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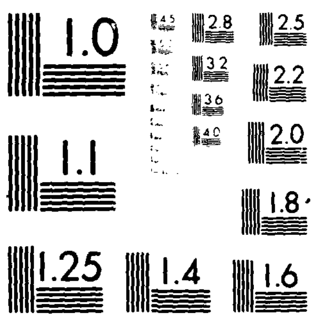

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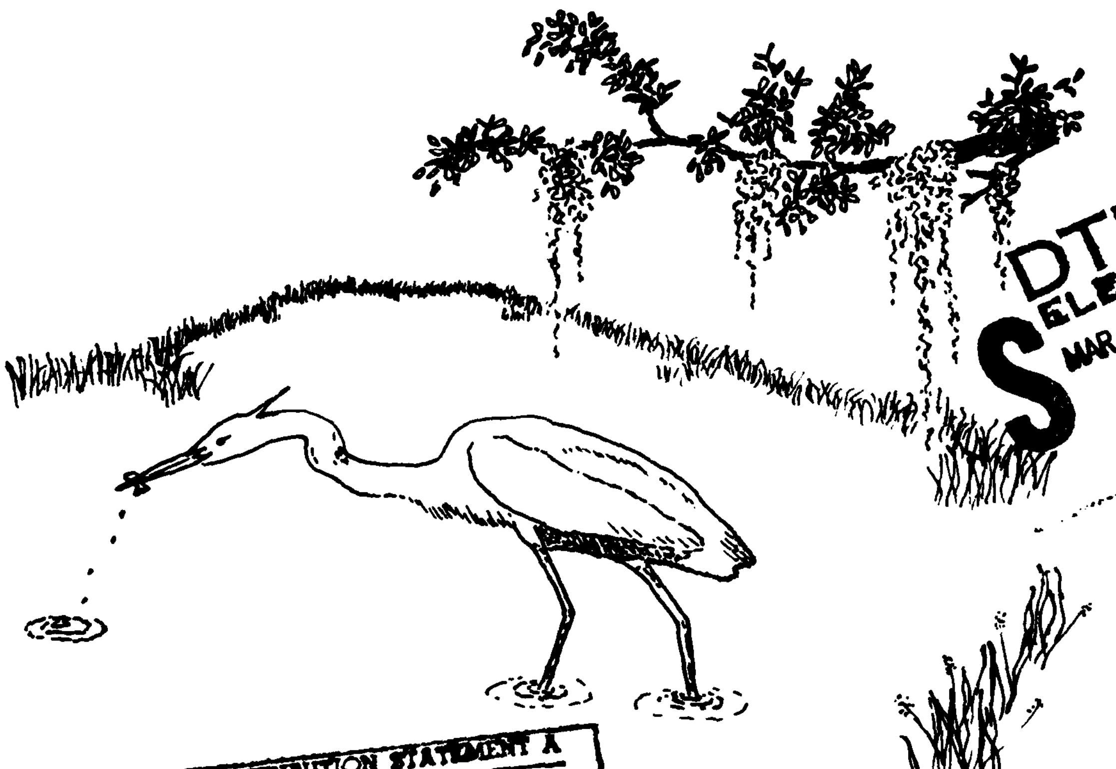
Carl L. Estes Lake

Sabine River, Texas

Draft

Environmental Statement



U.S. Army Engineer District
Fort Worth Texas
October 1975

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REPORT DOCUMENTATION PAGE

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Carl L. Estes Lake
Environmental impact
Rains, Smith, Wood, and Van Zandt Counties
Sabine River Basin, Texas

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

The Carl L. Estes Lake project fulfills flood control, water supply, fish and wildlife, as well as recreational needs for northeast Texas. Project will remove from private ownership 68,700 acres of land. There will be permanent loss of species due to inundation. At least 91 archeological sites could be adversely affected. There are no significant historical sites. There will be social, cultural, and economic impacts from loss of wildlife habitat, loss of flora and fauna, relocation of families, loss of lands, and change of social activities. Project requires acquisition and changes in land use. Relocating families, cemeteries, roads

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20. and utility lines will have social and psychological impacts upon area residents, but should not cause hardships. The combination of flood control, water supply, fish and wildlife, and recreation project will lie within parts of Rains, Smith, Wood, and Van Zandt Counties, Texas.

SUMMARY

CARL L. ESTES LAKE, SABINE RIVER, TEXAS

(X) Draft ( ) Final Environmental Statement

Responsible Office: U. S. ARMY ENGINEER DISTRICT, FORT WORTH
Colonel Joe H. Sheard, District Engineer
P.O. Box 17300
Fort Worth, Texas 76102
Telephone: 817 334-2300

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

2. Description of Action: Construction and operation of a multiple-purpose reservoir project on the Sabine River, Sabine River Basin, Texas. An earth, rock-fill embankment will provide 393,000 acre-feet of storage within the water supply pool and 1,205,700 acre-feet at the top of the flood control pool. The combination flood control, water supply, fish and wildlife, and recreation project will lie within parts of Rains, Smith, Wood, and Van Zandt Counties.

3. a. Environmental Impacts: The proposed Carl L. Estes Lake will help fulfill the needs for flood control, water supply, fish and wildlife, and recreation. The project will provide a dependable water supply yield of 132 cfs under 1985 conditions. Recreational opportunities will be provided for 500 thousand recreation days annually. In order to mitigate adverse impacts on wildlife habitat and the associated loss of hunting opportunity, approximately 25,350 acres of suitable habitat within the project will be made available for habitat preservation and improvement. The project will remove from private ownership 26,200 acres of flood plain hardwood forest; 7,700 acres of upland forest; 33,000 acres of pasture; 1,100 acres of cropland; 700 acres of miscellaneous land. Because of inundation and

construction, there will be a permanent loss of species within 25,400 acres. There will be additional adverse effect within the 19,100 acre flood pool due to periodic inundation. At least 91 known archeological sites could be adversely affected in the project area. There are no known historical sites of Federal, State or regional significance; however, the project will cause the displacement of existing gravesites. There will be social, cultural, and economic impacts from relocations, disruption and dispersal of homes and neighborhood friends; loss of land; modified shopping patterns; and alterations in social activities. The project also requires the relocation or modification of a refinery, roads, a railroad, and several miles of communication and utility lines.

b. Adverse Impacts. The project will require acquisition and subsequent change in land use of approximately 68,700 acres of land. At the water supply pool elevation, the project will inundate about 35 miles of the Sabine River; and about 50 acres of small farm ponds. Of the 25,400 acre area impacted by construction or inundation there will be a permanent loss of wildlife habitat and displacement or loss of wildlife. There will be additional adverse effects to the flora and fauna within the 19,100 acre flood pool. The 91 archeological resources will be subjected to adverse impacts. Tax receipts and income from lands to be acquired will be lost for the life of the project. Relocating families, cemeteries, roads, and utility lines will have social and psychological impacts upon area residents, but should not cause extreme hardships.

4. <u>Alternatives</u>: The following alternatives to either the entire Carl L. Estes project or to features incorporated therein were considered:

1. No Action.

2. Alternatives that will provide all of the authorized purposes.

   a. Six main stem reservoirs, projects A, B, C, D, E, and F.

3. Alternative that will meet one or more but not all, of the authorized project purposes:

   a. Flood Control

      1. Main Stem Reservoir

      2. Tributary Retarding Structures

      3. Flood Plain Fee Acquisition and Permanent Evacuation

      4. Flood Plain Easement Acquisition

      5. Flood Plain Zoning

   b. Water Supply

      1. Main Stem Reservoir

      2. Two Main Stem Reservoirs

      3. Tributary Reservoirs

      4. Multi-Stage Developed Reservoirs

      5. Groundwater

      6. Import by Pipeline

   c. Recreation

      1. Optimum Recreation Development with Construction of Carl L. Estes Lake

2. Additional Facilities at Existing Nearby Water Resource Projects

3. Additional Lakes in the Recreational Market Area

4. Access to Existing Streams Without Development

5. Access to Existing Streams With Development

6. Environmental Corridor/Greenbelt Without Construction of Carl L. Estes Lake

7. Designation as a Wild, Scenic, and Recreational River Area

d. Fish and Wildlife

1. Water Bank Act

2. Green Tree Reservoir

3. Provide Public Hunting Areas

5. <u>Comments Requested</u>:

Advisory Council on Historic Preservation

Environmental Protection Agency

Federal Energy Administration

Federal Power Commission

U.S. Department of Agriculture

U.S. Department of Commerce

U.S. Department of Health, Education, and Welfare

U.S. Department of Housing and Urban Development

U.S. Department of the Interior

U.S. Department of Transportation

State of Texas

City of Alba, Texas

City of Edgewood, Texas

City of Emory, Texas

City of Grand Saline, Texas

City of Mineola, Texas

City of Wills Point, Texas

Dallas Morning News

East Texas Council of Governments

Citizens Environmental Coalition

EAC of North Central Texas

Environmental Coalition of North Central Texas

Environmental Defense Fund

Izaak Walton League of America

League of Women Voters of Texas

National Audubon Society

National Wildlife Federation

Sierra Club

Sportsman Clubs of Texas

Texas Archeological Society

Texas Committee of Natural Resources

The Nature Conservancy

Dr. S. Alan Skinner, Director, Archeology
Research Program, Department of Anthropology
Southern Methodist University

6. Draft Statement to CEQ:

ENVIRONMENT STATEMENT
CARL L. ESTES LAKE, SABINE RIVER, TEXAS

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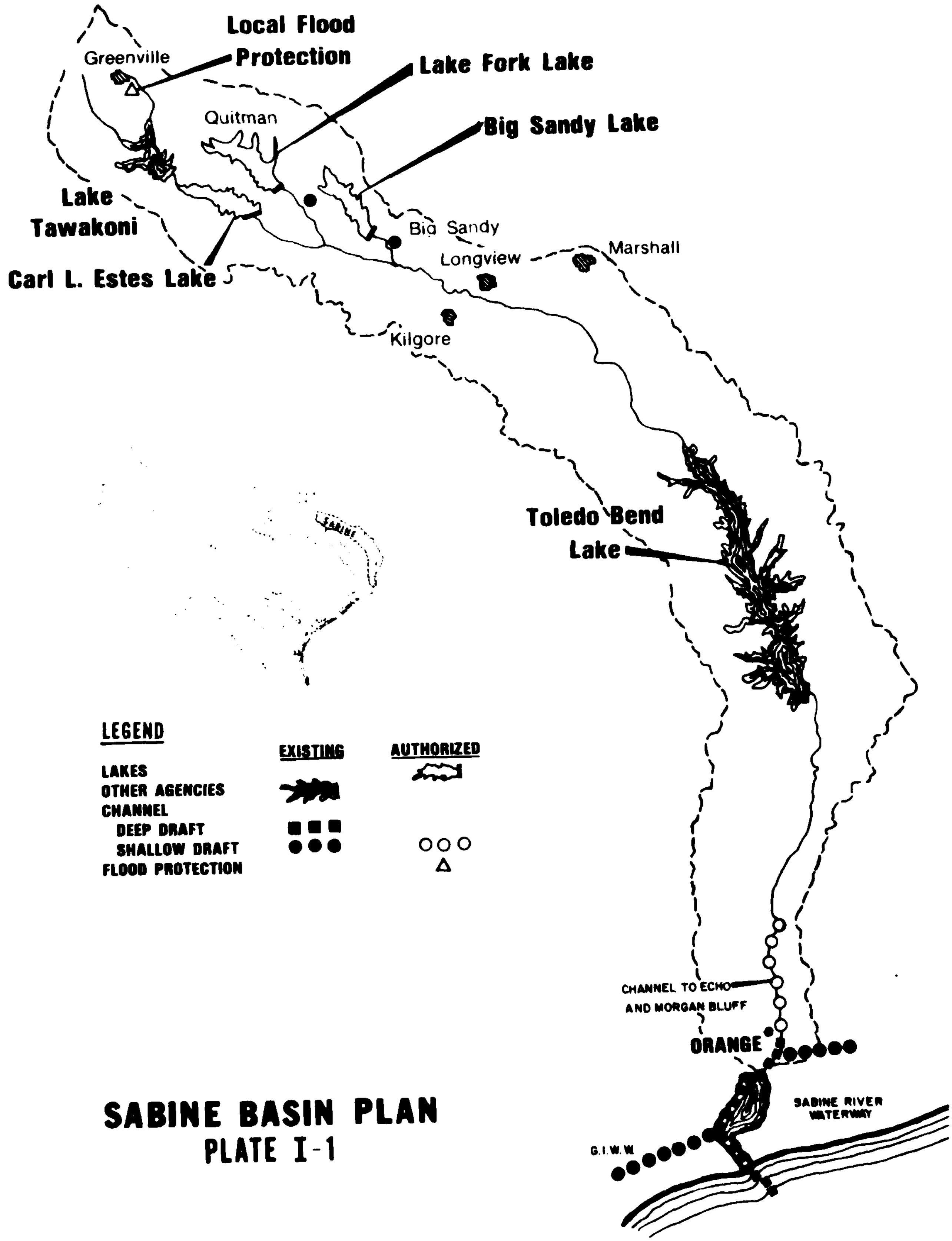
SECTION I - PROJECT DESCRIPTION

1.01 Project Authorization. Congressional authority for construction of Carl L. Estes Dam and Lake is contained in the Flood Control Act of 1970 (Public Law 91-611) approved 31 December 1970. The authorized purposes of this project are flood control, water supply, recreation, and fish and wildlife enhancement. This is substantially in accordance with the recommendations contained in House Document No. 91-429. The project was authorized as Mineola Lake, but was subsequently changed to Carl L. Estes Dam and Lake by Public Law 92-602, approved 27 October 1972. Other projects recommended for construction in House Document No. 91-429 are the multiple purpose dam and lake projects at Lake Fork and Big Sandy Lakes; a local flood protection project at Greenville, Texas; and an extension of an authorized navigation channel in the tidal reach of the Sabine River, see plate I-1.

1.02 Project Purposes. Carl L. Estes Lake will be a multipurpose lake that will incorporate flood control, water supply, fish and wildlife enhancement, and general recreation as project purposes.

1.03 Project Economics. The total investment cost of the Carl L. Estes project, including interest during the 6-year construction period, is $161.7 million at July 1974 price levels. Based on an interest rate of 5-7/8 percent, and a 100-year amortization period, the benefit-cost ratio for this project is 1.13 to 1.00. Pertinent economic data is presented in table I-1.



SABINE BASIN PLAN
PLATE I-1

Table I-1

Summary Economic Data

Economic data extracted from US Army Corps of Engineers, General Design Memorandum No. 2, General, Phase I - Plan Formulation, Carl L. Estes Dam and Lake, Sabine River, Texas. Complete document is available at US Army Engineer District, Fort Worth, PO Box 17300, Fort Worth, Texas 76102.

Total investment	$161,730,000
Average annual charge (including O&M)	10,100,800
Annual benefits	
Flood control	4,595,800
Water supply	6,241,000
Recreation	333,600
Fish and wildlife	104,300
Redevelopment	121,400
TOTAL	$ 11,396,100

Benefit-cost ratio: 1.13 to 1.0. Nonquantitable environmental benefits and costs are not reflected in this benefit-cost ratio.

1.04 Specific Location. The proposed Carl L. Estes damsite will be located at river mile 479.7 on the main stem of the Sabine River about 8 miles west of Mineola, Texas. At full conservation pool, elevation 379.0 feet msl, the lake will extend approximately 34.7 river miles downstream from the stilling basin of Iron Bridge Dam at Lake Tawakoni. The recommended project will be located in parts of Rains, Smith, Wood, and Van Zandt Counties.

1.05 Project Status. The project is in the advanced engineering and design detailed planning stage. Authority to initiate advance planning is contained in Public Works Appropriations Act approved 25 August 1972 (Public Law 92-405) and in Advice of Allotment C-91 dated 19 July 1973. Currently, the project is in the phase I formulation stage of planning. During this stage, previous studies are reviewed, refined and additional studies completed. If the project formulation is approved and funds are made available by Congress, the detailed plans, specifications, and cost estimate will be prepared and the construction phase initiated. If any major changes take place in the project during the latter phases, the environmental statement will be updated to reflect the changes.

Recommended Plan of Improvement

1.06 Embankment Description. Carl L. Estes embankment will be an earth and rock fill structure approximately 15,830 feet in length and having a crest height of 108.5 feet. The dam will have a crown width of 46.0 feet to accommodate the relocation of F.M. Road 17. A 200-foot wide uncontrolled ogee spillway will be constructed in the right abutment. The flood control outlet works will consist of one 15-foot diameter gated conduit controlled by two 7- by 15-foot slide gates. Selective withdrawals will be controlled by gates located at various levels to regulate lake stratification for downstream water quality. Pertinent data concerning recommended plan of improvement is summarized in table I-2.

Table I-2

Pertinent Data - Recommended Plan of Improvement

Miscellaneous			
Dam location			
River	Sabine		
River mile	479.7		
Drainage area, square miles	1,128		
Spillway Design Flood			
Peak inflow, cfs	367,500		
Volume, acre-feet	1,650,200		
Volume, inches	27.43		
Peak outflow, cfs	55,200		

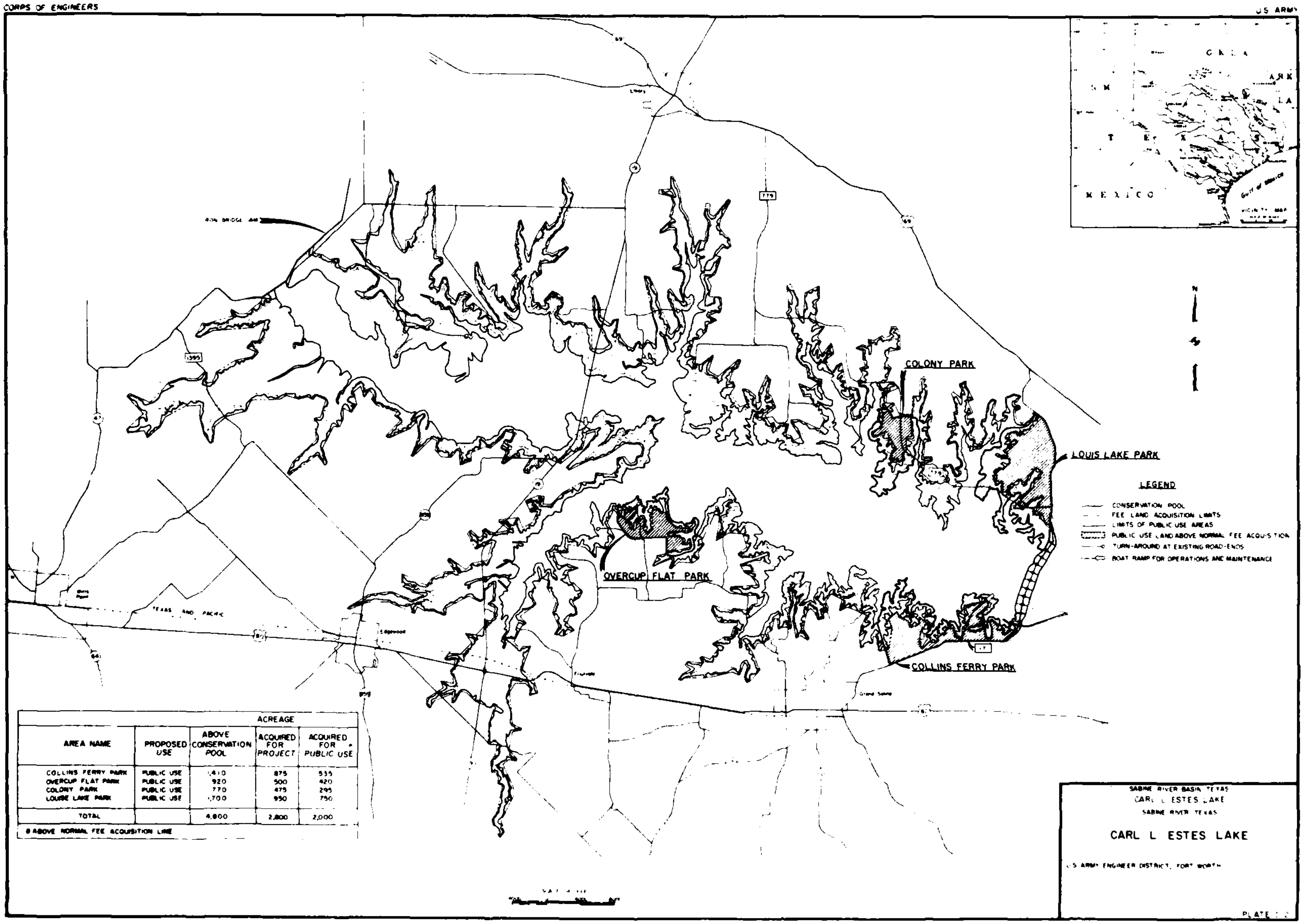
Reservoir	Elevation (feet msl)	Area (acres)	Capacity (acre-feet
Top of dam	428.5	-	-
Maximum design water surface	420.4	66,500	2,151,300
Top of flood control pool	403.0	44,000	1,205,200*
Top of conservation pool	379.0	24,900	393,000
Sediment storage	-	-	20,400

*Includes 20,400 acre-feet for 100-year sediment storage

Embankment	
Embankment details	
Type	Earth and rock fill
Total length, feet	15,830.0
Height above stream bed, feet	108.5
Freeboard, feet	8.1
Crownwidth, feet	46.0
Spillway section	
Type	Ogee weir (uncontrolled)
Net length at crest, feet	200.0
Outlet works	
Number	One
Type	Gated conduit
Size	One 15-foot diameter
Control	Two 7 by 15 foot slide gates
Invert	339.0

1.07 Lake. The Carl L. Estes Lake project will extend approximately 34.7 miles upstream from the embankment, and will inundate 44,000 acres at the top of the flood storage pool (elevation 403.0 msl). The water supply pool at elevation 379.0 msl will have 393,000 acre-feet of storage and a surface area of 24,900 acres (see plate I-2). The lake would have a conservation shoreline of approximately 153 miles. Only minimum facilities for public health and safety will be provided. Paragraph 1.09 presents more detail as to the recreation development.

1.08 Land Requirements. The land acquisition necessary to accomplish the authorized purposes consist of approximately 68,700 acres. The 68,700 acre project impact area presently consists of approximately 38 percent flood plain hardwood forest, 11 percent upland forest, 48 percent pasture, 2 percent cropland, 1 percent miscellaneous. Table 1-3 presents the land requirement necessary for the construction, mitigation, and operation of the project. The project will require the relocation of families associated with about 107 homes under the Uniform Relocation Assistance Act (Public Law 91-646). Relocation assistance will be in the form of payments and assistance to applicants who own property within the project area. The project will also necessitate the relocation of 23 miles of roads and highways, 1 mile of railroad, 12 miles of pipeline, 61 miles of electrical transmission lines, 1 refinery, and 2 cemeteries.



AREA NAME	PROPOSED USE	ACREAGE ABOVE CONSERVATION POOL	ACREAGE ACQUIRED FOR PROJECT	ACREAGE ACQUIRED FOR * PUBLIC USE
COLLINS FERRY PARK	PUBLIC USE	1,410	875	535
OVERCUP FLAT PARK	PUBLIC USE	920	500	420
COLONY PARK	PUBLIC USE	770	475	295
LOUISE LAKE PARK	PUBLIC USE	1,700	950	750
TOTAL		4,800	2,800	2,000

* ABOVE NORMAL FEE ACQUISITION LINE

Table I-3

Project and Aquisition Requirements

Land Requirements	Acres
Total fee area	68,700
Area occupied by conservation pool Below elevation 379.0 msl	24,900
Area occupied by flood pool (net) Area between elevation 379.0 and 403.0 msl	19,100
Area required for specific recreation	2,000
Downstream area required for wildlife mitigation and project operation requirement	12,000
Area required for damsite and spillway	500
Area required for project facilities and peripheral project lands	10,200

1.09 Recreation Development. To date, no interest has been shown by a non-Federal public body to provide assurances for recreational cost sharing. Even without full recreation development, the public is going to use the project. The plan for recreational development would provide only minimum facilities for public health and safety. These minimum facilities will consist of guardrails, turnarounds, and frame toilets on existing road ends. Approximately 2,000 acres of specific recreation lands will be acquired to protect the recreation potential of the project.

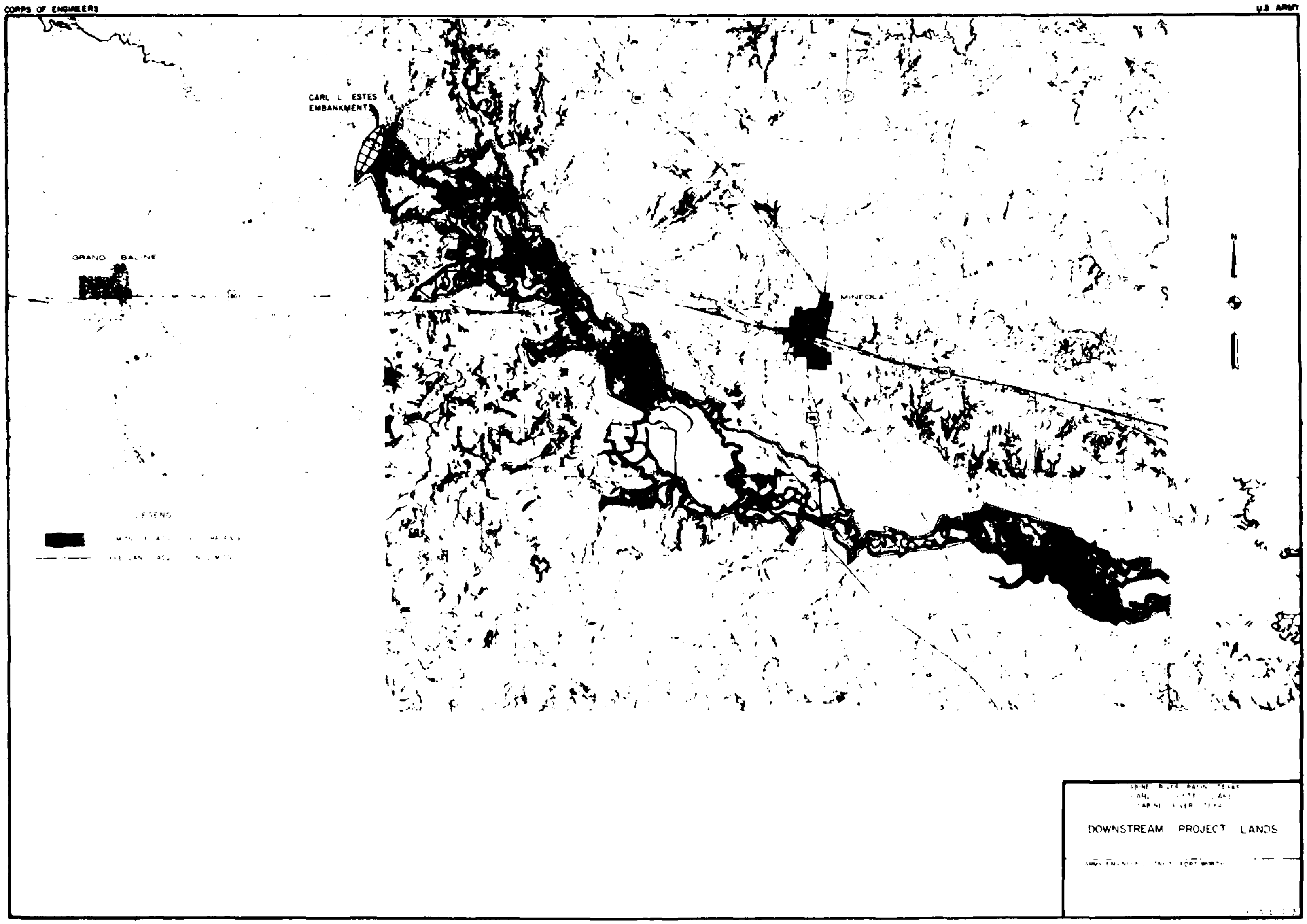
1.10 Wildlife Mitigation. House Document No. 91-429 authorized 15,000 acres of mitigation land to be purchased to offset wildlife losses associated with Carl L. Estes, Lake Fork, and Big Sandy Lakes. The Sabine River Authority (SRA) exercised its option to build Lake Fork Lake without Federal assistance in accordance with the provisions of the House Document. It appears that we now have authorization to purchase only 10,000 acres based on two Federal projects because no provision has been made to mitigate losses from the construction of a totally local project. For Carl L. Estes Lake, the authorization document also provided for the dedication of a 10,000-acre block of project land in the upper reaches of the project.

1.11 The draft U.S. Fish and Wildlife report dated 15 September 1975 concerning the fish and wildlife aspects of the Carl L. Estes project recommends that 12,000 acres of high qualitv flood plain forest dominated habitat, plus 13,350 acres of medium quality reservoir area upland habitat, be made available as wildlife habitat-type specific and man-day opportunity mitigation lands.

1.12 We concur with the U.S. Fish and Wildlife Service's estimate of the hunter-days which would be lost because of the project and further agree that the recommendations to mitigate these losses are reasonable.

1.13 With the proposed flood release of 4,000 cfs from Carl L. Estes Lake, approximately 12,000 acres of land downstream of the dam will be subjected to flooding, and normally flowage easements would be acquired on these lands. The Corps follows the joint policies of the Departments of Interior and Army relative to reservoir lands dated 28 June 1968, which govern the determination of acquisition lines and the criteria for determination of the various estates to be acquired. We have determined that these lands have substantial value for the protection and mitigation of the fish and wildlife resources and therefore these lands will be acquired in fee title in lieu of flowage easements to mitigate that losses caused by the Carl L. Estes project. Plate I-3 delineates the downstream project lands. This approximately 25,350 acres of land will be turned over to the Texas Parks and Wildlife Department for administration under the terms of a General Plan as provided in section 3 of Public Law 85-624, the Fish and Wildlife Coordination Act.

1.14 <u>Interrelationships With Other Water Resource Projects</u>.
Carl L. Estes, Big Sandy, and Lake Fork Lakes are important elements in the system of multiple purpose lake projects authorized by Public Law 91-611 for the Sabine River Basin, see plate I-1. Carl L. Estes is in the advanced engineering and design planning stage. Big Sandy Lake is estimated to be needed to meet in-basin and out-of-basin demands during the decade 1990-2000. Lake Fork Lake will be



CORPS OF ENGINEERS
U.S. ARMY
CARL L. ESTES EMBANKMENT
GRAND SALINE
MINEOLA
LEGEND
DOWNSTREAM PROJECT LANDS

built for water supply without Federal assistance under the auspice of the Sabine River Authority. The Sabine River Authority construction schedule for Lake Fork Lake provides for impoundment in July 1979. Public Law 91-611 also authorizes the Greenville local flood protection project and extension of an authorized commercial navigation channel. These authorized improvements are consistent with the comprehensive plan for the conservation and best use of the basin's water and related land resources formulated by the Sabine River Basin coordinating committee and approved by the Water Resources Council.

1.15 At the present time, major Federal flood control or multipurpose lakes do not exist in the basin. There are, however, eleven non-Federal lakes and one group of five off-channel lakes which serve as sources of municipal and industrial water supply, and recreation. A major project, Lake Tawakoni, has been developed by the Sabine River Authority of Texas, for water supply and recreation. Toledo Bend Reservoir, developed by the Sabine River Authorities of Texas and Louisiana, provides water supply, hydroelectric power, and recreation.

1.16 The Soil Conservation Service, USDA, has an upper Lake Fork Creek project for watershed protection and flood prevention on agricultural lands that was approved for operations under the authority of Public Law 83-566 on 25 July 1958. The watershed, located in parts of Hopkins, Rains, and Hunt Counties, Texas, has a drainage area of 227 square miles and includes 26 flood water retarding structures of which 18 are completed. This project, when completed, will provide flood protection to 12,600 acres of flood plain lands. A watershed work plan has been prepared for Mill Creek under the provision of Public Law 83-566. The Mill Creek watershed is located in Van Zandt County and has a drainage area of 127 square miles. This work plan consists of land treatment, 11 floodwater retarding structures, one multiple-purpose structure, and 24 miles of channel work. To date, none of the structural measures have been installed. Preliminary studies indicate that some of the planned floodwater retarding structures would not be needed if Carl L. Estes Lake is built. Construction of the structural measures have been held up, except the one multiple-purpose structure, until more information is available as to the status of the Carl L. Estes project. Application for Federal assistance has been made for the Upper Sabine, Irons Bayou, and Lower Sabine watersheds.

1.17 Environmental Protection. The contract awarded for the Carl L. Estes Lake project will include special provisions which will require the contractor to prepare an environmental protection plan to prevent environmental pollution during construction operations. Thus, the contractor will be held responsible for protection of environmental resources in connection with the project's construction. Included in the technical specifications are criteria for the prevention of air, water, and noise pollution, and of land despoilment from spillage and waste. Prevention of air pollution includes consideration of dust, smoke, fumes, and sprays. Criteria for prevention of water pollution cover spilling fuel, oil, and grease; runoff from concrete operations; sanitary and other waste disposal operations; asphalt operations; and from the use of herbicides and pesticides. Land despoilment considerations include spillage and waste from concrete, asphalt, and water curing operations, and the destruction of land forms and vegetation. Noise pollution as a result of all construction, sediment control, and clearing and grubbing operations is also covered by technical specifications.

Operation and Maintenance Program

1.18 Administration. The operation and maintenance of Carl L. Estes Lake will be a Federal function. The Corps of Engineers, Fort Worth District, will be responsible for the operation and maintenance of the project in accordance with its authorized purposes. However, the Corps of Engineers will encourage and enter into agreements with non-Federal public bodies to administer project land and water areas for recreation and fish and wildlife purposes and operate, maintain, and replace facilities provided for those purposes.

1.19 Operation and Maintenance Personnel. It is the policy of the Corps of Engineers to limit full-time specially trained operation and maintenance personnel to the minimum number required for proper operation and maintenance of project facilities. Seasonal maintenance will be performed by hired labor or contract labor when it is in the best interest of the Government. Repairs involving substantial costs or extraordinary maintenance will be accomplished by contract in lieu of hired labor whenever it is to the advantage of the Government.

1.20 Lake Regulation. The Corps of Engineers will be responsible for release of floodwater from the project. The flood control plan of operation is dependent upon the regulated release rate of the proposed lake, on downstream channel capacities of the Sabine River, and on releases from other lakes on the Sabine River. The Sabine River Authority, a State agency, will direct the releases from the water supply pool.

1.21 Land and Water Zoning. The land and water areas of the project will be zoned to insure safety, protection of property, and the resources of the project. All zoned areas will be clearly and appropriately designated with approved signs or buoys. Temporary zoning for special events of short duration may be permitted after approval by the project manager.

1.22 Outgrants. All outgrants including easements for roads and utility lines will be reviewed on an individual basis. The policy of attempting to have private roads and utility rights-of-way located on adjacent private property will be adhered to as much as possible. Lands will be acquired in flowage easement to allow for possible inundation. Designated project lands may be made available for grazing leases only on an interim basis as a management tool when such use does not conflict with the authorized purposes of the project. Concession leases will be granted in a fair and impartial manner. All outgrants, easements, and leases will be inspected by project and district personnel as required for compliance with Corps of Engineers policies, lease agreements, and public health and safety codes.

1.23 Recreation. The Corps of Engineers will assume the responsibility for the operation and maintenance of the minimum recreation facilities provided for public health and safety. The operation and maintenance program will consist of maintaining guardrails, turnarounds, and frame toilets, removal and disposal of solid waste and sewage, the mowing and control of undesirable vegetation, and pest control.

Resource Management

1.24 General. The concept underlying the management of project resources is to conserve, improve, and manage the resources for their best use and proper stewardship for the benefit of the general public. In accordance with the concept, the policies regarding the administration and management of the project have been formulated to make the majority of the lake and the Government-administered land available to the visiting public to the fullest extent compatible with an orderly and planned development. These policies control the administration, management, and development of the project area, but will not conflict with the operation of the project for its authorized purposes. They will be based on legislation enacted by Federal, State, and local governmental agencies and experience gained in the operation and development of similar projects and public parks.

1.25 Archeological and Historical Resource. If identifiable cultural sites are discovered during project operation, they will be protected and evaluated for inclusion in the National Register of Historic Places in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (30 CFR Part 800).

1.26 Fish and Wildlife Resource. The Texas Parks and Wildlife Department has the authority and responsibility to preserve and manage all resident fish and wildlife. The U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department also assume a dual responsibility for the management of migratory species. In recognition of the above responsibilities, the Corps of Engineers' policy is to encourage these agencies to assume the basic responsibility for the management of the fish and wildlife resources at this project. The Corps will assist in the fish and wildlife management program by developing and implementing a fish and wildlife habitat management plan. Fences will be constructed along project boundary to protect the wildlife resource by excluding vehicles and providing control of livestock intrusion. Recommendations made by the Texas Parks and Wildlife and Fish and Wildlife Service will be incorporated into the design, construction, clearing, management, and operation of the project, as applicable. Under the auspices of the Fish and Wildlife Coordination Act, Public Law 85-624, the Corps of Engineers and the U.S. Fish and Wildlife Service have developed a mitigation plan which would offset much of the project's adverse impact on the fish and wildlife resources. The mitigation plan provides approximately 12,000 acres of flood plain lands below the planned embankment and approximately 13,350 acres of suitable upland lake perimeter land. These lands will be offered to the Texas Parks and Wildlife Department under the terms of a General Plan as provided in Section 3 of Public Law 85-624.

1.27 Fishing and Hunting. Fishing and hunting on project lands and water will be in accordance with applicable Federal, State, and local laws; enforcement will be the responsibility of Federal and State agencies. In addition, fishing and hunting will be in accordance with the project land and water zoning plan.

1.28 Vegetation Resources. At the present time, there are no formal vegetation management programs for Carl L. Estes Lake; however, guidelines have been established for the preparation of a vegetation management plan. The basic objective of the management program will be to provide stewardship of the land and resources through protection, improvement, and management of the vegetative cover. This will be accomplished by planting, maintaining, and improving desirable trees and grasses.

1.29 It is essential that desirable trees and grasses be established and maintained during the early development stages of the project. Cultivation of row crops will be phased out as rapidly as practicable. Areas where tree or grass cover is already established will not be disturbed unless a more desirable plant species can be planted to benefit the area. Planting and simple drainage features will be used to control rapid runoff. Suitable tree and grass species will be established along the shoreline, where needed, and on public use areas where desirable.

Public Safety, Health and Sanitation

1.30 Aquatic and Terrestrial Vegetation Control Program. Excessive growth of undesirable aquatic plants can affect water quality, interfere with boating, and result in an imbalance of fish populations. Many of these plants can be controlled with approved chemicals, or by grazing, plowing or burning during periods of draw-down. However, the best and most effective means of control is to monitor aquatic plants for undesirable species and destroy them before they become a problem.

1.31 Terrestrial vegetation control will consist primarily of mowing grass and trimming shrubbery around project building. Herbicides will only be used to control vegetation when mechanical control is not practical.

1.32 Pest Control. The use of chemicals or mechanical pest control techniques will be used where practicable to control insects, rodents, and other pests which may be harmful to the health and safety of the public. Pesticides and other chemicals will only be used when other methods cannot control the pest problem. All pesticides will be selected for best results with the least adverse effects on the total environment from the list of pesticides registered by the Environmental Protection Agency. A mosquito surveillance program will be conducted during periods when mosquitoes are most active. Mosquito samples will be collected for analysis by project personnel. Mosquito breeding sites will be surveyed and an insecticide applied when necessary.

1.33 Sewage Disposal. The type of sewage disposal facilities selected for use at Carl L. Estes Lake will be based upon the best available, practical, and economical treatment disposal system that meets Federal, State, and local regulatory requirements. Close and continuing coordination will be maintained at all levels of government having special interest in health and sanitation. The design of sewage treatment facilities will be coordinated with the Environmental Protection Agency.

1.34 Solid Waste Disposal. Local municipal waste disposal facilities and contracts with off-project sanitary collectors will be used whenever practical. Sanitary landfills on project lands will be used only until a more practical and economical alternative can be found. The landfill areas, if used, will be located in an isolated area and will conform with all Federal, State, and local requirements. The solid waste disposal plan will be coordinated with the responsible health officials.

1.35 Water Quality Monitoring. Project personnel will collect water samples from swimming areas, and sources of potable water. Analysis of water samples will be performed by the State Department of Public Health. Monthly water samples will also be collected from the lake to measure temperatures and dissolved oxygen. Close and continuing coordination will be maintained with the Environmental Protection Agency, State Department of Public Health, and the Texas Water Quality Board.

1.36 Pollution Control. The control of air and water pollution and solid waste disposal shall be in accordance with Executive Order No. 11752 on Prevention, Control and Abatement of Air and Water Pollution at Federal Facilities, and the Federal Water Pollution Control Act (Public Law 92-500). All project personnel will maintain constant vigilance for sources of pollution to the reservoir and its stream tributaries.

1.37 Citation Authority. Rangers at Carl L. Estes Lake will be designated by the Chief of Engineers as having authority to issue citations for violations of the regulations covered by Title 36. Citations carry provisions for monetary fines or imprisonment under "Title 36 - Parks and Forest Chapter III - Corps of Engineers, Department of the Army, Part 327 - Rules and Regulations Governing Public Use of Water Resource Development Projects Administered by the

Chief of Engineers." Any person charged with such violation may be tried and sentenced in accordance with provisions of Section 3401 of Title 18, United States Code.

1.38 Law Enforcement. Enforcement of civil and criminal laws at the project will remain the responsibility of duly constituted officers of Federal, State, and local law enforcement agencies. The Corps of Engineers will cooperate fully with all officers responsible for the enforcement of laws relative to civil and criminal actions.

1.39 Visitor Interpretation and Education. A visitor interpretation and education program will be developed to inform and educate the public with regard to the purposes and concept of operation of the project and the rich historical, archeological, and natural features of the area. This program will be developed in accordance with the most professional and accepted methods of interpretation.

SECTION II - ENVIRONMENTAL SETTING WITHOUT THE PROJECT

2.01 Physiographical Description of the Sabine River Basin. The crescent-shaped Sabine River basin lies in eastern Texas and western Louisiana. The basin is relatively long and narrow, with a length of about 300 miles, and varies in width from 16 miles to about 48 miles. It is bounded by the basins of the Neches River on the west, the Trinity River on the northwest, the Red River on the north and northeast, and the Calcasieu River on the east. It extends from eastern Collin County about 35 miles northeast of Dallas, Texas, to about 165 miles southeast to the eastern boundary of Texas; thence southerly in Texas and Louisiana about 145 miles to the head of Sabine Lake near Orange, Texas. Its area is about 9,756 square miles, of which 2,330 square miles are in Louisiana and 7,426 square miles are in Texas. It embraces all or portions of 20 counties in Texas and 8 parishes in Louisiana. The Sabine River basin is shown on plate I-1.

2.02 The basin lies within the West Gulf Coastal Plain section of the Coastal Plain physiographic province. The land elevation within the basin varies from a few feet above sea level near the coast to about 750 feet above sea level in the headwaters. In the extreme upper end of the basin the land surface is undulating to gently rolling, and the streams lie in shallow valleys. In the lower 60 miles along the coast the land surface is flat to undulating. In the remainder of the area the land surface is rolling to hilly with occasional flat areas along the interstream divide. In the hilly section the principal streams are entrenched in broad flat valleys.

2.03 Description of the Watershed. The Sabine River has its headwaters in the eastern portion of Collin and Hunt Counties. From its headwaters the river flows in a southeasterly direction across parts of Collin, Hopkins, Hunt, Kaufman, Rains, Rockwall, Smith, Van Zandt, and Wood Counties. The portion of Sabine Basin that includes the Carl L. Estes watershed contains about 1,128 square miles.

2.04 The Carl L. Estes watershed lies chiefly in the East Texas Timber Belt a subdivision of the West Gulf Coastal Plain section of the Coastal Plain physiographic province. Only the upstream extremities of the lake will extend westward across the physiographic boundary into the adjacent Black Prairie subdivision. The East Texas belt is underlain by formations composed of sand, sandstone, and shale or clay. The Black Prairie is underlain by a sequence of formations composed principally of shale and limestone. Erosion has reduced the highland terrain to low hills having gently sloping tops and moderately steep sides. Crests of divides separating the principal tributaries are seldom more than a mile wide.

2.05 Description of the Project Area. The proposed project will be located on the main stem of the Sabine River at the junction of Van Zandt, Rains, and Wood Counties, Texas. Topographically, the forested highlands bordering the broad, shallow Sabine River valley are well dissected by heavily forested tributary drainages. The flood plain varies from approximately 1.0 to 1.5 miles in width, with local constriction of about 0.5 miles.

2.06 Because the topography does not easily lend itself to mechanized farming, much of the project area has been used as range or converted to pasture. This trend is expected to continue as farmers shift from row crops to livestock production. The 68,700 acre project area presently consists of 26,200 acres of floodplain hardwood forest; 7,700 acres of upland forest; 33,000 acres of pastures; 1,100 acres of cropland and 700 acres of miscellaneous lands.

2.07 The Sabine River is well entrenched in a broad, shallow and heavily forested flood plain. Throughout the project area, the river is meandering and has a small channel capacity in proportion to the area drained. Consequently, floods are experienced at frequent intervals throughout the year. The water quality is considered good.

2.08 Most of the project area is located in the land resource area called the Southern Coastal Plain. The soils of this resource area are mostly light-colored, fine, sandy loams and loamy sands with subsoil that ranges from loamy sand to plastic clay in texture. The upland soils are generally of low fertility, but most respond to fertilization. A portion of the Texas Blackland Prairie land resource area is found in the upper reaches of the project. The soils of this resource area are characterized gray and black calcareous clay grassland which have been formed from underlying clay marl, and chalky limestone.

2.09 Originally, the native upland vegetative complex consisted of a post oak savannah. Much of the area has been converted to pasture and cropland with the present trend toward an increase in pasture acreage at the expense of both forest and cropland. The flood plain is characterized by a hardwood forest which is dominated principally by willow oak (Quercus phellos).

Water Resource Problems and Needs

2.10 Flood Control. Flooding is the principal water-related problem in the Sabine River Basin. Throughout the basin, the streams are meandering, and in general, have small channel capacities in relation to their drainage area. Consequently, floods are experienced at frequent intervals throughout the year. Under existing floodplain development, the average annual flood damages exceed four million dollars. The flood control aspects incorporated in Carl L. Estes Lake will provide varying degrees of protection to approximately 170,000 acres of predominantly agricultural oriented floodplain.

2.11 Water Supply. The water supply study prepared by the Corps of Engineers indicates that the Upper Trinity River Basin will experience a water supply deficiency as early as year 2000. A portion of Carl L. Estes Lake dependable yield has been designated for transfer to the Upper Trinity River Basin in accordance with the Texas Water plan prepared by the Texas Water Development Board.

2.12 Water supply needs were studied for a seven-county area located immediately downstream of the project. The study area included Gregg, Harrison, Panola, Rusk, Upshur, Wood Counties and the rural portion of Smith County. The study indicated that at least two counties will experience water supply deficiencies by 1980. Four additional counties will exeed their water supply by 2020.

2.13 Recreation Needs. Corps of Engineers studies and the draft Texas Outdoor Recreation Plan (TORP) indicates that a wide deficit exists between the projected recreational needs in the Sabine River Basin and the capacities of all existing and proposed water resource development projects. Carl L. Estes Lake will not meet the deficit which exists in the area. Indications are that recreation needs will continue to exceed the increasing number of facilities being provided and that additional recreational outlets will be needed to help reduce this deficit.

Sabine-Neches River Estuary.

2.14 Sabine Lake. Sabine Lake is relatively shallow brackish estuarine containing approximately 56,000 acres (1). Its true value lies in the importance as nursery area for juvenile shrimp, crabs, and finfishes. The lake is located on the Louisiana-Texas state line at the southwestern corner of Cameron Parish, Louisiana, and the eastern edge of Jefferson County, Texas. The main tributaries entering the lake are the Sabine River, Neches River, the Intracoastal Waterway. Several smaller bayous enter along the southeastern edge of the lake. The channel to the Gulf of Mexico is Sabine Pass, located at the extreme southwestern end of the lake.

2.15 Sabine River Compact. The Sabine River Compact was signed by representatives of the states of Texas and Louisiana, and the United States on 26 January 1955, and subsequently ratified by the legislatures of the states and approved by the United States Congress. The major purposes of the Compact are to provide for an equitable apportionment of the waters of the Sabine River and its tributaries; and to establish a basis for cooperative planning and action for water conservation and utilization on the reach of the Sabine River common to both states, and for the apportionment of the benefits there from. The Compact provides for the free and unrestricted use of the water of the Sabine River and its tributaries above the stateline, subject only to the provisions that the minimum flow of 36 cubic feet per second must be maintained at the stateline.

Hydrological Characteristics.

2.16 General Climatic Data. The climate over the Sabine River watershed is generally mild, with the distinctive feature of a wide range of annual and daily temperatures. In summer the days are generally hot and humid and the nights moderately warm. The winters are cool with snowfall and subfreezing temperature rare in the lower section, but experienced occasionally in the more northerly parts of the basin for periods of short duration resulting from the passage of cold high pressure air masses from the northwestern polar regions and the continental highlands. The mean annual temperature at Wills Point is 65.6 degrees Fahrenheit and temperatues there have ranged from a maximum of 115 degrees to a minimum of -1 degree. The growing season averages about 240 days in the upper basin and about 285 days in the coastal region.

2.17 Precipitation. The annual precipitation averages about 50 inches over the Sabine River basin and about 40 inches in the upper reach above Gladewater, Texas. Extremes in annual precipitation in the Sabine River basin have ranged from a minimum of 17 inches at Greenville, Texas, in the upper basin, to a maximum of 95 at Beaumont, Texas, near the southern end. Periods of excessive precipitation have been experienced over all parts of the basin. Generally, the highest 24-hour and monthly periods have occured during major storms; however, there are some instances of heavy precipitation resulting from localized thunderstorms.

2.18 Winds. The prevailing wind is from a south-southeast direction. Winds are stongest during intense thunderstorms but are of short duration. The maximum recorded wind velocity of 91 miles per hour occurred at Port Arthur, Texas, in August 1940.

2.19 Stream Characteristics. The Sabine River rises in northwestern Hunt County and flows southeasterly through the city of Greenville about 60 channel miles to join Caddo Creek and the South Fork within Lake Tawakoni. The river flows about 250 miles to the State line near the town of Logansport, Louisiana; then southerly through Toledo Bend Reservoir and along the State line about 265 miles to Sabine Lake. Tidewater extends up the river about 33 miles from the coast. There are numerous streams tributary to the Sabine River, most of them small. Channels of the tributary streams are generally poorly defined, crooked, and badly obstructed by brush and drift. In rolling, hilly sections, these tributaries have relatively steep slopes and shallow valleys in their upper reaches. Tributary streams in the Gulf Coast Prairies have flat slopes and shallow valleys throughout the greater part of their lengths. Floods on these streams cover wide areas and, in some instances, floodwaters flow across interstream divides. Streambed elevations of the Sabine River vary from about 700 feet above mean sea level at the source, to about 320 feet above mean sea level at Carl L. Estes damsite (river mile 479.7) and to about -40 feet mean sea level at the mouth. The average slope of the overall streambed is about 1.3 feet per mile, and the average stream slope from the source to the Carl L. Estes damsite is about 3.7 feet per mile.

2.20 Chemical and Physical Water Quality. The U. S. Geological Survey, U.S. Department of the Interior, has collected water quality data from the Sabine River at two sampling stations near Emory and Mineola, Texas. The samples were taken between October 1967 and September 1974. The Emory sampling station is located at the intersection of the Sabine River and State Highway 19, approximately 7.2 miles south of Emory, Texas. The Mineola site is located on the Sabine River, approximately 3.5 miles south of Mineola on U.S. Highway 69. The proposed Carl L. Estes damsite is midway between these sampling stations. A summary of the water quality tests is shown in Table II-1. The average dissolved solid concentration increases from 109 mg/l (milligrams per liter) at Emory to 308 mg/l at Mineola. This is due to the increased dissolved solid inflow from Grand Saline Creek which enters the Sabine River below the proposed damsite. The chloride concentration similarly increase from an average concentration of 6.5 mg/l to 111 mg/l. A comparison of the chemical parameter presented in table 11-1 with the proposed Texas Water Quality Board stream standard shows that the dissolved oxygen concentration at Emory tends to drop below the 5.0 mg/l recommended minimum during low flow periods. The average concentration of sulfate increases from 14.5 mg/l at Emory to 45 mg/l at Mineola, and the average hardness increases from 76 mg/l to 95 mg/l. These average values are well within the recommended standards.

2.21. During January 1974, the Texas Water Quality Board (TWQB) conducted an intensive surface water monitoring survey at Lake Tawakoni. This survey included sampling stations on the main body of the lake and on the bays created by major tributaries. Tables II-2 & 3 presently a summary of Lake Tawakoni water quality data. An analysis of these chemical parameters indicates that the water quality of Lake Tawakoni is of generally good quality. Dissolved oxygen, pH, temperature values and most parameters were in compliance with the TWQB stream standards.

2 ?2 Biological Water Quality. A close relationship exists between the aquatic biota and the quality of water in which they live. Generally speaking, polluted waters are capable of supporting a much less diverse biota than are non-polluted waters, although biological productivity in polluted waters is often quite high.

Because of this relation, the planktonic productivity of Lake Tawakoni was determined by a survey conducted during January of 1974 by the Texas Water Quality Board. The results from samples collected at two lakes are shown in table II-4.

Table II-4
Plankton Data

Station No.	1	3
No. Species	10	8
No. Individuals (cells/l)	12,687	6,259
Diversity Index ($\bar{d}$)	3.14	2.70

List of Organisms (cells/liter)

Organism	1	3
CHLOROPHYTA (Green Algae)		
Actinastrum sp	958	--
Chlorella sp	2,394	2,155
Pediastrum sp	478	--
Ulothrix sp	958	--
Gonium sp	2,394	--
Selenastrum sp	1,197	513
Scenedesmus sp	958	821
Staurastrum sp	478	--
Microspora sp	--	308
CHRYSOPHYTA (Diatoms)		
Synedra sp	1,436	308
Navicula sp	1,436	513
Nitzchia sp	--	718
Melosira sp	--	923

TABLE II-1

SABINE RIVER WATER QUALITY DATA
U. S. Geological Survey

Parameter	Sampling Station 1967 to 1974 Near Mineola, Texas			Sampling Station 1967 to 1974 Near Emory, Texas			Proposed Texas Water Quality Board Standards
	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Average not to be Exeeded
Discharge, cfs	25,300.0	0.0	1,243.0	5,470.0	.2	994.0	-
Specific Conductance, umhos	11,400.0	70.0	565.0	1,222.0	68.0	242.0	-
Calcium, mg/l	130.0	5.0	28.0	55.0	5.5	25.6	-
Magnesium mg/l	32.0	1.2	6.6	18.0	1.5	4.0	-
Sodium, mg/l	1,970.0	10.0	61.0	.0	.0	.0	-
Potassium, mg/l	9.3	2.2	4.1	.0	.0	.0	-
Bicarbonate, mg/l	1,080.0	8.0	68.0	136.0	8.0	84.0	-
Carbonate, mg/l	.0	0.0	0.0	.0	.0	.0	-
Sulfate, mg/l	820.0	8.0	45.0	28.0	7.2	14.3	100
Chloride, mg/l	3,010.0	9.0	111.0	13.0	3.0	6.5	200
Nitrate, mg/l	10.0	0.0	0.8	5.0	.0	.4	-
Dissolved solids, mg/l	5,060.0	47.0	308.0	174.0	42.0	109.0	500
Hardness (total), mg/l	450.0	20.0	95.0	120.0	20.0	76.0	-
Hardness (noncarbonate) mg/l	320.0	0.0	40.0	170.0	.0	13.0	-
Sodium adsorption ratio	41.0	0.2	3.3	2.2	.4	.73	-
Silica, mg/l	18.0	2.0	6.8	8.5	.0	3.50	-
Fluoride, mg/l	0.7	0.0	0.2	.5	.1	.2	-
pH	7.9	5.9	7.0	7.7	6.4	7.2	6.0-8.[illegible]
Temperature, ^{o}C	29.0	2.0	17.2	31.0	4.5	18.5	[illegible]
Dissolved oxygen, mg/l	12.4	7.0	7.3	11.5	3.8	6.3	5.0
Phosphorus, mg/l	0.17	0.0	0.11	.44	.0	.13	-

TABLE II-2

LAKE TAWAKONI WATER QUALITY DATA BY
TEXAS WATER QUALITY BOARD

JANUARY 1974
Chemical Analysis, mg/l

Parameters	Stations 1 Lake- River channel near *dam*	2 Lake- Kitsee Bay near *FM 751 Bridge*	3 Lake- River channel *near FM 35 Bridge*	4 Lake- Caddo Bay in *river channel*	5 Lake- Pawnee Bay Arm	Proposed Texas Water Quality Board Stream Standards
BOD	2.0	2.0	2.0	2.5	3.5	--
TDS	87.5	87.0	87.5	97.5	92.5	200
NH_3-N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	--
NO_2-N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	--
NO_3-N	0.08	0.08	0.07	0.26	0.21	--
Kjel-N	0.5	0.4	0.4	0.5	0.6	--
Total - N	0.58	0.48	0.47	0.76	0.81	--
O-PO_4	< 0.03	0.07	0.03	0.20	0.27	--
T-PO_4	0.09	0.19	0.11	0.33	0.43	--
TSS	11	15	< 10	< 10	29	--
FSS	3	7	< 10	< 10	18	--
VSS	8	8	< 10	< 10	11	--
SO_4	13	14	13	16	16	50
Cl	6	6	5	7	7	75
Fecal Coliform, No/100ml	0	2	1	0	6	200
	Sediment Heavy Metal Analysis					EPA Sediment Guidelines
Arsenic	< 5.0	5.6	6.0	7.2	6.0	5.0
Cadmium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.0
Copper	5	10	7	11	9	50
Chromium	8	21	16	22	22	100
Lead	10	22	15	19	19	50
Manganese	500	380	360	300	290	--
Mercury	0.02	0.05	0.03	0.03	0.03	1.0
Nickel	10	16	12	17	15	50
Silver	< 10	< 10	< 10	10	10	-
Zinc	23	65	45	64	58	75

TABLE II-3

WATER QUALITY DATA OF SELECTED TRIBUTARIES OF THE SABINE RIVER
TEXAS WATER QUALITY BOARD

JANUARY 1974
Chemical Analysis, mg/l

Parameters	Stations 6 Cowleach Fork of the Sabine River; 2 miles east if Dixon	7 Cedar Creek at FM 1564 Bridge	8 Caddo Creek on County Road, 3 miles NW of Quinlan	9 South Fork of Sabine River on County Road, 2 miles South of FM 35	10 Bearpen Creek on County Road	Proposed Texas Water Quality Board Stream Standards
BOD	6.5	3.0	2.5	2.5	1.5	–
TDS	420	177	531	516	211.5	200
NH_3-N	3.8	< 0.1	< 0.1	< 0.1	< 0.1	–
NO_2-N	0.022	< 0.005	0.006	0.008	0.005	–
NO_3-N	1.0	0.03	0.19	0.27	0.03	–
Kjel-N	4.5	0.6	0.4	0.4	0.5	–
Total - N	5.72	0.63	0.57	0.68	0.53	–
O-PO_4	7.9	0.51	0.23	0.12	0.21	–
T-PO_4	9.0	0.50	0.34	0.22	0.42	–
TSS	28	10	< 10	10	33	–
FSS	18	4	< 10	2	23	–
VSS	10	6	< 10	8	10	–
SO_4	113	44	105	132	83	50
Cl	51	43	60	68	34	75
Fecal Coliform, No./100ml	200	30	64	170	86	200

2.23 Analysis of the significant water quality parameters indicates that the present quality of the water in the proposed project area is good to excellent. The data indicates that concentrations of the various chemical constituents during normal flow conditions are within the criteria set by the Texas Water Quality Board. Some individual samples during low flows are found to be outside the standards for short periods of time but cause only limited detrimental effects. There has, however, been a slight increase in pollution over the years as evidenced by decreases in the dissolved oxygen concentration and pH. The Sabine River generally offers a water of high quality as evidenced by its effluent limiting classification whereby an instream segment was measured and found to be within the proposed Texas Water Quality Board water quality standards. The waters of the Sabine River can thus be used with proper treatment for municipal water supply, recreation, and propagation of fish. The water upstream from the Emory site in Lake Tawakoni is presently being used for these purposes.

Geological Characteristics.

2.24 Structure. The proposed site is located on the west flank of the structural East Texas Basin. Regionally, bedrock strata supporting the Carl L. Estes watershed dip to the east-southeast into the basin. Because the dip of the strata is steeper than the regional slope of the terrain, the Sabine River cuts across a sequence of outcropping bedrock units, the oldest being in the vicinity of Lake Tawakoni and the youngest at the proposed damsite. Locally, the dip of the bedrock strata may vary from about 30 feet per mile to about 100 feet per mile. In parts of the proposed lake area the regional dip is interrupted by minor faulting. The largest structural anomaly in the watershed is the Grand Saline piercement salt dome located on the southern edge of the watershed.

2.25 Stratigraphy. Three principal bedrock units crop out within the Carl L. Estes watershed: the Wills Point formation, the Wilcox group, and the Carrizo formation. The oldest and lowermost unit is the Wills Point formation of the Midway group, Paleocene/Eocene age. The Wills Point formation is composed principally of sandy shale that grades upward into the overlying Wilcox group (undifferentiated). The Wills Point formation crops out in the upper part of the proposed lake area immediately downstream from Iron Bridge Dam. This is the area lying in the Black Prairie physiographic subdivision. The Wilcox group, overlying the Wills Point formation, crops out from 3 miles below Iron Bridge Dam to the proposed Estes damsite. The Wilcox group is best characterized as a sequence of soft sandstone and shale beds with a few lignite beds. Some of the sandstone beds are as much as 100 feet thick and extend for several miles. The lignite beds, however, are of local extent and usually vary in thickness from less than 1 foot to about 20 feet. The total thickness of the Wilcox group in this area is also variable, ranging from approximately 500 feet to about 1,000 feet. The Carrizo formation overlies the Wilcox group and crops out in the slopes of the Sabine valley near Estes Damsite. The Carrizo formation consists of sand and soft sandstone, but contains clay members locally.

2.26 Soils. Soils mantling the bedrock in this area are of two general types: alluvial soils or overburden, and residual soils derived from the weathered bedrock. Normally, the residual soils are gradational into the weathered bedrock and occur at elevations above the flood plain of the Sabine River and its tributaries. The composition of these soils is as varied as the bedrock which generates them. Since the bedrock in the highlands of the lake and damsite area is dominantly shale and sandstone, the resulting residual soils are of clay and sand. In most of the area the upland soils are sufficiently clayey and impermeable to prevent seepage from the numerous ponds that are scattered across the gentler upland slopes. Very few deposits of alluvial soil are present in the highlands, and those which do occur are generally limited to thin sheet wash deposits and minor accumulations in shallow draws. In contrast to the upland's thin alluvial deposits, the flood plain of the Sabine River and its tributaries contain thick deposits of alluvium. For example, the flood plain alluvium at the Carl L. Estes damsite is about 45 feet thick. Within the limits of the Estes Lake area the flood plain alluvium normally consists of a blanket of clay, underlain by clayey sand, which is followed by a basal gravel bed; however, the depositional history of the river caused considerable local variation in proportions of these materials.

2.27 Ground Water. The Carl L. Estes watershed is situated in an area of relatively high rainfall resulting in abundant recharge to the regional ground water aquifers, there are local bodies of perched ground water in the highlands. Generally, the configuration of the relatively high regional water table is a subdued relection of surface topography. This configuration causes the ground water to move toward the Sabine River and its tributaries, sustaining the perennial flow of the river. The sandstone members of the Wilcox group constitute an important subsurface ground water aquifer along the Wilcox outcrop belt and for some distance east of the Carl L. Estes watershed. Both percolating rainfall in the highlands and the flow of the Sabine River provide recharge to the Wilcox aquifer. Water wells penetrating the thicker and more extensive sandstones of the Wilcox group usually encounter ground water under artesian conditions.

2.28 Economic Geology. Only petroleum, salt, and lignite have been commercially exploited within the Carl L. Estes watershed, excluding

...ave local production of road building materials. Almost all
...mercial mineral extraction has been from the periphery of the watershed.
... are currently being produced in the vicinity of Alba, Texas,
... northern margin of the watershed ... the left en...
... [illegible] ... Latest available information indicates that
... [illegible] ...ls may lie within the area of the ... pool of the
... lake. Salt is currently being produced from deep ...
... the southern margin of the watershed ...
... [illegible] ... produced. Production of
... [illegible] ... and ended about 1940 ... mines were
... [illegible] ... lakes and ponds.

... A ... the ... environmental ... [illegible] ...

... [illegible] ... L.
... 1 ... dam ... the ... between the ...
... [illegible] ... dam ...
... [illegible] ...
... [illegible] ...
... considered ... the
... [illegible] ... throughout ... the ... propose
... dam ... from ... therefore
... [illegible] ... below.

... [illegible] ... of two stratigraphic
... [illegible] ...
... [illegible] ... the embankment.
... [illegible] ... and

soft sandstone of the Wilcox group, overlain by a thin cap of Carrizo sand or sandstone. Bedrock in the left (north) abutment is mostly Wilcox shale and soft sandstone, but also includes thin lignite beds. A greater thickness of the Carrizo formation overlies the Wilcox group on the abutment. The Carrizo is a sandstone formation but includes a shale member of variable thickness in this vicinity. Faulting occurs on the abutments and near the margins of the flood plain.

2.31 The south slopes of the Sabine valley from the damsite to approximately 2 miles upstream exhibit somewhat greater resistance to erosion than do the north slopes of the valley. Erosional resistance of the steeper south slopes is apparently the result of a greater degree of cementation of the sandstones in the upper part of the slopes. Bedrock under the flood plain alluvium is comprised of from 25 feet to approximately 40 feet of the basal part of the Carrizo formation, which is mostly sandstone. As elsewhere in the watershed, the overburden on abutment slopes varies in thickness from less than 1 foot to approximately 2 feet. Overburden on the gentle lower slopes of the left abutment may be as thick as 5 feet in localized areas. Flood plain overburden, in contrast with that on the abutments, reaches a maximum thickness of approximately 45 feet. The valley alluvial overburden consists of from 8 to 10 feet of clay upon a bedded complex of sand, which contains gravel at its contact with the bedrock.

Biological Characteristics.

2.32 Biotic Setting. Carl L. Estes Lake will be located in the transition area between the Austroriparian and Texan biotic provinces. These provinces are continuous geographic areas which are characterized by one or more ecological communities of plants and animals. The Austroriparian province includes those counties which lie east of a line running north from western Harris County to western Red River County, Texas. Because there is no abrupt physiographic change to limit the western migration of the Austroriparian ecological association, the boundary is somewhat arbitrary. The Texan province is generally regarded as an ecological transition zone between the pine and hardwood forests of the Austroriparian province and the grasslands of the western parts of the state. The alluvial flood plains of the stream system of the Sabine River provide the primary route for the westward migration of the Austroriparian ecological association into comparatively arid, generally grassland environment of the Texan province. The migration has resulted in the interdigitation and intermixing of the ecological association of two biotic provinces. This mixing of association is most evident in the project area where the plains species occupy upland habitats and the eastern species occupy the oak-hickory forests of the lowland habitats. The significance of this ecological transition is that many eastern forest birds and mammals reach their western range limit, and some prairie species reach the eastern extension of their habitats (2).

Flora

2.33 General. Vegetatively, the project area will interface with the Post Oak Savannah and the Blackland Prairies vegetational areas (16). The Post Oak Savannah is characterized by a unique association of upland forest and grassland prairie ecosystems. The dominant woody overstory species are post oak (Quercus stellata), blackjack oak (Q. marilandica), sandjack oak (Q. incana), and black hickory (Carya texana). The more conspicuous trees and shrubs include farkle berry (Vaccinium arboreum), southern blackhaw (Viburnum rufidulum), wing-rib sumac (Rhus copallina), parsley hawthorn (Cratagegus marshallii), possom-haw holly (Ilex decidua), yaupon (I. vomitoria). The understory grasses common to the area include little bluestem (Andropogon scoparius), silver blustem (A. saccharoides), Indiangrass (Sorghastrum nutans), switchgrass (Panicum virgatum), and Texas wintergrass (Stipa leucotricha).

2.34 For the most part, the Blackland Prairies vegetational area has been brought under cultivation. Research on the native vegetation indicates that a true prairie once existed, with little bluestem as the climax dominant. Little bluestem, big bluestem (Andropogon gerardi), and tall dropseed (Sporobolus asper) were found to be more prevalent in the eastern part of the region where protected, but give way to the short grasses westward. Other important grasses include Indiangrass, switchgrass, sideoats grama (Bouteloua curtipendula), hairy grama (B. hirsuta), silver bluestem, and Texas wintergrass. Under heavy grazing pressure, buffalograss (Buchloe dactyloides), Texas grama (Bouteloua rigidiseta), and many annuals increase. This vegetational area is characteristically free from trees or brush, but mesquite has invaded the southern portion of the region. Post oak and blackjack oak have also increased on the medium to light textured soils.

2.35 Bottomland Hardwoods. Even though the project area is associated with the previously mentioned vegetational areas, a vegetative community of great concern is that of the mesophytic hardwood forest. The flood-plain forest in the project area is dominated by willow oak. Green ash (Fraxinus pennsylvanica), cottonwood (Populus deltoides), black willow (Salix nigra), water elm (Planera aquatica), river birch (Betula nigra), switchcane (Arundinariz sp.), and button brush (Cephalanthus occidentalis) are the most frequently found stream side vegetation. Wide expanses of the alluvial floodplain support a mixture of cedar elm (Ulmus crassifolia), overcup oak (Quercus lyrata), water hickory (Carya aquatica), blackgum (Nyssa sylvatica), green ash, and willow oak. On the [illegible] floodplain, water oak (Quercus nigra) and hackberry (Celtis occidentalis) [illegible] important addition to the bottomland hardwood [illegible].

2.36 Large areas of bottomland forest [illegible] Trinity, and other major rivers have bee[illegible] Collier (9) as a distinct vegetation type. [illegible] unique because it is considered to be a westward extension of the hard- wood forests typical of river bottom areas to the southeast. [illegible] palmetto (Sabal taxana), Texas sugarberry (Celtis laevigata), [illegible] oak, willow oak, and cedar elm have been noted by [illegible] (44) and Braun (5) as being common in bottomlands of east Texas. Chambless (8) found overcup oak, green ash, willow oak, and sweetgum dominating the upper layer of vegetation in a Angelina river bottom area. Middle level dominants were possum-hawholly, American hornbeam (Carpinus caroliniana), red maple (Acer rubrum) and water elm (Planera aquatica). Nixon's (29) study of the Trinity River bottomland revealed that the most prevalent woody species were box elder (Acer negundo), Texas sugarberry, hawthorn, green ash, black willow, pecan, honey locust (Gleditsia triancanthos), and bur oak (Quercus macrocarpa). Sullivan and Nixon's (40) investigation of an eight-creek area revealed that white oak, sweetgum, and southern red oak dominated the upper canopy. The middle level was characterized by American hornbeam, red maple, and dogwood. Although not all of these investigations were within the confines of the project area, they indicate a flora profile that is generally characteristic of creek and bottomland flora in east Texas.

2.37 Upland Hardwoods. The upland hardwood forest in the project area is dominated by postoak, blackjack oak, and hickory on the drier sites with water oak, pecan and cedar elm along the tributary drainages. The native upland vegetative community originally consisted of a post oak savannah; however, much of the area has been cleared and converted to improved pasture and cropland.

2.38 Aquatic Flora. Aquatic plants can form one of the most conspicuous components of a lake or stream environment. Their role is highly important because many aquatic plants are essential to the survival of fish and other fauna of the aquatic environment. The photosynthetic species form the basis of the aquatic food web relationship that is necessary for all forms of aquatic animal life. The presence of aquatic plants has another bearing on the welfare of fish in that they contribute significantly to the cycles of nutrients and respiratory gases in the ecosystem.

2.39 The aquatic flora which occurs on the substrata of running water is a conglomerate assemblage of taxonomic groups, e.g., the algae, the mosses and liverworts, a few species of encrusting lichens, and flowering plants. Other groups of plants such as the ferns and horsetails have aquatic representatives, but they are of little significance in rivers and streams.

2.40 Rare and Endangered Plant Species. According to the report presented by the Rare Plant Study Center (34), there are approximately 221 rare and endangered plant species identified in Texas. Fifty-three of these species are distributed in east Texas forests and north-central Texas. Representatives of the 53 species may be found within proximity of the project. At least 9 of these species are indicated by their distributional patterns to possibly occur within the area of the proposed reservoir (15). These plants include serviceberry (Amelanchier arborea), meadow sedge (Carex branularis), nutmeg hickory (Carya myristicaeformis), downy danthonia (Danthonia sericea), American beakgrain (Diarrhena americana), cresed shield fern (Dryopteris cristata), grass of parnassus (Parnassia asarifolia), Louisiana palm (Sabal louisiana), and silky camellia (Stewartia malacodendron). Certain plant species included in the biological inventory are also considered by the Texas Organization of Rare and Endangered Species (43) to be rare and endangered in the Post Oak Savannah and the Blackland Prairies vegetational areas of Texas are designated in appendix F.

Fauna

2.41 Historic Setting. Although the Carl L. Estes watershed is characterized by liverse fauna; man, through his development and waste, has significantly reduced wildlife habitats and food suplies. These activities have had their impact upon wildlife populations. An examination of the early history of the watershed readily depicts this situation.

2.42 Some of the more noteworthy species no longer present are buffalo (Bison bison), black bear (Ursus americanus), gray wolf (Canis lupus), antelope (Antilocapra americana), cougar (Felis concolor), passenger pigeon (Ectopistes migratorius), and Carolina parakeet (Conuropsis carolinensis). Wildlife populations have also fluctuated with the associated changes in their habitats. Over the years, the conversion of the native forest and grasslands to farms and improved pasture has also resulted in gradually improving habitat conditions for certain species such as bobwhite quail (Colinus virginianus), mourning dove (Zenaidura macroura), cottontail rabbit (Sylvilagus foridanus), and possibly white-tailed deer (Odocoileus virginianus). Other species such as squirrels (Sciurus spp), bear, buffalo, antelope, and wild turkey (Meleagris gallopauo) suffered.

2.43 Present Setting. The animal communities of the watershed are typical of those found in the Sabine River basin. The white-tailed deer is the only big game species of significance in the watershed. The principal small game species include morning dove, bobwhite quail, fox squirrel (Sciurus niger), gray squirrel (S. carolinensis),cottontail rabbits and various species of waterfowl. Of the numerous species of waterfowl which frequent the watershed, the wood duck (Aix sponsa) and the mallard (Anas platyrhuncha), deserve specific mention. Other important small mammals represented are coyotes (Canis latrans), bobcats (lynx rufus), armadillos (Dasypus novemcinctus), opposums (Didelphis marsupialis), raccoon (Procyon lotor), mink (Mustela vison), nutria, and various rodents. The variety of bird species is fairly large, ranging from the threatened Southern bald eagle (Haliaeetus leuco-cephalus) to songbirds. Characteristic birds include but are not limited to the great blue heron (Ardea herodias), common egret (Casmerodius albus), great horned owl (Bubo virginianus), kingfishers (Megaceryle spp., robins (Turdus migratorius), many waterfowl, various small shorebirds, and more than a dozen kinds of sparrows. The amphibians and reptiles include several characteristic species of frogs, toads, turtles, lizards, skinks, and snakes.

2.44 The Sabine River and its tributaries provides a productive and viable stream fisheries resource. Principal fishes found in the river include largemouth bass (Micropterus salmoides), spotted bass (M. punctulatus), white bass (Morone chrysops), white crappie (Pomoxis annularis), channel catfish (Italurus punctatus), and flathead catfish (Pylodictic olivaris). Rough fish include various species of gar (Lepisosteus spp.), buffalo (Ictiobus spp.), bullhead (Ictalurus spp.), and shad (Dorosoma spp.). The Sabine River also contains a wide variety of minnows. The most numerous of minnows are Sabine shiner, emerald shiner, blacktail shiner, ghost shiner, red shiner, and silvery minnow.

2.45 Lake and farm ponds provide good habitat for bass, crappies, other sunfish and some catfish. However, many of these waters contain an overabundant population of nongame fishes such as gar, buffalofish, carp and shad.

2.46 Commercial Fishing. Commercial freshwater fishing occurs in the streams and lakes of the Sabine River and its tributaries. While most waters in Louisiana are open to commercial fishing, many areas in Texas, particularly in the upper basin, are closed. The amount of commercial fishing in the Sabine River above Toledo Bend Lake is considered to be minimal. Limited access to the river and poor navigability during extended periods of low flow have hindered the development of commercial fishing interest.

2.47 Sport Fishing and Hunting. Restricted public access has limited fishing and hunting opportunities on the Sabine River and its tributaries. Public access is generally concentrated at highway rights-of-way near bridge crossings. Hunting activities are light and generally restricted to landowners and their invited guests. Sporting fishing increases in intensity of use with distance downstream. The best fishing in the Sabine River occurs between Toledo Bend Dam and the mouth.

2.48 Endangered and Threatened Species. There are no known endangered or threatened species of fish in the watershed. The only endangered mammal suspected to be in the area is the red wolf (Canis rufus). The American alligator (Alligator mississippiensis) is the only endangered reptile known to occur within proximity of the watershed. A review of the status of bird species indicates the Southern bald eagle and the American peregrine falcon (Falco peregrinus anatum are endangered species whose range extends into the area. The endangered whooping crane (Grus americana) may also migrate through the area. The American osprey (Pandion hiaetus carolinensis) is a species of undetermined status that may be found in the project area. (54)

Historical Characteristics

2.49 Historical Perspective. From its earliest days the Sabine River basin has been an attractive environment for both man and animals. Its rolling timbered hills and fertile valleys provided homes for animal species like black bear, mountain lion, timber wolf, and otter. Indians from the Caddo, the Wichita, the Waco, the Kitsai, and Pawnee tribes roamed the land for ages before the early pioneers. As recently as 1760, the Tawakoni Indian tribe, a distinct part of the Caddoan linquistic group of nations, lived in and along the Sabine River in what is now Hunt, Rains, and Van Zandt Counties. The Caddos were an advanced society that combined hunting with agriculture to provide a constant food supply. They usually raised several varieties of beans, pumpkins, sunflowers, and tobacco, and harvested two crops of corn per year. In addition to the field crops they kept orchards of peach, plum, fig, and chestnut trees. They seemed to have gotten along well with the French explorers but had some differences with the Spanish. When the colonial pressure increased after the Louisiana Purchase, the Caddo Indians were forced from their homeland in 1835 by treaty. After appeals to the Federal Government, the Brazos Indian Reservation was established in 1855 where a number of Caddo and other Indians were induced to colonize under the supervision of Robert S. Neighbors. Despite the growing animosity of nearby settlers, they lived for a time on the Indian reservation, but soon pressure for their extermination became too great. They were allowed to escape to Oklahoma by Indian Agent Neighbors, who was subsequently killed for his act of mercy (56)

2.50 Agriculture had its beginning in the early 1800's with cattle raising as the main enterprise. Livestock was allowed to run wild in search of whatever grazing could be found. As railroads moved into the basin, the cotton farmer with his sod plow followed closely behind, forcing cattle farther and farther westward. When the fencing movement began in the 1870's, more land was brough into cultivation. As small farms appeared, each had a few acres of cotton and corn, the principal crops of the day. Enough wheat, fruit, and vegetables were grown for the family's own needs. By the turn of the century, barbed wire had virtually eliminated free range grazing on all open or cleared areas of the basin. Cotton became the most important crop. The small land tracts with small irregularly shaped fields on which simple machines and hand labor could be used were conducive to cottom production, Raising cotton for export was greatly enhanced by the rapid growth of markets in New England and western Europe. Railroads provided a way for delivery to the domestic market. The cash potential of agricultural and forest products encouraged credit institutions, shippers, transportation systems, and other service facilities to locate in the area.

2.51 Cotton production required large amounts of hand labor which was cheap and plentiful. Cotton production flourished until the 1930's. It was the main source of income for farmers in the middle and upper parts of the basin. About this time, other areas of the South and Southwest were expanding cotton acreages and lowering production costs through mechanization. The rolling topography of much of the Sabine basin, however, did not lend itself to use of mechanized farming, and many of the farms were too small to justify expenditures of such magnitude. When it became apparent to cotton farmers that their hand labor could not compete with the machines in other areas, some began raising different crops, and others turned to livestock production. Cotton has remained the principal crop over the years in the upper 10 percent of the basin, where soil fertility is high and topography is more favorable for mechanized farming.

2.52 Concurrent with the agricultural development of the basin, the forests underwent a period of exploitation and partial restoration. In the days of early settlement, much of the basin was covered with hardwoods and cypress in the flood plains of the Sabine River and its major tributaries. There were small hand operated sawmills that served local needs as early as the 1850's, but the forests remained essentially unchanged until the railroads penetrated the area. The movement of lumber out of the area began in 1881 when a major railroad completed the connection of its various lines. The so called "golden era" of the lumberman lasted from 1881 until about 1930. Peak production occurred from about 1910 to 1925.

2.53 The exodus of cotton as king of the economy was hastened when oil was discovered in large quantities in east Texas. During the 1940's and early 1950's, the shift away from cotton farming in most of the basin was complete. Many people, particularly tenant farmers, left the farm, while others found part time employment in the oil fields, industrial plants, and forestry related enterprises.

2.54 The present trend in the basin is toward larger and fewer farms. Cropland is being shifted into pasture for support of the rapidly increasing cattle population, both beef and dairy. Commercial broiler and egg production have become enterprises of major economic importance in some local areas of the basin. Beef production, which has a low labor but high land requirement, is often combined with off-farm employment.

2.55 Designated Historic Sites. Although the Carl L. Estes Lake watershed has many sites of historical significance, a review of the 4 February 1975 National Register of Historic Places indicates that no properties in the register will be affected by the project, and no properties with recognized potential for such designation are known to exist in the project area. A further examination of the historical resource revealed that there are no known sites, markers, or discoveries within the project boundary that are of State or regional significance.

2.56 The Texas Historical Commission identified the Smyrna Union Church and the grave of Neal Martin as two notable historic sites that lie very near the project (42). An investigation revealed that these sites will not be affected by the project.

Archeological Characteristics.

2.57 For the most part, the recorded life and culture of the ancient peoples who inhabited the upper Sabine River basin remain incomplete and poorly defined. This is in large measure due to the scattered and low density inhabitation of much of the area. During the past 30 years, archeologists have reported archeological findings in Dallas, Henderson, Kaufman, Van Zandt, and Young Counties. Recovered materials have included

Paleo-Indian, Archaic, Neo-American, and Historic period artifacts (39).

2.58 Yarbrough Site. The Yarbrough site, located on the south side of the Sabine River flood plain in Van Zandt County, is one of the most important archeological excavations carried out to date in the immediate area of the proposed project. This site was excavated in 1950 under the sponsorship of the University of Texas and the Works Progress Administration (24). The artifacts recovered at the Yarbrough site provided ample evidence to suggest various brief periods of occupation by highly nomadic Paleo-Indians. A cultural shift from the seminomadic hunting and gathering Archaic to the later more sedentary Neo-American stage is also evident (22).

2.59 Archeological Reconnaissance. Recently, an archeological study was carried out in the proposed project area along the Sabine River in northeast Texas. The study identified 91 archeological sites which represent several stages of man's cultural development. Extensive archeological materials were found at these sites. On the basis of these artifactural indices, there is evidence to suggest a cultural context extending from Late Archaic through the Historic stage. The findings indicate that a majority of the sites appear to be open campsites at which activities such as gathering, hunting, and manufacture of ceramic and lithic materials took place. Three of the sites yield evidence of what appears to be artificially constructed mounds which suggests that structures were present. Most of the sites were found on stream terraces located above the flood plain (27).

Social, Cultural, and Economic Characteristics.

2.60 General. A social, cultural, and economic study was completed for a four county area [illegible]

counties. The purpose of the study was to identify [illegible] as practicable, the parameters relevant to the [illegible] and economic conditions of the study area.

2.61 Population. Historical population data for the [illegible] area indicated that the population increased at an average annual rate of about 0.7 percent for the decades 1940 through 1970. The state experienced a population growth at an average annual rate of 1.9 percent during the same period. Table II-5 presents a comparison of population data for the study area with the state. (48). The population of the study area in 1970 was 141,592, which is about 1.3 percent of the population of the state. The study area population is project to increase to 293,900 by decade 2020.

TABLE II - 5

POPULATION GROWTH

Year	Population: Texas	Population: Study area	Average annual percent of growth/period: Texas	Average annual percent of growth/period: Study area	Study area as percent of Texas
1940	6,414,824	131,939			2.056
			1.86	-0.71	
1950	7,711,194	122,868			1.593
			2.19	2.62	
1960	9,579,677	126,087			1.316
			1.57	1.17	
1970	11,196,730	141,592			1.264
1980	12,886,000	164,800	-	-	1.279
2000	17,188,000	221,200	-	-	1.287
2020	22,990,000	293,900	-	-	1.278

2.62 Rural and Urban Population Distribution. Table II-6 presents the distribution of population between rural and urban classifications for 1960 and 1970, with percent changes for each census period. According to the 1970 census data, about 52 percent of the population in the study area was located in rural areas. The state's rural population for 1970 was approximately 20.3 percent. Urbanization of the study area for the period 1960-1970 increased by 19 percent, while the rural area increased about 7 percent. This compares with the state's urbanization rate of 24.1 percent (48).

TABLE II-6

RURAL AND URBAN POPULATION DISTRIBUTION

	Rains	Smith	Van Zandt	Wood	Area Total
1960					
Urban	-	51,739	-	5,783	57,522
Rural	2,993	34,611	19,091	11,870	68,565
Total	2,993	86,350	19,091	17,653	126,087
1970					
Urban	-	59,781	2,63[illegible]	6,135	6[illegible]
Rural	3,752	37,315	19,51[illegible]	12,45[illegible]	[illegible]
Total	3,[illegible]52	97,[illegible]	22,15[illegible]	1[illegible]	14[illegible]
Percent change in population distribution 1960 to 1970					
Urban	-	+15.5	-	+6.1	+19.2
Rural	+25.4	+7.8	+ 2.2	+4.9	+6.5
Total	+25.4	+12.4	+16.0	+5.3	+12.3

2.63 Ethnic Composition. The 1970 population of the study area was comprised of 80.1 percent Caucasian, 19.6 percent Negro, and 0.4 percent of other ethnic backgrounds, as compared to 86.8 percent Caucasian, 12.5 percent Negro, and 0.7 percent other races for the entire state. During the period 1960-1970, there was no significant change in the Negro population in contrast to the Caucasian population in contrast to the Caucasian population which increased 15 percent (50).

[illegible] Employment. Employment data (Table II-[illegible]) from the Texas Employment Commission revealed that nonmanufacturing jobs account for approximately [illegible] percent of the total work force (41). Table II-8 presents the 1970 employment profile by occupation for the study area and the state (51). Employment is projected to increase from [illegible] in 1970 to 107,200 in 2020. The unemployment rate for the area in 1972 was reported to be only 3.8 percent of total labor force as compared to [illegible] percent for the state (41).

PROJECTED EMPLOYMENT
1980-20[illegible]

Year	Study Area	Texas
198[illegible]	[illegible]	[illegible],015,400
2000	[illegible]	[illegible]
2020	[illegible]	[illegible],352,000

TA[illegible] 7

[illegible]

Category	Pai[illegible]	[illegible]	[illegible]	[illegible]	Study Area Total
Manufacturing	[illegible]	[illegible]	[illegible]	7[illegible]	14,510
Nonmanufacturing		[illegible]	[illegible]	4,[illegible]	3[illegible]
Agriculture	[illegible]	[illegible]	[illegible]	[illegible]	4,[illegible]
Unemployed	[illegible]	[illegible]			2,1[illegible]
Total	[illegible]	4[illegible]	[illegible]	[illegible]	57,000

2.65 Real Income Per Capita. The 1972 effective per capita income for the study area varied from a low of $2,430 in Rains County to a high of $3,301 in Smith County. The average per capita income for the study area was $3,147, 8.5 percent less than the state average. Per capita income has steadily increased over the years and is expected to increase to $13,384 in 2020 (36).

PROJECTED PER CAPITA INCOME
1980-2020

Year	STUDY AREA	TEXAS
1980	$4,089	$ 4,257
2000	$7,490	$ 7,580
2020	$13,384	$13,285

2.66 Taxation. County and city tax rates on real property are important indicators of economic stability. 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 1972 was $2.85; the lowest tax rate was $0.70. Real property tax rates per $100 assessed valuation in 1972 varied from a low of $0.88 in Smith County to a high of $1.25 in Rains County.

[illegible] Education. The median number of school years completed by persons [illegible] years and older in the study area for 1960 was 10.0 years, which was slightly below the state level of 10.4 years (51). Except for Smith County, the education attainment level for the study area in 1970 remained [illegible] the state level of 11.6 years.

[illegible] Housing. The four-county area housing conditions are considered favorable when compared with the housing conditions of the state. Approximately 65 percent of the area's housing units are owner occupied as compared to 58 percent owner occupied for the state. The 1970 Census of Housing also shows that the median gross rent ranges from 56 to 77 dollars for the study area compared to 95 dollars for Texas (52).

[illegible].69 Roads. Interstate Highway 20 and U.S. Highway 80 serve as the major vehicular access routes which cross the study area. These express-ways follow an east-west course through the area and link the study area with other regional, state, and national areas. Other significant regional and community thoroughfares that traverse the study area are U.S. Highway 69 and State Highways 19, 37, and 154. Numerous farm-to-market roads [illegible] provide the local transportation network that links communities with the major vehicular routes.

[illegible].70 Railroads. There are several railroads serving the industrial center's freight needs in the study area. They include the Kansas City Southern, the Missouri Pacific, Southern Pacific, Cotton Belt, and California Pacific. AMTRAK furnishes passenger service between Fort Worth and Marshall, stopping at Longview, Texas.

2.71 Air. Daily round trip passenger service is available between Pounds Field (Tyler Municipal Airport) and the major cities of Texas.

2.72 Bus. A bus line for both passengers and freight serves the main cities in the region and connects to metropolitan areas across the state.

2.73 Truck. There are five major freight lines operating in the region. Utilizing the major cities as transfer and distribution points, these firms handle the largest part of this regions's trucking. They are East Texas Motor Freight, Mo-Pacific Freight, Central Freight Lines, Red Arrow Lines, and Red Ball Lines.

2.74 Agricultural Trends. 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 14 percent from 1964 to 1969, while average farm values increased about 78 percent. The 1969 Census of Agriculture indicates a 60 percent average increase in the value of agriculture land during the period 1964-1969 (55). The average value per acre of Texas farm real estate has increased from $142 in 1969 to $238 in 1974 (45).

2.75 Land Use. Because a majority of the topography does not easily lend itself to mechanized farming, land used for pasture and range is increasing relative to other agricultural uses. This trend is expected to continue as farmers shift from row crops to livestock production. Table II-9 identifies the current land use as tabulated from the 1970 Conservation Needs Inventory of the Soil Conservation Service. This inventory reveals that forest and pasture land uses represent 79 percent of the study area as compared to 21.3 percent for the state (46).

TABLE II-8

OCCUPATION OF EMPLOYED PERSONS 16 YEARS OLD AND OVER CARL L. ESTES STUDY AREA AND STATE OF TEXAS, 1970

	Study Area		State of Texas	
Occupation	Employed	% of Total Employed	Employed	% of Total Employed
Professional, technical, managers and administrators	11,462	21.1	923,490	22.1
Sales, clerical, and kindred workers	11,668	21.6	995,620	23.8
Craftsmen, foremen, and operations, except transport	15,893	29.4	986,069	23.6
Transport, equipment, operations	2,648	4.9	154,624	3.7
Laborers except farm	2,583	4.8	188,219	4.5
Farmers, farm managers, farm laborers and farm foremen	2,650	4.9	153,800	3.7
Service workers including private workers	7,170	13.3	511,194	12.2
Occupations not reported	0	0	268,048	6.4
Total	54,101	100.0	4,181,064	100.0

TABLE II-9

LAND USE

Land Use	Acres	Study Area Percentage	State Percentage
Crops	211,207	12.1	21.3
Pasture	807,215	46.3	9.2
Range	35,284	2.0	51.1
Forest	569,303	32.7	13.1
Urban	76,857	4.4	3.1
Miscellaneous	43,330	2.5	3.2
Total	1,743,196	100.0	100.0

2.76 Existing Recreation Opportunities. Recreation opportunities within a four-county area comprised of Rains, Smith, Van Zandt , and Wood Counties are provided by pine and hardwood forests, as well as several quality lakes in the area. Water resource developments are the major recreational attractions. The majority of recreational demand in the area is of the water oriented type. Water oriented activities are: swimming, boating, water skiing, fishing, picnicking, camping, sightseeing, and hiking. There are no existing Corps of Engineers lakes in the area. There are several other Federal, State, county, and municipal agencies providing seven lakes which are used to a certain extent for outdoor recreation. Lakes constructed by agencies other than the Corps of Engineers have made only limited provisions for recreational development. These lakes are built for specific purposes such as water supply, cooling water, power, or combinations thereof. Recreation is not considered a project purpose, and only limited development is provided. Primary and second home development around these lakeshores inhibits the acquisition of additional lands for recreational development. The result is fairly exclusive use of the shoreline by adjoining landowners and limited public use of the water due to inadequate points of access. The seven lakes in this area total 44,649 water surface acres at their normal pool elevations. Each lake has its own unique setting and particular attractive qualities. Lake Tawakoni, a 36,700 surface acre municipal, industrial, and irrigation project is on the Sabine River encompassing 200 miles of shoreline in three counties with more than five square miles of submerged timber habitat. The twin municipal lakes of Tyler and Tyler East provide water supply together total nearly 5,000 surface acres of public recreation in Smith County. There are four small lakes in Wood County that provide flood control and recreation. Lake Hawkins is the largest with 1,064 acres, with Lake Quitman and Lake Winnsboro close behind at just over 800 acres each, and finally Lake Holbrook with 653 surface acres. All of these lakes are know for their fine sport fishing opportunities and camping facilities in the picturesque East Texas tradition.

2.77 The area contains Tyler State Park and Governor Hogg Shrine, a historical site. Tyler State Park is a 994 acre scenic playground set in one of the finest forest sections of Texas. Facilities include camping, picnicking, nature trails, screened shelters, restrooms and showers, snack bar, minature golf, fishing, swimming, and boating. The Governor Hogg Shrine commemorates the Hogg family, one of the foremost in Texas history and politics.

2.78 Several areas throughout the area are interesting tourist attractions. At Canton, "flea market" buffs enjoy "first Mondays," a traditional swap day with current emphasis placed on trading hunting dogs. At Emory, the Rains County Free Fair has been a popular attraction since the 1930's.

Quitman has a Dogwood Fiesta which features marked trails through one of the most striking natural beauty spots in the area. The city of Tyler has recreational attractions which include Tyler State Park, Goodman Museum, Hudnall Planetarium, the East Texas Fair, Tyler Rose Garden and annual Rose Festival, and other special events. The Caddo Indian Industrial Center west of Winnsboro is located in the large prehistoric Indian settlement andfeatures a tanning yard, ceramic paint making, and corn mills and shelters.

2.79 Land based recreational activities in the flood plain are, for the most part, limited to hunting and camping on private lands. Public access to the river for fishing, boating, canoeing, and other water oriented activities is limited primarily to highway crossing.

Expected Changes in the Environmental Setting in the Absence of the Proposed Project.

2.80 Physiography. The general physiography of the watershed is not expected to change significantly over the next 100 years. If the project is not constructed, a certain amount of aberrated alteration of the physical environment can be anticipated. This alteration could be motivated by sand and gravel mining operations or from land use changes associated with subdividing rural areas for suburban developments.

2.81 Hydrology. Streamflow of the Sabine River immediately downstream of the Iron Bridge Dam is dependent upon water releases from Lake Tawakoni. Since Lake Tawakoni does not maintain a constant release, an intermittent streamflow prevails within the watershed except during periods of excessive precipitation. Streamflow is not expected to change in the foreseeable future.

[illegible]

[illegible] wildlife habitat and the associated cultural communities [illegible]

[illegible] the [illegible] roaming [illegible] and will [illegible] not change appreciably. [illegible] small game species, mourning dove, bobwhite quail, [illegible] rabbits, gray and fox squirrels, have habitats of variable quality in the watershed. With the exception of squirrels, small game populations are low and do not provide a great deal of hunting. There is little or no trapping of fur animals in the watershed. Such general trends are expected to continue in the future due to current land ownership and land use.

.84 Archeology and History. Several stages of man's cultural development are suggested by the artifactural material recovered from several archeological and historical sites found within the watershed. Thus the watershed surely holds key answers to some of the major unsolved problems regarding origins, development, and interrelationships of the cultures in East Texas. The fast dwindling archeological resource of the watershed, which forms an important component of the state's historical heritage, has been destroyed or modified by man through his activities. Natural weathering processes, flooding, and man's actions are expected to continue to have an adverse impact upon the archeological and historical resources within the watershed. Future archeological investigations may salvage some of this heritage.

2.85 Social, Cultural, and Economic. The OBERS projections to year 2020 for the Water Resources Area 1201 show that the population will increase about 66 percent between 1980 and 2020; employment will increase about 71 percent; personal income will increase about 227 percent; earning from agriculture will increase about 132 percent; and earning from petroleum products will increase about 43 percent (47). Assuming the four-county study area growth will approximate the water resources area growth, considerable economic expansion and social and cultural changes can be expected in the study area.

2.86 Esthetics. The esthetic appearance of the study area is not expected to undergo substantial changes in the foreseeable future. Seasonal flooding of the watershed has prevented significant alterations of the landscape. This situation is expected to continue in the absence of the proposed project.

2.87 Land Use. The Carl L. Estes study area is generally well suited to agricultural production. Although this agricultural resource base will be slightly reduced as agricultural land is converted to urban, industrial, and other related developments required by a growing population, no drastic land use changes are expected to occur in the near future. As a result of the relatively low population density, land ownership, and annual flooding, significant developmental encroachment into the watershed will be restricted.

2.88 Recreation. Recreation demands in and adjacent to the study area are expected to increase because of increases in population, urbanization, income and education levels, leisure time, and other factors contributing to recreational activity. Adequate opportunities for fulfillment of recreational desires are needed to complement the area's improved standard of living. If additional recreation projects are not developed to meet the increasing demand, the recreational needs of this area will not be met, the land and water resources of existing projects will suffer from over use, and the quality of the recreational experience will be reduced.

SECTION III - RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

3-01 General. The Fort Worth District of the Corps of Engineers requested 27 public agencies or their representatives to evaluate the relationship of the proposed action on the Sabine River to their respective land use plans for the project area. These planning agencies were requested to determine areas of compatibility or conflict between the proposed project and existing or proposed land use plans, policies, and controls that have been formulated for the project area.

3-02 Comments on Land Use Plans. The replies, to this date, have revealed that there are no known existing or proposed Federal, State, or local land use plans, policies, or controls for the area affected by the recommended project. Written correspondence is included in section IX.

SECTION IV - THE PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

4.01 General. Implementation of the Carl L. Estes Project will produce cultural, economic, environmental and social impacts. Involved are (a) the temporary effects resulting from construction activities, (b) the permanent physical changes resulting from construction of the project, and (c) the direct and indirect effect of the operation and maintenance of the project.

4.02 Construction of the proposed project would require a minimum of 6 years, and many factors would affect the overall progress of a project of this magnitude. If construction were to commence, the Corps of Engineers will utilize a comprehensive series of design memoranda dealing with specific phases of planning. Requirements that adverse environmental effects be minimized are incorporated in plans and specifications for construction. These requirements are prescribed in detail to include such items as landscape preservation, fire prevention and protection, erosion control, and protection of water resources. Construction representatives will supervise and coordinate activities in connection with construction so as to minimize the temporary as well as permanent adverse environmental effects.

4.03 The tables which follow contain a discussion of the effects of the project, beneficial as well as adverse and steps that will be taken to reduce, correct or mitigate adverse effects.

Table [illegible]-
[illegible] PROBABLE IMPACT OF THE PROPOSED [illegible]

[illegible] FROM PROJECT CONSTRUCTION

[illegible] Parameters	Adverse Impact	Beneficial Impact	[illegible] Measures
[illegible]	The project will remove approximately [illegible],200 acres of land and water from private ownership for the life of the project. This conversion will involve [illegible],200 acres of flood plain hardwood forest; 7,[illegible]00 acres of upland forest; [illegible] acres of pastures; [illegible] acres of cropland; [illegible] acres of miscellaneous land. Recreation opportunities associated with the current land use would also be changed.	Public ownership of project land and water will permit public [illegible] and utilization [illegible] the basic resource. The [illegible] acres of land and water will be managed to protect the integrity of the resources, both natural and created, as well as providing recreation opportunities including fish and wildlife-oriented activities.	
[illegible] Sabine River and [illegible]	Approximately [illegible] miles of the Sabine River will be permanently inundated; this represents about [illegible] percent of its total length or approximately [illegible] percent of the presently existing natural flowing river. Toledo Bend, Lake [illegible], and the proposed project will inundate a total of [illegible] river miles of the Sabine River which is about [illegible] percent of its total length. Several miles of tributary streams will also be permanently inundated.	[illegible] miles of the Sabine River [illegible] downstream from the embankment as well as several miles of small tributary streams above and below the embankment.	[illegible] and [illegible] the Sabine River will [illegible] the project.
[illegible]	There will be elimination and loss of about [illegible] miles of riverine [illegible] on the Sabine River resulting from inundation. Tributary streams [illegible] will be permanently replaced with lake [illegible] of the stream [illegible] will [illegible] appear [illegible] the impoundment. These will [illegible] include such [illegible] lamprey, [illegible], spotted sucker, [illegible] darter, stonecat [illegible], and [illegible] other stream [illegible] those belonging to the genera Notropis, Hybognathus, and [illegible] will probably be totally inhibited or will, at least, be confined to the upper [illegible] of the tributary streams. [illegible] the project will [illegible] and [illegible] flows [illegible] downstream [illegible].	With [illegible] the [illegible] there [illegible] and tributary streams [illegible]. [illegible] streams [illegible] and [illegible] tributary streams [illegible] the water [illegible] will [illegible] public stream fishing [illegible].	[illegible]

	Adverse Impact	Beneficial Impact	Corrective Action or Mitigation Measures
3. Fish (cont'd)			
b. Farm Pond Fishery	There will be approximately 80 small farm ponds with a combined surface area of about 50 acres permanently inundated by the project.	The farm ponds will provide a small fisheries resource for stocking the project's lake fishery.	The farm pond fishery lost will be partially mitigated by public ownership, access and management of the 95 farm ponds above the water supply pool.
4. Wildlife			
a. Habitat	There will be a permanent loss of 24,900 acres of terrestrial wildlife habitat within the water supply pool. An additional 500 acres of habitat will be lost during the construction of the embankment and spillway. Of this 25,400 acre impacted area, there are approximately 13,500 acres of flood plain hardwood forest habitat including about 12,600 acres of productive woodduck habitat, classified as Type 1 wetland habitat by the U.S. Fish and Wildlife Service. There will be additional adverse effects to the wildlife habitat within the 19,100 acre flood pool during periods of inundation.	The 24,900 acre water supply pool will remove habitat from terrestrial wildlife utilization while substituting a resting and feeding area for migrant waterfowl and shore birds in general. The project will include approximately 12,000 acres of flood plain *forest habitat* downstream of the embankment to partially offset project related habitat losses. Peripherial project lands containing upland forest and old field dominated habitat will be accessible to the public	In order to minimize adverse impacts on wildlife habitat and the associated loss of hunting opportunity, approximately 25,350 acres of suitable habitat within the project will be made available for habitat preservation or improvement. Specially, a 12,000 acre tract of flood plain forest-dominated habitat will be purchased downstream of the embankment to mitigate the loss of wildlife associated with this type of habitat. In addition, 13,350 acres of project land, consisting of peripherial upland forest and old-field type habitat, will be made available for wildlife management.
b. Amphibians and Reptiles	In the lake area, those *amphibians* and reptilian species now existing in bottomland habitats would suffer the greatest impact due to displacement by inundation. It is expected that such species will experience sharp declines in numbers and biomass and will cease to exist within the lake and construction area. Public development in the parks and future private developments in proximity to the project would cause additional displacemeat of upland species through reduction in available habitat and physical disturbance.	Some protection and restabilization of upland populations will occur in suitable habitats along the periphery of the lake because of developmental restrictions on project lands. In the downstream mitigation area, water releases from the lake will help stabilize bottomland species. Crowding of these species will cause elimination of the weaker members and result in a residual population of superior individuals.	Public ownership, access, protection and management of project lands will partially mitigate loss of amphibians and reptiles.

[illegible] will be reduced [illegible] of other [illegible] will probably [illegible] after [illegible] This decline [illegible] associated with [illegible] fertility, [illegible] due to [illegible] of inundated timber, and [illegible] the gradual replacement of [illegible] desirable food plants [illegible] plants.

[illegible] replacement [illegible] water [illegible] disruptive [illegible] terrestrial [illegible] will [illegible] water [illegible]

[illegible]

	Adverse Impact	Beneficial Impact	Corrective Action or Mitigation Measures
5. Vegetation			
a. Aquatic	There will be loss of species within the reservoir area, i.e., 35 miles of the Sabine River, due to construction or inundation. Aquatic vegetation, through photosynthesis, respiration, growth rate, etc., affects such environmental factors as concentration of dissolved oxygen, carbon dioxide, ammonia, pH, light penetration, and siltation. Alterations in these factors could cause serious effects, e.g., heavy algae production, resulting in blooms and other undesirable after effects. In general, lake level fluctuations will probably inhibit growth of many aquatic species, but will probably not control any serious aquatic weed problems. Reduction of flows could negatively affect the downstream lotic ecosystems.	An increase in aquatic plants along the peripery of the lake can be expected, e.g., cat-tail, bulrush, lotus, water lily, pondweed, water lettuce, and duckweek. This natural phenomenon helps stabilize and reduce shoreline erosion. Aquatic plants are also extremely significant to wildlife. Primarily, they serve as food for ducks, geese, marsh birds, and shore birds. They also serve as important habitat in the fishery aspect of the lake. In the downstream area, periodic water releases could improve wetland quality and increase species diversity.	If aquatic plant populations become a public nuisance, they will be subject to necessary control measures as set out in the vegetative management plan.
b. Terrestrial	There will be a loss of species within the reservoir area, about 25,400 acres, due to inundation or construction. There would be varying additional adverse effects on species within the 19,100 acres of the flood pool during periods of inundation. In the project area, vehicular traffic and general misuse or abuse by visitors will have some avderse impact. Future public and private development around the project and in the downstream area is expected to further reduce existing species. Reduced flooding will decrease downstream flood plain fertility and effect species composition.	Hardwoods of many river bottoms could use about twice the amount of water that they get from rainfall in a normal growing season. Therefore, very short durations of flooding should have the same beneficial effects on growth as do seasonal rains. In the downstream area, periodic water releases would aid in preserving the existing bottomland habitat. (33)	Rapid evacuation of the flood pool would preserve more hardwoods in the flood pool and possibly benefit some of the hardwoods downstream.

	Adverse Impact	[illegible]	[illegible]
[illegible]			
Rare, Endangered or Threatened Plants	At present, it is not known whether the destruction of plant communities as a result of impoundment would constitute a serious loss of rare and endangered species. It is suggested, however, that such losses, if any, would probably be minimal due to the diverse and somewhat similar vegetational communities which are found in adjacent areas.		[illegible]
[illegible]	The principal impact upon the geologic resource will be the loss of access for mineral exploitation. There will be modification or cessation of production from five producing oil wells within the limits of the proposed lake area.		
[illegible]	There will be a permanent loss of [illegible] acres of natural [illegible] which will be inundated by the water supply pool. An additional 500 acres will be lost during construction of the embankment and spillway. There will be additional adverse effects to the esthetics within the 19,[illegible] acres flood pool. Thirty-five miles of the scenic Sabine River will also be lost.	[illegible] contribute significantly to the landscape of the broad Sabine River valley. The present [illegible] pattern would be further enhanced by the [illegible] [illegible] and [illegible] [illegible].	
[illegible]			
[illegible]	[illegible] construction of the [illegible]	[illegible]	[illegible]
Historical	[illegible] state significance.		[illegible] National Register [illegible]

	Adverse Impact	Beneficial Impact	Corrective Action or Mitigation Measures
3. Education	There will be a loss of tax revenue from the conversion of 68,700 acres of private land to public ownership. School districts may be required to realign or adjust their district boundaries and school bus routes.	Recreation development and related activities adjacent to the project should provide additional taxable income from new business and increase property values.	
4. Transportation	Construction activities associated with the project will cause temporary disruptions of transportation network. The project will require the relocation or alteration of 23 miles of roads, 1 mile of railroads, 8 miles of pipeline, and 61 miles of utility lines.	The relocated facilities will be replaced with the most modern and efficient facility that meets current Federal, State, and local governmental laws and regulations. There will be no service disruptions in the communication and utilities complex.	Traffic detours will be provided to maintain traffic flow with the minimum inconvenience to the public.
5. Community Cohesion	Local community cohesion will suffer from the proposed project. There will be a period of adjustment for the displaced tenants and land owners. Community development patterns will be altered.		
6. Population	There will be adverse social impact to members of 107 families which must be relocated		Every effort will be made to assure the owners and tenants of property to be acquired that they are paid a just and reasonable consideration in accordance with the Uniform Relocation Assistance and Real Acquisition Policies of 1970 (Public Law 91-646).
7. Recreation	Although the fishing and hunting recreation activities in the project area are generally limited to landowners and their invited guests, the project will adversely impact private fishing and hunting oriented recreation opportunities. The greatest impact will be within the 24,900 acre water supply pool.	With the project in operation, public fishing and hunting opportunities will be greatly increased. The project will provide for an estimated 750,000 recreation-days of use annually.	Displaced landowners and tenants will be permitted to pursue recreation activities on project lands.
8. Public Health	The project will provide aquatic habitat for some undesirable pests. Construction and operation of the project will provide a potential source of pollution, e.g., air, noise, water quality, etc.		A mosquito surveillance program will be initiated and control operation will be instituted when necessary. All health and sanitation programs will be coordinated with the Environmental Protection Agency and operated in compliance with Federal, State, and local regulations.

	Adverse Impact	Beneficial Impact
C. ECONOMIC PARAMETERS		
1. Regional Growth	Increased regional growth could create industrial development to the detriment of certain environmental elements.	The availability of adequate flood control, water supply for municipal and industrial uses, plus the potential recreational use of the [illegible], could result in production of more goods and services required by the general public.
2. Tax Revenues/ Property Values	Tax revenues on the land acquired for the project would be lost.	Increased property values would result from the reduction of flood hazard and from the developed recreational property. Higher property values attributable to the project would increase tax revenues.
3. Agricultural Activities	68,700 acres of agricultural land existing within the project area would be removed from production for the life of the project.	Those agricultural lands downstream from the project will receive less frequent flooding and thereby provide the opportunity for increased production.
4. Business and Industrial Activities	Increased business and industrial activities could have long-term adverse impacts, such as, increased traffic problems, further loss of vegetation, land disturbance, crowding of residential areas, and increased air and noise pollution.	The project will provide water and flood protection for future business and [illegible] development. Additional industrial and commercial businesses which develop in response to increased residential development will improve cash flow and tax base.
5. Employment/Labor Force	Employment opportunities associated with the area will be lost for the life of the project.	During the construction period, employment will greatly increase, wages produced will be spent in nearby retail and service establishments and wholesale businesses. Following construction, increases in recreation-related enterprises would partially compensate for the decline in construction-related employment opportunities. A permanent work force will be required for project operation and resource management.

TABLE IV-2

II. THE PROBABLE IMPACT RESULTING FROM PROJECT OPERATION AND MAINTENANCE

	Adverse Impact	Beneficial Impact	Corrective Action or Mitigation Measures
A. Probable Operational Impact Within Project Boundary			
1. Flood Control Pool	Uncontrolled inundation of the flood control pool will have varied adverse impacts upon wildlife and its habitat, vegetation, and recreation. The impact is closely related to the frequency, intensity, and duration of flooding.	When the flood control pool is not operational, this area will provide a potential for recreation and wildlife utilization. The less frequently flooded areas will have the potential for providing high quality habitat for rabbits, dove, and quail.	Project management plans will be developed and implemented to insure proper stewardship of the land and its resources during the interim periods when the flood pool is not operational.
2. Water Supply Pool	The large surface area of the lake will result in increased loss of water through evaporation. The lake will provide aquatic habitat for some undesirable plants and insects.	The lake will serve as a source of surface water supply for future municipal and industrial water requirements. A minor recharge to the Wilcox ground water aquifer can be expected, due to increased hydraulic head and increased area of surface water contact with the aquifer created by the lake.	A pest surveillance and control program will be initiated to prevent public nuisance.
a. Pool Fluctuation	The water level is expected to fluctuate and expose mud flats periodically as they are in other area reservoirs. Odors may be noticeable during periods of drawdown, but they should not be objectionable.	Periodic drawdown should favor the maintenance of the lake fishery. The exposure of large acreages of lake bottom area will permit oxidation and the establishment of herbaceous vegetation. Subsequent flooding will permit the release of nutrients into the aquatic food chain, thereby contributing to the productivity of the fishery.	
b. Water Quality	Upon impoundment, leaching of the mineral and organic constituents of the soils and the decomposition of the vegetative ground cover will cause increases in carbon dioxide, nitrogen (NO_3, NO_2, NH_3), phosphates, biochemical oxygen demand (BOD), color, and potassium. Corresponding decreases in the dissolved solids concentration and pH will occur. The scrub brush and bottom and second growth grasses will be the sources of the greatest pollution. The decomposition of grasses and scrub brush will cause a continual increase in carbon dioxide with time and a gradual increase in total nitrogen and phosphorous. With median flow conditions and normal variations in lake elevations, the initial condition should diminish and be neutralized rapidly after the conservation pool is filled, which normally takes five years.	The overall quality of the water in the lake should be well within the U.S. Public Health Service criteria for public drinking water supplies and within the Texas Water Quality Board criteria.	Water treatment techniques can remove nearly all undesired chemical, physical, and biological elements from potable water.

	Adverse Impact	Beneficial Impact	[illegible]
2. Water Supply Pool (cont'd)			
c. Thermal Stratification	A temperature gradient is expected to develop a barrier against mixing of lake water during the summer months. As a result, periodical water quality problems will arise due to the low dissolved oxygen in the hypolimnion (bottom) of the lake. Thus, the bottom water will develop an anaerobic environment during summer months with resulting increases in BOD, nitrogen, phosphorus, hydrogen sulfide, and iron.	Thermal stratification is a seasonal phenomenon which will be eliminated when the epilimnion (top) cools in the fall and the lake will mix.	
d. Recreation	The expected recreational use will adversely affect the environment through soil compaction and denudation of the flora. Because of the [illegible] facilities to limit foot and vehicular traffic, such abuse can be expected [illegible] on project lands, causing increased erosion and lake sedimentation. The estimated recreation demand will not be satisfied by the minimum recreation development proposed for the project.	The project will provide for an estimated [illegible] recreation-days of use annually. The project is expected [illegible] [illegible] for fishermen and [illegible] facilities for [illegible] and [illegible] will be limited.	A vegetative management plan and careful selection of recreation sites limit possible degradation of vegetation and loss [illegible] All possible [illegible] will be made to prevent [illegible] of the lake water from recreational activities [illegible] Facilities will [illegible] education [illegible] distribution of [illegible] sanitary facilities, the availability of litter bags for boats, and [illegible] of custodial [illegible]
3. [illegible]			
a. Lake Fishery	As the reservoir ages, submerged vegetation disappears, fertility decreases, benthic biomass decreases, the lake fishery should be characterized by a reduction in growth rate, net productivity, and an increase in nongame species.	During the early years of the impoundment, the lake should be characterized by a sharp rise in fish abundance and growth rates due to habitat expansion and increased nutrition. Excluding the initial peak production period, it is anticipated that the lake will provide a good quality fishery.	A fisheries management plan will be developed in cooperation with the Fish and Wildlife Service and the Texas Parks and Wildlife Department.
b. Farm Pond Fishery	If farm ponds are breached, their potential for initial stocking, nursery ponds and recreation [illegible] will be lost.	The estimated 80 small ponds within the conservation pool can be utilized in the initial stocking program, and serve as possible nursery ponds. The 95 farm ponds above the conservation pool will add significantly to the diversity and productivity of the biotic community. These small ponds can be utilized as nursery ponds or serve as a recreation opportunity for fishermen who prefer fishing on small impoundments.	The farm pond fishery will be an integral part of the fisheries management program.

	Adverse Impact	Beneficial Impact	[illegible]
5. Wildlife	The retention of floodwaters for regulation of downstream flows will alter the quality of the wildlife habitat in approximately 19,100 acres within flood control pool. As a result, habitat capability to sustain forest or brush land oriented wildlife species will be diminished. The five-year flood pool will experience the most frequent and prolonged inundations; consequently, it will provide the poorest quality habitat.	The flood control pool area subject to a lesser frequency of inundation will have the potential for providing habitat superior to that which is now experienced under current land use practices for rabbits, dove, and quail.	[illegible] plan will [illegible] conserva-[illegible] and mainten-[illegible] wildlife habitat. This plan will be developed in [illegible]peration with the Fish and Wildlife Service and the Texas Parks and Wildlife Department.
6. Shoreline	Wave action is expected to adversely impact the lake shoreline. The lake areas that are expected to be the most susceptible to erosion are those intercepted by long fetches and bordered by steep slopes. Steep slopes will also be susceptible to localized slumping after a rapid drawdown.	The lake shoreline will provide a habitat for small floating plants and they give protection, food, and shelter to various wildlife.	A shoreline erosion control program will be an integral part of the vegetative management plan.
7. Archeological/Historical Resources	Those undiscovered sites which are located on the sloping shore or beach areas around the lake may be adversely affected. These areas receive maximum, unscheduled destruction by wave action, erosion, and leaching caused by repeated inundation, and pilferage by casual artifact collectors.	Those sites that are covered by silt should be protected from destruction for the life of the project.	If identifiable cultural sires are discovered, they will be evaluated for inclusion in the National Register of Historic Places in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800).

	[illegible] Impact	[illegible]
B. [illegible] Operational Impact Downstream of Project		
1. Flood control	Because of the misconception that flood control projects [illegible] [illegible] [illegible] [illegible] security may be created for those who might develop the downstream flood plain.	[illegible] will [illegible] [illegible] [illegible] [illegible] provide [illegible] degree [illegible] [illegible] plain land [illegible] stream approximately [illegible] miles [illegible] the [illegible] of the Sabine River. [illegible] estimated that approximately [illegible] acres of predominantly [illegible] will receive some flood protection.
		The project will store water which [illegible] be released at the [illegible] of the Sabine River Authority for satisfaction of downstream water needs.
2. Water supply	Supplying water needs downstream would be delayed one to three months under normal conditions until the water reaches the minimum discharge level (elevation [illegible]) during deliberate [illegible] ment. Additionally, [illegible] flows would never be [illegible] restored.	
3. [illegible] Wildlife	When operational, the [illegible] alter the frequency and [illegible] flooding downstream [illegible] the project will [illegible] degrees of protection [illegible] land flood plain. The [illegible] flood plain [illegible] [illegible] stimulate [illegible] of the [illegible] plain forest [illegible] [illegible] and thus reducing wildlife [illegible] habitat. The [illegible] and intensity of [illegible] of the seasonally flooded [illegible] bottomland forest will result in [illegible] net decrease in the availability [illegible] shallow feeding areas for wintering waterfowl. [illegible] [illegible] alter the pattern [illegible] [illegible] between the [illegible] and downstream [illegible]	[illegible] downstream [illegible] habitat [illegible] which are [illegible] [illegible] are expected to provide [illegible] habitat for certain species of [illegible] [illegible] whitetailed deer, squirrel, [illegible] and wood ducks.

	Adverse Impact	Beneficial Impact	Corrective Action or Mitigation Measures
4. Streamflow Modification	The project will alter the natural pattern and quantity of flow of the Sabine River. Although the impact decreases with distance, the project will reduce streamflows from the damsite to Sabine Lake. The most adversely impacted reach will be the 35 miles immediately downstream. This reach can be expected to experience periods of extremely reduced flows during dry summer months. It is estimated that the average annual flow into Toledo Bend will be reduced approximately 5 percent.		
5. Downstream Fishery	The alteration of the natural pattern and quantity of flow as a result of project operations will affect the downstream fishery. The magnitude of project impact will be most extensive above the junction of Lake Fork Creek and will diminish with distance downstream as the uncontrolled watershed area increases.		A multi-level outlet system will provide for potential release of desirable quality water from the conservation pool for the maintenance of the downstream fishery.
6. Toledo Bend Lake	Assuming the dependable yield is transferred out-of-basin, the average annual inflow into Toledo Bend Lake would be reduced approximately 5 percent.	The project will be an advantage to Toledo Bend Lake hydropower operation; however, if water is transferred out-of-basin the advantage will decrease. Sedimentation in Toledo Bend will be reduced by 20,400 acre-feet during the 100-year project life.	
7. Sabine Lake Estuary	Project operation would reduce average annual inflow from the Sabine River into the Sabine Lake estuary under ultimate conditions by less than 2 percent. The reduced flow could increase salinity levels and alter the salinity gradient and decrease flow of nutrients. The impact upon the estuarine flora and fauna is n[illegible]nown. However, the hydropower operation at Toledo Bend Lake has a greater impact upon the estuary. As a result of power release operation the natural pattern of increasing salinities during the spring and summer has been replaced with near freshwater conditions which has adversely altered the natural estuarine environment (1).		

	Adverse Impact	Beneficial Impact	[illegible] Mitigation Measures
C. Operation and Maintenance Program			
1. Control of Vegetation	The control of troublesome plants will require an expensive long-term operation and maintenance program. The proposed program will utilize a combination of mechanical and chemical control measures. Minor air and noise pollution, soil compaction and erosion can be expected as an undesirable by-product of this program.	Control of undesirable flora is essential to protect the visiting public and employees from health hazards and nuisances. A safe, and esthetically pleasing environmental setting also provides for the enjoyment of the public.	The management of obnoxious flora will be an integral part of the vegetative management plan. Although aquatic flora is not expected to present problems, a monitoring program will be established to detect and destroy troublesome aquatic species.
2. Enforcement of Regulations	Since enforcement is limited to citation authority for violation of these provisions established by Title 36, Chapter III, Code of Federal Regulations, a designated enforcement officer may be confronted with hazardous situations without arrest authority or adequate protection.	Citation authority provides a management tool which can be used to insure compliance with the regulations. Other benefits are cleaner and safer public-use areas, increased visitor pleasure, and a deterrent against destruction of public property.	Except for Title 36 enforcement of civil and criminal laws at the project will remain the responsibility of duly constituted officers of Federal, State, and local enforcement agencies. The Corps of Engineers will cooperate fully with the appropriate law enforcement officials.
3. Pest Control Program	Proper pest control requires the commitment of a defined maintenance program which includes monitoring, prevention and control. The pest control program will utilize environmental sanitation procedures which eliminates food sources and place of harborage. Periodic application of approved pesticides will be used when necessary. This program will required commitment of capital, labor and resources. The impact upon the environment is not expected to be significant.	The public health hazards created by insects and rodents will be minimized by [illegible] prevention and control measures.	The pest surveillance and control program will be implemented in compliance with Federal, State and local health regulations.
4. Outgrant Program	Outgrants require an extensive long-term administration and [illegible] management program. Project land outgranted for development [illegible] the land resource for the life of the development. Minor environmental degradation may also be experienced.	Outgrants are authorized only to meet a public need.	[illegible]

		Adverse Impact	Beneficial Impact	Corrective Action or Mitigation Measures
5.	Resource Management	A resource management program will require a significant commitment of resources for the life of the project. Of particular concern is the irretrievable commitment of capital, labor and natural resources.	Implementation of a resource management program will permit the conservation, improvement, and management of the natural resources for their best use and provide proper stewardship for the benefit of the general public.	[illegible] management program will be based on the most current scientific knowledge which utilizes practical economical management techniques.
6.	Sewage Disposal	The principal adverse effects of a sewage disposal system would be the commitment of land for the life of the system and the need for coninued operation and maintenance. Public health hazards and nuisances are created by improper disposal of sewage.	Disposal of sewage in a Federal and State approved facility eliminates most of the adverse health and environmental impacts. Proper sewage disposal and treatment prevents pollution of surface and ground water, assists in the propagation and preservation of fish and wildlife, and is essential to protect the visiting public, employees, and nearby communities from disease transmitted through sewage.	The type of sewage disposal facility selected will be based upon the best available, practical economical system that meets Federal, State, and local regulatory requirements.
7.	Solid Waste Disposal	Solid waste disposal requires an expensive well-organized refuse handling system. Although refuse will be disposed of as frequently as necessary, a minor public nuisance is created by ordors, attraction of insects and rodents, and a certain amount of unsightliness. Disposal of solid waste is expected to require maintenance and commitment of a land resource.	Proper refuse disposal eliminates public health problems by substantially reducing insect and rodent infestation, minimizing fire, smoke, odors, and unsightliness. The primary advantage of a well-organized refuse handling system is that it insures disposal of solid waste in an acceptable efficient manner.	The method of solid waste disposal will be governed by the characteristics of the development and determined by careful study and analysis of the problems involved.

SECTION V - ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Probable Short-Term Adverse Impacts

5.01 Construction Period. During the extended construction period, there will be unavoidable adverse impacts, such as increased levels of noise pollution associated with heavy construction equipment traffic, and air pollution associated with airborne dust and emissions from internal combustion engines. There will be a certain temporary unsightliness from clearing and grubbing operations, excavation of borrow areas, and other related construction activities. Temporary turbidity and stream pollution in the project area and immediately downstream will be inevitable, due to soil disturbance by heavy equipment, removal of riparian and upland vegetation, and channelization associated with the outlet works and spillway. Turbidity, and sediment combined with reduced streamflows of the Sabine River will degrade and partially destroy the riparian ecosystem in the project area by smothering benthic organisms with silt, restricting streamflows, increasing temperature, and interrupting the food web. Wildlife disturbed by the construction activities would be displaced from the project area. Existing powerlines and communication lines will be relocated or raised in place. Construction activities may temporarily disrupt traffic flows which may cause minor inconveniences to the general public. These short-term adverse impacts can be minimized in certain situations by strict controls and penalties written into construction specifications and through close supervision of construction activities.

[illegible] Restriction [illegible] Sabine River. [illegible] impoundment, the project will prevent [illegible] releases, which under normal conditions [illegible] 3 [illegible] and [illegible] the impounded water [illegible].

[illegible] Water Quality Within the Impoundment. [illegible] mineral and organic [illegible] of the [illegible] ground cover [illegible] nitrogen [illegible], NH_3), [illegible] and [illegible] and pr[illegible] problems should [illegible].

Probable Long-Term Adverse [illegible]

[illegible] Project Land Requirements. [illegible] approximately [illegible] acres of land for the [illegible] lands downstream from private [illegible]. Current land use will be terminated [illegible] hardwood forest, 7,[illegible]00 acres of [illegible] pasture, 1,[illegible]00 acres of cropland and 700 acres [illegible] land.

5.05 Sabine River and Tributaries. [illegible] will inundate about [illegible] miles of the Sabine River and [illegible] tributary streams. The loss of 30 miles of river [illegible] the total length of the Sabine [illegible] the existing natural [illegible] and the proposed project will [illegible] Sabine River which [illegible] length.

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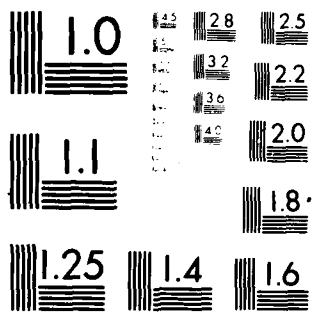


MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

5.06 Fish and Wildlife Resource. The stream fishery associated with about 35 miles of the Sabine River and several miles of tributary streams will be permanently lost. Some of the lotic flora and fauna will decline or disappear following impoundment. Fish migration in the Sabine River will be prevented. Approximately 80 small farm ponds will be permanently inundated by the water supply pool.

5.07 There will be a permanent loss of 25,400 acres of terrestrial wildlife habitat, including about 12,600 acres of productive wetland. The proposed impoundment will significantly affect the wildlife community that occupies the bottomland area of the Sabine River and its tributaries. This community can be expected to be partially displaced into adjacent areas; however, most species will eventually be lost, due to territorial requirements, and the limited carrying capacity of adjacent habitat. Upland wildlife located along the periphery of the lake will be displaced during periods of flooding. Some upland wildlife will be permanently displaced as a result of the construction of recreation facilities. The increased recreation visitation is expected to have a limited adverse impact upon wildlife. The project is not expected to adversely impact the American alligator, Southern bald eagle, or the red wolf.

5.08 Vegetative Resource. Construction of the project will result in the permanent loss of 24,900 acres of terrestrial vegetation within the water supply pool. There will also be a permanent loss of vegetation on approximately 500 additional acres associated with the construction of the embankment, spillway and outlet works.

During periods of flooding, there will be adverse impacts upon the terrestrial vegetation within the 19,100 acres of the flood control pool. Additionally, pedestrian traffic in the project area can be expected to cause a loss of vegetation through physical injury to the plants and by compaction of the soil.

5.09 Geological Resource. There will be a loss of access for mineral exploitation on approximately 500 acres associated with the embankment, spillway and outlet works. An additional 24,900 acres within the water supply pool will restrict future access for mineral exploitation. The proposed project will require modification or cessation of production from five producing oil wells within the limits of the project. Since drilling for oil will have to be conducted from platforms, earth pads, or from shore by directional drilling, access for future exploration and production will be rendered more costly.

5.10 Esthetic Resource. Thirty-five miles of the scenic Sabine River will be permanently lost. A generally pleasing scenery associated with about 25,400 acres of bottomland hardwood forest and uplands will be permanently lost due to inundation or construction. The retention of floodwaters will alter the existing esthetic setting in approximately 19,100 acres.

5.11 Historical and Archeological Resources. Since there are no existing or proposed historic landmarks, sites, or makers having National, State, or regional significance within the project area, there is no known adverse impact upon this resource. The archeological survey report concerning the Carl L. Estes Lake area indicates that there are at least 91 archeological sites representing several stages of man's cultural development that will be lost due to inundation, or endangered by construction activities. Under the auspices of Public Law 93-291, approved 24 May 1974, the Corps of Engineers will fund surveys and investigations as needed to undertake the recovery, protection, and preservation of historical and archeological data which might otherwise be lost as a result of the project. Those sites not discovered and salvaged during the intensive preconstruction survey would be lost for the life of the project.

5.12 Social, Cultural, and Economic Resources. In the project area, there are approximately 290 ownerships from which 180 tracts are proposed to be acquired in fee title. There are about 107 homes that must be removed from the project area. Because sentimental values are not considered when an appraisal is made on property, the relocated resident may be adversely affected. Many displaced tenants and landowners must go through a painful emotional experience of relocation. In addition, approximately 23 miles of roads and highways will have to be relocated, as well as 1 mile of railroad, 12 miles of pipelines, 61 miles of communication line, and 2 cemeteries. The relocation of the two cemeteries could produce additional psychological impact on those families who have family members or friend interred in the cemeteries. A refinery which is presently in operation in the flood pool will require protection.

5.13 Agriculture production, employment, income, and tax revenue derived from the land to be acquired will be forgone for the life of the project. Private recreation opportunities including fishing and hunting will also be lost. Minor social and cultural interruptions may be caused by the influx of visitors to the project. The expected increase in regional growth, business and industrial activities may cause increased traffic problems, crowding of residential areas, and increased air and noise pollution.

Probable Long-Term Adverse Impacts Resulting from Project Operation and Maintenance.

5.14 Flood Control Pool. During periods of inundation, there will be adverse effects upon recreation, vegetation, wildlife and its habitat within the 19,100 acre flood control pool. Since the five year flood pool will experience the most frequent and prolonged periods of inundation, it should receive the greatest adverse impact.

5.15 Water Supply Pool. Since the water supply pool will expose a large surface area, evaporation is expected to result in a measurable loss of the water resource. Pool fluctuation is expected to periodically expose unsightly mudflats which may emit noticeable odors. The initial water quality problems should be short-termed; however, seseasonal problems are expected to arise due to thermal stratification. The pool will also provide habitat for undesirable aquatic flora and fauna.

5.16 Recreation Resource. The minimum recreation development proposed for the project will not satisfy the estimated recreation demand for facilities or activities. The expected 500,000 annual visits will also have an adverse impact upon the environment. These impacts will include soil compaction, damage to vegetation, possible soil erosion, and increased lake sedimentation.

5.17 Fish and Wildlife Resource. Excluding the initial peak production period, the lake fishery should be characterized by a reduction in growth rate, net productivity, and an increase in non-game species as the lake ages. However, it is projected that the lake will provide a good quality fishery for such gamefish species as catfish, white crappie, sunfish, and largemouth bass. Farm ponds provide a potential for initial stockings, nursery ponds, high quality pond fishery and recreation use; if they are breached, this potential will be lost. When operational, the project will alter downstream flows of the Sabine River; consequently, the stream fishery resource will be affected. The magnitude of impact upon the fishery will diminish with distance downstream.

5.18 Upland wildlife located in the 19,100 acre flood control pool will be adversely affected during periods of flooding. Wildlife losses can be expected when flood water is held for long periods. Because the five-year flood pool will experience the most frequent and prolonged periods of inundation, it will provide the poorest quality wildlife habitat. A modification of the seasonally-flooded downstream hardwood forest will result in a decrease in the availability of shallow feeding areas for wintering the water fowl. The reduced frequency of downstream flooding will reduce flood plain fertility and impact those communities that have evolved with and are dependent upon such conditions.

5.19 Archeological and Historical Resource. Wave action is expected to adversely impact those undiscovered sites which are located on the shoreline. These areas receive maximum, unscheduled wave action, erosion, and leaching caused by repeated inundation.

5.20 Streamflow Modification. When operational, the project will permanently alter the natural flows of the Sabine River. The most adversely impacted area will be the 35 mile reach between the damsite and the junction of Lake Fork Creek. This reach can be expected to experience periods of extremely reduced flows during periods of drought. Assuming the dependable yield is transferred out-of-basin, the average annual inflow into Toledo Bend Lake is expected to be reduced by about 5 percent. The Sabine Lake estuary is expected to receive less than 2 percent reduction in average annual inflows.

5.21 Sabine Lake Estuary. Operation of the project under ultimate conditions would reduce the average inflows into the Sabine Lake estuary by less than 2 percent. The reduction of flows is expected to slightly increase salinity levels and decrease the flow of nutrients. The impact upon the estuarine flora and fauna is not known at this time.

5.22 Operation and Maintenance Program. The operation and maintenance program will require a significant commitment of resources for the life of the project. Of particular concern is the irretrievable commitment of capital, labor, and natural resources. Facilities constructed for the maintenance program will require the consignment of land for the life of the facility. Slight air and noise pollution can be expected from the operation of equipment. Minor environmental degradation and potential public health and nuisance hazards are associated with an active operation and maintenance program.

SECTION VI - ALTERNATIVES TO THE PROPOSED ACTION

No Action.

6.01 General. One alternative to the recommended project would be to forego the proposed improvement completely. Selection of this alternative would basically direct future growth and development in the watershed toward a *status quo* program, with continuation of flood damages to existing enterprises and improvements located downstream from the proposed project, and restriction of future growth and development because of a limited water supply.

6.02 Acceptance of the no action alternative would forestall federal acquisition of approximately 68,700 acres of land and water from private ownership. The no-development alternative would prevent the permanent loss of 25,400 acres by construction and inundation, plus the loss of 35 miles of the Sabine River and 80 small farm ponds totaling about 50 acres. It would also suspend the adverse impacts upon the flora and fauna that would eventually be destroyed, displaced, or eliminated during construction activities and inundation.

6.03 Adoption of the no-action option would prevent disruption of the existing social and economic environment. It would not necessitate the abandonment or relocation of family residences, cemeteries, utility lines, highway and railroads and one refinery. The 91 archeological sites would not be subject to possible project related adverse impacts.

Alternatives That Will Provide All of the Authorized Purposes.

6.04 Multiple-purpose Projects Considered. The alternative multiple-purpose projects investigated where those reservoir plans outlined in the "Comprehensive Basin Study, Sabine River and Tributaries, Texas and Louisiana, 16 April 1970." The proposed Carl L. Estes Lake (formerly Mineola) was separated from the three lake system, Mineola, Lake Fork, and Big Sandy Lakes, as presented in Plans A, B, C, D, E, and F of the survey report. Carl L. Estes project was evaluated with the same parameters established for Mineola Lake under the six alternative plans. A description of the six alternative multiple-purpose projects considered is as follows:

6.05 Project A. This project is the authorized multiple-purpose Carl L. Estes Lake as recommended in Plan A of the survey report. The damsite is located at river mile mile 475.6 on the Sabine River, about 38.9 miles downstream from the existing Iron Bridge Dam, and about two miles upstream from U.S. Highway 80. The lake would be in parts of Wood, Rains, and Van Zandt Counties. The lake would have a total controlled storage of 1,375,000 acre-feet and a water surface area of 46,900 acres at the top of flood control pool. Top of the water supply pool would be at elevation 372.5 having an area of 23,900 acres and a capacity of 386,000 acre-feet. Total allowance for a 100-year accumulation of sediment would be 20,400 acre-feet. The net water supply storage would provide a dependable yield of 83.4 million gallons per day under 2020 conditions of watershed development during a recurrence of the most severe drought of record. Land requirements for construction and operation would be about 57,000 acres in fee simple. Additional lands to be acquired in fee simple for public use and access would be about 600 acres.

6.06 The project would provide flood control storage capable of controlling the 50-year flood to within the existing downstream channel capacities. This project provides additional flood storage as a substitute for complementary channels, levees, or flowage easements. The flood control storage of 984,500 acre-feet would require an emptying time of 742 days.

6.07 Project B. This project is similar to project A except that it provides 674,500 acre-feet of flood control storage to control the 50-year flood. Flowage easements are also provided for flood releases. Releases from the project would be regulated to 8,500 cfs. until a 25-year flood storage of 549,750 acre-feet was available. Releases for the remaining 124,750 acre-feet of flood storage would be regulated to the existing downstream channel capacity of 2,000 cfs. A maximum emptying time of 43 days would be required to evacuate the 549,750 acre-foot flood storage and 87 days for the remaining 124,750 acre-foot flood storage.

6.08 Project C. This project is identical to Project B except flood releases would be limited to the capacity of the flood easement channel; however, during ordinary flood periods, an attempt would be made to keep release rates within existing channel capacities as would be done in Project B. The maximum emptying time would be 53 days.

6.09 Project D. This project would be formed by an earth and rock fill embankment, located at river mile 475.6 on the Sabine River. This project results in approximately the same degree of flood control as would be provided under Project A. The lake would have a total controlled storage of 1,065,000 acre-feet and a water surface area of 41,650 acres at the top of flood control pool. The water supply pool would be at elevation 372.5 with a capacity of 386,000 acre-feet. The net water supply storage of 370,100 acre-feet would provide a dependable yield of 83.4 million gallons per day under 2020 conditions. Land requirements for the project including construction of the embankment and operation of the lake would be about 51,000 acres in fee simple. A flood release channel would be constructed from the head of Toledo Bend Reservoir upstream 148.0 river miles to the Carl L. Estes damsite. The improved channel would provide for 8,500 cfs release immediately downstream and become progressively larger with distance downstream.

6.10 Project E. This project would be utilized for water supply, recreation and fish and wildlife--flood control storage would not be included. The embankment would be located at river mile 475.6 on the main stem of the Sabine River. The flooding downstream would be controlled through a combination of channel improvements and flood plain management. The channel improvements for this project, along with the peak dampening effect of the water supply lake would control only the flood magnitudes up to and including those which are expected to occur once in 5 years. Flood proofing and flood plain development limitations would alleviate some of the damages to the structural development within the flood plains, but its effect on damages to agricultural property would be negligible.

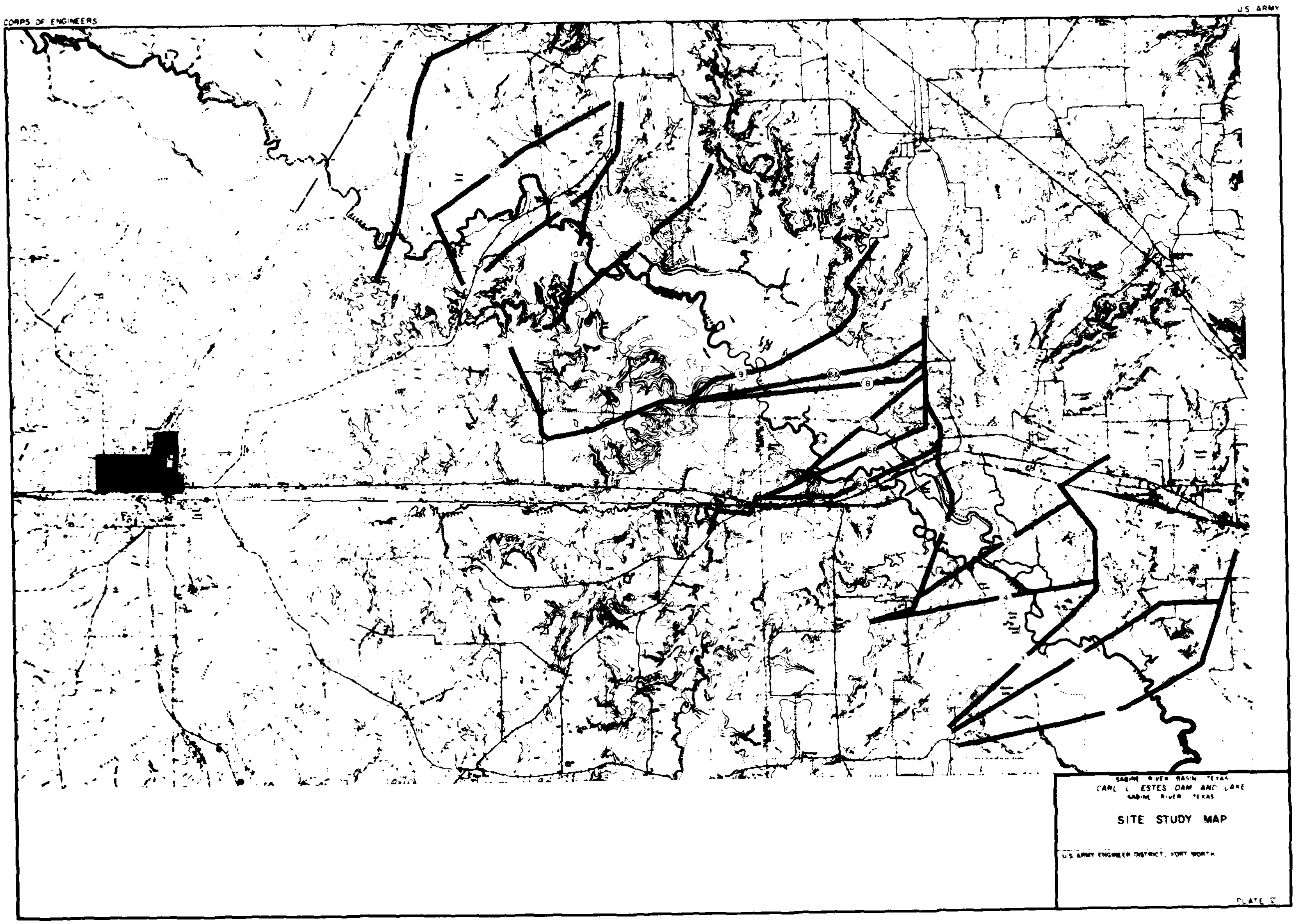
6.11 Project F. Project F consists of a water supply lake in combination with continuous parallel levees extending from the damsite downstream to the head of the Toledo Bend Reservoir. The damsite is at river mile 475.6 of the Sabine River. The project would provide 129 cfs (83 mgd) for water supply, recreation and fish and wildlife. The levees would control the lake spills to the extent that full protection against the 50-year flood would be provided to the headwaters of Toledo Bend Lake.

6.12 Selection of Project. The various projects discussed are composed of structural measures designed to meet existing and projected Sabine River Basin needs for flood control, water supply, recreation and fish and wildlife. Project D, E, and F were not recommended for further study because of the adverse impacts of levee and channel improvements on the downstream environment and the benefit-cost ratios were not favorable. Since Project B and C require large flood releases that would result in downstream flooding and develop smaller B/C ratio than Project A, they were eliminated from further evaluation. For these reasons, and because Project A minimized downstream adverse impacts, it was selected for additional evaluation.

6.13 Site Refinement of Project A. A total of 17 damsites (Plate VI-1) were considered between river mile 446.1 and river mile 483.4. These sites were picked on the basis of engineering practicality. A damsite was considered above and below each major tributary within the study area. Five of the sites were eliminated by inspection, because they offered no engineering or environmental advantage over other sites. Nine sites downstream of U.S. Highway 80 were investigated to the extent that it was determined that they were not economically feasible due to excessive relocation costs. Three sites were chosen for detailed evaluation. They are the lower site (site 9) at river mile 475.6, the middle site (site 10) at river mile 478.9, and the upper site (site 11) at river mile 480.1.

Environmental Evaluation.

6.14 General. Three potential damsites for Carl L. Estes Dam and Lake were evaluated to determine their relative impact upon the environmental resources within the Sabine River Basin. This evaluation was conducted by a comparative basis in that the three sites were compared to one another in terms of more or less adverse or beneficial impacts associated with individual sites, and not on the comprehensive effects of a reservoir per se. Due to their proximity to one another, there is relatively little difference in the adverse or beneficial environmental effects that the three sites would cause. However, there are differences in the magnitude and the accumulative effects among the three proposed sites. Results of this analysis indicate that of the three sites, the upper site would minimize the


CORPS OF ENGINEERS
U.S. ARMY
SABINE RIVER BASIN TEXAS
CARL L. ESTES DAM AND LAKE
SABINE RIVER TEXAS
SITE STUDY MAP
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
PLATE

environmental losses and adverse effects to a greater degree than the other two. The site least acceptable environmentally would be the lower site.

6.15 Location. The three sites evaluated all lie between State Highway 17 and U. S. Highway 80 on the Sabine River. The lower site nearest to U. S. Highway 80 is located at river mile 475.6. The upper site is located less than 5 river miles upstream (river mile 480.0) just below State Highway 17. The middle site is located closer to the upper site than the lower site at river mile 478.9. Site index of the area productivity on a relative scale is between 90 and 95 on the lower terraces and 80 to 90 on the upper terraces. Site index on the ridges varies from 60 to 80. Following is a general description of each site.

6.16 Lower Site (Site 9). Starting with the right abutment, the 4.5 mile long damsite traverses across open fields among several stock ponds, avoiding one large one. In avoiding the large pond, the proposed dam angles across the highest hill in the immediate area. This hill has been cleared and is now an improved pasture. The dam will then cross through a cutover patch of pine and oak-hickory hillside until it hits the upper terrace. At this point it crosses another improved pasture until it reaches the extensive hardwood timbered lower terrace area adjoining the Sabine River. The dam crosses through a densely timbered area and the river at mile 475.6 and lies just north of Lewis Lake. The lower and upper terraces are much narrower on the left abutment side of the river.

The remaining length of the dam from Lewis Lake to a point where it doglegs back north is a relatively flat, heavily timbered slope.

6.17 Middle Site (Site 10). The middle damsite envisions a dam approximately 2.3 miles long. Both abutments originate in open fields, traverse down the slopes to the upper terrace through improved pastures and heavily timbered areas, and then crosses down into the lower terraces adjoining the river at river mile 478.9. The middle site lies just above Cedar Lake and Neil Lake, both are sloughs which are flushed out several times a year by the high waters of the Sabine River.

6.18 Upper Site (Site 11). The upper site lies 250 to 750 feet to the south of and parallel to State Highway 17. Both abutments originate in open fields on hills. The length of the dam is approximately 2.3 miles and crosses similar terrain, although the lower terraces are narrower than the middle site. More open pasture areas are evident than in the middle site, however.

6.19 Environmental Elements. The environmental impact analysis of the three sites was conducted by evaluating the differences in effect that the middle and upper sites would experience in comparison to the lower site. Although many of the effects are interrelated, they have been separated for discussion purposes into five broad categories. Effects as they relate to these categories are discussed below.

6.20 Geological Elements. Evaluation of the geological aspects associated with damsite selection revealed no significant differences between sites. Specific areas of concern included soil erosion, fossil deposition, salt domes, unique rock outcroppings, faults and mineral deposits. Inundation of some oil and gas wells will occur no matter which site is selected. Also any problems related to abandoned coal mines (if any) in the Alba area would affect all three sites; hence no significant difference among the three.

Hydrological Elements

6.21 Cedar Lake-Lewis Lake Phenomena. There are two sloughs that lie between the lower and middle damsites that are rather unique hydrologically. The two sloughs drain into the Sabine River in a northwesterly direction during normal or low-flow. However, when waters rise and the main channel becomes bank full, and old river channels become active, a reversal of the drainage flow occurs in the two sloughs. As the flood waters increase, a flushing action takes place within the sloughs. If flood waters continue to rise they will cover the entire flood plain with water moving rather swiftly through the main channel and the old channels. This phenomenon occurs several times each year. The lower site will eliminate both of these sloughs through inundation. At the middle site, unless engineering design and operation of the reservoir prevents it from happening, the two sloughs would not receive the flushing action and flow reversal as frequently. A channel would also have to be constructed from Neil Lake into the Sabine below the middle site to allow for drainage. The upper site would have essentially the same effect as the middle site but with less alteration of existing drainage patterns.

6.22 Wind-driven Wave Damage. Due to the large expanse of water along the 4.5 mile long dam face of the lower site, wind-driven wave damage to shoreline areas would be greater than at the middle and upper sites. Three factors influence the size of wind waves, wind velocity, the duration of the time the wind blows, and the extent of the open water across which it blows (fetch). Fetch in this instance would be greater in the lower site.

6.23 Evaporation Difference. The middle damsite would experience less evaporation loss than the other two as the water supply pool of the middle site is the smallest of the three, followed in order of size by the lower site and then the upper site. Due to the relatively small differences in water supply pool size the evaporation aspect is considered insignificant.

6.24 Flood Damage. Downstream flood damage would be greater the further upstream the damsite is located because the area of uncontrolled downstream runoff is increased. The lower damsite would provide the greatest flood protection followed by the middle and upper sites.

6.25 Water Yield. Water yield for water supply purposes would not be affected no matter which damsite is selected. However, downstream flows and yields will be different depending on the location of the damsite. Downstream flows and yield would be a corollary to the flood damage downstream in that the further upstream the damsite is located, the greater the area of uncontrolled downstream runoff.

6.26 Biological Elements. Generally speaking, the biological losses and damages are decreased as the damsite location moves upstream toward Lake Tawakoni. For example, the upper and middle sites would inundate less of the existing riverine ecosystem than the lower site. In this instance, the flood pools of the upper and middle sites are only less than 600 surface acres different from the lower site. However, the flood plain below the middle and upper sites is much richer in terms of fish and wildlife populations and diversity. Consequently the effect on fish and wildlife population and diversity is much more adverse with the lower site as it would inundate approximately 2600 acres of prime deer and squirrel habitat that the two upper sites would not. Also located within the 2600 acres are Cedar and Neil Lakes, two rich biological areas, which would also be lost with the lower site through inundation. These two lakes would also be affected by the upper two sites, but steps could be taken to minimize the effects through engineering and reservoir operation techniques. They would also be preserved and managed for fish and wildlife as they would be acquired for mitigation of fish and wildlife habitat losses elsewhere.

6.27 Archeological and Historical Elements. Again, generally speaking, archeological losses and damages are decreased as the damsite location moves further upstream toward Lake Tawakoni. The upper and middle sites would affect the area less adversely than the lower site in terms of accumulative impact, in that several archeological sites exist among the three damsites. The area in the vicinity of

Cedar Lake is especially rich in archeological resources, consequently the upper site, followed by the middle site would be the most acceptable from the archeological point of view. No known items of historical significance have been found in the study area resulting in no difference in terms of effects among the damsites on this aspect.

Cultural Elements

6.28 Loss of Tax Roll Land. Little difference will be experienced by local governments in the loss of tax roll land no matter which site is selected. The lower and middle sites will cause the loss of approximately the same amount of land. The upper site would involve slightly more (approximately 600 acres) tax land lost.

6.29 Relocations. Relocations of roads and highway, pipelines, telephone, and power lines would be less affected by the upper and middle sites in comparison to the lower site. Relocation of a railroad, two cemeteries, and a refinery would take place regardless of which damsite is selected. It should be noted, however, that the middle site would generate a higher cost in relocating the above facilities. Disruption due to relocations would not vary significantly among sites.

6.30 Recreation Development. The three proposed damsites would offer essentially the same lake oriented recreation development potential. However, the lower site would eliminate current popular river and slough fishing and hunting areas. Should the area between the lower and middle sites be preserved in the form of mitigation efforts associated with the development of the middle or upper site, a greater mix of recreational opportunities could be realized.

6.31 Commercial Timber. Although there is little commercial lumbering in the study area today, the potential exists. The area has been cut over from the time it was first settled up to the present. The present bottomland hardwood forest has been extensively logged and only pockets of climax hardwood overstory remain. In addition to the bottomland hardwoods, the three damsites lie in the western edge of the southern pine forest. Remnant stands of short-leaf and loblolly pine can be found scattered throughout the area. Pine tree farms are also frequent in the areas. Selection of the lower site would cause the loss of a greater potential commercial timber production area than the two upper sites.

6.32 Family Displacements. Five and perhaps six families would be displaced between the lower and middle sites. Only two or three families would be displaced between the upper and middle sites. If the upper site was selected, the seven to nine families downstream would be left intact. However, due to the increase in elevation of the conservation pool requirements, this downstream relief would be offset by additional displacements upstream. Therefore, site selection among the three sites would have relatively the same impact on family displacement.

6.33 Agriculture. Agriculture in the area consists primarily of beef and dairy farming. Improved pasture in the study area is either Bermuda grass or dallisgrass. Most of the area, however, is in native pasture. Both the improved and native pasture land will be affected by any dam or reservoir. Damsite location is not significantly important, as little difference in total losses would be expected from one site over another.

6.34 *Conclusions*. Based on the preceding discussions, it was recommended that the planning for a multipurpose project be continued at the upper site (Site 11) above the presently authorized site. This new site at approximate river mile 480.1 would contain an uncontrolled ogee spillway and a gated outlet works.

6.35 To obtain a better alignment for the spillway, an adjustment was made to the right abutment by moving it downstream to the middle damsite abutment. The final alignment is a combination of the upper and middle sites which is called Site 10A, river mile 479.7.

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

6.36 General. During the project formulation process, various alternatives are examined. This procedure involves a screening process which develops or eliminates alternatives in pursuit of the most acceptable plan. The discussion which follows presents those alternatives that were not evaluated in great depth because they were not found to be economical, practical, or feasible.

Structural Flood Control Alternatives

6.37 Main Stem Reservoir. This project would be a single purpose flood control embankment and lake located at river mile 479.7 on the main stem of the Sabine River. It would provide 995,300 acre-feet of flood control storage for control of a 50-year flood. The flood control pool would inundate 39,200 acres.

6.38 Tributary Floodwater Retarding Structures. A system of floodwater retarding structures in lieu of the proposed Carl L. Estes project was not investigated in detail. A coordinated report between the Soil Conservation Service (S.C.S.) and the Corps of Engineers recommended that these smaller single-purpose flood control structures be installed in six watersheds of the upper Sabine River Basin. Therefore, continuing coordination with the S.C.S. will be conducted to eliminate any unnecessary conflicts between these planned flood control projects.

Non-structural Flood Control Alternatives.

6.39 Flood Plain Fee Acquisition and Permanent Evacuation. This non-structural alternative would involve public acquisition and permanent evacuation of the 50-year flood plain between Lake Tawakoni and the confluence of the Sabine River with Lake Fork Creek. Only those land uses that conform to the adopted land use plan would be allowed in the flood plain.

6.40 Flood Plain Easement Acquisition. Federal acquisition of a restrictive easement was considered for the area encompassed by the limits of the 50-year flood plain along the Sabine River from Lake Tawakoni to the confluence with Lake Fork Creek. This plan would require the evacuation and permanent preclusion of habitable dwellings within the easement area.

6.41 Flood Plain Zoning. Controlling development of floodprone areas through the adoption of flood plain ordinances and other reasonable regulations was considered as a method of reducing flood damages. Implementation of a flood plain zoning program rests initially with the State of Texas or its delegated political subdivisions. The role of the Federal Government in this alternative is limited to providing guidance, technical information and general support of the program.

Structural Water Supply Alternatives.

6.42 Main Stem Reservoir. A single purpose water supply project was examined at river mile 479.7 on the Sabine River. It would provide 393,000 acre-feet of water supply storage. The water supply pool would inundate 24,900 acres.

6.43 Two Main Stem Reservoirs. There would be no economic advantage in developing one reser ir for immediate water supply needs and deferring development of the other reservoir to satisfy the needs in year 2000.

6.44 Tributary Reservoirs. Because of the shape of the basin, a comparable dependable yield cannot be developed from tributary reservoirs.

6.45 Multi-Stage Developed Reservoir. The projected water needs are such that multi-stage development would not provide any economic advantage over single-stage construction.

Non-structural Water Supply Alternative

6.46 Groundwater. Existing groundwater resources are not sufficient to meet the future demands of the study area.

6.47 Import by Pipeline. No surplus water is available from reservoirs for importation.

Recreation Alternatives

6.13 Optimum Recreation Development with Construction of Carl L. Estes Lake. with this alternative, Carl L. Estes Lake would be constucted with optimum recreation development. This plan will give primary emphasis to providing sufficient recreation facilities for the continued enjoyment and maximum sustained use by the visiting public consistent with the carrying capacity and esthetic and biological values. Four park areas, containing approximately 4,800 acres above the conservation pool, are planned for recreational development. The project will provide opportunities for initially 1,700,000 recreation days annually at its optimum 5,700,000 recreation days annually. Because of its proximity to large metropolitan areas, it has the potential to partially satisfy the deficiency of outdoor recreation opportunities of the area. Recreation development is planned to provide opportunities for activities such as camping, picnicking, hiking, and water based recreation. An environmental greenbelt corridor is planned for the 12,000 acre downstream area which will be purchased for wildlife mitigation. The recreational, including fish and wildlife, and social opportunities of this corridor will be almost limitless. Opportunities for fishing, hunting, backpacking, hiking, primitive picnicking, and camping will be provided.

6.49 Additional Facilities at Existing Nearby Water Resource Projects. There are no existing Corps of Engineers lakes in the market area and agencies other than the Corps of Engineers make only limited attempts to develop the recreational potential of the lakes they construct. These lakes, built for specific purposes, are not intended for recreational use; and even though they become attractions to the public, few facilities are provided to enhance this use. In most instances where the agency leaves the shoreline in private possession, second home development prevents ready access to the lake for public enjoyment.

6.50 Additional Lakes in the Recreational Market Area. A relatively small 50 road mile day-use recreational market exists for Carl L. Estes Lake. This area does not provide for the many large water based recreational developments because of the competing projects which presently exist. Lake Tawakoni is just above Carl L. Estes Lake and it serves the same market area that Estes would. However, because of the private development along the shoreline and limited public use development at the lake, access for the use of Lake Tawakoni is limited. Two other authorized projects which could meet portions of the market area demand for recreational development are Lakeview Lake on Mountain Creek, a tributary of the Trinity River, and Big Sandy Lake on Big Sandy Creek, a tributary of the Sabine River. The proposed Big Sandy project would be near Carl L. Estes Lake and they would complement each other by providing a multi-unit attraction which would draw visitors from longer distances to use the wide variety of facilities. Besides these proposed Federal multipurpose projects, the Sabine River Authority is presently constructing Lake Fork Lake which has limited provisions for recreation development. Even though small impoundments built along the streams of the area could provide local recreation attraction, they would not be as economically feasible as the multipurpose project.

6.51 Access to Existing Streams Without Development. This alternative to recreation development would provide no improvements along the creeks in the project area. It would make the existing access public, 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 developers, such as boating, skiing, sailing, and fishing on a large scale will not be present. 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.

6.52 Access to Existing Streams With Development. This alternative in lieu of Estes Lake would provide public access to the 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 only meet a fraction of the demand which would be met by the proposed Estes project. 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, and helping to meet a portion of the need for "river type" recreation. The present environmental setting would remain virtually unchanged except in the vicinity of the access points. The detriments of this alternative would include minor plant material damage and soil erosion which would occur at points of access; no large water based attraction to meet the 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.

6.53 Environmental Corridor/Greenbelt Without Construction of Carl L. Estes Lake. This alternative consists of acquiring a linear strip of right-of-way and other fee-owned lands adjacent to the river channel. An extensive network of trails, green areas, playgrounds, and picnic and camping areas would help partially meet the recreational and leisure needs of the area. This type of development would provide facilities for a portion of the demand for picnicking and camping, and only minor adverse environmental impacts would occur. The detriments of this alternative would include minor adverse impacts from foot traffic, which would result in soil compaction, loss of vegetation, and possible soil erosion. Also, 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.

6.54 <u>Designation as a Wild, Scenic, and Recreational River Area.</u> With this alternative, no multipurpose lake project would be involved, but lands would be purchased or easements acquired along the Sabine River and its tributaries to insure public access for recreational purposes. For a wild and scenic river designation, a river and its immediate area must be considered natural or esthetically pleasing, and possess outstanding scenic, recreation, geologic, fish and wildlife, historic, cultural, or other similar values. There are three classifications through which the Federal Government could participate in providing recreational development along the Sabine and its tributaries. The requirements of each classification include: (1) Wild river area. Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and water unpolluted will qualify. Since many road crossings exist throughout the length of the Sabine and its tributaries, and many private roads provide access to agricultural lands, the Sabine River and its tributaries do not ideally fit into this category. However, this does not imply that short stretches of the river could not meet the criteria for wild river designation. (2) Scenic river areas. Rivers or sections of rivers that are free of impoundments, with shorelines largely undeveloped, but accessible in places by road, qualify in this category. The Sabine River's two major impoundments, Lake Tawakoni and Toledo Bend Lake, are about 150 miles apart, providing a long stretch of the river with flow. The State of Texas in a report entitled, "Texas Waterways-A Feasibility Report on a System of Wild, Scenic, and Recreational Waterways in Texas," classified the 205 mile stretch of the Sabine River between the Tawakoni Dam and Joaquin as having the potential for a scenic river classification. (3) Recreational river areas. Rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that have undergone some impoundment or diversion in the past can qualify as a recreational river. All of the open stretches of the Sabine River could fit into this category. Under this concept, a corridor or strip of land would be purchased on each side of the river. This 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. Minor adverse 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.

Fish and Wildlife Alternatives

6.55 Water Bank Act. The Water Bank Act 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. Agreements entered into under this Act would provide for preserving and improving the existing migratory waterfowl and other species habitat located along the Sabine and its major tributaries. There are no known detrimental environmental aspects associated with the implementation of this Act. This program is currently 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.

6.56 The lands immediately below Lake Tawakoni Dam are wet most of the time and are of suitable quality and size to qualify under this Act. The Water Bank Act is an ongoing program, but no funds were included in the FY75 program. Additionally, recent decisions by the President regarding budget expenditures and reductions have cast doubts on whether or not this program will be continued. Although the existing wildlife habitat would be preserved by implementing this alternative, no consideration is given to water supply, recreational elements, or flood control needs in the area.

6.57 Green Tree Reservoir. 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. 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. 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. Oak heads 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.

6.58 The topography of the site should be relatively flat so a large area can be flooded to a shallow depth at a reasonable cost. 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). 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 was 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. 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. The detrimental aspects of this alternative 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 loss of these lands would occur. The lands immediately below Lake Tawakoni Dam and in proximity to the proposed Carl L. Estes Lake are suitable as a site for a green tree reservoir.

6.59 Provide Public Hunting Areas. 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. 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. No major impacts upon the flora and fauna would occur with control of vehicle access and use in the management area. Additional man-days of hunting could be accommodated in an area where lands available for public hunting are scarce. The detriment of this alternative would be that only limited types of recreational pursuits would be made available, and the demands for water based recreation would not be met.

Alternatives to the Proposed Operation and Maintenance Program.

6.60 Flood Control Operation. One alternative to the proposed regulation of the flood control pool would be to stop all regulatory flood control. Uncontrolled discharge of floodwaters from a flood control project would endanger lives, and cause extensive damage and loss of property downstream. This alternative is totally unacceptable. Four alternative release rates were investigated to find a plan acceptable from an environmental standpoint, balancing the adverse impacts as much as possible between the periphery of the proposed lake and the existing downstream area. The following table displays some pertinent data from this analysis.

Alternatives	Flood Plain Acres Inundated	Time Required to Empty Flood Pool
2,000 cfs	0	+700 days
4,000 cfs	12,000	160 days
6,000 cfs	13,400	140 days
8,500 cfs	16,900	125 days

6.61 The 2,000 cfs release plan would confine the flood release to the existing downstream channel capacity. Such operation would necessitate the inundation of flood pool land for over 700 consecutive days under project flood conditions. This operational alternative would cause severe adverse impacts within the flood control pool. There would also be adverse impacts to the downstream flood plain ecosystem resulting from reductions in flows and periodic flooding. The 6,000 cfs and 8,500 cfs releases were considered to shorten the time required in lowering the water level from the flood pool and to reduce adverse impacts to vegetation and wildlife along the periphery of the lake during flood stages. These releases would result in excessive flooding downstream of the project. The currently recommended operational plan will provide for downstream release capability of up to 4,000 cfs, thereby reducing the adverse impacts to plants and animals along the periphery of the lake, as well as the downstream fishery and riparian ecosystem.

6.62 Water Supply Operation. The Sabine River Authority is the local sponsor for the project. It is expected that the Authority will contract with the Government for all of the water supply storage to be included in the lake. Water supply releases or withdrawals from the project will be the responsibility of the Authority under permit from Texas Water Rights Commission. No water supply storage is included in the project from which the Corps of Engineers can supply regulated releases.

6.63 Control of Undesirable Vegetation. A no-action alternative would prevent terrestrial and aquatic vegetation control which helps maintain a safe, healthful, pleasant and functional environment. This option would not require the irretrievable commitment of capital, labor and natural resources and it would permit natural succession. Control of vegetation by mechanical techniques offers a practical management alternative. The advantage of this management technique is that chemical herbicides are not utilized. However, mechanical methods are expensive and they are not effective in all situations. A third alternative is chemical control of undesirable vegetation. The advantages of this alternative are that it is relatively inexpensive, fast and effective. Pollution hazards and the possible side effects are the principal disadvantages. The proposed control method is to use a combination of mechanical and chemical control measures. This management opportunity permits the project manager to evaluate each situation individually and prescribe the type of control necessary.

6.64 Enforcement of Regulations. Because the enforcement of civil and criminal laws at Carl L. Estes Lake is the responsibility of duly constituted officers of Federal, State, and local law enforcement agencies, the alternative to enforcement of regulations will be restricted to those presently possible within the current authority of the U.S. Army, Corps of Engineers. Specifically, the Corps of Engineers enforcement authority is restricted to those provisions under Title 36, Chapter III, Code of Federal Regulations.

6.65 The no-action alternative is not realistic because it does not permit enforcement of regulations which have been established for the protection and safety of the general public. Requesting the public to comply with regulation is a viable alternative to no-action. Persons who violate the published rules and regulations of conduct would be courteously informed that they were acting in violation and would be requested to stop. The advantage of the alternatives is that most people will comply with the request and none of the problems of enforcement are encountered. The primary disadvantage is that an individual may willfully disregard the compliance request. The proposed method of enforcement of regulation is to request compliance. If the result of this approach is unsatisfactory, citations will be issued in accordance with Title 36, Chapter III, Code of Federal Regulations.

6.66 Pest Control. Since mosquitoes, ticks, flies and other common pest create public health hazards and nuisances, a no-action pest control program would not be acceptable. An alternative to no-action would be to develop a program with emphasis on biological pest control which utilizes insect predators and parasites. This is a desirable alternative; however, biological control techniques have not been developed to the point that they can satisfactorily control most pest problems. The proposed pest control program will utilize environmental sanitation procedures which eliminates food sources and places of harborage. Periodic applications of approved pesticides will be used to prevent heavy pest infestations. This program will provide for the control of pests with only a minimum use of toxic chemicals.

6.67 Outgrants. An alternative to the general outgrant program would be to terminate all outgrant actions. This proposal would not be feasible because it would exclude public services, easements and rights-of-way for public roads and utility lines, etc. Another alternative would be to permit unrestricted outgrants. This would result in disorder and possible adverse environmental effects. The proposed outgrant program will review and judge all applications on an individual basis. All outgrants will be inspected by project and district personnel for compliance with policies, agreements, and public health and safety codes.

6.68 Recreation Program. Without stopping public use of the project, it is not feasible to terminate a recreation maintenance and management program. Project lands have been offered to state and local agencies for recreation management but were not accepted. Corps of Engineers management became mandatory after the other agencies declined to use these lands. The proposed plan for recreation development provides only minimum facilities for public health and safety in accordance with Public Law 89-72. These minimum facilities will consist of guardrails, turnarounds, and frame toilets on existing public roads.

6.69 Fish and Wildlife Management. The fish and wildlife management program is essentially the responsibility of the Texas Parks and Wildlife Department. Under the auspices of the Fish and Wildlife Coordination Act, Public Law 85-624, the Corps of Engineers and the U.S. Fish and Wildlife Service have developed a mitigation plan which would offset much of the project's adverse impact on the fish and wildlife resources. The mitigation plan provides approximately 12,000 acres of flood plain lands below the planned damsite and approximately 13,350 of suitable upland lake perimeter lands. These lands will be turned over to the Texas Parks and Wildlife Department for administration under the terms of a General Plan as provided in section 3 of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq). If the Texas Parks and Wildlife Department is unable to accept these lands for administration, then the Corps of Engineers will take over their administration.

6.70 Resource Management. The most apparent alternative to having a resource management program is not to have a program. When the influences of man and his activities are imposed upon the natural environment, some type of management is necessary to protect and prevent the deterioration of the environment. Therefore, a policy of no resource management would not be in the best interest of the public. The most feasible alternative, and the proposed course of action is to prepare vegetative and fish and wildlife management plans and implement the program.

6.71 Sewage and Solid Waste Disposal. If no provisions are made for waste disposal, a serious health and sanitation problem would be created as well as an aesthetically displeasing environment. The proposed course of action will consist of collecting and depositing sewage in a treatment facility. Solid waste will be disposed of in the most practical and economical manner that meets Federal, State, and local health laws. The advantage of this proposal is that waste will be dealt with in an accepted manner that will not create a health hazard, nuisance or pollution problem.

SECTION VII - THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01 The Sabine River Basin is an underutilized natural water resource which is important in maintaining and improving the living standards and life's amenities for the people of the region. The proposed project will have a long-term effect on the region, river basin, state and nation, and from a human viewpoint, this effect may be termed either good or bad depending upon changing trends and needs of our society.

7.02 Once the project is developed, a portion of the resources and their potential will be commited for the maintenance and enhancement of man's environment and the preservation of a portion of the natural environment for the foreseeable future. Even though the water of the region and basin is a valuable asset, it is also a destructive natural resource. In the future, its value will be even greater, and hopefully less destructive based on man's activities and decisions.

7.03 In evaluating the long-term impacts of a project on the environment, it is recognized that man is an integral part of the environment. The primary factor in deciding whether to further alter an ecosystem or not (i.e., proposed action versus no action) should be to determine which action will provide the most desirable environment for man with minimum adverse impact on the natural environment. Today, many views of man's past actions have been considered as improper, which have resulted in serious impacts on the natural environment. Nevertheless, it would also be disastrous to attempt to revert back to, or try to maintain a separate environment for man and nature.

We must continue to endeavor to maintain and improve the quality of life even as man's ability to make wise environmental decisions is developing.

7.04 The people living in the proposed project area are an important part of the present ecosystem. A sufficient water supply, the regulation of erratic streamflow, the recreational opportunities, the preservation of wildlife species and habitat, and the preservation of scientific and archeological sites will help to stabilize and maintain the long-term productivity of the ecosystem for the present and future populace.

SECTION VIII - ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

8.01 The construction of the project will necessarily involve a significant commitment of resources. Of particular concern in this statement are irreversible and irretrievable commitments of resources that will result from construction of the Carl L. Estes project.

8.02 The construction of the embankment, spillway, and all supporting facilities will require an extensive bill of materials commonly utilized, including earth fill, gravel, sand, cement, copper, steel, lumber, and others. To a considerable degree, these basic materials are reclaimable with some penalty; however, their commitment to the project should generally be considered a long-term and irreversible commitment of resources.

8.03 In addition to the required industrial resource, the project will involve a substantial expenditure of manpower, energy, and money which will constitute an irretrievable commitment of these resources.

8.04 The project will also require a substantial commitment of land as a basic resource. This land is necessarily lost for the life of the project so far as other productive uses are concerned. The project will require the commitment of approximately 68,700 acres of **privately** owned land to public ownership. Of this acreage, the lake will occupy some 24,900 acres when at the top of the conservation pool; and the embankment, spillway and outlet works will occupy an additional 500 acres.

8.05 The construction of the project will result in the commitment of a vegetation resource and its associated wildlife habitat. Indigenous fish and wildlife will be lost or displaced within the project boundary.

8.06 The project will transform approximately 35 miles of the Sabine River from an intermittent free-flowing stream to a lake environment. Natural streamflows of the Sabine River will be modified by the project. Theoretically, this would not be an irreversible loss since this portion of the river would revert to a free-flowing condition should the lake be drained at the end of its economic life.

8.07 Probably any remaining structural traces of man's occupancy of the project area would be lost. Those artifacts of man's prehistory buried beneath the surface and not destroyed in actual construction operation would remain intact, albeit less likely for recovery. Excavation and removal of archeological sites and resulting destruction of the sites involved would be irreversible, as would be the loss of future opportunity for studies at some of these sites.

SECTION IX - COORDINATION AND COMMENT AND RESPONSE

9.01 General. The National Environmental Policy Act of 1969 requires that the expertise and views of a broad range of knowledgeable people be used in preparing environmental statements. This section contains a history of the coordination effort, and the written correspondence of those who have provided input for the draft environmental statement. Table IX-I is provided to facilitate finding the correspondence of particular agencies, organizations, or individuals.

TABLE IX-I

COORDINATION WITH OTHERS
(by subject)

AGENCY	FULL TEXT
ARCHEOLOGY	
Texas Historical Commission	9-2
HISTORY	
Texas Historical Commission	9-5
Van Zandt County Historical Survey Committee	9-12
LAND-USE PLANS	
U.S. Department of Agriculture	
Soil Conservation Service	9-14
U.S. Department of the Interior	9-15
Environmental Protection Agency	
State of Texas:	
Division of Planning Coordination	9-17
Texas Highway Department	9-19
Texas Parks and Wildlife Department	9-21
General Land Office	9-22
Texas Historical Commission	9-26
Bureau of Economic Geology	9-29
Texas Water Rights Commission	9-30
Texas State Soil and Water Conservation Board	9-32
Texas Air Control Board	9-33
Texas Water Development Board	9-34
East Texas Council of Governments	9-35

Van Zandt County
Billy F. Hullum, County Judge 9-36
Wood County
H. C. Douglas, County Judge 9-37
Joe J. Smith, Mayor of Mineola, Texas 9-38

9.02 History of Coordination Prior to Developing the Environmental Statement: (a) Since submission of the 1940 report on survey of the Sabine River and tributaries, Texas and Louisiana, four public hearings have been held to ascertain the views and desires of local interests with respect to improvements for flood control and allied purposes. Pursuant to the authorizing resolution for the restudy of the Sabine River Basin, public hearings were held in Longview, Texas, on June 24, 1946; in San Augustine, Texas, on June 25, 1946; in Orange, Texas, on May 29, 1962; and in Longview, Texas, on July 18, 1962. (b) A formal Congressional hearing on flood problems of the Sabine River Basin was convened in Longview, Texas, on February 28, 1969, by the Flood Control Subcommittee of the House Committee on Public Works. During this hearing, a summary of the Corps of Engineers plan of improvement proposed in the comprehensive Sabine Basin study was presented to the assembly. (c) A public hearing on the Sabine survey report was held by the Corps of Engineers at Longview, Texas, on 25 June 1970. (d) By letter, dated 2 July 1973, the District Engineer submitted a notice of initiation of advance engineering and design studies to 954 Federal, State, and local governmental agencies, conservational or environmental groups, and individuals known to have an interest in the study. Comments were invited on flood control, water supply, water quality control, recreation, environmental problems, and other water resource development needs so the Corps of Engineers could respond to their desires and needs during the planning process. (e) Hearings were convened before the Texas Water Development Board and the Texas Water Pollution Control Board in June 1966 at Longview and Orange, Texas. Included in the Texas Water Development Board's presentation at both hearings were statements in support of the plan, then being formulated, for the comprehensive Sabine Basin study.

9.03 Summary of Project Coordination Since Initiation of the Environmental Impact Statement: (a) A community planning session was held by the Fort Worth District, U. S. Army Corps of Engineers to discuss the Carl L. Estes Dam and Lake project. The planning session was held in the multipurpose building at the Mineola High School, Mineola, Texas, on 25 April 1974. The meeting was held to inform the general public of the status of advanced engineering mnd design studies that have been performed on the project. The 195 attendees were encouraged to exchange views, offer comments, and express their ddesires so they could be considered in the project plan formulation. (b) Coordination letters from the Texas State Historical Survey CCommittee discussing the possible impacts on the archeological resources and the need for an in-depth survey are included in this section. (c) The fish and wildlife aspects of the project plan presented in this statement were informally coordinated with staff representatives of the U. S. Fish and Wildlife Service. In accordance with the Fish and Wildlife Coordination Act of 1958, the Fish and Wildlife Service has prepared a formal report.

Mr. R. M. Maginn, resident wildlife biologist of the Little Sandy hunting club, aided in the compilation of a checklist of the bird species for the project area. (d) Coordination letters requesting information on any historical sites which might be adversely affected by the project were sent to the Texas Historical Commission, and the Historical Survey Committee of Rains, Smith,, Van Zandt, and Wood Counties. Correspondence with Mr. V. B. Shaw of Wood County, Mrs. Faye Laney, Van Zandt County, and the Texas Historical Commission indicates that there are no known historical sites or markers that will be adversely affected by the project. (e) Also included in this section are the replies from Federal, State, and local governmental agencies in regard to possible conflicts of the proposed project with their land-use plans, policies, and controls. A list of the agencies from whom responses have not been received follows:

U.S. Department of Agriculture
  Agriculture Stabilization and Conservation Service
  Executive Director, Emory, Texas
  Executive Director, Canton, Texas
U.S. Department of Housing and Urban Development
  Regional Administrator
  Flood Insurance Office
U.S. Department of the Interior
  Bureau of Outdoor Recreation
Rains County
  County Judge
  Ceil B. Johnson
  Mayor of Emory, Texas
  Albert A. Clark
Van Zandt County
  Mayor of Edgewood, Texas
  Fred Hutchins
  Mayor of Grand Saline, Texas
  M. L. Garland
  Mayor of Wills Point, Texas
  Truett Mayo
Wood County
  Mayor of Alba County, Texas
  James Reid

Texas State Historical Survey Committee
Box 12276, Capitol Station, Austin, Texas 78711
Truett Latimer
Executive Director

July 5, 1973

Mr. Floyd H. Henk
Colonel, CE
District Engineer
Fort Worth Distric, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Henk:

Reference is made to the Notice of Initiation of Advance Engineering and Design Studies for the Carl L. Estes Dam and Lake on the Sabine River, dated 2 July 1973. The area indicated is known to contain highly important cultural resources which should be taken into consideration in the planning process when ecological and environmental conditions and problems are reviewed.

Enclosed to assist in the early planning for this project is an archeological survey which was carried out in 1971 by the Texas Water Development Board and the Texas Historical Survey Committee. The survey indicates the presence of extensive archeological materials and information in need of study and salvage to prevent irretrievable loss of cultural information as a result of proposed construction and inundation in the area. More than 90 sites representing several stages of man's cultural development in the area were located.

Scientific recovery of information can mitigate the adverse effects of the proposed project. A reliable sample of all significant cultural and ecological resources should be made through research and testing under the direction of a competent professional archeological group. Measures other than recovery should also be considered and might include protection for future generations of sites above the water line through proper preservation management.

Thank you for soliciting our comments early in the planning process. Please let us know if we can be of further assistance.

Sincerely,

Truett Latimer
Executive Director

By,

James M. Malone
Assistant State Archeologist

JMM/lsb

cc: Walter Tibbitts

TEXAS HISTORICAL COMMISSION
P O BOX 12276 CAPITOL STATION AUSTIN TEXAS 78711
TRUETT LATIMER
EXECUTIVE DIRECTOR

August 20, 1974

Mr. Gordon A. Walhood
Chief, Engineering Division
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, TX 76102

Attention:
SWFED-PR

Dear Sir:

Regarding your inquiry of 8 August as to our knowledge of historic sites that might be adversely affected by the projected Carl L. Estes Dam and Lake Project, we have the following to report:

There are two sites that to our knowledge lie very near or within the floodplain shown on your map.

One of these is the SMYRNA UNION CHURCH which our records show as standing 5.5 miles west southwest of the town of Emory, Rains County. This church stands at the site of the schoolhouse wherein on Sept. 2, 1902, the Farmers Educational and Cooperative Union of America (National Farmers Union) was founded. This site was marked by a plaque installed on the wall of the Smyrna Union Church some years ago. It might be possible for the Corps of Engineers to negotiate with the community and have the church building and the plaque relocated, with a supplemental plaque to state that the actual founding site later came under the waters of the Carl L. Estes Lake, should it prove from an on-site inspection by you that the Lake will indeed cover this site. We have not made an on-site inspection, nor have we the prospect of making such an inspection, but deem it to be to your interest to do so preliminary to issuance of an environmental impact statement.

The other is the grave of Neal Martin on FM 47, 4 miles north of Wills Point, Van Zandt County. Neal Martin was a Kentuckian who moved to Texas in 1816 and hunted in early days in Van Zandt County. He fought in the Battle of San Jacinto in the Texas War for Independence, was later a Texas Ranger, and served in the United States Army during the Mexican War. He lived for many years in Van Zandt County and died there in 1879. He grave was awarded a commemorative marker in 1968. We have not made an on-site inspection, not do we have the prospect of doing so, but we would judge it to be in your best interest for you to do so, preliminary to the issuance of an environmental impact statement. If by chance the grave does lie within the floodplain, it might be possible for you to contact the proper authorities and see that the grave is relocated.

There are no markers that we know of for the various Indian sites which lie within this floodplain. We enclose a few pages of miscellaneous information concerning these Indian sites. To our knowledge you have previously been informed about these sites by an archeologist, but you may have missed the sociological history which surrounds them. Since they have not previously been marked, it might not be considered adverse to them to have the lake cover them. The Cherokee people may have some expressions to give you, but as of now our files hold no expressions of the sociological significance of the sites.

If we might be of further assistance to you, please call upon us.

Very sincerely,

Deolece Parmelee

Mrs. Deolece Parmelee
Director of Research

Enc.

Indian Mound Staked Off for Excavation

Mound Near Grand Saline.

...ast Texas Bureau of The News Photos.
...line, has been staked off in ten-
...help tell the story of Indian arts
...ffen, archeologist in charge.

Indian Mound Yields Relics Of Long Ago

Excavation Is Done Under Direction Of Archeologist

East Texas Bureau of The News.

GRAND SALINE, Texas, May 4.—A great earthen mound, mute reminder of the days when Indian villages dotted the hills of Van Zandt County, soon may yield its secret of the centuries.

A crew of excavators working under the sponsorship of the University of Texas and the WPA is digging into the oblong elevation hoping to find new material that will shed additional light on the habits and customs of early Texas Indians.

The work, which started March 29, will require about six months. W. A. Duffen, archeologist of the Texas University staff, is in charge. Hundreds of arrowheads, bits of pottery and grinding stones have been taken from the mound and catalogued. As yet, however, explorations have not yielded sufficient material to reconstruct a definite picture of Indian life in this area.

The mound is about five miles from Grand Saline on the Yarborough farm and is only a few hundred yards from the banks of the Sabine River. For generations it has stirred the imaginations of Van Zandt County residents but this is the first time thorough and systematic excavating operations have been undertaken.

"The story of the mound, when finally pieced together, may be significant in more ways than one," explains Duffen. "It is possible that it represents the western outpost of the mound builders. To date we have no record of any Indian mounds farther west."

Duffen said also that the Van Zandt County mound may have been the point of contact between the mound builders and the plains Indians.

The fact he added from findings have indicated the Indians who lived near the mound were semicivilized agriculturalists. It is possible they built semipermanent homes.

"Along with a large number of projectile points we have found manos and metates, or grinding stones. Other interesting discoveries we have made are pitted hammer stones, used in the manufacture of percussion implements.

"On the fragments of pottery, too, we have found intricate designs reflecting a keenly developed sense of the artistic. Mound builders, as a rule, were responsible for the greatest advance in the arts."

The mound, though only about eight feet high, is 370 feet long and 240 feet wide. Nearby is a burrow pit now filled with water. The earth used in building the mound was taken from the site of the pit.

About 300 yards to the south excavators found a small darkened area of soil but as yet its significance has not been determined. Presumably fires were burned at this site during the Indian occupation. Fragments of pottery also have been found there.

Explorations Conducted.

Superficial explorations of the mound were conducted more than a half century ago by Tom Joslin, Van Zandt County farmer, who discovered what appeared to be slabs of petrified wood. Joslin, now in his eighties, believes the wood originally may have been part of an Indian canoe. He advances the theory that the Indians may have used the canoe to transport salt up Saline Creek from the brine deposits near the present site of Grand Saline. The salt, he thinks, may have hastened the process of petrification.

The Indians who occupied this particular area were likely the Red River Caddoes, according to Duffen, although he says there may have been a slight infiltration of the Wichitas from the west and northwest. Each group was distinguished by its tribal habits and customs.

Describing the early Indian occupation of East and Northeast Texas, the current issue of the Texas Ar...

9-8

Van Zandt Co.

"The largest group of Indians living in Texas during the dates, 1690 to 1730, was that of the Caddo tribes who dwelt in a crescent-shaped area extending from the southern extremity of the Pine Belt in East Texas, northward up the Trinity, Neches and Sabine Valleys to the Red River and thence westward along the Red River to the present Texas Panhandle. This great Indian family seemingly was broken into three major classifications: (1) the Hasinai Confederacy, in the lower half of the Texas Pine Belt and extending across the Sabine into Louisiana; (2) the Caddo proper group, living in Northeast Texas and adjacent sections of Arkansas, Louisiana and Oklahoma, and (3) the Wichita group dwelling in the Upper Red River Valley and on the headwaters of the Trinity."

Described by Almanac.

The Texas Almanac describes the relatively high cultural status of the Caddo tribes, calling attention to their homes, built of slender poles and wattle work of tough grass, stuffed with mud. Corn and other agricultural crops were cultivated.

Mounds, as a rule, are found in or near river valleys. This was to provide ready access to a water supply. The Mississippi Valley is dotted with them. Indian villages, too, were invariably near a river, creek or springs. At one time it was believed the mounds marked tribal burial grounds. This idea now is generally discredited. In some instances the elevations undoubtedly figured in tribal ceremonies. Near Alto there is a large mound, shaped like a horse shoe, that is believer to have served as an early temple. It, too, is being explored.

The Van Zandt County mound, like the one near Alto, has been checked off in ten-foot squares and explorations are made one square at a time. Each shovelful dirt is carefully examined for relics that to the archaeologist serve the function of the printed word.

Houston Chronicle
7-17-1931

SPOT WHERE FAMOUS INDIAN DIED IS NOW A CORNFIELD

IF, on the night of [illegible] 16, 1931, tourist [illegible] of Tyler had to detour [illegible] the old Canton road, the [illegible] them [illegible] for probably was the only sound to break the stillness. Far different, however, was the night of July 16, [illegible]

Ninety-two years ago the [illegible] Van Zandt County [illegible] of wailing:

"Go she peevle as she pr[illegible]
Go she peevle as she [illegible]
She neclnee, shee [illegible]
Patagoshe peevle [illegible]
long."

"General" Bowles, the [illegible] Cherokee chief, [illegible] his own prophecy [illegible] gun of a Texas [illegible] his last chance [illegible] Neches bottom forest camp, to which they had retreated after his final vain effort to rally his warriors, his people were mourning their loss. [illegible] rose the notes of their [illegible] chant.

o o o

Chief Foretells His Death

A blood-stained strip of [illegible], now green with growing corn, separated them from [illegible] of victorious Texans [illegible], after one of the greatest battles ever fought with Indians on Lone Star soil. The battle cost the Cherokees their homes as well as "General" Bowles.

But to go back to [illegible] morning of the [illegible], the morning on which the [illegible] old chief foretold the [illegible] of Cherokee opposition to [illegible] to leave Texas.

For the second [illegible] 10 days important [illegible] at the home of Chief Bowles. Indian Agent Martin Lacy, [illegible] his interpreter, W. G. W. Jowers and young John H. Reagan, just recently come to Texas, were among them. Weighty matters were to be discussed for, after having given time to consult his chiefs and head men, Agent Lacy had returned to hear the great chief's report of the Cherokee answer to President Mirabeau B. Lamar's decree of removal beyond Red River.

[illegible] his Visitors [illegible] his [illegible] had [illegible] on the [illegible] while [illegible] interested [illegible] aged chief [illegible] in defence of his people. [illegible] neither of the principals [illegible] the other, this [illegible] interview proceeded with [illegible] dignity and frankness. The chief of the Cherokees [illegible] fully delivered [illegible] his council had declared in favor of war with only [illegible] Much [illegible] "no," and thus prophetically concluded his speech:

"I am an old man. I shall not [illegible]. If I fight, the white men will kill me. If I refuse to fight, my people will kill me. But for a long time I have led my [illegible] I must still stand by [illegible]"

[illegible] preserved the speech for history.

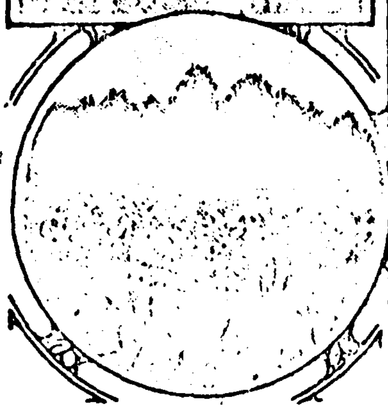
The [illegible] war, which was to free [illegible] Texas from the Cherokees, swiftly followed this consultation. After a preliminary engagement, July [illegible], near Chandler, in Henderson County, resulting in a Cherokee retreat up [illegible] Creek at sundown, the decisive battle, in which [illegible] Indians and 500 Texans are said to have engaged, occurred in Van Zandt County on the following day.

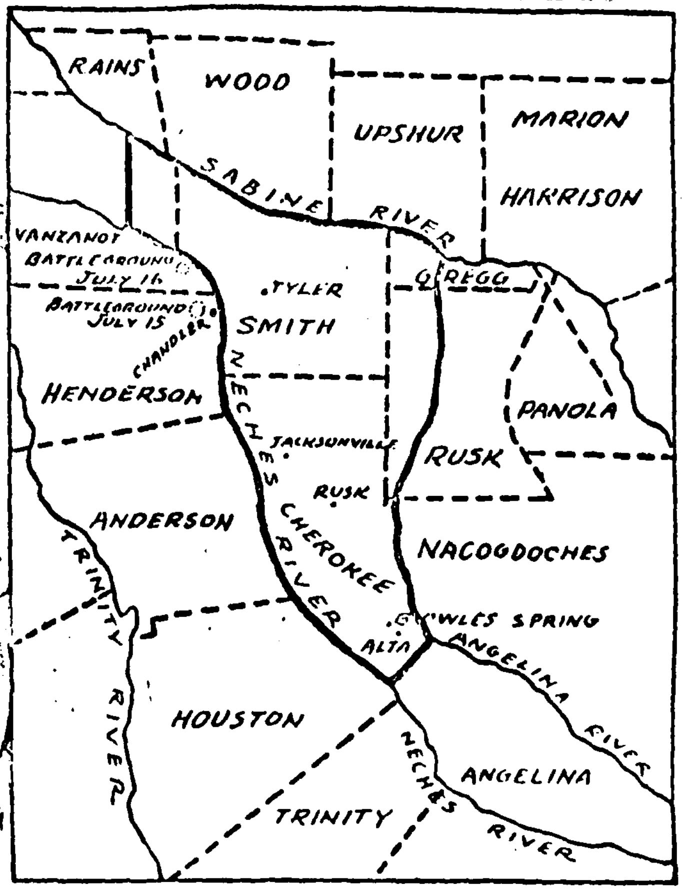
Concerning the location of these battles there has been much disagreement. Dr. Albert Woldert of Tyler has marked the sites which, after spending years in investigating all available sources of information, he accepted as the true locations.

According to Doctor Woldert, the second battle was fought on the North [illegible] tract, about [illegible] miles from the Henderson-Van Zandt line, about one-half mile [illegible] of the [illegible] and three-fourths mile [illegible] of [illegible] Springs. Years ago the descendants of the soldiers who fought in it had a big barbecue on the site.

Those [illegible] to visit the historic spot should leave the Tyler-Dallas highway at the first right-hand road after crossing west of the Neches, follow the old Canton Road to a negro settlement and there obtain from [illegible] Hill, long-time resident, further specific directions to the battlefield, much of which is now in cultivation.

P. 2





Upper Left: In this thicket, opposite the cross, is the spring near which Chief Bowles received the message in Cherokee County from Mirabeau Lamar, president of the Republic of Texas, notifying the chief and his warriors that they must quit Texas. Afterward the spring became a general watering place, but in recent years it has become the center of a thicket. It is on the J. J. Tullis farm near Redlawn, Cherokee County. Boy Scouts at Rusk plan to clean out the spring and appropriately mark the spot.

Right: Map of the territory where the decisive battle between Texans and Cherokees took place, in which their leader, "General" Bowles, lost his life. The heavy line marks the area occupied by the Cherokees in 1836.

Lower Left: The log in the foreground marks the spot where "General" Bowles is said to have died. Dr. Albert Woldert of Tyler, after considerable research, located the spot and drove an iron rod into the ground as a permanent marker. This section of the old battlefield is now a cornfield.

o o o

Pursuit of Indians Renewed

On the morning of July 16, under the blistering rays of a summer sun, the Texans, with the regiment of Col. Edward Burleson in the lead, renewed pursuit. Five [illegible] entrenched in thicket and ravine.

Hot and almost famished for water, they are given no time to dismount. Before they can be driven back, a detachment of warriors claims one man and seven horses as toll.

But the conflict has just begun. Swiftly formed Burleson lines, supported by the regiment of Gen. Thomas J. Rusk, are soon in action. Down a hill, through open woods, they rush to the attack, volunteer as well as grizzled regular undaunted by the odds.

In a few moments the village of the Delawares is on fire. From a field canopied with black columns of smoke comes the sound of rapid firing. Both sides are pressing the battle. Time comes when the Texans, according to reports of some survivors, are in danger of being repulsed. Then an order to concentrate fire on the leader turns the tide.

Conspicuous, indeed, is the "General" as he rides his blazeface horse up and down the line, urging a charge. A "magnificent picture of barbaric manhood," says John H. Reagan. Wearing a silk vest, military hat, sword and sash, which had been gifts from his friend, Gen. Sam Houston, the gallant old leader makes an easy target. Shot after shot comes his way. One pierces his thigh. Struck again and again, his horse goes down. Still the "General" desperately urges a charge.

But his warriors fail to rally. They flee toward the dense woods of the Neches bottom, leaving their wounded chief on the field of their defeat.

No cry for quarter. Valiantly the old Cherokee attempts to walk off the field. Another shot! He falls, rises to a sitting position and proudly faces his foes.

His dignity in council, his devotion to his tribe in sustaining their decision for war against his own judgment, his courage in battle, now silently plead his cause. Young John H. Reagan rushes forward, intent on saving his life. Too late! A fatal shot pierces the "General's" brain.

o o o

Cherokee War Is Ended.

Through the night sounds of a weird Indian dirge reached the Texas camp. Next morning the Cherokees were gone. Thus ended "The Cherokee War." By July 25 the pursuit was halted. The scattered remnants of the tribe eventually joined their Oklahoma kinsmen.

In these two July engagements several of the highest Texas officials were wounded—Acting President David G. Burnet, Secretary of War Albert Sydney Johnston, Maj. David Kaufman, afterward congressman, Capt. S. W. Jordan and Adjutant Gen. Hugh McLeod. Some of them had been members [illegible] put an end to [illegible] negotiations, they accompanied the Texas regiments which had been assembled at the place of rendezvous for just such a contingency.

"General" Bowles, as he is usually called, the half-breed son of a Scotch-Irish trader and a Cherokee mother, was born in 1756, probably in North Carolina. Dr. Emmett Starr, the Cherokee historian, describes him as being decidedly Gaelic in appearance; grey eyes and sandy red hair. After his first westward migration he lived in Lost Prairie, Ark., then came to Dallas territory, and, about 1822, moved down into the Nacogdoches country.

Two of his children are known. After the July defeat, his son, John Bowles, lost his life in an attempt to lead a band of survivors into Mexico. His daughter, Rebecca, married a son of the famous Sequoyah, inventor of the Cherokee alphabet.

Dr. Woldert of Tyler has also traced the history of the "General's" treasured sword. After his death it was awarded to Captain Smith, the soldier who fired the fatal shot. Captain Smith afterwards presented it to the Clinton Lodge, A. F. and A. M., at Henderson. Col. James H. Jones, a Henderson citizen, carried it through the Civil War. About 1891, it was presented to Judge W. H. Barker of Oklahoma. He, in turn, presented it to the Cherokee Nation. Today this gift of Sam Houston to an Indian friend rests in the tribal archives at Tahlequah.

Wills Point, Tex. 75169
Oct 17, 1974

Mr. Gordon A. Walhood

Dear Sir;

In answer to your letter of August 1, 1974 - about the Carl L. Estes Dam + Lake Project on Sabine River, Texas - I find several cemeteries around this area on the map. I thought this map + being marked might be of some help to you. In working in the Historical Committee the past 12 yrs I have discovered these + have marked them on the map.

Right now I can't
think of anything that
stands in the way. I
will be in the watch
through my historical
committee, and will
be in touch with you.
Thank you, I am

Yours truly
[illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 648
Temple, Texas 76501

June 14, 1974

Mr. Gordon A. Walhood
Chief, Engineering Division
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Walhood:

This is in reply to your letter of June 3, 1974 asking how the Carl L. Estes Dam and Lake project might conform to or conflict with any activity we have planned for the project area.

We have prepared a watershed work plan on Mill Creek under provisions of Public Law 83-566. The plan consists of land treatment and 11 floodwater retarding structures, one multiple purpose structure, and 24 miles of channel work. None of the structural measures have been installed. We plan to contract the multiple-purpose structure within the next three or four months. This structure is located in the upper reach of Mill Creek and will provide municipal water for the City of Canton in addition to flood storage. We see no conflict of the installation of this structure with your project.

We have alerted the local sponsors of the Mill Creek project to the fact that the installation of the Carl L. Estes Lake would require a revision of the Mill Creek plan. A part of the flood plain (benefited area) of Mill Creek would be involved in your project. We have made some preliminary studies, based on the preliminary data for your project, furnished to us and have determined that some of the floodwater retarding structures planned on Mill Creek would not be needed if the Carl L. Estes Lake is installed. We held up on constructing the structural measures on Mill Creek, except the multiple-purpose structure, until more information was available on the Carl L. Estes Lake.

We are interested in coordinating the Mill Creek project with the Carl L. Estes project. We would appreciate knowing which site you select for the Estes reservoir as soon as possible so we can begin work with the local sponsors of Mill Creek on revising this plan.

Sincerely,

Edward E. Thomas
State Conservationist

United States Department of the Interior
BUREAU OF RECLAMATION
SOUTHWEST REGION
AUSTIN DEVELOPMENT OFFICE
P.O. BOX 1946
AUSTIN, TEXAS 78767

IN REPLY
REFER TO

June 7, 1974

Mr. Gordon A. Walhood
Chief, Engineering Division
Fort Worth District
Corps of Engineers
Post Office Box 17300
Fort Worth, Texas 76102

Dear Mr. Walhood:

Thank you for your letter of June 3, 1974 advising of your advanced engineering and design studies for the Carl L. Estes Dam and Lake project. The Bureau of Reclamation has no land use plan or any other proposals which would be affected by the project.

We appreciate the opportunity to comment on the project.

Sincerely

Norman G. Flaigg
Planning Officer

cc: Regional Director
Bureau of Reclamation
Amarillo, Texas
w/c incoming letter

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

June 21, 1974

OFFICE OF THE
REGIONAL ADMINISTRATOR

Mr. Gordon A. Walhood
Chief, Engineering Division
Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Walhood:

This is in response to your letter requesting information on any land use plans we might have in connection with your engineering and design studies for the proposed Coril L. Estes Dam and Lake project area.

Our agency has no specific land use plans at this time. We would suggest, however, that the project be developed with knowledge of and consonance with the water uses and water quality criteria for segment number 0506 of the Sabine River (Texas Water Quality Standards). Additional information on existing water quality can be obtained from the Texas Water Quality Board.

If you should need further assistance, please let us know.

Sincerely yours,

Arthur W. Busch
Regional Administrator

OFFICE OF THE GOVERNOR
DIVISION OF PLANNING COORDINATION

September 3, 1974

Mr. Gordon A. Walhood
Chief, Engineering Division
Department of the Army
Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Walhood:

In response to your request for information concerning the affected project area of the Carl L. Estes Dam and Lake project, the Governor's Division of Planning Coordination has distributed your letter with the attached map to various interested and affected State agencies.

As a result of this review process, the following comments are submitted for your consideration:

1. The Texas Highway Department has indicated in previous correspondence to the Corps that the redesign of the reservoir to the flood pool elevation of 406.5 msl, plus the spiraling construction costs would require an increase in cost estimates for highway adjustments.

2. It was noted by the Texas Parks and Wildlife Department (TP&WD) that construction of the proposed facility, coupled with previous impoundment structures, will result in the elimination of approximately half of the original Sabine River bottom area. The TP&WD expressed its concern over the continuing attrition of riverine ecosystems caused by the construction of large reservoirs in the State, and has indicated its objection to the proposed facility.

3. The General Land Office (GLO) has submitted several land ownership plats which indicate the location of land under the management of the GLO which will be inundated, and has requested a justification for the proposed project.

4. It was recommended by the Texas Historical Commission (THC) that an archeological survey and assessment be conducted on the proposed project area, and that the assessment be cognizant of the results of the previous reconnaissance. The THC also indicated that the alternative damsite would be preferred, as this site would result in less destruction of the cultural resources known to be in the area.

5. Preference for the alternative damsite was also indicated by the Bureau of Economic Geology, as the authorized site might cause leakage into the Carrizo aquifer.

6. Comments from the Texas Water Development Board indicated that the proposed facility is part of the Texas Water Plan, and has recommended construction of the project.

Enclosed are the comments from the review participants; these comments were submitted with the constructive intent of aiding your planning efforts, and should be reviewed in their entirety. If we can be of further assistance, please let us know.

Sincerely,

JAMES M. ROSE
Director

JMR/jgb

Enclosures

cc: Mr. B. L. DeBerry, Texas Highway Department
Mr. Clayton T. Garrison, Texas Parks and Wildlife Department
The Honorable Bob Armstrong, General Land Office
Mr. Truett Latimer, Texas Historical Commission
Dr. W. L. Fisher, Bureau of Economic Geology
Mr. A. E. Richardson, Texas Water Rights Commission
Mr. Harvey Davis, Texas State Soil and Water Conservation Board
Mr. Charles R. Barden, Texas Air Control Board
Mr. Harry P. Burleigh, Texas Water Development Board

COMMISSION

REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

TEXAS HIGHWAY DEPARTMENT

11TH AND BRAZOS
AUSTIN, TEXAS 78701

STATE HIGHWAY ENGINEER
B. L. DEBERRY

July 2, 1974

IN REPLY REFER TO
FILE NO. D8-P 454

U.S. Army Corps of Engineers
Carl L. Estes Dam and Lake, Sabine River Project
Rains, Wood and Van Zandt Counties

Mr. Wayne N. Brown, Chief
State Planning and Development
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

Reference is made to your letter dated June 14, 1974, transmitting a letter dated June 3, 1974 from the U.S. Army Corps of Engineers and a project plan for the above described project.

The Department has had previous correspondence with the Sabine River Authority and the Corps of Engineers concerning this project and has furnished to the Corps on July 6, 1971, approximate estimates of cost for adjusting our highways based on a flood pool elevation of 393.0' msl. On July 18, 1973, in response to a Corps of Engineers "Notice of Initiation of Advance Engineering and Design Studies", the Department advised the Corps that, due to both inflationary cost trends and their raising the proposed flood pool elevation to 400.0' msl, the previous estimate would be deficient. Our review of the Corps' letter dated June 3, 1974 and the attached project plan indicates a possible flood pool elevation of 406.5' msl, which would, of course, again raise the estimated cost of adjusting our highways to accommodate the reservoir.

As always, the Department will cooperate with all reservoir agencies in planning adjustments to our facilities and in preparing agreements to accomplish the work.

Based on the date of receipt (June 17th) this office had only five working days before our comments were due to your office by the 24th. In most instances this is insufficient time to obtain a thorough review and evaluation within the Department. It would be appreciated if at least three weeks were scheduled for review of such documents and at least 30 days scheduled for review of draft environmental statements from other agencies.

Sincerely yours

B. L. DeBerry
State Highway Engineer

By: [signature]

R. L. Lewis, Chief Engineer
of Highway Design

cc: Federal Highway Administration

TEXAS

PARKS AND WILDLIFE DEPARTMENT

CLAYTON T. GARRISON [illegible]

JOHN H. [illegible]
AUSTIN, [illegible]

July 12, 19[illegible]

Mr. [illegible]
State Planni[illegible]
[illegible]
[illegible]
Austin, [illegible]

Attention: [illegible]

Dear Mr. [illegible]:

This is in [illegible] the letter of [illegible], Chief, Engineering Division, U.S. Corps of [illegible], dated [illegible], 19[illegible] concerning the Carl [illegible] and [illegible], [illegible] Counties, Texas.

This Department is concerned [illegible] the [illegible] riparian ecosystems from the large number of [illegible] within the State. Our fresh water [illegible] fish [illegible], [illegible] terrestrial [illegible] and flora indigenous to [illegible] bottoms are being severely diminished.

Coupled with other impoundments now existing on the [illegible] River, this project will obliterate almost half of the entire [illegible] River bottom in Texas.

The subject project will eliminate the [illegible] of all benefits from riparian fisheries and wildlife on a large area and, on that basis, we object to the construction of the Carl Estes Reservoir.

Thank you for the opportunity to comment on this letter.

Sincerely,

CLAYTON T. GARRISON
Executive Director

CTG:WJS:ac

General Land Office
AUSTIN, TEXAS 78701
BOB ARMSTRONG, COMMISSIONER

Planning Division
July 5, 1974

General James M. Rose, Director
Division of Planning Coordination
Office of the Governor
P.O. Box 12428 Capitol Station
Austin, Texas 78711
Attn: Brice L. Barnes

Dear General Rose:

Our staff has reviewed the data provided by the Corps of Engineers concerning the proposed dam and lake on the Sabine River. By this communication we would like to make the Corps aware of four parcels of mineral classified Public Lands which will be inundated by the proposed reservoir. The General Land Office is responsible to the public trust for management of the mineral resources of these lands. Also, this office is responsible for the management of the streambed and the mineral resources beneath the Sabine River in the project area. The attached map indicates the location of the land under General Land Office management.

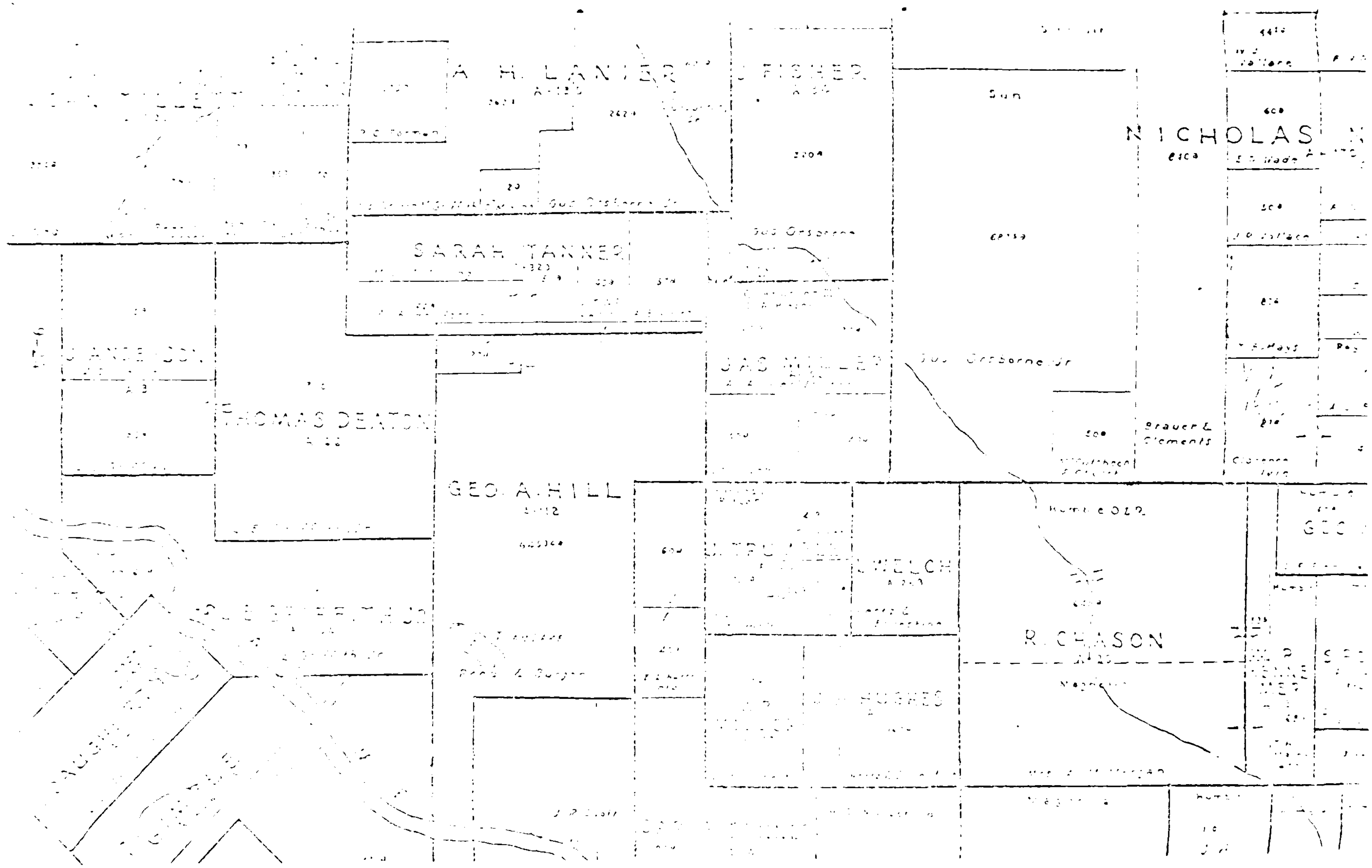
We will be very interested in the justification for this proposed reservoir project for the Sabine River Basin. Thank you for the early notification of this project.

Sincerely,

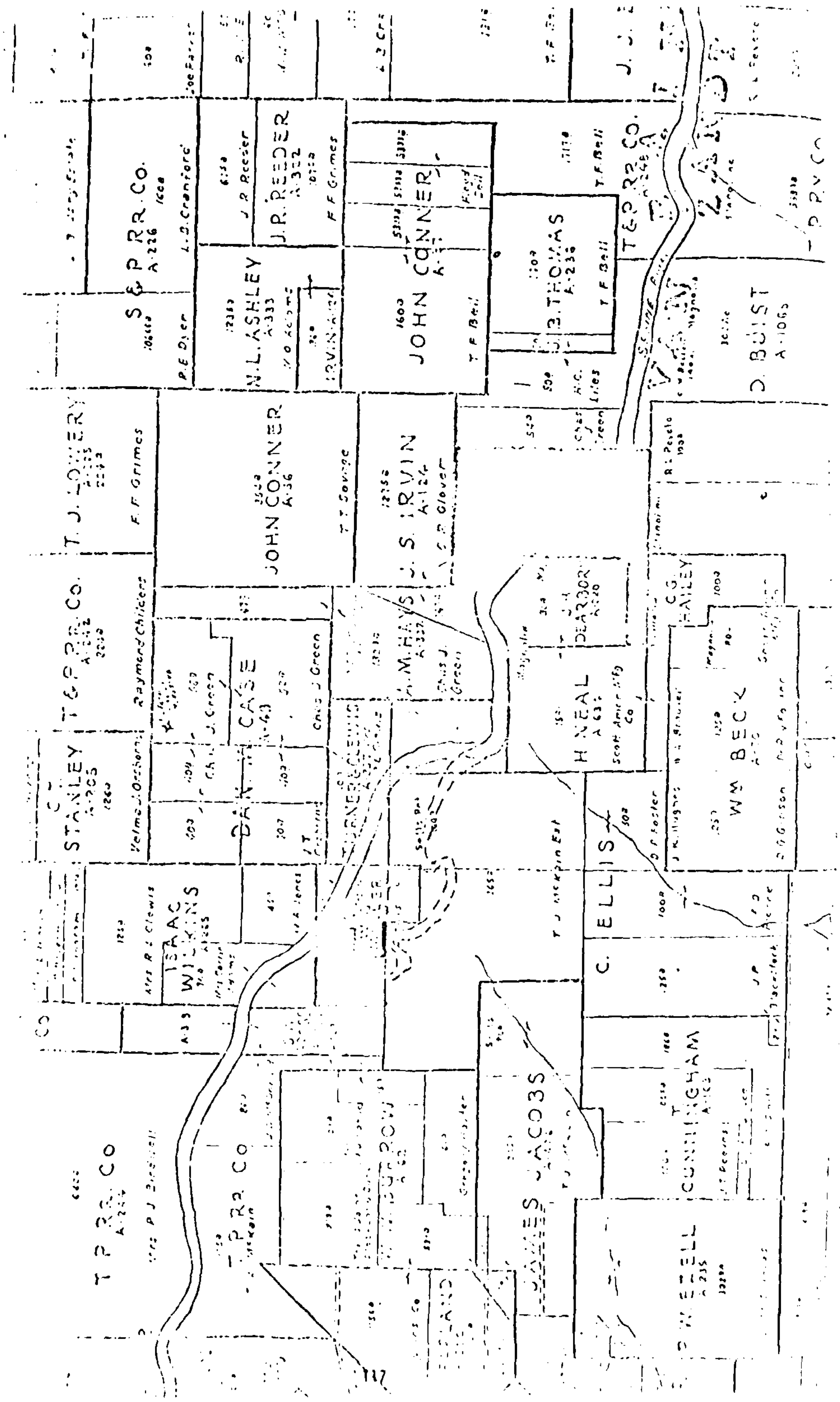
Bob Armstrong
Commissioner

by
Wayne D. Oliver

MHM/ka



A. H. LANIER
J. FISHER
Sun
NICHOLAS
Sub Osborne Jr
SARAH TANNER
JAS MILLER
Brauer & Clements
THOMAS DEATON
GEO. A. HILL
J. WELCH
R. CHASON
Magnolia
HUGHES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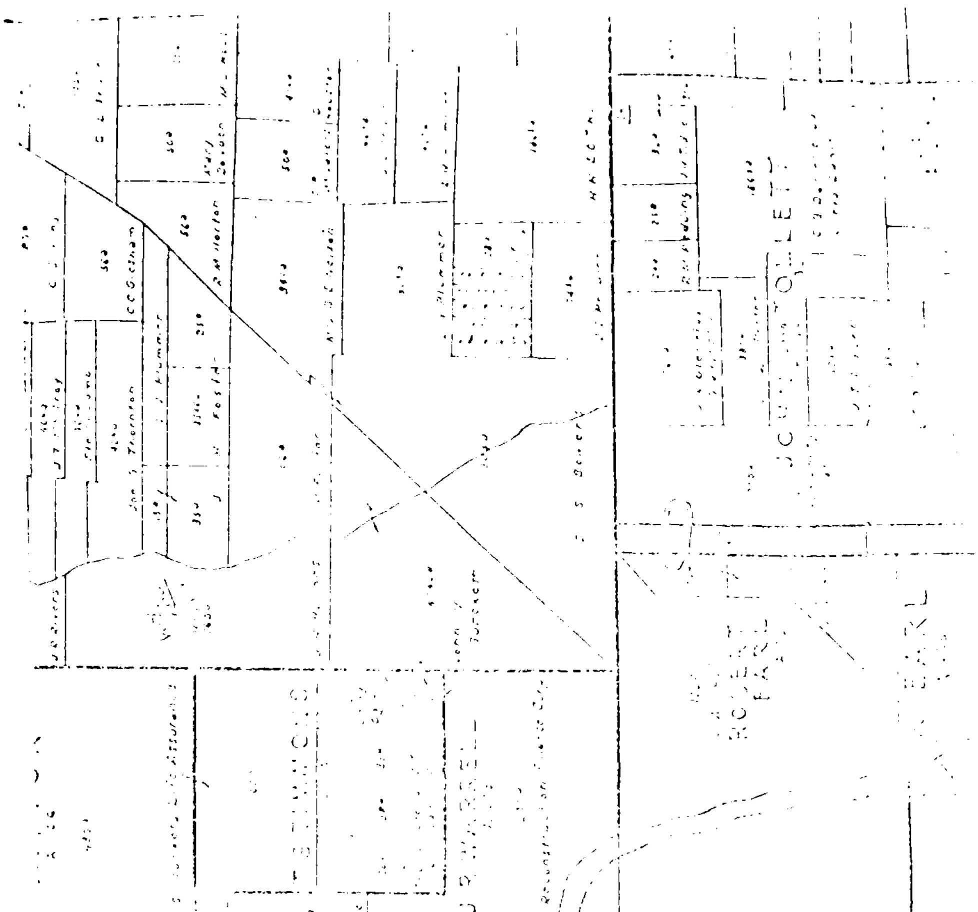

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Texas Historical Commission
Box 12276, Capitol Station
Austin, Texas 78711
Truett Latimer
Executive Director

July 3, 1974

Mr. Wayne N. Brown, Chief
State Planning and Development
Office of the Governor
Division of Planning Coordination
P.O. Box 12428, Capitol Station
Austin, Texas 78711

RE: Carl L. Estes Dam and Lake, Sabine River, Texas Project

Dear Mr. Brown:

In response to your request concerning the above-referenced project, we have examined the document and map and offer the following comments:

1) In March 1973 the Texas Water Development Board and the Texas Historical Survey Committee published Archeological Survey Report 19, *Proposed [illegible] Reservoir*. This report can be used for initial guidance in preparing engineering and design studies for the project.

   In addition, the Corps of Engineers should implement an in-depth archeological assessment study of the area. Costs of such a study should be based on information received in response to bids requested by the Corps and made by institutions qualified to carry out such studies. Examples are the Texas Archeological Project in Austin and the Archeological Research Program at Southern Methodist University in Dallas.

2) The reconnaissance carried out during the winter of 1971 indicated the presence of rather extensive archeological materials. Ninety-one sites representing several stages of Man's development in the area were located. The assessment projects mentioned above should include a comprehensive systematic, broad coverage of groups of sites and their cultural affiliations and relationships, rather than studies based on individual, isolated sites. The nucleus of these studies of groups of sites should be the four mound sites located earlier. Simultaneously, testing, analysis and comparison with a number of nearby smaller, outlying sites which have demonstrated cultural affiliation and coevality with the mound sites should be carried out. The preliminary survey indicated similarities in pottery designs as well as lithic materials. There are indications that prehistoric settlement patterns in East Texas were usually spaced out over several miles so that clusters or groups of related sites would be the rule rather than one large village. Recovery of information on the nature of these settlement patterns and occupation relationships should be one of the major objectives of the studies.

Mr. Wayne N. Brown
July 3, 1974
Page 2

Particular attention should also be given to sites situated along the shorelines of the proposed reservoir, of which there are many. Past experience has demonstrated that one of the most destructive forces at work on cultural materials in the state today is the wave action along the shores of existing reservoirs.

3) Finally, as indicated to the Corps several times previously, the alternative dam site shown on the attached map would be the preferred site from the standpoint of mitigation of cultural destruction. Approximately 15 sites in the vicinity of the authorized site would be preserved if the alternate site is chosen. In addition, sites were sparse and small in the area of the alternative dam site, apparently in part owing to the poor quality, highly eroded, sand cemented limonite and hematite soils.

4) Site groups or clusters which should be included in those to be further investigated, tested, and analyzed are:

VN5 (Yarbrough mound site)	RA3[illegible] (mound site)
VN7	RA[illegible]
VN10	RA35
VN43	RA3[illegible]
VN44	
VN4[illegible]	
VN61	
VN62	

RA31 (mound site)	VN35 (mound site)
RA2	VN4
RA3	VN[illegible]
RA28	VN[illegible]
RA29	VN19
RA30	VN20
RA32	VN22
RA36	VN23
RA39	VN2[illegible]
RA40	VN30
RA41	VN31
RA42	VN32
	VN33
	VN36
	VN37
	VN39
	VN40
	VN42
	VN50
	VN51

Thank you for the opportunity to comment on this project. If we may be of further assistance in this or other matters, please advise.

Sincerely,

Truett Latimer
Executive Director

By

Alton K. Briggs
Archeologist

AKB:pc

THE UNIVERSITY OF TEXAS AT AUSTIN
BUREAU OF ECONOMIC GEOLOGY
AUSTIN, TEXAS [illegible]

[illegible]

June 21, 1974

Mr. Wayne N. Brown, Chief
Division of Planning Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

The staff of the Bureau of Economic Geology has reviewed the memorandum about the Carl L. Estes Dam and Lake. It is our opinion that the alternative damsite is a better location, because of potential leakage into the Carrizo aquifer at the authorized damsite.

Best regards.

Sincerely,

Charles M. Woodruff, Jr.
Research Scientist

CMW:kk

TEXAS WATER RIGHTS COMMISSION

STEPHEN F. AUSTIN STATE OFFICE BUILDING

COMMISSIONERS

JOE D. CARTER, CHAIRMAN
475 2453

OTHA F. DENT
475 2451

DORSEY B. HARDEMAN
475 45[illegible]

A. E. RICHARDSON
EXECUTIVE DIRECTOR
475 24[illegible]

AUDREY STRANDTMAN
SECRETARY
475 4514

June 21, 1974

Mr. James M. Rose, Director
Governor's Division of Planning
Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Attention: Mr. Wayne N. Brown

Re: Corps of Engineers Study, Carl L. Estes Dam and Lake, Sabine River, Texas.

Dear Mr. Rose:

In reply to your request by Memorandum of June 14, 1974, the Commission staff has reviewed the letter of June 3, 1974, from the Chief of the Engineering Division, Fort Worth District, Corps of Engineers, requesting information from your office on the following items:

1. Current land use plans of the State concerning the referenced project area.

2. Compatibility or incompatibility of the proposed project with other plans, projects, or activities in the region.

With respect to the first item, the staff of the Texas Water Rights Commission finds that the current land-use plans for the project area are implicit in the basic justification furnished by the Southwestern Division Engineer in his testimony to Congress on March 12, 1974. Congress was informed that the referenced project was an important unit in the authorized plan of improvement of the Sabine River Basin to control 50-year floods and provide complete flood protection to 18,344 acres of agricultural land; and partial protection to 380,359 acres of agricultural, urban, and suburban lands in the flood plain below the dam. In addition, the project

P. O. BOX 13207 AREA CODE 512 AUSTIN, TEXAS 78711

Mr. [illegible] M. R[illegible]
June 2[illegible], 197[illegible]
Page [illegible]

[illegible] water supply for [illegible] area. Further, the project would [illegible] public [illegible] [illegible] use [illegible] and contribute [illegible] [illegible] fish and wildlife resources. Finally, [illegible] [illegible] [illegible] redevelopment areas eligible to receive [illegible] P.L. [illegible].

With [illegible] to the [illegible], the staff finds the [illegible] [illegible] with other [illegible] plans, projects, actions, [illegible]. Specifically, the staff finds that the [illegible] of [illegible] report [illegible] to Congress [illegible] [illegible] [illegible] 12, 19[illegible], is still valid. [illegible] [illegible] the Texas Wat[illegible] [illegible] 8, 196[illegible], [illegible] that the [illegible] local [illegible] for the [illegible] the event that appropriate local interests were not [illegible] [illegible] sponsorship. Further, [illegible] [illegible] 19[illegible], designated the [illegible] River Authority [illegible] as cooperating local sponsor along with the Texas Wat[illegible] Board.

The staff emphasizes that these comments in response to planning inquiries from the Fort Worth District Engineering Division Chief, should not be misconstrued as a full-fledged field-level staff review of the subject project. The one-page summary data furnished is considered insufficient for a rigorous analysis.

If you have any questions on the foregoing comments, please advise Dr. Alfred J. D'Arezzo of the Texas Water Rights Commission staff, telephone 512-475-2678.

Sincerely yours,

A. E. Richardson

A. E. Richardson

AER-AJD:ll

TEXAS STATE SOIL AND WATER CONSERVATION BOARD
1018 First National Building
Temple, Texas 76501
AREA CODE 817, 773-2250
June 20, 1974

Mr. Wayne N. Brown, Chief
State Planning & Development
Office of the Governor
Division of Planning Coordination
P. O. Box 12423, Capitol Station
Austin, Texas 78711

Re: Carl L. Estes Dam & Lake Project

Dear Mr. Brown:

Thank you for bringing the Corps of Engineers' notice concerning Carl L. Estes Dam and Lake to our attention.

We have no land use plans for the project area that are of a type that would conflict with the planning process. Three of our Soil and Water Conservation Districts have individual farm and ranch conservation plans with many of the agricultural landowners that will be displaced by the project. However, acquisition of these farms and ranches for project purposes will terminate the plans.

Sincerely yours,

Harvey Davis
Executive Director

HD:ej

TEXAS AIR CONTROL BOARD

PHONE 512/[illegible]
8520 SHOAL CREEK BOULEVARD

CHARLES R. BARDEN, P. E.
EXECUTIVE DIRECTOR

AUSTIN, TEXAS – 7875[illegible]

[illegible]
Chairman

[illegible], P.E.
Vice-Chairman

ALBERT [illegible]
[illegible]
CHARLES [illegible]
JAMES [illegible]
FRED [illegible]
WILLIE L. [illegible]
JOE C. [illegible]

Jun 20, 197[illegible]

Mr. Wayne T. Brown, Chief
State Planning and Development
Office of the Governor
Division of Planning Coordination
P. O. Box 12428, Capitol Station
Austin, Texas 78711

Dear Mr. Brown:

In regard to the Carl L. Estes Dam and Lake, Sabine River, Texas Project, our agency has no plans which would appear to conflict with the successful completion of this project.

We appreciate being consulted on this matter. If we can provide additional assistance, please contact me.

Sincerely yours,

Bill Stewart, P.E.
Director
Control and Prevention

cc: Mr. Richard Leard, P.E., Regional Supervisor, Tyler

TEXAS WATER DEVELOPMENT BOARD

P. O. BOX 13087
CAPITOL STATION
AUSTIN, TEXAS 78711

HARRY P. BURLEIGH
EXECUTIVE DIRECTOR

AREA CODE 512
475-3571

1700 NORTH CONGRESS AVENUE

June 26, 1974

IN REPLY REFER TO
TWDBP-O

Mr. Wayne N. Brown, Chief
State Planning and Development
Division of Planning Coordination
Office of the Governor
P.O. Box 12428, Capitol Station
Austin, Texas 78711

Dear ~~Mr. Brown:~~ Wayne

Please refer to your memorandum of June 14, 1974 transmitting a copy of June 3, 1974 correspondence from the Ft. Worth District, Corps of Engineers relating to the authorized Carl L. Estes Dam and Lake Project.

This project is an element of the Texas Water Plan. The Texas Water Development Board has worked closely with the Corps of Engineers and the Sabine River Authority of Texas for many years in support of authorization and construction of the project. Severe flooding problems along the Sabine River below Lake Tawakoni in recent years has demonstrated the acute need for the Carl L. Estes project for flood-control purposes in addition to water supply and other purposes which the project will serve.

We are not aware of any plans or activities within the area which would conflict with the project.

If additional information is needed, please advise.

Sincerely,

Harry

Harry P. Burleigh

East Texas Council of Governments
4 FLOOR • CITIZENS BANK BLDG • KILGORE, TEXAS 75662 • 214/984-8641
SERVING A FOURTEEN COUNTY REGION

June 20, 1974

Mr. Gordon A. Walhood
Chief, Engineering Division
U. S. Army Corps of Engineers
Fort Worth District
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Walhood:

This is in reference to your letter of June 3, 1974, regarding the advanced engineering and design studies for the Carl L. Estes Dam and Lake project. The East Texas Council of Governments is presently engaged in a study of the existing natural resources of the 14-county region. This study is inventory in scope only and will not deal with future proposals of land use.

The area in question, however, is designated in this inventory as being located within the 100-year flood plain; therefore, we are encouraging local governments to discourage any further growth and development within this area pursuant to the requirements of the Federal Flood Disaster Protection Act of 1973.

The affected project area does not, therefore, conflict with any known land use plans by us or other governmental entities. It conforms with the future planning activities of our region.

I hope this answers your questions. Let me know if I can be of any other service.

Sincerely,

Patrick R. Burke

Patrick R. Burke
Director of Physical Planning

PRB/dwd

Office Of
BILLY D. HULLUM
COUNTY JUDGE

RUTH NELL MASSEY
SECRETARY

JUDY ARMSTRONG
SECRETARY

VAN ZANDT COUNTY
CANTON, TEXAS 75103

June 25, 1974

Mr. Gordon A. Walhood
Chief, Engineering Division
U. S. Army Corps of Engineers
Fort Worth District
P. O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Walhood:

There are no land use plans for the Carl L. Estes Dam and Lake by Van Zandt County at this time.

If I can be of further help, please let me know.

Sincerely yours,

Billy D. Hullum
County Judge

BDH:ja

The County of Wood

Quitman, Texas

Office of The

COUNTY JUDGE

June 6, 1974

DEPARTMENT OF THE ARMY
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Att: Mr. Gordon A. Walhood
Chief, Engineering Department

Dear Sir:

In response to your letter of June 3, 1974, you are advised Wood County has not imposed any land use regulations which would effect your planning of the Carl L. Estes Reservoir near Mineola, or the construction thereof.

The only instance in which the county could or might be effected is inclusion of any county roads in the immediate reservoir area. These would have to be entirely closed or relocated.

Thank you for your inquiry and if I can furnish further information to assist you, please let me know.

I hope that the Corps will determine that the original dam location will prove to be the most feasible.

Sincerely yours,

H. C. Douglas

H. C. Douglas

MINEOLA TEXAS GATEWAY TO THE PINES

The City of Mineola

JOE J. SMITH, Mayor

MINEOLA, TEXAS

June 11, 1974

Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

ATTENTION: Gordon A. Walhood
Chief, Engineering Division

Dear Sir:

I am sorry for the delay in answering you letter of June 3, 1974, but I wanted the City Council to see the letter and express their opinions first.

Right now, we have no projects scheduled that would affect the lake or surrounding area. We see no conflict in any area. The City is very pleased with the plans being made for this lake. Our only request is for water rights applications, as soon as these applications are available.

Sincerely yours,

Joe J. Smith
Mayor

JJS/kb

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Glossary

ACRE-FEET - The volume of water contained in 1 surface acre 1 foot deep.

ALGAL BLOOM - Rapid and flourishing growth of algae.

ALLUVIUM - Sediments, usually mineral or inorganic, desposited by running water.

AQUIFER - A water-bearing stratum of permeable rock, sand, or gravel.

BIOCHEMICAL OXYGEN DEMAND - The amount of oxygen required to decompose (oxidize) a given amount of organic compounds to simple, stable substance.

BIOMASS - The total weight of matter incorporated into (living and dead) organisms.

BIOTA - All of the species of plants and animals occurring within a certain area or region.

COLIFORM - Structurally and functionally resembling certain bacteria of the vertebrate intestine called "Bacillus or Escherichia" coli.

COMMUNITY COHESION - A group of people who live and interact with unifying force due to one or more characteristics providing a commonality such as race, education, income, ethnicity, religion, language, social class, and/or mutual economic and social benefit.

CONSERVATION (WATER SUPPLY) STORAGE - Space in a lake 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.

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.

DOMINANT - An organism that controls the habitat at any stage of development; in practice the organism that is most conspicuous and covers the most area.

DRAWDOWN - The magnitude of change in surface elevation of a body of water as a result of the withdrawal of water therefrom.

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.

ENVIRONMENT - The sum total of all the external conditions which may influence organisms.

EPILIMNION - The turbulent superficial layer of a lake between the surface and a horizontal plane marked by the maximum gradient of temperature and density change. Above the hypolimnion, (q.v.).

ESTUARINE - Of/ the mouth region of a river that is affected by tides.

FAUNA - The animals of a given region taken collectively; as in the taxonomic sense, the species, or kinds, of animals in a region.

FETCH - The expanse of open water which can be affected by the wind.

FISHERY - Of/ fish populations as the basis of an industry, recreational or commerical.

FLOOD PLAIN - That portion of a river valley which is covered in periods of high (flood) water; ordinarily populated by organisms not greatly harmed by short immersions.

FLORA - Plants; organisms of the plant kingdom; specifically, the plants growing in a geographic area, as the Flora of Illinois.

FOOD WEB - All of the interconnecting "food chains" in a community.

GATED CONDUIT - An artificial or natural duct with controllable gates attached which can be used to close off the flow of water through the duct.

HABITAT - The sum total of environmental conditions of a specific place that is occupied by an organism, a population, or a community.

HYPOLIMNION - In certain lakes, the portion (below the zone of warmer water) which receives no heat directly from sunlight and no aeration by vertical circulation.

LOTIC - Of/ rapid water situations, living in waves or currents.

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.

MESOPHYTE - A plant that grows in environmental conditions that are medium in moisture conditions.

OUTGRANT - an instrument authorizing administrative responsibility of Army-controlled real property to other Federal agencies, State and local agencies, private organizations and individuals.

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}.

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.

RIPARIAN - Related to or associated with the land which borders a stream or river.

RIVER MILE - A unit of measure 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.

SAVANNA - A level grassland of tall grasses, interspered with trees and shrubs. The vegetation is able to survive a hot dry season of considerable length.

STREAM COMMUNITY - All of the plants and animals associated with a stream and their complex interrelationships.

TURBIDITY - Condition of water resulting from suspended matter; water is turbid when its load of suspended material is conspicuous.

UPLAND - All types of land forms other than depressions or those areas in close proximity to rivers, streams or seas.

WATERSHED - The defined area from which water drains and flows into a particular watercourse or body of water.

WETLAND, TYPE I - Seasonally flooded basins or flats where the soil is covered with water during variable seasonal periods but usually is well drained during much of the growing season.

APPENDIX A

CARL L. ESTES LAKE

BIOLOGICAL INVENTORY - FISHES

Species	Preferred or general habitat	Abundance in Region	Range in State	Range in the United States	Project Impact
Longnose gar <u>Lepisosteus</u> <u>osseus</u>	Warm, sluggish water	Common	Statewide	Minnesota to Vermont, south to Gulf and Rio Grande River	Insignificant
Gizzard shad <u>Dorosoma</u> <u>cepedianum</u>	Freshwater, may enter brackish water	Very common	Statewide	Minnesota to New Jersey, south to Gulf and into Mexico	Insignificant
Threadfin shad <u>Dorosoma</u> <u>petenense</u>	Fresh and brackish water	Very common	Statewide except for high plains and trans-pecos regions	Gulf of Mexico entering streams from Florida into Mexico	Insignificant
Small mouth buffalo <u>Ictiobus</u> <u>bubalus</u>	Large rivers and small lakes	Very common	Statewide	Southern Minnesota to Michigan and south to Mexico	Insignificant
River carpsucker <u>Carpiodes</u> <u>carpio</u>	Rivers and lakes	Very common	Statewide	Montana to Pennsylvania south to Tennessee and Texas	Insignificant
Carp <u>Cyprinus</u> <u>carpio</u>	Rivers and lakes, deposits eggs in shallow water	Common	Statewide	Widely introduced in the U.S. from Europe	Insignificant
Channel catfish <u>Ictalurus</u> <u>punctatus</u>	Flowing clear waters of streams or rivers	Common	Statewide	Great Lakes south to Gulf of Mexico	Insignificant
Black bullhead <u>Ictalurus</u> <u>melas</u>	Larger streams or rivers	Common	Statewide, but rare in west Texas	New York and North Dakota to Texas	Insignificant
Flathead catfish <u>Pylodicutus</u> <u>olivaris</u>	Larger rivers	Common	Statewide	Mississippi Valley into Mexico	Insignificant
Spotted sucker <u>Minytrema</u> <u>melanops</u>	Creeks and small rivers	Common	East, southeast, and north central Texas	Great Lakes to Florida, Mississippi Valley to Rocky Mountains and Texas	Moderate
White bass <u>Morone</u> <u>chrysops</u>	Deep, still water of lakes	Common	Statewide, except trans-Pecos region	Minnesota, east through Great Lakes, south to Alabama and Texas	Insignificant
Large mouth bass <u>Micropterus</u> <u>salmoides</u>	Clear, running streams and clearer, colder lakes	Common	Statewide	Minnesota to Quebec, south to Arkansas and northern Oklahoma	Insignificant
Spotted bass <u>Micropterus</u> <u>punctatus</u>	[illegible], rivers, and [illegible]	Common	[illegible]	[illegible]	[illegible]

APPENDIX A (Continued)

Species	Preferred or general habitat	Abundance in Region	Range in State	Range in the United States	Project Impact
Red Shinner Notropis lutrensis	Streams, rivers, and brooks	Very common	Statewide	Wyoming to Minnesota and Illinois, southwest to Mexico	Moderate to Severe
Bullhead minnor Pimephales vigilax	Shallow water and small muddy streams	Common	Statewide except west Texas	Minnesota and West Virginia to Northern Alabama and Texas	Moderate
Mosquito fish Gambusia affinis	Shallow sloughs and pools	Very common	Statewide	Illinois and Indiana south to Florida and into Mexico	Moderate
Pugnose minnow Opsopoeodus Emiliae	Streams, ponds and lakes	Common	Statewide except for high plains and trans-Pecos regions	Minnesota to Michigan and south to Florida and Texas	Insiginficant
B.S. Top minnow Zygonectes notatus	Streams, ponds, and lakes	Common	Statewide except for high plains and Trans-Pecos regions	Iowa to Ohio, and south to parts of Tennessee, Mississippi, and Texas	Insignificant
Silverside Menidia audens	Streams, ponds, and lakes	Common	Northeast Texas, blackland prairie and cross-timbers regions	Southeastern U.S.	Insignificant
Green sunfish Lepomis cyanellus	Warmer lakes and streams	Common	Statewide	Minnesota and Great Lakes south to Mexico; not east of the Allegheny Mountains	Insignificant
Orange-spotted sunfish Lepomis humilis	Streams, ponds, and lakes	Uncommon	East, central and north Texas	North Dakota to West Ohio and south to Texas and northern Alabama	Insignificant
Redear sunfish Lepomis microlophus	Lakes, ponds, and streams	Common	Statewide, rare in trans-Pecos region	Missouri to southern Indiana, south to Florida and Texas	Insignficant
Bluegill sunfish Lepomis macrochirus	Lakes, ponds, and quiet streams	Very common	Statewide	Widespread, from Minnesota to Florida and Texas	Insignificant
Longear sunfish Lepomis megalotis	Streams, especially clear brooks	Very common	Statewide	Iowa to South Carolina and south Texas	Insignificant
Yellow bass Morone mississippiensis	Streams, ponds, and lakes	Very common	East Texas and northern coastal prairies	Southern Minnesota to Ohio and southward in Mississippi Valley	Insignificant

APPENDIX A (Continued)

Species	Preferred or general habitat	Abundance in Region	Range in State	Range in the United States	Project Impact
Warmouth Lepomis gulosus	Streams, ponds, and Lakes	Uncommon	Statewide	Southern Minnesota and Great Lakes region south to Texas and Florida	Insignificant
White crappie Pomoxis annularis	Ponds, lagoons, bayous, and all sluggish waters	Very common	Statewide, except trans-Pecos region	Minnesota and Great Lakes south to Texas	Insignificant
Black crappie Pomoxis nigromaculatus	Streams, ponds, and lakes	Common	Statewide, except for south Texas, high plains and *trans-Pecos* region	Upper Mississippi Valley and Great Lakes south to Florida and Texas	Insignificant
Freshwater drum Aplodinotus grunniens	Larger lakes and lowland streams	Very common	Statewide	Great Lakes south into Mexico	Insignificant
Golden shiner Notemigonus crysoleucas	Lakes, ponds, and streams	Common	Statewide, not west of Edwards Plateau and high plains region	Canada to Florida and introduced west of Rockies	Insignificant

Appendix F

CARL L. ESTES LAKE

BIOLOGICAL INVENTORY - AMPHIBIANS AND REPTILES

Species	Habitat	Range in Region or State	Abundance in Region	Range in United States	Project Impact
Lesser intermedia *Siren intermedia*	Debris in ditches, ponds, and bodies of shallow water	Eastern central and south Texas	Very Common	Central and lower Mississippi valley west to eastern greater Texas	Minimal
Spotted salamander *Ambystoma maculatum*	Around ponds, and beneath stones or boards in moist environment	Northeast Texas only	Common	Eastern one third of nation except Florida west to east Texas and Wisconsin	Minimal
Marbled salamander *A. opacum*	Variety; from moist sandy areas to dry hillsides	Eastern one fourth of Texas	Common	Eastern one fourth of nation Massacusetts to Florida west To Texas and Illinois	Minimal
Small-mouth salamander *Ambystoma texanum*	Under logs, boards, and debris near ponds and swamps or where moisture is abundant	East and southwest Texas	Occasional	Ohio to southern Iowa and south to the Gulf	Minimal
Cricket frog [illegible]	Lowlands, bogs, ponds, and [illegible]	Statewide	Common	Michigan and Ohio to eastern Colorado and northeast Mexico	Minimal
Eastern tiger salamander *A. tigrinum*	Under logs, boards, [illegible] debris where moisture is abundant	East central and west Texas	Uncommon	Mississippi and Ohio Valleys and eastern seaboard to New Jersey	Minimal
Central newt *Notophthalmus viridescens*	Swamplands, woodlands, ponds and ditches, river bottoms in the south	East Texas	Common	Mississippi Valley to Minnesota	Minimal
Central dusky salamander *Desmognathus auriculatus*	Near brooks, hills, springs, or seeps but usually absent from larger streams	East edge of Texas	Common	Louisiana	Minimal
Dwarf salamander *[illegible] quadridigitata*	Low swampy areas, under all types of shelter	East Texas coastal	Very Common	Gulf coast Texas to North Carolina	Minimal
[illegible]	Sandy, spring-fed springs	Far east Texas	Uncommon	Gulf coast Texas to Alabama	Minimal
[illegible]	Forested areas, [illegible]	East half of State	Very Common	Southeast [illegible] Louisiana to Massachusetts	Minimal
[illegible]	[illegible]	[illegible]	[illegible]	Florida [illegible] central and [illegible]	[illegible]

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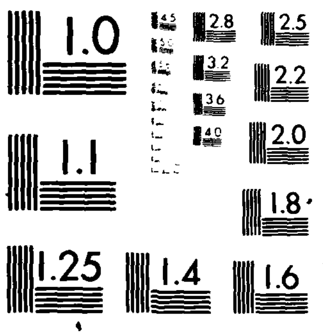

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963-A

Appendix B (Continued)

Species	Habitat	Range in Region or State	Abundance in Region	Range in United States	Project Impact
Eastern gray treefrog <u>H. versicolor</u>	Small trees and shrubs near or standing in shallow bodies of water	Statewide except south	Very Common	Eastern half of U.S. except Florida	Minimal
Southern gray treefrog <u>H. chrysocelis</u>	Small trees and shrubs near or standing in shallow bodies of water	Statewide except south	Very Common	Sabine Valley	Minimal
Strecker's chorus frog <u>Pseudacris strecki</u>	Woods, rocky ravines, streams lagoons, sand prairies, and fields	Statewide except for north and west	Common	Central Texas, Oklahoma and Arkansas	Minimal
Upland chorus frog <u>P. triseriata</u>	Moist woodlands, ponds, bogs, swamps and marshes	East Texas	Very Common	Southeast U.S., east Texas to New York	Minimal
Woodhouse toad <u>Bufo woodhousei</u>	Sandy areas around shores of lakes or in river valleys	Statewide, except far south Texas	Common	New England to Gulf Coast and west to Michigan, northeast Oklahoma and eastern Louisiana	Minimal
Bullfrog <u>Rana catesbeiana</u>	Lakes, bogs, sluggish portions of streams, cattle tanks	Statewide	Common	From east coast, west to Wisconsin and Nebraska south through the central plains	Minimal
Bronze frog <u>R. clamitans</u>	In logs and stumps around swamps bayheads, and environs of streams	East Texas	Very Common	Gulf Coast to North Carolina	Minimal
Pickerel frog <u>R. palustris</u>	Cool water in bogs, rocky ravines, and meadow streams	Northeast Texas	Common	Eastern U.S. except Florida and Georgia	Minimal
Leopard frog <u>Rana pipiens</u>	Arid conditions and around watercourses and cattle tanks	Statewide	Very Common	South Nebraska to Central America	Minimal
Eastern narrow-mouthed toad <u>Gastrophryne carolinensis</u>	Borders swamps and small streams where there is available shelter (logs and boards)	Northeast Texas	Very Common	Gulf coast Texas to Virginia	Minimal
Snapping turtle <u>Chelydra serpentina</u>	Any permanent body of fresh water, large or small	Statewide, except far west Texas and the valley	Uncommon	South Canada to Gulf; Atlantic Ocean to Rocky Mountains	Minimal
Alligator snapping turtle <u>Macroclemys temmincki</u>	Bottom of lakes or rivers	Fareast Texas	Uncommon	Gulf Coast Texas to Florida and Lower Mississippi Valley	Minimal
Mississippi mud turtle <u>Kinosternon subrubrum</u>	Bayous, lagoons, and swamps	East and southeast Texas	Occasional	Missouri to Louisiana to east central Texas	Minimal
Missouri slider <u>Chrysemys floridana</u>	Ponds, lakes, big swamps or marshes, and rivers	Far north east Texas	Uncommon	Mississippi Valley to Missouri	Minimal

Appendix B (Continued)

Species	Habitats	Range in Region or State	Abundance in Region	Range in the United States	Project Impact
Red-eared turtle *Pseudemy scripta*	Quiet water with muddy water and lots of vegetation	Statewide	Common	Ohio and Iowa to New Mexico	Minimal
Three-toed box turtle *Terrapene carolina*	Essentially terrestrial, hiding in mud or water or beneath logs or rotting vegetation	North and northeast Texas	Common	Missouri to Texas and Alabama	Minimal
Ornate box turtle *Terrapene ornata*	Plains and prairies, in sandy, arid conditions	Statewide	Common	Indiana to southeast Wyoming through Texas	Minimal
Green anole *Anolis carolinensis*	On fences, around old buildings on shrubs, trees, vines, or the ground	Northeast, east, and southeast Texas	Common	Extreme southeast Virginia to Key West, west to Oklahoma and central Texas	Minimal
Prairie lizard *Sceloporus undulatus*	Sand dunes, brushy flatlands, cliffs, and bases of buttes	Statewide	Very Common	South Dakota to northern Mexico; west to southwest Arizona	Minimal
Fine-lined skink *Eumeces fasiatus*	In Texas, it is distinctly arboreal and ascends trees	East and southeast Texas	Rare	New England to northern Florida and west to Wisconsin and east Texas	Minimal
Broad-headed skink *E. laticeps*	Arboreal; swamp forests to urban lots strewn with debris	East Texas	Common	Southeast U.S., Texas to Pennsylvania	Minimal
Southern prairie skink *Eumeces septentrionalis*	Shallow burrows, and excavations in soft soils	North and south central; through east Texas	Uncommon	Extreme south Manitoba to Wisconsin and Kansas	Minimal
Ground skink *Lygosoma laterale*	Woodland floor among leaves, decaying wood and detritus	South, central, north central and east Texas	Uncommon	Southern New Jersey to Florida Keys; west to east Kansas and central Texas	Minimal
Six-lined racerunner *Cnemidophorus seylineatus*	Open woodlands and fields	East Texas	Common	Maryland south through Florida, west to east Texas, north to Minnesota	Minimal
Slenderglass lizard *Ophisaurus attenuatus*	Subterranean	East Texas south to Rio Grande	Uncommon	North Carolina south to Florida; west of Mississippi, south to Texas and Mexico	Minimal
Black racer *Coluber constrictor*	Logs, woodlands, through east Texas	Eastern Texas	Common	North Carolina to east Texas and southeast Oklahoma, north to southern Indiana, and south through Florida	Minimal
Northern ringneck snake *Diadophis punctatus*	Under rocks and logs in wooded areas, most woodlands	Devil's and Pecos Rivers northeast to southeastern panhandle	Common	From Atlantic to Pacific	Minimal

Appendix B (Continued)

Species	Habitats	Range in Region or State	Abundance in Region	Range in United States	Project Impact
Great plains rat snake *Elaphe guttata*	Under stones and in rock crevices, caves, canyons or rocky draws	Statewide	Uncommon	South central U.S., Utah to Texas to Illinois	Minimal
Texas rat snake *Elaphe obsoleta*	Varied habitats through the state	Central and east Texas	Common	Western Louisiana, east and central Texas	Minimal
Eastern hognose snake *Heterodon platyrhinos*	Primarily sandy areas and dry prairie areas	Statewide except far west	Common	Eastern half of U.S. to Dakotas except Maine	Minimal
Speckled kingsnake *Lampropeltis getulus*	Upland woodlands, stream valleys open plains and prairies under logs, rocks, etc.	Statewide	Common	South Central U.S., Iowa to Louisiana	Minimal
Eastern coachwhip *Masticophis flagellum*	Open grasslands and semideserts	East Texas	Very Common	Southern half of U.S.	Minimal
Red-bellied watersnake *Natrix erythrogaster*	Rivers, swamps, and other aquatic regions	Statewide	Common	Southern Delaware to northern Florida and southeastern Alabama	Minimal
Broad-banded water snake *N. fasciata*	Marshes, swamps, and shallow bodies of water	Northeast Texas	Common	Lower Mississippi Valley	Minimal
Graham's water snake *N. grahami*	Margins of ponds, streams, along sloughs and bayous, and in swamps	Northeast Texas	Uncommon	Central U.S., Iowa, Texas to Alabama	Minimal
Diamond-backed watersnake *Natrix rhombifera*	Lakes, rivers, ditches, and cattle tanks	Statewide, except far west Texas and west panhandle	Common	Iowa to Gulf; Alabama to central Texas and northeast Mexico	Minimal
Rough greentree snake *Opheodrys aestivus*	Climbs among trees, vines, shrubs, and enters water	Statewide, except west Texas and panhandle	Common	New Jersey to Florida; Kansas to Texas	Minimal
Texas brown snake *Storeria dekayi*	Among trash or debris in parks, cemeteries, and larger urban areas	Eastern half of Texas	Very Common	Central U.S.; Minesota to Texas, Louisiana coast	Minimal
Flat-headed snake *Tantilla gracilis*	Under rocks where there is at least some moisture	Statewide, except panhandle and west Texas	Common	Southwestern Arkansas and southeastern Oklahoma to south texas	Minimal
Ribbon snake *Thamnophis proximus*	Semi-aquatic, close to streams and other bodies of water	Statewide	Very Common	Wisconsin and Colorado south to Louisiana, Texas, and eastern Mexico	Minimal

Appendix B (Continued)

Species	Habitat	Range in Region or State	Abundance in Region	Range in United States	Project Impact
Texas lined snake <u>Tropidoclonion</u> <u>lineatum</u>	City lots, trash dumps, parks open prairies and timbered areas	North central Texas	Uncommon	Central Texas	Minimal
Rough earth snake <u>Virginia</u> <u>striatula</u>	Under boards, stones, logs, and in trash piles	Northeast Texas	Very Common	Southeastern U.S., Mississippi Valley to Virginia	Minimal
Southern copperhead <u>Agkistrodon</u> <u>contortrix</u>	Lowlands, ground near swamps and streams	Statewide, except far west and south Texas, and panhandle	Common	South Kansas through Oklahoma and central texas to the Gulf	Minimal
Western cottonmouth <u>Agkistrodon</u> <u>piscivoris</u>	Upland areas, swamps, and bayous, may be with rattle-snakes and copperheads	East and central Texas	Common	Southern Illinois to southwestern Alabama west to southeast Kansas, eastern Oklahoma, and central Texas	Minimal

APPENDIX - C

CARL L. ESTES LAKE

BIOLOGICAL INVENTORY - BIRDS

Species	Seasonal Status	Range In State	Abundance in Region	Range in United States	Project Impact
Common loon Gavia immer	Spring or Summer	Statewide	Uncommon	Nationwide, except for arid southwest	Minimal
Western grebe Aechmophorus occidentalis	Spring or fall	Statewide	Rare to Casual	Western U.S., winters, south to Mexico	Minimal
Pied-billed grebe Podilymbus podiceps	Migrant, winter	Migrant through much of State, mainly south Texas	Common to fairly Common	North central United States	Minimal
White pelican Pelecanus erythrorhynchos	Fall or winter	Statewide	Irregularly Scarce to rare	West to north United States	Minimal
Anhinga Anhinga anhinga	Spring	Northwest & central Texas	Irregularly common	California, Arizona, New Mexico, Colorado, and Texas	Minimal
Great white heron Ardea occidentalis	Winter	Orange, Galveston, Aransas, Jim Wells, Nueces, and Cameron Counties	Casual	Primarily Florida and adjacent areas	Minimal
Great blue heron Ardea herodias	Summer or winter	Resident throughout most sections	Common to Uncommon	Most of North America	Minimal
Little blue heron Florida caerulea	Summer	East, central and coastal sections	Common to scarce	Eastern United States south to Peru	Minimal
Cattle egret Bulbulcus ibis	Migrant	Coastal and perhaps other parts of the State	Uncommon	Southwestern United States	Minimal
Common egret Casmerodious albus	Summer or winter	East and south Texas	Uncommon	Northern United States south to the Strait of Magellan	Minimal
Louisiana heron Hydranassa tricolor	Summer	Statewide, except for panhandle	Uncommon to scarce	New Jersey, Gulf States, and lower California	Minimal
Black-crowned night heron Nycticorax nycticoray	Summer	Most of State, mainly the coast	Uncommon	Canada south to South America	Minimal
Yellow-crowned night heron Nyctanassa violacea	Summer migrant	Eastern two-thirds of Texas, winters on coast	Uncommon	Northeastern United States south to Peru and Brazil	Minimal
Least bittern Ixobrychus exilis	Migrant	Eastern half and locally in panhandle and at El Paso	Rare	Northwestern United States	Minimal

APPENDIX - C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
American bittern <u>Botaurus lentiginosus</u>	Migrant	Most sections in summer, winters along the coast	Uncommon	Canada south to the Gulf states	Minimal
Canada goose <u>Branta canadensis</u>	Migrant	Migrant throughout, along coast and locally inland	Common	Northern United States	Minimal
White-fronted goose <u>Anser albifrons</u>	Migrant	Most of State except trans-Pecos, mainly Gulf coast	Uncommon	Gulf States	Minimal
Snow goose <u>Chen hyperborea</u>	Fall or Winter	Statewide	Common to scarce	Gulf states (to panhandle of Florida) and North Carolina	Minimal
Blue-snow goose <u>Chen caerulescens</u>	Migrant	Eastern half of State and entire coast	Uncommon	Gulf of Mexico	Minimal
Mallard <u>Anas platyrhynchos</u>	Migrant	North in summer, winter migrates throughout State	Common	Nationwide	Minimal
Gadwall <u>Anas strepera</u>	Winter	Throughout the State	Common	Northern United States	Minimal
Pintail <u>Anas acuta</u>	Winter	Statewide	Common	Nationwide	Minimal
Green-winged teal <u>Anas crecca</u>	Winter	Statewide	Common	West and northeast United States	Minimal
Blue-winged teal <u>Anas discors</u>	Winter	Migrant throughout, winters along coast and into north Texas	Common	Canada south to southern United States	Minimal
Cinnamon teal <u>Anas cyanoptera</u>	Winter	Migrant throughout, winters in south Texas and along the coast	Uncommon	Southwestern United States, south	Minimal
American wigeon <u>Mareca americana</u>	Winter	Statewide	Common	Northern United States to South and Central America	Minimal
Shoveler <u>Spatula clypeata</u>	Winter	Statewide, except for panhandle and other cold sections	Common	Nationwide	Minimal

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
Redhead Aythya americana	Migrant	Migrant statewide, winters on coast and locally inland	Common	Northwestern United States	Minimal
Wood duck Nyroca Americana	Summer or winter	Statewide	Common to scarce	Minnesota south to East Texas, Gulf States and Florida	Minimal
Ring-necked duck Aythya collaris	Winter	Migrant statewide, winters on coast and locally inland	Uncommon	Northern United States	Minimal
Canvasback Aythya valisineria	Winter	Migrant statewide, winters on coast and locally inland	Uncommon	Northwest United States	Minimal
Lesser scaup Aythya affinis	Winter	Mainly along coast, inland to north Texas	Common	Nationwide	Minimal
Bufflehead Bucephala albeola	Winter	Along coast, inland to north and west Texas	Uncommon	Nationwide	Minimal
White-winged scoter Melanitta deglandi	Fall or Winter	North East, central, and south Texas	Rare and Irregular	North Dakota, North Carolina, rarely to Florida and Gulf States	Minimal
Ruddy duck Oxyura jamaicensis	Winter	Along coast and inland to to north and west Texas	Common	Nationwide	Minimal
Hooded merganser Lophodytes cucullatus	Migrant	Along coast, eastern half of State and panhandle	Rare	Northern United States to Gulf Coast	Minimal
Turkey vulture Cathartes aura	Resident	Statewide, except in panhandle, trans-Pecos, and Staked Plains in winter	Common	South Canada south to Strait of Magellan	Minimal
Black vulture Coragyps atratus	Resident	Statewide, except Staked Plains	Uncommon	Ohio and Maryland to Chile and Argentina	Insignificant
Sharp-shinned hawk Accipiter striatus	Winter	Winters stateside, breeds in northern half of state	Uncommon	Most of North America	Insignificant
Cooper's hawk Accipiter cooperii	Winter	Breeds statewide, winters statewide, except panhandle	Uncommon	Southern Canada south to northern Mexico	Insignificant
Red-tailed hawk Buteo jamaicensis	Resident	Winters statewide, summers may be rare in Rio Grande delta	Uncommon	Alaska and Canada south to Panama	Insignificant
Red-shouldered hawk Buteo lineatus	Resident	Locally eastern half of state. Occurs west (rarely) to panhandle, Del Rio and Rio Grande valley	Rare	Southern Canada south to Mexico	Insignificant
Broad-winged hawk Craxirex platypterus	Spring or fall	Statewide, but rare in Big Bend and panhandle	Irregularly abundant to scarce	Canada south to East Texas, Gulf States, and Florida	Insignificant

APPENDIX C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
Bald eagle Haliaeetus ieucocephalus	Winter	Statewide, but scarce in panhandle and west Texas	Rare and irregular	Canada south to Baja, California Texas, Gulf states, and Florida	Insigni-ficant
Marsh hawk Circus cyaneus	Winter	Winters statewide, summers locally in northern half of State	Common	Alaska, Canada, south to southern United States	Insigni-ficant
Osprey Panpion haliaetus	Migrant	Statewide, but winters very rarely along coast	Rare	Almost cosmopolitan, migratory	Insigni-ficant
Sparrow hawk Tinnunculus sparverius	Winter	Statewide, breeds in eastern, northern, and western parts	Common	Most of North and South America	Insigni-ficant
Bobwhite Colinus viriginianus	Resident	Statewide, except Staked Plains and trans-Pecos	Common	Central and eastern United States south to Guatamala	Minimal
Sandhill crane Grus canadensis	Migrant	Statewide, widely along coastal prairie and locally along Rio Grande, and in south Texas	Common	Canada south to northern United States, also southeastern United States and Cuba	Insigni-ficant
King rail Rallus elegans	Fall	Statewide but rare in panhandle and west Texas	Rare and local	Minnesota to New York, south to Central Texas and Florida	Insigni-ficant
Sora Porzana carolina	Migrant	Statewide, winters along coast, rarely in central Texas and panhandle	Uncommon	Canada south to southeastern United States	Insigni-ficant
Yellow rail Coturnicops nove boracensis	Winter	Along the coast and eastern half of state	Rare to casual	Ohio, Connecticut, central eastern California New Mexico, Gulf States to South Carolina and Virginia	Insigni-ficant
Purple gallinule Porphyrula martinica	Summer	Summers in eastern half of state, most frequent near coast, casual in panhandle	Rare	Southeastern United States south to Argentina	Insigni-ficant
Common gallinule Gallinula chloropus	Summer	In eastern half of State winters near coast and along Rio Grande	Rare	Southern Canada south to South America	Insigni-ficant
American coot Fulica americana	Winter	Statewide	Common	Canada south to Ecuador	Insigni-ficant
Killdeer Oxyechus vociferus	Resident	Statewide	Common	Canada south to central Mexico	Insigni-ficant

APPENDIX C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
Common snipe Capella Gallinago	Winter	Statewide	Common	North America to northern Eurasia	Insignificant
American woodcock Rubicola Minor	Winter	Statewide except panhandle and west Texas	Fairly common to uncommon	North Dakota south to Texas, Oklahoma Virginia, and Florida	Insignificant
Spotted sandpiper Actitis macularia	Migrant	Statewide, breeds in panhandle and north Texas	Uncommon	Northern Alaska and Canada south to central United States	Insignificant
Pectoral sandpiper Calidris melanotos	Migrant	Statewide, except trans-Pecos (probably casual there)	Uncommon	Arctic and Siberia south to southern South America	Insignificant
Least sandpiper Calidris minutilla	Migrant	Statewide, mainly along coast; inland to northeast, north central, and west Texas	Common	Alaska and Canada south to South America	Insignificant
Veery Hylocichla fuscescens	Spring	Statewide but rare in panhandle and western half of state	Scarce	Northern United States to Northeast Arizona northern Georgia and central Texas	Insignificant
Louisiana waterthrush Seiurus Motacilla	Spring or fall	Statewide, but rare in panhandle and west Texas	Common to uncommon	South Great Lakes region and New Jersey south to east Texas, Gulf Coast and Central Florida	Insignificant
Yellow-breasted chat Icteria virens	Migrant	Statewide, except for Staked Plains	Rare	Nationwide	Insignificant
House sparrow Passer domesticus	Resident	Statewide	Rare	Nationwide	Insignificant
Eastern meadowlark Sturnella magna	Winter	Eastern half of State, west locally to east	Common	Canada south through eastern United States Gulf States	Insignificant
Red-winged blackbird Euphagus cyanocephalus	Resident	Statewide	Common	Nationwide	Insignificant
Brewer's blackbird Euphagus cyanocephalus	Winter	Statewide	Abundant to fairly common	West Great Lakes region, south to northwest Baja, California; Nevada; northeast Arizona northern New Mexico; and Gulf States	Insignificant
Brown-headed cowbird Molothrus ater	Resident	Statewide	Rare	Southern Canada south to northern Mexico	Insignificant
Eastern bluebird Sialia currucoides	Resident	Eastern two-thirds of State from panhandle to the valley	Uncommon	East of Rockies south to the Gulf states. east of Arizona	Insignificant

APPENDIX C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
Loggerhead shrike *Lanius ludovicianus*	Resident	Statewide	Common	Canada south to Mexico and Gulf States	Insignificant
Starling *Sturnus vulgaris*	Resident	Statewide	Common	Nationwide	Insignificant
Prothonotary warbler *Protonotaria citrea*	Spring or fall	Statewide, but rare in panhandle and west Texas	Common to uncommon	South Great Lakes region and New Jersey south to east Texas, Gulf Coast and central Florida	Insignificant
White-eyed vireo *Vireo griseus*	Spring or summer	Statewide, but rare in panhandle and west Texas	Common to fairly common	East Nebraska to New York, south to central Mexico, U.S. Gulf Coast and Southern Florida	Insignificant
Louisiana waterthrush *Seiurus motacilla*	Spring or fall	Statewide, but rare in panhandle and west Texas	Common to uncommon	Southern Great Lakes region and southern New England, south to east Texas, Gulf States and south Georgia	Insignificant
Cardinal *Cardinalis cardinalis*	Resident	Throughout most of State	Common	Canada south to Gulf States	Insignificant
Painted bunting *Passerina ciris*	Summer	Throughout most of State	Common	Across southern U.S.	Insignificant
Indigo bunting *Linaria cyanea*	Spring or Summer	Statewide	Very common to fairly common	Southwest South Dakota, east to southern Maine south to Gulf Coast and northern Florida	Insignificant
American goldfinch *Spinus tristis*	Winter	Throughout the State	Common	Southern Canada to northern Baja, California, southern U.S.	Insignificant
Rufous-sided towhee *Piplio erythrophthalmus*	Winter	Throughout the State	Common	Southern Canada south to eastern Gulf Coast	Insignificant
Vesper sparrow *Pooecetes gramineus*	Resident	Throughout the State	Common	Canada south to southwestern states, Missouri	Insignificant
Common tern *Sterna hirundo*	Fall	South, central, north, and east Texas	Rare to casual	North Dakota, Wisconsin, and Pennsylvania south to Texas and Florida	Insignificant
Black tern *Chlidonias niger*	Migrant	Through most parts, winters on coast	Uncommon	North America to southern hemisphere	Insignificant
Yellow-billed cuckoo *Coccyzus americanus*	Summer	Statewide	Common	Southern Canada south to Mexico	Insignificant
Screech owl *Otus asio*	Resident	Statewide	Uncommon	Alaska, southern Canada south to Central Mexico	Insignificant

APPENDIX C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
Great horned owl Bubo virginianus	Resident	Statewide	Uncommon	Limit of trees in Arctic to Strait of Magellan	Insigni-ficant
Barred owl Strix varia	Resident	East, north, and central Texas, west to the pan-handle, south to Corpus Christi	Rare	Canada to Honduras	Insigni-ficant
Short-eared owl Asio flammeus	Winter	Throughout much of State	Uncommon	Arctic south to central U.S.	Insigni-ficant
Ruby-throated hummingbird Archilochus colubris	Summer	Eastern two-thirds of State west to Pecos River and panhandle	Uncommon	Southern Canada south to Gulf states	Insigni-ficant
Belted kingfisher Megaceryle alcyon	Resident	Throughout much of State	Common	Alaska, Canada, south to southern U.S. and Panama	Insigni-ficant
Yellow-shafted flicker Colaptes Auratus	Winter	Statewide	Common to fairly common	Alaska to Newfoundland south to southeast Texas, Gulf Coast and Florida	Insigni-ficant
Red-shafted flicker Colaptes cafer	Winter	Statewide	Rare	Central North Dakota south through western United States	Insigni-ficant
Red-headed woodpecker Melanerpes erysthrocephalus	Transient	East and central Texas; west to panhandle and Corpus Christi	Rare	Southern Canada, east of Rockies south to Gulf states	Insigni-ficant
Yellow-bellied sapsucker Sphyrapicus varius	Winter	Statewide	Uncommon	Alaska, central Canada south to south-western U.S. and Georgia	Insigni-ficant
Hairy woodpecker Dendrocopos villoscens	REsident	Wooded sections of east and north Texas; south to Waco, Houston, Rockport	Uncommon	Alaska, Canada, south to Mexico	Insigni-ficant
Downy woodpecker Dendrocopos pubescens	Transient	East, north and central Texas; west to panhandle; south to coast	Rare	Alaska, Canada, south to Gulf states southwestern U.S.	Insigni-ficant
Eastern kingbird Tyrannus tyrannus	Summer	Statewide, except trans-Pecos; most numerous along coast	Uncommon	Central Canada south to Gulf of Mexico	Insigni-ficant
Western kingbird Tyrannus verticalis	Summer	Statewide	Common	Southwestern Canada south to Mexico	Insigni-ficant

APPENDIX C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impacts
Scissor-tailed flycatcher *Muscivora forficata*	Summer	Statewide, except extreme western tip, (casual at El Paso)	Common	Southeastern Colorado, southern Nebraska south to south Texas, southern Mexico and Panama	Insignificant
Acadian flycatcher *Empidonax virescens*	Summer	North central, central, east, and south Texas	Common to uncommon	South Dakota to southern New England, south to central and southeastern Texas, Gulf Coast and Central Florida	Insignificant
Eastern wood pewee *Contopus viren*	Summer	Eastern and central Texas; west to Edwards Plateau, south to Victoria	Rare	Southern Canada south to Gulf States	Insignificant
Vermilion flycatcher *Pyrocephalus Rubinus*	Winter	Statewide, but rare in panhandle, north central and eastern Texas	Rare	Southeastern California to southwestern Utah and central Texas, Gulf States, and Florida	Insignificant
Tree swallow *Tridoprocne bicolor*	Spring	Statewide	Fairly common	Southern California, Idaho, Colorado, southern North Dakota, central Nebraska, northwestern Tenessee and Virginia; casually to southern states.	Insignificant
Bank swallow *Riparia riparia*	Migrant	Statewide	Uncommon	Northern hemisphere, South America	Insignificant
Barn swallow *Hirunda rustica*	Migrant	Statewide	Common	Northern hemisphere to South America	Insignificant
Cliff swallow *Petrochelidon pyrrhonota*	Summer	Locally, except in east Texas and upper coast	Common	Alaska, Canada, south to central Mexico	Insignificant
Purple martin *Progne subis*	Summer	Throughout most of State. rare in west Texas	Common	Southern Canada south to northwestern Mexico and Gulf States	Insignificant
Blue jay *Cyanocitta cristata*	Resident	Panhandle and north and east Texas; south to Houston and San Antonio	Common	Southern Canada, east of Rockies, south to Gulf States	Insignificant
Common crow *Corvus brachyrhynchos*	Resident	Eastern and northern Texas west to panhandle, south to upper coast	Common	Canada south to southwestern U.S. and Gulf States	Insignificant
Carolina chickadee *Parus carolinensis*	Resident	Eastern, northern and central Texas, west to panhandle, south to San Antonio	Common	Central U.S. south to Gulf States	Insignificant
Brown Creeper *Certhia familiaris*	Winter	Statewide, but rare in southern part of State	Uncommon	Alaska, Canada, to Gulf states	Insignificant

APPENDIX C (Continued)

Species	Seasonal Status	Range in State	Abundance in Region	Range in the United States	Project Impact
House wren <u>Trolopytes aedon</u>	Winter	Statewide, except in panhandle and colder	Uncommon	Southwestern U.S. and central parts of eastern U.S.	Insignificant
Bewick's wren <u>Thryomanes bewickii</u>	Resident	Statewide, except counties in eastern part and upper coast	Common	Canada south through middle and western U.S. to south central Mexico	Insignificant
Carolina wren <u>Thryothorus ludovicianus</u>	Resident	Eastern two-thirds of State; visitor to panhandle	Common	Ontario and New England south to northeastern New Mexico and Gulf states	Insignificant
Long-billed marsh wren <u>Telmatodyttos palustris</u>	Winter	Statewide, except panhandle and colder northern parts	Rare	Southern Canada south to Mexico and Gulf coast	Insignificant
Short-billed marsh wren <u>Cistothorus platensis</u>	Spring or fall	Statewide, but rare in panhandle	Uncommon to scarce	Canada south to northwestern Oklahoma, Arkansas, Gulf states to southern Florida	Insignificant
Mockingbird <u>Mimus polyglottos</u>	Resident	Statewide	Common	Southern Canada south to southern Mexico	Insignificant
Robin <u>Turdus migrator</u>	Winter	Statewide	Common	Canada south to southern Mexico and Gulf states	Insignificant
Song sparrow <u>Melospiza melodia</u>	Winter	Statewide	Uncommon	Canada south through western U.S. to mountains of central Mexico, in eastern U.S. to mountains of Georgia	Insignificant
Ruby-crowned kinglet <u>Regulus calendula</u>	Winter	Statewide, except panhandle	Common	Alaska, Canada, south in mountains of California, Arizona, and New Mexico to Gulf states	Insignificant
Savanna sparrow <u>Passerculus sandwichensis</u>	Winter	Throughout the State	Common	North Alaska across Canada to northern U.S.	Insignificant
Mourning dove <u>Zenaida macroura</u>	Resident	Statewide	Common	Nationwide	Insignificant
Roadrunner <u>Geococcyx californianus</u>	Resident	Every section, less frequent in eastern parts	Uncommon	Southwestern U.S. south to central Mexico	Insignificant
Common nighthawk <u>Chordeiles minor</u>	Summer	In all sections	Common	Canada to Gulf states	Insignificant
Red-bellied woodpecker <u>Centurus carolinus</u>	Resident	East Texas west to Panhandle south to central coast	Uncommon	Great Lakes to Florida and Gulf coast	Insignificant
Pileated woodpecker <u>Hylatomus pileatus</u>	Year around	North central, central southeast and central Texas	Fairly common to uncommon	[illegible] western Montana, east Texas, Gulf coast and southern Florida	[illegible]

Appendix D

CARL L. ESTES

BIOLOGICAL INVENTORY - MAMMALS

Species	Habitat	Range in Region or State	Abundance in Region	Range in the United States	Project Impact
Opossum *Didelphis marsupialis*	Deciduous woodlands, prairies, marshes and farmlands	Statewide except for far west Texas	Common	Eastern half of U.S.	Minimal
Eastern mole *Scalopus aquaticus*	Subteranean (damp or boggy)	Statewide	Uncommon	Eastern half of U.S. to Dakotas	Minimal
Little Short-tailed shrew *Cryptotis parva*	logs and leaf litter in moist, forested areas	Statewide except for far west	Common	Eastern half of U.S. to New York	Minimal
Georgia bat *Pipistrellus Subflavus*	Caves, crevices in cliffs, buildings, and other man-made structures	Statewide except far west	Common	Eastern half of U.S. except Maine & Florida	Minimal
Big brown bat *Eptesicus fuscus*	Forests, attics, buildings, and caves	North half of State	Common	Nationwide except Flordia	Minimal
Armadillo *Dasypus novemcinctus*	Where soils are more diggable in vicinity of streams and ponds, but avoids marshy areas	North central, east, south central, and south Texas	Common	Texas east along the Gulf to, and including Florida	Insignificant
Evening bat *Nycticeius humeralis*	Hollow trees along forested areas and watercourses, attics, and other man-made structures	East Central and South Texas	Common	Eastern half of U.S. to New York	Minimal
Red bat *Lasiurus borealis*	Roost in the open in trees	Statewide	Uncommon	Central & eastern states; far west coastal states	Insignificant
Raccoon *Procyon lotor*	Broadleaf woodlands and mixed pine forests along streams or lakes	Statewide	Common	Nationw de, except parts of Montana, Wyoming, & Colorado	Insignificant
Ringtail *Bassariscus astutus*	Rock piles, stone fences, canyon walls, and talus slopes	Central & west Texas, panhandle	Common	Texas, west to California southern Colorado & Utah	Insignificant
Long-tailed weasel *Mustela Frenata*	Variety of habitats from far east to to far west Texas; coextensive with packet, gophers & ground squirrels	Statewide except north	Uncommon	Nationwide except desert Southwest	Minimal
Mink *Mustela vison*	Smaller streams, lakes, ponds, & waterways	Central and east Texas	Uncommon	Nationwide, except west Texas, New Mexico, Arizona, southern California, & Nevada	Minimal
Spotted skunk *Spilogale putoris*	Wooded areas, tall-grass prairie, rocky canyons, & outcrops	Statewide, except southern portion of panhandle	Uncommon	Nationwide, except far north & New England	Insignificant

Appendix D (Continued)

Species	Habitat	Range in Region or State	Abundance in Region	Range in the United States	Project Impact
Striped skunk *Mephitis mephitis*	Woody or brushy areas and their associated farmlands	Statewide	Very Common	Nationwide	Insigni-
Gray fox *Urocyon cinereoargenteus*	Short-grass plains and mixed hardwood forests	Statewide, except panhandle	Common	Southern states and New England	Insignificant
Coyote *Canis latrans*	Ranges from desert scrub through grassland into timber section	Statewide	Very Common	Central and western U.S.	Insignificant
Bobcat *Lynx rufus*	Rocky canyons and outcrops, or heavy thickets	Statewide	Uncommon	Texas to North Dakota & west to coast, plus southern states	Insignificant
Eastern gray squirrel *Sciurus cardinensis*	Dense hammocks of live oak and water oak, and in cypress, black gum and magnolia that border streams	East Texas	Common	Eastern half of U.S.	Minimal
Fox squirrel *Sciurus niger*	Open upland forests of mixed trees, e.g., oak-hickory woodland or other food producing trees	Statewide, except panhandle, west Texas, and Rio Grande Valley	Common	East Texas north to North Dakota and east to coast	Minimal
Pocket gopher *Geomys bursarius*	Lives in underground burrows dug in sandy soils where topsoil is 4 inches deep	Statewide, except west, south central Texas and Rio Grande Valley	Common	Texas north to North Dakota and Wisconsin and Minnesota	Insignificant
Hispid pocket mouse *Perognathus hispidus*	Sandy soil with herbaceous vegetation	Statewide	Common	Texas, New Mexico, north to North Dakota	Insignificant
Beaver *Castor canadensis*	Aquatic, requiring water in form of pond, stream, lake or river	Statewide	Uncommon	Nationwide except desert Southwest	Minimal
Long-tailed harvest mouse *Reithrodontomys fulvescens*	Grassy or weedy areas, with shrubs, creek bottoms with grasses, vines and bushes	Statewide except central Texas and the northern portions of the panhandle and west Texas	Common	Texas, Oklahoma, Arkansas, Louisiana	Insignificant
Gray harvest mouse *Reithrodontomys montanus*	Climax, or near climax, well-drained grassland	Central, north central, and west Texas and panhandle	Common	Texas, New Mexico, north to South Dakota	Insignificant
White-footed mouse *Peromyscus leucopus*	Woodlands and bottomlands of creeks and rivers	Statewide	Very Common	Central and eastern U.S.	Insignificant
Cotton mouse *P. gossypinus*	Woodlands along water courses where stumps, down logs, brush & vines offer retreats	East Texas	Common	Southwestern U.S. from Texas to Virginia	Minimal
Hispid cotton rat *Sigmodon hispidus*	Tall grass areas of old fields and natural prairies	Statewide	Common	South Arizona & New Mexico, Texas, Oklahoma, & Kansas east to the coast	Insignificant

Appendix D (Continued)

Species	Habitat	Range in Region or State	Abundance in Region	Range in the United States	Project Impact
Florida woodrat *Neotoma floridana*	Swamplands, forested uplands, and arid plains. Construct surface house or underground burrow	East and south central Texas	Uncommon	Texas to Florida, north to Kansas and Pennsylvania	Insignificant
Pine vole *Pitymys pinetorum*	Woodlands where leaf litter and lodged grasses offer suitable protection	Far East Texas	Common	Eastern one third of U.S. from Texas to Maine	Minimal
House mouse *Mus musculus*	Houses, stores, outbuildings, and other structures	Statewide	Very Common	Nationwide	Insignificant
Roof rat *Rattus rattus*	Stores, warehouses, houses, gins, and barns	Most of State	Common	Nationwide	Insignificant
Norway rat *Rattus novegicus*	Buildings, stores, garbage dumps, and uncultivated areas	Widespread in State	Very Common	Nationwide	Insignificant
Nutria *Myocaster coypus*	Swamps, marshes, along the shores of rivers and lakes	Statewide, except west Texas and and panhandle	Common	Louisiana, Oregon, and widespread over U.S.	Insignificant
Eastern cottontail *Sylvilagus floridanus*	Brushlands, pastures, fields, and streamsides	Statewide, except west Texas and Big Bend	Common	Texas to North Dakota and east to coast	Insignificant
Swamp rabbit *Sylvilagus aquaticus*	Poorly drained river bottoms and coastal marshes among associated shrubs, trees, and vines	East and south central Texas	Common	Texas, Oklahoma, Louisiana, Arkansas, Mississippi, Alabama, and Tennessee	Insignificant
White- tailed deer *Odocoileus virginianus*	Suitable brushy or wooded areas throughout State	Statewide	Common	Eastern, Rocky Mountain, and Pacific Coast states	Insignificant

References: (Davis, 1966) and (Burt, 1964).

APPENDIX - E

CARL L. ESTES LAKE

BIOLOGICAL INVENTORY - AQUATIC VEGETATION

Species	Habitat	Wildlife Utilization Value	Abundance In Region	Range in Region or State	Range in the United States	Project Impact
Pickerelweed *Pontederia*	Shallow water, including the margins of any body of water	Good: seeds eaten by ducks	Common	Regionwide	Throughout south-eastern U.S.	Minimal
Water pennywort *Hydrocotyle*	Along roads and canal margins, grows on water as floating mat	Poor: ocassionally the foliage and seeds are eaten by waterfowl	Common	Regionwide	Through south-eastern U.S.	Minimal
Green algae *Chara*	Slow-flowing streams or hard-water lakes	Important for waterfowl and good habitat for fish-food organisms	Common	Statewide	Nationwide	Minimal
Cattail *Typha*	Shallow bays, marshes, and all moist areas in both fresh and brackish water	Good for waterfowl roosting and protectional cover	Common	Statewide	Nationwide	Minimal
Smartweed *Polygonium*	Along streams, rivers, ponds, lakes, marshes, and ditches	Slight to minimal	Common	Regionwide	Southeastern U.S.	Minimal
Water primrose *Jussiaea*	Along ditchbanks, roadsides, streams, ponds, lakes, and borrow pits	Good: Waterfowl utilize the seeds	Common	Regionwide	Florida and Mexico to Argentina and Peru	Minimal
Pondweed *Potamogeton*	Canals, streams, and lakes	Fair: seed heads utilized by waterfowl foliage is of secondary importance	Sparse	Regionwide	Southeastern U.S.	Minimal
Buttonbush *Cephalanthus*	Swamps, ponds, and stream banks	Good to excellent: seeds eaten by mallards and woodducks. Roosting and covering for water-fowl and other wildlife	Common	Regionwide	Florida to Texas	Minimal

References: (Correll and Correll 1972)

APPENDIX F

CARL L. ESTES LAKE

BIOLOGICAL INVENTORY - TERRESTRIAL VEGETATION

Species	Range in State	Status or Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Texas	United States
Red maple *Acer rubrum*	P.	Uncommon	U.G., S., F&G, M., S.M., H.B.	Eastern half of U.S.	Minimal	Minimal	Insignificant
Ohio buckeye *Aesculus glabra*	P., P.O.S., B.P., C.T., and E.P.	Common	S.M.	Texas, Oklahoma, Kansas, Nebraska, east to Great Lakes	Minimal	Insignificant	Insignificant
River birch *Betula nigra*	P., and P.O.S.	Endandgered (TOES, 1973)	U.G., S., F.&G.M., S.M., H.B.	Eastern half of U.S., except for Florida	Moderate	Minimal	Insigificant
American hornbeam *Carpinus caroliniana*	P., G.P., and M., and P.O.S.	Common	W., U.G., S., F.&G.M., H.B.	Eastern half of U.S., except for Florida	Minimal	Insignificant	Insignificant
Water hickory *Carya aquatica*	P., G.P. and M., P.O.S., and B.P.	Common	W., U.G., S., S.M., F.&G.M., H.B.	Gulf states and up, southeast border to Pennsylvania	Minimal	Insignificant	Insignificant
Bitternut hickory *C. cordiformis*	P., G.P. and M., and P.O.S.	Common	W., U.G., S., S.M., F.& G.M., H.B.	Eastern half of U.S.	Minimal	Insignificant	Insignificant
Black hickory *C. texana*	P., G.P. and M., and P.O.S.	Common	W., U.G., S., S.M., F.&G.M., H.B.	Texas, Oklahoma, Louisiana, Mississippi, Arkansas and Missouri	Minimal	Insignificant	Insignificant
Mockernut hickory *C. tomentosa*	P., and P.O.S.	Common	W., U.G., S., S.M., F.&G.M., H.B.	Eastern half of U.S., except for Florida and Great Lakes	Minimal	Insignificant	Insignificant
Pecan *C. illinoensis*	Statewide except H.P.	Common	W., U.G., S., S.M., F.&G.M., H.B.	Southwestern U.S., north to Minnesota and Michigan	Minimal	Insignificant	Insignificant
Sugarberry *Celtis laevigata*	Statewide except for B.P.	Common	U.G., S., F.& G.M., S.M., H.B.	Southeastern U.S.	Minimal	Insignificant	Insignificant
Hackberry *C. occidentalis*		Common	U.G., S., F.& G.M., S.M., H.B.	Kansas north to North Dakota east to coast and New England	Minimal	Insignificant	Insignificant
Eastern redbud *Cercis canadensis*	P., G.P. and M., P.O.S., and B.P.	Rare (TOES, 1973)	U.G., S., F.& G.M., S.M., H.B.	Eastern half of U.S., except for southern Florida	Moderate	Insignificant	Insignificant
Flowering dogwood *Cornus florida*	P., P.O.S., and B.P.	Common	W., U.G., S., S.M., F.&G.M., H.B.	Texas east to northern Florida north to Great Lakes and New England states	Minimal	Insignificant	Insignificant

APPENDIX F (Continued)

Species	Range in State	Status of Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Texas	United States
Hawthorn *Crataegus sp.*	P.O.S., B.P., and S.T.P.	Rare (TOES, 1973)	W., U.G., S., F.&G.M., S.M., H.B.	Gulf States	Moderate	Insignificant	Insignificant
Common persimmon *Diospryros virginiana*	Statewide except for S.T.P., E.P., H.P., and T.P.M.B.	Common	U.G., S., F.& G.M., S.M., H.B.	Southeastern U.S.	Minimal	Insignificant	Insignificant
White ash *Fraxinus americana*	P., G.P. and M., P.O.S., B.P., and C.T. and P.	Endangered (TOES, 1973)	W., U.G., S., S.M., H.B., F.&G.M.	Southeastern U.S.	Moderate	Insignificant	Insignificant
Green ash *F. pennsylvanica*	Statewide except for R.P., H.P., and T.P.M.B.	Common	W., U.G., S., S.M., H.B., F.&G.M.	Central and Eastern U.S.	Minimal	Insignificant	Insignificant
Swamp privet *Forestiera acuminata*	P., G.P. & M., P.O.S., and E.P.	Rare (TOES, 1973)	W., U.G., S., H.B.	East Texas north to Missouri and Illinois east to Alabama and along Gulf Coast to Georgia	Moderate	Insignificant	Insignificant
Honeylocust *Gleditsia triacanthos*	Statewide except for H.P., T.P., & T.P.M.B.	Common		Eastern half of U.S.	Minimal	Insignificant	Insignificant
American holly *Ilex opaca*	P., G.P. & M., and P.O.S.	Rare (TOES, 1973)	W., U.G., S., H.B., F.&G.M., S.M.	Southeast and Eastern States	Moderate	Insignificant	Insignificant
Yaupon *I. vomitoria*	P., G.P.&M., P.O.S., S.T.P., and E.P.	Common	W., U.G., S., H.B., F.&G.M., S.M.	Gulf and Atlantic Coasts States	Minimal	Insignificant	Insignificant
Black walnut *Juglans nigra*	G.P.&M., P.O.S., B.P., C.T.&P., E.P., & R.P.	Endangered (TOES, 1973)	S., F.&G.M.	Eastern half of United States	Moderate	Insigni-	Insignificant
Eastern red cedar *Juniperus virginiana*	P., P.O.S., B.P., and E.P.	Common	U.G., S., F.&G.M., S.M. H.B.	Eastern half of United States	Minimal	Insignificant	Insignificant
Sweetgum *Liquidambar styraciflua*	P., G.P.&M., and P.O.S.	Common	W., U.G., S., F.&G.M., S.M.	Southeastern U.S.	Minimal	Insignificant	Insignificant
Osage-orange *Maclura pomifera*	Statewide except for S.T.P., and H.P.	Common	U.G., F.&G.M.	Texas, Louisiana, Oklahoma and Arkansas	Minimal	Insignificant	Insignificant
Black tupelo *Nyssa sylvatica*	P., G.P. & M. & P.O.S.	Rare (TOES, 1973)	W., U.G., S., H.B., F.&G.M.	Eastern half of U.S.	Moderate	Insignificant	Insignificant
Red mulberry *Morus rubra*	Statewide except for H.P., and T.P.M.B.	Endangered (TOES, 1973)	U.G., S., F.&G.M.	Eastern half of U.S.	Moderate	Insignificant	Insignificant

APPENDIX F (Continued)

Species	Range in State	Status of Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Texas	United States
Eastern cottonwood <u>Populus</u> <u>deltiodes</u>	Statewide except for H.P., and T.P.M.B.	Common	U.G., S., F.& G.M., S.M., H.B.	Eastern half of U.S. except for Florida	Minimal	Insigni- ficant	Insignificant
Water elm <u>Planera</u> <u>aquatica</u>	P., G.P.&M., and P.O.S.	Common	W.	Texas north to Illinois east to North Carolina and Florida	Minimal	Insigni- ficant	Insignificant
Black cherry <u>Prunus</u> <u>serotina</u>	P., G.P.&M., P.O.S., and B.P.	Endangered (TOES, 1973)	U.G., S., F.&G.M., S.M. H.B.	Eastern half of U.S.	Moderate	Insigni- ficant	Insignificant
Coastal plain willow <u>Salix</u> <u>caroliniana</u>	P., G.P.&M., P.O.S.	Common	U.G., S., F.&G.M., S.M. H.B.	Southeastern U.S.	Minimal	Insigni- ficant	Insignificant
White oak <u>Quercus</u> <u>alba</u>	P., G.P.&M., P.O.S.	Endangered (TOES, 1973)	W., M.&S., U.G., S., F.&G.M., S.M. H.B.	Eastern half of U.S.	Moderate	Insigni- ficant	Insignificant
Southern red oak <u>Q.</u> <u>falcata</u>	P., G.P.&M., P.O.S.	Endangered (TOES, 1973)	W., M.&S., U.G., S., F.& G.M., S.M., H.B.	Southeastern U.S.	Moderate	Insigni- ficant	Insignificant
Overcup oak <u>Q.</u> <u>lyrata</u>	P., G.P.&M., P.O.S.	Endangered (TOES, 1973)	W., M.&S., U. G., S., F.&G. M., S.M., H.B.	Southeastern U.S. except for Florida	Moderate	Insigni- ficant	Insignificant
Blackjack oak <u>Q.</u> <u>marilandica</u>	P., G.P.&M., P.O.S. E.P., and R.P.	Common	W., M.&S., U. G., S., F.&G. M., S.M., H.B.	Southeastern U.S. except for Florida	Minimal	Insigni- ficant	Insignificant
Chinkapin oak <u>Q.</u> <u>muehlenbergii</u>	P., B.P., C.T.P&P., E.P., and T.P.M.B.	Common	W., M.&S., U. G., S., G.&G. M., S.M., H.B.	Eastern half of U.S. except for Florida	Minimal	Insigni- ficant	Insignificant
Water oak <u>Q. Nigra</u>	P., G.P.&M., & P.O.S.	Common	W., M.&S., U. G., S., F.&G. M., S.M., H.B.	Southeastern U.S.	Minimal	Insigni- ficant	Insignificant
Willow oak <u>Q.</u> <u>phellos</u>	P., G.P.&M., & P.O.S.	Common	W., M.&S., U. G., S., F.&G. M., S.M., H.B.	Southeastern U.S. except for Florida	Minimal	Insigni- ficant	Insignificant
Post oak <u>Q.</u> <u>stellata</u>	Statewide except for [illegible], and T.P.M.[illegible]	Common	[illegible] G., S., F.&G. M., S.M., [illegible]	Southeastern [illegible] except for Florida	[illegible]	[illegible] ficant	[illegible]

APPENDIX F (Continued)

Species	Range in State	Status of Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Project Impact Texas	Project Impact United States
Shumard oak *Q. shumardii*	P., G.P.&M., P.O.S. and B.P.	Rare (TOES, 1973)	W., M.&S., U.G., S., F.&G. M., S.M., H.B.	Southeastern U.S. except for Florida	Moderate	Insignificant	Insignificant
Black oak *Q. velutina*	P., G.P.&M., & P.O.S.	Common	W., M.&S., U.G., S., F.&G. M., S.M., H.B.	Southeastern U.S. except for Florida	Minimal	Insignificant	Insignificant
American elm *Ulmus Americana*	Statewide except for H.P.	Common	W., U.G., S., H.B., F.&G.M.	Eastern half of U.S. except for south Florida	Minimal	Insignificant	Insignificant
Winged elm *U. alata*	Statewide except for S.T.P., R.P., H.P., and T.P.M.B.	Common	W., U.G., S., H.B., F.&G.M.	Southeastern U.S.	Minimal	Insigni-	Insignificant
Cedar elm *U. crassifolia*	Statewide except for R.P., H.P., and T.P.M.B.	Common	W., U.G., S., H.B., F.&G.M.	Texas, Oklahoma, Louisiana and Arkansas	Minimal	Insignificant	Insignificant
Slippery elm *U. rubra*	Statewide except for R.P., H.P., and T.P.M.B.	Common	W., U.G., S., H.B., F.&G.M.	Eastern half of U.S. except for Gulf Coast States	Minimal	Insignificant	Insignificant
Big bluestem *Andropogon gerardi*	Statewide	Common	U.G., S., S.M. H.B.	Maine to Montana, south to Florida, Wyoming, Utah and Arizona	Minimal	Insignificant	Insignificant
Silver bluestem *A. saccharoides*	Statewide except Pineywoods	Common	U.G., S., S.M., H.B.	Missouri to Colorado, and Alabama to Arizona	Minimal	Insignificant	Insignificant
Little bluestem *A. scoparius*	Statewide	Common	U.G., S., S.M., H.B.	Texas to Arizona	Minimal	Insignificant	Insignificant
Slender bluestem *A. tener*	P.	Common	U.G., S., S.M., H.B.	Gulf States to Oklahoma	Minimal	Insignificant	Insignificant
Splitbeard bluestem *A. ternarius*	P., G.P.&M., P.O.S., B.P., and C.T.&P.	Common	U.G., S., S.M., H.B.	Gulf, south Atlantic States to Kentucky, Missouri and Nebraska	Minimal	Insignificant	Insignificant

APPENDIX F (Continued)

Species	Range in State	Status of Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Project Impact Texas	Project Impact United States
Broomsedge bluestem *A. virginicus*	P., G.P.&M., P.O.S., and S.T.P.	Common	U.G., S., S.M., H.B.	Southern half of U.S., California to New York	Minimal	Insigni-ficant	Insignificant
Oldfield threeawn *Aristida oligantha*	Statewide	Common	S., F.&G.M., S.M., H.B.	Gulf States, Oklahoma, Arkansas, Tennessee, and North Carolina	Minimal	Insigni-ficant	Insignificant
Arrowfeather threeawn *A. purpurascens*	P., G.P.&M., P.O.S. and B.P.	Common	S., F.&G.M., S.M., H.B.	Gulf States, Arkansas, Tennesee, North Carolina	Minimal	Insigni-ficant	Insignificant
Wright threeawn *A. wrightii*	Statewide except for P., G.P.&M., & P.O.S.	Common	S., F.&G.M., S.M., H.B.	Western two-thirds of Oklahoma southern Kansas, Texas, west to California	Minimal	Insigni-ficant	Insignificant
Giantcane *Arundinaria gigantea*	P., and G.P.&M.	Endangered (TOES, 1973)		East Texas and Oklahoma to Atlantic coast, north to Missouri, Indiana, Illinois Kentucky and Ohio	Moderate	Insigni-ficant	Insignificant
Common carpetgrass *Axonopus affinis*	P., G.P.&M., and P.O.S.	Common	W.	Throughout south from Virginia to Florida and west to Texas and Arkansas	Minimal	Insigni-ficant	Insignificant
Sideoats grama *Bouteloua curtipendula*	Statewide except for P.	Common	U.G., S., F.&G.M., S.M., H.B.	Montana, south to Virginia Alabama, Texas, Arizona and southern California	Minimal	Insigni-ficant	Insignificant
Hairy grama *B. hirsuta*	Statewide	Common	U.G., S., F.&G.M., S.M., H.B.	Wisconsin and North Dakota to Texas, Colorado, Arizona and California; peninsular Florida	Minimal	Insigni-ficant	Insignificant
Buffalograss *Buchloe dactyloides*	Statewide	Common	W., S., H.B.	Minnesota and Montana south to northwestern Iowa, Texas, west Louisiana and Arizona	Minimal	Insigni-ficant	Insignificant
Rescuegrass *Bromus uhioloides*	Statewide	Common	W., U.G., S., S.M., H.B., F.&G.M.	Virginia to Florida, southern coast states westward to California and Oregon	Minimal	Insigni-ficant	Insignificant
Mat sandbur *Cenchrus pauciflorus*	Statewide	Common	S., H.B.	United States except Montana Idahao and Maine	Minimal	Insigni-ficant	Insignificant
Tumble windmill grass *Chloris verticillata*	Statewide	Common	H.B.	California, Arizona, New Mexico, Texas, Louisiana, Colorado, Oklahoma, Kansas, Missouri, Illinois, Indiana	Minimal	Insigni-ficant	Insigificant

APPENDIX F (Continued)

Species	Range in State	Status or Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Texas	United States
Bermuda grass Cynodon dactylon	Statewide	Common	W., M.&S., F.&G.M., S.M., H.B.	Nationwide except North Central	Minimal	Insignificant	Insignificant
Virginia wildrye Elymus virginicus	P.O.S., B.P., S.T.P., E.P., and R.P.	Common		Nationwide except California Oregon, Nevada	Minimal	Insignificant	Insignificant
Weeping lonegrass Eragrostis curvula	P., P.O.S., S.T.P., R.P., H.P., & T.P.M.B.	Common	S.M., S.	Florida, Texas, Arizona	Minimal	Insignificant	Insignificant
Plains lonegrass E. Intermedia	Statewide except for P., and H.P.	Common	S.M., S.	Missouri, Kansas, Arizona, Texas, Louisiana & Arkansas	Minimal	Insignificant	Insignificant
Purple lonegrass E. spectabilis	Statewide except for T.P.M.B.	Common	S.M., S.	Maine to Minnesota, Florida to Arizona	Minimal	Insignificant	Insigificant
Bent-awn plumegrass Erianthus contortus	P., G.P.&M., P.O.S.	Common	S.M., S.	Gulf & South Atlantic states to Oklahoma, Missouri and Tennessee	Minimal	Insignificant	Insignificant
Red lonegrass Eragrostix Oxylepis	Statewide	Common	S.M.S.	New Mexico to Alabama, Colorado Kansas, Oklahoma & Tennessee	Minimal	Insignificant	Insignificant
Tall fescue Festuca elatior	G.P.&M., B.P., S.T.P., E.P., R.P., and H.P.	Common	U.G., S., F.&G.M. S.M., H.B.	Nationwide	Minimal	Insignificant	Insignificant
Fall witchgrass Leptoloma cognatum	Statewide	Common		Minnesota to New Hampshire south to Florida, west to Texas and Arizona, and in northern Mexico	Minimal	Insignificant	Insignificant
Perennial ryegrass Lolium multiflorum	Statewide except S.T.P.	Common	W., U.G., S., S.M.	Newfoundland to Virginia, Alaska to California	Minimal	Insignificant	Insignificant
Carolina jointtail Manisuris cylindrica	Statewide except for H.P. & T.P.M.B.	Common		North Carolina to Florida west to Texas, and north to Oklahoma and Missouri	Minimal	Insignificant	Insignificant
Cutover muhly Muhlenbergia expansa	P., G.P.&M., P.O.S.	Common	H.B., U.G.	Coastal plain from Virginia to northern Florida; southern coast states.	Minimal	Insignificant	Insignificant
Seep muhly M. Reverchonii	P.O.S., B.P., C.T.&P., E.P., R.P., & T.P.M.B.	Common	H.B., U.G.	Texas and Oklahoma	Minimal	Insignificant	Insignificant

APPENDIX F (Continued)

Species	Range in State	Status or Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Texas	United States
Beaked panicum *Panicum anceps*	P., G.P.&M., P.O.S., and B.P.	Endangered (TOES, 1973)	W., M.&S., U.G., S., F.&G.M., H.B.	Atlantic & Gulf coastal plains Maryland to Texas	Moderate	Insigni-ficant	Insignificant
Blue panicum *P. antidotale*	Statewide except for P., C.T.&P, and T.P.M.B.	Common	W.M.&S., U.G., S., F.&G.M. H.B.	Experimentally grown in Texas, Oklahoma and Arizona	Minimal	Insigni-ficant	Insignificant
Vine-mesquite *P. obtusum*	Statewide except for P.	Common	W., M.&S., U.G., S., F.&G.M., H.B.	Western Missouri to Colorado, south to Arkansas, Texas, Utah and Arizona	Minimal	Insigni-ficant	Insignificant
Scribner panicum *P. scribnerianum*	Statewide	Common	W., M.&S., U.G., S., F.&G.M., H.B.	United States except for southeast coast states	Minimal	Insigni-ficant	Insignificant
Switchgrass *P. virgatum*	Statewide	Endangered (TOES, 1973)	W., M.&S., U.G., S., F.&G.M., H.B.	Maine to North Dakota and Wyoming, south to Florida Nevada and Arizona	Moderate	Insigni-ficant	Insignificant
Knotgrass *Paspalum distichum*	Statewide	Common	W., M&S., U.G., S., F.&G.M., H.B.	Atlantic and southern coast states and along west coast from California to Washington and east to Idaho	Minimal	Insigni-ficant	Insignificant
Brownseed paspolum *P. plicatulum*	P., G.P.&M., P.O.S. B.P., and S.T.P.	Common	W., M.&S., U.G., S., F.&GM., H.B.	Florida and the coastal plain from North Carolina to east Texas	Minimal	Insigni-ficant	Insignificant
Dollisgrass *P. dilatatum*	Statewide except for C.T.&P., and H.P.	Common	W., M.&S., U.G., S., F.&G.M., H.B.	Virginia to Florida, southern coast states westward to Arizona	Minimal	Insigni-ficant	Insignificant
Common Reed *Phragmites communis*	Statewide except for P.O.S., C.T.&P. & E.P.	Common	W., M&S., U.G., S., F.&G.M., H.B.	Widespread in U.S.	Minimal	Insigni-ficant	Insignificant
Texas bluegrass *Poa arachnifera*	Statewide except for C.T.&P., S.T.P., & H.P.	Common	W., U.G., S., F.&G.M., S.M., H.B.	Southern Kansas, Arkansas, Oklahoma and Texas	Minimal	Insigni-ficant	Insignificant
Knotroot bristlegrass *Setaria geniculata*	Statewide	Common	W., M.&S., U.G., S., F.&G.M., S.M.	Massachusetts to Florida west to California, north to Illinois & Kansas	Minimal	Insigni-ficant	Insigificant

APPENDIX F (Continued)

Species	Range in State	Status or Abundance In Region	Importance to Wildlife	Range in United States	Project Impact Region	Texas	United States
Indiangrass *Sorghastrum nutans*	Statewide	Common		Maine to Manitoba and North Dakota, south to Florida and Arizona	Minimal	Insignificant	Insignificant
Johnson grass *Sorghum halepense*	Statewide	Common		Southern half of U.S.	Minimal	Insignificant	Insignificant
Tall dropseed *Sporobolus asper*	Statewide except for C.T.&P., H.P. and T.P.M.B.	Common	U.G., S., S.M., H.B.	Missouri, Kansas, Mississippi Louisiana, Arkansas, Texas, and Oklahoma	Minimal	Insignificant	Insignificant
Sand dropseed *S. cryptandrus*	Statewide except for P.	Common	U.G., S., S.M., H.B.	Most of U.S. except forested areas, in southeast and and California	Minimal	Insignificant	Insignificant
Pineywoods dropseed *S. junceus*	P., and G.P.&M.	Common	U.G., S., S.M., H.B.	Throughout Coastal Plain from Virginia to east Texas	Minimal	Insignificant	Insignificant
White tridens *Tridens albescens*	Statewide except for P.	Common		Texas, Oklahoma and New Mexico	Minimal	Insignificant	Insignificant
Purpletop *T. flavus*	Statewide except for S.T.P., H.P., and T.P.M.B.	Common		Mostly on the Coastal Plain New Jersey to Texas, north to Iowa	Minimal	Insignificant	Insignificant
Eastern gramagrass *Tripsacum dactyloides*	Statewide except for S.T.P.	Common		Massacusetts to Michigan, Iowa and Nebraska and throughout the southern states	Minimal	Insignificant	Insignificant
Broadleaf uniola *Unida latifolia*	P., and P.O.S.	Endangered (TOES, 1973)		Texas, Oklahoma, and United States	Moderate	Minimal	Insignificant
Longleaf uniola *U. sessiliflora*	P., P.O.S., & G.P.&M	Common		East Texas & Oklahoma to Atlantic coast, north to Virginia	Moderate	Minimal	Insignificant
Serviceberry *Amelanchier arborea*	P.	Rare and Endangered (Fisher et al, 1972)	U.G., S., H.B., F.&G. M., S.M.	Northeast Texas, Louisiana Oklahoma to Florida, north to Canada	Moderate	Minimal	Insignificant
Meadow sedge *Carex granularis*		Rare and Endangered (TOES, 1973, and Fisher et al, 1972)	W., M.&S., S. U.G., S.M. H.B., F&G.M.				

APPENDIX F (Continued)

Species	Range in State	Status or Abundance In Region	Importance of Wildlife	Range in United States	Project Impact Region	Texas	United States
Nutmeg hickory Carya myristicae formis	P., G.P.&M., and P.O.S.	Rare and Endangered (TOES, 1973, and Fisher, et al, 1972)	W., M.&S., S. U.G., S.M. H.B., F&G.M.	Gulf coast and lower Mississippi Valley Region			
Downy danthonia Danthonia sericea	P.	Rare and Endangered (Fisher et al, 1972)					
Ameican beakgrain Diarrhena Americana	P.	Rare and Endangered (Fisher et al, 1972)					
Cresed shield fern Dryopteris cristata	P.	Rare and Endangered (Fisher et al, 1972)					
Grass of parassus Parassia asarifolia	P.	Rare and Endangered (Fisher et al, 1972)					
Louisiana palm Sabal louisiana		Rare and Endangered (Fisher et al, 1972)	S., F.&G.M.				
Silky camellia Stewartia malocodendron	P.	Rare and Endangered (Fisher et al, 1972)					
Spanishmoss Tillandsia usneoides	P., G.P.&M., P.O.S., S.T.P., and E.P.						

* Range in State

P. - Pineywoods
G.P.&M. - Gulf Prairies and Marshes
P.O.S. - Post Oak Savannah
B.P. - Blackland Prairies
C.T.&P. - Cross Timbers and Prairies
S.T.P. - South Texas Plains
E.P. - Edwards Plateau
H.P. - High Plains
R.P. - Rolling Plains
T-P. M&B. - Trans-Pecos, Mountains and Basins

Importance to Wildlife

W. - Waterfowl
U.G. - Upland Gamebirds
F.&G.M. - Fur and Game Mannals
H.B. - Hoofed Browers
M.&S. - Marshbirds and shorebirds
S. - Songbirds
S.M. Small mammals

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