite evaluation of the particular parameter by an interdisciplinary evaluation team whose members are considered qualified by training and background.

Comment: "The positive EIU value assigned to commercial fisheries is conjectural. There are various legal and economic constraints which suppress commercial fishing and there is no present indication that these constraints will be modified."

Response: Within the context of this comment, it is agreed that the potential for commercial fishing at the proposed project is conjectural for the reasons cited. However, for the purposes of the EES, the term "commercial fisheries" refers specifically to commercial fish species. In assessing the impact of the proposed reservoir on commercial fisheries (commercial fish species), evaluation was based on three sets of data: (a) a list of commercial fish species present in the area, (b) an estimate of the present maximum sustained annual yield, and (c) an estimate of the potential maximum sustained annual yield of commercial fish after the reservoir is completed. Thus, in line with the intent of the EES to evaluate the environmental impacts, an assessment was made of the potential to yield commercial fish species rather than an economic assessment of the impact on commercial fishing. To avoid confusion on this point, the term "commercial fisheries" in table III-1 has been amended to read "commercial fish species."

Comment: "Waterfowl use at Aubrey Lake will be a transfer of use from other areas, thereby decreasing the EIU value of those areas. As waterfowl use at Aubrey will not be 'new' use, no EIU value should be assigned."

Response: By assuming a static waterfowl population, and by assuming the EIU value assigned to waterfowl in table III-1 represents a projected increase in waterfowl numbers at the proposed reservoir, it can be agreed that the premise set forth is valid. However, the EIU value assigned to waterfowl represents an increase in potential waterfowl habitat after completion of the reservoir. Within the constraints of the EES, no attempt was made to predict the actual number of waterfowl that may inhabit the area or their origin.

Comment: "Page III-6, Table III-2. The assignment of a high positive EIU value to BOD should be explained. Intensive public use of the lake could lead to an increase in fertility resulting from the introduction of organic wastes. Unless sanitation measures are strictly enforced, BOD levels in the lake could become undesirably high."

Response: BOD is measured in terms of concentration, and this concentration is expected to be reduced by dilution in the large volume of Aubrey Lake. In addition, the improved quality of effluents from treatment plants at Gainesville, Collinsville, and Tioga, as described in response to the Texas Water Quality Board comment, is expected to improve initial study conditions. Both of these considerations combine to reflect a positive EIU value for BOD in the Battelle-Columbus evaluation procedure.

While it is conceded that the possibility exists, it is difficult to conceive of conditions of public use of the lake water to the intensity necessary to significantly affect its fertility. Intensive use of the land surrounding the lake by private developments and by recreational usage of public areas does pose a potential problem of pollution. The Corps of Engineers will cooperate with responsible Federal, State, and local agencies in the abatement and prevention of all types of pollution at the proposed project. However, the primary responsibility for control of point source discharges of effluents lies with the Environmental Protection Agency and the Texas Water Quality Board, through the National Pollutant Discharge Elimination System instituted pursuant to sections 402 and 405 of PL 92-500 and State waste control orders. If findings by the Texas Water Quality Board indicate that private sewage facilities such as septic tanks cause, or may cause, pollution, the Texas Water Quality Board may delegate regulating power over these types of facilities to the concerned counties under sections 21.083 and 21.084 of the Texas Water Quality Act. Solid waste disposal activities at sites such as garbage dumps, landfills, and auto junk yards are under

the individual or joint control of the Texas Water Quality Board, Texas Department of Health, and the affected counties, pursuant to the Texas Solid Waste Disposal Act of 1969, as amended.

Comment: "We see no relationship between the loss of 106 acres of ponds, stock tanks, and reservoirs, and the future construction of others adjacent to the project area. The building of new ponds also would occur without the project."

Response: Concur. This paragraph has been deleted.

Comment: "Pages III-25 to III-28, Waterfowl. A +4.2 EIU value is assigned to waterfowl and several pages are devoted to the justification of this assumed value. It is contended that the project will lure waterfowl from the Mississippi Flyway because there is a deficit of habitat similar to that which will be provided by Aubrey Lake in the States of Arkansas and Louisiana. No reference is made to other types of waterfowl habitat such as the four million acres of coastal wetlands in Louisiana or the wetlands being improved for waterfowl as a result of continuing and expanding waterfowl management programs throughout both flyways. The conclusion that there is a deficit of habitat in Arkansas and Louisiana seems without basis."

Response: The hypothesis and discussion on the possibility of migrating waterfowl shifting from the Mississippi to the Central Flyway has been deleted.

Comment: "The estimate of 3,000 annual man-days of waterfowl hunting with the project does not agree with the estimated contained in the August 31, 1973, report of the Bureau of Sport Fisheries and Wildlife, which is 400 man-days."

Response: This number for annual man-days of waterfowl hunting has been changed from 3,000 to 400.

Comment: "The effect of the project on wild animals' habitat should be more than moderately adverse considering the inundation of 25,200 acres . . . and the recurrent inundation of another 7,400 acres in the flood control pool. To this loss must be added the impact of concentrated recreational use . . ."

Response: Concur. These effects have been included in the paragraph, Intangible Impact on Esthetics.

Comment: "The third sentence implies that inundation of sites (covering with water and silt) will protect the sites (relatively) from further destruction. Not all inundated sites are covered with silt."

Response: The third sentence of paragraph 6c was revised to read, "Those sites that are covered by silt during the life of the project could be relatively protected from further destruction."

Comment: "The discussion of the impact of recreational use of the area around Aubrey Reservoir is inadequate. The statement should contain more detail on . . . picnic and camping areas. The impacts of construction of roads and use of roads also should be considered."

Response: Section III, paragraph 9, Recreational Elements, states that "Some environmental degradation is expected to occur from the estimated 6,240,000 annual visits to the project. The detrimental impacts would include soil compaction from vehicular and foot traffic, damage to vegetation, possible soil erosion and increased lake sedimentation, and pollution from sanitary facilities and recreational equipment." A vegetative management plan and careful selection of recreational sites are actions which will be taken to limit possible degradation of vegetation and loss of topsoil through erosion. Pollution control must meet State and Federal requirements. All possible efforts will be made to prevent pollution of the lake water from recreational activities. Pollution will be discouraged by (a) education of the public, (b) provision of conveniently located trash receptacles, (c) availability of litter bags for boats, and (d) presence of custodial patrols. A wildlife and fisheries management plan will assure the availability of fish and wildlife habitat.

Comment: "A discussion of the effects of construction of Aubrey Reservoir on recreational use of Lewisville Lake should appear in this section (Section III) and/or Section IV, page IV-5."

Response: Adverse impacts resulting from, or related to, the recreational opportunities available at Lewisville Lake have been included in section IV, paragraph 10.

Comment: "The first sentence should be modified to identify the 25,200 acres as reservoir surface at conservation pool elevation."

Response: The sentence has been revised to read "Construction of the proposed reservoir would inundate . . . approximately 25,200 acres of reservoir surface at the conservation pool level."

Comment: "A systematic survey does not provide protection of archeological resources, but it does provide information which can be used to mitigate the impact on these resources."

Response: The subject sentence was revised to read "Mitigation of impacts on these resources can best be accomplished by conducting a systematic survey . . ."

Comment: "The discussion of mitigation measures to relieve adverse impacts is not adequate. The discussion should include measures to be taken to avoid pollution from sanitary facilities, as this is one adverse impact that can be largely avoided by provision and care of sanitary facilities. The discussion should include more detail on soil compaction, vegetation damage, soil erosion and sedimentation, and measures to be taken to mitigate the impacts."

Response: Mitigation measures for possible water pollution resulting from sanitary facilities include providing sewage treatment facilities based upon the best available, practical, and economical treatment and disposal system that meets Federal, State, and local requirements. Mitigation measures for impacts on vegetation will include a comprehensive forest and vegetative management program. In the recreational areas, trees, shrubs, grasses, and ground cover will be planted as early as possible in order that reasonable growth can occur prior to development for public use. Vegetation that can withstand heavy use will be favored in order to preserve the beauty of the recreation areas. Additional mitigation measures for vegetation and sanitary facility impacts were added to section IV in the paragraphs on vegetation and recreational resources.

Comment: "Adverse Impacts on the Lewisville Lake Project. Archeological sites to be inundated should be listed as an adverse effect."

Response: A paragraph to cover this adverse effect was included in section IV.

Comment: "Page V-5, paragraph (g). This paragraph contains the only reference in the draft statement to pipelines which will have to be abandoned or relocated. These should be described and discussed as appropriate in the sections concerning the 'Project Description', 'Environmental Setting Without the Project', and 'The Environmental Impact of the Proposed Action'."

Response: The specific roads, communication and utility lines, railroad, and cemetery that would require relocation, alteration, or modification resulting from the proposed project have been included in sections II and III.

Comment: "Page V-7, Detrimental Aspects. In this context, 'procrastination' of salvage of archeological resources cannot be considered a detrimental aspect of the no-action alternative."

Response: This sentence was removed from the subject paragraph.

Comment: "Page V-89, Table V-19. The 'No-Action' figure for Amphibians and Reptiles does not seem to conform to figures used for the other elements."

Response: This error was noted and corrected.

(17) Texas Department of Agriculture.

Comment: "We believe an excellent job has been done in the design of this project and in the preparation of the environmental impact statement."

(18) General Land Office, State of Texas.

Comment: "While we have no specific arguments with this project, there is concern with each and every stream impoundment in regard to the overall effect this retention has on the inflow of fresh water to our bays and estuaries. There are presently studies underway which will hoepfully (sic) give us data relating to minimum requirements for our bays. Soon we may be able to speak more directly to this question."

Response: The Corps of Engineers is vitally interested in the results of the mentioned studies and hopes that the data will be useful for future water resources planning.

(19) Texas Parks and Wildlife Department.

Comment: "The 54,600 acres at maximum water surface referenced paragraph 2, section I, . . . appears to be in conflict with figures presented in the summary and on page I-5."

Response: In the initial planning and design stages of the proposed project, hydrological data and computations determined that 54,600 acres at elevation 655.2 feet msl would be flooded during the largest probable rain to fall within the Aubrey watershed, i.e., about 28 inches of rain in 48 hours. The probability of a rain of this magnitude is very remote; however, it would flood this additional area above the flood control pool elevation of 636.0 feet msl because more water would be entering the watershed than could escape through the 100 foot wide spillway. To aid in reducing the "apparent conflict" between amounts of land, the sentence in section I, paragraph 2, was revised to read "The maximum design water surface area for the proposed project was determined to be 54,600 acres at elevation 655.2 feet msl." The summary figure of 25,200 acres is the lake surface acreage at the conservation pool elevation of 627.0 feet msl. The 43,560 acres in section I, paragraph 4b, is the total number of acres to be acquired by the Federal Government for all purposes of the Aubrey project.

Comment: "The topic in Section I of the initial reduction in fish productivity needs more discussion."

Response: The statement of reduced productivity has been determined to be inaccurate and has been deleted.

Comment: "Section I, paragraph 5b. Consideration should be given to the establishment of native vegetation on those areas where heavy visitation is not expected."

Response: Some of the same sentiments are expressed in section III, paragraph 3a(2).

Comment: "Page II-50, Paragraph b, Waterfowl Species. The presence of a nesting woodduck population should be noted."

Response: Concur. This particular species has been included in the discussion.

Comment: "The second sentence of Section II, paragraph 11h(3) should be revised to include, '. . ., and damages resulting from floods will likely increase if unrestricted urban development in flood plain areas continues.'"

Response: Concur. The sentence has been revised.

Comment: "To imply that the inundation of thousands of acres of agricultural land and wildlife habitat can be construed as an environmental improvement is, indeed, subject to question."

Response: Resource development is generally based on a system of "trade-offs" whereby some elements of the environment are reduced in quantity to increase the quantity of others. Very seldom is any one element completely lost. In this case, some agricultural land and wildlife habitat are traded for an increased amount of water necessary to sustain all organisms and maintain the existing and predicted standard of health and happiness.

Comment: ". . . the background information which would permit a specific critique (of the EES) could only be obtained under a system of close coordination where the Department has representation during the early stages of plan formulation. . . . We do, however, strongly criticize the lack of timely coordination of this matter with the Department . . . To insure that all interests are provided an opportunity to be heard, it is imperative that organizations having professional expertise in the areas of concern and representing a broad spectrum of interest be included in the formulation of such evaluations."

Response: The use of the Battelle-Columbus Environmental Evaluation System on the Aubrey project was an experiment to determine if it could be utilized to display the environmental elements of a water resource project in the north central Texas area. This

experimental study was contracted to the Institute for Environmental Studies at North Texas State University, Denton, Texas. The institute was selected because it is located in the general vicinity of the project, it had access to the expertise needed to make the evaluation, and it could be as objective as any other evaluator.

Comment: "The discussion (in Section III, pages 25-27, paragraph C) referring to a shift in waterfowl populations from the Mississippi River Wetlands should be omitted, unless specific information documenting this assumption can be provided."

Response: This discussion has been deleted from the final environmental impact statement.

b. Nongovernmental entities. The coordination requirements set forth in Public Law 91-190 (25), state that copies of draft environmental impact statements will be made available for comment to certain institutions and individuals. In accordance with these guidelines, those institutions and individuals having expertise or interest in any and all aspects of the proposed project were asked to review and comment on the accuracy of the information contained in the statement. The comments received have been reviewed and evaluated, and, where applicable, incorporated in this statement. The views of the groups or individuals replying are included below, and copies of their letters are incorporated in this section.

(1) Sierra Club, Lone Star Chapter.

Comment: "We urge that hydrological data on the impact of the proposed project on the estuaries of Galveston and Trinity Bays be obtained, and included in the Final Statement."

Response: Project related effects on water quality and supply in the area downstream from the proposed project to the Gulf of Mexico have been incorporated in section III.

Comment: "We urge that an adequate Archeological exploration be conducted, and the results included in the Final Environmental Statement."

Response: Further archeological explorations will be encouraged and conducted by qualified scientists. This is assured by Executive Order 11593, "Protection and Enhancement of the Cultural Environment," and Federal laws. Because of the scope of work, and the work schedule of the National Park Service, a comprehensive archeological exploration and salvage program will not be accomplished until it is definite that the project will be constructed. Additionally, many archeologists prefer that sites be left undisturbed until the last possible moment because the methodology of salvaging and

preserving archeological resources is continually becoming more sophisticated, enabling more data to be obtained from each site.

(2) Trinity Improvement Association.

Comment: "The optimum project, as proposed, would produce the greatest positive impact and benefits."

(3) Southern Methodist University, Department of Anthropology, Archaeology Research Program.

Comment: "The Draft Environmental Impact Statement for Aubrey Lake includes a balanced approach to the archaeological resources which will be affected by the Aubrey Lake project. . . the necessary studies of the nonrenewable evidence of man's past contained at Aubrey Lake will be recorded and preserved through the coordinated efforts of all agencies involved with the project."

(4) North Texas State University, Institute for Environmental Studies.

Comment: ". . . since most of our comments concern style, and there are no apparent conflicts with our report, we can make no serious criticism of the draft."

(5) Denton County Historical Survey Committee.

Comment: "We are very anxious to see that historical markers are placed at appropriate places so that the historical significance of cemeteries and old abandoned communities might not be lost."

Response: The Corps of Engineers will work closely with agencies and groups interested in the history and archeology of the area to assure that significant items and sites of historical events are marked and recorded for posterity.

(6) Texas Archeological Society.

Comment: "The section Possible Sites, page II-66, concerns the early man material found at the Lewisville Site during its construction. I would like to see a little more emphasis placed on the possibility of similar sites being in the Aubrey Lake construction area. Also, cooperation of the Corps in allowing reasonable time for excavation if such deep sites are found during construction."

Response: The following sentence has been added to section III, paragraph 6c: "Because of the significant archeological finds uncovered during excavation activities connected with construction of Lewisville Dam and the possibility of uncovering similar finds in the proposed Aubrey Dam area, care will be exercised during

excavation operations at Aubrey Lake to bring any material suspected of being of archeological value to the attention of qualified archeologists for evaluation and salvage."

Comment: "In Appendix F and G the same site designation numbers appear to be allotted to different sites, ie. sites designated as 41DN4 through 15 seem to be assigned to sites both in the Aubrey and Lewisville Lake areas."

Response: In section III, paragraph 6b has been extended as follows: "Sites designated as 41DN4 through 41DN15 in this appendix are not to be confused with the sites in appendix G carrying identical designations." Also, in section III, paragraph 14e, the following sentence was added: "Sites designated as 41DN4 through 41DN15 in this appendix are not the same sites carrying identical designations in appendix F."

(7) League of Women Voters of Dallas.

Comment: "Some information is given concerning water needs and possible sources for Dallas and its customer cities; however, it is not made clear whether all of the water supply from Aubrey will be allocated to Dallas."

Response: Tentative agreements allocate 74 percent of the water supply storage from Aubrey Lake to the city of Dallas and 26 percent to the city of Denton.

Comment: "'The proposed Aubrey Lake would develop an estimated dependable yield of 67.2 mgd under 1985 conditions, and 60.1 mgd at year 2085 conditions.' (pp. V 59-61)"

Response: This data was incorrect. It has been corrected to comply with previous statements of 84 and 75.6 mgd, respectively.

Comment: "While such proposals as the Elm Fork and Trinity River greenbelts are not viable alternatives to Aubrey Lake, since they lack the water supply component, we hope that they will be considered in preparation of future Corps proposals for the watershed."

Response: A similar proposal is discussed as a single purpose fish and wildlife alternative in section V entitled "Environmental Corridor Between Aubrey and Lewisville Lakes."

(8) Texas Committee on Natural Resources.

Comment: "The Corps Draft Environmental Impact Statement. . . is curiously circumspect with regard to the destruction of flora and fauna within the zone of the lake. For instance, at several

points within the statement, sections containing comment on the biological effects of the project literally dismiss the importance of preserving 'mammals rare to this area, but common in the rest of the United States.'"

Response: In the sentence referred to, the phrase "in occurrence" following the word "rare" was inadvertently omitted. When the study team from the Institute for Environmental Studies at North Texas State University made a summary of the mammals present in the project area during the study period, they termed 9 of the 26 species encountered "rare in occurrence." In any defined area, certain mammals will be sighted less often than others because their position in the ecological pyramid or the suitability of the habitat may limit their numbers. Appendix D and the sentence in section II, paragraph 4b(4)(b), have been revised accordingly.

Comment: "Also conspicuously prominent as a detrimental factor is the manipulation . . . of the East Cross Timbers Physiographic Region. This unique ecosystem has already been decimated, and further action could forever remove what must be considered as a special element of the environment."

Response: In section III, paragraph 3a(2), there is a discussion of the loss of a portion of the East Cross Timbers. It states, in part, " . . . establishment of areas around the reservoir which are restricted from certain uses such as grazing, indiscriminant cutting, and vehicular traffic will permit restoration and preservation of some of the unique forests of this area, and will make them available to more people in the future." Although the project will cause the loss of a portion of this area, the area remaining can be preserved through proper land use planning and management. Taking no action at all - not constructing the project - would not automatically insure preservation of this area since it is contained within many private landholdings. Thus, no single land use policy can be expected to prevail, and it is likely the landowners may have other uses planned for these areas.

Comment: "In the Statement much is made of the fact that the proposed lake may possibly serve as a way station for migratory waterfowl venturing through the Central Flyway. Yet only the most tenuous kinds of evidence exist to justify this position."

Response: We have no way of ascertaining that Aubrey Lake will attract migratory waterfowl. We can only state that with the presence of available water, the possibility exists that Aubrey Lake could be used as a rest area and could "shortstop" a percentage of the waterfowl during north and south migrations. The discussion on the possible shift from the Mississippi to the Central Flyway has been deleted.

Comment: "Significant interest in the archaeological resources of the proposed area of inundation exists . . . Yet, apparently, no archaeological organization has been able to mount a full field survey of all of the identified sites, nor have efforts been made to identify further sites. Surely, the destruction of such a large number of sites, without proper evaluation, cannot be shrugged off so easily as is done in the Statement."

Response: The question of further evaluation and salvage of archeological resources in the Aubrey Lake area is addressed in the response to the comment from Mr. Bob Turner of the Texas Archeological Society. Also, the protection which will be afforded archeological resources, and the process which will be followed in evaluating and salvaging them under Federal law and Executive Order 11593, "Protection and Enhancement of the Cultural Environment," are discussed in reply to a comment by the Lone Star Chapter of the Sierra Club. Basically, further archeological explorations will be encouraged and will be conducted by qualified scientists when it is definite that the project will be constructed.

Comment: "Immediately, however, we can fear for all of the 'positive aesthetic benefits' mentioned in the Draft Statement, for uncontrolled development around Aubrey Lake may utterly denigrate these positive values. Unstructured development on and around the shores of the reservoir might well lead to clutter and unacceptable population density."

Response: The land bordering Aubrey Lake and extending landward to the guide taking line will be administered under the operation and maintenance program of the Corps of Engineers. This program contains strict guidelines for land use management and development. The State of Texas does have a law which requires the setting of septic tanks and leaching fields a distance away from a water supply impoundment. The distance is determined by the percolative qualities of the soils into which the tank and field are to be constructed. Through enforcement of this regulation, the degradation of the good quality Aubrey Lake water would be minimized. In addition, all point source discharges, including industrial, public, and private discharges, that may exist in the watershed will be controlled by interim permit from the Environmental Protection Agency through the National Pollutant Discharge Elimination System (NPDES) instituted pursuant to sections 402 and 405 of PL 92-500. If findings by the Texas Water Quality Board indicate that private sewage facilities such as septic tanks cause, or may cause, pollution, the Texas Water Quality Board may delegate regulating power over these types of facilities to the concerned counties under sections 21.083 and 21.084 of the Texas Water Quality Act. Solid waste disposal activities at sites such as garbage dumps, landfills, and auto junkyards are under the individual or joint

control of the Texas Water Quality Board, Texas State Department of Health, and the affected counties, pursuant to the Texas Solid Waste Disposal Act of 1969, as amended.

Comment: "The language of the system is used to impute quantitative values to essentially qualitative kinds of aesthetic values. In general, these values with reference to the Aubrey project are in no way adequately explained by the Environmental Evaluation system."

Response: Esthetic values are intangibles. Their qualities and quantities are evaluated on the basis of the observer's previous sensory perceptions, education, and sensitivity. Therefore, it is understandable that it is difficult to arrive at the same evaluation of the proposed project's esthetic values in quantitative terms.

Comment: "Speculative recreational and commercial use has wreaked havoc at several other Corps lakes in the area."

Response: The general observation that speculative recreational and commercial use has wreaked havoc at several other Corps lakes (also non-Corps) in this area is correct. This recognized fact has been, and is, of continuing concern to the Corps and other agencies having responsibility for control and maintenance of surface water impoundments available for use by the general public. In section III, paragraph 3a, of the statement, the potential adverse or negative impact on natural terrestrial vegetation is recognized. It is pointed out that areas around the reservoir will be restricted to prevent deterioration through general abuse, overgrazing, indiscriminant cutting, and vehicular traffic in an effort to preserve and restore the unique timber and other vegetation of the area. In section III, under Recreational Elements, additional discussion is directed toward environmental degradation which is expected to occur to vegetation from foot and vehicular traffic from the more than 6 million estimated annual visits to the project.

Comment: "Understandably, many social interactions to be found within the lake area will be uprooted and destroyed. To gratuitously alter a human community is never to be treated so lightly as in the Statement."

Response: In section II, paragraph 7, social interactions are discussed in detail, together with descriptions of existing churches, schools, and transportation routes in the area and the impact of Aubrey Lake construction. In section III, specific impact information is presented on social and cultural elements, as determined by the field surveys and investigations completed in the area. Information presented in paragraph 8 covers the project related impacts of social interactions expected to be uprooted or destroyed by the lake.

Comment: "To construct the lake is also to alter the economy of the area. Agriculture and commercial activities will probably be replaced by recreationally oriented endeavors . . . Care needs to be taken so as to not underestimate the potential of present economic use or to overestimate future income to be derived from the project. . . Also, more information needs to be drawn up concerning future economic benefits which will offset the projected loss of income forecast due to inundation of productive lands and commercial establishments."

Response: The observation that construction of the lake will alter the economy of the area is consistent with results of this district's studies from which information is presented in the various sections of this statement and throughout its companion document, the general design memorandum. Evaluation of the economic effect of the proposed lake includes calculations of the monetary value of net income lost on lands to be inundated. This value constitutes a negative project benefit. It is compared with the annual value of the estimated cost of lands and the larger amount used as a cost of the project to insure conservatism in the economic evaluation. Estimates are not made of future income derived from recreationally oriented endeavors which are expected to replace some existing agriculture and commercial activities.

While these activities will contribute to the altered or transformed economy of the area, they, in the main, are secondary in nature and are restricted from use in determination of economic justification of the project. Consequently, treatment of these types of potential economic effects, either induced by or stemming from the project, is limited to recognition in descriptive terms, based on experience from similar developments. Evaluation of primary benefits expected to accrue from the project purposes of water conservation, recreation, and fish and wildlife are summarized in table I-2.

(9) National Wildlife Federation.

Comment: "Is there a Master Plan relative to the water supply for the area or is the planning piecemeal?"

Response: There are several long range water supply plans in existence, e.g., plans of the city of Dallas, the Water Rights Commission, the North Central Texas Council of Governments, and the Trinity River Authority.

Comment: "At a time of energy insufficiency we feel that recreation such as sport motor boating and extensive recreational travel by air polluting automobiles should be curtailed."

Response: Concur. This position advocates the necessity for providing recreational opportunities such as Aubrey Lake. Located very close to the metroplex, Aubrey Lake would aid in limiting travel time and reducing fuel consumption.

Comment: "The Aubrey Lake plan, if implemented, would give the 'kiss of death' to existing stream fisheries or future stream fishers of the system."

Response: The joint operations of Aubrey and Lewisville Lakes for downstream needs could require frequent releases from Aubrey Lake. These releases, together with sediment reductions below the dam and in Lewisville Lake, would improve the fish habitat in both areas. Water releases from Aubrey Lake will attract and concentrate fish in the discharge channel and stilling basin.

Comment: "We fail to find evidence that the sister impoundments are quality fisheries and cannot conceive of the Aubrey Lake being any different."

Response: Lewisville Lake supports a fair to poor quality fishery and receives approximately 650,000 visitations annually for fishing. Initially, Aubrey Lake would produce mainly game species, and intensive fishing is anticipated. In time, both the game species and sport fishing success would be reduced. Most of the fishermen from the Dallas-Fort Worth-Denton area who now fish in Lewisville, Grapevine, Lewisville, and Texoma Lakes would use Aubrey Lake. An estimated 500,000 man-days of fishing annually would occur.

Comment: "The draft does not give sufficient statistical data to support the assumption that capping of wells in the Toledo Bend Reservoir is totally reliable."

Response: It is not our belief that any statistical data would be sufficient to prove the capping of wells will be "totally reliable." We do believe, as stated in the report, that it is highly unlikely that any oil seepage will occur and that all of the wells that would be inundated will also be capped and plugged in accordance with the regulations and specifications of the Texas Railroad Commission.

Comment: "As a group we challenge table II-5. There is too much of a lack of clarity and substantiation for us to be in agreement. In fact, we question the validity of the tables in general."

Response: The data in table II-5 are used to demonstrate the fact that the average evaporation rate is usually higher in the summer months when compared to winter months. We fail to understand the reason for challenging this fact and/or table, or any other

table in the document, for lack of clarity or substantiation. The accompanying explanation, paragraph 3c(2)(e), section II, includes the sources and methods used for estimating the average net annual evaporation loss. Furthermore, the data in table II-5, and all other tables, can easily be substantiated from the records, reports, literature, etc. from which they were computed or taken.

Comment: "We sincerely feel . . . that the best alternative would be NO ACTION!"

Response: The "no action" alternative would not provide a dependable water supply, which is an authorized purpose that should be recognized as an integral part of the selected alternative.

Comment: "Paragraph 3a states that 84,000,000 gallons of water per day will be available for municipal and industrial uses. There is no data in the proposal that demonstrates the need for this amount of water."

Response: A detailed outline, section II, paragraph 11h(1), on the Dallas long range water supply demonstrates a water deficit of 134 mgd by the year 2000.

Comment: "We find insufficiency of evidence to support the 6.24 million recreation user-days per year. For one thing there will only be 11 sites developed and further one cannot expect quality recreation at the maximum number. People leave a city to escape a crowd and not to join one or else they attend a carnival."

Response: The estimate of recreational use for Aubrey Lake is based primarily on the anticipated recreational activities of the people within the market area (i.e., the geographical area from which 80 percent or more of the day-use would originate), their needs for outdoor water oriented recreational experiences, and the resources available to meet these needs. Determination of recreation needs was based on current and projected participation rates. Table VIII-3 presents data on projected unsatisfied recreation needs for the market area.

Table VIII-3

PROJECTED UNSATISFIED RECREATION NEEDS
(in annual recreation-days)

1980	1990	2000	2010	2020
3,432,551	5,105,540	7,158,338	9,645,353	12,593,418

On the basis of experience at other projects, it is obvious that the Aubrey project would not have the capacity to accommodate visitation of this magnitude indicated for the market area without resource deterioration. Therefore, optimum capacity for the lake,

6,240,000, was based on an analysis of the aspects of size, location, sustained ecological balance, and other characteristics of the proposed project. In the final analysis, Aubrey Lake would not only reduce overcrowding, but would fulfill many of the unsatisfied recreation needs and provide a better variety of recreational activities as well.

Comment: "We also feel that pollution control at the 11 recreational sites has been skimmed over."

Response: Pollution control at all Corps of Engineers lakes must meet State and Federal requirements. All possible efforts will be made to prevent pollution of the lake water from recreational activities. Pollution will be discouraged by (a) education of the public, (b) provision of conveniently located trash receptacles, (c) availability of litter bags for boats and recreational vehicles, and (d) the presence of custodial patrols.

Comment: The NEPA statement draft does not answer many questions about the existing impoundments in the area. Are the available recreation use days utilized? How well?"

Response: There are millions of people using the current lakes and facilities which are available in the market area. The Corps of Engineers is the largest supplier of water oriented outdoor recreation resources in the market area, with lakes totaling 141,060 surface acres at their normal recreation pools. Municipal water supply lakes constitute another 51,947 surface acres. Most of the Corps of Engineers lakes are approaching or exceeding optimum visitation, based on present recreation development. Lakes constructed by agencies other than the Corps of Engineers have made only limited provisions for recreational development.

Comment: "If Aubrey Lake were to be constructed, how many miles of streams would remain to be utilized recreationally?"

Response: About 65 miles of the Elm Fork and numerous miles of smaller tributary streams would remain to be utilized for recreational purposes.

Comment: "We further suggest that surface water use conflicts, such as frictions between fishermen, swimmers, boaters and water skiers have not been considered."

Response: A water use plan will be prepared and presented in the master plan for Aubrey Lake. The objective of the plan will be to minimize safety hazards while allowing maximum utilization of all water areas available. The plans will indicate low speed areas, uncleared areas, shallow areas, low pool hazards, and restricted areas.

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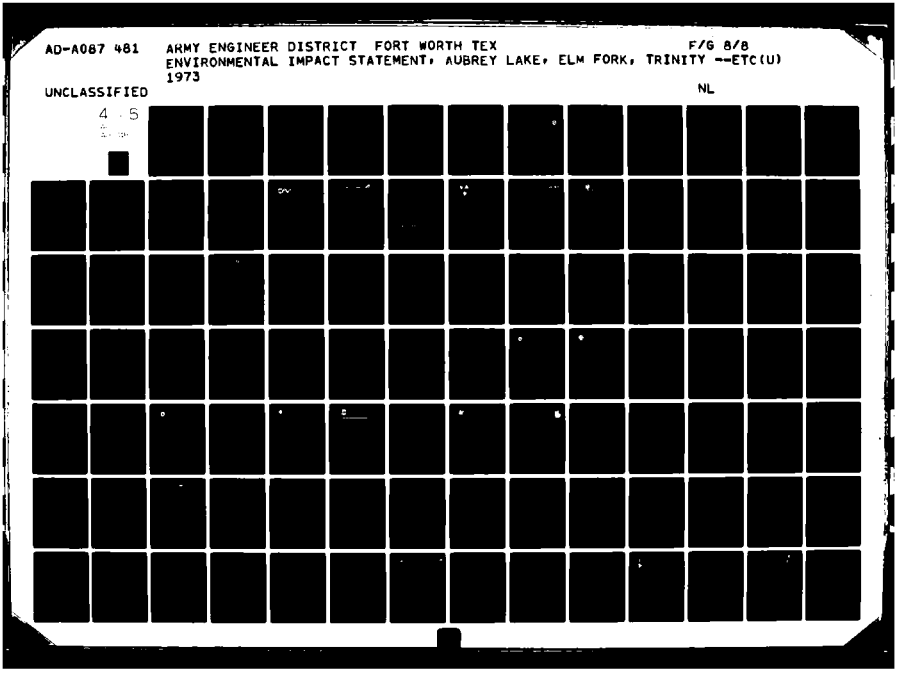

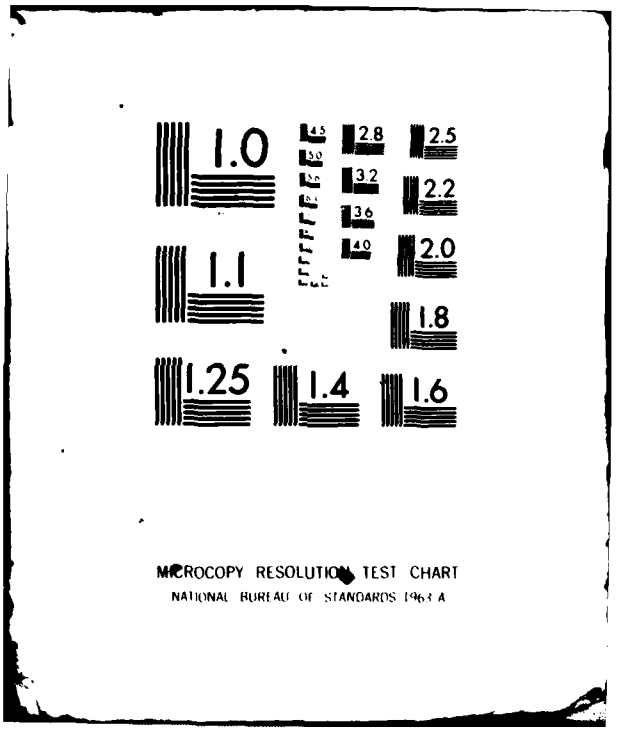
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NATIONAL BUREAU OF STANDARDS 1963 A

(10) League of Women Voters of Texas.

Comment: "Could the stated purposes of water conservation and recreation be as well or better served by using one of the alternative plans which meet all of the authorized purposes? We feel the public needs additional detailed information on the alternative plans."

Response: If the stated purposes could be as well or better served by one of the alternative methods with the same or lesser degree of adverse social, economic, and environmental impact, that alternative would have been selected. Evaluation of all known and reasonable alternatives to the Aubrey project was presented in section V. The evaluation of each alternative included all known details, presented the benefits and detriments of the alternative, and stated the reasons for selection or rejection of the alternative. Had a more usable alternative been discovered, this fact would have been included in the impact statement.

Comment: "Would not sufficient water supply be available to the Dallas-Fort Worth metroplex growth areas by using the small impoundments alternative even though the projection indicates that the first cost might be slightly higher and the MGD factor slightly lower? Projections of population growth for the next few decades change daily, often with some indication of a tendency toward slowing growth. If this trend is predictive, would not the alternative which considers several small impoundments built over a longer period of time be more flexible and responsive to change? Even if a slow-down in population growth does not materialize, a recent Dallas League of Women Voters study has indicated that the Dallas area has a sufficient water supply for the projected population through 1995."

Response: Current data presented by Forrest and Cotton, Inc. (12) indicates that "The supply available through existing supply facilities will be adequate to 1980." Data presented in this report, section II, paragraph 11h(1), indicates that Dallas anticipates a water supply deficit of about 134 mgd by the year 2000. Reduction of the Aubrey supply by 12.6 mgd, as projected in the Small Upstream Watershed Projects alternative, section V, paragraph 2b(3), will aggravate this deficit, and presently there is no assurance that this 12.6 mgd deficit could be replaced under more desirable cost and environmental conditions. Additionally, a slowdown in population growth doesn't necessarily coincide with a slowdown in water use or consumption. Also, the small impoundment alternative would convert more stream associated habitat to lake associated habitat than the Aubrey project, with a larger quantity of both aquatic and terrestrial flora and fauna suffering from the presence of the multitudes of visitors expected to recreate around the smaller lakes.

Comment: "Would the conservation pool level at Lewisville Lake be raised less than the proposed 7 feet if one of the alternative plans were chosen? It appears from the draft that the Aubrey Lake project would inundate an additional 6,400 acres by raising the Lewisville Lake level. If any one of the alternative plans was used, would the Lewisville Lake need to be raised 7 feet? If not, what increase in pool level would you estimate for each of the alternative plans, and how many acres would be additionally covered with water under each alternative plan?"

Response: As noted in section I, paragraph 3, Aubrey and Lewisville Lakes are planned on an exchange of storage basis to provide the same degree of flood protection as that presently afforded by Lewisville Lake. Thus, a portion of the presently required flood storage capacity in Lewisville will be shifted to Aubrey, and this Lewisville flood capacity will then be employed for water conservation. The setting of the conservation pool levels and flood storage capacity for each reservoir involves trade off computations designed to maximize the storage capacities and minimize the land areas affected. The raising of Lewisville Lake's conservation pool to 522.0 feet msl and inundation of 6,400 acres of flood pool represented the optimum trade off. The adoption of other alternatives to the Aubrey project, such as no action or water importation, would permit the present level of Lewisville Lake to remain unaffected. Selection of an alternate damsite would not significantly affect the proposed 7 foot pool raise. Since less of the watershed above Lewisville Lake would be controlled by implementation of the four small impoundments alternative, a somewhat larger flood storage capacity would be required in Lewisville Lake.

Comment: "Would not the inundation of the 460 acres of land and 43 miles of streams which seemed to be indicated in the draft to be the projected result of building the small impoundments alternative construction be a viable trade-off if fewer than the 90 families scheduled to be relocated under the present plan could be required to disrupt their employment, shopping, social, and cultural activities?"

Response: Basing a determination of the desirability of one alternative over another on three isolated parameters to the exclusion of all other considerations would be open to question on the basis that the evaluation procedure was incomplete, that the determination reached was subjective, and that the requirements by NEPA were unfilfilled. Thus, all known beneficial or detrimental factors relating to a given alternative must be considered.

Comment: "Would any or all of the 26 prehistoric and historic archeological sites and the assorted buildings and cemeteries of historic interest be saved under any of the alternative plans mentioned? More detailed information would be helpful in evaluating

this potential saving of irreplaceable sites and artifacts. It seems that a very low PIU (parameter importance unit) numerical rating of these various alternative plans. There also seems to be very little supportive information explaining how you evaluated the information used to abstract the environmental factors into the hierarchial EES (environmental evaluation system) which used the PIU value system evolved from the Battelle-Columbus report. It seems inevitable that there will be many subjective evaluations in assigning numerical values in these complex formulas to the factors mentioned in this question."

Response: As noted in table 1 of appendix G, the publication of the exact location of archeological sites has been deliberately avoided in order to prevent improper use of such information. Improper use of this information generally results in indiscriminate destruction of sites by lay artifact hunters. This does not, however, preclude the acquisition of more precise site information from other informed sources by parties with genuine scientific interest and adequate background in requisite disciplines.

The question of subjectivity or bias on the part of individuals participating in evaluations required by the EES was one of the significant concerns of the Battelle-Columbus team that devised the EES. Their final report (51) included the following comments:

"The subject of weighting or ranking of environmental parameters is sure to be controversial. Since it is impossible to develop a completely objective ranking, many would argue that no weighting system at all should be developed.

"The successful evaluation of environmental impacts does require, however, some expression of the relative value or severity of these impacts. Thus, the Battelle-Columbus project team has provided a ranking system which it feels reflects its best judgment at this time. There is no question, however, that further development of the system, field testing, and inputs from the Bureau (of Reclamation) will be necessary to provide a more universally acceptable ranking system."

A comparative review of the similarities between the types of Bureau of Reclamation projects for which the EES was designed and the Aubrey project concluded that the EES was acceptable and applicable to the Aubrey project. To avoid possible contentions of bias, the actual evaluation process was assigned to North Texas State University. To further insure objectivity and repeatability, North Texas State University, as noted on page A-3, retained the values assigned by the Battelle-Columbus project team.

In the Battelle-Columbus team procedure for developing parameter weights for the EES, the relative importance of the parameter

was expressed in commensurate units (PIU) by quantifying several individuals' subjective value judgments. These individuals represented diverse disciplines and included ecologists, landscape architects, social scientists, and engineers. The weighting technique used was based on sociopsychological scaling techniques and the Delphi Procedure. These two methodologies were used to produce a technique that, in general, is systematic in nature, minimizes individual bias, produces consistent comparisons, and aids in the convergence of judgments. Technical discussions of the sociopsychological scaling techniques and the Delphi Procedure may be found in the literature cited in the Battelle-Columbus report (51).

Comment: "Would not the recreational and sports fishing purposes discussed in the draft as well as the factors mentioned in question #5 be as well or better served by choosing the alternative of several small upstream impoundments? It would seem that this alternative might better serve the recreational purpose and also increase the esthetic value of the areas involved as it would probably result in more shoreline, more remaining trees, more good fishing and camping areas, and more interesting views and vistas than would the inundation of one large area."

Response: The premise suggested, although subjective in nature, may be well founded. However, it does not take all factors into consideration. When all benefits and detriments to this alternative were considered, it was concluded that detriments outweighed benefits and the alternative was rejected as stated in section V, paragraph 2b(5).

Comment: "Would any of the alternative plans serve the stated purpose of flood control better than the Aubrey Lake project? It seems from the impact statement that Aubrey Lake is not considered necessary for flood control; therefore, it would be helpful to know if any of the alternative plans would serve this purpose."

Response: Flood control is presently achieved by Lewisville Lake. As explained in the reply to question 3, Aubrey will share a portion of the flood control function presently performed by Lewisville Lake. It is anticipated that the present degree of flood protection will be maintained with or without the Aubrey project, or with or without any of the possible alternatives.

(11) Advisory Council on Historic Preservation.

Comment: ". . . the Corps of Engineers . . . should locate, inventory, and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under the agency's jurisdiction or control that appear to qualify for listing on the National Register of Historic Places."

Response: A meeting was held with the Denton County Historical Survey Committee on 2 July 1973 to discuss the procedure necessary for the restoration and preservation of the Hammons' house described in section II as architecturally unique for the area. Since the time of this meeting, the necessary paper work should have been submitted to qualify this house for listing on the National Register of Historic Places. Our present intent is to relocate this house and ancillary structures, but to what specific site is still as yet undetermined.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P. O. Box 648
Temple, Texas 76501

July 30, 1973

Colonel Floyd H. Henk, District Engineer
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Floyd:

We have completed our review of the draft environmental statement for Aubrey Lake, Elm Fork, Trinity River, Texas which was transmitted to us in a letter dated July 23, 1973.

The environmental statement very adequately describes the environmental impact of the proposed project as well as containing measures to minimize adverse effects.

We feel this statement represents a commendable effort to carry out the letter and intent of Public Law 91-190.

We appreciate the opportunity to review and comment on this draft statement.

Sincerely,

J. B. Leath For
Edward E. Thomas
State Conservationist

cc:
Dr. T. C. Byerly, Office of the Secretary, USDA, Washington, D. C.
Kenneth E. Grant, SCS, Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
Atlanta, Georgia 30309

8420 August 17, 1973

Floyd H. Henk, Colonel
Corp of Engineers
Department of the Army
P.O. Box 17,300
Fort Worth, Texas 76102

Dear Colonel Henk:

The review has been completed for the draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas. Richard McHenry, River Basin Specialist and Nathan Byrd, Resource Specialist of the Resource Use and Management Unit of the Southeastern Area, State & Private Forestry have the following comments:

The subject environmental statement adequately describes the proposed project's impacts on forest resources.

Page I-6, refers to forest and vegetation management and the technical assistance offered by the Soil Conservation Service. We are pleased to learn of this arrangement. The author may also wish to refer to the Resource Protection and Environmental Improvement Plan for the Optima Lake Project. Some concepts of the Optima Lake plan may apply to this project, particularly that part concerning tree establishment.

On Pages III-46 through 49 are references to expected changes in land use due to development of the lake . We strongly recommend the sponsors consider land use planning and zoning to guide these developments. Many alternative methods of encouraging local and state adherence to intelligent land use principles should be available to the authors. We recommend the maximum use of discretionary power in guiding land use around this recreation site.

Pages V-77 and V-81 mention that the "recreation river" or "greenbelt" alternatives would not satisfy the regional demand for a large body of water with developed public use areas. We are aware that other large dams and lakes are planned for this region. These will probably fill the recreation needs for large bodies of water. If so, then the scenic river/greenbelt alternatives

may be a more viable alternative.

What are the regional needs for large bodies of water?

What part of the recreational demand for large bodies of water can be supplied by the other reservoirs scheduled for construction in this region?

Thank you for the opportunity of reviewing this impact statement.

Sincerely,

Frederick W. Honing

FREDERICK W. HONING
Area Environmental Coordinator

E, gv

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

Aug. 9, 1973

OFFICE OF
THE REGIONAL DIRECTOR

Our Reference: EI # 0773-257

Floyd H. Henk
Colonel, CE
District Engineer
Department of the Army
Fort Worth District Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Re: Evironmental Impact Statement
Aubery Lake, Elm Fork, Trinity River,
Texas

Dear Mr. Henk:

Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2)(C) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

Wm. F. Crawford

William F. Crawford
Environmental Impact Coordinator

ORD EI-1

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE Southern Region
819 Taylor Street, Room 10E09
Fort Worth, Texas 76102

August 10, 1973

WFS2x1

Colonel Floyd H. Henk
District Engineer, Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

Reference is made to your SWFED-PR letter dated 23 July 1973, with inclosure.

We appreciate having been provided a copy of the draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas.

As you are aware, following the review of a draft or final Environmental Impact Statement, all official comments are issued by the Department of Commerce, Office of the Deputy Assistant for Environmental Affairs.

From our unofficial viewpoint, and with consideration of the National Weather Service's area of interest and competence in water management and related land use, we offer the following comments:

> The draft environmental impact statement, Aubrey Lake, demonstrates that a very considerable degree of thought and effort has been directed toward a thorough and comprehensive evaluation of the project as proposed, and of the alternatives that offer a reasonable approach to practicability, including that of no action.
>
> In the balance, the proposal appears well conceived and we have no additional comments concerning the draft environmental impact statement.

The NWS responsibilities with respect to such services as severe local storm warnings, wind warnings for recreational lakes and our river and flood warning program, require that we have a continuing interest in the Aubrey Lake Project and we will appreciate being advised of future developments.

Sincerely,

Glenn L. Audsley
Regional Hydrologist

cc: Dr. William Aron, Director, Office of Ecology and Environmental Conservation, National Oceanic and Atmospheric Administration

Engr

FEDERAL POWER COMMISSION
REGIONAL OFFICE
819 Taylor Street
Fort Worth, Texas 76102
August 10, 1973

In reply refer to:
PWR-FW

Colonel Floyd H. Henk
District Engineer
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

This refers to your letter of July 23, 1973, which transmitted for our review and comments the draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas.

We have reviewed the report to determine the possible effect of the planned improvements on the construction and operation of bulk electric power facilities, including existing and potential hydroelectric developments, and on natural gas pipelines. It does not appear that the proposed improvements would adversely affect the construction or operation of such facilities, therefore we have no comments on the draft statement.

The opportunity to review the draft environmental statement is appreciated. Please note that the review was made at field level and the comments herein do not necessarily represent the official position of the Federal Power Commission.

Sincerely yours,

Donald L. Martin

Donald L. Martin
Regional Engineer

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

August 13, 1973

OFFICE OF THE
REGIONAL ADMINISTRATOR

Colonel Floyd H. Henk
District Engineer
Fort Worth District, Corps
of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Re: 06-4-14-TX

Dear Colonel Henk:

We have reviewed the Draft Environmental Impact Statement prepared by your office for the proposed Aubrey Lake, Elm Fork, Trinity River, Texas project. The proposed development consists of an earthen dam at river mile 600 of the Elm Fork of the Trinity River about 4 miles northwest of the City of Aubrey, in Denton County, Texas. The earthen embankment will have a maximum height of 136 feet above the streambed, will be about 14,690 feet long, and will have a crest width of 42 feet. There will be a 100-foot long uncontrolled spillway on the left abutment and a 13-foot diameter bi-level outlet conduit in the right flood plain. The maximum water surface area will be 54,600 acres at elevation 655.2 feet mean sea level (msl). The normal expected conservation pool will inundate 25,200 acres at elevation 627.0 msl. Total land required will be 43,560 acres, consisting of 1,187 tracts and 945 ownerships. Also, there will be approximately 5000 acres of covered flood easements acquired.

The project is in the advanced engineering and design stage of planning. Based on November 1, 1972, price levels, the estimated cost of the project is $99,430,000 and has a benefit/cost ratio of 2.6 to 1.0.

We are classifying your Draft Environmental Impact Statement as Category 3, Inadequate. Our reason for categorizing it Inadequate is the segmented approach of evaluating this project exclusive of the total Trinity River system. This classification and the date of our comments will be published in the

Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We have the following additional comments for your consideration:

1. Item 2b(3), page III-12, discusses the multi-level water release capability of the dam. However, we could find no mention of specific elevations of the releases nor the projected release volumes or schedule. We believe both these issues are significant in terms of regulating water quality downstream from the reservoir.

With regard to release volumes, will there be a continuous minimum release or will there be periods of no release? Hopefully, the watershed yield will permit continuous releases, as this would eliminate entrapment of fish and their possible suffocation due to low oxygen levels.

2. Item 3a(2), page III-14, mentions that man's activity in the project area has reduced the actual forested area to less than 5000 acres. We assume that most, if not all, of this timber will be cleared prior to operation of the lake. However, we could find no mention of the estimated acreage to be cleared nor the method to be used in the clearing operation. We believe the inclusion of this data would strengthen the statement. Although open burning is permitted under certain circumstances, we strongly suggest that consideration be given to shredding, chipping, or burying non-marketable residue, as the environment should gain more from its decomposition than from it being burned.

3. Location of Borrow Areas - We could find no mention of the location of borrow areas nor the estimated volume of material required for construction of the earthen dams. If the borrow areas are located outside the impounding area of the lake, they could have significant impact on the land area around the reservoir. We believe inclusion of this basic information would strengthen the statement.

4. The impacts of the project as presented in the statement appear to be directed primarily at the effects of the water area and its inundated land area as a separate independent unit. We believe that there are two other specific impact areas which should be related to the project. These are: (1) effects of the project on peripheral development and the effects of this peripheral development on the project, and (2) the cumulative effect of this project on the total Trinity River System.

Implementation of the proposed project should trigger commercial, residential, and possibly some industrial development around the periphery of this lake. This growth could produce numerous secondary effects, such as increased volume of solid waste, increased number of septic tanks, loss of vegetation, increased runoff, the need for additional highways, and numerous other impacts - both beneficial and adverse - to the environment. In essence, the land area directly and indirectly involved by the proposed project may be two or three times that actually required for construction of the project. We believe the inclusion of these secondary effects is necessary to evaluate total effects of the project on the environment.

The presentation in Section I - Project Description, paragraphs 1-5, would lead the reader to believe that the proposed project plus Lewisville Lake constitutes an individual unit, separate from any other river system or complex. However, paragraph 6, Authorizing Document, page I-8, states that Aubrey Lake is a unit of the comprehensive plan of improvement for the Trinity River Basin, Texas. Therefore, we believe the statement must address the cumulative effects (inter-relationship) of this project to the total Trinity River System.

We believe that, by including a presentation and subsequent discussion of the above two items in the statement, the overall report would be strengthened.

5. The proposed Aubrey Lake in combination with the existing Lewisville Lake form a significant water supply system. At similar lakes throughout the region, peripheral development has not been controlled. In some cases (Canyon Lake as an example), the use of septic tanks as wastewater treatment facilities plus other effects of developments has led to water quality deterioration. Therefore, we believe it is of utmost importance for the Corps of Engineers to encourage local county officials to exclude septic tank construction and use around the peripheral area of the lake.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us five copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

Arthur W. Busch
Regional Administrator

Enclosure

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

North Central Texas Council of Governments

P. O. Drawer COG Arlington, Texas 76011

August 1, 1973

Mr. Floyd H. Henk
Colonel, CE
District Engineer
Department of the Army
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

As the Regional Clearinghouse for the North Central Texas area, our staff has reviewed the draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas, and we have no comments on this subject.

We trust this satisfies your requirement to comply with the Environmental Policy Act of 1969. We thank you for the continuing opportunity to comment on these proposals and if we may be of further assistance, please feel free to call upon us.

Sincerely,

Jim Parr
Director of Regional Services

JP/bc

360 Place 1201 N. Watson Rd. (Hwy 360) Dallas/Fort Worth (817) 261-3331

TEXOMA Regional Planning Commission
Council of Governments Cooke, Grayson & Fannin Counties
1000 Arnold Blvd. Denison, Texas 75020 Telephone (214) 786-9556 & 465-3220

August 7, 1973

Floyd H. Henk
Colonel, CE
District Engineer
Department of the Army
Fort Worth District
Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Subject: Environmental Impact Statement, Aubrey Lake

Dear Colonel Henk:

The Texoma Regional Planning Commission has reviewed the draft Environmental Impact Statement for the proposed Aubrey Lake as required by the National Environmental Policy Act of 1969. The staff of the Planning Commission visited the general location of the proposed reservoir in Grayson and Cooke Counties to satisfy the conclusions of the draft Environmental Impact Statement-as it relates to those counties.

The primary area of concern which may have a negative environmental impact with relation to the proposed reservoir would be the location of the sewage treatment plant of the City of Tioga, in Grayson County. It is possible that the sewage treatment plant may become inundated during high flood water periods. According to the Environmental Impact Statement, this condition may exist on a once in forty-six year frequency. Adequate information was not available to determine precisely the elevation of the sewage treatment plant. The proposed elevation of the flood control pool of 636.0 above MSL will definitely affect any future sewage treatment plant improvements for Tioga, should the population of the City increase as expected as a result of the close proximity of the proposed reservoir to the City. Special consideration to the quality of effluent discharged from the existing or from a future sewage treatment plant will be necessary in order to pre-

vent any adverse environmental affect when the lake is constructed. A new sewage treatment system for Tioga due to the natural drainage of the surrounding area and the short distance to the proposed lake will definitely cause a financial hardship on the City that otherwise would not have been necessary. There will not be sufficient distance between the City of Tioga and the proposed lake for natural cleansing of the affected stream. It is my intention, therefore, to make this a part of the public record so that when the City of Tioga proposes any new improvements to the sewage treatment system, the City will not be faced with an unburdenson problem of satisfying environmental regulations due to the close proximity of a municipal water supply, which the Aubrey Resorvoir would undoubtedly become.

With the exception of the potential problem of the Tioga sewage treatment plant, the Texoma Regional Planning Commission concurs with the draft Environmental Impact Statement on the proposed Aubrey Lake and finds that the positive environmental effects far out weigh those of the negative.

I trust that you will find this information helpful in the preparation of the final Environmental Impact Statement for the proposed Aubrey Lake, however, should you desire further documentation, please do not hesitate to contact me.

Sincerely,

Jerry W. Chapman

Jerry W. Chapman
Executive Director

JWC/ge

cc: The Honorable G.T. Cannon
Mayor
P.O. Box 206
Tioga, Texas 76271

City of Denton • Municipal Building, Denton, Texas 76201

Office of City Manager

August 9, 1973

Department of the Army
Fort Worth District, Corps of
Engineers
P.O. Box 17300
Ft. Worth, TX 76102

Attn: Col. Floyd H. Henk
District Engineer

Gentlemen:

The City of Denton has reviewed the draft of the Environmental Impact Statement for Aubrey, Elm Fork, Trinity River, Texas. While the City of Denton does not have the expertise to actually pass judgement on all aspects of this document, we do have a keen interest in the impact this project will have on this area. We believe this statement covers the investigation and evaluation of questions raised by interested citizens at the public hearings. We agree with your conclusions that the benefits to be gained from this project will by far outweigh any detrimental effect to the area.

We sincerely appreciate the diligence and concern exhibited by your staff in pursuing this project.

Sincerely,

James W. White

James W. White
City Manager
City of Denton

JW/ka

cc: File

CITY OF FORT WORTH, TEXAS

OFFICE OF THE CITY MANAGER
1000 THROCKMORTON STREET
FORT WORTH, TEXAS 76102
335-7211 / AREA CODE 817

August 8, 1973

Colonel Floyd H. Henk
District Engineer
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

The draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas, has been received and reviewed by the City staff. It has been determined that the proposed action will have no negative effects on the City of Fort Worth. The water supply, flood control, recreation, and fish and wildlife conservation resulting from the construction of Aubrey Lake should have a positive effect on the immediate and surrounding areas.

Thank you for the opportunity to review and comment on the draft environmental impact statement for Aubrey Lake.

Sincerely yours,

W. Ralph Hardy
Assistant City Manager
for Community Development

WRH/js

dallas water utilities
500 S. Ervay • Dallas, Texas 75201 • (214) 748-9711

17 August 1973

Col. Floyd Henk
Fort Worth District
U. S. Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Col. Henk:

We have reviewed the draft "Environmental Impact Statement--Aubrey Lake." It is an excellent report and very comprehensive. The only substantive suggestion we would have is to consider expanding on paragraph 4 A (1), Water Supply, page I-3. As you know, the primary interest of the City of Dallas in Aubrey Lake is the increased dependable yield of water for the domestic use of the City of Dallas and its twenty-one customer cities which will be generated by construction of Aubrey Lake and its operation in conjunction with Lewisville Reservoir.

The City of Dallas has commissioned a Long Range Water Supply Study to determine requirements for raw water supplies and to provide alternate methods of satisfying these requirements up to the year 2050. The study is currently in draft form and has not yet been officially adopted by the City of Dallas. I am enclosing a copy of the Draft Summary Report for your information. You will note that construction of Aubrey Lake is a key element in the recommended plan for development in this report. It is suggested that you may want to extract relevant material from our study to enlarge on the criticality of Aubrey Lake in respect to providing additional water supplies in the near term future.

Yours very truly,

Henry J. Graeser
Director

HJG:IMR:jd
cc: Messrs. George Schrader
Jim Schroeder
I. M. Rice
A. A. Briggs
Att.

DOLPH BRISCOE
GOVERNOR

EXECUTIVE DEPARTMENT
DIVISION OF PLANNING COORDINATION
BOX 12428, CAPITOL STATION
AUSTIN, TEXAS 78711
PHONE 512 475-2427

August 28, 1973

Colonel Floyd H. Henk
District Engineer
Fort Worth District
Corps of Engineers
Department of the Army
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

Pursuant to the provisions of Section 102(2)(c) of the National Environmental Policy Act of 1969, the Office of the Governor, Division of Planning Coordination (the State Planning and Development Clearinghouse), and other interested and affected Texas State agencies have reviewed the draft environmental impact statement titled, "Aubrey Lake, Elm Fork, Trinity River, Texas."

The following comments and concerns were offered:

1. The Texas Water Quality Board (TWQB) expressed concern for the discussion of water quality conditions (page II-54 of the DEIS) and felt that it should be broadened to assess the circumstances described in their enclosed comments. TWQB recommends that the Corps review the overall problem of nutrients discharged into the watershed of the proposed lake with the Trinity River Authority (TRA). TRA is currently studying nutrient loading as a component of their basin planning activities.

2. The Texas Water Rights Commission (TWRC) felt that the draft environmental impact statement would be greatly enhanced by the inclusion of a careful appraisal of the effectiveness of the Battelle-Columbus Environmental Evaluation System for the Aubrey Lake project. The TWRC also felt that the DEIS would be enhanced by giving greater emphasis to the relationship between this project and the unique population growth and migration phenomenon characteristic of this North Central Texas area.

3. The Texas State Soil and Water Conservation Board (TSSWCB) noted that the Table V-11, page V-48, indicates that the Dallas area will have a 119,200 acre feet deficit in their projected year 2020 annual supply. The TSSWCB's latest information indicates that the City of Dallas has contracted with the Upper Neches River Municipal River Authority for an annual yield of 114,335 acre feet which is not included in Table V-11.

4. The Texas Highway Department indicated that U.S. Highway 377 and Farm to Market Roads 372, 455 and 922 will be affected by the Aubrey Lake project; but they anticipate no difficulties in the negotiation of formal agreements between the State of Texas and the federal government.

Additional comments were received from the Texas Industrial Commission and the Texas Air Control Board. Several other agencies, including the Texas Water Development Board and the Texas Parks and Wildlife Department, are presently completing the development of comments on this draft environmental impact statement. We urge you to seriously consider the enclosed comments and those additional comments which will be forwarded to you in their entirety. All of the commenting agencies have put a great deal of time and effort into the study of this project.

Thank you for the opportunity to review this draft environmental impact statement. If we can be of further assistance, please contact us.

Sincerely,

James M. Rose
Director

JMR:jfw

Enclosures

cc: Mr. Hugh C. Yantis, Jr.
Texas Water Quality Board

Mr. A.E. Richardson
Texas Water Rights Commission

Mr. Harvey Davis
Texas State Soil and Water Conservation Board

Mr. B.L. DeBerry
Texas Highway Department

Mr. James H. Harwell
Texas Industrial Commission

Mr. Charles R. Barden
Texas Air Control Board

EXECUTIVE DEPARTMENT
DIVISION OF PLANNING COORDINATION
BOX 12428, CAPITOL STATION
AUSTIN, TEXAS 78711
PHONE 512 475-2427

DOLPH BRISCOE
GOVERNOR

October 1, 1973

Colonel Floyd H. Henk
District Engineer
Fort Worth District
Corps of Engineers
Department of the Army
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

On August 28, 1973, we submitted a letter with comments from Texas State agencies on the draft environmental impact statement titled, "Aubrey Lake, Elm Fork, Trinity River, Texas."

Subsequently, we received additional comments from the Texas Parks and Wildlife Department, the General Land Office, and the Texas Department of Agriculture. These agencies' comments should be considered in their entirety. Copies of the comments are enclosed. Please place them with our original letter and enclosures.

Thank you for your consideration.

Sincerely,

James M. Rose
Director

JMR:jf

Enclosures

cc: Mr. Clayton Garrison
Parks and Wildlife Dept.

Hon. Bob Armstrong
General Land Office

Hon. John C. White
Dept. of Agriculture

EDMUND L. NICHOLS
Assistant Commissioner

September 11, 1973

Mr. James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Rose:

We have reviewed the Draft Environmental Impact Statement for the Aubrey Lake project, Elm Fork, Trinity River, Texas.

We believe that an excellent job has been done in the design of this project and in the preparation of the environmental impact statement. The project should result in greater conservation and use of water resources in this area.

Sincerely,

Ed Nichols (c.v.)
Edmund L. Nichols

ELN/cv

THIS PAPER IS MADE FROM COTTON A PRINCIPAL CROP OF TEXAS
Texas Department of Agriculture, John C. White, Commissioner, P.O. Box 12847, Austin, Texas 78711

SEP 17 1973

Div. of Plan. Coord.

General Land Office

AUSTIN, TEXAS 78701
BOB ARMSTRONG, COMMISSIONER

ENVIRONMENTAL PLANNING DIVISION
September 14, 1973

Mr. Walter Tibbitts, III
Acting Director
Division of Planning Coordination
Governor's Office
Austin, Texas 78711

RE: Aubrey Lake

Dear Mr. Tibbitts:

While we have no specific arguments with this project, there is concern with each and every stream impoundment in regard to the overall effect this retention has on the inflow of fresh water to our bays and estuaries. There are presently studies underway which will hopefully give us data relating to minimum requirements for our bays. Soon we may be able to speak more directly to this question.

Sincerely,

W. D. Oliver
Director

WDO/prm

COMMISSION

REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

TEXAS HIGHWAY DEPARTMENT
11TH AND BRAZOS
AUSTIN, TEXAS 78701

STATE HIGHWAY ENGINEER
D. L. DEBERRY

August 7, 1973

IN REPLY REFER TO
FILE NO. D-5

SUBJECT: Draft Environmental Impact Statement for Aubrey Lake, Elm Fork of Trinity River, Texas

Mr. Walter Tibbitts
Acting Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

RECEIVED
AUG 8 1973
Div. of Plan. Coord.

Dear Sir:

We have reviewed the draft environmental impact statement for Aubrey Lake (Site 1), which is to be constructed by the Corps of Engineers on the Elm Fork of the Trinity River in portions of Cooke, Denton and Grayson Counties. The principal highway routes in the area which will be affected by the project include U.S. Highway 377 and Farm to Market Roads 372, 455 and 922. Although previous correspondence with the Corps concerning the relocation or modification of existing highway facilities within the limits of the reservoir has been very limited, we anticipate no difficulty in the negotiations which customarily precede the execution of a formal agreement between the State and the Federal Government. On similar projects throughout the State, our negotiations with the Corps have always been characterized by a high level of cooperation and a mutual desire to provide a system of highways and farm to market roads which will provide the greatest benefit in the reservoir area.

If you desire additional data or information concerning the above matters, we will undertake a more detailed study concerning the effects of the proposed reservoir construction.

Sincerely yours

B. L. DeBerry
State Highway Engineer

By: Marcus L. Yancey Jr.

Marcus L. Yancey, Jr.
Assistant State Highway Engineer

TEXAS STATE SOIL AND WATER CONSERVATION BOARD
1018 First National Building
Temple, Texas 76501
AREA CODE 817, 773-2250

August 9, 1973

Walter Tibbitts, Acting Director
Division of Planning Coordination
Executive Department
Box 12428, Capitol Station
Austin, Texas 78711

Re: Aubrey Lake Environmental Statement

Dear Mr. Tibbitts:

We have reviewed the draft environmental statement for Aubrey Lake proposed for construction on the Elm Fork of the Trinity River.

Generally, the statement is quite thorough and, in our opinion, adequately presents the environmental consequences of the project.

We did note one possible oversight in Table V-11, Dallas System Reservoirs and Imports, page V-48. The table indicates that the Dallas area will have a 119,200 acre feet deficit in their projected year 2020 annual supply. According to our information, the City of Dallas has contracted with the Upper Neches River Municipal River Authority for a dependable annual yield of 114,335 acre feet from Lake Palestine. This import is not included in the table. If our information, as reported in the April 1972 issue of "Water for Texas", a Texas Water Development Board publication, remains pertinent to the status of the Dallas area water supply, the table should be corrected. Incidentally, the reference to Table V-10, page V-42 on page V-37 apparently needs to be corrected to Table V-11, page V-48.

Thank you for the opportunity to review the draft statement.

Sincerely yours,

Harvey Davis

Harvey Davis
Executive Director

HD/gek:ej

RECEIVED
AUG 10 1973
Div. of Plan. Coord.

TEXAS WATER RIGHTS COMMISSION

SAM HOUSTON STATE OFFICE BUILDING

COMMISSIONERS

JOE D. CARTER, CHAIRMAN
476-2453

OTHA F. DENT
476-2451

DORSEY B. HARDEMAN
476-4326

August 7, 1973

LOUIS L. McDANIELS
EXECUTIVE DIRECTOR
476-2452

AUDREY STRANDTMAN
SECRETARY
476-4514

Mr. Walter G. Tibbitts III, Acting Director
Governor's Division of Planning Coordination
Sam Houston State Office Building
Austin, Texas 78711

Re: US Army Engineer District, Fort Worth, Draft Environmental Impact Statement on Aubrey Lake, Elm Fork, Trinity River, Texas, July 20, 1973.

Dear Mr. Tibbitts:

In response to your request by Memorandum of July 26, 1973, the Commission staff has reviewed the referenced Draft Environmental Impact Statement (DEIS) for the Aubrey Lake, Texas project. A copy of our staff Memorandum of Review is attached for your information and use.

The staff finds that:

1. The referenced DEIS appears to be in consonance with the policies and guidelines in Section 102 (2)(C), National Environmental Policy Act (NEPA) of 1969.

2. The Battelle-Columbus Environmental Evaluation System (EES), used as the basis for the referenced report, demonstrates without question, the complexity of comprehensive environmental impact analysis, as envisaged by NEPA of 1969. It is evident that the large number of economic, political, social, technical, and environmental parameters used in the EES are susceptible of being weighted differently when viewed from

various competing public needs and interests. The DEIS would be enhanced by including some evidence that the report is not an experimental, one-time simulation or application of an evaluation model. A brief review of results of applying the Battelle-Columbus EES to other projects would help to substantiate the appropriateness of the EES for the Aubrey Lake project.

3. The DEIS and the project itself would be enhanced if special emphasis were given to the pressing demands generated by the phenomenal population growth and migration trends in the North Central Texas region.

We caution you that the attached interim staff Memorandum of Review not be misconstrued or misinterpreted as the Texas Water Rights Commission's final or formal feasibility determination of the referenced project under the provisions of Section 6.073, Texas Water Code. The Commission will make such determination only after the Chief of Engineers, Washington, D.C., has submitted the final report for review and approval to the Governor of the State of Texas. Therefore, the Commission emphasizes at this time, that regardless of the prior extensive coordinating actions by the US Army Engineer District, Fort Worth, in the project development phase, the Texas Water Rights Commission, in the exercise of its statutory functions of administering and regulating the use of State waters, reserves the right to make independent reviews of all water resources projects involving diversions, impoundments, uses affecting quantity and quality, and modification of natural streamflow conditions in order to make final determinations on water resources construction projects and on appropriations of State waters. These final determinations will be made after required public hearings are held in accordance with Section 6.073, Texas Water Code.

The attached Memorandum of Review and the preceding summary comments are submitted as constructive suggestions to the planners concerned in order to assist them in their project development and justification actions. Finally, special attention is invited to the conditions and proviso contained in subparagraphs 1.1 c, and 1.2, of the attached Memorandum regarding essential limitations in the scope of this staff review.

Sincerely yours,

A. E. Richardson
Executive Director

AER-AJD:ll

Attachment
As stated.

To the Executive Director
Texas Water Rights Commission

August 7, 1973

MEMORANDUM OF REVIEW
OF
US ARMY ENGINEER DISTRICT,
FORT WORTH
DRAFT ENVIRONMENTAL IMPACT STATEMENT
ON
AUBREY LAKE,
ELM FORK, TRINITY RIVER, TEXAS,
JULY 20, 1973.

Staff Review Coordinator: Dr. Alfred J. D'Arezzo,
Environmental Sciences Analyst

1. INTRODUCTION

1.1 Basis for Review.

a. By Memorandum of July 26, 1973, the Acting Director of the Governor's Division of Planning Coordination transmitted and requested review comments by August 10, 1973, on the Draft Environmental Impact Statement (DEIS) on Aubrey Lake, prepared by the US Army Engineer District, Fort Worth.

b. This review by the Texas Water Rights Commission's staff is made in accordance with the Commission's responsibilities as a member agency of the State's Interagency Council on Natural Resources and the Environment (ICNRE) -- assisting the Governor's Division of Planning Coordination in that Division's capacity as the State to Texas' Clearinghouse for the review of the Federal programs governed by

the policies and regulations contained in the Revised Office of Management and the Budget (OMB) Circular A-95, dated February 9, 1971.

c. The staff review comments contained herein should not be misconstrued as expressions of the actual or probable views or rulings of the Texas Water Rights Commission either on the specific engineering details of the final project plans or on the potential issuance of permits for water rights which may be involved in the project. Further, this staff review is not intended as a rigorous description of, and evaluation of, all the probable effects on existing water rights, the future uses of State of Texas' water, or the probability of impairment of use of existing facilities because of proposed construction.

1.2 Special Proviso.

The Texas Water Rights Commission was not requested to make an OMB Circular A-95 Clearinghouse Review of the technical plans or reports for the proposed construction project prior to receipt for review of the DEIS for the proposed project. The lack of an opportunity to make a field-level review of the technical plans or reports prior to the review of the DEIS compels that our comments herein be regarded as tentative pending the opportunity to make a technical, field-level review of the project plans, including the water rights impacts thereof. However, the Commission staff believes that even if the project plans had been submitted for review, certain aspects of the project would not have been clarified until after the DEIS was prepared. Hence, while this review presumably is limited to the DEIS, review comments unavoidably impinge on certain basic premises of the project itself.

2. PROJECT DATA

2.1 Authorization and Status.

Congressional authority for the construction of Aubrey Lake is contained in Rivers and Harbors Act, approved 27 October 1965 (Public Law 89-298), in accordance with the Plan of Improvement outlined in House Document 276 (89th Congress, 1st Session). Authority to initiate advance planning on Aubrey Lake is contained in Public Works Appropriation Act of 1970, approved 11 December 1969 (Pub. Law 91-144), and in Advance of Allotment No. C-57, dated 7 June 1970. The project is in the advanced engineering and design stage.

2.2 General Description.

The following description, contained on pages V-8 and V-9 of the DEIS, is considered essential:

> "The project purposes of Aubrey Lake for which alternatives were explored are water supply, recreation, and fish and wildlife. Flood control is not an added or increased purpose of Aubrey Lake. The Aubrey Lake project at river mile 60.0 of the Elm Fork of the Trinity River has been planned, on an exchange of storage basis with existing Lewisville Lake at river mile 30.0, to provide the same degree of flood protection in combination as that provided by Lewisville Lake alone. Flood-control storage in Lewisville Lake will control floods of up to 35-year frequency when regulating releases in proportion to existing downstream channel capacities. However, the project as originally planned would control floods of about 50-year frequency when operated in conjunction with the authorized improved channels. This would be in consonance with the regional statistical analysis conducted for House Document No. 276, which found that each project in the Trinity River system should be planned to regulate 50-year floods to nondamaging proportions. Sufficient flood-control storage would be retained in

Lewisville Lake to regulate flood runoff from the 968 square miles of drainage area between the two lakes, and sufficient flood-control storage would be provided in Aubrey Lake for its 692-square-mile drainage area. Flood-control storage allocated to Aubrey Lake would take into consideration that the rainfall rates on the smaller drainage area controlled by Aubrey Lake are from a relatively greater areal distribution of higher rainfall intensities. As a consequence, although the total volume of flood-control storage is slightly increased, the degree of flood-control protection is not altered by the projects in combination. Flood control, therefore, is not an added or increased purpose of Aubrey Lake."

2.3 Pertinent Project Data.

a. Project purposes: Water supply, flood control, recreation, and fish and wildlife conservation.

b. Location:

(1) Counties: Denton, Cook, and Grayson Counties, Texas.

(2) Streams: Elm Fork of the Trinity River, and Isle du Bois Creek, Trinity River Basin.

(3) Drainage area: 692 square miles.

(4) River mile: 60.0.

c. Number of reservoirs: One.

d. Storage capacity:

(1) Top flood-control pool: 908,100 acre-feet.

(2) Top conservation pool: 650,300 acre-feet.

(3) Sediment: 54,600 acre-feet.

e. Dependable water supply (initially):

(1) Cubic-feet per second: 130.

(2) Million gallons per day: 84.

(3) Acre-feet per year: 94,203.

f. Surface area:

(1) Top water-supply pool: 25,200 acres.

(2) Top flood-control pool: 32,600 acres.

g. First cost: $99,430,000.

h. Annual cost: $4,215,900.

i. Annual benefits:

(1) Fish and wildlife: $371,100.

(2) Water supply: $4,546,300.

(3) Recreation: $5,895,300.

j. Benefit-cost ratio:

Based on an interest rate of 3-1/4 percent, and using November 1, 1972, price levels, and a 100-year amortization period, the benefit-cost ratio for this project is 2.6 to 1.0.

k. Land requirements:

(1) Conservation pool level: 25,200 acres.

(2) Flood pool level: 32,600 acres.

(3) Public use and/or facilities: 2,800 acres.

1. Annual visitations by recreationist: 6,240,000.

2.4 Special Action by Texas Water Rights Commission.

On June 4, 1969, the Texas Water Rights Commission, after due notice had been given pursuant to Article 8280-9, Section 24, Revised Civil Statutes, issued an order designating the Cities of Dallas and Denton, Texas, as cooperating local sponsors to negotiate with the United States Army, Corps of Engineers, for a project relating to Aubrey Reservoir.

3. COMMENTS

3.1 Need to Evaluate the Effectiveness of the Battelle-Columbus Environmental Evaluation System (EES).

The staff believes that a brief summary evaluation statement should be made regarding the effectiveness of the EES procedure. The staff believes that the DEIS would be enhanced if it were possible to eliminate the impression that the use of the EES was an unresolved experimental endeavor.

The staff believes that the EES is a reasonably comprehensive procedure. The problems brought out in the management of water, land, and air resources shows that all those areas are interrelated. The application of the Battelle-Columbus EES brings out vividly that an action in any resource area results in far-reaching impacts on others. The EES analysis shows that the consequences of environmental resources management intersect a broad spectrum of economic, political, social, technical, and environmental values which are viewed and weighted differently by different interest groups. The EES analysis shows that it is impossible to satisfy all the constraints in the four categories, 18 components, and the 78 parameters which constitute the Battelle-Columbus EES. The Battelle-Columbus EES provides a comprehensive method of determining alternative combinations and trade-offs to achieve the highest

satisfaction of public wants. Unfortunately, there is no effective market mechanism to allocate resources for public wants as there is for the private sector of the economy. Consequently, other means must be found to induce various segments of the public to reveal their preferences for public goods. The EES does not completely fulfill this requirement. At the level of comprehensive planning for river basins, sub-basins, or specific projects, there is no substitute for planners to interact with the public throughout the planning process. Therefore, with the proviso of continued interaction between the planners and the public, the EES provides a very effective process of refining and choosing among alternative approaches for satisfying public wants, evaluating them on the basis of their social, environmental, and economic feasibility, as well as for engineering and economics.

In view of the foregoing, the staff suggests that the DEIS contain a clear explanation distinguishing between the "experimental" and the "nonexperimental" aspects of using the Battelle-Columbus EES as the basis for evaluating this vital project. In other words, it might be helpful to indicate, for comparative purposes, which other Federal projects, if any, have used the Battelle-Columbus EES as the basis for preparing environmental impact statements pursuant to the National Environmental Policy Act (NEPA) of 1969.

3.2 Need to Focus on the Unique Population Growth Phenomenon in Project Area.

The staff believes that special emphasis must be focused clearly on the phenomenal population growth and migration trends in the North Central Texas area.

Analysis shows that the requirement for multipurpose water resources developments, such as Aubrey Lake, can no longer be regarded as hypothetical planning requirements. An analysis of the pattern of population distribution and

migration dynamics compels the conclusion that very serious repercussions will result unless comprehensive developments are undertaken in the North Center Texas area to accommodate the needs of people in one of the most densely populated regions of the world. Dr. Robert K. Holz, in his study "Texas Population in 1970: 7. Patterns of Population Districation," published in the Texas Business Review, June 1973, states:

> "In Texas, 11 clusters, nodes, or regions of population concentration are apparent. Each region contains at least 1 percent of the state's population; together they comprise almost two thirds of the Texas population. . .The state of Texas has an area of 267,338 square miles and a population of 11,196,730, or an average density in 1970 of 42.7 persons per square mile - not a very dense population by either U.S. or world standards. The density of the U.S. population in 1970 was 57.4; that of the world was 63. In the Texas regions of greatest population concentration, the average per square mile ranges from 1,666 at Dallas-Fort Worth to 79 at Amarillo. Even the low figure is significantly above the state average. For all 11 regions combined, the density figure is 301 persons per square mile.
>
> "Three of the population regions are significantly larger than the others; they are called major regions in this study. In descending numerical order they are (1) Dallas-Fort Worth, (2) Houston-Galveston, and (3) San Antonio-Austin-Waco. The first two regions contain more than 18 percent of the state's population, and the third contains over 13 percent. Together the three regions contain 49.5 percent of the population on just 4.5 percent of the state's total area. Dallas-Fort Worth has the largest population - 2,043,638 - and the densest - 1,166 persons per square mile." (Emphasis added.)

Analysis indicates that this phenomenal population concentration process will continue, and in fact, be accelerated in the future. In this regard, Dr. Holz states:

> "Our final concern is with the residential distribution of the Texas population in the years ahead. Do present trends provide any key to where Texans will live in the future? . . .The "new settlers" on the "Texas frontier" will, to an overwhelming degree, take up residence in the 11 population nodes, and the 3 major nodes will absorb the bulk of this new population. . . Most of this new population will settle in cities, and the percentage of Texans classified as urban will probably rise above the 79.7 percent shown by the 1970 Census. Potential for economic growth is greatest in the 27 counties of the 11 population regions, and it will be there that business and industry will continue to concentrate their activities."

In view of the foregoing, the real problem facing the State is no longer one of searching for alternatives or in refining the project details, but rather the potential failure to implement decisively, expeditiously, and in an orderly manner, the comprehensive public works plan for the urban population concentration in the greater Dallas-Fort Worth region. Delays in accomplishing needed developments aggravate the problems of relocating and readjusting piecemeal, uncoordinated developments resulting in steadily greater costs to provide needed facilities without serious loss of environmental benefits.

Therefore, the staff suggests that maximum emphasis be given in the DEIS to the implications of the unique population growth and migration dynamics involved in the greater Dallas-Fort Worth region. Emphasis should be given that the requirements of this population concentration are so compelling that the greater danger to the economy and the

environment lies in inaction or further delay. Analysis of costs estimates for this project since authorization indicates a steady climb from approximately $50.5 million in 1971 (See pamphlet "Water Resources Development" by the US Army Corps of Engineers, Texas, 1971 (January 1971), page 40.) to approximately $99.4 million (See Table V-20, DEIS).

4. CONCLUSIONS

4.1 The Draft Environmental Impact Statement under review appears to conform to the basic requirements of Section 102(2)(C) of the National Environmental Policy Act of 1969.

4.2 The subject project and the DEIS pertaining thereto would be greatly enhanced if careful consideration were given to the comments presented in paragraph 3, above, suggesting that the document be edited to include a brief but careful appraisal of the effectiveness of the Battelle-Columbus Environmental Evaluation System for the project under review. In addition, it is believed that the document would be enhanced by giving greater and special emphasis to the unique population growth and migration phenomenon involved in the project area.

Alfred J. D'Arezzo

AJD:11

NOTED:

A. E. Richardson
Executive Director

GORDON FULCHER
CHAIRMAN
LESTER CLARK
VICE-CHAIRMAN
J. DOUG TOOLE
HARRY P. BURLEIGH

TEXAS WATER QUALITY BOARD

CLAYTON T. GARRISON
JIM C. LANGDON
J. E. PEAVY, MD
HUGH C. YANTIS, JR.
EXECUTIVE DIRECTOR
PH. 475-2651
A.C. 512

314 WEST 11TH STREET 78701
P.O. BOX 13246 CAPITOL STATION 78711
AUSTIN, TEXAS

August 10, 1973

RE: Corps of Engineers Draft
Environmental Impact Statement,
Aubrey Lake

Mr. Walter G. Tibbitts III
Acting Director
Division of Planning Coordination
Office of the Governor
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Tibbitts:

The staff of the Texas Water Quality Board has reviewed the Draft Environmental Impact Statement of Aubrey Lake, Elm Fork of the Trinity River. The discussion of water quality conditions (presented on page II-54) is not acceptable and it should be broadened to assess the following circumstances:

1. That the algae bloom in headwaters of Lewisville Lake might result from natural problems and stream conditions other than wastewater effluent effects.

2. The premise "that dispersal of nutrients into Aubrey Lake will reduce algae blooms below Aubrey Lake Damsite" does not abrogate the potential of algae bloom in Aubrey Lake. The inference of the EIS is that the algae problem is shifted upstream.

3. The subject of municipal wastewater treatment plant improvements and corresponding quality effects of effluent impounded by the proposed lake should be correlated to the water quality objectives of the FWPCA Amendments of 1972 and the construction schedule of the dam.

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AUG 13 1973
Div. of Plan. Coord.

We recommend that the Corps review the overall problem of nutrients discharged into the watershed of the proposed Lake with the Trinity River Authority, since the TRA has underway studies and modeling of nutrient loading in their Basin Planning activities.

Thank you for the opportunity to review this statement, and if we may be of further assistance, please let us know.

Very truly yours,

Emory G. Long

Emory G. Long, Director
Administrative Operations

DEM:ww

TEXAS
PARKS AND WILDLIFE DEPARTMENT

COMMISSIONERS
JACK R. STONE
CHAIRMAN, WELLS
JOE K. FULTON
LUBBOCK
PLARE E JOHNSON
AUSTIN

COMMISSIONERS
BOB BURLESON
TEMPLE
JOHN M. GREEN
BEAUMONT
LOUIS H. STUMBERG
SAN ANTONIO

CLAYTON T. GARRISON
EXECUTIVE DIRECTOR

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

September 11, 1973

Mr. Randy Whittington
Division of Planning Coordination
Executive Department
Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Whittington:

Reference is made to your memorandum of July 26, 1973 and the attached Draft Environmental Impact Statement for Aubrey Lake.

Members of my staff have reviewed the statement and offer the following comments for your consideration:

Page I-2 - In sentence one, an acreage figure of 54,600 acres is given. This appears to be in conflict with figures presented in the summary and on page I-5.

Page I-4 - The last sentence on this page refers to initial reduction in fish productivity. The Department suggests that more explanation of this statement be provided.

Page I-6 - The section titled "Forest and Vegetative Management" is quite interesting. We do, however, suggest that consideration be given to the establishment of native vegetation on those areas where heavy visitation is not expected. The selection of species should be made so as to provide for reestablishment of rare or endangered plant species and/or species of value to wildlife.

Page II-50 - Paragraph b, Waterfowl Species. The presence of a nesting woodduck population should be noted.

Page II-92 - Paragraph 3, Flood Control Needs. The second sentence should be revised. ..., and damages resulting from floods will likely increase if unrestricted urban development in floodplain areas continues.

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SEP 19 1973
Water Quality Board

Pages II-78, II-91, V-65 and 66 - While the Statewide Comprehensive Outdoor Recreation Plan (1968) reports a shortage of outdoor recreation opportunities for trails, boat ramps, camping facilities, scenic roads, picnic sites, and golf holes in Planning Region II, a deficit of water surface acres is not indicated. A surplus of 271,339 surface acres of water is indicated for 1968 (Paragraph 4.2.2.16, Volume IV, 1968 SCORP).

A review of the Statewide Comprehensive Outdoor Recreation Plan further reveals that providing additional recreation opportunities in the Dallas-Fort Worth Area is of high priority at the current time. The Statewide Comprehensive Outdoor Recreation Plan would support the provision of additional facilities at existing projects in the following order:

1) Additional facilities on water closest to urban residences where time and distance are shortest.

2) New water-oriented projects providing additional recreational opportunities.

Page II-91 and 92 - Recreation Needs. As noted in the environmental statement, there are substantial facility deficiencies at existing Corps lakes in this area of the State. This would seem to suggest that correction of these deficits be given at least equal priority to recreational development at Lake Aubrey. Consideration of this action would be desirable in that it would result in the maximization of utilization of the water surface area administered by the Corps.

Section III - The Environmental Impact of the Proposed Action

The use of the environmental evaluation system produced by Battelle-Columbus Laboratories is of interest to the Department. The attempted quantification of environmental aspects of project development is, indeed, a bold step and one which must be taken. For this attempt, we commend the Corps and its contractual institution.

Unfortunately, the Department cannot concur with the substance of this case example. To imply that the inundation of thousands of acres of agricultural land and wildlife habitat can be construed as an environmental improvement is, indeed, subject to question.

In reviewing the quantification procedure, members of my staff have attempted to envision the assumptions and reasoning upon which the final numerical quantification is based. They advise me that the background information which would permit a specific critique could only be obtained under a system of close coordination whereby the Department has representation during the early stages of plan formulation.

Our criticism of this case example is not intended to reflect on the personal or professional integrity of those who have labored long and hard to develop the present figures. We do, however, strongly criticize the lack of timely coordination of this matter with the Department.

The entire formulation and planning process upon which this evaluation is based requires the use of assumptions and subjective preferences. This is a recognized necessity in attempting such a task. It would be entirely unrealistic to expect that personal interest, association, and background would not affect such judgment decisions. To insure that all interests are provided an opportunity to be heard, it is imperative that organizations having professional expertise in the areas of concern and representing a broad spectrum of interest be included in the formulation of such evaluations.

In addition to the aforementioned concern, several specific areas of evaluation should be given further consideration.

A. Stimulated activities adjacent to the reservoir.
B. Inundation of terrestrial habitat adjacent to Lewisville Reservoir.
C. Land use changes along the river between Aubrey and the headwaters of Lewisville.
D. Flow characteristics of the stream as affected by project operation. A specific water release operation pattern based upon present and future basin demands and future construction plans should be included.

Page III 25-27 - Waterfowl. Paragraph C. The discussion referring to a shift of waterfowl populations from the Mississippi River Wetlands should be omitted, unless specific information documenting this assumption can be provided.

The reference to waterfowl habitat deficits along the Mississippi River should be discussed in more detail. Those major projects which have resulted in waterfowl habitat destruction as well as those which will, in the future, affect the current habitat status should be discussed.

Analysis of the benefit-cost ratio as derived in the Impact Statement reveals that approximately 55% of the project benefits are allocated to recreation. However, neither the Impact Statement nor the General Design Memo clearly indicates how much consideration will be given to recreation in project operation. As lake level fluctuations and downstream releases of water from the dam will be critical to recreational opportunities afforded and the enjoyment of the project, it is highly recommended that operational policies favorable to recreation be established and implemented, at least in proportion to the recreational benefit ratio attributed to the project above. Specifically, these policies should include maximizing lake level stability during the summer recreation season and maintaining regular flows in the river channel downstream from the dam. Water supply functions must not be allowed to dominate operational policy of the project if the high recreation benefit noted above is to be claimed.

The Department appreciated having had the opportunity of commenting on this draft environmental impact statement.

Sincerely,

CLAYTON T. GARRISON
Executive Director

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SIX
FORT WORTH, TEXAS 76102

819 Taylor Street

August 21, 1973

IN REPLY REFER TO 06-00.8

Colonel Floyd H. Henk, District Engineer
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

The draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas furnished with your letter of July 23, 1973, has been reviewed by this office and our Texas division office. Also, we have a copy of the Texas Highway Department's August 7, 1973, letter to the State of Texas Coordinator, commenting on the draft statement.

Although the environmental impacts on most items are discussed in depth, there is little mention of what effects the proposed reservoir will have on the existing highway system. We suggest that the final environmental impact statement include a comprehensive discussion on what effects the proposed reservoir will have on both the existing and planned highway systems.

Sincerely yours,

Marvis E Monroe

for J. W. White
Regional Administrator

United States Department of the Interior

OFFICE OF THE SECRETARY
SOUTHWEST REGION
Room 4030, 517 Gold Avenue SW.
Albuquerque, New Mexico 87101

ER 73/1071

District Engineer
Corps of Engineers, U. S. Army
Post Office Box 17300
Fort Worth, Texas 76102

Dear Sir:

This is in response to your letter of July 23, 1973, addressed to the Assistant Secretary, Program Policy, which requested review and comment on a draft environmental statement for Aubrey Lake, Elm Fork, Trinity River, Texas.

It is the general view of the Department of the Interior that the draft statement, although voluminous and detailed in its presentation, has certain serious omissions as well as inadequacies in the evaluation of environmental impacts.

For example, nowhere in the statement is there a full explanation of anticipated water releases from Aubrey Dam and resultant changes in downstream flow regimen. Land use, fish and wildlife habitat, and recreational activities would be affected. We suggest that comparative flow data be presented and consideration be given to the probable impacts. On pages V-24 and V-25 it is stated that "Current trends in recreation indicate that stream-oriented recreation areas are at a premium, and that stream channelization and dam building are reducing good stream-type recreation areas and affecting their quality." The potential for increased recreational use of the channel between Aubrey Dam and the head of Lewisville Lake after construction of Aubrey Reservoir and the impact on the area should be discussed.

Recognition also should be given to the reduction in downstream streamflow and inflow to Trinity Bay that would be caused by evaporation losses from Aubrey Lake and the higher water surface elevation in Lewisville Lake.

It is not clear whether the Environmental Evaluation System (EES) used to evaluate the project included Lewisville Lake or was limited to Aubrey Lake. Lewisville Lake will be changed in size as a result

of the project, and its operation will be coordinated with that of Aubrey Lake. In view of this relationship the environmental evaluation should give equal consideration to both components of the project.

The following specific comments are submitted for your consideration and use in developing a final statement for the project.

Summary Sheet

On page 2 the total land to be acquired is given as 43,500 acres. However, on page III-14 it is indicated that 35,050 acres of land would be required for the site. This discrepancy should be clarified.

Project Description

Page I-4. "The project would provide opportunities for up to 6,240,000 recreation days annually." How was this use determined, and how will it be distributed in point of time and location? In view of the large numbers of visitors that evidently will be present in peak use periods, further explanation of location, size, facilities provided, and public-use capacity of each site would seem warranted.

Page I-4. The sentence beginning at the bottom of this page is questionable. No evidence is given to support the contention that the initial productivity of the reservoir for fish would be reduced but would subsequently increase. New reservoirs typically are highly productive because of the inundation of vegetation and comparatively fertile soils. Later this productivity decreases.

Page I-5, Wildlife Management. The first sentence in the section should be modified to give the Bureau of Sport Fisheries and Wildlife credit for having primary responsibility for the management of migratory birds.

Pages I-5 and I-6. The sections concerning "Wildlife Management" and "Forest and Vegetation Management" appear too general. Some discussion of specific management measures would be helpful. Planing for these management programs should be coordinated with appropriate Federal, State, and local interests.

Environmental Setting Without the Project

Pages II-13 to II-18, Economic Geology. Available data have revealed that during 1970 mineral deposits in Denton County yielded sand and

gravel, clay, petroleum, and natural gas valued at about $1.7 million; deposits in Cooke County yielded petroleum, natural gas liquids, and natural gas valued at about $30 million; and deposits in Grayson County yielded natural gas, petroleum, natural gas liquids, stone, and sand and gravel valued at about $34.8 million.

The statement recognizes the existence of economic mineral resources within the reservoir site and states that only sand and gravel and petroleum deposits are currently being worked, but that some clay, shale and limestone of the Woodbine and Weno formations have been used in the past for brick and pottery manufacture and for dimension stone.

The statement points out that sand and gravel production from the area has been substantial. Sand and gravel have been produced from 14 locations within the reservoir site, including 12 locations along the Elm Fork River. Probably more locations exist from which the commodity has been recovered. However, installation of the proposed dam and reservoir probably would not seriously affect the availability of sand and gravel in the area. The statement does not explain the effect of the proposal on two active sand and gravel operations just above and below the damsite.

Page II-17. The environmental statement adequately describes the existence of 12 producing oil wells and 114 test wells located in or near the reservoir site. Yields from 10 of the pumping wells are low - 2 or 3 barrels-per-day, 2 days per week - and all wells will be capped or plugged in accordance with Texas Railroad Commission regulations.

Page II-41, Area Aquatic Vegetation. Does the wetland acreage include areas of this type in the bottomlands downstream of the Aubrey dam site and around the periphery of Lewisville Lake? These locations will be influenced by the project and should be considered.

Pages II-41 to II-43, Area Terrestrial Vegetation. A separate discussion of bottomland vegetation is needed. This type has the highest wildlife value and will be the most affected.

Page II-56, Animals. We have no recent record of white-tailed deer in the project area.

Pages II-81, Bureau of Sport Fisheries and Wildlife. The meaning of the hunting estimate of 2,350 man-days is not clear. It seems to indicate waterfowl hunting, however, a figure of 3,000 man-days of waterfowl hunting is given on page III-28. The statement should specify that the Bureau of Sport Fisheries and Wildlife has estimated 400 man-days of waterfowl hunting annually with the project.

Page II-85, Area Fishery. The source of data on commercial fishing at Lewisville Lake should be given. We were not aware that commercial fishing has ocurred in this lake within the last several years.

Page II-86, Biology. What is meant by the "present precarious course" of the area fisheries?

The Environmental Impact of the Proposed Action

The proposed action will not affect any existing or proposed unit of the National Park System, nor any site eligible for registration as a National Historic, Natural or Environmental Education Landmark.

The final statement should contain evidence of contact with the Texas Historic Preservation Officer and include his comments concerning the effect of the undertaking upon historical and archeological resources.

The draft statement suggests that intensive archeological surveys, testing and salvage will be undertaken. However, no definite plan to mitigate the impact on archeological resources is presented. The final statement should include this information.

Page III-5, Table III-1. The basis for specific EIU values in this and succeeding tables is not explained so that interpretation is difficult. The evaluation of aquatic vegetation, for instance, is open to question. We wonder whether the detrimental aspects of aquatic vegetation in a reservoir have been considered. Such vegetation tends to bind nutrients thus reducing fertility, increases BOD in winter die-off, provides escape cover for fish, reduces fishing area and success, and often is a factor in the overabundance of nongame fishes.

The positive EIU value assigned to commercial fisheries is conjectural. There are various legal and economic constraints which suppress commercial fishing, and there is no present indication that these constraints will be modified.

Waterfowl use at Aubrey Lake will be a transfer of use from other areas thereby decreasing the EIU value of those areas. As waterfowl use at Aubrey will not be "new" use, no EIU value should be assigned.

Page III-6, Table III-2. The assignment of a high positive EIU value to BOD should be explained. Intensive public use of the lake could lead to an increase in fertility resulting from the introduction of organic wastes. Unless sanitation measures are strictly enforced, BOD levels in the lake could become undesirably high.

Page III-18, paragraph 4. We see no relationship between the loss of 106 acres of ponds, stock tanks, and reservoirs, and the future construction of others adjacent to the project area. The building of new ponds also would occur without the project. Should the presence of the lake promote residential development on surrounding areas, pond construction would be less with the project than without the project.

Pages III-25 to III-28, Waterfowl. A +4.2 EIU value is assigned to waterfowl and several pages are devoted to the justification of this assumed value. It is contended that the project will lure waterfowl from the Mississippi Flyway because there is a deficit of habitat similar to that which will be provided by Aubrey Lake in the States of Arkansas and Louisiana. No reference is made to other types of waterfowl habitat such as the four million acres of coastal wetlands in Louisiana or the wetlands being improved for waterfowl as a result of continuing and expanding waterfowl management programs throughout both flyways. The conclusion that there is a deficit of habitat in Arkansas and Louisiana seems without basis.

One negative aspect that appears to have been overlooked is the impact of intensive recreational activity and development on the waterfowl potential at Aubrey Lake. The disturbance factor alone would be highly adverse.

Page III-28, paragraph (e). The estimate of 3,000 annual man-days of waterfowl hunting with the project does not agree with the estimate contained in the August 31, 1973, report of the Bureau of Sport Fisheries and Wildlife, which is 400 man-days.

Page III-29, Intangible Impact on Esthetics. The effect of the project on wild animals' habitat should be more than moderately adverse considering the inundation of 25,200 acres of bottomland wildlife habitat and the recurrent inundation of another 7,400 acres in the flood control pool. To this loss must be added the impact of concentrated recreational use of the remaining habitat in the project area.

Page III-30, Amphibians and Reptiles. The conclusion that amphibians and reptiles will increase in zones that are permitted to "return to nature" is valid but reflects a condition of restoration rather than a net gain as might be inferred.

Page III-42. Impact on Recorded Sites. The third sentence implies that inundation of sites (covering with water and silt) will protect

the sites (relatively) from further destruction. Not all inundated sites are covered with silt. Some will be eroded away by currents.

Page III-45, Recreational Elements. The discussion of the impact of recreational use of the area around Aubrey Reservoir is inadequate. The statement should contain more detail on adverse impacts caused by concentration of use around service facilities such as picnic and camping areas. The impacts of construction of roads and use of roads also should be considered.

Page III-50, Impact on Lewisville Lake. A discussion of the effects of construction of Aubrey Reservoir on recreational use of Lewisville Lake should appear in this section and/or section IV-10, page IV-5. Consideration should be given to such details as increased sediment in Lewisville Lake, noise and air pollution, and the length of time such adverse impacts may be expected to continue as a result of construction of Aubrey Dam.

Any Adverse Effects which Cannot be Avoided Should the Proposal be Implemented.

Page IV-1. The first sentence should be modified to identify the 25,200 acres as reservoir surface at conservation pool elevation.

Page IV-4, Archeological Resources. A systematic survey does not provide protection of archeological resources, but it does provide information which can be used to mitigate the impact on these resources.

Page IV-4, Recreational Resources. The discussion of mitigation measures to relieve adverse impacts is not adequate. The discussion should include measures to be taken to avoid pollution from sanitary facilities as this is one adverse impact that can be largely avoided by provision and care of sanitary facilities. The discussion should include more detail on soil compaction, vegetation damage, soil erosion and sedimentation, and measures to be taken to mitigate the impacts.

Pages IV-5 and IV-6. Adverse Impacts on the Lewisville Lake Project. Archeological sites to be inundated should be listed as an adverse effect.

Alternatives to the Proposed Action

Page V-5, paragraph (g). This paragraph contains the only reference in the draft statement to pipelines which will have to be abandoned or relocated. These should be described and discussed as appropriate

in the sections concerning the "Project Description," "Environmental Setting Without the Project," and "The Environmental Impact of the Proposed Action."

Page V-7, Detrimental Aspects. In this context, "procrastination" of salvage of archeological resources cannot be considered a detrimental aspect of the no-action alternative.

Page V-89, Table V-19. The "No Action" figure for Amphibians and Reptiles does not seem to conform to figures used for the other elements.

Any Irreversible and Irretrievable Commitments of Resources which would be Involved in the Proposed Action Should it be Implemented

The pictorial treatment in this section is a novel approach, but we believe that in many cases it would be inadequate for a full presentation of commitments.

Sincerely yours,

Willard Lewis

Willard Lewis
Special Asst. to the Secretary

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION
WASHINGTON, D.C. 20590
Room 11A23, 819 Taylor Street
Fort Worth, Texas 76102

August 15, 1973

Floyd H. Henk
Colonel, CE
District Engineer
Department of the Army
P. O. Box 17300
Fort Worth, Texas 76102

Dear Sir:

Reference is made to your letter of 23 July 1973 concerning the environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas.

The Office of Safety, Federal Railroad Administration, has no jurisdiction or authority in projects of this kind and therefore I have no comments to offer.

Very truly yours,

D. R. Holmes,
Regional Director

OMAR BURLESON
17TH DISTRICT
TEXAS

MRS. JUDITH CURTIS
ADMINISTRATIVE ASSISTANT

ZENO J. PHILLIPS
SPECIAL ASSISTANT

MEMBER
COMMITTEE ON
WAYS AND MEANS

Congress of the United States
House of Representatives
Washington, D.C. 20515

July 26, 1973

Colonel Floyd H. Henk
District Engineer
Department of the Army
Fort Worth, Texas 76102

Dear Colonel Henk:

Thank you so very much for your letter of July 23 and for the draft environmental impact statement on Aubrey Lake, Elm Fork, Trinity River, Texas.

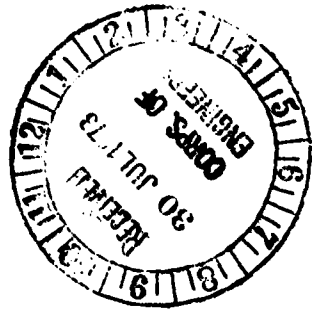
Colonel, I greatly appreciate having this statement.

With many thanks and good wishes, I remain

Sincerely yours,

Omar Burleson

OB:C/m



SIERRA CLUB

FOUNDED IN 1892

LONE STAR CHAPTER

August 7, 1973

Colonel Floyd H. Henk, District Engineer
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

We have reviewed the Draft Environmental Impact Statement for Aubrey Lake, Texas, and offer the following recommendations for the Final Statement.

I. We urge that hydrological data on the impact of the proposed project on the estuaries of Galveston and Trinity Bays be obtained, and included in the Final Statement.

II. We consider the environmental evaluation study, done by North Texas State University, to be, not only inadequate, but ludicrous. The Study, based on the new Battelle-Columbus method (described in the Draft Statement) had a total plus score of 1.74, and was thereby judged environmentally beneficial. But any change in any category could change the total.

Since the Battelle method had a 14 point parameter importance unit for Indians, so does the NTSU Study. There are no Indians in the area, and this parameter could have been excluded, but then they would have been 14 points short. The "Indian" score obviously turned out "no change", but Heaven help the study if any Indians turn up.

The most mysterious parameter listed is "Mystery"—the real mystery being, how was it determined that the "Mystery" factor would be increased 0.20? But, had "Mystery" been decreased by 1.75, then the project would have proved environmentally unfeasible—based on the mystery factor alone.

The Archeological PIU has already changed the total. This parameter had a PIU of 13, based on two known sites—a net change of -4.68. However, Southern Methodist University, (Dallas) has since conducted an archaeological reconnaissance, and discovered 25 more sites. If each of the previously known two sites was worth -2.34, then 27 sites should come out as -63.18—impossible since the maximum is 13. But, even with -13—there goes the study. Of course , mathematical acrobatics could be used on other catagories to plus the score, but we seriously question the value of a system, under which we believe, any proposed project, anywhere, could be scored to appear environmentally beneficial. We feel the Battelle system is mostly based on personal opinion, and individual whimsey.

We urge that an entirely new environmental evaluation, based on adequate scientific study be begun, completed, and included in the Final Environmental Impact Statement.

III. The SMU Archeological Reconnaissance was only a start. We urge that an adequate Archeological exploration be conducted, and the results included in the Final Environmental Statement.

Thank you for the opportunity to comment on the Draft Statement.

Sincerely,
Mary Wright

Mrs. Franklyn Wright, Conservation Chairman
9720 Wisterwood
Dallas, Texas 75238

TRINITY IMPROVEMENT ASSOCIATION

TELEPHONE (817) 261-1661 ■ 2615 AVENUE E EAST ■ SUITE 118 ■ ARLINGTON, TEXAS 76011

August 9, 1973

Colonel Floyd Henk
District Engineer
U. S. Army Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

In accordance with your request, the Trinity Improvement Association has reviewed the "Draft Environmental Impact Statement, Aubrey Lake, Elm Fork, Trinity River, Texas." Based on that review we offer the following comments:

(1) It is apparent that the total environment will be enhanced by the completion of Aubrey Lake. The lake will obviously change the ecology of the region, but these changes will result in greater benefits to man and the environment.

(2) The Trinity Improvement Association would urge that the Corps of Engineers utilize the "Proposed Plan for Aubrey Lake" rather than any of the "Alternatives to the Proposed Acts" presented in the Draft Environmental Impact Statement. In the opinion of the Association the alternatives would fall short of meeting the stated purposes of the Lake. The optimum project, as proposed, would produce the greatest positive impact and benefits.

(3) The positive environmental impact of Aubrey Lake will be realized to greater degrees in the future as the Dallas-Fort Worth-Denton area continues to grow and develop. The lake will provide much needed recreational facilities. It will also insure that a region that would probably be transformed into housing units and industries will remain in a rural state.

Sponsoring a coordinated program of improvement for the entire Trinity River Basin including flood control, soil-water-forest conservation, navigation, reclamation, alleviation of stream pollution, conservation of wildlife, and storage of water for municipal, agricultural, industrial and recreational uses.

(4) A knowledge of the future water supply requirements for North Central Texas enhances the benefits of Aubrey Lake. The high quality of water impounded by the Lake will not only contribute substantially to meeting the region's water needs, but will be aesthetically pleasing.

(5) The periodic flooding, that would be controlled by Aubrey Lake in conjunction with Lewisville Lake, would enhance the productivity of the land and protect the wildlife that resides within the flood plain. The Lake would also result in an increase of water fowl and aquadic wildlife that is not common to the region.

We appreciate the opportunity to review and comment on the "Draft Environmental Impact Statement, Aubrey Lake." We would urge that the project be expedited as rapidly as possible. Delays will only esculate the costs of the project to the taxpayers which,in our opinion, is detrimental to the total environmental picture.

Sincerely,

Lowell Duncan
Executive Director

LD/pc

SOUTHERN METHODIST UNIVERSITY

DEPARTMENT OF ANTHROPOLOGY
DALLAS, TEXAS 75222
Archaeology Research Program

August 9, 1973

Colonel Floyd H. Henk
District Engineer
Fort Worth District
U. S. Army Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

The Draft Environmental Impact Statement for Aubrey Lake includes a balanced approach to the archaeological resources which will be affected by the Aubrey Lake project. An initial reconnaissance is the first step in predicting the impact that can be expected by the project but as you point out (pg. II-65), it does not represent a comprehensive in-depth evaluation of the resources. Therefore, an intensive archaeological site survey needs to be completed before salvage excavations at important sites can be planned and carried out. I am sure that the necessary studies of the nonrenewable evidence of man's past contained at Aubrey Lake will be recorded and preserved through the coordinated efforts of all agencies involved with the project.

Sincerely,

S Alan Skinner/bbh

S. Alan Skinner
Director
Archaeology Research Program

SAS:bbh

North Texas State University
Denton, Texas 76203
Institute for Environmental Studies

July 31, 1973

Colonel Floyd H. Henk
District Engineer
Department of the Army
Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

I have read the draft of the "Environmental Impact Statement for Aubrey Lake, Elm Fork, Trinity River, Texas". I have also received comments on the draft from Drs. Pearson, Stewart and Zimmerman, and Professors Knox and Miller. Dr. Abshire is no longer in Denton and Dr. Roach is out of state this month. Since Dr. Odom is responding personally as president of the Denton County Historical Society, I did not ask for his comments. These individuals contributed to the report "A Systems Evaluation of the Environmental Impact of the Aubrey Reservoir Project on Elm Fork of the Trinity River in North Texas" prepared by the Institute for Environmental Studies at North Texas State University and submitted to the U.S. Army Corps of Engineers in 1972.

We realize that there was extreme difficulty in assembling the various reports and inputs into the draft. However, we believe that some of the clarity and precision in our report was lost in the construction of the draft. Some of the discontinuities in the draft produce a certain vagueness which does not reflect the time, effort and expense taken by the Corps and the Institute for Environmental Studies to properly assess the impact of Lake Aubrey. However, since most of our comments concern style, and there are no apparent conflicts with our report, we can make no serious criticism of the draft.

N. T. Box 5218 • AC 817-788-2157

I have enclosed a copy of a letter from Mrs. Mary Sapp who represented the Sierra Club at the public meeting in Denton on 27 October 1972. I believe that she read the letter written by Mrs. Franklyn Wright which appears on page VIII-6 in the draft. Considering the letter and Mrs. Sapp's comments during and after the meeting, her letter to Dr. Silvey suggests a change in attitude after reading our report. I have also enclosed my response to her letter.

We have enjoyed working on the Aubrey impact assessment with the Corps. Each member of your staff has been most courteous and helpful. We look forward to working with the Corps in the future to help maintain the environmental integrity of Northern Texas.

Sincerely,

Lloyd C. Fitzpatrick

Lloyd C. Fitzpatrick, Ph.D.
Acting Associate Director,
Institute for Environmental
Studies

LCF/kd
enc.

February 26, 1973

Mrs. Mary Sapp
4624 Gulfstream
Dallas, Texas 75234

Dear Mrs. Sapp:

Dr. Silvey forwarded your letter to me since I coordinated the Aubrey study. I am quite pleased with your assessment of the study and report. We believe that it was reasonably thorough for the time constraints. It is difficult for anyone to assess the overall impact of the reservoir by examining a single value of +1.74. Essentially, it appears to be an equal trade-off between the present system and a large lotic one.

Many of your suggestions for items to be included in the Battelle system are good. However, most of these and additional ones are included in the draft and final Environmental Impact Statement which is prepared by the Corps of Engineers. I suggest that you obtain a copy of their draft statement of which our report is only a part. This draft is sent to EPA for review. It is available to the public for 70 days. The draft with input and feedback from EPA and any other agencies, clubs, individuals, etc., is returned to the Corps for consideration and revision. Then the Final Statement is written and sent to FEE, CEQ, Congress, etc.

Several of us have given considerable thought to revising the Battelle EES so it will be more effective in assessing water resource projects in the North Texas region. We are attempting to obtain outside financial support for this purpose.

VIII-THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

A copy of our report is being sent under a separate cover.

Again, we appreciate your comments and hope to continue a dialogue with you in the future. If we can be of any service, please contact us.

Sincerely,

Lloyd C. Fitzpatrick, Ph.D.
Assistant Professor
of Biological Sciences

LCF/kd

February 19, 1973

Dr. J.K.G. Silvey
Distinguished Professor and
Chairman of Biology
North Texas State University
Denton, Texas 76203

Dear Dr. Silvey:

I have kept the enclosed studies much longer than I had intended. I found the systems evaluation of Aubrey Reservoir of particular interest since the past five months I have been intensively studying the Elm Fork and the Trinity River. Hence the delay in returning these.

I commend you and your staff for the detail in which you analysed the environmental system in the Aubrey report. You produced an impressive amount of information for the three month limitation of time. Perhaps now that the National Environmental Protection Act has been in existence for several years, such construction projects as Aubrey Reservoir will have evaluation of environmental systems at the very outset of the planning when they would be of most value either in determining if the project is valid or if there are areas of particular sensitivity.

The recommendations resulting from your study were the most significant part and perhaps should be placed in the front of the report. These recommendations and the red flags are perhaps the most productive part of any such report. It would be difficult for me to assess overall environmental impact as negative or positive with the "with project" and "without project" totals so close in numerical value.

I realize that the Battelle-Columbus system is a somewhat superficial attempt to give numerical value to environmental components. However, there seems to be elements missing -- they are the assessment of the purposes of the project. In the case of Aubrey Reservoir those, of course, would be flood control, water conservation, recreation and water supply. Since these are human needs, they should be factored into the assessment. For example, the need for water supply could be evaluated on the basis of current supply, projected population growth, alternative sources of water, expected life span of reservoir etc. For a project such as the Trinity River for which you recommend a tailored version of EES transportation requirements and alternative methods should be explored.

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Also in the Battelle system there does not seem to be an allowance for particularly sensitive areas of an environmental system; i.e., in an area such as Los Angeles air pollution should be given much greater weight....in areas such as the Pennsylvania Dutch Country religious groups should be given more weight....in areas such as Texas perhaps natural beauty, native vegetation etc. should be given more value. To make the evaluation system reliable and significant the weighting system might need to be altered for the particular area.

I am somewhat concerned in looking at several impact statements and studies that various methods are being used, that some are not in great enough detail to detect red flags such as yours did. Perhaps this is just an effect of the environmental study being so new. I also feel that the studies are not being made always to coincide with the proper stages of designing and decision making. Perhaps this too will be corrected with time.

I would like very much to have a copy of this report for my own reference. Do you suggest that I contact the Corps of Engineers to obtain one? I believe that the Battelle system merits further study and modification. Do you know if the Corps of Engineers plans to use this method for the Trinity River Basin Study?

Again, I am very grateful for the extended use of your materials. If our group can be of help to you at any time, please let us know.

Sincerely,

Mrs. Robert H. Sapp
4624 Gulfstream
Dallas, Texas 75234

239-5103

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

Denton County Historical Survey Committee
E. Dale Odom, Chairman
420 Headlee Lane, Denton, Texas 76201
Phone 817/382-3541

August 6, 1973

Colonel Floyd H. Henk
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

We have received the draft of your proposed Environmental Impact Statement, and while other members have not had an opportunity to examine it, the Committee has instructed me to write our reaction to it.

The Committee is now engaged in efforts to have the Hammons House mentioned in the draft put on the National Register of Historic places; we also hope to find funds to restore it. We appreciate the cooperation of the Corps and especially Mr. Sam Garrett in this endeavor.

We very much hope that we will have further cooperation from you when the project is begun and the task of moving cemeteries and gravesites begins. We are very anxious to see that historical markers are placed at appropriate places so that the historical significance of cemeteries and old abandoned communities might not be lost. We hope very much that since we have no funds appropriated for this purpose that through cooperation of Federal, state and county governments that markers can be purchased and placed in the appropriate places. We will certainly cooperate in this in every way we can.

We appreciate the growing concern on the part of the public and of government agencies for the preservation of our historical heritage. This task seems to fall to a relatively few interested persons and we appreciate your professional people like Mr. Garrett who will make efforts to assist us.

Thank you for the opportunity to respond to the draft; I hope this response does not prevent us from raising other points in the future.

Sincerely yours,

E. Dale Odom

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E. Dale Odom
Chairman, Denton County Historical Survey Committee

5913 Sycamore Creek Road
Fort Worth, Texas, 76134
August 4, 1973

Colonel Floyd H. Henk
District Engineer
Corps of Engineers
Fort Worth, Texas

Ref: Draft, Environmental Impact Statement, Aubrey Lake

Dear Sir,

After reviewing the archeological sections in particular and the remainder of the draft with a more general view it appears to me that Aubrey Lake Reservoir could be constructed with a minimum impact on the regions residents. That is,those living within the lake boundarys. For those with property fronting or close to the lake it should prove a regular "bonanza".

Concerning the archeological resources which will be affected it appears the survey in the proposed Aubrey Lake area was of minimum size and brief and that additional work should be carried out prior to any construction start.

The Section Possible Sites, page II-66 concerns the early man material found at the Lewisville Site during its construction. I would like to see a little more emphasis placed on the possibility of similar sites being in the Aubrey Lake construction area. Also cooperation of the Corps in allowing reasonable time for excavation if such deep sites are found during construction.

In Appendix F and G the same site designation numbers appear to be allotted to different sites, ie. sites designated as 41DN4 through 15 seem to be assigned to sites both in the Aubrey amd Lewisville Lake areas. I suggest you have Skinner at SMU and Nunley at Richmond College correct these descrepancys.

I appreciate the Corps inclusion of the archeological resources in this statement and hope that when this project gets the go-ahead that sufficient funds will be allocated for excavations at key sites.

Sincerely,
Robert L. Turner Jr.
Robert L. Turner, Jr.
Regional Vice President, North Tex.
Texas Archeological Society

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LEAGUE OF WOMEN VOTERS OF DALLAS 2626 W. MOCKINGBIRD, DALLAS, TEXAS 75235

August 13, 1973

Colonel Floyd H. Henk, District Engineer
Fort Worth District, Corps of Engineers
Post Office Box 17300
Fort Worth, Texas 76102

Dear Colonel Henk:

The League of Women Voters of Dallas would like to enter the following comments in your records concerning the Draft Environmental Impact Statement for Aubrey Lake, Elm Fork, Trinity River.

Since 1960, the League of Women Voters has supported, nationally, long-range planning of water resources development, management of water resources on a river-basin or regional basis, informed weighing of alternative plans, and citizen participation in water resource decisions. We appreciate the opportunity to consider your Statement on this project.

Water Supply: Provision of an adequate water supply for future population of the Upper Trinity River watershed is, we believe, the single valid reason for construction of Aubrey Lake. Therefore, the Statement should include data supporting the need for additional water for this area, and relating the Aubrey Lake project to water supply plans for the Upper Trinity Basin as a whole.

Some information is given concerning water needs and possible sources for Dallas and its customer cities; however, it is not made clear whether all of the water supply from Lake Aubrey will be allocated to Dallas.

Several statements indicate that the dependable yield is calculated as 84 million gallons per day for 1985 and 75.6 mgd for 2085, after sediment deposit. However, there is also a statement that, "The proposed Aubrey Lake would develop an estimated dependable yield of 67.2 mgd under 1985 conditions, and 60.1 mgd at year 2085 conditions." (pp. V 59-61) These latter figures correspond to the yield allocated to Dallas, averaging 63.66 mgd. (p. II-90)

Recreation: We agree that the provision of an additional site for lake-oriented recreation will be welcomed by that segment of the population which is already enjoying other area lakes. However, the greatest need for outdoor recreation facilities in this urban area is for open space more immediately accessible to population centers.

So far as water resource development is concerned, the principal source of such areas is multiple use of creek and river flood plains for flood control and recreation. While such proposals as the Elm Fork and Trinity River greenbelts are not viable alternatives to Aubrey Lake, since they lack the water supply component, we hope that they will be considered in preparation of future Corps proposals for the watershed.

Environmental Impact: The advantages of water supply and, to a lesser extent, recreation potentials to be gained by construction of Lake Aubrey do, in our opinion, outweigh the environmental damage which would result in the immediate area of the lake. We disagree with the indication of the Environmental Evaluation System that the reservoir would have a positive environmental impact on the project area.

While the parameters included in the Batelle-Columbus system provide a useful check-list of factors to be considered in evaluating environmental impacts, the system's uniform weighting of these factors for all projects is certainly subject to question. In the case of Lake Aubrey, insufficient weight is given to loss of 31,000 acres of productive crop and pasture land (p. IV-5) and to destruction of the streamside forest ecological system (p. III-36).

The Environmental Quality ratings appear, in numerous cases, to be arbitrary and illogical. For example:

Ecology (p. III-5):

We find no explanation given for the favorable rating (+1.56) given for Terrestial Habitats and Communities-Land Use. On the contrary, the text states that, "The effect on wild animals' habitat in the project site should be only moderately adverse" (p. III-29) and that, "With inundation and destruction of the habitat, all terrestial organisms will be displaced." (p. III-30)

Environmental Pollution (p. III-6):

The rating for Water Pollution-BOD (+7.50) appears to be erroneous. The text (p. III-10) indicates that inundation of vegetation will cause immediate and significant increases in biochemical oxygen demand and that, "The total effect and the time required to completely neutralize the problem is dependent on so many physical and climatological factors that it defies definition."

The evaluation indicates no change whatsoever in Air Pollution. With a forecast of 6.24 million days annually of recreation use for the lake, surely some vehicular emissions are to be expected. Assuming that the lake-users travel to the lake with an average of 3.12 persons to the car, there will be 2 million car trips to the lake. Assuming that they come an average distance of 25 miles to the lake, for a round-trip of 50 miles per visit, the lake-users will account for 100 million vehicle miles of travel annually. Additional emissions will be contributed by motor boats and commercial vehicles.

Esthetics (p. III-7):

Many of the judgments as to esthetics are subjective. We would disagree with the evaluation given for Wooded and Geologic Shoreline (+5.42) in view of the fact that, "The mixed lowland forest which is found only near the streams will be lost because of the project." (p. III-36) The new flood-plain forest will consist of willow and cottonwood. (p. III-38)

Human Interest (p. III-8)

We find no explanation of the favorable ratings given to Educational/Scientific Packages-Ecological (+2.60), Geological (+4.40), and Hydrological (+2.22). And we can think of no reason why study of a man-made lake would be more instructive than study of existing natural features.

Even more obscure are the improvements attributed to Historical Packages-Events (+0.66) and Persons (+1.10). The only explanation offered as to how these Packages may be enhanced is possible publicity--presumably occasioned by the inundation of the sites of the events and the graves of the persons. (p. III-44)

The positive ratings for Mood/Atmosphere: Awe-Inspiration (+0.22), Mystery (+0.20), and Oneness with Nature (+1.10) are surely subject to question by those who prefer a quiet wooded stream to a lake filled with motor boats and water-skiers.

Alternatives: We agree with the findings of the Draft Environmental Impact Statement that Lake Aubrey is the least expensive and probably the least environmentally damaging of the various projects which can assure equivalent water resources for the Upper Trinity area.

We hope that, before additional projects are proposed, the alternative of better population distribution will be considered by business and government policy-makers. We see nothing in the experiences of Los Angeles or Chicago to indicate that urban populations of 6 million (as projected for the Dallas area by 2020) are beneficial to people or to their environment.

Sincerely,

Pearl L. Wincorn

Mrs. Herbert Wincorn
Environmental Quality Chairman

TEXAS COMMITTEE ON NATURAL RESOURCES
4144 COCHRAN CHAPEL ROAD
DALLAS, TEXAS 75209
(214) 352-8370
August 10, 1973

Col. Floyd H. Henk, District Engineer
Department of the Army
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Col. Henk:

Enclosed are the comments of TCONR concerning Draft Environmental Impact Statement on Aubrey Lake.

Please include these comments in the record.

Sincerely yours,

Edward C. Fritz

ECF:edf

Encl.

BOARD OF GOVERNORS: Edward C. Fritz, Chairman; Mrs. Cleve Bachman, Jim Bowmar, E. W. Mudge, Jr.

CONTRIBUTING FELLOWS: Mrs. Glen Cornelius, Mrs. J. Claude Evans, Hazel C. Green, Ed Kutac, Mrs. William C. Miller, Mrs. Harold Volk, Mrs. Geth Osborn White

FELLOWS: Dr. W. Frank Blair, Mrs. Fagan Dickson, Howard Dodgen, Kay Evans, Dr. Frederick R. Gehlbach, Dr. Ira Gabrielson, Cass Germany, Mrs. J. W. Hershey, Mrs. Howard Kittel, Campbell Loughmiller, Micheaux Nash, Jr., Mrs. Stephen C. Thayer, Aylmer H. Thompson, Mrs. Larry White

Comments of TCONR in Reference
to Draft Environmental Impact Statement
on Aubrey Lake Project
by U.S. Corps of Engineers

I. Introduction

At first glance, only minor environmental objections appear in the Draft Environmental Impact Statement to cast doubt upon the worth of this project. However, when the various impact features of the project are considered as a whole, many serious sorts of objections surface. Although some sensible and tangible reasons are stated to justify the proposal, many more factors, not explicit in the EIS, can be uncovered tending to deny its viability. As with any magnitudinous action which will significantly alter ecological relationships, a very deep awareness of all of the aspects of the Aubrey proposal needs to be had before precipitous events destroy irretrievable and precious natural resources and human communities.

II. The Aubrey Ecosphere: Unique or Ordinary?

The Corps Draft Environmental Impact Statement, while thorough in detail and professional in execution, is curiously circumspect with regard to the destruction of flora and fauna within the zone of the lake. For instance, at several points within the statement, sections containing comment on the biological effects of the project literally dismiss the importance of preserving "mammals rare to this area, but common in the rest of the United States." (II-49, Appendix D) Since this particular project will directly change only this area, and because its effects will be fairly insignificant over the "rest of the United States", doubts are immediately raised as to the desirability of the possible extirpation of "locally rare" sic species. Is the destruction of one kind of animal in one area an expedient way to

guarantee its continued existence in other locales? A reasonable person could hardly think so. The Texas Endangered Species Act recognizes the values of preserving in Texas those species which are in danger of extinction in Texas, even though they may not be endangered in some other states.

Also conspicuously prominent as a detrimental factor is the manipulation and destruction of another rare natural feature, a section of the East Cross Timbers Physiographic Region. This unique ecosystem has already been decimated, and further action could forever remove what must be considered as a special element of the environment.

In the Statement much is made of the fact that the proposed lake may possibly serve as a way station for migratory waterfowl venturing through the Central Flyway. Yet only the most tenuous kinds of evidence exist to justify this position.

In spite of the environmental benefits touted to be a part of this project, even a brief examination of the facts as presented by the Draft Impact Statement raises serious doubts as to the long term ecological benefits of the proposal.

III. Archaeological Sites Within the Project: Projected Loss

Significant interest in the archaeological resources of the proposed area of innundation exists. (cf pp. II 58-66, VIII 17-19) Yet, apparently, no archaeological organization has been able to mount a full field survey of all of the identified sites, nor have efforts been made to identify further sites.

The quest for information about the origin and development of man depends vitally on archaeology. Surely, the destruction of such a large number of sites, without proper evaluation, cannot be shrugged off so easily as is done in the Statement.

IV. Land use changes wrought by the lake

With the construction of Aubrey Lake, massive land use changes will rapidly transform the areas immediately adjacent to the project. Eventually, these changes may be felt in further situated regional areas.

The Statement fails to grapple with the impact of these factors, merely mentioning that land acquisition and development will be uncontrolled and devoted to speculative exploitation.

At once, the lake will inundate many thousands of acres, replacing one set of productive factors with another. Admittedly, much of the land within the area of the reservoir zone is badly utilized, contributing to economic stagnation.

However, in a rapidly urbanizing area, undeveloped land is probably the most rare commodity. In this area, known euphemistically as the "metroplex", land values are appreciating rapidly, even in the fringe zones involved in this project (see table II-14), all of which are presently far removed from the urban milieu.

To remove large amounts of land from further development is to invite grave reverberations in the not-so-distant future, as urbanization moves further out from the metropolitan core. Although this sort of factor is difficult to speak to in quantitative terms, those who would remove large amounts of land from future use invite serious future environmental implications.

Immediately, however, we can fear for all of the "positive aesthetic benefits" mentioned in the Draft Statement, for uncontrolled development around Aubrey Lake may utterly denigrate these positive values. Unstructured development on and around the shores of the reservoir might well lead to clutter and unacceptable population density.

Speculative recreational and commercial use has wreaked havoc at several other Corps lakes in the area. In the Aubrey Draft Statement, while much mention is made of anticipated land use changes, no expression of awareness exists for the grossly detrimental possibilities of this particular factor of the project. (pIII-46)

V. Social and Economic Factors

Understandably, many of the social interactions to be found within the lake area will be uprooted and destroyed. Although the number of residents to be found within the boundaries of the project is not large, many other persons are bound to this area by historical and traditional ties. To gratuitously alter a human community is never to be treated so lightly as in the Statement.

To construct the lake is also to alter the economy of the area. Agriculture and commercial activities will probably be replaced by recreationally oriented endeavors. While it is difficult to estimate the net effect of such a change with any degree of certainty, care needs to be taken so as not to underestimate the potential of present economic use or to overestimate future income to be derived from the project, lest irreversible action be taken on the basis of inadequate or incorrect financial data.

The Draft Environmental Impact Statement largely fails to present adequate supporting economic data necessary to validate conclusions about the economic effects of the project. Specifically, more detailed information needs to be available in order to have a better breakdown of current economic activity within the affected area. Also, more information needs to be drawn up concerning future economic benefits which will offset the projected loss of income forecast due to inundation of productive lands and commercial establishments.

VI. Aesthetic values

Mrs. Franklyn Wright's letter (VIII-58) makes several good points about some of the mystifying aspects of the environmental evaluation system outlined in Pg III, 1-2. The language of the system is used to impute quantitative values to essentially qualitative kinds of aesthetic values. In general, these values with reference to the Aubrey project are in no way adequately explained by the Environmental Evaluation system.

VII. Alternatives and Closing Comments

Implicit in the Draft Environmental Statement is the sense that long-range planning for the future utilization of the water resources of this region has been all too particularistic, often oriented towards single projects, with only the most tenuous linkage to future needs and trends. This sense of the haphazard and the piecemeal does not act to convincingly support arguments for the Aubrey project.

In the long run, will this lake contribute to the future of the region in a sound, constructive way, or will it merely postpone the necessary search for viable answers to very difficult sorts of questions about resource management? Will the project be a manipulation of the environment for the good of man and nature, or is it but another ill-conceived effort to avoid inevitable realities? Most important, will the construction of Aubrey Lake enhance the quality of life in this area, or will it result in the further wholesale destruction of the already tattered linkages between man and nature? None of these questions have been sufficiently discussed in the Aubrey Draft Environmental Statement, and meaningful answers are sadly lacking.

THE UNIVERSITY OF TEXAS AT SAN ANTONIO
4242 PIEDRAS DRIVE EAST, SUITE 250 · SAN ANTONIO, TEXAS 78284

DEPARTMENT OF ENVIRONMENTAL STUDIES

August 20, 1973

Department of the Army
Fort Worth District Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

attn: Bruce M. Cowan, Major CE
Acting Deputy District

Dear Major Cowan:

At the invitation of Mr. Robert E. Apple, South Central Executive, National Wildlife Federation I agreed to guide my graduate class in Applied Ecology in reviewing the draft environmental impact statement for the proposed Aubrey Lake project.

Having 20 graduate students I divided them and we are really sending you two statements from the class.

Sincerely,

J. Leland Hepworth

J. Leland Hepworth, Ph.D.
Associate Professor
Environmental Studies
University of Texas at San Antonio

JLH:ch

cc: Robert E. Apple

Statements relative to the "Draft Environmental Impact Statement Aubrey Lake, Elm Fork, Trinity River, Texas", prepared by U.S. Army Engineer District, Fort Worth, Texas.

These statements are the result of the scrutiny and consideration of a graduate class in Applied Ecology, Summer Session II, 1973 at the University of Texas at San Antonio under the guidance of Dr. J. Leland Hepworth. There were twenty-one students in the class who are majoring in various fields of environmental management. They are as follows:

P.J. Alaniz
L.A. Biggers
A.L. Broden
R.K. Buchner
J.W. Bullard
L.L. Claar
G.C. Davis
W.W. Edwards
C.A. Hendricks
W.R. Jackson
Richard L. Wormell
R.D. Lindemann
H.L. Martin, Jr.
B.F. Ramzinski
A.J. Reyna
J.C. Shaeffer
G.C. Stiegler
W. Van Winkle, Jr.
H.D. Waters, Jr.
J.J. Warren
R.L. Wenske

Is there a Master Plan relative to the water supply for the area or is the planning piecemeal? There simply are not enough facts for ecologists to be judicious relative to the project.

We find insufficiency of evidence to support the 6.24 million recreation user-days per year. For one thing there will only be 11 sites developed and further one cannot expect quality recreation at the maximum number. People leave a city to escape a crowd and not to join one or else they attend a carnival.

We also feel that pollution control at the 11 recreational sites has been skimmed over.

At a time of energy insufficiency we feel that recreation such as sport motor boating and extensive recreational travel by air polluting automobiles should be curtailed.

The Aubrey Lake plan, if implemented, would give the "kiss of death" to existing stream fisheries or future stream fishers of the system. Streams remain viable as a fishery for a much longer period of time than an artificial lake. We fail to find evidence that the sister impoundments are quality fisheries and cannot conceive of the Aubrey Lake being any different. Lakeside developers would soon pollute the body of water as has been the case in many other similar circumstances.

Creating an unnatural lake would have many adverse effects. One of these would be the loss of part of the unique Cross Timbers.

It is our suggestion that a Cross Timbers Park and natural area be established.

From the data given in the draft it appears that 47 species of birds would have their habitat impinged upon and some would be extirpated from the site should the reservoir be constructed.

The plans to repressurize some of the capped oil wells in the area sounds unwise. This could blow the caps off and cause leakage. In fact, there is danger of both petroleum and salt water leakage into the water body should it be constructed. Further, in the face of existing petroleum shortages, there are 12 producing wells in the proposed site that would be inundated, thus stopping production.

The draft does not give sufficient statistical data to support the assumption that capping of wells in the Toledo Bend Reservoir is totally reliable. Nothing is said about the costs of these functions.

In this day of diminishing farmlands and increased starvation in the world can we conceivably remove this land from food production? Commercial fishery is given as an alternative to farm food production and yet no evidence is given that commercial fisheries are at the current time effective in sister impoundments.

As a group we challenge Table II-5. There is too much of a lack of clarity and substantiation for us to be in agreement. In fact, we question the validity of the tables in general.

The construction of the reservoir would adversely affect the rabbit population of the area. It should be kept in mind that

the cottontail rabbit supplies more meat for the American family than migratory water fowl and is nonmigratory and therefore available locally when needed.

Another adverse impact would be the inundation of reptile habitat and the movement of reptiles to higher ground. In the case of the venomous reptiles this would create a hazard to human beings who were in the area as the basin filled. This was the case with the filling of the Keystone Reservoir in Oklahoma.

We sincerely feel as professional engineers, mathematicians, biologists, geologists, ecologists and as students of environmental management that the best alternative would be NO ACTION! This would overcome all of the opposition we have stated or will state. This project is now untimely, unneeded, and environmentally unsound. It is our respectful opinion that the Army Corps of Engineers could put their efforts to projects of greater worth at this time.

In addition to the NO ACTION alternative we feel that the following actions have merit:

(1) Small upstream watershed improvements.

(2) Waste water recycling.

(3) Improving legal access to existing streams.

(4) Establishing combined public hunting, green belt, and low water retention dams.

As far as the other alternatives are concerned we considered them as being superfluous and felt it was a waste of time and paper to have included them.

The draft states "no significant changes"--then goes on to list exceptions. This is misleading. The plan purports to change the ecosystem in question from terrestrial to man-made aquatic and this certainly is significant.

Here we are being redundant, but we feel that to expend the energy to construct the project would be an irreversible and irretrievable commitment of resources and therefore strongly feel that the proposed project should not be implemented.

With the exception of Mrs. Wright's letter we feel that the other letters are of little consequence to the real issues at stake.

The proposed Aubrey Lake project is supposedly based on the beneficial aspects of flood control, overcoming water supply deficiencies, increased recreational opportunities, and conservation of fish and wildlife. However, we find a dearth of truly justifiable factors for creating this artificial lacustrine ecosystem at the expense of exploiting and disturbing the existing environment. The meager benefits, if any, do not justify the expenditure, especially during this time of energy crisis and paucity of agricultural land.

Flood Control

As a flood control project, the proposed Aubrey Lake would be an invalid utilization of resources and would result in the destruction of valuable, irretrievable, irreplaceable assets in the area. In addition to this, the proposal would be merely the sharing of functions with the extant Lewisville Lake which appears adequate for downstream flood control measures. The authors of the draft indicate that flood control is not a beneficial nor justifiable reason for the construction of Aubrey Lake. Therefore, flood control is a nonfunctional feature of this proposal which we strongly feel cannot be supported. It is further suggested impounding water has the tendency towards raising the ground water levels of the area which in turn reduces the absorption potential of the solum during periods of heavy precipitation which often precedes flooding.

Water Supply

Paragraph 3a states that 84,000,000 gallons of water per day will be available for municipal and industrial uses. There is no data in the proposal that demonstrates the need for this amount of water. The data used was pre-1970 census and its reflections have not been borne out by actual population increment. It is suggested that increased water would only assist in bringing about an increased population concentration in the area thus reducing the overall quality of life. In short, the proposal has not demonstrated the environmentally sound need for additional water nor justified the huge costs of the construction nor the loss of terrestrial habitat.

Recreation

The NEPA statement draft does not answer many questions about the existing impoundments in the area. Are the available recreation use days utilized? How well?
If Aubrey Lake were to be constructed, how many miles of streams would remain to be utilized recreationally?

The proposal states that the upland game habitat which currently stands at only 11,000 acres would be reduced to 5,600 acres--a 58% reduction!

It is stated that "the birds may stop here during their migration to the Gulf Coast." There is not sufficient evidence to warrant this. Without grain fields for forage many of the birds would find a resting place without the essential food

supply. We further suggest that surface water use conflicts, such as frictions between fishermen, swimmers, boaters and water skiers have not been considered.

Fish and Wildlife Conservation

We recognize that should Aubrey Lake be constructed there would not be a significant gain in aquatic species as they would be represented in the other impoundments of that general area. However, the numbers of the existing terrestrial species would be greatly reduced by the proposed Aubrey Lake impoundment. Further, the following increase of people in the area during nesting seasons would be disturbing to upland game birds.

As a final conclusion we suggest that the efforts of the Army Corps of Engineers be directed to more needful projects. We speak as ecologists and citizens.

Thank you very much for allowing us to study and comment upon this draft NEPA statement in behalf of the National Wildlife Federation.

League of Women Voters of Texas

DICKINSON PLAZA CENTER • DICKINSON, TEXAS 77539 • 713

MRS. DARVIN M. WINICK, PRESIDENT

August 17, 1973

Floyd H. Henk, Colonel, CE
District Engineer, Corps of Engineers
Fort Worth District
Fort Worth, Texas

THIS PAGE IS BEST QUALITY PRACTICABLE
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Dear Sir:

The League of Women Voters of Texas thanks you for sending us the draft of the Environmental Impact Statement for Aubrey Lake. We would like to make the following comments concerning the proposed project.

The League of Women Voters supports in general the broad purposes set out in the draft which you list as water conservation, recreation, fish and wildlife, and flood control. We also support procedures that supply information and encourage intelligent weighing of alternative plans in order that there can be meaningful citizen participation in water resource decisions. As the proposed plan for Aubrey Lake will inundate more than 25,000 acres of agricultural land and change the land use and wildlife patterns of 43,500 acres we feel the following questions need to be addressed before a final draft of the Aubrey Lake EIS is made:

1. Could the stated purposes of water conservation and recreation be as well or better served by using one of the alternative plans which meet all of the authorized purposes? We feel the public needs additional detailed information on the alternative plans.

2. Would not sufficient water supply be available to the Dallas-FortWorth metroplex growth areas by using the small impoundments alternative even though the projection indicates that the first cost might be slightly higher and the MGD factor slightly lower? Projections of population growth for the next few decades change daily, often with some indication of a tendency toward slowing growth. If this trend is predictive would not the alternative which considers several small impoundments built over a longer period of time be more flexible and responsive to change? Even if a slow-down in population growth does not materialize a recent Dallas League of Women Voters study has indicated that the Dallas area has a sufficient water supply for the projected population through 1995.

3. Would the conservation pool level at Lewisville Lake be raised less than the proposed 7 feet if one of the alternative plans were chosen? It appears from the draft that the Aubrey Lake project would inundate an additional 6400 acres by raising the Lewisville Lake level. If any one of the alternative plans was used would the Lewisville Lake need to be raised 7 feet? If not, what increase in pool level would you estimate for each of the alternative plans, and how many acres would be additionally covered with water under each alternative plan?

4. Would not the inundation of the 460 acres of land and 43 miles of streams which seemed to be indicated in the draft to be the projected result of building the small impoundments alternative construction be a viable trade-off if fewer than the 90 families scheduled to be relocated under the present plan could be required to disrupt their employment, shopping, social and cultural activities?

5. Would any or all of the 26 prehistoric and historic archeological sites and the assorted buildings and cemeteries of historic interest be saved under any of the alternative plans mentioned? More detailed information would be helpful in evaluating this potential saving of irreplacable sites and artifacts. It seems tha a very low PIU (parameter importance unit) numerical factor has been given to the esthetic, socio-economic, and archeological-historical factors in arriving at the final numerical rating of these various alternative plans. There also seems to be very little supportive information explaining how you evaluated the information used to abstract the environmental factors into the hierarchial EES (environmental evaluation system) which used the PIU value system evolved from the Battelle-columbus report. It seems inevitable that there will be ma ny subjective evaluations in assigning numerical values in these complex formulas to the factors mentioned in this question.

6. Would not the recreational and sports fishing purposes discussed in the draft as well as the factors mentioned in question #5 be as well or better served by chosing the alternative of several small upstream impoundments? It would seem that this alternative might better serve the recreational purpose and also increase the esthetic value of the areas involved as it would probably result in more shoreline, more remaining trees, more good fishing and camping areas and more interesting views and vistas than would the inundation of one large area.

7. Would any of the alternative plans serve the stated purpose of flood control better than the Aubrey Lake project? It seems from the impact statement that Aubrey Lake is not considered necessary for flood control, therefore it would be helpful to know if any of the alternative plans would serve this purpose.

Before the final draft of the Environmental Impact Statement for Aubrey Lake is prepared the League of Women Voters of Texas requests that the public be given an opportunity to consider alternative plans. We think that citizen participation in the decision-making process concerning Texas water resources is essential to serving the best interests of all the people of Texas.

Sincerely yours,

Mrs. Darvin M. Winick, President
League of Women Voters of Texas
by Mrs. Donald L. Titus
Mrs. Donald L. Titus, Director
Board of LWV of Texas

cc: Mrs. John Anderson, Director
Mrs. Wilfred Higgins, Director
Mrs. Barney Glickman, Director
Mrs. Laurence Perrine, EQ Committee
Mrs. Tom Miller, EQ Committee

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ADVISORY COUNCIL
ON
HISTORIC PRESERVATION

WASHINGTON, D.C. 20240

September 19, 1973

Col. Floyd Henk
District Engineer
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Col. Henk:

This is in response to your request of July 23, 1973, for comments on the environmental statement for Aubrey Lake, Elm Fort, Trinity River, Texas. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that while your draft environmental statement provides an excellent description of the historical questions involved, it does not fully comply with Executive Order 11593 "Protection and Enhancement of the Cultural Environment," of May 13, 1971 (copy enclosed).

The draft environmental impact statement describes possible adverse effects the undertaking will have on two potential nominees to the National Register of Historic Places, the Hammons' House (pp IV 3-4) and the prehistoric and historic archeological sites (p IV 4) identified by the Bousman and Verett archeological report. In compliance with Section 2(a) of Executive Order 11593, the Corps of Engineers, with the advice of the Secretary of the Interior and in cooperation with the Texas State Historic Preservation Officer, should locate, inventory, and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under the agency's jurisdiction or control that appear to qualify for listing on the National Register of Historic Places.

The Advisory Council would also like to call your attention to Section 2(b) of Executive Order 11593 which requires federal agencies to exercise caution to insure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished or substantially altered. If properties likely to meet the criteria for placement on the Register will be so affected, the Advisory Council should be notified and provided an opportunity to review and comment pursuant to Section 2(b).

THE COUNCIL, *an independent agency of the Executive Branch of the Federal Government, is charged by the Act of October 15, 1966, with advising the President and Congress in the field of Historic Preservation, commenting on Federal, federally assisted, and federally licensed undertakings having an effect upon properties listed in the National Register of Historic Places, recommending measures to coordinate governmental with private activities, advising on the dissemination of information, encouraging public interest and participation, recommending the conduct of special studies, advising in the preparation of legislation, and encouraging specialized training and education, and guiding the United States membership in the International Centre for the Study of the Preservation and the Restoration of Cultural Property in Rome, Italy.*

Upon compliance with Executive Order 11593 the Advisory Council will provide more substantive comments on the Draft Environmental Impact Statement regarding the Aubrey Lake Project.

If you should have questions on this matter please contact Louis Wall of the Advisory Council staff at our Denver Office at P.O. Box 26552, Belmar Station Lakewood, Denver, Colorado 80226.

Sincerely yours,

Ken Tapman
Compliance Officer

Dallas County Audubon Society

DALLAS, TEXAS

August 8, 1973

Col. Floyd H. Henk
Department of the Army
Fort Worth District. Corps of Engineers
P.O. Box 17300
Fort Worth. Texas 76102

Dear Col. Henk,

In regard to the environmental draft of the proposed Aubrey Reservoir project, we would like to suggest another environmental evaluation statement. We do not feel that any study based on the Batelle Colombus system could be of value.

Very sincerely,

Betty Miller
Conservation Chairman

MRS. WILLIAM C. MILLER
4723 Shadywood Lane
Dallas, Texas 75209

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ENVIRONMENTAL
DEFENSE
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2728 DURANT AVENUE, BERKELEY, CALIFORNIA 94704/415 548-8906

August 27, 1973

Floyd H. Henk
Colonel, CE
District Engineer
P. O. Box 17300
Fort Worth, Tex 76102

Dear Colonel Henk:

Please excuse my delay in replying to your letter of July 26, 1973, wherein you requested comments on the draft environmental impact statement on the proposed Aubrey Lake project.

Due to other work and responsibilities, I am unable to make comments on the EIS. Thank you for your patience in this matter.

Sincerely yours,

Gerald H. Meral
Staff Scientist

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NATIONAL AUDUBON SOCIETY

950 THIRD AVENUE, NEW YORK, N.Y. 10022 (212) 832-3200 Cable: NATAUDUBON

August 14, 1973

Col. Floyd H. Henk
District Engineer
U. S. Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Col. Henk:

On 23 July 1973, you addressed a copy of the draft environmental impact statement for Aubrey Lake, Elm Fork, Trinity River, Texas, to the southwest regional representative of the National Audubon Society at Austin.

The statement and your letter was forwarded to this office in New York City because Mr. John Spinks, our former southwest regional representative, left the employ of the National Audubon Society last June to become field secretary of the Wildlife Society. The vacant position has not been filled.

I want you to know that it was not due to lack of interest that the National Audubon Society was unable to comment on the Aubrey Lake statement by 10 August 1973 as requested.

Sincerely,

Charles H. Callison
Executive Vice President

CHC:psb

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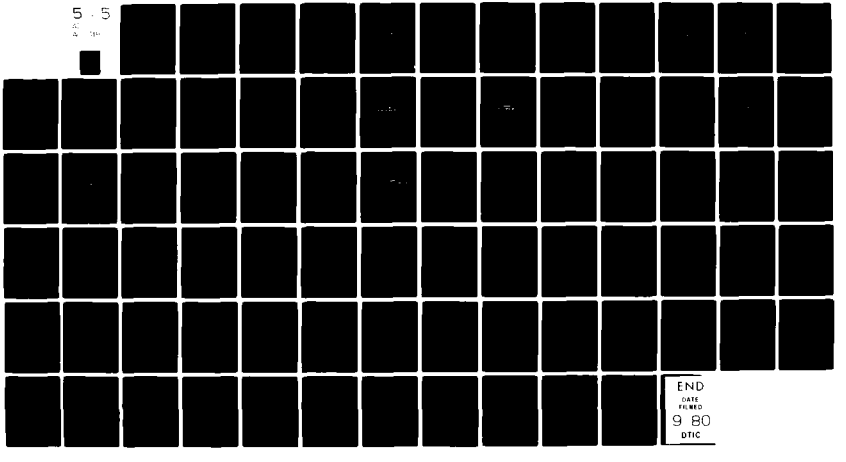

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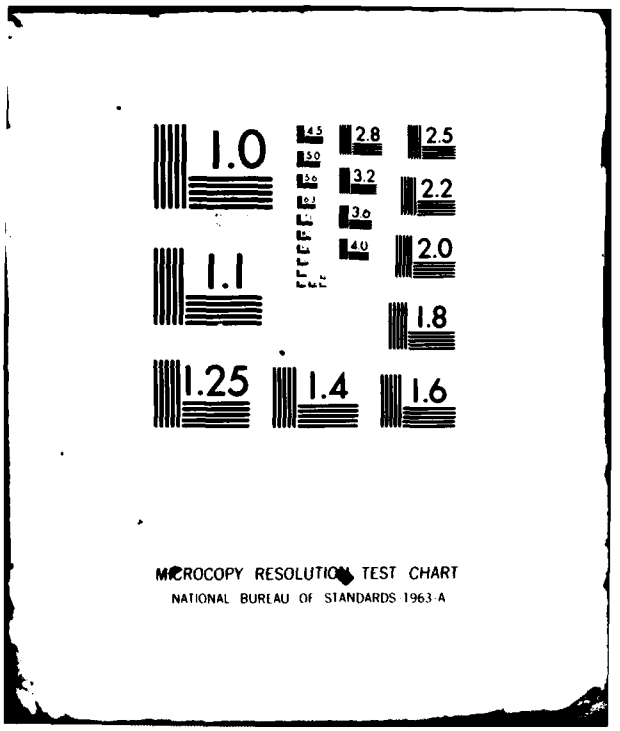
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GLOSSARY

GLOSSARY

ABORESCENT - Resembling a tree in properties, growth, structure, and appearance.

ACRE-FEET - The volume of water contained in 1 surface acre 1 foot deep.

ALLUVIUM - Sediments, usually fine materials, deposited on land by running water.

AMMONITE FOSSILS - Members of a large, extinct group of cephalopod mollusks, related to the living, chambered-shelled nautilus.

AQUIFER - A water-bearing stratum of permeable rock, sand, or gravel.

BIOCHEMICAL OXYGEN DEMAND - A test for the detection and measurement of pollution of water in which the quantity of oxygen that has been used by oxidizable materials is determined under standardized conditions. Abbreviated BOD.

BIOTA - All of the species of plants and animals occurring within a certain area or region.

BRACHIOPODS - Marine, shelled animals with two unequal, but usually bilaterally symmetrical, calcareous shells.

CANOPY - The uppermost layer in a forest consisting of the crowns of trees or shrubs.

CONSERVATION POOL - Space in a lake allocated for storage of water for such purposes as municipal and industrial water supply, irrigation, electric power production, and recreation.

DAY-USE MARKET AREA - The geographical area from which 80 percent or more of the day-users will originate.

DISCHARGE - As applied to a stream, the rate of flow, or volume, of water flowing in a given stream, at a given place, and within a given period of time.

DISSOLVED OXYGEN - The oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation. Abbreviated DO.

ECHINOID FOSSILS - Members of phylum Echinodermata, consisting of marine animals, most of which have a radial, five-rayed symmetry. Examples are starfishes, brittle stars, sea urchins, and sea lillies.

ECOLOGY - The study of the relationships between an organism and its environment.

ECOSYSTEM - The dynamic system formed by the interactions and reactions of all the members of a community with the physical and chemical features of the environment.

EDAPHIC - Resulting from or influenced by the soil rather than the climate.

ENVIRONMENT - The sum total of all the external conditions which may influence organisms.

EXOGYRA GENERA - A member of the oyster family resembling Gryphaea, but with the valves more equal and always spirally coiled, and having an obscure tooth on the hinge.

FERRUGINOUS - Containing iron; exhibits red coloring in rocks.

FLOOD - An overflow on land that is not normally covered by flood water.

FLUVIATILE - Produced by stream action.

FOOD WEB - All of the interconnecting "food chains" in a community.

GRYPHAEA GENERA - A member of the oyster family which is characterized by a strongly arched left valve, incurved beak, and a flat opercular right valve.

GUIDE TAKING LINE - The line used for the purpose of land aquisition, based on policy in Corps regulations. This line is located 5 feet vertically or 300 feet horizontally (whichever is the greater distance) from the established conservation pool level.

HABITAT - The sum total of environmental conditions of a specific place that is occupied by an organism, a population, or a community.

KINGERA GENERA - Members of phylum Brachiopoda, characterized by acorn-like shape and looped valves.

LACUSTRINE - Of, relating to, or formed in lakes.

LIGNITIC - Containing lignite, a brownish-black, low-grade coal.

LITHOLOGICALLY - Relating to the character of a rock formation.

LITTORAL - The zone in a lake or pond that extends from the shore to the greatest depth at which plants are rooted.

MEAN SEA LEVEL - Sea level at its mean position midway between mean high and low water adopted as a standard for the measurement of heights.

MONOCLINE - Strata that dip for an indefinite or unknown length in a single direction.

NICHE - The role of an organism in the environment.

OLD FIELD VEGETATION TYPE - A type of vegetational community which consists primarily of annual forbs and short-lived grasses supporting a very diverse assemblage of animal life. It is a secondary stage in the natural process of ecological succession normally associated with abandoned crop fields.

OSTREA GENERA - Members of the class Polecypoda; commonly known as oysters.

OUTCROP - A geological stratum which is exposed on the surface of the earth.

OVERSTORY - The layer of trees in a forest or wooded area that forms the canopy.

PELECYPODS - Marine animals characterized by bivalvular protective shells in which each valve is asymmetrical, but a mirror image of the other valve. Examples are clams, scallops, bivalved mollusks, mussels, and oysters.

pH - The reciprocal logarithm of the hydrogen ion concentration. The concentration is the weight of hydrogen ions in grams per liter of solution. Neutral water has a pH value of 7 and a hydrogen ion concentration of 10^{-7}.

PIEZOMETRIC - An imaginary surface or level that everywhere coincides with the static level of water in an aquifer.

RECREATION DAY - A standard recreational unit of use, defined as a visit by one individual to a recreation site or area for recreation purposes during all or any reasonable portion of a 24-hour period.

RECREATION DEMAND - The measured, implied, or predicted ability and desire of the people in a designated recreation area to expend (exert) recreation on a designated recreation resource. The demand may be latent, as in an undeveloped area which would be used if it were developed.

RECREATION NEEDS - Needs that exist when the demand for recreational opportunities exceeds the supply of recreational opportunities.

RECREATION RESOURCE - All of the elements (facilities, lands, management programs, and botanical and zoological elements) which combine to provide the opportunity for recreation experiences.

RIVER MILE - A unit of measurement starting from the mouth of a watercourse upstream along the deepest part of the channel of the main course to its designated point of origin.

STRATA - Sheet-like masses of sedimentary rock or earth of one kind lying between beds of other kinds.

STRATIGRAPHY - That section of geology that deals with the origin, composition, distribution, and succession of strata.

THALWEG - A line following the lowest part of a valley, whether under water or not.

UNDERSTORY - A foliage layer lying beneath and shaded by the main canopy of a forest.

WATERSHED - (1) The area contained within a divide above a specified point on a stream; (2) the divide between drainage basins.

APPENDIXES

APPENDIX A

DESCRIPTION OF ENVIRONMENTAL EVALUATION SYSTEM

APPENDIX A

Description of Environmental Evaluation System

The environmental system which will be modified by the Aubrey Lake project has evolved through long-term interactions among biological, physical, and cultural elements. It is impossible to assess the impact of the Aubrey Lake project on all of these elements. Therefore, this complex system must be abstracted into selected elements and parameters which capture the essence of the environment, i.e., those elements and their interactions from which the emergent properties of the system derive. These elements must represent "handles" on the environment which can be measured easily and are sensitive enough to reflect the environmental impact of the Aubrey Lake project.

The Environmental Evaluation System (EES) developed by Battelle-Columbus (9) for the Bureau of Reclamation's water resource projects is an adequate system for numerical evaluation of the environmental impact of the Aubrey Lake project. Essentially, the EES abstracts the environment into a hierarchical system (i.e., from general to specific) of 4 categories, 18 components, and 78 parameters. (see plate III-1).

The environmental parameters represent significant specific attributes of the environment which are relevant to water resource projects and which collectively capture the environmental quality with and without the project. The difference between the "with" and "without" environmental quality represents the impact of the project. The EES was used so the total numerical environmental impact index would reflect both spatial and temporal effects of the Aubrey Lake project. Systematic consideration was given to short-term or construction (the first 5 years) and long-term or use (the next 15 years) effects; and upstream, site, and downstream effects.

The rates of environmental, sociological, economic, cultural, demographical, etc. changes in this country make a 20-year forecast truly "long term." Therefore, because of the levels of resolution and confidence associated with many of the Battelle-Columbus EES parameters, the long-term (use period) impact calculations were conservatively restricted to within a 20-year period from initiation of the project. Since the project will not begin for several years, this represents a projection greater than 20 years. However, it is felt that the impact estimates will apply to most of the EES parameters for a longer period of time associated with the "normal" life of reservoirs in this part of the country. It is also anticipated that the U.S. Army Corps of Engineers will undertake or contract periodic reevaluations of the reservoir's impact, thus keeping abreast of changes which may not be predictable now.

A total of 1,000 points were apportioned among the four categories according to the weighting procedure developed by Attelle-Columbus and explained in their report (9). The points assigned to each category were then apportioned among their components and parameters according to the same weighting procedure. The values assigned to the environmental parameters are referred to as Parameter Importance Units (PIU) and reflect the relative importance of each parameter. Numbers in parentheses in plate III-1 represent the points assigned to categories, components, and parameters. Because the weights given to the parameters by Battelle-Columbus (9) represent their relative importance within the EES, and should not vary from project to project according to the subjective judgment of the investigating team, these weights were retained. In this way, objectivity was maintained during the analysis. This produced a numerical environmental impact index for the Aubrey Lake project which can be easily replicated and directly compared with impacts of other projects evaluated with the EES, especially those in the Trinity River Basin.

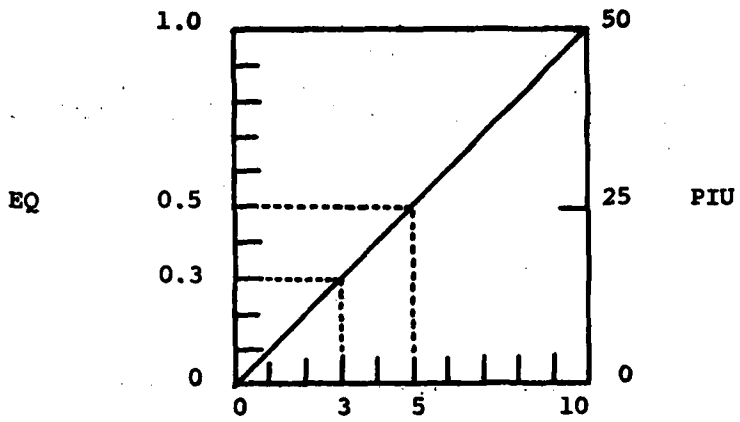
All environmental parameters were transformed into commensurate units according to the procedure described in the Battelle-Columbus report (9). This transformation followed three basic steps.

a. Weight parameters according to their relative importance in PIU's.

b. Transform all parameter estimates (based on field measurements and/or literature data) into corresponding units of Environmental Quality (EQ = 0 to 1). This scaling procedure of each parameter into a 0 to 1 range (0 = extremely poor quality; 1 = extremely high quality) provides a common base with which all parameters, regardless of their PIU's, can be directly compared, and results in impacts that can be expressed in commensurate units. The transformation of a parameter estimate or measurement into EQ is achieved through use of a value function which relates the various levels of parameter estimates or measurements to appropriate EQ levels. Figure A-1 is an example of a value function. The value functions developed by Battelle-Columbus (9) were employed in this study. From the figure, it can be seen that a parameter with an absolute measurement value of 5 has an EQ of 0.5 and a PIU of 25 ($EQ \times PIU_{max}$).

Figure A-1

Example of a Linear Value Function



Actual Parameter Measurement
In Absolute Units

Modified from the Battelle-Columbus Report

c. Obtain commensurate units or Environmental Impact Units (EIU), which are calculated as: EIU = EQ x PIU_{max}. Environmental impacts are measured in EIU's. For example, assume that the measurement of 5 represents the present status of the parameter (figure A-1) without the project, and the predicted measurement of the parameter with the project is 3. From figure A-1, the absolute value of 5 corresponds to an EQ of 0.5 and an absolute value of 3 corresponds to an EQ of 0.3. The impact of the project on the parameter in EIU's is calculated as:

$$\begin{aligned} \text{Project Impact} &= \text{EIU (with)} - \text{EIU (without)} \\ &= (0.3 \times 50) - (0.5 \times 50) \\ &= (15) - (25) \\ &= -10 \end{aligned}$$

The percent EQ change resulting from the project is calculated as:

$$\% \text{ EQ change} = \frac{\text{EQ (with)} - \text{EQ (without)}}{\text{EQ (without)}} \times 100$$

or, a change of

$$\frac{0.3 - 0.5}{0.5} \times 100 = -40\%$$

To capture the spatial and temporal aspects of the Aubrey Lake project's impact on the parameters, two time frames (construction or short term = 5 years; and operation, use, or long term = the following 15 years) and three spatial frames (upstream, site, and downstream) were used for the "with" project EIU evaluation. The "without" project EIU's were evaluated using a single time frame and the three spatial frames. Calculation of an impact index (in EIU's) which contains spatial and temporal elements required use of a worksheet-matrix. Figure A-2 is an example of a worksheet-matrix used to incorporate the spatial and temporal components into a single impact index for a given parameter.

Figure A-2

Worksheet-Matrix

Temporal \ Spatial	Upstream (RI=0.25)	Site (RI=0.50)	Downstream (RI=0.25)
"Without" (RI=1.0)	10	10	10
"With" Construction Period (RI=0.25)	8	8	8
"With" Use Period (RI=0.75)	4	4	4

Worksheet-matrix used to include spatial and temporal components in an index of the project's impact on a given parameter. RI = relative importance of each frame. RI's are assigned on the basis of professional judgment of the evaluator to the spatial and temporal frames. Numbers in each cell represent means of actual parameter measurements, estimates, or predictions. Modified from Battelle-Columbus Report.

The worksheet data must be transformed into Environmental Quality Units (EQ) for each parameter for the "with" and "without" project considerations. This is achieved in four basic steps:

(1) Assign relative importance (RI) to each spatial and temporal frame according to professional judgment of the evaluator.

(2) Multiply this RI factor by the actual parameter measurement in each cell.

(3) Sum the products of RI and the actual parameter measurement in each cell for the "with" and "without" values. This results in an estimate of the parameter value which is weighted according to the relative importance of each spatial-temporal frame.

$$\text{Parameter value (PIU) ("with" or "without")} = \sum_{i=1}^{n} \sum_{j=1}^{m} C_{ij} X_{ij},$$

where

- i = Spatial index
- j = Temporal index
- C_{ij} = Importance of cell ij (RI)
- X_{ij} = Measurement of cell ij
- n = Number of spatial areas considered

(4) Determine the EQ of the weighted parameter estimates for "with" and "without" the project from the linear value function graph (figure A-1).

The environmental impact on a parameter in EIU is calculated as:

$$EIU = (PIU \times EQ_{with}) - (PIU \times EQ_{without})$$

where EQ's are derived according to the preceding four steps.

The following is an example using data in the previous worksheet (figure A-2) and the value function graph (figure A-1) to calculate the environmental impact on a parameter:

Weighted Parameter
Measurement Without Project = 1.0 ((0.25 x 10) + (0.50 x 10) + (0.25 x 10)) = 10

Weighted Parameter
Estimate with Project = 0.25 ((0.25 x 8) + (0.50 x 8) + (0.25 x 8)) = 2

Construction Period

Weighted Parameter
Estimate With Project = 0.75 ((0.25 x 4) + (0.50 x 4) + (0.25 x 4)) = 3

Use Period

The total "with" project weighted parameter estimate = 5.0 (3 + 2 above)

The total "without" project weighted parameter estimate = 10 (above)

For this example, the environmental quality (EQ) is determined from figure A-1 by applying the 10 absolute units and the 5 absolute units derived above.

"Without" EQ = 1.0 (Corresponding to 10 absolute units)
"With" EQ = 0.5 (Corresponding to 5 absolute units)

The environmental impact (EIU) on the parameter is:

$$EIU = (PIU \times EQ_{with}) - (PIU \times EQ_{without})$$
$$= (50 \times 0.5) - (50 \times 1.0)$$
$$= -25$$

$$\% \text{ EQ change} = \frac{EQ \text{ (with)} - EQ \text{ (without)}}{EQ \text{ (without)}} \times 100$$
$$= \frac{0.5 - 1.0}{1.0} \times 100$$
$$= \frac{-0.5}{1.0} \times 100$$
$$= -50\%$$

Therefore, to obtain the total numerical impact index for the entire project, it is necessary to determine the EIU for each specific parameter and then sum over all 78 parameters. The Environmental Impact Index in EIU's is determined by using the following equation:

$$EIU = \sum_{i=1}^{78} w_i EQ_i \text{(with)} - \sum_{i=1}^{78} w_i EQ_i \text{(without)},$$

where

i = parameter index
w_i = relative importance of i^{th} parameter in PIU
EQ_i = environmental quality coefficient of i^{th} parameter obtained from value function graph

In general, a negative (-) change indicates an adverse environmental impact and a positive (+) change indicates a beneficial impact.

The EES uses "Red Flags" to point out extremely fragile environmental elements (i.e., those likely to be significantly changed adversely by a project) and/or those for which adequate quantitative data are unavailable at the writing of the environmental impact statement. "Red Flags" are used to indicate parameters which require further detailed study and/or should be given special consideration in the planning and modification of the project. In this study, "Red Flags" should be seriously considered during the planning, construction, and use phases of the Aubrey Lake project.

Four rules are used to determine if a negative change in a parameter constitutes a "Red Flag" and type of flag that should be used. Each of these rules is based on a change in the parameter's environmental quality (EQ) as measured by the extent of difference between the "with" and "without" evaluations. As previously indicated, the EQ of a parameter is determined from a value function graph.

For Ecology Parameters:

Rule 1 - Minor Flag: The negative change in percent between the "with" and "without" EQ is between 5 and 10 percent.*

Rule 2 - Major Flag: The negative change in percent between the "with" and "without" EQ is greater than 10 percent.

For all other parameters:

Rule 3 - Minor Flag: The negative change between the "with" and "without" EQ is greater than or equal to 0.1 in absolute value and this results in a percentage change of less than 30 percent.

Rule 4 - Major Flag: The negative change between the "with" and "without" EQ is greater than or equal to 0.1 in absolute value and this results in a percentage change of more than 30 percent.

$$*\text{Percent} = \frac{\text{"with" EQ} - \text{"without" EQ}}{\text{"without" EQ}} \times 100$$

APPENDIX B

AMPHIBIANS IN THE PROPOSED AUDREY LAKE AREA

Appendix B

Amphibians in the Proposed Aubrey Lake Area

Species	Abundance
Ambystoma texanum Small-Mouthed Salamander	Occasional
Scaphiopus holbrooki Eastern Spadefoot	Common
Bufo debilis Green Toad	Common
Bufo speciosus Texas Toad	Common
Bufo woodhousei Woodhouse's Toad	Common
Acris crepitans Cricket Frog	Common
Hyla cinerea Green Tree Frog	Rare
Pseudcris clarki Spotted Chorus Frog	Common
Rana catesbeiana Bullfrog	Common
Rana pipiens Leopard Frog	Occasional
Gastrophryen olivacea Western Narrow-Mouthed Toad	Rare

APPENDIX C

REPTILES IN THE PROPOSED AUDREY LAKE AREA

Appendix C

Reptiles in the Proposed Aubrey Lake Area

Species	Abundance
Chelydra serpentina Snapping turtle	Common
Kinosternon flavescens Yellow mud turtle	Common
Kinosternon subrubrum Common mud turtle	Occasional
Sternothaerus carinatus Keel-backed Muskturtle	Occasional
Deirochelys reticularia Chicken turtle	Occasional
Graptemys pseudogeographica Gray-false map turtle	Rare
Pseudemys scripta Pond slider	Common
Terrapene carolina Box turtle	Occasional
Terrapene ornata Western box turtle	Common
Trionyx spinifer Spiny softshell	Common
Anolis carolinensis Green anole	Rare
Crotaphytus collaris Collared lizard	Rare
Phrynosoma cornutum Texas horned lizard	Occasional
Sceloporus olivaceus Texas spiny lizard	Common

Appendix C - Continued

Species	Abundance
Sceloporus undulatus Eastern fence lizard	Occasional
Ophisaurus attenuatus Slender grass lizard	Occasional
Cnemidophorus seclineatus Six-lined racerunner	Rare
Eumeces fasciatus Five-lined skink	Rare
Eumeces septentrionalis Prairie skink	Common
Lygosoma laterale Ground skink	Common
Coluber constrictor Racer	Occasional
Diadophis punctatus Eastern ringneck snake	Occasional
Elaphe obsolete Rat snake	Occasional
Haldea striatula Rough earth snake	Common
Masticophis flagellum Coachwhip	Common
Natrix erythrogaster Watersnake	Occasional
Natrix rhombifera Diamond-backed water snake	Common
Opheodrys aestivus Rough green snake	Common
Pituophis melanoleucus Bull snake	Occasional

Appendix C - Continued

Species	Abundance
Tantilla gracilis Flat-headed snake	Common
Thamnophis proximus Western Ribbon snake	Occasional
Agkistrodon contortrix Copperhead	Occasional
Agkistrodon piscivorus Cottonmouth	Common

APPENDIX D

MAMMALS IN THE PROPOSED AUBREY LAKE AREA

Appendix D

Mammals in the Proposed Aubrey Lake Area

Species	
Common Name	Scientific Name
Oppossum	Didelphis marsupialis
Armadillo	Dasypus novemcinctus
Red Bat	Lasiurus borealis
Raccoon	Procyon lotor
Ringtail	Bassariscus astutus
Spotted Skunk	Spilogale putorius
Striped Skunk	Mephitis mephitis
Gray Fox	Urocyon cinereoargenteus
Coyote	Canis latrans
Fox Squirrel	Sciurus niger
Pocket Gopher	Geomys bursarius
Hispid Pocket Mouse	Perognathus hispidus
Long-tailed Harvest Mouse	Reithrondontomys fulvescens
Gray Harvest Mouse	Reithrondontomys montanus
Deer Mouse	Peromyscus maniculatus
White-footed Mouse	Peromyscus leucopus
Cotton Rat	Sigmondon hispidus
Eastern Wood Rat	Neotoma floridana
Muskrat	Onadatra zibethicus

Species

Common Name	Scientific Name
Nutria	*Myocastor coypus*
Housemouse	*Mus musculus*
Jack Rabbit	*Lepus californicus*
Swamp Rabbit	*Sylvilagus aquaticus*
Cottontail	*Sylvilagus floridanus*
White-tail Deer	*Odocoileus virginianus*

APPENDIX E

BIRDS IN THE PROPOSED AUBREY LAKE AREA

Appendix E

Birds in the Proposed Aubrey Lake Area

Species			
Common Name	Scientific Name	Resident	Migratory
Great Blue Heron	Ardea herodias		X
Green Heron	Butorides virescens		X
Little Blue Heron	Florida caerulea		X
Common Egret	Casmerodius albus		X
Gadwall	Anas strepera		X
Pintail	Anas acuta		X
Green-Winged Teal	Anas carolinensis		X
Blue-Winged Teal	Anas discors	X	
American Widgeon	Mareca americana		X
Shoveler	Spatula clypeata		X
Redhead Duck	Aythya americana		X
Turkey Vulture	Cathartes aura	X	
Black Vulture	Coragyps atratus	X	
Cooper's Hawk	Accipiter cooperii	X	
Red-Tailed Hawk	Buteo jamaicensis	X	
Swainson's Hawk	Buteo swainsoni		X
Marsh Hawk	Circus cyaneus	X	
Sparrow Hawk	Falco sparveius	X	
Bobwhite	Colinus virginianus	X	
American Coot	Fulica americana	X	
Killdeer	Charadrius vociferus	X	
Upland Plover	Bartramia longicauda		X

Appendix E - Continued

Species			
Common Name	Scientific Name	Resident	Migratory
Spotted Sandpiper	Actitis macularia		X
Mourning Dove	Zenaidura macroura	X	
Screeh Owl	Otus asio	X	
Great Horned Owl	Bubo virginianus	X	
Chuck-Wills-Widow	Caprimulgus carolinensis		X
Common Nighthawk	Chordeiles minor		X
Chimney Swift	Chaetura pelagica		X
Ruby Throated Hummingbird	Archilochus colubris		X
Black Chinned Hummingbird	Archilochus alexandri		X
Belted Kingfisher	Megaceryle alcyon	X	
Yellow Shafted Flicker	Colaptes auratus		X
Red Bellied Woodpecker	Centurus carolinus	X	
Donny Woodpecker	Dendrocopos pubescens	X	
Eastern Kingbrid	Tyrannus tyrannus		X
Scissor-Tailed Flycatcher	Muscivora forficata	X	
Great-Crested Flycatcher	Myiarchus crinitus		X
Eastern Wood Pewee	Contopus virens		X
Horned Lark	Eremophila alpestris	X	
Bank Swallow	Riparia riparia		X
Barn Swallow	Hirundo rustica		X
Cliff Swallow	Petrochelidon pyrrhonota		X
Bluejay	Cyanocitta cristata	X	
Crow	Corvus brachyrhynchos	X	

Appendix E - Continued

Species			
Common Name	Scientific Name	Resident	Migratory
Carlina Chickadee	Parus carolinensis	X	
Tufted Titmouse	Parus bicolor	X	
Brown Creeper	Certhia familiaris		X
House Wren	Troglodytes aedon		X
Carolina Wren	Thryothorus ludovicianus	X	
Mockingbird	Mimus polyglottos	X	
Catbird	Dumetella carolinensis		X
Brown Thrasher	Toxostoma rufum	X	
Robin	Turdus migratorius	X	
Eastern Bluebird	Sialia sialis	X	
Cedar Waxrving	Bombycilla cedrorum		X
Loggerhead Shrike	Lanius ludovicianus	X	
Starling	Sturnus vulgaris	X	
Red-Eyed Vireo	Vireo olivaceus		X
Warblers (Bl. and Wh.)	Mniotilta varia		X
House Sparrow	Passer domesticus	X	
Eastern Meadowlark	Sturnella magna	X	
Redwing Blackbird	Agelaius phoeniceus	X	
Orchard Oriole	Icterus spurius		X
Boat-Tailed Grackle	Cassidix mexicanus	X	
Cowbrid	Molothrus ater	X	
Cardinal	Richmondena cardinalis	X	

Appendix E - Continued

Species			
Common Name	Scientific Name	Resident	Migratory
Blue Brosbeak	Buiraca caerulea		X
Indigo Bunting	Passerina cyanea		X
Painted Bunting	Passerina ciris		X
Dickcissel	Spiza americana		X
Savannah Sparrow	Passerculus sandwichensis		X
Vesper Sparrow	Pooecetes gramineus		X
Lark Sparrow	Chondestes grammacus		X
Goldfinch	Spinus tristis	X	
Slate-Colored Juneo	Junco hyemalis		X
Field Sparrow	Spizella pusilla		X
Harris Sparrow	Zonotrichia querula		X
White Crowned Sparrow	Zonotrichia leucophrys		X
White Throated Sparrow	Zonotrichia albicollis		X
Lincoln's Sparrow	Melospiza lincolnii		X
Song Sparrow	Melospiza melodia		X

APPENDIX F

ARCHEOLOGY IN THE PROPOSED AUBREY LAKE AREA

Table 1. Aubrey Reservoir Settlement Data.

Site number -- 41 represents TEXAS, DN or CO represents the county in which the site occurs either Denton or Cooke county, and the sites are numbered consecutively in each county.

Environment -- macro: P) - Grand or Blackland prairie district
T) - Eastern Crosstimbers district
micro: 1) - River or drainage
2) - Floodplain
3) - Floodplain rise
4) - Fluviatile terrace
5) - Upland slope
6) - Upland

Site description -- discussion of artifacts occurence, area, soil, and any distinguishing factors of a site.

Activity -- 1) Tool manufacturing: flakes possibly with cores, preforms broken, projectile points, and hammerstones.
2) Hunting: preforms, broken and whole projectile points, and flakes.
3) Cooking: ceramics, burned bone, and fire cracked rock.
4) Wild food processing: manos, metates, heavy chopping tools, and bone.
5) Quarrying: natural workable material usually quartzite cobbles or outcroppings of sandstone, flakes, cores, and preforms.
6) Mussel shell collecting: concentrations of mussel shell in or adjacent to a site.
7) Ceremonial: burials.

Period -- Neo-American: Ceramics and/or arrow points
Archaic: Dart points

F-1

Site Number	Environment Macro	Micro	Site Descriptions	Activity	Period
41DN9 (con't)			By R. King Harris in the 30's. The site has since been destroyed by gravel operations. It was approximately 9000 square meters and the soil is clay.		
41DN10	P	2	A light scattering of flakes and fire-cracked rock covering 150 square meters. The soil was black clay	1,3	-
41DN11	P	3	Flakes, bone, mussel shell, ceramics scattered on both sides of a small drainage of the Elm Fork, with both clay and sandy soil. This site may be an extension of 41DN5.	1, 3,4,6	Neo-American
41DN12	P	4	A surface scatter of cores, flakes, fire-cracked rock, bifaces, hammerstones, and mussel shell. It was also the site of an old house and there was a pot hole in the site about 80 c.m. deep. The site covers 2500 square meters.	1,3,6	-
41DN13	P	5	Surface scatter of cores, flakes, hammerstones, manos, and fire-cracked rock. The soil is clay and the site covers 300 square meters.	1,3,4	-

Site Number	Environment Macro	Micro	Site Descriptions	Activity	Period
41DN4	T	5	A thin surface flake scatter, covers 600 square meters, sandy soil	1	-
41DN5	P	2	A surface scatter of mussel shell, flakes, fire-cracked rock, cores, bone, ceramics, arrow points in a small drainage, material seems to be eroding out of the sides of the drainage. Cultural debris cover 1200 square meters	1,2,3,6	Neo-American
41DN6	T	6	A surface scatter of flakes, and retouched flakes	1	-
41DN7	T	4	A surface scattering of flakes, cores, manos, and fire-cracked rock. It covers 300 square meters and is sandy soil	1,4	-
41DN8	T	2	Flakes, dart points, mussel shell, burned bone, cores, fire-cracked rock all of which were eroding out of a bank of a small tributary of the Isle du Bois. The site covered an area of 100 square meters and the soil was clay	1,2,3,6	Archaic
41DN9	P	4	Flakes, bifaces, dart and arrow points, ceramics, scrapers, choppers, celts, manos, drills, mussel shells, burials, and 2 possible mounds were collected and excavated	1,2,3,4, 6,7	Archaic & Neo-American

Site Number	Environment Macro	Environment Micro	Site Descriptions	Activity	Period
41DN14	P	4	A light scatter of flakes, cones, and fire-cracked rock, no indication of subsurface material. The area of the site covered 2500 square meters and soil was clay.	1,3	-
41DN15	T	4	Large amounts of manos, metates, mussel shell, fire-cracked rock, flakes, cores, hammer-stones, dart and arrow points, and ceramics. Seemingly continued at least to a depth of 40 c.m., if not further. Situated on a sandy terrace projection.	1,2,3,4, 6	Archaic & Neo-American
41CO11	T	5	A surface flake scatter, but a core was eroding out of the side of a gully about 30 c.m. below surface. Cultural debris covered 100 square meters.	1	-
41CO12	T	2	A scatter of flakes on rodent back dirt, and it covers 10 square meters.	1	-
41CO13	T	5	Flakes, cores, dart points and unmodified quartzite cobbles on surface and eroding out of gully about 20 c.m. below surface. Cultural debris covered about 2800 square meters.	1,2,5	Archaic

Site Number	Environment Macro	Micro	Site Descriptions	Activity	Period
41 CO14	T	5	Surface scatter of flakes and cores, unmodified quartzite cobbles eroding out of hillside. Northern part of site had been bulldozed. Covered 200 square meters.	1,5	-
41CO15	T	4	A scatter of cores, flakes, fire-cracked rock, manos, bone, hammerstones, dart and arrow points, and a waco sinker on the edge of a sandy terrace for about 300 meters. Entire site covers 15000 square yards.	1,2,3,4	Archaic & Neo-American
41CO16	T	3	Tested in 1963 by Hoffrichter and Gilmore. Dart points, cores, flakes, and fire-cracked rock where recovered. Cultural debris cover 900 square meters on a dark sandy loam soil. The rise was a natural levee, produced by stream overflow.	1,2,3	Archaic
41CO17	T	5	A surface scatter of dart points, flakes, fire-cracked rock, and a scraper. Cultural debris cover 4400 square meters on an upland slope which is terminated by the Isle du Bois Creek. The soil is sandy loam.	1,2,3	Archaic
41CO18	T	5	A light scatter of flakes and fire-cracked rock found mostly in the back dirt of rodent holes. The soil is sandy loam and the area covered by cultural debris is 500 square meters.	1,3	-

Site Number	Environment Macro	Environment Micro	Site Description	Activity	Period
41C019	T	5	A surface scatter of cores and natural quartzite cobbles eroding out of hill side. Cultural debirs cover 2500 square meters and the soil is dark sandy loam.	5	-
41C020	T	6	A surface concentration of flakes, cores, and unmodified quartzite cobbles covering 100 square meters. The soil is dark sandy loam.	5	-
41C021	T	6	The remains of a log cabin built about 1870. It is 10 feet by 12 feet and made out of oak. No nails were found and logs were notched.	-	Historic
41C022	T	4	A scatter of flakes and fire-cracked rock which were found in the back dirt of rodent holes. Cultural debris covered 2500 square meters and the soil was sand. Vegetation cover was extremely heavy.	1,3	-
41C023	T	6	A surface scatter of flakes, cores, manos, and hammerstones, also unmodified quartzite cobbles were abundant. Cultural debris covered 2500 square meters and the soil was sand. Settlers have lived on the site since 1835.	1,4,5	-

Site Number	Environment Macro	Micro	Site Description	Activity	Period
41CO24	T	6	A surface scatter of cores, heavy choppers, and unmodified quartzite cobbles. The artifacts cover 900 square meters adjacent to a small intermittment stream.	4,5	-

APPENDIX G

ARCHEOLOGY IN THE EXISTING LEWISVILLE LAKE AREA

SUMMARY OF THE IMPACT OF GARZA-LITTLE ELM RESERVOIR UPON ARCHEOLOGICAL RESOURCES AND GENERAL RECOMMENDATIONS

Generalizing from Prewitt's excellent statement concerning the effects of Lake Texoma upon archeological sites (Prewitt 1972: 6-11), it is possible to define three Zones of Effect caused by the placement of a reservoir in a locale of riparian occupation. These are:

Zone I. Those areas which can be expected to be covered by water and/or silt during the active life of the reservoir and be thereby relatively protected from further destruction.

Zone II. The sloping shore/beach areas around the perimeter of the reservoir that are directly affected by fluctuations in the water level. This zone can be defined as that shoreline lying within the vertical distance between the minimum water level and the spillway elevation. This is the area of maximum, unscheduled destruction of archeological data by such diverse factors as rapid erosion caused by wave action, rapid leaching of bone and shell caused by

repeated inundation, and extensive exploitation by casual relic collectors.

Zone III. All other areas in the locale affected in any way by the construction of the dam and its subsequent filling are included in this zone. These areas include the dam site and attendant construction activities; recreational and housing construction attracted to the area by the reservoir; and roads, causeways, bridges, ditches, etc., constructed as a result of the placement of the reservoir. This is the zone of maximum scheduled destruction of archeological data. Loss of data in this zone can be controlled by careful work in advance of planned construction.

For purposes of the present study, Zone I is defined as that portion of the reservoir lying below 500'; Zone II lies between 500' and 535'; while Zone III consists of all other areas, and is mainly above 535' above mean sea level. As indicated in Table 4, 7 sites (about 13 per cent) lie in Zone I; 28 (50 per cent) lie in Zone II; and 20 (37 per cent) lie in Zone III. Five of the reported sites lie well outside the reservoir area and are not included.

It is apparent that those sites in Zones II and III are currently imperiled by the effect of the reservoir, and should be given first

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priority attention. A systematic program of site sampling, description and analysis should be implemented immediately. This program must be directed not only toward adding to the archeological record (as have been most "salvage" programs of the past), but should include theoretical considerations as well.

The approach here suggested modifies and extends the concept of salvage archeology to include the gathering and analysis of data not directly affected by the immediate impact of a specific project. Instead, it is proposed that all data essential to a complete understanding of the archeology of the impacted area be considered.

TABLE 4

DISTRIBUTION OF SITES ACCORDING TO ZONES

Zone I	Zone II	Zone III
41 DN 3, 5, 6, 9 10, 30, 60	41 DN 1, 2, 4, 11 12, 28, 29, 33 34, 35, 36, 37 38, 39, 41, 42 43, 45, 47, 49 50, 51, 52, 53 55, 57, 58; 59	41 DN 7, 8, 16, 18 20, 21, 22, 23 24, 25, 26, 27 31, 32, 40, 44 46, 48, 54, 56

TABLE 5

SITES RECOMMENDED FOR FURTHER WORK

Recommended for Extensive Investigation:

Sites: 41 DN 4, 25, 31, 25

Recommended for Testing:

Sites: 41 DN 7, 8, 11, 20, 21, 23, 24, 27, 27, 37, 41, 41, 42, 43, 46

Recommended for Further Collections When Possible:

Sites: 41 DN 29, 33, 49, 57

Recommended for Analysis of Existing Collections:

Sites: 41 DN 3, 5, 6, 10, 12, 48, 51, 52, 58, 59, 60

TABLE 1

EXPLANATION OF SITE DESCRIPTIONS

Modern Site Designation (Former Designations)

The modern site designation follows the trinomial convention in which the first number, 41, represents Texas, the two letters, DN, represent Denton County, and the last number designates a specific site. Former designations may refer to earlier U.S.G.S. grids, local site names, or earlier, uncorrelated use of the trinomial convention.

Location: Location data are given to place the site in general geographic and environmental context. Accurate description of exact location is here avoided deliberately to forestall improper use of such information.

Elevation: Approximate average elevation above mean sea level as determined by location on U.S.G.S. contour map.

Description: Specific statements concerning the nature of the site.

Surface Indications: Observed evidence of human behavior.

Interpretation: Activities which likely occurred at the site, based on interpretation of artifacts and site location. Estimation of chronological position of these activities.

Reported by: Individual or individuals of record.

Remarks: General statements about the site including estimation of importance of the site and recommendation for further work.

The descriptions follow the format outlined in Table 1. Partial sentences are frequently used to keep verbiage to a minimum.

41 DN 1 (41-17D6-1; De-14; Site A; Baptist Campground Site)

Location: Terrace forming north bank of Pecan Creek in vicinity of Camp Copass, one-half mile or so from former river channel.

Elevation: 505-510' (estimated)

Description: Site presently exposed only when reservoir level is well below conservation pool elevation. Previous descriptions indicate site covers more than one acre of sandy midden soil. Depth of midden is undetermined.

Surface Indications: Midden soil, burned rock, flakes and chips, points, drills, scrapers, pottery fragments.

Interpretation: Harris (1940) reports the majority of points from the site are Type A (Fresno), 24 per cent, and Types B and C (Harrell), 47 per cent. He also reports one polished stone celt. Stephenson (1948) mentions two applique sherds at this site. Harris (personal communication) indicates this is a classic example of a Henrietta Focus site. It seems, in addition, to have been intensively occupied. Although it is not now possible to determine with accuracy, it seems clear that a wide variety of activities were performed here. The location of the site and the wide variety of activities suggest perhaps a relatively permanent village.

Reported by: Harris 1940; Stephenson 1948.

Remarks: This site is an excellent example of the direct effect of a reservoir, such as Garza-Little Elm (and Lake Dallas before it), on the archeological resources of an area. As the level of the lake fluctuates, the site is progressively eroded. Whether any cultural material remains at the site at this late date is problematical. Data so far reported from here indicate this site may be particularly rewarding as regards resolution of problems concerning the Henrietta Focus and the transition from hunting and gathering to food production. When conditions permit (probably in October-November when the lake level is typically low), intensive, controlled sampling here is strongly

recommended. In addition, private collections from this site should be carefully analyzed and described.

41 DN 2 (41-17D6-4; sometimes erroneously called the Landtrip Site)

Location: Low, sandy ridge "three miles southwest of Aubrey . . . 300 yards east of the Elm Fork . . . on the edge of the wide bottoms" (Stephenson 1948).

Elevation: 520' (estimated).

Description: Stephenson (1948) mentions bone and shell appearing in a very sandy matrix covering two acres. Site was under cultivation when first reported but it was not found during the present survey. It is likely covered by silt.

Surface Indications: Broken bone and shell; points; sherds.

Interpretation: Stephenson reports sherds found here are of widely scattered origin such as East Texas (Frankston Focus, Titus Focus), the Mississippi Valley; and Mexico. Although Harris (personal communication) has evidence to indicate the Mexican sherd "Tanco Polychrome?" Stephenson (1948) is actually from site number 41 DN 8, The Pearsall Site, the remaining exotic sherds are enough to make this site interesting in relation to possible trade in late prehistoric times.

Reported by: Stephenson 1948, 1949, 1950.

Remarks: This site has likely been silted over. No further work is recommended.

41 DN 3 (41-18C4-1; De-2; Little Elm Site)

Location: East floodplain of Little Elm Creek, north of junction of Little Elm and Doe Creeks.

Elevation: 490-500' (estimated, site presently submerged).

Description: Site is part of about one to two acres of a sand dune in the eastern floodplain of Little Elm Creek. Dune sand

reportedly was several feet deep, depth of cultural debris is uncertain. Site was in cultivation when reported.

Surface Indications: Chipped stone tools; polished and ground stone tools; potsherds; flakes.

Interpretation: Stephenson (1948) reports the following types: Six Alba points, 7 Gary points, and 3 Ellis points; 8 flake scrapers; 1 "Waco sinker" and 1 polished stone celt. He also interpreted the site to represent the remains of a small village of the late pottery period.

Reported by: Stephenson 1948, 1949, 1950.

Remarks: Although Stephenson recommended further work at this site, none was accomplished. Consequently, it is essential that private collections from this site be described and analyzed in order to salvage what information remains from this potentially important site.

41 DN 4 (41-18C4-3; De-3; Brown Site; Tollie Gilbert Site)

Location: East bank of Little Elm Creek about one mile downstream from the mouth of Pecan Creek.

Elevation: 520-540'.

Description: Cultural debris is scattered over about seven acres of sandy loam (Fig. 2). Woodbine sandstone outcrops throughout upper elevations of the site which overlooks the Little Elm floodplain, while sandy midden soil is apparently several feet deep in various places. Lower elevations of the site interfinger with the Little Elm floodplain. Although the site is presently overgrown with a thick covering of grass, it was planted in watermelons when reported by Stephenson and had apparently been cultivated for several decades previously. Even so, there appears to be portions of the site which remain relatively undisturbed. That part of the site which intergrades into the Little Elm floodplain seems particularly promising in this regard.

Surface Indications: Midden soil; bone (human and non-human); shell; points; drills; sherds; scrapers (Fig. 7m); flakes and chips; cores.

Interpretation: This site has likely been occupied since Archaic times. Stephenson (1948) reported 154 tools from this site including: 9 Gary points; 4 Sterrett points; 39 Alba points; 5 Harrell points; 1 small celt fragment; 23 sherds; and 36 scrapers.

He considered the assemblage to be somewhat different from most other sites he knew in the area, and concluded that a double occupation of the site must be represented. Specifically, he felt that the earlier occupations represented at the site were associated with central Texas, while the later represented strong influence from the Caddoan area. Although it is not yet possible to determine chronology at this site, a high proportion of exotic stone at the site does indicate strong influence from the area west of the reservoir. Furthermore, a casual analysis of lithic debris collected during the present survey indicates a complete range of stone tool manufacture occurred here. In addition, there likely are burials, storage pits, and possibly, houses.

All things considered, this site must be considered as one of the more significant so far known in the reservoir area.

Reported by: Stephenson 1948, 1949, 1950.

Remarks: Extensive exploration of this site is of utmost importance, since it lies in the area most affected by the proposed increase in the conservation pool and is one of the more important sites so far discovered. Stephenson similarly recommended this site be partially excavated. Collections made by private individuals at this site should also be analyzed and described.

41 DN 5 (41-18C7-2; Ledbetter Site)

Location: Presently submerged, the site lies about three miles north of Lewisville and about 100 yards west of the old Elm Fork channel.

Elevation: 480' (estimated).

Description: As described by Stephenson, the site consists of cultural debris in a sandy matrix covering more than three acres of a high sandy ridge paralleling the Elm Fork. Has been extensively cultivated.

Surface Indications: Midden soil; burned rock, points, drills, scrapers, celts, pottery fragments.

Interpretation: Stephenson (1948) reports 60 per cent of the sherds are plain, shell tempered (Nocona Plain) and the remainder are clay tempered plain and decorated. He reports projectile point types including 4 Gary, 7 Alba, and 3 Harrell, and regarded this site to represent a mixture of Frankston Focus and Henrietta Focus traits in the culture of a group of people who were, themselves, neither. This rather remarkable interpretation is based only on the presence of "classic" traits of these two foci, and can no longer be verified at this site. Stephenson also noted "indications of at least one house structure and several burials at the site" (Stephenson 1949:26). Harris (personal communication) reports recovering a Plainview golondrina here.

Reported by: Stephenson 1948, 1949, 1950.

Remarks: Stephenson gave highest priority to excavation at this site, considered it "the most significant site in this reservoir to excavate" (Stephenson 1948). Very little systematic work was done here, however, except surface collections by amateurs. Existing collections from this site should be analyzed and described.

41 DN.6 (41-18C7-3; De-6; Lake Dallas Site)

Location: Presently submerged, this site is part of a slight sandy rise in the western Elm Fork floodplain approximately one mile below the old Lake Dallas spillway. It lies approximately across the river channel from the mouth of Little Elm Creek.

Elevation: 470' (estimated).

Description: About an acre of sandy midden soil several feet deep. Portion of sand dune where cultural debris was found was badly wind eroded. Partial excavation of the site by members of the Dallas Archeological Society and the River Basin Surveys revealed some cultural material in apparently undisturbed strata.

Surface Indications: Points, scrapers, gouges, "Waco sinkers," burned rock.

Interpretation: This site is one of two major type sites of the Carrollton Focus (Crook and Harris 1952c), and has yielded the entire range of artifacts that are used to define this focus as outlined earlier in this paper and described in detail elsewhere (Crook and Harris 1952c, 1954). Stephenson (1948) reports a total of 205 projectile points from the site (this was before the DAS excavations), of which 13 are "lanceolate" forms, 11 Orla, 16 Gary, 20 Sterrett, and 62 Trinity. Several Plainview points have been reported here (Harris 1951). This site is also a type site for the Carrollton Ax (Crook and Harris 1954b).

Reported by: Stephenson 1948, 1959, 1950; Harris 1951; Crook and Harris 1952c, 1953, 1954b).

Remarks: Sporadic work at this site has produced what appears to be some of the earliest cultural remains in north central Texas. As a result of the efforts of a number of different groups and individuals who have worked at this site, data have been scattered. Future work should include specific efforts to collate these data, if possible, re-analyze and describe the artifacts in light of recent studies of lithic technology.

41 DN 7 (41-17D6-3; De-12; Cagle Site)

Location: Eastern floodplain of Elm Fork several miles north of the reservoir area.

Elevation: 550'.

Description: Site not located in current survey. As reported by Stephenson cultural materials were found scattered over about 15 acres of sandy pasture land. The site is apparently in a combined uplands slope-floodplain situation.

Surface Indications: One point and four sherds, mammoth bones.

Interpretation: Stephenson (1948) interpreted this site to represent "a large pottery village site." The reasons for this guess are far from clear but seem to depend mostly on accounts furnished by the landowner. Certainly, the material collected and/or observed by Stephenson does not support such a conclusion. Harris (personal

communication) believes the site to be relatively insignificant except, perhaps, for that portion containing mammoth remains.

Reported by: Stephenson 1948, 1949, 1950.

Remarks: Stephenson strongly recommended that this site be extensively excavated in several sections. He based this recommendation on accounts by the landowner of burials and artifacts at the site, plus the discovery of mammoth bones here. The site remains somewhat of an enigma. It should be tested.

41 DN 8 (41-17D9-11; Pearsall Site)

Location: High, sandy hill on the south side of Hickory Creek.

Elevation: 580'.

Description: Shallow, sandy deposit with cultural debris scattered throughout approximately two acres. Site is currently overgrown with dense grass cover but was formerly cultivated.

Surface Indications: Midden soil, points, drills, scrapers.

Interpretation: Stephenson reports one sherd of Tonto Polychrome here and interprets the site as representing "a large village of the late pottery period" (Stephenson 1949:28).

Reported by: Stephenson 1948, 1949, 1950; Harris (personal communication).

Remarks: Although this site is not in the area directly affected by the waters of the reservoir, it is located in an area sure to be affected by over-all impact of the reservoir on the area. Furthermore, since the site is frequently mentioned as potentially important source of data, further collecting and testing is recommended here.

41 DN 9 (41-18C7-7)

Location: A slight ridge located in the floodplain about 100 yards northeast of Hickory Creek and 200 yards southwest of the Elm Fork. Presently submerged.

Elevation: 470' (estimated).

Description: Occupational debris scattered over about one-quarter acre. Sandy clay matrix. Part of site badly eroded by frequent flooding. Site was under cultivation when first reported.

Surface Indications: Flakes, chips; polished stone tools; sherds; (actually very scanty amount of material reported).

Interpretation: Stephenson felt this site was probably one of the small pottery sites related to 41-18C7-2 & 6, although "this is little more than a guess." He also reports 2 celts here.

Reported by: Stephenson (1948).

Remarks: Stephenson recommended no further work. The value of the site seems today to be what little information its presence can lend to studies of settlement pattern.

41 DN 10 (41-18C7-9)

Location: South bank of Hickory Creek, near junction with the Elm Fork. Presently submerged.

Elevation: 470' (estimated).

Description: Midden soil and occupational debris eroding from about one acre of a low sand and gravel ridge at the edge of the T-1 terrace.

Surface Indications: Points, scrapers; sherds; midden soil.

Interpretation: Stephenson remarks on the rather extensive amateur collection from this site (including 56 arrow and 40 dart points) and concludes this is another of the late pottery sites of the area.

Reported by: Stephenson 1948.

Remarks: Although the site is covered today, collections made from the site should be located, analyzed and described.

41 DN 11 (41-18C4-4; Wells Site)

Location: Western floodplain of Little Elm Creek, across from 41 DN 27.

Elevation: 520'.

Description: Cultural debris found mingled throughout several acres of the upper few inches of low sandy ridge roughly paralleling the creek. Site badly eroded in places and has been in cultivation for many years.

Surface Indications: Since local collectors have known of the site and have collected specimens there for some time, few distinct tools can be found here today. Midden soil; point fragment; burned rock; flakes; chips; chunks; bone; shell.

Interpretation: Based on the volume and variety of material reported from this site, there may very well have been a sizable village located here. The present survey did not find enough material to support this interpretation, however.

Reported by: Harris (this report).

Remarks: This site is quite extensive, and although it has been eroded, plowed, and picked over for a number of years, it seems to be a very good locale for controlled surface collections and trenching. In addition, effort should be made to find, analyze and describe collections made from this site.

41 DN 12 (41-18C4-8; Bob Peace Site)

Location: Terrace forming part of the west bank of Little Elm Creek. Presently submerged.

Elevation: 510' (estimated).

Description: Material scattered over about one half acre of sandy soil, exposed when lake level drops in late summer and fall.

Surface Indications: Harris reports points; scrapers; sherds; flakes; etc.

Interpretation: Harris believes the site to be a small Henrietta Focus site.

Reported by: Harris (personal communication).

Remarks: Material collected by Harris from this site should be analyzed and described. In addition, the site should be tested when lake level permits.

41 DN 13

This site is in the Grapevine Reservoir area.

41 DN 14

This site is in the Grapevine Reservoir area.

41 DN 15

This site is located about 14 miles west of Denton.

41 DN 16 (Cranston Pottery Kiln)

Location: Uplands area overlooking spring-fed tributary of Hickory Creek.

Elevation: 560'.

Description: Historic pottery kiln site with ruins and waste piles of stoneware. Site badly disturbed.

Interpretation: Cranston Pottery Kiln, operated at this site from 1854 to 1880.

Reported by: Jim Malone, Texas State Historical Survey Commission.

Remarks: Although this site lies outside the area to be affected by the rise in lake level, it is certain to be affected by the total

impact of the lake. Therefore, it is recommended that this historically unique site be incorporated into the program of historical site preservation and restoration suggested elsewhere in this report.

41 DN 17 (SMU-X-41DN3)

This site lies far distant from the area of present concern.

41 DN 18 (Roark Pottery Kiln)

Location: Terrace of small tributary entering the Elm Fork floodplain from the east.

Elevation: 560'.

Description: Various ruins and structures of this historic site are scattered over approximately one acre.

Interpretation: These are the remains of the Roark Pottery Kiln, operated from about 1868 until the early 20th century.

Reported by: Jim Malone, Texas Historical Survey Commission.

Remarks: This site is sure to be further affected by indirect impact of the presence of the reservoir. It is recommended to be included in the historical site preservation and restoration program proposed elsewhere in this report.

41 DN 19 (Serran Pottery Kiln)

This site is not in the immediate reservoir area.

41 DN 20

Location: West bank of Little Elm Creek, south, southwest of 41 DN 4.

Elevation: 520-540'.

Description: Occupational debris mixed in sandy loam, scattered over perhaps one acre. Site currently overgrown with grass but has obviously been under cultivation in recent past. Woodbine sand outcropping in upper reaches of site but intergrades with Little Elm terrace. Severely eroded in spots.

Surface Indications: Midden soil; flakes; chips; burned rock; bone fragments.

Interpretation: Not enough information for interpretation.

Reported by: Richland Archeological Society.

Remarks: If the scanty amount of cultural material observed at this site is an accurate indicator of the degree of occupation, then no further work is recommended. It could be, however, the site is a buried one. The site should be tested with additional work contingent upon the results.

41 DN 21

Location: Upland slope east of Running Branch Creek, north, northwest of 41 DN 40.

Elevation: 550'.

Description: Cultural debris appears on gopher mounds dotting a large, thickly grassed pasture. Grass covers sandy loam consisting in higher elevations of elements derived from the Woodbine formation and of alluvial deposits in the lower elevations. The site has formerly been in cultivation. Depth of occupation not determined, but may be considerable.

Surface Indications: One point; flakes; chips; burned rock.

Interpretation: Not enough information for interpretation.

Reported by: Richland Archeological Society.

Remarks: Since this site lies just across the running branch from 41 DN 40, is situated on an upland slope, and has yielded a high percentage of exotic lithic material, it may very well be a buried

version of the latter. It should be tested, with further work depending upon the results.

41 DN 22

Location: North of the point where a small, intermittant creek enters the Elm Fork floodplain from the east.

Elevation: 540'.

Description: Higher parts of the site consist of lower portion of an upland slope. This slope intergrades with an Elm Fork terrace. Cultural material found sparsely spread over about one-half acre. Site badly eroded, covered with scattered mesquite trees, brush, never in cultivation.

Surface Indications: Dart point (Fig. 7f) flakes; chips; historic ceramics; stone lined wall.

Interpretation: This appears to be the site of an Archaic occupation followed by a considerably later historic occupation. Both the caracteristics of the dart point and the fact that all of the chipped stone artifacts are of material exotic to the area support the former interpretation. The latter interpretation is obvious.

Reported by: Richland Archeological Society.

Remarks: No further work is recommended.

41 DN 23

Location: One hundred yards north of 41 DN 24.

Elevation: 540'.

Description: Scattered cultural debris along sandy ridge. Sandy stratum containing cultural material lies from surface to six inches deep paralleling Little Elm Creek. Site presently in cultivation.

Surface Indications: Scattered lithic material.

Interpretation: Few artifacts were collected here; therefore, an interpretation is not possible. It should be noted, however, that all lithic material gathered here (only 26 pieces) is of material not usually found in the reservoir area.

Reported by: Richland Archeological Society.

Remarks: Should be tested in conjunction with 41 DN 24.

41 DN 24

Location: Long, high, sandy ridge lying between Little Elm Creek and one of its tributaries.

Elevation: 540'.

Description: Cultural material is eroding out of a sandy matrix for a distance of approximately 200 yards along the west bank of Little Elm Creek. Grass newly planted throughout the immediate area of the site. Badly eroded in places.

Surface Indications: Heavy concentrations of lithic debris; points (Fig. 7d); drills (Fig. 7o); flakes; chips; sherd; midden soil.

Interpretation: This site was picked from a U.S.G.S. topo map as a logical place to have been occupied in prehistoric times. This guess was subsequently verified. For the same reasons that the site could be picked from the map, it can be guessed to be a major site. Based on the diversity of material found, although the sample is small, it is obvious that a wide variety of activities were performed here.

Reported by: Richland Archeological Society.

Remarks: This site may very well be one that can yield data concerning the early effects of the introduction of food producing technology into the area. The site should be thoroughly tested.

41 DN 25

Location: A portion of the northern terrace system of Hickory Creek, bounded on the south by a small, springfed tributary.

Elevation: 550-570'.

Description: Occupational debris is spread over approximately seven or eight acres along a high terrace. Site badly disturbed in several locations by gravel pit operations. Currently overgrown with grass but formerly in cultivation. Cultural material seems to lie mostly in sandy clay surface stratum. This layer ranges in thickness from zero to several feet.

Surface Indications: Midden soil; points (Fig. 7c); scrapers (Fig. 7j); hammerstone (Fig. 4c); choppers; mano fragment; retouched flakes; bone; shell; sherds.

Interpretation: The kinds of artifacts found indicate the site to be "classic" Henrietta Focus. The site is similar in ecological situation to 41 DN 4 and 41 DN 24, but, unlike these two, lies west of the Elm Fork and can be expected to yield a significantly different array of artifacts, thereby aiding the differentiation of sociocultural groups within the heretofore monolithic Henrietta Focus. The evidence clearly indicates a wide range of behaviors at this site. It is clearly the location of a prehistoric village.

Reported by: Richland Archeological Society.

Remarks: Even though it lies out of the area to be directly affected by the lake waters, this site should be thoroughly tested. Because of the extent of the site and uneven distribution of occupational material, localized trenching is recommended. House pits, storage pits and graves should be thus uncovered.

41 DN 26

Location: Sandy ridge on the southeast bank of Little Elm Creek, about 1000 feet east of 41 DN 4.

Elevation: 540'.

Description: Western edge of the site is the steep bank of Little Elm Creek. From this point, the site gently slopes upland to its highest elevations in remnants of the Woodbine Formation. Although the site was probably in cultivation in the recent past, the ground is currently concealed by a thick grass cover. Occupational

debris appears scattered over perhaps an acre. Nothing is known about the stratigraphy of the site, but there seems to be a good chance that much of the site is undisturbed below the plow zone.

Surface Indications: Midden soil; burned rock; points (Fig. 7b); bone; fossil bone (in the Woodbine); shell; pottery.

Interpretation: The location of this site and the kinds of cultural material found here suggest that it is perhaps one of a number of alternative village sites located in this area. This interpretation is supported by the diversity of activities indicated by the artifacts found here. The artifacts can be collectively described as representative of the Henrietta Focus.

Reported by: Richland Archeological Society.

Remarks: The site may very well be one of the least disturbed village sites yet reported in the area. It should be tested in conjunction with work at 41 DN 4 and 41 DN 27.

41 DN 27

Location: Point of land which forms part of the east bank of Little Elm Creek about 1200' north of 41 DN 26.

Elevation: 540'.

Description: Cultural debris scattered over sandy pasture sloping from Woodbine outcropping in upper elevation down to, and intergrading with, an alluvial terrace (Fig. 3). Part of site was formerely in cultivation, but entire site now covered with dense growth of grass with interspersed trees and brush.

Surface Indications: Midden soil; points (Fig. 7a); flakes; bone; historic junk.

Interpretation: The paltry amount of material observed here does not lend itself to interpretation.

Reported by: Richland Archeological Society.

Remarks: Site should be tested to determine its extent.

41 DN 28 (41-18C4-6)

Location: Part of a large, sandy rise on the north side of a small, spring-fed tributary which enters Little Elm Creek from the west. Presently submerged.

Elevation: 510' (estimated).

Description: Cultural material appears scattered throughout several acres of a formerly cultivated field.

Surface Indications: Points; scrapers; pottery.

Interpretation: Harris (1951a) describes this as a Henrietta Focus site, based on Nocona Plain sherds; 5 arrow points; 6 Gary points and 10 Ellis points he reports here.

Reported by: Harris (1951a).

Remarks: None.

41 DN 29 (41-18C4-7)

Location: West bank of Little Elm Creek, approximately 1000' east of 41 DN 28. Presently submerged.

Elevation: 510' (estimated).

Description: Cultural debris eroding from sandy ridge paralleling Little Elm Creek.

Surface Indications: Pottery, midden soil; points; flakes; scrapers.

Interpretation: Harris considers this to be a typical small Henrietta Focus site.

Reported by: Harris (this report).

Remarks: Although the site is presently submerged, it is revealed when the lake level drops, usually in the late summer and fall, it should be carefully and systematically sampled before the conservation pool is raised.

41 DN 30 (41-18C7-8)

Location: In the floodplain below the dam, east of the confluence of a major tributary and the Elm Fork.

Elevation: 460'.

Description: Presently silt covered, this site was reported by Stephenson, but could not be located by him. Harris reports a small amount of artifactual material appearing in a small area of a sandy lowland rise.

Surface Indications: Chipped stone tools; flakes; chips; sherds.

Interpretation: According to Harris, this is a small Henrietta Focus site.

Reported by: Stephenson 1948; Harris (this report).

Remarks: None.

41 DN 31 (41-17D6-2; Landtrip Site)

Location: High in the uplands overlooking the eastern Elm Fork floodplain.

Elevation: 640'.

Description: Occupational detritus exposed throughout about ten acres of a high sandy ridge. Part of site has been under cultivation, but part lies in wooded area apparently never disturbed by plowing. Portions of site badly eroded.

Surface Indications: Midden soil; points; scrapers; celts; burned rock; flakes; sherds.

Interpretation: Harris has made an extensive collection from this site and feels that the material represents a more or less continuous occupation from very early Archaic until very late prehistoric times. He has early projectile point types such as Angostura from this site as well as more recent points and Nocona Plain pottery.

Reported by: Harris (this report).

Remarks: Although this site does not lie in the area directly affected by the reservoir, it quite likely will be quite soon indirectly disturbed by such activities as housing development. The dramatic overview of the floodplain the site affords will make it a prime building location when the lake level is increased. This fact, plus its importance as one of the relatively few sites with undisturbed strata makes extensive excavation here a matter of high priority.

41 DN 32 (41-17D6-7)

Location: Uplands about one mile due east of 41 DN 31.

Elevation: 620'.

Description: Site is currently under cultivation. It lies along the northern bank of a small tributary of the Elm Fork. A horse pen is situated in central portion of the known extent of cultural debris, and the site is otherwise badly disturbed.

Surface Indications: Flakes; burned rock.

Interpretation: Although the site today shows only scanty remains of occupation, Harris reports extensive collections he and others have made at this site. He considers it to be a typical Henrietta Focus site.

Reported by: Harris (this report).

Remarks: None.

41 DN 33

Location: Eastern terrace of Little Elm Creek. Presently submerged.

Elevation: 510'.

Description: Local residents report mammoth remains eroding from creek terrace at this site when the lake level drops.

Reported by: Richland Archeological Society.

Remarks: The site should be carefully observed when conditions permit to determine if there may be human association with the mammoth fossils.

41 DN 34

Location: Peninsula extending northward from the dam. Before the lake filled, the site formed part of the west bank of Stewart Creek.

Elevation: 520'.

Description: Historic site, consisting of ruins of farmhouse, outbuildings, well, etc., some dating from mid-19th century.

Reported by: Richland Archeological Society.

Remarks: Information from this site should be included in the program for historic site preservation and restoration as recommended elsewhere in the present report.

41 DN 35 (41-18C7-14)

Location: Point of land projecting northward from dam. Site is part of terrace which once formed the west bank of the Elm Fork. It is south of the confluence of Hickory Creek and the Elm Fork.

Elevation: 520'.

Description: Very heavily eroded. Artifacts very scanty and scattered over about one acre.

Surface Indications: Few chipped stone artifacts (Fig. 7k).

Interpretation: According to Harris, the portion of the site presently exposed is only part of a small Henrietta Focus occupation.

Reported by: Harris (this report).

Remarks: None.

41 DN 36 (41-17D9-18)

Location: Low sandy ridge about one mile south of the point where Pecan Creek enters the floodplain.

Elevation: 520'.

Description: Site presently overgrown with very dense cover of grass, brush, brambles, cane, and willow. Artifacts have been found on the surface and are believed to occur in undisturbed subsurface deposits of unknown depth.

Surface Indications: At present, nothing. Harris reports a wide variety of lithic debris and tools (Fig. 5; Fig. 7e, g).

Interpretation: Harris believes this to be an Archaic site with buried, relatively undisturbed components.

Reported by: Harris (this report).

Remarks: This site will be directly affected by the proposed change in conservation pool level. This, plus promise the site offers in terms of stratigraphy, makes its further investigation mandatory and of the most urgent priority.

41 DN 37 (41-18C4-5)

Location: Low, sandy ridge in the floodplain of Little Elm Creek, just across from 41 DN 4.

Elevation: 520'.

Description: Essentially the same general description as 41 DN 11, this site lies just downstream from the latter.

Surface Indications: Widely scattered lithic debris.

Interpretation: According to Harris, this represents a small Henrietta Focus occupation.

Reported by: Harris (this report).

Remarks: This site will be covered by the increase in conservation pool. Although there were few surface indications when recently visited, the site should be further investigated, perhaps with exploratory trenches to uncover possible house locations.

41 DN 38

Location: Below dam on a high terrace just south of the mouth of a major tributary of Stewart Creek.

Elevation: 500'.

Description: Surface of the site badly eroded. Presently overgrown with dense cover of grass, but has been in cultivation. This is one of the few sites discovered that does not lie in the Eastern Cross Timbers. Even so, since it is on an Elm Fork Terrace, the ecosystem is not distinctively Blackland Prairie.

Surface Indications: Widely scattered lithic material (Fig. 7n).

Interpretation: The site likely represents a brief Archaic occupation similar to that suggested by site 41 DN 22.

Reported by: Richland Archeological Society.

Remarks: None

41 DN 39

Location: On the T-2 terrace south of dam, overlooking an eastern tributary of the Elm Fork.

Elevation: 500'.

Description: Artifacts scattered over several acres of terrace uplands. Site badly eroded, portions formerly in cultivation. Relatively large spring nearby.

Surface Indications: Scattered lithic tools and debris (Fig. 7i); historic house ruins; historic sherds (3 blue featheredge).

Interpretation: Site possibly occupied in Archaic times. Historic occupation likely dates back to mid-19th century.

Reported by: Richland Archeological Society.

Remarks: Site should be included as a key element in the historic site study recommended in this report.

41 DN 40 (41-18C4-9)

Location: Hill of Woodbine formation overlooking Running Branch Creek.

Elevation: 560'.

Description: Large, open, sandy field derived from Woodbine formation. Fast-flowing, freshwater spring erupts from the sandstone in the lower elevations of the site. Site formerly in cultivation, badly eroded in some areas.

Surface Indications: Abundance of lithic material, including points (Fig. 7h); flakes; scrapers (Fig. 71); choppers; also some historic debris.

Interpretation: The site has obviously been occupied by groups as early as the Archaic. Harris points out that the material he has collected here is distinctively different from Henrietta Focus sites and seems to have a strong resemblance to artifacts commonly found in Central Texas.

Reported by: Harris (this report).

Remarks: This site should be examined extensively to determine if there are undisturbed strata. Sampling procedures should include particular attention to lithic debris.

41 DN 41

Location: Sandy, sloping western bank of Little Elm Creek.

Elevation: 520-530'.

Description: Large, open peanut field. Cultural material scattered over several acres. Depth of sand and occupational material undetermined.

Surface Indications: Midden soil; lithic tools and debris; mano; historic material.

Interpretation: Not enough material recovered or observed to justify interpretation.

Reported by: Richland Archoelogical Society.

Remarks: Site similar in some respects to 41 DN 11. Should be tested to determine extent of occupational material.

41 DN 42

Location: Low terrace forming part of north bank of Hickory Creek, just east of small, spring-fed tributary.

Elevation: 535'.

Description: Portion of site formerly cultivated, now overgrown with dense grass cover. Other parts of site eroded, disturbed by historic construction. Depth of sand not determined.

Surface Indications: Very scarce scatter of lithic debris; recent historic material and ruins.

Interpretation: None possible, but seems likely to be a buried site.

Reported by: Richland Archeological Society.

Remarks: This may represent a sheer flight of fantasy, but the site should be tested, primarily on the basis of its excellent and likely location.

41 DN 43

Location: Sloping bank of small tributary of Cooper Creek.

Elevation: 530'.

Description: This site lies partly in the floodplain of a small creek directly across from a high bank cut into the Woodbine formation. A fast-flowing, freshwater spring lies not more than 500' upstream. Lithic material is scattered over about a quarter acre. The site has been disturbed by bulldozer and plow, although at present not in cultivation.

Surface Indications: Flakes; chips; burned rock.

Interpretation: Not enough data.

Reported by: Richland Archeological Society.

Remarks: May be buried occupation here, simple test is recommended.

41 DN 44

Location: High, terrace/Woodbine uplands west of lake.

Elevation: 570'.

Description: Very badly eroded. Artifacts apparently have been "let down" from no-longer-present higher strata. Large portions of the site are presently covered by modern junk and trash. Portions of site in previously cultivated field. Site bisected by fences, covers about eight acres.

Surface Indications: Historic junk; flint chips and tools; ferruginous sandstone tools (Fig. 4a).

Interpretation: Likely the site of Archaic occupations. Carrollton Ax found here (Fig. 4b).

Reported by: Richland Archeological Society.

Remarks: None.

41 DN 45

Location: High terrace south, southwest of 41 DN 38.

Elevation: 500'.

Description: Historic farmsite.

Reported by: Richland Archeological Society.

Remarks: Should be included as a key element in the recommended historic site preservation and restoration.

41 DN 46 (41-17D3-1)

Location: Western floodplain of Elm Fork, well upstream from the reservoir area.

Elevation: 560'.

Description: Cultural material reported eroding from the surface in an area of approximately three acres. Site not visited in current study.

Surface Indications: sherds and bones (human).

Interpretation: Stephenson felt this to be the site of a late prehistoric "pottery village" and burial ground.

Reported by: Stephenson 1948.

Remarks: Although this site lies far above the area of the present study and will not be directly affected by the proposed increase in the elevation of the conservation pool, it clearly will be affected by the overall effect of Corps projects. The site should be re-located and tested.

41 DN 47 (41-17D6-2)

Location: Site presently submerged, it is located east of the Elm Fork just north of a major tributary.

Elevation: 510' (estimated).

Description: "Open occupational area."

Surface Indications: Lithic tools; debris.

Interpretation: Stephenson reports 1 Gary; 1 Ellis; 1 arrowpoint fragment; 1 large drill; and 3 pieces of hematite.

Reported by: Stephenson 1948.

Remarks: None.

41 DN 48 (41-17D6-5)

Location: Uplands between Elm Fork and Little Elm Creek.

Elevation: 640'.

Description: About one acre of a low-lying ridge in the uplands. Portions of the site have been disturbed by cultivation and erosion, other portions appear relatively undisturbed and timber covered.

Surface Indications: Lithic tools and debris.

Interpretation: Harris knows this site well, and considers it to be a small Archaic site.

Reported by: Stephenson (1948).

Remarks: Materials from this site should be included in the recommended study of private collections.

41 DN 49 (41-17D9-1; Frank Site)

Location: Western terrace of Elm Fork.

Elevation: 510' (estimated).

Description: This site is periodically inundated, as it was when visited in the course of the present work and as it was when

visited by Stephenson in 1948. It lies on a low, sandy ridge in the T-1 terrace some three-quarters of a mile west of the old Elm Fork channel.

Surface Indications: Midden soil; points (including some made of obsidian (Fig. 6); four-edged, alternately beveled bifaces (Fig. 6g); drills (Fig. 6h); scrapers (Fig. 6f, i); grooved pieces of sandstone; perforated, polished stone; sherds, decorated and plain.

Interpretation: Harris considers this to be one of the most important Henrietta Focus sites presently known in the area. Sherds from East Texas (Allen and Titus Foci) have been identified here, although the majority of sherds are Nocona Plain, the type characteristic of the Henrietta Focus.

Reported by: Stephenson (1948).

Remarks: Although Stephenson considered the site to be "destroyed" in 1948, much material has been collected from the site since then. There can be no doubt that the site is severely damaged by periodic inundation, but it is for this very reason that it should be extensively and systematically investigated as soon as possible. In addition a thorough analysis and description of private collections from this site should be performed.

41 DN 50 (41-17D9-2)

Location: On a western Elm Fork terrace, northeast of the village of Lake Dallas.

Elevation: 515' (estimated).

Description: Site is about one acre of a low sandy ridge lying on the terrace. When first reported, it was covered with timber. Site has since been destroyed by lakeshore development.

Surface Indications: Scraper; flakes; chips.

Interpretation: According to Harris, this was a small Archaic site.

Reported by: Stephenson (1949).

Remarks: None.

41 DN 51 (41-17D9-3)

Location: On the western terrace, about one mile northeast of 41 DN 50.

Elevation: 510'.

Description: Presently inundated.

Surface Indications: Points; scrapers; midden soil; sherds.

Interpretation: Based on material collected here by Harris and others, it seems clear that this site (as well as the one described just above) represents an early Henrietta Focus occupation.

Reported by: Stephenson (1948); Harris.

Remarks: This is another of those sites that have been intensively collected for years. These collections should be analyzed and described.

41 DN 52 (41-17D9-4)

Location: On a western terrace, about one-half mile south of 41 DN 51.

Elevation: 510' (estimated).

Description: Very similar to 41 DN 51 and 52. Also presently inundated.

Surface Indications: Points; scrapers; four-edged, alternately beveled knives.

Interpretation: Harris indicates his belief that this site is representative of a Henrietta Focus occupation.

Reported by: Stephenson (1948); Harris.

Remarks: Collections from this site should be analyzed and described.

41 DN 53 (41-17D9-5)

Location: Uplands, one quarter mile south of Hickory Creek.

Elevation: 510' (estimated).

Description: Site was not visited in course of present work, may presently be inundated. Stephenson reported the site to be an open occupational area, heavily timbered.

Surface Indications: None described.

Interpretation: Stephenson considered this site to represent a typical small campsite . . . probably one of the series of small, temporary, late pottery sites.

Reported by: Stephenson (1949).

Remarks: None.

41 DN 54 (41-17D9-7; Ball Cemetery)

Location: Edge of uplands about three-fourths mile south of Hickory Creek.

Elevation: 560'.

Description: Woodbine sandstone outcroppings throughout a high, sandy ridge.

Surface Indications: Historic cemetery.

Interpretation: Stephenson reports site as location of possible prehistoric burial ground.

Reported by: Stephenson (1948).

Remarks: None.

41 DN 55 (41-D9-8)

Location: Northern terrace of Hickory Creek.

Elevation: 510' (estimated).

Description: Site presently submerged. It is part of a formerly open field on a narrow terrace remnant lying between Hickory Creek and the uplands.

Surface Indications: Points; large bifaces.

Interpretation: Small, non-pottery (Archaic?) site from which a "very large Gary Stemmed point made of ferruginous sandstone" and "a base fragment of a Plainview point" was recovered.

Reported by: Stephenson (1948).

Remarks: None.

41 DN 56 (41-17D9-9)

Location: Uplands, one mile north of Hickory Creek.

Elevation: 540'.

Description: Part of a large, open upland pasture above and surrounding several springs at the head of a short, deep canyon tributary of Hickory Creek. Shallow, sandy soil. Not located by present survey.

Surface Indications: Points?

Interpretation: None justified.

Reported by: Stephenson (1948).

Remarks: Apparently, Stephenson found nothing at this site, and reported it on the basis of statements made by local informants.

41 DN 57 (41-18C4-2; Old Irish Site; Hackberry Site)

Location: Eastern terrace of Little Elm Creek.

Elevation: 510' (estimated).

Description: Site presently inundated, but is periodically exposed when lake level drops. It consists of about an acre of a larger, formerly cultivated field of shallow, sandy soil, forming a slight ridge above the floodplain.

Surface Indications: Midden soil; scrapers; triangular, alternately beveled bifaces; bison scapulae; mussel shell; points; sherds.

Interpretation: Excavation at this site has produced over 1031 tools, including 240 Gary points; 36 Scallorn points; 16 Harrell points; 92 Yarbrough points; 54 Edgewood points; and 54 Ellis points. In addition, bison scapula "hoes"; 5 "cooking" pits; and 4 "trash" pits have been reported. This site likely represents a number of occupations from the Archaic until proto-historic times.

Reported by: Stephenson (1948); Barber (1969).

Remarks: This site affords a classic example of the tenuous nature of archeological field surveys. When Stephenson visited the site in 1948, he observed nothing on the surface, and subsequently dismissed the site as not meriting further investigation. Since then, erosion of the site (caused in large part by periodic inundation) has revealed the site as perhaps one of the most significant yet reported in the area. Further investigation should be conducted at the site when the lake level permits, and private collections from the site should be carefully analyzed and described.

41 DN 58 (41-18C4-4; Rocky Point Site)

Location: Tip of high terrace remnant overlooking eastern floodplain of Elm Fork.

Elevation: 500' (estimated).

Description: Site is presently inundated but is exposed periodically. It has been described as an open occupational site of some two or three acres.

Surface Indications: Points; sherds; drills.

Interpretation: Harris considers this site to represent the location of a typical Henrietta Focus occupation.

Reported by: Stephenson (1948).

Remarks: Material previously collected from the site should be included in the analysis and description of artifacts from the area.

41 DN 59 (41-18C7-5)

Location: Upland slope leading to eastern bottomlands of Little Elm Creek.

Elevation: 510' (estimated).

Description: Site presently submerged. Soil conditions previously described as shallow, silty clay in a cultivated field.

Surface Indications: Grooved sandstone blocks; celt; points; scrapers; sherds; four-edged, alternately beveled bifaces.

Interpretation: Harris considers the site to be Henrietta Focus.

Reported by: Stephenson (1948).

Remarks: Material collected from this site should be described and analyzed.

41 DN 60 (41-18C7-6)

Location: Edge of western river terrace, one-quarter mile south of 41 DN 5.

Elevation: 480' (estimated).

Description: Site composes about two acres of a shallow, brown loam and sand deposit. Badly eroded.

Surface Indications: Midden soil; flakes; points; scrapers.

Interpretation: Material similar to that from 41 DN 5, and, therefore, likely to be Henrietta Focus in type.

Reported by: Stephenson (1948).

Remarks: Material from site should be analyzed and described.

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