US Army Corps
of Engineers
Fort Worth District

BIG CYPRESS BAYOU
FISH AND WILDLIFE HABITAT RESTORATION
JEFFERSON, TEXAS

ECOSYSTEM RESTORATION REPORT
AND
INTEGRATED ENVIRONMENTAL ASSESSMENT

May 2000

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FOR

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Prepared by

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in Cooperation with the

CITY OF JEFFERSON, TEXAS
and the
CYPRESS VALLEY ALLIANCE

SYLLABUS

This Ecosystem Restoration Report presents the results of a study conducted under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended (33 USC 2201). The purpose of this study was to identify the ecosystem degradation caused by the construction and operation of Lake O' the Pines and subsequent development activities, evaluate measures to restore important ecosystem resources, and recommend an ecosystem restoration project, if one could be identified which meets the applicable project criteria. At the request from the city of Jefferson, Texas, the Fort Worth District, United States Army Corps of Engineers, completed this study.

The city of Jefferson is located in Marion County in northeast Texas, approximately 14 miles downstream of Lake O' the Pines. The study area is located along Big Cypress Bayou within the Jefferson city limits. Prior to the impoundment of Lake O' the Pines, Big Cypress Bayou had significantly more areas of wetlands, and bottomland and upland forests. Operation of the project has reduced the magnitude of flooding, which has directly degraded habitat, but also resulted in increased agricultural practices and other land use changes, further degrading the values of wetland and forested habitat. The construction of Lake O' the Pines also degraded the value of aquatic habitat by altering the flow regime of Big Cypress Bayou and serving as an impediment to the movement of fish and other aquatic organisms upstream of the reservoir's dam.

The study area was investigated and found to be suitable for ecosystem restoration, particularly fish and wildlife habitat restoration. The objective of the recommended plan is to restore bottomland habitat values by utilizing forest management practices including selective thinning and planting of hard and soft mast producing tree species. Further, permanent backwater wetlands will restore waterfowl nesting, rearing and wintering habitat, and reestablish bald cypress and bald cypress/water tupelo vegetative communities. The restoration of an early successional vegetative component, an emergent wetland, and a contiguous riparian corridor will benefit the free migration of avian and wildlife species throughout proposed project area, and restore habitat for neotropical migratory birds and bats. Lastly, gravel bars will be used to the restore aquatic habitat for spawning of paddlefish and other fish and aquatic organisms. The recommended plan will benefit resident species of wildlife such as squirrels, rabbits, deer, raccoon, various reptiles and amphibians.

The recommended plan consists of restoration of approximately 30 acres of bottomland hardwood forests, 2.9 acres of bottomland hardwood wetlands, 5 acres of urban wildscape including bat roosting and nursery habitat, 0.25 acres of emergent wetland, and 1.84 acres of instream spawning habitat for paddlefish and other aquatic species. The total project cost is estimated to be $1,898,887. This total project cost results in an average annualized cost, including operations and maintenance costs, of approximately $136,900. Implementation of the recommended plan would increase the average annualized habitat units by 17,925.07 habitat units over the without project ("no action") alternative at an average annualized cost of $5.65 per habitat unit gained.

Implementation of the project will be cost-shared between the Federal Government and the non-Federal partner; each party will be responsible for $1,371,560 and $527,327, respectively. The city of Jefferson has stated their support for the recommended plan and intend to act as the non-Federal partner during project implementation. Jefferson will also be responsible for all operation, maintenance, replacement, and repair costs. Both Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service are also supportive of the recommended plan.

An Environmental Assessment (EA) was integrated into this Ecosystem Restoration Report (ERR) to assess the possible impacts that could occur if the recommended plan were implemented. Items marked with an asterisk (*), both in the index and throughout the body of the ERR, indicate information required to fulfill National Environmental Policy Act requirements. A Finding of No Significant Impact, if appropriate, will be issued after reviewing comments on the EA.

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INTRODUCTION

* **Study Authority**. The study is authorized under the continuing authority provided to the Chief of Engineers by Section 1135 (b) of the Water Resources Development Act of 1986, as amended. The U.S. Army Corps of Engineers is the lead agency for this study. By letter dated May 6, 1997, the city of Jefferson expressed their desire to participate in an ecosystem restoration study. A copy of the letter is located in Appendix A.

* **Study Objective and Scope**. The objective of the study was to determine if the construction and/or operation of the Lake O' the Pines project had contributed to the degradation of the quality of the environment. And further, to determine the feasibility of implementing measures for restoration of ecosystem quality through modifications either at the project site or at other locations that have been affected by the construction or operation of the project. The selected measures will be recommended for implementation if they are feasible and consistent with the authorized project purposes, and will improve the quality of the environment in the public interest.

Field investigations were conducted to determine existing vegetational coverage of the area. Site visits were conducted to evaluate the overall quality of the habitats for their ability to support wildlife and meetings were held with resource agencies and the project sponsor to determine potential initiatives for wildlife habitat restoration.

A multidisciplinary team approach was used to conduct the study. In addition to the Fort Worth District, study participants included the Texas Forest Service, Texas Parks and Wildlife Department (TPWD), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers' Institute for Water Resource (IWR) and Waterways Experiment Station (WES), Bats Conservation International (BCI), Historical Preservation Consulting Services, Shapins Associates (under contract to the Fort Worth District), the city of Jefferson, and the Cypress Valley Alliance.

* **Study Location**. Lake O' the Pines, was constructed by the U.S. Army Corps of Engineers, and was known as Ferrel's Bridge Reservoir until it was renamed in 1958. It is a multipurpose reservoir authorized primarily for flood control, but also provides storage for industrial and municipal water supply and recreation. It is located on Cypress Creek in Marion, Harrison, Upshur, Morris, Camp, and Titus Counties. Ferrel's Bridge Dam is located about 8 miles west of the city of Jefferson. The reservoir controls a drainage area of 880 square miles and has a maximum surface area of 38,200 acres. At conservation pool level, it has a surface area of 18,700 acres. Construction of the reservoir began in 1955, and it was placed in operation in December 1959.

Jefferson is located in Marion County in northeast Texas, approximately 16 miles north of Marshall. The study area is located within the city limits of Jefferson along Big Cypress Bayou, approximately

14 river miles downstream of the Lake O' the Pines dam. Figure 1 shows the study area and its relation to Lake O' the Pines.

Preliminary Restoration Plan. The Preliminary Restoration Plan (PRP) for Big Cypress Bayou, Jefferson, Texas, dated August 1, 1997, briefly described the degradation of the downstream ecosystems caused by the construction of Lake O' the Pines, the proposed restoration activities, and project benefits, costs, and importance of project outputs.

The proposed restoration described in the PRP included the restoration of: 1) 60-acres of habitat restoration (bottomland hardwoods and wetlands) including 2 acres of emergent wetland; 2) 1200 linear feet of aquatic habitat along an oxbow; 3) 1100 linear feet of riparian forest; 4) 1000 linear feet of paddlefish spawning habitat; 5) 1.25 acres of native wildflower/flowering and fruiting shrub; 6) swallow nesting and bat roosting habitat on the support structures and subdecking of the abandoned railroad bridge; and supplemental features (boat ramp and utility relocations, and maintenance access). The estimated total project cost was $3,500,000.

Table 1 below summarizes the number of acres and habitat units identified under existing and with-project conditions during the preliminary restoration plan phase.

TABLE 1
PRELIMINARY RESTORATION PLAN HABITAT DATA

	Existing Conditions		With Project	
Habitat Type	Acres	Habitat Units	Acres	Habitat Units
Wetlands	2	1.0	2	3.85
BLHM	60	30.0	65.75	62.46
Other	8	0.8	-	-
Successional	-	-	1.25	1.19
Total	70	31.8	70	66.50

CYPRESS VALLEY WATERSHED

*** General.** The Cypress Valley watershed is located in northeast Texas and is a sub-basin of the Red River Basin. It lies between the Sulphur River Basin on the north and the Sabine River Basin on the west and south. The watershed drains to Big Cypress Bayou and flows through Caddo Lake at the Texas-Louisiana border. Big Cypress Bayou, between Lake O' the Pines and Caddo Lake, is roughly 40 miles long. Discharge is largely controlled by releases from Lake O' the Pines with input from tributaries and local runoff after heavy rains. The principal tributaries of Big

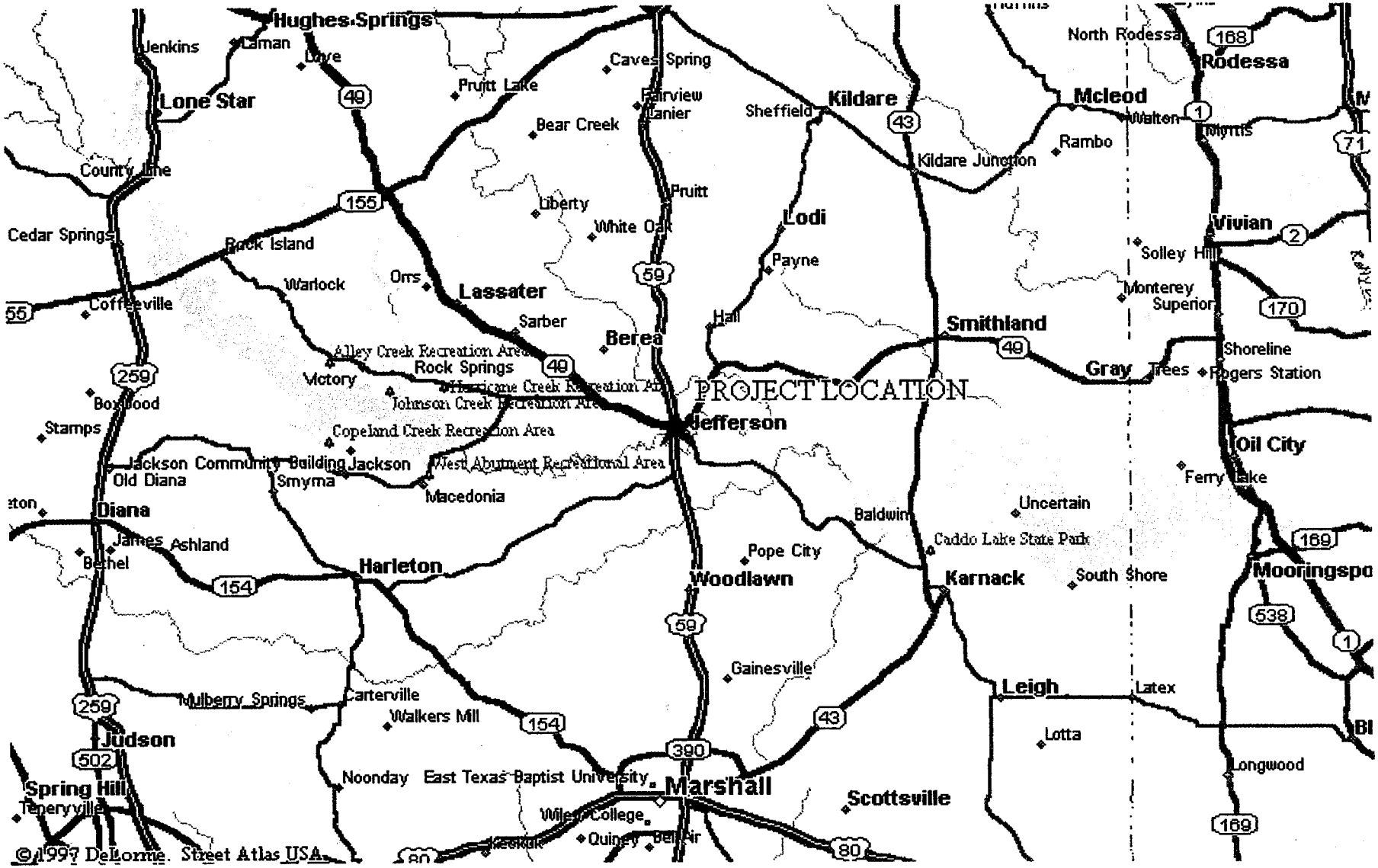

Figure 1 – Regional Map of Study Area

Cypress Bayou are two blackwater streams, Black Cypress Bayou and Little Cypress Bayou. Both of these tributaries converge with Big Cypress Bayou downstream of the city of Jefferson. The watershed is primarily rural. Groundwater in the Basin is derived from Carrizo-Wilcox and Queen City Aquifers and is a primary source of supply for rural dwellings.

***Climate.** The watershed has a climate generally subtropical with hot, humid summers and relatively mild winters. The Gulf of Mexico plays a dominant role during the spring and summer months, while modified polar air masses contribute significantly to the fall and winter climate. The daily maximum temperature for Marion County averages approximately 76 degrees Fahrenheit (F) and the minimum temperature averages approximately 52 degrees F. Daytime temperatures in summer usually exceed 90 degrees F. Winter temperatures are relatively mild with the temperature falling below freezing only a few days a year. The mean annual rainfall amount is 46 inches. The first frost in the fall is around November 15 and the last frost in the spring is around March 15. The length of the growing season is approximately 240 days.

***Topography**. The watershed is characterized by gently rolling to hilly terrain dissected by flat floodplains and terraces. The watershed lies within the West Gulf Coastal Plain in what is recognized as the East Texas Embayment. This region has local relief and a gentle gulfward slope to the land surface. The headwaters of Big Cypress Bayou originate in the southwest portion of Hopkins County, Texas. From there the Bayou flows eastward and southeastward about 100 miles emptying into Caddo Lake at the Texas-Louisiana boundary line.

***Soils.** The sediments within the watershed are of Quaternary and Tertiary age and represent periods of both fluvial and marine deposition. The alluvium in the basin was deposited by Big Cypress Bayou unconformably on an eroded Tertiary surface and is of recent formation. Soil types include the Mooreville-Mattex and the Latch-Mollville associations.

The Mooreville-Mattex association is made up of moderately to somewhat poorly drained, slowly permeable soils with loamy and clay loam subsoils located on flood plains. The Mooreville soils are moderately well drained acid soils formed on loamy sediments. The Mattex soils consist of very deep, somewhat poorly drained, slowly permeable soils. The Latch-Mollville complex is made up of poorly drained to moderately well drained soils that formed on alluvium on flood plain terraces. The Latch soils consist of very deep, moderately well drained, and nearly level to gently sloping soils that formed on sandy alluvium sediments. The Mollville series consists of very deep, poorly drained, and nearly level to depressional soils formed in old alluvium reworked by wind.

***Water Quality**. Water quality is generally rated as good to excellent with most parameters exceeding state water quality standards (Freese and Nichols 1977; U.S. Army Corps of Engineers, Vicksburg District 1994). Localized water quality problems do exist in the basin, however, primarily from low dissolved oxygen levels due to the reduced flows and high summer temperatures. Elevated concentrations of chlorides, total dissolved solids, coliforms and nutrients have also been observed. Overall, water quality in the basin can be described as slightly acid, with low turbidity, low total alkalinity and low total hardness (Ryan 1985). Recent field surveys, however, indicate hydrocarbon-

based pollution events have occurred from below Lake O' the Pines to, and including, Caddo Lake. Non-point source and unregulated point source from cities and commercial and agricultural activities are the primary threats to water quality in the watershed.

***Air Quality.** The air quality of Marion County in east Texas is generally considered to be of high quality as might be expected in an area that is primarily rural in character without much heavy industry. There are no air monitoring stations in Marion County. Marion County is in an Attainment Area for carbon monoxide (CO), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2); is unclassified for ozone (O_3) and particulate matter (PM10), and the presence of lead (Pb) is not designated. The closest air monitoring station is located in the city of Longview, roughly 25 miles east-southeast of Jefferson. Ozone summaries for this station show that in 1996, ozone levels of 0.08 ppm were exceed four times in the Longview area.

***Land Use.** The watershed was historically dominated by pine-hardwood forest; however, human intervention has dissected the once contiguous forest into a patchwork of different land uses. The original upland forest has been extensively cleared for agricultural purposes, especially in the western portion of the basin. Some of the bottomland forests have been converted to monocultured pine forest for commercial timbering. Currently, the principal land uses include hay production, cattle grazing and pine timber production (Hayes 1987). Oil and gas production, as well as homesite developments, have also contributed heavily to the reduction of forested lands in the basin.

***Aquatic Resources.** The key factors influencing the overall habitat value of the aquatic resources in the 40 mile segment of Big Cypress Bayou between Lake O' the Pines and Caddo Lake are the controlled releases from Lake O' the Pines with input from tributaries and local runoff after heavy rains. The development of Lake O' the Pines has greatly altered the natural hydrology of the Big Cypress Bayou flood plain by reducing the magnitude, frequency and duration of peak flows downstream of the dam. The dam is designed to release a maximum controlled flow of 3,000 cubic feet per second (cfs), whereas, prior to reservoir construction, flood flows within Big Cypress Bayou reached up to approximately 55,000 cfs.

Aquatic habitats within the basin are extremely diverse, ranging from large palustrine emergent and forested wetlands, such as those found at Caddo Lake to intermittent tributaries in the upper portions of the watershed. Between these areas is the perennial flow of Big Cypress Bayou and its tributaries with riffles, runs and pools and sluggish flowing areas within numerous oxbows, sloughs and backwaters. These aquatic habitats support a wide variety of aquatic fauna and flora. Aquatic substrates within the watershed are composed primarily of sand, clay, silt or organic detritus and are relatively homogeneous throughout the basin. Major woody vegetation species occurring on the stream banks or overhanging the water include bald cypress, water elm, river birch, black willow and buttonbush. Common emergent and floating plants include several species of pondweed and smartweed, duckweed, water primrose, white and yellow waterlilies, American Lotus and cattail, along with a variety of sedges and rushes. Steep banks, the scouring effects of high flows, and dense canopy cover of overstory trees often limit the aquatic vegetation found in and along the stream channel (Ryan 1985).

Over 80 species of fish are documented within the watershed, many of which are rare and/or at the westernmost limits of their distribution (Hoover et al. 1996). Local fish assemblages are taxonomically dominated by darters and minnows and to a lesser extent by sunfishes, exploiting a wide variety of habitats and microhabitats. Especially in the backwater systems, where the habitats are defined primarily by hydraulic parameters (velocity and depth) and instream structure (vegetation and woody cover), the fishes exhibit a high degree of habitat specialization (e.g., Baker and Ross 1981; Meffe and Sheldon 1988). Major sport fishes in the basin include channel and flathead catfish, white bass, white and black crappie, largemouth and spotted bass, and other various sunfishes. Primary forage species include gizzard and threadfin shad, small sunfishes, minnows and shiners. Spotted sucker, freshwater drum, carp, longnose and spotted gar and black and yellow bullheads are the primary rough fish species (Ryan 1985).

Characteristic insects are larvae and adult mosquitoes, deer fly, caddisfly, damselfly, skimmer, water boatman and water strider. Crayfish and grass shrimp are common crustaceans. Mud turtle, Texas slider and red-eared slider turtles were observed, along with a few reptiles and amphibians.

***Terrestrial Resources**. The vegetation and wildlife resources in the watershed are diverse and productive. Most of the watershed is located within the Pineywoods vegetational region of Texas and Louisiana, with the exception of the extreme western portion, which occurs in the Post Oak Savannah ecological region (Correll and Johnston 1979; Gould 1975). Bald cypress swamps are present along drainages in the eastern portion of the watershed and are significant in Caddo Lake and along Big Cypress Bayou upstream of Caddo Lake. Seven major vegetation/land use cover types have been delineated by TPWD for the area using Landsat imagery along with ground truthing procedures and computer classification analyses (McMahan, et al. 1984; Campo 1986). These seven types, one of which is water, all occur within the study area. The remaining types include pine-hardwood forest, grassland, mixed bottomland hardwood forest, bald cypress/flooded hardwood forest, upland hardwood forest, and cropland.

Due to the wide variety and interspersion of vegetation cover types and land uses within the watershed, wildlife populations are diverse and numerous. Approximately 216 bird, 47 mammal and 90 reptile and amphibian species are found in the Cypress Valley watershed. The bottomlands of east Texas contain important wintering habitat for various waterfowl species, and historically have played a key role in sustaining continental waterfowl populations. The USFWS has acknowledged the importance of the terrestrial habitats provided by the associated floodplain forest in this area by classifying the area as a Resource Category 2 under the Mitigation Policy. Mitigation planning goals for these habitats are no net loss of in-kind habitat values. The region includes a significant portion of the breeding and wintering wood duck population, and winters 30 percent of the North American mallard population, both of which are on the National Species of Special Emphasis (NSSE).

The pine-hardwood forest is the predominant vegetation cover type in the basin, occupying approximately 48 percent of the total area. According to Campo (1986), loblolly and shortleaf pines comprise about 85 percent of the dominant and co-dominant trees in the pine-hardwood forests being managed specifically for the production of timber, while mixed hardwoods comprise about 50

percent of the stands in unmanaged forests. Southern red oak, post oak, blackjack oak, sweetgum, winged elm and red maple are the major hardwood trees commonly found in the western portions of the basin, while these trees, along with hickories, water oak, white oak, Shumard oak, blackgum and sugarberry, are more common in the eastern portions of the watershed. Primary shrub species are hawthorns, flowering dogwood, sassafras, American beautyberry, sumac, farkleberry, deciduous holly, redbud and southern waxmyrtle . Groundcover is usually sparse, except in regeneration areas, and consists of a variety of vines, forbs and warm season grasses.

Common wildlife species found in the pine- and upland hardwood forests include white-tailed deer, fox and gray squirrels, raccoon, eastern cottontail, gray fox, coyote, armadillo, barred owl, mourning dove, pine warbler, blue jay, American crow, northern cardinal and various rodents and reptiles. Mature overstory vegetation in the pine-hardwoods and upland hardwoods provides abundant mast, snags and cavities for these forest dwellers. Numerous shrubs, vines and herbaceous plants also provide a diversity of food and cover. However, much of the pine-hardwood and upland hardwood forests in the area have been logged and converted to managed pine timber production. Pine forest stands provide less mast and overall have reduced wildlife values for the forest species.

Grassland occurs on approximately 25 percent of the basin, and consists of improved pastures and native grasses. It is generally used for hay production and cattle grazing. Dominant warm season species for the improved pastures include coastal and common bermudagrass, bahiagrass and dallisgrass. Rye, oats and wheat are the primary winter crops. In addition, pastures are often over seeded with legumes such as clovers and vetches. Native grasses which occur on less intensively managed pastures include bluestems, Indiangrass, and various panicums and paspalums. Forbs such as ragweed and croton are common invaders.

Grassland provides habitat for a variety of non-woodland wildlife species, including the northern bobwhite, eastern meadowlark, red-tailed hawk, scissor-tailed flycatcher, cottontail, coyote and numerous rodents. The intensive management practices, such as fertilization, herbicidal weed control and mowing, that are usually undertaken to improve grasslands for hay production and cattle grazing, generally lower the habitat value of grasslands to wildlife species by reducing the diversity and structure of herbaceous vegetation used for food, cover and nesting. Most of the grasslands in the basin are intensively managed, thus they generally provide only medium to fair wildlife habitat values.

Bottomland hardwoods occur on 18 percent of the watershed. Two distinct bottomland cover types are recognized. These are mixed bottomland hardwood forest and bald cypress swamp/flooded hardwood forest. Mixed bottomland hardwoods occur along major streams and tributaries, and are the more extensive of these two types. Water oak and willow oak are the dominant tree species with cherrybark oak, southern red oak, white oak, overcup oak, blackgum, sweetgum, sugarberry, winged elm, and bald cypress being major associated species. Water elm and river birch are locally abundant along stream banks. The bald cypress/flooded hardwood forest occur in association with Caddo Lake and upstream backwaters. Bald cypress is the predominant species with major associated tree species including swamp and water tupelo, overcup oak, water oak, willow oak, sweetgum, water

elm and bitter pecan. Wetland shrubs and groundcover plants are also common and include buttonbush, swamp privet, smartweed, lizard's tail and numerous sedges and rushes. Common floating or submergent vegetation in the swamps includes American lotus, water hyacinth, alligatorweed, arrowhead, elodea, duckweed, parrotfeather and pondweeds.

Mixed bottomland hardwood forests are dominated by forest dwelling species such as gray and fox squirrels, white-tailed deer, raccoon, swamp rabbit, barred owl, pileated woodpecker and Carolina chickadee. They also provide habitat for resident and migratory waterfowl. These wildlife species require a variety of niches within the bottomland hardwood forest for food, cover and reproductive habitat. Mature overstory trees provide hard and soft mast (e.g., acorns, pecans, hackberries, etc.), while understory shrubs and herbaceous plants produce fruit and seeds for food. Old growth areas of mature hardwoods provide numerous cavities and snags used by wildlife for dens, nests or refuge sites. Debris and brush piles, which often accumulate in bottomlands due to flooding, are also valuable to many of the species for cover and refuge.

Bald cypress swamps and flooded hardwood forests host numerous specialized wetland species, including alligator, alligator snapping turtle, beaver, mink, muskrat, prothonotary warbler and several species of plants. At least 11 species of plants, commonly found in the southeastern United States, reach the western periphery of their ranges in the swamps in this area (Spain 1981). The swamps are extremely valuable wintering and production areas for waterfowl, especially wood ducks and mallards, colonial waterbirds and other migratory birds.

Upland hardwood forests occur primarily in the western sections of the Cypress Valley watershed, and are located on hilly, well-drained sandy soils of the uplands. Besides post oak and blackjack oak, other species include loblolly and shortleaf pines, yaupon, American beautyberry, farkleberry, hawthorn, sumac and rusty blackhaw viburnum. Groundcover consists mostly of vines such as greenbriar, wild grape and dewberry. These forests comprise only a little over four percent of the basin.

Croplands occupy only two percent of the area, and are often cultivated on a rotational basis with pasturelands (Campo 1986). Grain and truck crops, such as grain sorghum, corn, wheat, vegetables, watermelons, etc., comprise the bulk of this land use. Wildlife species inhabiting croplands are generally opportunistic and use these areas primarily as a potential food source. Characteristic wildlife species include white-tailed deer, opossum, striped skunk, mourning dove, red-winged blackbird, cottontail and rodents. As with grasslands, croplands in the basin usually provide only medium to fair wildlife value to these species.

***Recreational, Scenic and Aesthetic Resources.** The freshwater lakes are the dominant resource attraction in the Cypress Valley watershed. A multitude of different water bodies in the region provides boating, fishing and swimming opportunities. The study area is located within the city limits of Jefferson, Texas along Big Cypress Bayou. The primary recreational activities are canoeing, boating, and fishing, with limited water skiing. The bayou can be accessed from a public boat ramp in Jefferson.

***Socio-Economic Conditions**. Marion County (population 9,883) has an economy centered around recreational activities, timber production, oil and gas production and agriculture. The county is one of the most impoverished in the State and has the worst poverty rate of any Texas county that does not border the Rio Grande. Texas Department of Human Services poverty population statistics shows 36.8 percent of the county's non-institutionalized population living below the poverty line ($6,450 for a single individual in 1990). The county has a lower educational attainment level and a lower per capita yearly income than the statewide average. Only 62 percent of Marion County adults are high school graduates and 7.6 percent of the over 25 population have degrees compared to 72.1 percent of graduates and 20.3 percent degrees statewide. Marion County per capita income is $10,450 and median family income is $15,288 compared to $14,590 per capita and $27,016 median family income statewide. All statistical references in this paragraph are based on a 1995 report by the Texas Engineering Extension Service (Texas A & M 1995).

Jefferson is the county seat and largest city in the county with a population of 2,131. Jefferson has a rich historical heritage based on commercial navigation. Its main source of income is tourism -- there are over 60 bed and breakfast facilities in the city. Currently the city is suffering from slight out migration of its population, most notably young people. Closely reflecting the statistics of Marion County, Jefferson is not a wealthy community - 33 percent of the city's population fall below the poverty line.

Environmental Degradation. The construction and impoundment of Lake O' the Pines destroyed existing habitat and subsequent shoreline development activities further degraded the existing environment. It was noted earlier Lake O' the Pines inundates 18,700 and 38,200 surface acres of land at the conservation pool and flood pool, respectively. Historically covered with a mixture of bottomland hardwood and upland forests, emergent wetlands and tall grass prairies (Correll and Johnston 1970, Gould 1975), this land, at the time of inundation, was covered with broad remnants of each of those historic vegetation types along with agriculture fields and pasture lands.

In addition to the destruction of habitat caused by the construction and impoundment of the reservoir, there have been significant adverse impacts on the aquatic fauna and flora downstream of the reservoir. Control of flooding eliminates many acres of backwater habitat resulting in reduced food supply sources, less cover, less spawning and nursery habitat for fish, a redistribution and reduction of organic matter, a reduction in plankton production and, finally, a disruption of fish territory and migration patterns.

According to the USFWS (1985), the indirect downstream effects of reservoir construction on natural bottomland ecosystems are often more destructive, albeit not as immediate, as the direct impacts. Adverse impacts observed downstream of the Lake O' the Pines include: 1) an unnatural bottomland hydroperiod causing major vegetational changes toward more xeric species as a result of the reduction in flooding; 2) the reduction of silt and associated nutrient inputs to downstream bottomlands; 3) the loss of aquatic flora and fauna, and bank-stabilizing vegetation as a result of excessive bed and bank scour from irregular reservoir releases; 4) disruption of normal feeding and

spawning cycles of fish which use floodplains; 5) elimination of high flows into bottomlands which prevents the input of bottomland nutrients into the aquatic system; and 6) potential negative effects to plant communities as a result of prolonged water releases during the growing season.

Specific impacts on the downstream aquatic fauna and flora include: 1) a reduction in the benthos production as a result of less food and habitat in the Bayou; 2) reduction of cover, spawning and nursery habitat for fish; 3) disruption of fish territory and migration patterns; 4) reduction in plankton production; and 5) a redistribution and reduction of organic matter.

The operation of the reservoir has also had an adverse impact on the bottomland ecosystem. The reduction in downstream flooding has increased the amount of land available for agricultural production. In addition to the clearing of bottomland forests for agricultural land, agriculture activities such as plowing, tilling, planting and or grazing disturb the soil, thereby affecting the survival of invertebrates. These activities also cause increased erosion, increasing the rate of sedimentation. Fertilizers, herbicides and pesticides are introduced into the aquatic system resulting in a degradation of the water quality.

The construction and operation of the Lake O' the Pines has also provided a catalyst for the harvesting of bottomland hardwood forests. Timber production below the lake is becoming increasing significant as most of the forests of the Pacific Northwest have been cut over, and the southern climate is much more favorable for intensive silviculture. Although a number of the major timber companies have deferred cutting bottomlands at present, most of the negative impacts are on private lands and by small timber contractors. Timber harvesting practices are not regulated in the state of Texas. Most of the commonly used harvesting techniques have some negative impacts on hardwood systems. Harvesting only the best trees and clearcutting of large acreages is detrimental to wildlife and regeneration of the forest resources, as is the construction of haul roads. Replanting of clearcut areas is generally done with pine seedlings since they have a faster regeneration rate than do hardwoods. Even mature pine plantations support decreased wildlife populations and no waterfowl. Further, the loss of tree species diversity results in a loss of the numbers and diversity of the wildlife species that utilize the forest for habitat. Even in those clearcut areas replanted with a variety of mixed pine and hardwood tree species, the fact all the trees are the same age means the stands lack certain requisites needed by many wildlife and bird species, such as cavities for nesting and reproduction and snags for roosting. The loss of mature cavity trees has also adversely impacted the roosting habitat for native bat species, which in East Texas' Pineywoods region, are primarily tree dwellers. Bats are exceptionally vulnerable to extinction because they are the slowest reproducing mammals on earth for their size, with most producing only on young annually. More than 50 percent of U.S. bat species are already listed as endangered or are in severe decline. The single greatest cause for this is loss of traditional roosts.

Early successional vegetation is an important component of bottomland forests and the wildlife and avian species they support. Wildfires played a major role in the natural regeneration process of the forest by providing openings in the canopy. Native herbaceous vegetation and shrubs, as well as seedlings of bottomland and pine trees were dependent upon these openings to become established.

This habitat was utilized by many bird and wildlife species, as well as insects. Suppression of fire has had a profound effect on the amount of this type of habitat that exists today in stands of bottomland hardwood forests.

The construction and subsequent inundation of Lake O' the Pines not only destroyed the existing habitat in the immediate area, but by modifying the natural hydrologic regime of the Big Cypress Bayou ecosystem, it adversely impacted the aquatic and terrestrial habitat downstream. The degradation of the riparian habitat as a result of this, as well as land use changes that have occurred in the region, have combined to significantly degrade the quality and quantity of habitat for both aquatic and terrestrial wildlife species and thus, have reduced the diversity and richness of the species that now exist.

STUDY AREA

***Existing Conditions**. The study area is located in the city limits of Jefferson along the banks of Big Cypress Bayou. Because of distinct differences in the existing resources and possible ecosystem restoration opportunities to be found in the study area, five distinct sections were identified. The separate sections are delineated in Figure 2 and include the West, Core, East, South and Big Cypress Bayou sections.

West Section. This 38-acre section is located along the north bank of Big Cypress Bayou, west of the Polk Street bridge (Business Highway 59). The area (known as St. Catherine's Island) was once separated from Jefferson by an oxbow that connected at both ends to Big Cypress Bayou. The island has since reconnected to the main flood plain adjacent to the bayou. The area was the likely source of material used to construct flood control levees in the late 1940s. Several interior drainages within the area hold rain, local runoff and overflow from the bayou during flood events for relatively short periods of time (depending on flood duration or sustained releases from Lake O' the Pines) before the water drains back into the Big Cypress Bayou. Further, a large stormwater pipe opening just south of an existing parking lot drains toward the bayou in a narrow channel near Polk Street through this section. The bayou's edge in this section is natural with sand being deposited by overbank flows and cypress knees protruding from the water.

Common overstory tree species in this area include overcup oak, willow oak, water oak, sweetgum, baldcypress, sugarberry, water hickory and cottonwoods. Major understory species include saplings of the overstory trees, willow, river birch, water elm, winged elm, and American hornbeam. Shrub and vine species in the understory consist of American beautyberry, trumpet-creeper, greenbriar, wild grape, rattan, deciduous yaupon, and poison ivy. Characteristic herbaceous vegetation includes sedges, giant cane, Canada wildrye, Virginia wildrye, smartweeds, and violets. Some wildlife species observed in this section of the study area included white-tailed deer, beaver, gray squirrel, wood duck, great blue heron, belted kingfisher, and several species of passerine birds, reptiles and amphibians.

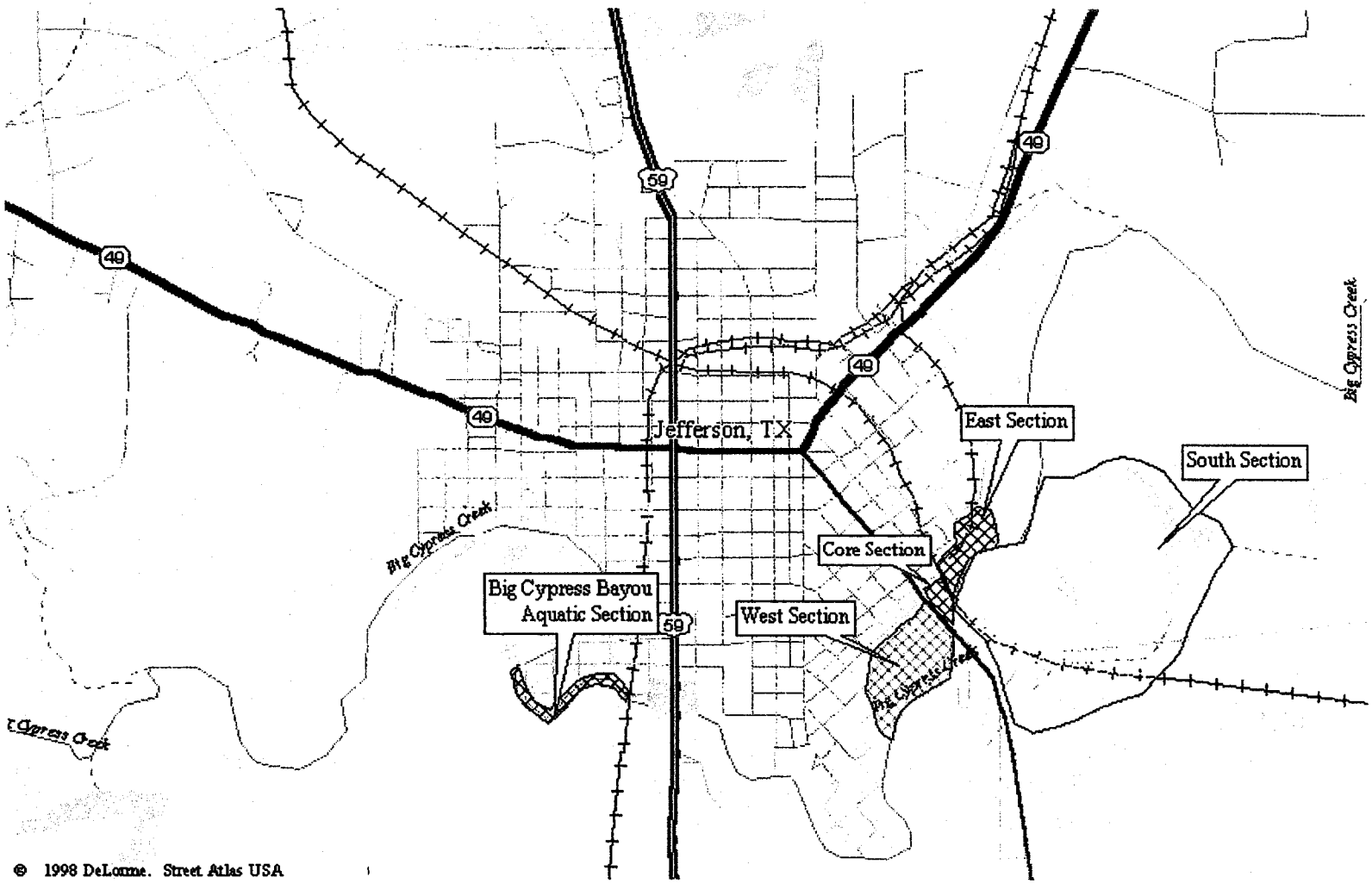

Figure 2 – Detailed Study Area Map

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This section was noted for a lack of hard mast tree species in certain stands. This is primarily due to the limited hard mast seed source available for the natural seeding process and the closed canopy, which prohibits seedling regeneration due to the lack of light penetration. Other stands lack both species and age diversity. These stands are generally dominated by densely growing sweet gum of all the same age. Further, there is a lack of cavities suitable for nesting and brood rearing activities.

The single most intrusive man-made feature is a dirt road that bisects this area (Photo 1). The road is set above the elevation of the adjacent lands. A 36-inch culvert under the road in one low lying area allows water to flow under the road in that section, but otherwise the road cuts off the natural sheet flow of water through the area. Even though it is seldom used, no vegetation grows on the road making it is a visual scar in an area where the rest of the resources are natural looking.

Core Section. This section extends from Polk Street to the current Louisiana and Arkansas Railroad bridge, bounded by the bayou and Dallas Street. An abandoned Louisiana and Arkansas Railroad bridge (Circa 1901/1907), owned by the city of Jefferson, lies between the two. This section encompasses a little over 3 acres of land, and consists of a public boat ramp (Photo 2) and parking lot, mowed grasses and cultivated shrubs (owned and maintained by TPWD). A number of native vines, such as trumpet-creeper, grow along the abandoned railroad structure. The land between the abandoned railroad bridge and the active bridge is kept free of trees as a result of the right-of-way management techniques utilized by the Louisiana and Arkansas Railroad Line and contains a variety of grass and sedge species. The bayou's edge is highly disturbed as a result of the boat ramp. The ramp area is regularly dredged, and the material placed along the bank. There is almost no habitat value for wildlife. Wildlife species observed include butterflies and hummingbirds that utilize the flowers of the vines growing up the sides of the abandoned railroad bridge.

Currently, the city of Jefferson is constructing an environmental education learning center on the northern boundary (Dallas Street) of this section. Adjacent to this area is Jefferson's historic downtown region.

East Section. This section consists of about 27 acres of land, and extends from the Louisiana and Arkansas Railroad bridge downstream approximately one-half mile. For the most part, this area is covered by a diverse mixture of bottomland hardwood, with observed wildlife species and tree, shrub and herbaceous vegetation similar to that of the West section. However, the configuration of this section is relatively narrow and includes the levee that separates developed portions of Jefferson from the bayou and the canopy, at least in the first quarter mile portion, is much more open. The levee has an opening in this area to allow maintenance workers access to the city of Jefferson's raw water intake facility that is located approximately one- quarter mile downstream of the Polk Street Bridge. This area is also used by the general public to gain access to the Big Cypress Bayou. Vehicles are often parked in an open area below the levee causing adverse impacts to understory and ground vegetation.

North and east of this location, another portion of land in this section was cleared for construction of a small railroad depot and roughly four miles of track. This railroad is operated on a part-time

basis during the tourist season. A major portion of the land over which the railroad tracks pass is covered with a diverse mix of bottomland hardwoods. The forest stands in this area are of moderate to high quality for wildlife and are crisscrossed by several interior drainages, a few of which have narrow outlets to Big Cypress Bayou. Unfortunately, the underlying area is an old city landfill that was closed in the early 1970s. Walking through the area during field investigations revealed trash lying on the surface of the ground in many areas.

South Section. This section consists of 313 acres of primarily upland forest. Once a mixed pine-hardwood forest, today it is a mix of unmanaged pine-hardwood forest and pine plantation. Most of the forest has been commercially harvested since 1972, when the current owner purchased the property. Portions of the upland forest have been managed differently and there are several age classes now represented. There are stands of pure pine as a result of clearcutting and replanting with mixed loblolly and shortleaf pine seedlings in plantation-style rows. Some stands were subjected to natural regeneration techniques, i.e., selected trees are left at the time of harvesting to provide seed sources for natural regeneration processes, and benefited with a pine release plan, i.e., the suppression of the establishment of hardwoods using herbicides. Finally, there are mixed pine-hardwood forest stands that have not been managed since being clearcut approximately 12-15 years ago. Currently these stands are dense thickets of mixed pine and hardwood saplings.

This section also contains several unique natural resource features. One such natural resource is the presence of a 10 to 12 acre bald cypress swamp (Photo 3) complete with resident American alligator. Characteristic of the natural bottomland hardwoods that would have surrounded this oxbow pond historically, a narrow band of bottomland hardwoods was left intact on a small portion of the land north of the pond. Surrounded by pure pine and mixed pine-hardwood forests, the swamp is covered with a continuous mat of duckweed. The swamp is a mesocosm replica of Caddo Lake with its tall cypress trees, Spanish moss and the other unique vegetation, birds and wildlife that make up a biological community that is considered irreplaceable and unique.

A second natural feature is the series of overflow swales found on the flood plain and terraces parallel to the stream channel. The differences in relief provided by the swale produce profound vegetational variations (Nixon et al. 1973; Chambless and Nixon 1975). The land that parallels the bayou channel in the South section has six relatively distinct vegetational and topographic zones from the bayou's edge to the upland mixed pine-hardwood forests. There are many large bald cypress and oak trees comprising the overstory species in this area which are at least 75 years old. There is little understory or ground cover vegetation in this area, partly due to the closed canopy.

It is known from historic maps and pictures of the area in the mid- to late-1800's, almost all of the forests along the bayou were cut to supply firewood needed by the stream boats navigating the Big Cypress Bayou up to Jefferson, and to clear the land for cotton farming.

The South section has a great diversity of wildlife species due to the mosaic like vegetational communities -- upland pine and mixed pine-hardwoods, open grasslands, bald cypress swamp, and mixed bottomland hardwoods. In addition, there is little contact with humans on this tract of land

Photo 1. Dirt road bisecting West area.

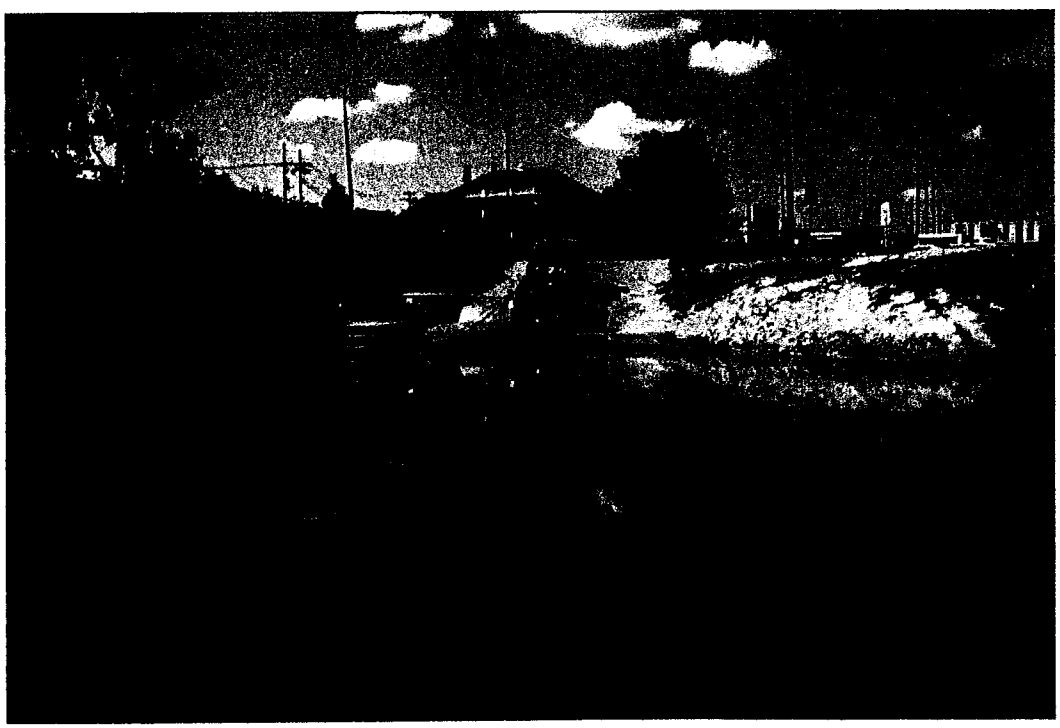

Photo 2. Boat ramp in Core area.

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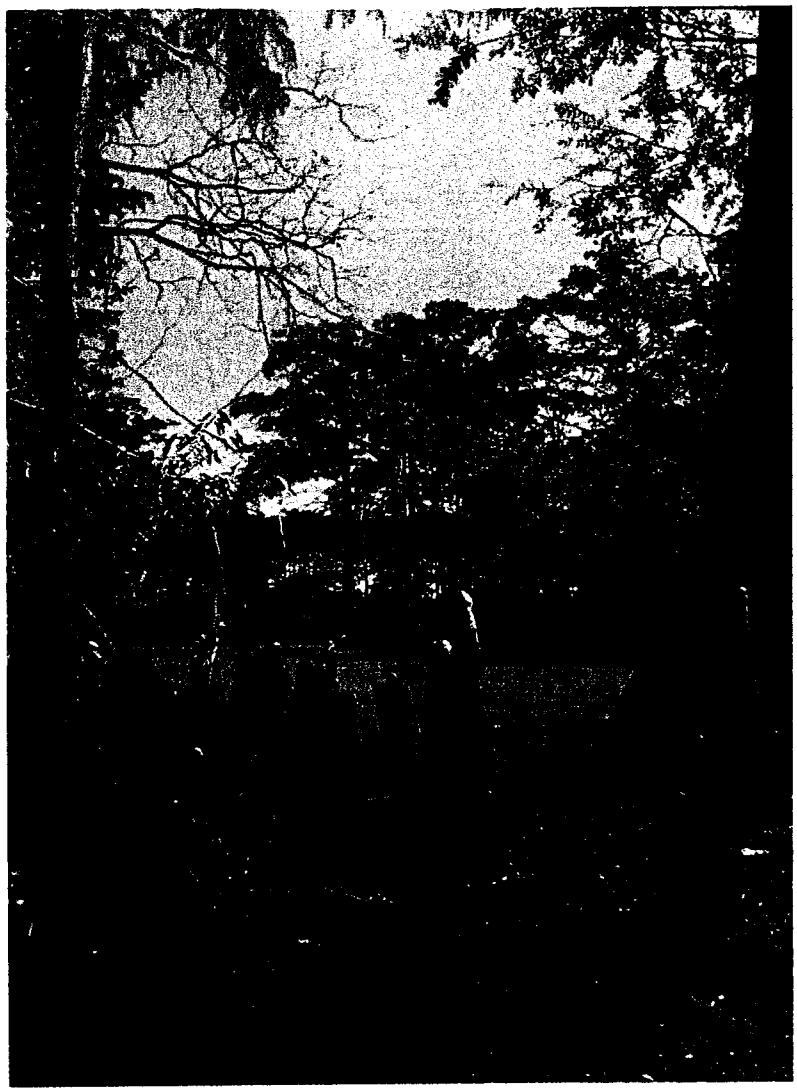

Photo 3. Bald cypress swamp in South area.

so species normally absent in the presence of humans are found here. Common species include white-tailed deer, raccoon, opossum, gray squirrel, beaver, great blue heron, belted kingfisher, prothonotary warbler, several species of passerine birds, alligator, alligator snapping turtle, beaver, mink, and muskrat, as well as waterfowl, especially wood ducks and mallards, colonial waterbirds and other migratory birds.

Figure 3 is an artist's rendering portraying preliminary observations of the existing conditions for the terrestrial portions of the study area following an initial site visit.

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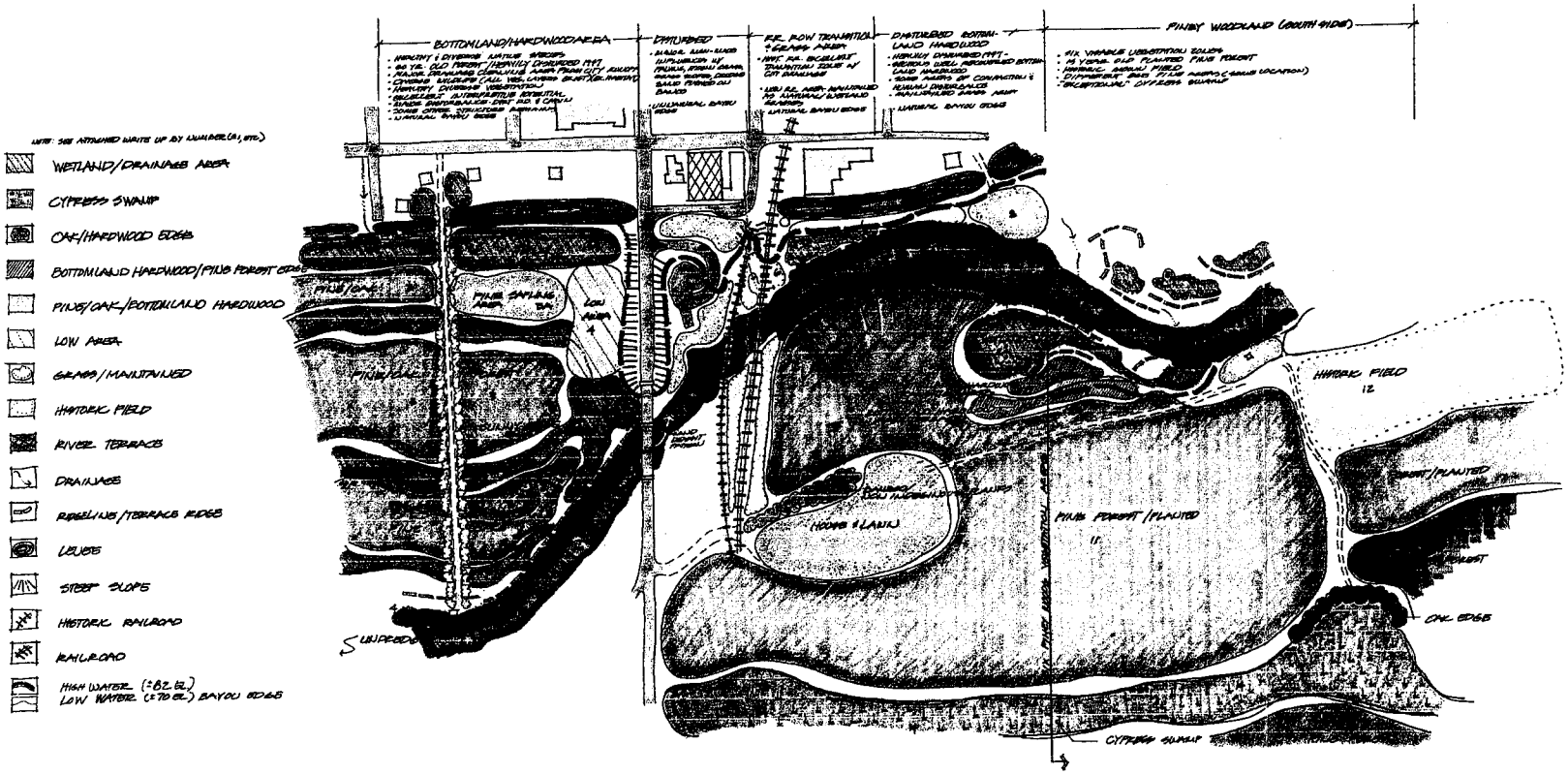
EXISTING CONDITIONS



BIG CYPRESS BAYOU
FISH AND WILDLIFE HABITAT RESTORATION PLAN

0 100 200 300 400

JEFFERSON TEXAS

FIGURE 3

Big Cypress Bayou. Polk Street coincides with a major change in the morphology of the bayou's channel in the study area. Downstream the river was historically navigable (channelized) and is wide (125-130 feet) and deep (to 40 feet) with little instream cover except for cypress knees. In contrast, the reach upstream is shallow and meandering with submerged logs and riparian vegetation. Substrates are primarily sand, clay, silt or organic material. A portion of the Bayou, located upstream of the Texas & Pacific Railroad bridge, west of U.S. Highway 59 in the southeast portion of Jefferson, is characterized by relatively shallow water over a firm sand and clay substrate that extends approximately 1,800 feet to an extensive area of bedrock. Other factors influencing the aquatic resources are the controlled releases from Lake O' the Pines, local runoff following rains and input from tributaries.

These impacts affect a large number of aquatic species, but have had a profound effect on the paddlefish (*Polyodon spathula*). The paddlefish was listed as an Endangered Species by the Texas Parks and Wildlife Department in 1977 after it became apparent the species range and numbers were diminishing in Texas (Pitman 1991).

The paddlefish is a planktivorous, freshwater species originally found only in North America throughout the Mississippi Valley and adjacent Gulf Slope drainages. The species was prevalent in Texas in the San Jacinto River, Trinity River, Neches/Angelina River, Sabine River, Big Cypress Bayou, Sulphur River and tributaries of the Red River. Paddlefish are large fish, growing up to 7 feet and 200 pounds. They have smooth, tough skin with small scales on the upper lobe of the tail and are readily distinguishable by their broad, elongated snout. The paddlefish fish have highly specific feeding and reproductive habitat needs. Backwater or other area rich in zooplankton and with low current velocities are necessary for feeding and resting, while clean, gravel substrates with high current velocities are needed for successful spawning. At the time paddlefish were placed on the Texas Endangered Species list, small populations were found only in the lower reaches of five East Texas rivers, of which Big Cypress Bayou was one.

Habitat Suitability Indices and Habitat Units. The above Existing Conditions section identified a number of opportunities and constraints found in the study area toward the restoration of habitat for a wide variety of fish and wildlife species. In order to identify and evaluate potential restoration opportunities it was necessary to establish a baseline of current habitat values in the study area for comparison, therefore, an overall evaluation of the quality of the existing natural resources based on their value as wildlife, avian, and aquatic habitat was conducted. Evaluation procedures used were the Habitat Evaluation Procedures (HEP) and the draft Bottomland Hardwood Community Model (BLHCM) developed by the USFWS. Both HEP and BLHCM utilize various habitat characteristics within sample plots to numerically define the comparative value of habitat quality based on a 0 to1 scale, where 1 represents optimum habitat conditions and 0 represents habitat conditions of no usable value. HEP evaluates habitat based on Habitat Suitability Index (HSI) models for wildlife species that typify a targeted habitat type (i.e., bottomland hardwoods, wetlands, etc.). BLHCM evaluates habitat conditions based directly on the habitat characteristics of the vegetative community rather than an individual wildlife species. According to USFWS, there has

been a strong correlation shown between the results of both of these methodologies in previous evaluations in east Texas.

The HSI values represent the overall value that results from running an HSI model. Habitat units (HU) are derived by multiplying the overall HSI score from each section by the number of acres in that section. Table 2 summarizes the habitat values of the existing natural resources for each individual section of the study area.

TABLE 2
EXISTING HABITAT SUITABILITY INDICES (HSI) AND HABITAT UNITS (HU)

Section	Habitat Type	Acres	HSI	HU
West	Bottomland hardwood	38.0	.55	20.9
Core	Open, disturbed	3.5	0.0	0.0
East	Bottomland hardwood	20.0	0.4	8.0
	Open, disturbed	7.0	0.0	0.0
South	Pine-hardwood	260.0	0.5	130.0
	Grassland	53.0	0.15	8.0
Big Cypress Bayou	Aquatic (paddlefish)	569.7	0.20	113.9

Endangered or Threatened Species. According to the USFWS, the species listed in Table 3 have utilized the study area or similar areas, primarily as a migratory corridor during fall and/or spring migrations. Because of this, it is necessary to determine the potential to adversely impact any of the listed species by implementation of proposed project features.

TABLE 3
ENDANGERED OR THREATENED SPECIES (Federal Register July, 1995)

Bald eagle	*Haliaeetus leucocephalus*	Endangered
Interior least tern	*Sterna antillarum*	Endangered
Red cockaded woodpecker	*Picoides borealis*	Endangered
American peregrine falcon	*Falco peregrinus anatum*	Endangered
Arctic peregrine falcon	*Falco peregrinus tundrius*	Threatened
Louisiana black bear	*Ursus americanus*	Threatened
Piping plover	*Charadrius melodus*	Threatened

The red cockaded woodpecker is known to occur within the Cypress Bayou Basin. Bald eagles are sighted with some regularity wintering near major impoundments in the basin, such as Lake O the Pines and Caddo Lake. Peregrine falcons are infrequently sighted during migration within the basin and interior populations of least tern, the Arctic peregrine falcon and piping plover may migrate through the project area.

Several State of Texas listed species of concern may occur in the area. These are Rafinesque's big-eared bat (*Plesotus rafinesquii*), southeastern bat (*Myotis austroriparius mumfordii*), osprey (*Paudion haliaeetus carolinensis*), wood stork (*Mycteri americana*), swallow-tailed kite (*Elanoides forficatus*) and river darter (*Hadropterus shumardii*). Also the paddlefish (*Polyodon spathula*) is on the State of Texas Endangered Species list.

Cultural Resources. The cultural resources under consideration in the study area may be identified as archaeological sites and architectural or structural elements in the landscape that are at least 50 years of age. The area of potential effect (APE) is generally characterized as that bottomland, floodplain and terrace margin along Big Cypress Bayou between the valley wall and the Bayou and south of the foot of Marshall Street on the west to the foot of Washington Street on the northeast. The study area begins at the south end and is bounded by a line running about 200 feet west of Marshall Street and the Bayou, northwest to the intersection of Marshall and Camp streets; thence, the boundary heads north diagonally to the intersection of Lake and Market streets. Thereafter, the boundary follows Lake Street northeasterly for one block, turns northwest on Vale Street and then back northeasterly on Dallas Street. It subsequently follows the projected line of Dallas from Vale Street northeasterly for four blocks before turning southeasterly to tie back into the Bayou.

Evidence indicates that the inception of human activity in the proposed project vicinity likely dates to before 10,000 years ago and prehistoric exploitation of the adjacent uplands and riverine system lasted until the early 1800s.

Historically, Big Cypress Bayou may have been visited by Luis de Moscoso de Alvorado between 1541 and 1545, as he led the survivors of the Hernando de Soto expedition back to Mexico following de Soto's death on the Mississippi River in 1541. Later, the area came under the domain of Spain, which was competing with the French to the north and east for land entitlement. By 1823 the area was under the rule of the Republic of Mexico until Texas won independence in 1836. Euro-American and Afro-American occupation of the vicinity increased during the early 1840s and for 30 years Jefferson was an economic center due to river trade from east along the Red and Mississippi rivers, reaching a climax between 1868 and 1872. River traffic for commercial purposes essentially ceased in 1872 with completion of the railroad through Jefferson and inception of commercial rail traffic. The population and importance of Jefferson declined as a commercial center after 1872.

A non-invasive surface survey of the project area identified six historic archaeological loci, three of which included structural remains. One of the historic sites is an apparent habitation locus with a well or cistern, while a second includes surface brick fragments and evidence from a soil probe of

a buried surface between 30cm and 40cm below surface. Another of the historic sites appears to be a linear distribution of building debris placed along the Bayou in the old wharf area to retard erosion prior to levee construction in the 1940s. Two intact architectural resources were recorded, one being a 1907 iron truss with wood tresses railroad bridge, and the second a water storage tank dating to around 1917. In addition, nine loci were identified that have high potential for containing buried archaeological deposits, while six natural features or landforms are believed to have archaeological potential. No evidence was forthcoming of prehistoric occupations in the project area; however, it is believed that any prehistoric sites have been buried by alluvial deposition due to historic land use practices.

The South section is known to contain two historic features. A Civil War era ordnance magazine and a large, clearcut open meadow on which Federal troops encamped and trained in the late 1860's. The powder magazine, donated to the Historical Foundation of Jefferson prior to their restoration of the building and its subsequent listing on the National Register of Historical Places, is a small, one and one-half story, single room brick building that is located on a bluff overlooking Big Cypress Bayou. Constructed during the Civil War primarily for the storage of powder and munitions, the building is surrounded by undeveloped lands and, thus, retains most of its natural setting. With the exception of the tract of land upon which the powder magazine is located, the remaining south section was not surveyed for cultural resources and/or archeological sites during the course of this study. Appendix F contains the complete documentation for the cultural investigation.

Hazardous, Toxic and Radioactive Waste (HTRW). A HTRW Initial Assessment was completed for the purpose of identifying possible hazardous wastes and/or other environmental concerns within the study area.

The HTRW Initial Assessment relied primarily on the use of existing documents, and also involved a site visit and environmental records search. The purpose of the visual inspection was to ascertain the existence, if any, of seeps, discolorations in soil and water, dead vegetation, signs of dumping and/or filling, strange odors, and any other general indication of the presence of hazardous waste conditions. Environmental Protection Agency (EPA), Texas Natural Resource Conservation Commission (TNRCC) and the Texas Department of Health (TDH) records were also reviewed to obtain any information on violations, litigation, history of chemical releases, nearby legal or illegal landfilling and dumping, and past and present land use, including treatment, disposal, and storage of hazardous waste. Local residents and a city employee were interviewed and a land use evaluation was conducted. The interviews were for the purpose of collecting information such as land ownership and the occurrence of any chemical spills or releases, not registered or documented in the environmental records database.

The visual survey, which included photographs and a walk-through of the project limits, noted no indications of seepage or surface drainage of sludge or other visually contaminated liquid material. Water was stained and appeared to be in fairly good condition. Streamflow was moderate and it appeared that minimal runoff from non-point sources of contamination had affected water and sediment quality. Concrete construction material, bricks and other debris were noted in scattered

locations along the northern (left) bank, downstream from the Polk Street bridge. These were determined to be remnants of foundations dating back prior to the 1950s. Additional surface debris (i.e., household waste and construction material) was noted along a 0.5 mile linear area located further downstream. This area was determined to be a series of landfilled pits representing the old city municipal landfill, and had been closed since the mid-1970s. The area south of Big Cypress Bayou was primarily wooded, with limited access on each side of Polk Street due to private ownership. No significant environmental problems along the channel were noted.

The EPA database records search noted no businesses within one mile listed under RCRA or CERCLA registration. No Superfund or National Priority List sites were noted, nor were any Toxic Release Inventory sites (emission sources) listed in the records. One site, previously an auto dealership, was noted on the TNRCC Voluntary Cleanup Program Site Report as being in the remediation phase. At that location, high concentrations of Total Petroleum Hydrocarbons (TPH) and lead contaminants were noted in soil, probably resulting from used oil having escaped beneath hydraulic lifts. The location was in the Ark-La Gas Building along Lafayette Street, approximately 0.3 miles from the project. No sites were noted on either the Emergency Response Notification System or the Hazardous Material Incident Reports within 0.5 miles of the proposed project.

Results of the TNRCC petroleum storage tank (PST) records search indicated the presence of four registered PST locations within 0.5 miles of the project area. Two were noted as leaking (LPSTs) and were both found to be within 0.25 miles of the project area. The records showed only minor soil contamination associated with each (Humble Oil and Coke Chevrolet) and no remedial action plan (RAP) required. No State registered spill sites were noted within 0.5 miles of the proposed project.

Interviews with a city of Jefferson employee and a local resident indicated that no spill records were maintained. Also, no such occurrences of spills or releases were recollected other than the previously mentioned Ark-La Gas Building. Results of the land use evaluation did not reveal any major environmental concerns. Examination of a bird's eye drawing from 1872 indicated that the Jefferson central business district had been completely developed at that time, much as it remains today. Historical land usage consisted of residences to the north and west of downtown Jefferson, a river boat port located near what is now the Polk Street bridge, various shops, a foundry, and a few small factories. According to the map, the southern portion appeared to be vacant and had, at most, been utilized as agricultural and/or forestry land. Conversations with a lifetime resident of Jefferson indicated that the southern portion of the project area had undergone little or no activity, other than a few residences and a small guest ranch, since the 1930s. Aerial photographs dating back to 1954 were also examined with evidence of the city municipal landfill downstream (east) of the project in all photographs. Although commercial development presently remains in the northern half of the study area, the nature of business is mostly tourism with numerous retail shops, some office space and several restaurants. To date, no commercial activities are known to have been associated with any hazardous waste or chemical releases into the environment within the immediate project area.

Based on knowledge of the study area, it is not believed any active CERCLA sites, or any other substantial environmental risks exist within the proposed Big Cypress Bayou project area.

PLAN FORMULATION

***Objectives, Opportunities and Constraints.** Field surveys were conducted to document the existing conditions of the natural resources within the study area, determine potential ecosystem restoration opportunities and identify any constraints that might limit the implementation and future viability of potential ecosystem restoration measures. Comments and recommendations from the resource specialists were incorporated into a number of possible restoration measures appropriate to the habitat type, site location and existing conditions. Figure 4 is an artist's rendering portraying the preliminary restoration opportunities that were identified. This rendering was developed before individual sections were determined, but it includes all possible features identified, including those later determined not to be included in the recommended plan.

West Section. The environmental objective in this section is to restore a hydrologic regime compatible with flooded bottomland hardwood forests, improve existing bottomland hardwood forest stands using forest management techniques and reduce the impact of man-made intrusions on natural resources.

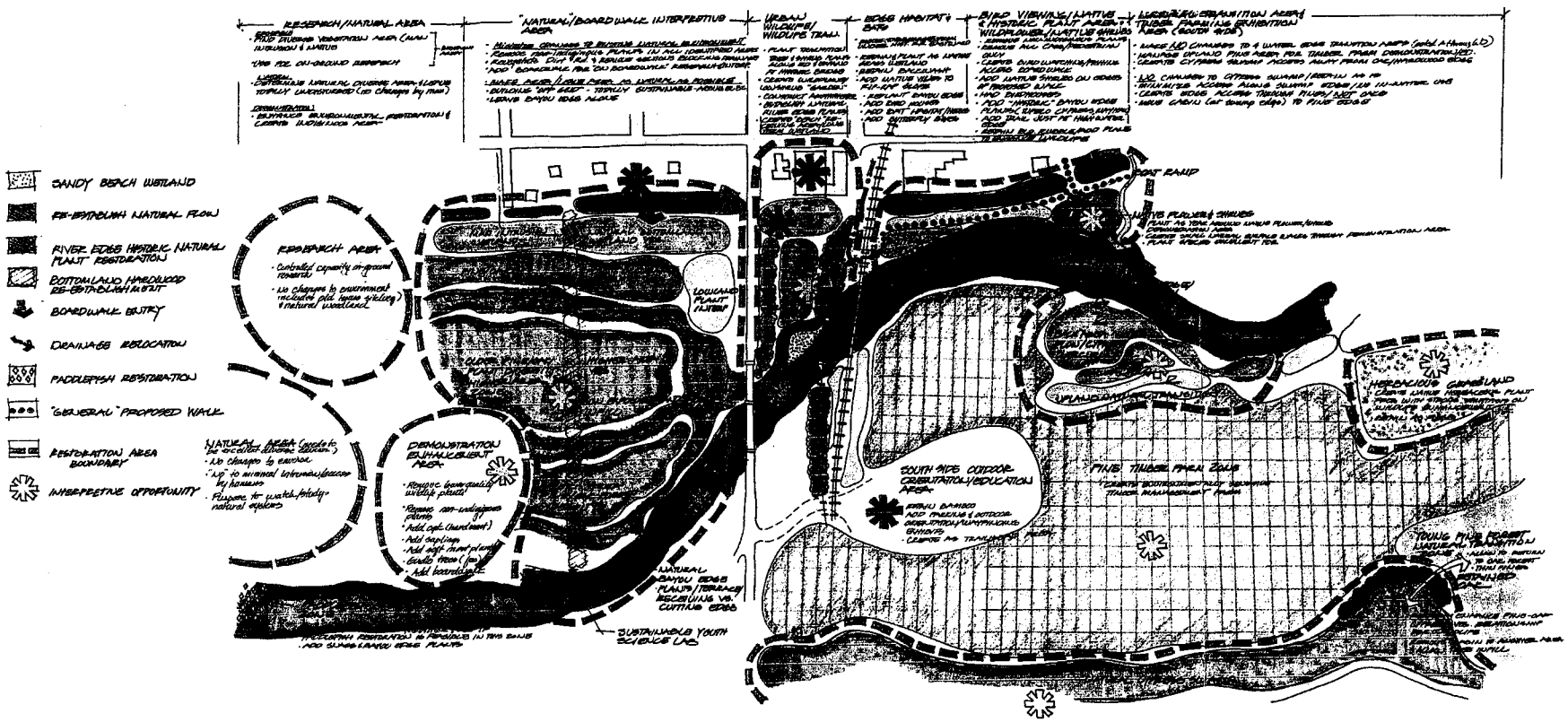
Partial restoration of the hydrologic regime could be achieved by restoring the historical oxbow, or the construction of an impoundment. The destruction of already scarce bottomland hardwood habitat from dredging and construction activities associated with restoring the oxbow made this alternative infeasible. By taking advantage of the existing natural drainages, the careful placement of low weirs (compacted, earthen embankments) would allow water to be retained in existing low areas. The addition of water control structures would allow the manipulation of water levels and duration of retention to promote the growth of vegetation, improve habitat, and provide opportunities for regeneration of bald cypress and possibly tupelo trees.

The restoration of bottomland hardwood species, particularly mast producing trees could be achieved by selective thinning of tree species which have little wildlife habitat value, thereby opening the canopy allowing greater penetration of light for improved natural regeneration, and providing areas for the establishment (planting) of mast producing trees. In certain stands, the passive thinning of the canopy by girdling lower quality tree species would provide additional cavities and snags for roosting and nesting of several bottomland hardwood wildlife and avian species.

Cutting the elevated road down to match the grade of the adjacent topography and planting it with soft mast seed and fruit producing shrubs and herbaceous vegetation would remove the physical structure and restore additional wildlife habitat, without removing the edge effect that is needed by some wildlife and bird species.

Core Section. The objective is to restore the severed ecological corridor for movement of wildlife species between existing bottom land hardwood area, and to increase the edge habitat for birds and wildlife. This area is it not suitable for complete bottomland hardwood reforestation due to the location and degree of human presence. However, the site is eminently suited to restoration of a narrow bottomland hardwood riparian corridor in conjunction with restoration of early

RESTORATION OPPORTUNITIES PLAN



BIG CYPRESS BAYOU

FISH AND WILDLIFE HABITAT RESTORATION PLAN

0 100 200 300 400

JEFFERSON TEXAS

FIGURE 4

successional vegetation which is a component of bottomland hardwood systems that is lacking in this area and compatible with an urban setting. This type of restoration would increase habitat for neotropical bird species, including hummingbirds, butterflies and insects, reptiles and small mammals. The restoration of early successional vegetation in this area would further improve the area for bats because it would serve as a draw for increased populations of a variety of insect species that would serve as an additional food source for bats. The improvement of a small, existing emergent wetland in this area would provide habitat for additional species.

The concept of an "urban wildscape" was identified as having the greatest potential for achieving the ecosystem restoration objectives. The urban wildscape is patterned after a highly successful program within TPWD designed to assist homeowners to establish and maintain habitat for wildlife by providing the basic requisites of food, water and cover for urban wildlife species such as butterflies, songbirds and small mammals.

The urban wildscape incorporates a variety of native trees, shrubs, grasses and flowers to provide food sources such as acorns, nuts, berries, buds, fruit, nectar and seeds used by a variety of wildlife. This variety assures an assortment of food is available throughout each of the four seasons. Further, combining open spaces with irregular borders and varying degrees of vegetation shapes, heights and densities creates an "edge effect". This produces numerous types of protective cover, and a diverse habitat to accommodate a variety of wildlife and bird species.

The abandoned Louisiana and Arkansas Railroad bridge (Photo 4) provides an important component of the ecosystem restoration of the core area. The bridge trestles support habitat (vines, etc) for hummingbirds and butterflies (compatible with an urban wildscape). More importantly, given the bridge's span and thermal mass, its height above Big Cypress Bayou, its heavy wooden trestles on each side of the bayou, its historical significance, and its location in the core area, the bridge presents an excellent opportunity for providing scarce bat habitat.

A literature review indicated that there are 11 species of bats in Marion County (Table 4). Two of the 11 species are considered rare. The Rafinesque's big-eared bat is state listed as threatened and is considered rare throughout its United States distribution, but has no federal listing status. The Southeastern Myotis is also considered rare throughout its distribution, but has no state or federal status.

Five of the eleven species (marked with asterisks in the table), including the two rare species listed above, have the potential for using artificial bridge roosts. Field reconnaissance revealed the potential of the bridge to provide an excellent environment for bat habitat. Suitable locations for certain species of bats include open flight areas (no vegetation within 10 feet) that are at least 10 feet above the ground. Other species, such as the rare Rafinesque's big-eared bat, prefer open roost areas made of wood such as the conditions created in a large hollow tree or a darkened undisturbed room in an old abandoned house. Unlike the crevice-dwelling bats, big-eared bats prefer habitat hidden in vegetation at least 10-feet above the ground. In addition, bats use river corridors as flyways for movement and feeding activities.

TABLE 4
BAT SPECIES OF MARION COUNTY, TEXAS
(Schmidley, D.J. 1991. The Bats of Texas)

*Southeastern Myotis	Myotis austroriparius
Silver-haired bat	*Lasionycteris noctivagans*
Eastern Pipistrelle	*Pipistrellus subflavus*
*Big brown bat	*Eptesicus fuscus*
Red bat	*Lasiurus borealis*
Seminole bat	*Lasiurus seminolus*
Hoary bat	*Lasiurus cinereus*
Northern yellow bat	*Lasiurus intermedius*
*Evening bat	*Nyctecieus humeralis*
*Rafinesque's big-eared bat	*Corynorhinus rafinesquii*
*Mexican free-tailed bat	*Tadarida brasiliensis*

The right-of-way under the railroad bridge must be kept clear. Fortunately, the area is naturally low, covered with sedges and grasses, and is suited for the restoration of an emergent wetland area. There is a small drainage from the downtown area that runs in a narrow channel under the abandoned railroad bridge. This drainage could be diverted to the area between the railroad bridges where a natural outlet to the bayou channel already exists. This would increase the amount of water in this area. The adjacent terrace areas could then be planted with native grasses that will tolerate wet conditions for extended periods of time.

Lastly, utilizing topographic survey data, it was determined that given the existing topography and elevation of the land in the Core section, relocation of the existing boat ramp facilities and overhead utility lines would be necessary in order to add fill and raise the grade to support the planting of early successional vegetation and bottomland hardwood species to restore the area to a more natural condition. Further, the trees planted as part of the riparian corridor restoration would eventually interfere with the utility lines.

East Section. While this approximately 27 acre section of land has bottomland hardwood stands with a diversity of vegetation and wildlife species similar to those in the West section, it has been determined that much of the site, approximately 20 acres in total, needs to be eliminated from consideration for restoration because it is part of an old city landfill. The configuration of the remaining acreage is relatively narrow and includes the levee separating the bayou from developed portions of Jefferson. There is an opening in the levee in this section which allows public access to Big Cypress Bayou, and to a city owned raw water intake facility located along the bayou's edge roughly one-quarter mile downstream from the active railroad bridge. Adverse impacts to understory and ground vegetation in this area are caused by vehicles which are often driven and parked in an open area between the levee and bayou. The restoration objective in this section is to restore the

Photo 4. Historic railroad bridge located in Core area.

this section is to restore the bottomland hardwood forest, improve habitat diversity and reduce the impact of man-made intrusions on natural resources.

Using the above criteria, ecosystem restoration activities would be undertaken on 7 acres of land contiguous with the rest of the restoration area and adjoining the bayou, and mimic those identified for the bottomland hardwood stands in the West section. This would include selective thinning and planting of mast-producing trees. In addition, the opportunity exists to restore significant portions of the understory vegetation, increasing the overall diversity of the vegetation in this area and improving the habitat for a variety of wildlife and bird species. Diversity would be further achieved by the restoration of some currently open, disturbed areas using the urban wildscape concept similar to that found in the Core section.

South Section. Although the size, location and unique natural resources of this section would be ideal for ecosystem restoration, it is privately owned. Even assuming the city of Jefferson had the capability to acquire the land, the cost would comprise the majority of the restoration cost. It is unlikely the land would be donated for an ecosystem restoration project. Subsequently, no ecosystem restoration alternatives were investigated in this area.

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Big Cypress Bayou. The objective of ecosystem restoration of Big Cypress Bayou is to restore aquatic habitat for the paddlefish and other native species. The presence of rock substrates within the study area, although scarce within the Big Cypress Bayou, provides an excellent opportunity to improve spawning habitat (i.e., flowing water over a gravel substrate) for approximately 40 species of fish, including the paddlefish. The construction of gravel bars to take advantage of the existing substrate and suitable flow regime would help accomplish this goal. Three potential sites were identified. The first site is located upstream of the Highway 59 bridge on the downstream edge of the bedrock substrate; a second site is located just upstream of the Texas & Pacific Railroad bridge; and a third site is located between the Highway 59 and Business Highway 59 bridges, in an area where the bayou splits to go around a small island. The major constraint to these sites, but most especially for the island site, is construction access.

Evaluation Methodology. Using HSIs established for the existing conditions of each major habitat type in each section, restoration opportunities were evaluated by comparing the baseline HSI values with projected HSI values given implementation of a proposed restoration alternative or level of alternative. These values were then averaged and annualized over the life span of a project. In this case, the project life was set for 75 years, based on the number of years it takes for most hard mast producing bottomland hardwood trees (e.g. oaks, pecans, bald cypress) to reach their full maturity.

Evaluations of bottomland hardwood and wetland habitat quality were derived using HSI and BLHCM models. Determinations of appropriate evaluation procedures for the habitat quality of the urban wildscape and bat habitat restoration component in the Core section, the urban wildscape component in the East section and the aquatic habitat component in Big Cypress Bayou were sought from experts in their respective fields. It was determined to use habitat evaluation procedures based on HSI models specific for wildlife and bird species known to utilize urban wildscapes to address the wildscape component of the Core and East sections. Evaluation of the bat habitat quality of the bridge and surrounding area was based on professional judgement from Bats Conservation International (BCI) experts in the field of bats and bat habitat (see Appendix A). Evaluation of in-stream habitat quality for fish, especially paddlefish, was based on a HEP model developed by WES which takes into consideration general habitat requirements of paddlefish and others fish species and specifically tailors them to the Big Cypress Bayou system. The baseline HSI value represents a lack of suitable substrate for spawning, the reduction in backwater flows into the bayou as a result of the control of downstream flood waters and the cutoff of fish migration routes following the construction of the Ferrel's Bridge Dam at Lake O' the Pines. The future with project HSI values are based on optimal requirements as recommended by resource specialists.

*** Ecosystem Restoration Alternatives.** Based on the problems, needs, and opportunities identified, the following restoration goals were developed. They are: 1) the improvement of bottomland habitat values by utilizing forest management practices such as selective thinning and planting of hard and soft mast producing tree species; 2) restoration of permanent backwater wetlands to restore waterfowl nesting, brood rearing and wintering habitat and provide sites for establishment of bald cypress and bald cypress/water tupelo vegetative communities; 3) restoration

of an early successional vegetative component; 4) improvement of emergent wetlands adjacent to existing riparian/bottomland hardwood forest; 5) reestablishment of contiguous riparian corridor to allow migration of avian and wildlife species throughout proposed project area; 6) establishment of instream habitat for spawning of paddlefish and other fish and aquatic organisms; and 7) restoration of habitat for neotropical migratory birds and bats.

A number of alternatives, including the "no action" alternative, were evaluated for each section using cost effectiveness and incremental analyses to develop criteria for deciding which alternatives would be incorporated into the recommended plan.

No Action. Under the "no action" alternative, the study area would remain in the ownership of a mix of public and private entities. Future projection of the no action alternative is equivalent to a description of the future/without project. Because of the mixed ownership, there is great potential for the existing bottomland forests stands to become increasingly fragmented. As the stands age and mature, their value as timber increases and it is expected that some of the private owners would take advantage of the reduced flooding potential as a result of controlled releases from Lake O' the Pines and harvest the timber on their property in the future. This would significantly degrade the habitat quality of the existing bottomland hardwood forests, causing significant adverse impacts to multiple species of birds and wildlife. It would be expected that any loss in the amount and diversity of the habitat would directly correlate to losses in the numbers and diversity of the wildlife species the habitat will support. Without some effort to restore the backwater that was historically present within these floodplains, the growth and regeneration of such species as bald cypress and/or water tupelo would continue to decline. The Core area would continue to be utilized strictly as an access point to the bayou with the parking lot and boat ramp dominating the site and would supply little or no habitat value in the future.

In addition, with the increasing change in land uses and loss of existing bottomland hardwoods in the region, it would be expected that the diversity and numbers of the bat population in the region would continue to decline. Without suitable habitat for roosting and nursery colonies, the bat species that are already on the state's list of threatened and endangered species would only continue to become more rare. And the species that are utilizing unsuitable and unsafe habitat such as the upper stories of some of the old buildings in the downtown area would continue to be disturbed and displaced as the buildings are either demolished, or as is the case in Jefferson, renovated. The degraded condition of the East section, which is owned by the city of Jefferson, is not expected to improve. Finally, without a project, there would be little habitat within the Big Cypress Bayou system between Lake O' the Pines and Caddo Lake that is suitable for spawning, especially for the endangered paddlefish.

West Section. The ecosystem restoration alternatives proposed are the construction of a bottomland hardwood wetland complex consisting of three wetland cells, selective thinning of exotic vegetation and low quality tree species, planting of hard and soft mast tree and shrubs species, reestablishment of bald cypress-water tupelo vegetative communities, and the addition of wood duck nesting boxes. The alternatives were further broken down to different scales and evaluated by cost

effectiveness and incremental cost analysis. An underlying assumption of the analysis was that the elevation of the dirt road in this area would be graded to match the topography of the adjacent land, except where it will serve as the dike for wetland cell #3. The restoration alternatives are described below:

- Wetland Complex (Cell #1): Shallow impoundment cell of approximately 0.19 acres of land.
- Wetland Complex (Cell #2): Shallow impoundment cell of approximately 2.36 acres of land.
- Wetland Complex (Cell #3): Shallow impoundment cell of about 0.35 acres of land.
- Forest Management (1): 20- one-inch caliper containerized trees, 10- one gallon containerized shrubs, and 50 seedlings per acre with selective thinning.
- Forest Management (2): 10- one-inch caliper containerized trees, 5- one gallon containerized shrubs, and 100 seedlings per acre with selective thinning.
- Forest Management (3): 150 seedlings per acre and selective thinning.
- Bald Cypress and Water Tupelo Planting (1): 100 seedlings per acre of wetland and selective thinning.
- Bald Cypress and Water Tupelo Planting (2): 250 seedlings per acre of wetland and selective thinning.
- Nesting Boxes (1): 2 wood duck nesting boxes per wetland acre and 1 wood duck nesting box per 225 linear feet of bottomland hardwood bayou edge.

Core Section. The ecosystem restoration alternatives are the restoration of a riparian corridor with and without a "wildscape" component, construction of bat habitat, and improvement of an emergent wetland. The alternatives were further broken down to different scales and evaluated by cost effectiveness and incremental cost analysis. The restoration alternatives are described below:

- Wildscape (1): Remove boat ramp and parking lot and relocate utilities; riparian corridor restoration using 40- three inch caliper trees; turfing 3 acres with native grasses.
- Wildscape (2): Remove boat ramp and parking lot and relocate utilities; riparian corridor restoration using 40- three inch caliper trees; remaining 3 acres planted with native understory tree, shrub, and herbaceous vegetation known to attracted urban wildlife.
- Bat Habitat (1): Construct and place 3 crevice-dwelling bat houses on 20' poles.

- Bat Habitat (2): Construct optimal bat habitat super structure over bayou and attach 12 Oregon Bridge Wedges, 7 Texas-Bat Abodes and 2 Big-eared Bat-Abodes.

- Bat Habitat (3): Utilize the existing abandoned railroad bridge as a super support for 12 Oregon Bridge Wedges, 7 Texas-Bat-Abodes and 2 Big-eared Bat-Abodes.

- Emergent Wetland (1): Divert drainage from under old railroad bridge to area between the bridges; add high quality wetland plants; eliminate the cultivated grasses and weeds and plant native grasses in area surrounding wetland.

East Section. The ecosystem restoration alternatives are a combination of the construction of a "wildscape" component, selective thinning of exotic vegetation and low quality tree species, and planting of hard and soft mast tree and shrubs species. The alternatives were further broken down to different scales and evaluated by cost effectiveness and incremental cost analysis. The restoration alternatives are described below:

- Forest Management (1): 20- one-inch caliper containerized trees, 20- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning.

- Forest Management (2): 10- one-inch caliper containerized trees, 10- one gallon containerized shrubs and 100 seedlings per acre with appropriate selective thinning.

- Wildscape (1): 30- three inch caliper trees; 15- one inch caliper trees; turf 2 acres with native grasses; relocate boat ramp and parking lot.

- Wildscape (2): 15- three inch caliper trees; remaining 2 acres planted with native understory tree, shrub, and herbaceous vegetation known to attracted urban wildlife.

Big Cypress Bayou. The restoration alternative is the establishment of gravel bars. The alternatives were further broken down to different scales and site locations and evaluated by cost effectiveness and incremental cost analysis. The restoration alternatives are described below:

- Aquatic Habitat (1, 2 and 3): 300, 750, or 1000 feet, respectively, of gravel bar upstream of Texas & Pacific Railroad bridge west of Highway 59.

- Aquatic Habitat (4, 5 and 6): 300, 750, or 1000 feet, respectively, of gravel bar by island.

- Aquatic Habitat (7, 8 and 9): 300, 750, or 1000 feet, respectively, of gravel bar downstream of shoal area.

Incremental Cost Analysis. Comparative analysis techniques (Robinson et al. 1995) were used to determine the most cost effective plans and levels of restoration in terms of costs per habitat unit gained. The computer model used to run these cost effective and incremental cost analyses was the

IWR-Plan: Decision Support Software, Beta Version 1.5. Appendix B contains the results of incremental analyses for each section of land within the study area. All the alternatives and/or levels of alternatives identified above were evaluated using annualized habitat unit gains versus annualized cost estimates (including those for operations and maintenance).

West Section. Results of the analysis determined that four restoration alternative combination plans would be cost effective and incrementally justified for this section of land. The combination plan chosen by the study team as the recommended alternative plan would provide the greatest amount of increased habitat value and the most habitat diversity and is made up of the following components:

- Shallow impoundment wetland cell of approximately 0.19 acres of land.
- Shallow impoundment wetland cell of approximately 2.36 acres of land.
- Shallow impoundment wetland cell of about 0.35 acres of land.
- 10- one-inch caliper containerized trees, 5- one gallon containerized shrubs, and 100 seedlings per acre with selective thinning.
- 250 seedlings per acre of bald cypress and water tupelo and selective thinning.
- 2 wood duck nesting boxes per wetland acre and 1 wood duck nesting box per 225 linear feet of bottomland hardwood bayou edge.

The effects of the restoration over time on the Habitat Suitability Indices and Habitat Units are presented below.

TABLE 5
WEST SECTION RECOMMENDED RESTORATION FEATURES
HABITAT SUITABILITY INDICES (HSI) AND HABITAT UNITS (HU)

Habitat	Without Project		With Project FY+5				With Project FY+75			
	HSI	HU	HSI	HU	HU Increase	%Gain	HSI	HU	HU Increase	% Gain
Bottomland hardwood	0.55	12	0.60	13.08	1.08	9%	0.95	20.71	8.71	72.6%
Bottomland wetlands	0.0	0	0.95	2.85	2.85	100%	0.95	2.85	2.85	100%
Bald cypress plantings	0.0	0	0.60	1.80	1.8	100%	0.90	2.7	2.7	100%
Wood duck boxes	0.0	0	0.75	3.00	3.0	100%	0.95	3.8	3.8	100%

The small number of habitat units gained by the restoration alternatives in this section is a reflection on the size of the area (the underlying principal of HEP analyses is that the maximum number of habitat units is one unit per acre). However, implementation of the alternatives will increase the

value of the existing habitat to close to the maximum level (0.95 HSI) obtainable over the life of the project.

Core Section. Results of the analysis determined that three restoration alternative combination plans would be cost effective and incrementally justified for this section of land. The choice of best buy plan was made in conjunction with input from the local citizens of Jefferson obtained through a series of public meetings. This section of land serves as a very visible entrance to the historic downtown area of Jefferson and it was important to the local sponsor that this area provide high quality habitat and still be visually pleasing. The recommended restoration alternative plan is made up of the following components:

- Removal of the boat ramp and parking lot and relocation of the utility lines; riparian corridor restoration using 40- three inch caliper trees; remaining 3 acres planted with native understory tree, shrub, and herbaceous vegetation known to attracted urban wildlife.

- Utilize the existing abandoned railroad bridge as a super support structure for 12 Oregon Bridge Wedges, 7 Texas-Bat-Abodes and 2 Big-eared Bat-Abodes.

- Divert drainage from under old railroad bridge to area between the bridges; add high quality wetland plants; eliminate the cultivated grasses and weeds and plant native grasses in area surrounding wetland.

The effects of the restoration over time on the Habitat Suitability Indices and Habitat Units are presented below.

TABLE 6
CORE SECTION RECOMMENDED RESTORATION FEATURES
HABITAT SUITABILITY INDICES (HSI) AND HABITAT UNITS (HU)

	Without Project		With Project FY+5				With Project FY+75			
Habitat	HSI	HU	HSI	HU	HU Increase	%Gain	HSI	HU	HU Increase	% Gain
Riparian corridor	0	0	0.75	0.56	0.56	100%	0.95	0.71	0.71	100%
Wildscape	0	0	0.75	2.25	2.25	100%	0.95	2.85	2.85	100%
Bat habitat	0.2	401.92	0.95	17182.08	16780.16	4175%	0.95	17182.08	16780.16	4175%
Emergent wetland	0.2	0.05	0.8	0.2	0.15	30%	0.8	0.2	0.15	30%

The large number of habitat units gained by the restoration alternatives in this section is a reflection of the feeding range of the anticipated bat populations expected as a result of providing ideally suited abodes for roosting and nursery colonies. It is documented that a single colony of 150 big brown bats can eliminate 38,000 cucumber beetles, 16,000 June bugs, 19,000 stink bugs and 50,000 leafhoppers in a single summer (Tuttle and Hensley 1993).

East Section. Results of the analysis determined that four restoration alternative combination plans would be cost effective and incrementally justified for this section of land. The

combination plan identified as the recommended alternative plan would provide the greatest amount of increased habitat value, the most habitat diversity, and the best chance of survival given the constraints of the area. The recommended restoration plan for this section is made up of the following components:

- 20- one-inch caliper containerized trees, 20- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning.

- 15- three-inch caliper trees; remaining 2 acres planted with native understory tree, shrub, and herbaceous vegetation known to attract urban wildlife.

The effect of the restoration over time on the Habitat Suitability Indices and Habitat Units are presented below.

TABLE 7
EAST SECTION RECOMMENDED RESTORATION FEATURES
HABITAT SUITABILITY INDICES (HSI) AND HABITAT UNITS (HU)

	Without Project		With Project FY+5				With Project FY+75			
Habitat	HSI	HU	HSI	HU	HU Increase	%Gain	HSI	HU	HU Increase	% Gain
Bottomland hardwood	0.4	2.00	0.50	2.5	0.5	25%	0.95	4.75	2.75	137.5%
Wildscape	0.0	0.00	0.75	1.5	1.5	100%	0.95	1.90	1.90	100%

As in the West section of the proposed project area, the small number of habitat units gained by the recommended plan in this section is a reflection on the size of the area. Incorporation of wildscape plant materials in this area would improve the habitat quality of both the core and the east areas for urban wildlife, such as neotropical birds and insects, by supplying a second component of suitable habitat that they can move back and forth between. That, in addition to the recommended restoration efforts in this area would help to increase the value of the existing habitat.

Big Cypress Bayou. Results of the analysis determined that four restoration alternative combination plans would be cost effective and incrementally justified for this section of land. The combination plan identified as the recommended plan would substantially increased the aquatic habitat value in Big Cypress Bayou for spawning by multiple species of fish and aquatic organisms, including the endangered paddlefish, while taking advantage of cost savings opportunities. The recommended restoration plan for this section is made up of the following components:

- 1000 feet of gravel bar upstream of Texas & Pacific Railroad bridge west of Highway 59.
- 1000 feet of gravel bar downstream of shoal area.

The effect of the restoration on the Habitat Suitability Indices and Habitat Units are presented below.

TABLE 8
BIG CYPRESS BAYOU RECOMMENDED RESTORATION FEATURES
HABITAT SUITABILITY INDICES (HSI) AND HABITAT UNITS (HU)

	Without Project		With Project FY+5				With Project FY+75			
Habitat	HSI	HU	HSI	HU	HU Increase	%Gain	HSI	HU	HU Increase	% Gain
Aquatic	0.2	113.94	0.955	541.22	427.28	375%	0.955	541.22	427.28	375%

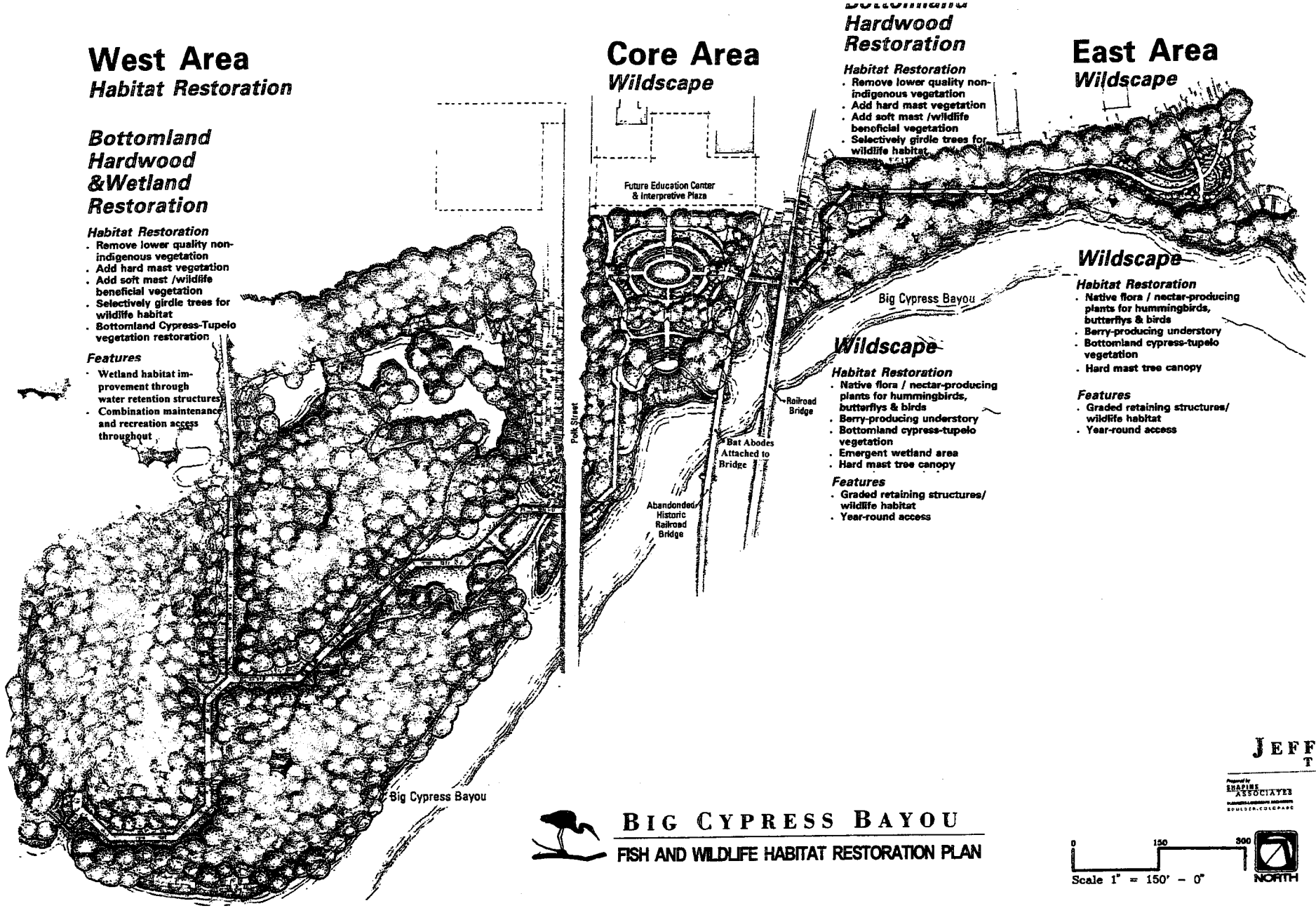
The gravel bar site that showed the highest habitat gains was the site downstream of the shoal area, which is the one of the few sites between Lake O' the Pines and Caddo Lake that has hard substrate. The addition of a 1000-foot gravel bar downstream of this site gives each a synergistic effect by adding habitat value for no further costs. The railroad site is in close proximity to the shoal site, which allows for savings on the costs associated with construction access when the gravel bars are constructed in conjunction with one another. Therefore, it was decided that the plan calling for the construction of 1000 foot gravel bars at both sites was the best buy in terms of instream aquatic habitat gains for the dollars spent.

The identified restoration sites were the only sites suitable in the reach between Lake O' the Pines and Caddo Lake. The large number of habitat units gained by this alternative is a reflection of the surface water acreage within this reach (569.7 acres), and the high likelihood that many fish species would migrate these distances to find suitable spawning habitat. This is especially true for the paddlefish.

* RECOMMENDED RESTORATION PLAN

Description. The recommended restoration plan was designed to restore the biological integrity of the floodplain community through a combination of measures directed at specific habitat types. Taken collectively, these measures will restore ecosystem integrity, diversity and stability. Restoration measures will include restoration of bottomland hardwoods, bottomland hardwood wetlands, emergent wetlands, reestablishment and regeneration of bald cypress, establishment of an early successional vegetation or "wildscape" component and restoration of open water habitats with gravel bars to improve instream fish spawning. In addition, it is proposed to provide bat roosting on the support structures of an abandoned railroad bridge. An artistic rendering of the terrestrial features of this recommended plan is shown in Figure 5. The restoration plan for this project is relatively complex and consists of different restoration alternatives at various levels of effort for each of the proposed project sections.

West Section. The West section of land consists of 38 acres of land bound by Big Cypress Bayou on the southeast, the undeveloped right-of-way of Jackson Street on the southwest north to roughly the intersection of Camp and Marshall; thence the boundary heads northeast diagonally to the intersection of Lake and Market streets. Thereafter, the boundary follows the undeveloped right-



BIG CYPRESS BAYOU

FISH AND WILDLIFE HABITAT RESTORATION PLAN

JEFFERSON
TEXAS

Prepared by
SHAPINS ASSOCIATES
BOULDER, COLORADO

Prepared for
U.S. Army Corps of Engineers
Fort Worth District

0 150 300
Scale 1" = 150' - 0"

NORTH

FIGURE

of-way of Lake Street easterly, generally along the alignment of the existing levee where it is bound by Polk Street.

One component of the recommended restoration plan in the West section calls for forest management activities. Management activities will include the planting of mast tree and shrub species at a rate of 10 one-inch caliper containerized trees, 5 one-gallon containerized shrubs and 100 seedlings per acre. The habitat value gains were based on the assumption that the variety of native mast and fruit-bearing tree and shrub seedlings used would include water oak, willow oak, overcup oak, southern red oak, and Shumard oak; hickories, including pecan, water hickory, and butternut hickory; and black walnut. Incorporation of a minor soft mast component including baldcypress, blackgum, sugarberry, green ash, American elm, and river birch will provide increased diversity in the area. Understory species will include hawthorns, flowering dogwood, sassafras, American beautyberry, farkleberry, yaupon holly, redbud, and wax myrtle. The planting of the tree and shrub seedlings will be spread out over two growing seasons in order to help ensure a higher rate of survivability. It has been learned from past experience that harsh conditions in the initial planting season can be very costly in terms of the time, effort and money if survival of the plantings is low and has to be redone. Extending the time of the plantings also allows lessons learned during the initial planting phase and first growing season to be applied to the second planting phase.

In order to reduce competition and improve the chances for these mast producing species to survive and thrive it will be necessary to open the canopy and allow light to penetrate the understory and herbaceous vegetation layers. Minimal management practices, such as selective clearing or thinning through injection or girdling of trees will need to be applied. The species to be removed will vary from stand to stand but from initial investigations the species most effected will be sweetgum. Sweetgum occurs naturally in low, wet areas on the acidic sands of the Pineywoods, Gulf Prairies and Marshes, and the Post Oak Savannah regions of Texas. It is part of the east Texas pine-hardwood forest association and is native to the project area, but its fruit is not utilized by very many wildlife and bird species as food sources. In the West section, the number of sweetgums is too great and the stands are too dense to provide more than low to moderate quality habitat. Additionally, the draft Fish and Wildlife Coordination Act Report provided by USFWS recommended that sweetgums and other soft-mast species comprise no more than 25 percent of the hardwood canopy in order to improve habitat conditions in the area.

The West section also contains other species of vegetation that are not native components of bottomland hardwoods – swamp privet, mimosa, and ligustrum. Both swamp privet and ligustrum were found in some abundance. Ligustrum is often used as an ornamental planting in yard landscaping and has invaded portions of this site. There were only a couple mimosas, probably the result of seeds being carried in by birds or winds from nearby yards. Efforts will be made to eliminate these exotic components from the proposed project area, in so far as it is possible and practical. In some areas of this section, understory vegetation is too thick for efficient use by certain wildlife species. Selective thinning will reduce this and will aid in the reestablishment of the hardwood tree seedlings in some of these sites. In addition, selective thinning by herbicide injection or girdling will leave the trees to die standing to provide snags and cavities and increase wildlife

habitat values. Some of the small understory vegetation may be cut down and left to increase the amount of brush piles and tree stumps that provide perch and refuge sites for a number of bottomland hardwood dwellers.

A second component is the construction of a wetland complex to improve wildlife, waterfowl and fisheries habitat and allow the regeneration of bald cypress and possibly water tupelo. The wetland complex consists of 3 wetland cells, 0.19, 2.36 and 0.35 acres, respectively. The cells will be created by the construction of two compacted earthen levees with crest widths of roughly 5 feet. The top elevation of both berms is set at elevation 178.0 National Geodetic Vertical Datum (NGVD), which according to hydrologic models, coincides with the elevation of a one-year flood event on Big Cypress Bayou in this area. In an attempt to minimize the potential for wash outs of the dike and erosion problems as a result of flooding, the dikes were designed with different side slopes. On the downstream side (closest to the river), the dikes will have a gradual slope of 10 feet horizontal to every one foot vertical, expressed as 10H:1V. The upstream side of the dike (inside the cell) shall be sloped 4H:1V to minimize changing or disturbing existing ground conditions. Contrary to the construction of most created wetland cells where fill material for use in the earthen levees is acquired by borrowing dirt on site, it was determined that fill material would be brought from off site. The reason for this is two-fold. First, it isn't necessary to carve out water impoundment areas. The existing floodplain topography already has natural low-lying interior drainages. Secondly, avoiding on site excavation minimizes adverse impacts to the existing resources.

The design of the wetland cells, which can be seen in Appendix C, uses existing topography to dictate the impoundment areas. Addition of the earthen levees allows water captured by overbank flood events and local rainfall to be held for extended periods of time. Incorporating water control structures into each of the levees will provide a means to regulate and manipulate the depths of the water in the individual wetland cells to maximize vegetation growth and habitat values. The control structures consist of three major components; an inlet flashboard riser, a 24-inch galvanized corrugated metal pipe, and an outlet galvanized metal apron. Aluminum stoplogs can be manually placed or removed from the flashboard riser to set the water level elevation, as desired. See Appendix C for more detailed design of the water control structures.

The smallest of the wetland cells, Cell #1, is located in the southwest quadrant of the West section, approximately 1,100 feet upstream of the Polk Street bridge. The berm for this cell, aligned parallel to Big Cypress Bayou, sets approximately 75 feet back from the river bank. The compacted earthen embankment is approximately 70 feet in length with an average height of about two feet and will inundate 0.19 acres of land when filled. Water depth will vary depending on the topography of the land; the maximum depth being approximately 4 feet.

The berm of the second wetland cell, Cell #2, located just to the west of Polk Street, extends for a total length of 284 feet. Like the berm for Cell #1, it sets back from the river approximately 70 feet and is aligned parallel to Big Cypress Bayou. The water control structure will be placed at a low point in the dike alignment, in this case, a point that coincides with a small channel that carries storm water runoff from Jefferson's downtown area to the bayou. This berm has a maximum height of 8

feet and an average height of 3 feet. The maximum depth of water in this cell is 8 feet, but roughly 90 percent of this cell has a maximum depth of 2 feet or less.

Wetland Cell #3 will be created by the same berm as Cell #2, as it backs up water through an existing 36-inch culvert crossing the dirt road that bisects the West section. See Figure 6 for the exact location in relation to the other features in the West. In order to create a third cell that can be regulated separately from Cell #2, the existing culvert will be removed by excavating the earth material and placing a new water control structure in the same location. The spot will then be backfilled and restored to the present elevation and grade. Use of the road and existing culvert allows the creation of a third wetland cell without the added costs associated with the construction of another berm.

Restoration of the floodplain hydrologic regime and creation of the wetland complex allows the opportunity to restore a few acres of flooded bottomland hardwood forest and improve the existing habitat in the area by increasing the diversity of the habitat types and the wildlife and avian species it will support. The third and fourth components of the recommended plan rely on creation of this habitat type – artificial regeneration of bald cypress, and possibly water tupelo, and the addition of wood duck nesting boxes.

The recommended plan calls for the planting of 250 bald cypress seedlings per acre of wetland habitat. Because construction of the wetland complex will create approximately 3 acres of flooded habitat, a total of 750 bald cypress seedlings will be planted in the wetland cells of the West section.

Supplementary to the planting of bald cypress seedlings in the area, interest has been express by local citizens about the possibility of attempting to establish water tupelo in the wetland cells along with the bald cypress. The bald cypress-water tupelo vegetation association has been documented in many historic accounts of vegetation of the region, but remnant populations are increasingly hard to find. The best known and largest of these bald cypress/water tupelo stands is located in James Bayou, approximately 10 miles northwest of Jefferson. A private landowner in that area has offered to allow water tupelo seedlings to be harvested from swampy areas on his property for transplanting in the created wetland cells. While this restoration effort was not formally included in the recommended restoration features of the proposed project, it was determined that environmental personnel from the Corps will provide consultation for this effort in conjunction with the bald cypress plantings.

The fourth component of the recommended plan in this section is the addition of wood duck nesting boxes to help restore waterfowl nesting and brood rearing habitat. Based on recommendations of USFWS biologists, wood duck nesting boxes will be added at the rate of two boxes per acre of forested wetland habitat and one box for every 225 feet of bayou edge habitat. Since the wetland cells will inundate a total of 2.9 acres and there is approximately 1800 feet of bayou edge, costs used in incremental analyses (Appendix B) for the addition of wood duck boxes were based on the assumption that a total of 14 boxes would be added.

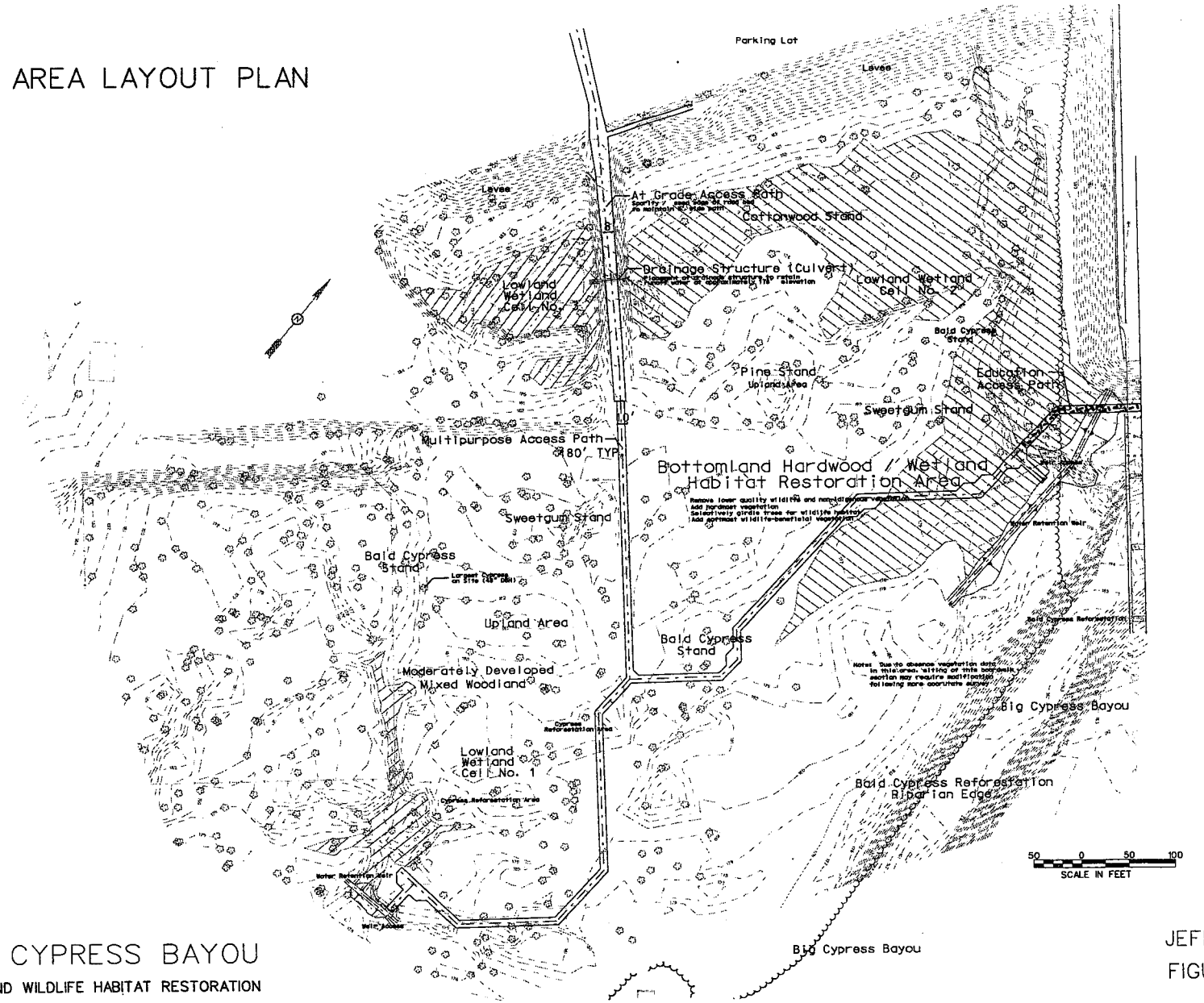
Given that bald cypress seedlings are very sensitive to the depth of the water to which they are subjected, the successful restoration of a bald cypress/flooded hardwood component requires the capability of manipulating water levels to optimize vegetation growth. To do this, it will be necessary to have access to the water control structures on each of the cells, except when Big Cypress Bayou is at flood stage and the wetland dikes are being overtopped. In order to determine the optimal elevation of the stop logs in the water control structures and document how the water depth in each cell responds to minor flooding events or thunderstorms and the subsequent local runoff, it will be necessary to be able to access the wetland cells and document water levels. The design of the elevated maintenance access in this area is a direct result of this need and the desire to keep impacts to the restoration areas of the proposed project to a minimum. The only other alternative for comparable access would require bringing in additional fill and building up an access path that would stay above the normal flood elevation. This did not seem feasible or desirable due to the adverse impacts that would be caused to existing resources.

The total length of the elevated maintenance access in the West section is approximately 1,566 linear feet. The access will be 8 feet wide in order to accommodate maintenance vehicles. The access is at a constant elevation of 180 feet NGVD with a maximum height above the existing ground level of 8 feet (at the Cell #2 control structure), and an average height of 3 feet. Footings will be 12-inch diameter cast in place reinforced concrete drilled shaft piers. The depth of the piers will vary according to the ground elevation. Piers placed where elevation is 178 feet NGVD or below will be placed to a depth of 15 feet, while piers placed where the elevation is above 178 feet NGVD will be placed to a depth of 10 feet. Treated southern pine will be used to construct the superstructure beams, joists and stringers, as well as the decking surface of the access ramp. Entrance to the access ramp will be just below Cell #3 off of the existing road. The road, which also serves as the embankment for Cell #3, will have a crest width of 10 feet at this point and be at the same elevation as the assess ramp to allow for an easy transition.

The final components included in the recommended restoration plan for this area is cutting the elevated road down to match the grade of the adjacent topography below the transition area from gravel access to elevated access. In walking through the West section, this road stands out as the most intrusive feature in an area that is relatively natural. Removing the artificial grade of the road, loosening the hard packed soil and covering it with a layer of topsoil to facilitate success of planting, and planting it with soft mast seed and fruit producing shrubs and herbaceous vegetation will remove the physical structure and restore additional wildlife habitat. Figure 6 shows the proposed layout of project features in the west section.

Core Section. The Core section of land (3.5 acres) bound by Polk Street on the west, Dallas Street on the north, the current Louisiana and Arkansas Railroad bridge on the east and the bayou on the south. It is located between the bayou and the Cypress Valley Alliance's Environmental Education Center, currently under construction just across Dallas Street to the north. This area is also the highly visible entrance to Jefferson's historic downtown region. Therefore, restoration opportunities appropriate for this area need to be compatible with the urban setting while restoring valuable habitat for numerous wildlife and bird species. The recommended plan for the

WEST AREA LAYOUT PLAN



BIG CYPRESS BAYOU

FISH AND WILDLIFE HABITAT RESTORATION

JEFFERSON, TEXAS

FIGURE 6

Core section consists of several components - bottomland hardwood riparian corridor restoration, early successional vegetation or "wildscape" restoration, emergent wetland improvement, and bat roosting and nursery abodes. To restore habitat value in this area, it will be necessary to remove the existing boat ramp and parking lot, relocate the overhead utility lines, and add fill to bring the elevation gradient of the area up to a level comparable to adjacent riparian areas and that will support tree, shrub and herbaceous vegetation needed to restore the area to a more natural condition.

The first component of the recommended plan in the Core section is the restoration of a riparian corridor of bottomland hardwoods along the bayou. In order to accommodate the planting of trees in this area it will be necessary to construct a retaining wall along approximately 270 feet of the bayou edge where the existing boat ramp is located. There is no "natural" bayou's edge in this area, nothing remains of the bottomland hardwood vegetation that would have been in this area originally. The bank along the bayou was cut to accommodate the construction of the boat ramp and subsequent maintenance has caused further degradation of the bank. Natural processes in the bayou and the location of concrete piers that support the Polk Street (Business Highway 59) bridge just upstream cause a natural deposition of sand along the bank of the bayou where the ramp is located. It has been necessary to periodically dredge the bayou in this area to remove the sand, which has, in turn, been piled on the top of the ground in the area. The retaining wall, with a maximum height of 3 feet above the ground and a concrete spread footing will establish a hard edge to the bank and allow for the addition of fill that will support the planting of bottomland hardwood tree species along this edge.

To flatten the existing slope in this area, the terrain will be graded and a series of three retention walls will be placed making several terrace levels. The retention walls, constructed of weathered ironstone with mortar grout, are a maximum of 1.5 feet in height. The total length of the retention walls in the riparian restoration area is approximately 165 feet. Starting at the top, the first wall is roughly 60 feet long, the second is about 55 feet long and the lowest one is approximately 50 feet long. The tree species to be used to restore the bottomland hardwood component will include water oak, willow oak, overcup oak, southern red oak, and Shumard oak; hickories, including pecan, water hickory, and butternut hickory; baldcypress, blackgum and river birch. Because the area is currently devoid of any bottomland vegetation, the riparian corridor will be restored with 40 3-inch caliper containerized trees. This will allow the trees to establish faster and will help speed restoration of viable riparian corridor habitat.

The second component of the recommended restoration plan is the establishment of approximately 3 acres of early successional vegetation, a component of bottomland hardwoods that is lacking in the area and compatible with an urban setting. This type of restoration will increase habitat for neotropical bird species, including hummingbirds, butterflies and insects, reptiles and small mammals. It will also improve the area for bats since it will draw increased populations of a variety of insects that will serve as an additional food source. The wildscape will incorporate a variety of native trees, shrubs, grasses and flowers to provide year around food sources such as acorns, nuts, berries, buds, fruit, nectar and seeds used by a variety of wildlife. Further, the diverse vegetation provides irregular borders with varying degrees of shapes, heights and densities for protection from

weather and predators. See Appendix D for a detailed wildscape design plan for this area and a list of the species included. Just as the with the riparian restoration area, the wildscape restoration area will be graded and built up in order to establish the planting beds needed to accommodate the tree, shrub and herbaceous plant species that have been identified for use. Many of these beds, especially those for the herbaceous plant material, need to have hard edges in order to control the growth and spread of the plants. A retention complex was designed to accommodate both of these features. As in the lower section, the complex is a series of three retention walls interconnected with an oval concrete access path. The maximum height of each retention wall is 1.5 feet and the total length of the walls is 400 linear feet. The walls, constructed of structural reinforced concrete and faced with natural stone quarried in the immediate vicinity are approximately 125, 135 and 150 linear feet, respectively, starting at the top. The retention walls in this area form the top half of a large oval. The 8 foot wide concrete access path interconnecting the retention structure will serve several functions: 1) as access into the site; 2) as the top of the upper retention wall; and around the lower half, 3) as the edge needed to form planting beds; 4) the foundation needed to support climbing plant trellises, and 5) as access to maintain the plant beds.

The third component of the recommended plan for the Core area is the improvement of a one-quarter acre emergent wetland between the abandoned and current railroad bridges. Kansas City Southern, owners and operators of the current Louisiana and Arkansas Railroad line, maintain this area as right-of-way. For safety reasons, reforestation is out of the question. Fortunately, this area is naturally low and covered with sedges and grasses. It would be possible to increase the amount of water available for further development and improvements to the wetland area by diverting a small drainage (from the downtown area) that currently runs in a narrow channel under the old railroad bridge structure. A natural outlet to the bayou channel located in this area would serve as the outflow. Recommended improvements include the addition of wetland plantings including pickerel weed, sagittaria and eleocharis. The adjacent terrace areas would be planted with grasses, such as inland sea oats, broomsedge bluestem and switchgrass, which are native to the area and will tolerate wet conditions for extended periods of time.

The fourth component of the recommended restoration plan in this section is the modification of an abandoned railroad bridge whose span, thermal mass, height above water source, support structure on either side of the bayou (Photo 5) and location adjacent to the wildscape habitat presents the opportunity to provide excellent bat roosting and nursery habitat. Further, the bridge's trestle supports habitat (trumpet vine, etc.) for hummingbirds and butterflies making it very compatible for inclusion with a wildscape design.

The recommended plan calls for attaching seven Texas Bat-Abodes, two Big-eared Bat-Abodes, and twelve Oregon Bridge Wedges to the structure. Design and quantities of bat-abodes are per instruction by BCI. The Texas Bat-Abode is designed for crevice-dwelling bat species. All the bat species marked with an asterisk in Table 7, except for the Rafinesque's big-eared bat, have the potential to use the Texas Bat-Abode. The basic structure of this abode has external panels on either side and 1x2-inch spacers sandwiched between ½-3/4 inch exterior grade plywood partitions. The spacers will produce crevices with the ideal width (3/4 of an inch). At least one side of each of the

Photo 5. Underside view of railroad bridge support structure

plywood partitions will be coated with polyurethane and sprinkled with rough sand to provide footholds for the bats. The number of partitions is arbitrary and limited only by the ability to support the weight of the structure. Heavy lag-bolts will be used to anchor the unit to the bridge.

The Big-eared Bat-Abode has end panels with open flyway access and spacers that are used as braces to hold the panels together. The upper-most spacers should be roughened for roosting bats. The bottom panels are angled and do not meet, forming a narrow 1-inch slit across the bottom to provide some airflow and allow the droppings to fall away. These units can also be anchored to the bridge using heavy lag-bolts. Because big-eared bats are more sensitive to disturbance than other bat species, the abodes should be placed in areas of low probability of activity and painted in such a manner as to avoid attracting attention.

The final design is the Oregon Bridge Wedge, an inexpensive method of retrofitting bridges with roost habitat. A single piece of 5/8- or ¾-plywood is cut to dimensions of at least 18-inches high by 24 inches wide. Backed with three 1x2-inch wood strips along the top and sides these panels can be bolted to a protected part of the bridge. Although ¾ inch spacing has been determined to be the most bat-friendly width for North American species, larger species, such as the big brown bat, will use wider crevices. To retain the secluded feeling in the panel, however, the entrance should remain restricted to ¾ inches with only the top beveled out-wards. While wedges can be placed on any adequately sized, flat concrete or wood surface, it is recommended the panels be placed nearest to the sun-warmed top deck (preferably as high as possible between the heat-trapping bridge beams),

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at least 10 feet high, with a clear flyway (at least 10 feet) and out of view or reach of potential predators or vandals. Details of the abodes and bridge structure can be seen in Appendix C.

Maintenance access in the Core section consists of a 10-foot wide gravel path, 1,105 feet in length, along the west-side of the section to accommodate maintenance vehicle access to the bayou. There is a natural deposition of sediment (fine sand) along the bayou here and it is anticipated that overtime sand will build up at the base of the proposed retaining wall and have to be periodically removed. Also incorporated into the design of the wildscape area is a series of gravel paths to allow for maintenance of the plantings (weeding, pruning, replanting, etc). The total length of these gravel paths is 510 feet with a width between 4 and 8 feet.

Currently there are overhead utility lines belonging to the Southwest Electrical Power Company which run north and south through the middle of the Core area and across the bayou (can be seen in Photo 2). These will be relocated to run along the west edge of Polk Street where they will not interfere with any aspect of the recommended restoration plan. Figure 7 shows the Core area layout plan.

East Section. The East section of land (approximately 7 acres) is bound on the east by the bayou, on the south by the active Louisiana and Arkansas Rail Line, on the west by the outer boundary of the existing levee which runs parallel to Austin Street and on the north in a direct line from the bayou's edge to Washington Street. Much like the Core section, this area is also expected to receive a fair amount of human presence. Of the 27 acres of land in this section initially investigated for ecosystem restoration, all but 7 acres were eliminated because they are part of an old

city landfill and therefore, not desirable for restoration. The restoration objective in this section is to restore the bottomland hardwood forest, improve habitat diversity, and reduce the impact of man-made intrusions on natural resources. The recommended plan in this section is a combination of forest management practices similar to those recommended in the West section and a smaller scale version of the wildscape component of the Core area.

The first component of the recommended plan in this area calls for forest management activities. The configuration of the land in this section is linear and the canopy cover is much more open than the forested stands in the West. Also, because portions of the forest stand have been kept open by vehicle traffic, there is a noted lack of understory and ground vegetation in certain areas.

Augmentation of these vegetation layers will increase the overall diversity of the vegetation in the area and improve the habitat for a variety of wildlife and bird species. Management activities include planting 20 one-inch caliper containerized trees, 20 one gallon containerized shrubs and 50 seedlings per acre of existing forest (5 acres total in this section). Recommendation for the use of increased numbers of containerized trees and shrubs and fewer seedlings when compared to the West was made to help speed the recovery and restoration of habitat in this section and to give the plantings a greater chance for long-term survival. The reason is because this section of land is expected to have more pedestrian traffic and be more visible than the restoration area in the West.

Tree species used will include water oak, willow oak, overcup oak, southern red oak, and Shumard oak; hickories, including pecan, water hickory, and butternut hickory; and black walnut, baldcypress, blackgum, sugarberry, golden ash, American elm, and river birch. Understory species will include hawthorns, flowering dogwood, sassafras, American beautyberry, farkleberry, yaupon holly, redbud, and wax myrtle. Because of the open canopy in this section, minimal management practices, such as selective thinning will be necessary.

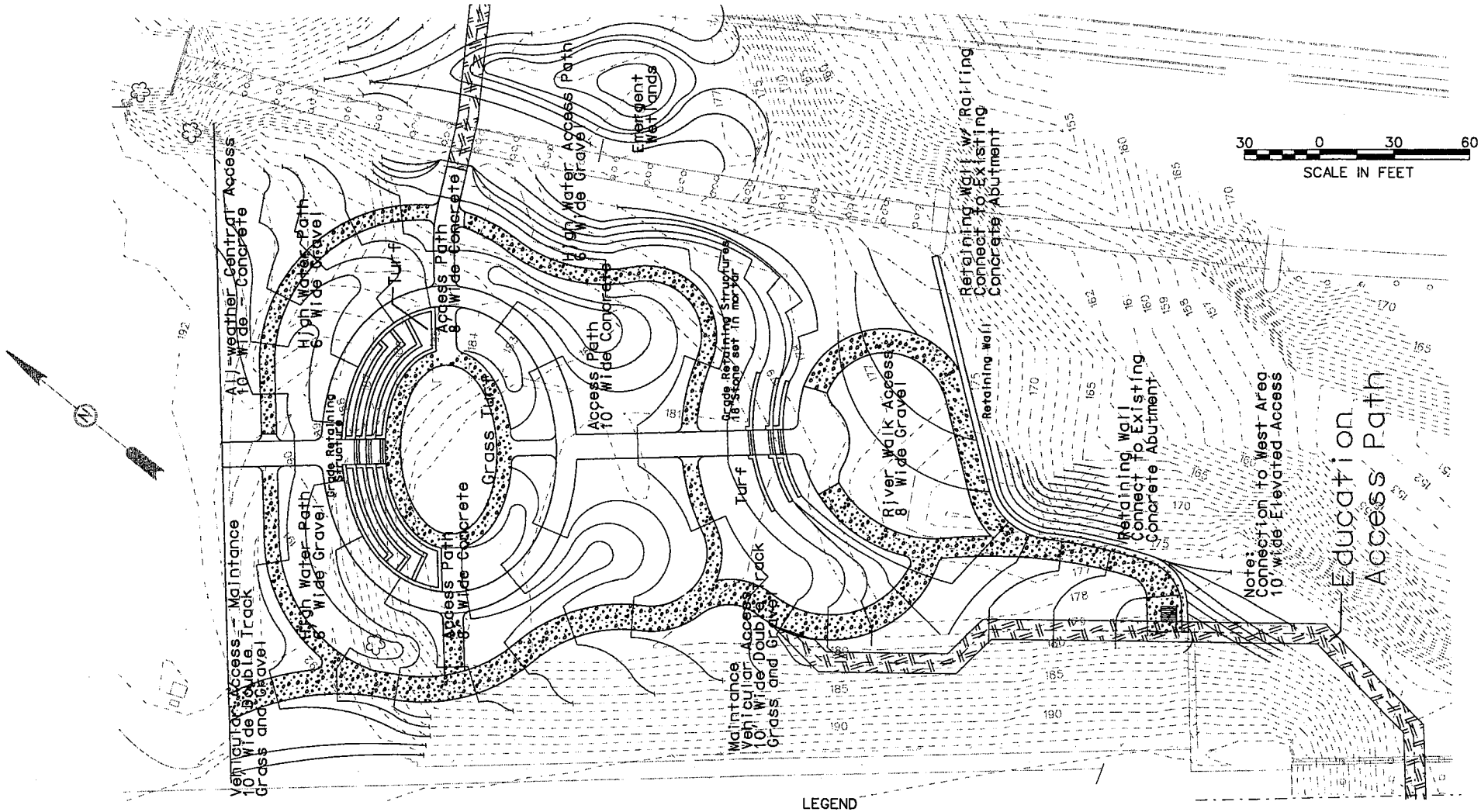
The second component of the recommended plan in this section is 2 acres of urban wildscape. By providing a second component of suitable habitat, neotropical birds, butterflies and other insects will be able to move back and forth between the Core and East areas, which, according to TPWD urban wildlife biologists, will improve the habitat quality for urban wildlife in both sections. Minor grade and fill activities will be necessary to accommodate establishment of elevations necessary to support the recommended wildscape plantings. Two grade retention walls will be required to hold the grade and to create the hard edges needed for planting beds. One retention wall, constructed of placed rock, is approximately 375 feet in length and varies in width between 2 and 20 feet. The second retention wall, constructed of weathered ironstone with mortar grout, is approximately 160 feet in length and 1.5 feet high.

Maintenance access is comprised of gravel path to, in and around the urban wildscape that will accommodate the weeding, pruning, and replanting needed on a routine basis to maintain the area. The path is approximately 350 feet long and 8 feet wide. Figure 8 shows the East area layout plan. Detailed design and wildscape planting plans are found in Appendices C and D, respectively.

Big Cypress Bayou. The recommended plan for aquatic restoration in Big Cypress Bayou is construction of gravel bars. The two sites selected for gravel bar construction are located immediately below a well-established rock out-crop (Photo 6) and immediately upstream of the Texas & Pacific Railroad bridge just west of Highway 59. At the time Photo 6 was taken, the rock out-crop was inundated by high flow. In order to optimize aquatic habitat value, each of the gravel bars will be 1000 feet in length and approximately 30 feet in width with the centerline located in the thalweg of the channel. Recommendations on the gravel bar design are based on extensive research of Big Cypress Bayou by WES personnel. It includes the use of heterogeneous substrate ranging from small gravel (1-3 inches diameter) to rather large and flat stones, and centering the gravel bar in the thalweg to ensure consistent flow during low-water periods and reduce sedimentation. Other design considerations include providing a maximum length to correspond to the upstream-downstream boundary of a typical outside bendway (approximately 1,000 feet); and the construction which shapes the gravel bar in a "V" shape with the "V" pointed upstream. Further, the surface of the bar at the middle of the river is slightly depressed to maintain deepest flow at the thalweg; and the depth of the gravel should be such to form a stable substrate.

The non-uniform rock/gravel mixture is typical of naturally-formed gravel bars and is expected to result in better compaction of substrate, while providing refuge for adult fishes from the current's velocity and offer more spaces for the attachment of eggs and invertebrates than a homogeneous mixture of gravel.

CORE SECTION LAYOUT PLAN



LEGEND

MAINTENANCE GRAVEL ACCESS PATH

EDUCATION CONCRETE ACCESS PATH

ELEVATED EDUCATION ACCESS PATH

BIG CYPRESS BAYOU

FISH AND WILDLIFE HABITAT RESTORATION

JEFFERSON, TEXAS

FIGURE 7

EAST AREA LAYOUT PLAN

BIG CYPRESS BAYOU

ISH AND WILDLIFE HABITAT RESTORATION

LEGEND

MAINTENANCE GRAVEL ACCESS PATH

ELEVATED EDUCATION ACCESS PATH

JEFFERSON, TEXAS

FIGURE 8

Photo 6. Riffle in rock out-crop area of Big Cypress Bayou.

Environmental Education and Interpretation. The recommended plan will have significant social, cultural, scientific and educational value by building upon the restoration objectives and taking advantage of the restored resources. The city of Jefferson, and particularly the Cypress Valley Alliance, has secured the cooperation of local industries and state colleges to provide educational and vocational opportunities of the restoration project. In conjunction with these initiatives, the recommended plan will provide excellent educational and vocational opportunities for elementary, secondary, as well as college students within the surrounding region. It should be noted without the ecosystem restoration project, the educational features would not have any utility or value as a stand-alone feature as the current degraded ecosystem does not offer any redeeming educational or social value.

Therefore, the recommended plan also includes environmental education features, i.e., additional access, not required solely for project construction, operation or maintenance. These features are described as either strictly educational, or when features required for project construction, operation, and construction also have an educational element, a dual purpose.

The educational access includes access in each of the West, Core and East areas. They include 155 linear feet of elevated access connecting the West area to the Core area, as well as a 475 linear foot

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elevated access connecting the Core Area (similar to the elevated access in the West area) to the east area. In addition, there is a concrete path approximately 250 feet long and 8 feet wide starting at the top center of the of the Core area running straight down to the edge of Big Cypress Bayou, where it widens to form a small overlook. Lastly, 530 linear foot gravel path from the terminus of the Core area access to the urban wildscape, as well as a 25 foot elevated access over a ponding area, in the east area is included.

The majority of the access identified in the recommended plan is required from a maintenance perspective, and is the minimum required in order to accomplish the objectives of the restoration plan. It is realized this same access will have significant social, cultural, scientific and educational value as an educational opportunity for visitors. This "dual purpose" access includes the remaining access in the West area, as well as a portion of the gravel path in the east area. In addition, this dual-purpose perspective also pertains to a portion of the grade retention structures in the Core section and the infrastructure (support planking and rail) required to attach the bat habitat to the railroad bridge. A portion of the retention structures (not including the wall located at the bayou's edge or within the riparian corridor) in the Core section, will compliment a planned interpretative plaza and an education and visitor center (currently under construction), and expected to attract visitors. Lastly, the infrastructure required for the installation of the bat habitat upon the railroad bridge will also serve to enhance access to the bridge between the Core section and the area east of the bridge.

he city of Jefferson and the Cypress Valley Alliance strongly support the incorporation of the above environmental education purposes and features into the recommended plan. These features are compatible with the Jefferson Open Spaces Master Plan. One goal of the Master Plan is to develop educational opportunities involving the surrounding natural ecosystem. Portions of the Master Plan, not developed as part of the recommended plan, include the following. Additional interpretive access with several small platforms that will be used as outdoor classrooms. Small piers onto small platforms overlooking Big Cypress Bayou that could be used for observation platforms or recreational fishing. An observation tower that would allow observation and interpretation of the different levels of vegetation and wildlife habitat usage of a bottomland hardwood forest. Interpretive signage to describe the ecology of the resources and explain the history of the steamboat era and old wharf area to the founding of Jefferson. A central interpretive plaza and an Education and Visitors Center (currently under construction) located just north of project lands in the Core section where educational classes and visitor groups could gather and access the project. The acquisition of land located on the east bank of the bayou that would be connected to the Core section by the railroad bridge. The Jefferson Open Space Master Plan is compatible with the recommended ecosystem restoration project, and would serve the surrounding region by developing educational opportunities.

As previously discussed, the formulation of the education features is based on the educational and social potential afforded by the restoration project. The justification for Federal participation in ducational features as part of the recommended plan is defined in Policy Guidance Letter No. 59, creation Development at Ecosystem Restoration Projects. The formulation of the educational

features was conducted within the following framework:

- are totally ancillary, i.e. project was not formulated solely for education.
- do not add to the project cost (dual-purpose access only).
- take advantage of the project's educational potential.
- do not diminish the ecosystem restoration purpose.
- are not vendible.
- would not exist without the project.
- are economically justified.
- are within the 10% Federal cost participation limit

Economic justification is based on an evaluation of competing facilities, existing and expected future use with and without the recommended plan, and the unfulfilled demand. According to the Texas Parks and Wildlife Department, Texas Outdoor Recreation Plan (TORP), which identifies population, usage, and demand trends within the region, including the study area, the demand for education facilities, such as trails, is steadily increasing. Further, it is noted that there is an inadequate supply of these types of facilities. Applying the appropriate participation rates to the population of potential users, the access will be used to capacity from the time it becomes available to the public through the period of analysis.

Current standards indicate access of this type can accommodate 18,900 visitors per year per mile of trail. For a 4,565-foot trail (access), the capacity usage would be (4,565/5,280) x 18,900 equals 16,341 visitor days per year.

Point values are assigned based on selective criteria applicable to the proposed trail. The criteria and assigned points are as follows:

• Several general activities; one high quality value activity -	13 points
• No comparable opportunities within 45 minutes time -	8 points
• Optimal facilities to conduct activities -	10 points
• Good access to and within site	17 points
• Above average esthetic quality	9 points
	57 points

The current unit day value for Fiscal Year 1999 is $6.15 for 57 points. Applying this value to 16,341 visitor-days results in a benefit of approximately $100,497.00 per year.

The assignment of cost to the educational features, for both economic justification and project cost sharing, is based on the "dual purpose" nature of those identified project features. Any project feature that serves purely educational purpose will be assigned solely to education. Project features required for project construction, operation and maintenance but which also serve an education purpose will have their costs apportioned equally to ecosystem restoration and education. Table 9 displays the apportionment of costs associated with the educational features.

TABLE 9
APPORTIONMENT OF PROJECT EDUCATIONAL FEATURE COSTS
(January 2000 Price Level)

Area:	Total Cost[1]	Assigned to Restoration	Assigned to Educational
West:			
Access - Dual	$ 146,791.00	$ 73,395.50	$ 73,395.50
Access - Educational	$ 14,191.25	$ 0.00	$ 14,191.25
Core:			
Access - Maintenance	$ 17,280.50	$ 17,280.50	$ 0.00
Access - Education	$ 48,827.50	$ 0.00	$ 48,827.50
Dual - Retention	$ 86,168.15	$ 63,342.15	$ 22,826.00 [2]
Dual - Infrastructure	$ 26,425.00	$ 13,212.50	$ 13,212.50 [3]
East:			
Access - Dual	$ 3,745.00	$ 1,872.50	$ 1,872.50 [4]
Access - Education	$ 16,968.50	$ 0.00	$ 16,968.50
Total	$ 360,396.90	$ 169,103.15	$ 191,293.75

[1] From the detailed cost estimate in Appendix C.
[2] Includes one-half the cost of 400 L.F. of retention wall.
[3] Includes one-half the total cost of the support planking and rail.
[4] Includes one-half of the cost of 350 L.F. of gravel path.

Table 10 displays the summary of the expected annual benefits and costs of the education features. Note that economic justification is based on only those costs associated with education. The total cost associated with these features is estimated at $310,948.42. The average annual cost, using an interest rate of 6.875% over a 50-year project life is $22,175.

TABLE 10
ECONOMIC JUSTIFICATION OF EDUCATION FEATURES
(January 2000 Price Level)

Annual Cost	Annual Benefit	Benefit-Cost Ratio
$ 14,400.00	$ 100,497.00	7.0

Total Project Costs of the Recommended Plan. Table 11 displays the summary of the total estimated construction costs for the recommended plan. The complete detailed cost estimate is located in Appendix C. Table 12 displays the estimated total project cost, comprised of all expenditures related to the Ecosystem Restoration Report, plans and specifications, land and

relocations, construction, and construction management. The total project cost of the recommended plan is estimated at $1,898,887.

TABLE 11
SUMMARY OF ESTIMATED CONSTRUCTION COST[1]
(January 2000 Price Level)

Item	Total Cost	Allocated to Restoration	Allocated to Educational
West Area:			
Wetland Complex	$ 29,743.50	$ 29,743.50	$ 0.00
Reforestation	$ 25,985.00	$ 25,985.00	$ 0.00
Access	$ 160,982.25	$ 73,395.50	$ 87,586.75 [2]
Wood Duck Boxes	$ 700.00	$ 700.00	$ 0.00
Subtotal West Area	$ 217,410.75	$ 129,824.00	$ 87,586.75
Core Area:			
Urban Wildscape	$ 216,618.15	$ 193,792.15	$ 22,826.00 [3]
Emergent Wetland	$ 7,140.00	$ 7,140.00	$ 0.00
Riparian Corridor	$ 34,000.00	$ 34,000.00	$ 0.00
Bat Habitat	$ 255,325.00	$ 242,112.50	$ 13,212.50 [4]
Access	$ 66,108.00	$ 17,280.50	$ 48,827.50
Boat Ramp Relocation	$ 62,269.50	$ 62,269.50	$ 0.00
Utility Relocations	$ 20,264.00	$ 20,264.00	$ 0.00
Subtotal Core Area	$ 661,724.65	$ 576,858.65	$ 84,866.00
East Area:			
Urban Wildscape	$ 77,676.00	$ 77,676.00	$ 0.00
Reforestation	$ 12,425.00	$ 12,425.00	$ 0.00
Access	$ 20,713.50	$ 1,872.50	$ 18,841.00 [5]
Subtotal East Area	$ 110,814.50	$ 91,973.50	$ 18,841.00
Big Cypress Bayou-Gravel Bar	$ 95,520.00	$ 95,520.00	$ 0.00
TOTAL	$ 1,085,469.90	$ 894,176.15	$ 191,293.75

[1] From detailed cost estimate located in Appendix C.
[2] Includes cost of access allocated solely to educational ($14,191.25), and half of cost of the dual purpose (maintenance/educational) access ($146,791.00).
[3] Includes half of the cost of 400 L.F. of the grade retention structures.
[4] Includes half of the total cost of the support planking ($12,460.00) and rail ($13,965.00).
[5] Includes half of the cost of the dual purpose (maintenance/educational) access ($3,745.00).

TABLE 12
ESTIMATED TOTAL PROJECT COST
(January 2000 Price Level)

Item	Cost
Ecosystem Restoration Report	$ 270,000.00
Plan and Specifications	$ 230,000.00
Lands, Easements, Rights-of-Way, Relocations, Disposal Areas (LERRD):	
Land:	
Payments and Administration	$ 95,830.00
Relocations:	
Boat Ramp	$ 62,269.50
Utility	$ 20,264.00
Engineering and Design & Supervision and Administration	$ 16,506.70
Subtotal Relocations	$ 99,040.20
Total LERRD	$ 194,870.20
Construction:	
Ecosystem Restoration	$ 894,176.15
Educational	$ 191,293.75
Supervision and Administration	$ 108,546.99
Subtotal Construction	$ 1,194,016.89
Monitoring	$ 10,000.00
TOTAL PROJECT COST	$ 1,898,887.09

Importance of Project Outputs. In Texas, it is estimated that more than 60 percent of the historical bottomland hardwoods and bottomland forested wetlands have been lost due to reservoir construction and operation, agricultural conversion, timber production, and urban and industrial development. Numerous studies have documented the increasing scarcity of bottomland hardwood forests in Texas and the nation. Studies by TPWD indicate that of the remaining 37 percent of the original bottomland hardwoods and riparian vegetation left in the state, most is found in east Texas where it is increasingly threatened due to land use changes. Cypress swamps are very fragile and, as a result, are becoming increasingly scarce due to adverse impacts of timber harvesting, residential and commercial development, and other land use activities which can change the hydrologic conditions required for propagation.

According to the Texas Environmental Almanac (1995), the overwhelming loss of and threats to wildlife, plants, and natural communities are a direct result of habitat alteration and destruction. One hundred and eighty nine species of trees and shrubs, 42 species of woody vines, 75 species of grasses, and 802 species of herbaceous plants occur in Texas' bottomlands. They are known to support 116 species of fish, 31 species of amphibians, 54 species of reptiles, 273 bird species and 45 species of mammals. At least 74 species of threatened and endangered animals depend directly on bottomland hardwood systems and over 50 percent of neotropical songbirds not Federally listed as endangered or threatened are associated with these systems. In the Pineywoods of East Texas, where native bat species are primarily tree dwellers, the loss of mature cavity trees has adversely impacted their roosting habitat. The loss of the bats' traditional roost habitat and their slow rate of reproduction make them exceptionally vulnerable to extinction, with over 50 percent of native American bat species already listed as endangered or with populations in severe decline. Besides contributing to the biodiversity of Texas and providing critical wildlife and bird habitat, bottomland hardwood systems 1) serve as catchment and water retention areas in times of flooding; 2) help control erosion; 3) contribute to the nutrient cycle, and 4) play a vital role in maintaining water quality by serving as a depository for sediments, wastes and pollutants from runoff. Despite these important functions, bottomland hardwoods ecosystems are one to the most endangered ecosystems in the United States.

The proposed recommended plan is consistent with State and Federal government initiatives to conserve and increase declining wetland acreage. It is also consistent with the North American Waterfowl Management Plan with its goal of preserving and increasing North America's waterfowl population.

Early successional vegetation, historically an important component of bottomland forests, is utilized by many bird and wildlife species, as well as insects. It also happens to be very compatible for use in an urban environment. By providing the basic requisites of food, water and cover for wildlife, the "wildscapes" attract urban wildlife species such as butterflies, songbirds and small mammals. The addition of this vegetation type, in conjunction with bottomland hardwood forest stands, improves the overall quality of the habitat in the proposed project area by increasing diversity of the habitat types, and therefore, the variety of wildlife and bird species it will support.

At the time paddlefish were placed on the Texas State Endangered Species List in 1977, small populations were found only in the lower reaches of five East Texas rivers, of which Big Cypress Bayou was one. In 1992, TPWD developed a Paddlefish Recovery Plan. The plan devised a paddlefish restoration program for each river basin with the goal of restoring paddlefish stocks in targeted recovery areas to levels needed to remove the species from the state's Endangered Species List and to support viable fisheries. Stocking rates were determined for each target area and beginning in 1992, thousands of 8"-10" paddlefish fingerlings have been stocked.

Table 13 summarizes the recommended plan identified as a result of the incremental analysis. It describes the restoration components and identifies the average annual habitat units gained, the

annualized costs (including O & M) and the annualized costs per habitat unit gained for each section of land within the proposed project area.

TABLE 13
RECOMMENDED PLAN DETAILS
(January 2000 Price Level)

Section	Restoration Alternative Combinations	Average Annual Habitat Unit Gains	Annualized Costs (dollars)	Average Annualized Cost (dollars/ AAHU)
West	Plant 10- one inch caliper containerized trees, 5- one gallon containerized shrubs and 100 seedlings per acre with appropriate selective thinning on 21.8 acres of land. Develop 3 bottomland hardwood wetland cells totaling 2.9 acres. Plant 250 bald cypress seedlings per acre of wetland and appropriate selective thinning. Install 2 wood duck nesting boxes per wetland acre and 1 wood duck nesting box per 225 linear feet of bottomland hardwood bayou edge for a total of 14 boxes.	24.96	$25,036	$1,003.04
Core	Relocate boat ramp, parking lot and utility lines; plant riparian corridor using 40- three inch caliper trees; remaining 3 acres planted with native understory tree, shrub, and herbaceous vegetation known to attracted urban wildlife. Utilize the existing abandoned railroad bridge as a super support for 12 Oregon Bridge Wedges, 7 Texas-Bat-Abodes and 2 Big-eared Bat-Abodes. Divert drainage from under old railroad bridge to area between the bridges; add high quality wetland plants; eliminate the cultivated grasses and weeds and plant native grasses in area surrounding wetland.	16823.44	$53,449	$3.18
East	Plant 20- one inch caliper containerized trees, 20- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning on 5 acres of land. Plant 15- three inch caliper trees; remaining 2 acres planted with native understory tree, shrub, and herbaceous vegetation known to attract urban wildlife.	5.63	$13,538	$2,404.62
Big Cypress Bayou	Placement of 2- 1000 foot gravel bars, one downstream of shoal area and one upstream of Highway 59.	1071.04	$9,326	$8.71
Totals		17,925.07	$101,349	$5.65

The recommended plan will increase the average annual habitat units gained by 17,925.07 habitat units over the without project ("no action") alternative at an annualized cost of $5.65 per unit, including operations and maintenance costs. The recommended plan will restore approximately 30 acres of bottomland hardwood forest, 2.9 acres of bottomland hardwood wetlands, 5 acres of urban wildscape, 0.25 acres of emergent wetland and 1.84 acres of instream spawning habitat for approximately 40 species of fish. In addition, it will supply roosting and nursery habitat for bats and wood ducks, not to mention the myriad of other insects, butterflies, hummingbirds, neotropical songbirds, waterfowl, wildlife, amphibian and reptilian species that will benefit. The recommended plan directly addresses the loss and scarcity of the resources described above as well as complements various state and federal plans for restoring resources.

Other Project Impacts

***Soils**. The recommended plan would utilize the qualities of existing soils to develop forested habitat, wetlands, and urban wildscape. The planting of mast producing trees and shrubs are expected to cause minimal disturbance to soil and then only in the immediate vicinity of the chosen planting sites. Construction of the wetland cells and maintenance access in the west section will result in the disturbance of the soil in the immediate construction area. Material to be used for the earthen embankments will be brought in from outside the project area to reduce adverse impacts. Safeguards to reduce soil erosion will be implemented during construction. The grade and fill activities in the already highly disturbed core and east sections will be kept to the minimum necessary to accomplish the objective and safeguards to reduce soil erosion will be implemented during construction. Only minor adverse impacts to the soils would occur from implementation of the proposed project.

***Water Quality**. The recommended plan has the potential for adversely impacting water quality within Big Cypress Bayou on a temporary basis. The placement of 2000 feet of gravel at the bottom of the instream channel will cause an increase in the amount of turbidity in the area of construction and an increase in total suspended and dissolved solids moving downstream for a short time following construction. This will be a temporary impact. The recommended gravel bar sites were carefully selected to minimize any future long-term adverse impacts to water quality while maximizing the quality of the instream habitat. The water in the construction areas is relatively shallow and moves relatively swiftly even during the summer months. This should keep siltation of the gravel bars to a minimum, a factor that is extremely important in order for the gravel bar to be suitable for spawning activities in the future.

Potential impacts to water quality may result from the construction of the wetland cells, the grading and fill activities in the core and east areas, and the construction of maintenance access. These activities could temporarily result in a slight increase in the suspended sediment load in Big Cypress Bayou. In addition, activities associated with the removal and reconstruction of the boat ramp could increase the sediment load on a temporary basis. To minimize any of these impacts safeguards to reduce soil erosion will be implemented during construction. There will be no significant adverse

impacts to the water quality in the proposed project area from implementation of the proposed project, except on a temporary basis. In fact, as the planted materials grow and mature, it is expected that they will act as traps and sinks for pollution from runoff of the downtown Jefferson area.

***Air Quality.** No significant adverse impacts to air quality would occur from implementation of the proposed project.

***Land Use.** The proposed project will not have any adverse impacts to land use in the area. It is hoped that the project as proposed will serve as a model to local landowners and citizens for incorporating improvements on their own lands and in their own yards for simple ways to improve the quality of wildlife habitat.

***Aquatic Resources.** Any adverse impacts to the aquatic habitat from the construction of the gravel bars and other project features would be short term and the system would recover completely once terrestrial vegetation is well established in all the project areas. In fact it is expected that habitat gains for the river reach between Lake O' the Pines and Caddo Lake will be significant. Overall, the recommended plan will help to improve the aquatic habitat in Big Cypress Bayou. Development of additional forested and vegetated areas around and over the stream will provide shade to help maintain water temperatures within optimum ranges for the growth and development of aquatic organisms. More trees and vegetation in the riparian zone would improve the ability of ıe corridor to provide buffering against environmental pollutants in stormwater runoff and increase .ıe input of organic nutrients to Big Cypress Bayou.

***Terrestrial Resources.** There will be no adverse impacts to the terrestrial resources in the proposed project area from implementation of the recommended plan. In fact, the gains in habitat quality will be significant.

***Endangered or Threatened Species.** The proposed project has been reviewed by the U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department. The recommended plan is not likely to adversely affect federally listed threatened or endangered species and is specifically designed to benefit at least two species on the Texas Endangered Species List- Rafinesque's big-eared bat (*Plesotus rafinesquii*) and paddlefish (*Polyodon spathula*).

***Cultural Resources.** The recommended plan will result in minor impacts in most areas except for the following six tasks: (1) removal of existing boat ramp facilities, (2) construction of new boat ramp facilities, (3) construction of the wetland cells, (4) construction of raised maintenance access route, (5) rerouting a few city drainage channels and (6) removal of an artificially raised dirt road. Additional minor impacts can be anticipated from the planting of new vegetation or the selective removal of unwanted vegetation as part of the restoration efforts.

As a result of the archeological and cultural resources investigations conducted during this study, ɔtentially buried archaeological deposits (filled urban blocks), older surfaces buried under post-,80 fills, standing historic structures pre-dating 1950, natural landform features potentially

containing sealed archaeological remains, and visible archaeological remains were identified. The field and archival work has established the range of potential archaeological investigations that may be required during subsequent project phases. A formal program of archaeological testing would be implemented based on the findings given here and coordinated with the appropriate historic preservation agencies (e.g., Texas Historical Commission). See Appendix A for concurrence letter. A summarized version of the cultural resources report of findings and recommendations is included in Appendix F.

Coordination with the Texas Historical Commission Division of Architecture has been initiated with respect to the historic railroad trestle supported iron bridge. The Deputy Texas Historic Preservation Officer response to a CESWF request for no adverse effect concurrence is provided in Appendix A. Concurrence will be provided once the plans and specifications on the handrail design and attachment detail meeting the *Secretary of the Interior's Standards for Rehabilitation* have been provided to their office. Subsequently, concurrence with the Advisory Council on Historic Preservation will complete the process with respect to the bridge.

***Recreational, Scenic, and Aesthetic Resources**. The recommended plan will, at the worst, have only slight adverse impacts on the recreational, scenic and aesthetic resources in Jefferson, which will be far out weighed by the large positive long-term impacts.

The relocation of the boat ramp and possible "no wake" restrictions on motorized watercraft within the proposed project area may be viewed as a negative impact by some segment of recreational users. Scenic and aesthetic resources in the area might be adversely impacted on a temporarily basis during the construction phase of the project, but the benefits to the highly visible core and east areas will be immediately seen with the establishment of the wildscape plant materials. Much of this vegetation will be containerized plant and bedding materials that become quickly established and attractive to view. The addition of trees and shrub species to the existing forested tracts will improve the aesthetics of these areas even given the fact that it will take several years for these trees and shrubs to mature.

***Socio-Economic Conditions**. The recommended plan will not have any adverse impacts on the socioeconomic conditions in Jefferson. In fact, it is possible the plan will indirectly benefit the local economy. One of Jefferson's sources of income is from tourism. The location of the proposed project area adjacent to the historic downtown area and across the street from the new Environmental Education Center may provide an additional attraction to Jefferson's rich historical heritage based on commercial navigation along Big Cypress Bayou.

PROJECT IMPLEMENTATION

Project Management Plan. This Project Management Plan (PMP) describes the activities to be undertaken during subsequent phases including plans and specifications (including the scope of work, schedule and funding requirements), project construction, and monitoring. During plans and specifications, the following major tasks would be performed:

- Preparation of Plans and Specifications (P&S)
  - Complete Project Final Design
    - Wetland Cells
    - Maintenance Access
    - Bat Habitat
    - Finalize Grading Plan for Core and East Section Wildscape Areas
    - Grade Retention Structures and Planting Beds
  - Complete Plans and Specifications
  - Request & Receive Commitment of Federal Funds for Construction
  - Execute Project Cooperation Agreement
  - Acquire Real Estate
  - Advertise and Award Construction Contract
- Project Construction
- Monitoring

Plans and Specifications. The plans and specifications phase will be initiated.after the approval of the Ecosystem Restoration Report. During this phase the remaining detailed design of the various project features will be completed, including the water control structures and wetland cells, grade control structures, bat habitat dwellings, and access. Also, detailed layouts will be shown for the reforestation and urban wildscape areas, including the identification of species and a planting plan. This detailed design will culminate in drawings (plans) and detailed specifications for each component of the project. Also, this detailed design will enable preparation of a firm cost estimate for the project. The cost of the plans and specifications is a part of the overall total project cost.

Also during the plans and specifications phase, a commitment of Federal funds for construction will be received. At this point the project is approved and funded for construction. After the commitment of Federal funds, the Project Cooperation Agreement will be executed between the Federal Government and the non-Federal partner, followed by real estate acquisitions completed by the non-Federal partner. In addition the non-Federal partner will be responsible for all relocations including the boat ramp and the utility lines.

Once all the required real estate is acquired, a construction contract will be advertised, and awarded pending the receipt of a responsive bid. The plans and specifications phase is expected to take 20 months to complete. Table 14 displays the summary of the estimated cost of the plans and specifications phase.

TABLE 14
PLANS AND SPECIFICATIONS PHASE COSTS
(January 2000 Price Level)

PLANS AND SPECIFICATIONS	
Engineering and Design	$150,000.00
Planting Plan	$10,000.00
Environmental & Cultural Review Coordination and Compliance	$10,000.00
Cost Engineering	$10,000.00
Real Estate Review	$20,000.00
Construction Contract Award	$10,000.00
Project Management	$20,000.00
TOTAL PLANS AND SPECIFICATIONS	$230,000.00

Project Construction. After award of a construction contract, the Government would oversee the actual construction of the restoration project. Construction activity includes wetland cells and water control structures, access, filling and grading, grade retention structures, and the bat habitat structures. These features are expected to be completed within 12 months.

The construction contract will also provide for oversight of the reforestation, riparian corridor, and urban wildscape plantings. A variety of procedures will be used to establish the different plant species identified for inclusion in the recommended plan. These procedures will depend on the type of plant material, whether it is containerized or a bareroot seedling, nursery grown or started from seed, the location where it is to be planted (i.e., wetland, wildscape, existing forest stand, etc.), the optimal planting season for the particular species, and soil and climate conditions at the time of planting. In addition, some of the planting will take place over two growing seasons. This will include the hard and soft mast producing species to be used and the bald cypress seedlings to be planted in the wetland complex. That way any lessons learned during the first year will be applied to the seedlings planted in the second year and any changes to the operation of the wetland cells or modifications of forest management techniques necessary to improve the survival of the seedlings can be implemented.

Inherent with this contract, a warranty period for the actual construction items and the plantings will be specified before final acceptance of the project.

Monitoring and Adaptive Management. An important component of project implementation is the monitoring of the ecosystem's response to the restoration measures. By connecting the ecosystem response to the restoration as well as the management measures, potential

beneficial adaptations and adjustments to the project or management plan can be identified to ensure continued success of the project.

To accomplish this goal, periodic monitoring of the restoration measures will be conducted by the Fort Worth District. This is especially true of the plantings that will have to be frequently monitored from their initial planting until reasonable stabilization is achieved. In the West and East sections, the planting of the tree and shrub seedlings will be spread out over two growing seasons. It has been learned from past experience that this will help to ensure a higher rate of overall survivability of the plantings in case the initial planting season conditions are abnormally harsh.

Review of literature on the artificial regeneration of bald cypress documented that it is difficult to successfully restore bald cypress habitat. The health of the seedlings and their survivability in relation to the management of water levels in the wetland cells will be monitored closely during the initial year following establishment. Lessons learned during the first year will be applied to the seedlings planted in the second year. Any changes to the operation of the wetland cells deemed advantageous to increase the quality and/or conditions for habitat and bald cypress survival will be implemented, as necessary.

A planting plan has already been developed for the Core and East sections of the proposed project and can be seen in Appendix D. Periodic replanting of a small number of trees, shrubs and herbaceous plant beds that comprise the wildscape areas has been included in the annual operation and maintenance cost estimates. However, it is expected that through time the design will change and evolve to reflect the unique conditions and characteristics of the site locations and the ideas and preferences of the maintenance personnel who care for the plants.

In addition to periodic cleaning of the bat houses, surveys of the number and species of bats utilizing the abodes will be conducted. The three different types of bat abodes described in the recommended plan are known to appeal to different species of bats and will support various populations. Recommendations were made by bat specialists as to the initial location, placement, types and numbers of the bat abodes to be added to the railroad bridge support structure. Results of periodic surveys will allow changes to be made to these parameters based on the rates of usage of the habitat. This allows initial costs of the abodes to be kept to a minimum, while maximizing the flexibility of the bat habitat management to adapt to changes over time.

The location and placement of gravel bars in Big Cypress Bayou, based on recommendations of TPWD and WES biologists, was determined specifically to maximize the aquatic habitat value and minimize the need for maintenance. Both TPWD and WES are involved in periodic aquatic habitat and fish surveys in Big Cypress and are very interested in the results of this particular restoration effort. Once a gravel bar is constructed, it would become economically infeasible to change its location, but changes could be made to restocking plans, such as TPWD's Paddlefish Recovery Plan. And it would certainly give the Corps the chance to learn about planning and implementing instream habitat of this type for future applications.

As noted above, in the effort to ensure the success of the recommended plan, restoration efforts implemented will be periodically surveyed to provide feedback on the response of the ecosystem and its resources to the management measures taken. This way, adaptations and adjustments can be made to the project and the management plan that may be necessary and feasible to the success of the project over the long-term. It is anticipated that the formal monitoring will be accomplished over a two year time period beginning after the completion of the construction of project features and the initial planting of the vegetational components.

Project Schedule. Table 15 displays the project schedule.

TABLE 15
PROJECT MILESTONE SCHEDULE

Initiate Plans and Specifications	July 2000
Commitment of Federal Funds for Construction	December 2000
Execute Project Cooperation Agreement	March 2001
Acquire Real Estate	March 2002
Advertise Construction Contract	April 2002
Initiate Construction	June 2002
Complete Construction	June 2003
Complete Planting	June 2004
Complete Monitoring	June 2005

Project Cooperation Agreement. The Project Cooperation Agreement (PCA) is a contract between the Federal Government and the non-Federal partner describing the rights and responsibilities of each party during project implementation, including cost sharing. Appendix H is a copy of a draft model agreement. The PCA will be executed after the receipt of the commitment of Federal funds for construction and prior to the advertisement of a construction contract.

Cost Apportionment. As described in the PCA, the total project cost assigned to ecosystem restoration will be shared between the Federal Government and the non-Federal partner on a 75% and 25% proportion, respectively. The components of the non-Federal partner's 25% share are highlighted below.

- Credit for the value of all lands, easements, rights-or-way, relocations, and disposal areas (LERRD's)

- Credit for the value of any work-in-kind (WIK) services performed by the non-Federal partner or its contractors.

- In the event the sum of the values for LERRD's and WIK is less than the 25% contribution, the non-Federal partner will contribute the balance in cash.

- In the event the value of the LERRD is greater than 25%, the non-Federal partner will be reimbursed in cash in order to reduce the total contribution to 25%.

- Credit for work-in-kind is limited to 80% of the total non-Federal partner's contribution, and cannot result in a reimbursement.

The cost apportionment for the education features will be shared between the Federal Government and the non-Federal partner on a 50% and 50% proportion, respectively. Table 16 displays the current estimate cost apportionment.

Work-in-Kind. Work in kind is services or materials provided by the non-Federal partner during post-feasibility phase design and construction. Further, with regard to work-in-kind, the non-Federal partner will comply with applicable Federal and state laws and regulations, including the requirement to secure competitive bids for all work to be performed by contract. Contributions of cash, funds, materials or services from other than the non-Federal partner may be accepted; however, such contributions will not be credited to the non-Federal partner's share, but rather will be applied to the entire total project cost and therefore reduce both the Federal and non-Federal share.

As part of the recommended plan, the city of Jefferson would provide the abandoned Louisiana and Arkansas Railroad bridge to be used as the support structure for the bat abodes. The abandoned bridge is ideal as a support structure given its location and spatial characteristics. Granted this is a "material" to be provided by the sponsor during project implementation, a credit for work in kind will be given. The value of the work in kind credit is based on the cost of constructing comparable bat habitat support structures. The total cost of a constructed bat habitat support structure, not including engineering, design, supervision and administration is $225,000. This is the value of the credit for work in kind. See estimate and sketch drawings in Appendix C.

Real Estate Plan. Real Estate requirements for the project include 37.2 acres of land. The city of Jefferson currently owns approximately 10.5 acres in fee. The remaining lands are in private ownership. County records indicate that 16 ownerships are involved. A breakdown of these lands into the project segments, West Section, Core Section, East Section, and Aquatic Restoration can be found in Table E-1. The total cost of real estate, including contingency, is estimated to be $95,830.00.

Operation and Maintenance. The non-Federal sponsor is responsible for all project operation, maintenance, repairs, replacement, and rehabilitation. Estimated annual operations and maintenance costs totaling $21,000 were calculated with the restoration costs in the incremental cost analyses in Appendix B. Breakdown of the costs is as follows: $16,000 per year for labor based on 20 man hours per week or 1040 man-hours per year at a salary of approximately $12.00 per hour plus benefits and $6,000 per year for materials and supplies.

TABLE 16
COST APPORTIONMENT
(January 2000 Price Level)

Total Project Cost	$	1,898,887.09
Ecosystem Restoration	$	1,688,463.96
Education	$	210,423.13 (1)
Federal Share		
Ecosystem Restoration	$	1,266,347.97
Education	$	105,211.56
Total Federal Share	$	1,371,559.54
Jefferson Share:		
Ecosystem Restoration	$	422,115.99
Educational	$	105,211.56
Total Jefferson Share	$	527,327.55
Jefferson Share:		
Ecosystem Restoration:		
LERRD Credit:		
Lands and Payments	$	95,830.00
Boat Ramp Relocation	$	62,269.50
Utility Relocation	$	20,264.00
Engineering, Design & Administration	$	16,506.70
Subtotal LERRD	$	194,870.20
Work-in-Kind	$	225,000.00
Cash	$	2,245.79
Total Ecosystem Restoration	$	422,115.99
Education:		
Cash	$	105,211.56
Jefferson Share Summary:		
LERRD	$	194,870.20
Work in Kind	$	225,000.00
Cash	$	107,457.35
Total Jefferson	$	527,327.55

(1) Includes a proportion of construction supervision costs assigned to education.

Operation and maintenance activities of the proposed project will be varied and are expected to include the following activities: 1) periodic weeding, pruning, watering and replanting of plant materials in the wildscape areas to maintain the plants health and manage the growth of the vegetation; 2) picking up trash throughout the project area; 3) removal of debris from maintenance access paths, such as tree limbs or brush, after flood events, hard rainstorms and wind storms; 4) periodic replacement and repair of boards of wooden access paths; 5) yearly checking and cleaning of wood duck nesting boxes and bat abodes to make sure they are in good repair and not infested with wasp nests or bee hives; 6) the tree and shrubs seedlings planted to improve the existing forest stands will need to be regularly monitored and forest management techniques, such as additional thinning will need to be applied periodically as the planted trees and shrubs mature; 7) some of these trees and shrubs will need to be trimmed, pruned, removed or replaced over time; and 8) monitoring and management activities associated with the operation of the 3 wetland cells.

It will be necessary to set staff gauges (poles with centimeters or inches marked on them) in several places in each of the wetland cells in order to be able to determine the actual water depth is in various locations within the cells. Research on artificial regeneration of bald cypress has establish preliminary guidelines of 5 to 45 centimeters for the range of water depth that promotes the continued growth and development of bald cypress trees, especially in the seedling stage, and those water depths and conditions that are detrimental to seedling survival. In the first few years of operation, it will be necessary to document duration of water retention in the cell following flood and local runoff events in relation to the setting of the stop log elevation at the water control structures. Average water depth in the wetland cells is expected to be a primary factor in the success of artificially regenerating bald cypress and water tupelo. While this activity is not difficult in itself, it will require report keeping and frequent surveys of the wetland cells. It must be remembered that these activities will have to be conducted at each of the individual cells since each is unique and will need to be operated differently.

The tree, shrub and herbaceous plant species incorporated into the planting design of the wildscape areas on the Core and East areas were specifically selected because they are native to the region. These species are known to grow with a minimal of maintenance compared to most plant species found in typical landscape designs. However, given the variety of plant types and the closeness of the plantings, it is anticipated that upkeep of the wildscape areas will require a significant amount of time. Some weekly maintenance activities will occur here all year long. These activities will include weeding, pruning, watering and replanting of plant materials to manage the growth of the vegetation and maintain the plants in a healthy condition.

COORDINATION OF THE RECOMMENDED PLAN

Views of Sponsor. The city of Jefferson has been identified as the non-Federal sponsor. The city has reviewed the draft Ecosystem Restoration Report, and supports the recommended plan. A letter of intent from Jefferson stating their support for the recommended plan and their intent to fulfill the responsibilities of the non-Federal partner during project implementation is located in Appendix A. A major supporter of the project, the Cypress Valley Alliance, has also reviewed the

report, and supports the recommended plan, and will continue to work closely with the city of Jefferson during the implementation of the project. A letter of support from the Cypress valley Alliance is included in Appendix A.

***Results of Agency Coordination**. As previously noted in this report, representatives from the Texas Forest Service, Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Institute for Water Resource, Waterways Experiment Station, Bats Conservation International, and Historical Preservation Consulting Services have contributed to the development and evaluation of the ecosystem restoration alternatives. In addition, information on water and air quality was obtained from the Texas Natural Resources Conservation Commission. In accordance with coordination requirements set forth by the National Environmental Protection Act (NEPA), the draft Ecosystem Restoration Report was reviewed by resource agencies, including the Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Environmental Protection Agency (Region 6), Texas Historic Commission and the Texas Natural Resources Conservation Commission. A letter and report on the cultural resources survey undertaken as a component of this project was sent to the Texas State Historic Preservation Officer for preliminary review and concurrence with the survey findings is included in Appendix A. A letter documenting USFWS support of the proposed project is provided in Appendix G, along with a copy of their Coordination Act Report. Letters of support received from the Texas Parks and Wildlife Department and Bats Conservation International, Inc. are included in Appendix A.

Regulatory Requirements. The proposed project has been reviewed in accordance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. In addition, Executive Order 11990, Protection of Wetlands, and Executive Order 11988, Floodplain Management, were considered during the development of the proposed project. The recommended plan would impact waters of the United States and is subject to provisions of Section 404 of the Clean Water Act. The project's terrestrial restoration activities would meet the conditions of Nationwide Permit 27, Wetland and Riparian Restoration and Creation Activities. The State of Texas has issued a water quality certificate for Nationwide Permit 27 and therefore no further coordination is required under Section 404. The aquatic restoration activities of the project are not specifically met with any of the Nationwide Permits currently in effect; however, they are covered by a Letter of Permission. A Letter of Permission (LOP) is a procedure designed to expedite Section 404 authorization of work not posing significant adverse individual or cumulative impacts. The aquatic restoration activities associated with the proposed project are in compliance with the terms and conditions of LOP-1. There are no feasible alternatives to conducting the proposed project within the floodplain since the project as proposed requires siting within the floodplain to meet its intended purpose. However, the proposed activities would not induce development in, alter boundaries of, or significantly impact the 100-year floodplain in any way. The proposed project is in compliance with Executive Order 11988, Floodplain Management. The proposed project would neither adversely impact nor result in any loss of wetland areas, so the project is in compliance with Executive Order 11990. A draft Environmental Assessment (EA) and draft Finding of No Significant Impact (FONSI) have been prepared and will be provided to the general public, agencies, and interested parties for a 30 day review per procedures as outlined by NEPA. After receiving the

public and agency input, the District Engineer will determine if all environmental concerns have been adequately addressed and if the FONSI can be signed, completing the NEPA process.

CONCLUSIONS

This Ecosystem Restoration Report (ERR) documents the results of a study conducted under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended (33 USC 2201). The study sought to identify the environmental degradation caused by the construction and operation of Lake O' the Pines and subsequent development activities, and evaluate measures to improve the functional stability, quality and integrity of important ecosystem resources. A cost-effective ecosystem restoration project would be recommended, if applicable.

The recommended plan consists of restoration of approximately 30 acres of upland and bottomland hardwood forests, 2.9 acres of bottomland hardwood wetlands, 5 acres of urban wildscape including bat roosting and nursery habitat, 0.25 acres of emergent wetland and 1.84 acres of instream spawning habitat. The total project cost is estimated at $1,898,887. This report identifies positive benefits to wildlife habitat given the implementation of the recommended plan.

The city of Jefferson has been identified as the non-Federal sponsor and supports the recommended plan and intends to act as the non-Federal sponsor during project implementation. A complete description of the sponsor's responsibilities during project implementation is located in the Project Cooperation Agreement. Prior to commencement of project implementation, the sponsor has agreed to meet the following requirements of local cooperation:

a. Hold and save the United States free from damages due to construction, operation, and maintenance of the project, but not including damages due to the fault or negligence of the United States or its contractors;

b. Provide without cost to the United States all lands, easements, rights-of-way, including borrow and dredged material disposal areas necessary for construction, maintenance and operation of the project;

c. Provide without cost to the United States all necessary relocations and alterations of buildings, utilities, storm drains, roads, bridges (except railroad bridges which are cost shared) and other community services;

d. Maintain and operate the project after completion in accordance with regulations prescribed by the Secretary of the Army;

e. In addition to other cost sharing responsibilities, assume full responsibility for all project costs in excess of the Federal cost limitation of $5,000,000;

f. Assume full responsibility for 25% of the total project cost assigned to ecosystem restoration; and 50% of the total cost assigned to education;

g. Any costs incurred in the cleanup of hazardous materials located on project lands and covered under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) shall be considered a non-Federal responsibility for which no cost sharing credit can be given. The project sponsor shall be required to operate, maintain, repair, replace and rehabilitate the project in a manner so that liability will not arise under CERCLA.

A letter of intent was provided by the city of Jefferson, and contains sufficient information to conclude that the city has sufficient financial capability to provide the required cash contribution.

Extensive coordination and input was obtained from the U.S. Fish and Wildlife Service, Bat Conservation International, Inc., and the Texas Parks and Wildlife Department during the development of the recommended plan and both agencies are supportive of the project. The recommended plan is consistent with State and Federal government initiatives to conserve and increase declining wetland acreage. It is also consistent with the North American Waterfowl Management Plan with its goal of preserving and increasing North America's waterfowl population.

An Environmental Assessment (EA) was integrated into the ERR to assess the possible impacts of the recommended plan. A public notice will be released, disclosing the availability of the EA. A Finding of No Significant Impact, if appropriate, will be issued after reviewing comments on the EA.

RECOMMENDATIONS

I propose the recommended plan described in this Ecosystem Restoration Report be authorized for implementation under the authority of Section 1135 of the Water Resources Development Act of 1986, as amended, as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. The first cost of this project is estimated to be $1,898,887.

Prior to commencement of construction, local interests must agree to meet the requirements for non-Federal responsibilities as outlined in this report and future legal documents. The City of Jefferson has demonstrated that they have the authority and the financial capability to provide all non-Federal requirements for the implementation, operation, and maintenance of the project. The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works' construction program not the perspective of higher review levels within the Executive Branch.

James S. Weller
Colonel, Corps of Engineers
District Engineer

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FINDING OF NO SIGNIFICANT IMPACT

BIG CYPRESS BAYOU
FISH AND WILDLIFE HABITAT RESTORATION
JEFFERSON, MARION COUNTY, TEXAS

An Ecosystem Restoration Report with an integrated Environmental Assessment (EA) has been made of alternatives to provide environmental restoration on lands in Jefferson, Marion County, Texas. The proposed project would include restoration of approximately 30 acres of upland and bottomland hardwood forests, 2.9 acres of bottomland hardwood wetlands, 5 acres of urban wildscape, 0.25 acres of emergent wetland, 1.84 acres of instream spawning habitat and utilization of an existing, old abandoned railroad bridge as a support structure for bat roosting and nursery abodes. The purpose of the restoration activities is to improve bottomland habitat values by utilizing forest management practices such as selective thinning and planting of hard and soft mast producing tree species; develop permanent backwater wetlands to restore waterfowl nesting, brood rearing and wintering habitat and provide sites for establishment of bald cypress; establish an early successional vegetative component; improve an emergent wetland adjacent to existing riparian/bottomland hardwood forest; reestablish contiguous riparian corridor to allow free migration of avian and wildlife species throughout proposed project area; develop aquatic habitat for spawning of paddlefish and other fish and aquatic organisms; and restore habitat for neotropical birds, chimney swifts and bats.

Several plans were evaluated for their potential to restore ecosystem function and stability. Alternatives included various levels of forest management measures to improve riparian and bottomland hardwood habitat for the benefit of multiple species of birds and wildlife; alternatives for created wetland development to benefit waterfowl, shore and wading birds and allow reestablishment of historic vegetation communities; alternatives to provide instream habitat for multiple species of fish; alternatives to establish a component of early successional vegetation to benefit neotropical birds, hummingbirds, butterflies and other urban wildlife species; and alternatives to create suitable habitat for bats for nesting and brooding rearing. In addition, a "no action" plan was evaluated.

The recommended plan would impact waters of the United States and is subject to provisions of Section 404 of the Clean Water Act. The terrestrial restoration activities recommended would meet the conditions of Nationwide Permit 27, Wetland and Riparian Restoration and Creation Activities. The State of Texas has issued a water quality certificate for Nationwide Permit 27 and therefore no further coordination is required under Section 404. The aquatic restoration activities recommended are not specifically met with any of the Nationwide Permits currently in effect, however, they are in compliance with the terms and conditions of Letter of Permission (LOP)-1. The proposed project also is located within the floodplain of Big Cypress Bayou. The project as proposed requires siting within the floodplain to meet its intended purpose and further, the project would not induce or increase flood damages within the area. The proposed project is in compliance with Executive Order 11988, Floodplain Management. The proposed project would neither adversely impact nor result in any loss of wetland areas so the project is in compliance with Executive Order 11990.

Based on the EA and results of coordination, I have concluded that the recommended plan will not have a significant adverse impact on the natural or man-made environment. The project as proposed would restore floodplain values to fish and wildlife resources.

DATE 17 Apr '00

James S. Weller
Colonel, Corps of Engineers
District Engineer

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APPENDIX A – CORRESPONDENCE

CITY OF JEFFERSON

ey B. Heaster, Jr.
Anita Per
City Secre

July 10, 1996

Colonel Peter T. Madsen
District Engineer
U. S. Army Corps of Engineers
Fort Worth District
P. O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Madsen:

This is to advise you that the City of Jefferson supports the proposed project to restore the historic port of Jefferson within the City of Jefferson, Texas. We concur with the findings and conclusions, and support the construction of the proposed project. In addition, we have examined a copy of the model Local Cooperation Agreement, and fully understand and agree with its provisions, including the cost sharing requirements.

We agree to meet the requirements for non-Federal responsibilities as outlined in the Cypress Valley Watershed Reconnaissance Report, dated September 1995, for this environmental restoration project, subject to compliance with the laws of the State of Texas concerning municipalities. We understand, at present, our financial responsibility is estimated to be approximately $1,125,000.00 based upon a project cost of $5,000,000.00 and cost sharing split of 75/25, Fed/Non-Fed.

More specifically, we understand, that as the local sponsor, the City of Jefferson, Texas, would be responsible for the following items of local cooperation:

a. Provide without cost to the United States all lands, easements, rights-of-way necessary for the project.

b. Provide without cost to the United States all necessary relocations and alterations of buildings, utilities, roads, highways bridges, and other community services.

c. Hold and save the United States free from damages due to construction, operation and maintenance of

the project, but not including damages due to the fault or negligence of the United States or its contractors.

d. Maintain and operate the project after completion in accordance with the regulations prescribed by the Secretary of the Army.

e. Make a cash contribution of at least five percent of the total project cost.

f. If the value of the contributions provided under paragraphs a, b, and f are less than twenty-five percent of the total project cost, provide an additional cash contribution in the amount necessary to make the total non-Federal contribution equal to twenty-five percent of the total project cost. The City of Jefferson, Texas, understands that lands, easements, and rights-of-way discussed in paragraph a, which have already been obtained by the Department, prior to the initiation of design studies cannot be credited toward this twenty-five percent value.

g. Contribute toward construction costs when substantial land enhancement or similar type benefits will accrue in accordance with existing policies for regularly authorized projects.

h. Prevent encroachment which could interfere with maintenance and operation of the project.

i. Comply with the provisions of the "Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970", Public law 91-646, approved January 2, 1971.

The City of Jefferson, Texas, requests the Fort Worth District proceed with the plans and specifications phase of project implementation. Please accept this letter as our intent to participate as the project non-Federal sponsor.

Sincerely yours,

Carey B. Heaster, Jr.

Carey B. Heaster, Jr.
Mayor

CITY OF JEFFERSON

ey B. Heaster, Jr.
or

Anita Perot
City Secretary

May 6, 1997

Colonel Peter T. Madsen
District Engineer
U. S. Army Corps of Engineers
Fort Worth District
P. O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Madsen:

This is to advise you that the City of Jefferson remains committed to serve as the local sponsor for the Port of Jefferson Environmental Restoration Project. On July 10, 1996, the City sent a letter of intent to you concerning this proposed project. A copy of the letter is enclosed for your review.

We are specifically interested in wildlife habitat, such as wetlands restorations, use of native plants in the landscape, birdnesting boxes, paddle fish habitat, and bat roosting areas. We understand and agree to support the non-Federal responsibilities associated with construction of the project as outlined in working papers provided to us to date. We are prepared to assist the Corps in any way we can to make this project on Big Cypress Bayou successful.

Please let me know whenever you should need any additional information or assistance.

Sincerely,

Carey B. Heaster, Jr.
Mayor

Enclosure

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

REPLY TO
ATTENTION OF

May 21, 1998

Environmental Division

SUBJECT: Cultural Resources Potential in the Proposed Big Cypress Environmental Restoration Project Area, Jefferson, Marion County, TX

James Bruseth, Ph.D.
Deputy Texas Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, Texas 78711-2276

Dear Dr. Bruseth:

The U.S. Army Corps of Engineers, Fort Worth District in conjunction with the city of Jefferson propose to create an environmental restoration park along Big Cypress Bayou and immediately adjacent to the historic portions of the town. The project area covers approximately 45 acres, which includes the old turning basin landing and all of the St. Catherine's Island portions of the original survey plat. Due to the sensitive nature and the potential for historic resources in the project area, an archival investigation followed by a surface reconnaissance was carried out to assess the potential for location and distribution of historic properties.

The enclosed report of findings is submitted for your review and comments and as an initial coordination document to be used in steering the project through subsequent phases. Project design elements have not been finalized, and minor modifications will likely take place throughout the life of the project, including construction. However, a number of areas that will require sub-surface investigation have already been identified, as well as areas that can be avoided. The project also identified a number of loci with potentially intact buried cultural deposits. These locations may require intensive investigations prior to construction and/or careful monitoring during construction.

Consequently, the U.S. Army Corps of Engineers, Fort Worth District seeks your concurrence with the program outlined in the report recommendations. Please provide your

determination in a response letter or by signing the concurrence signature block provided on this letter and returning it to our office. If you have any questions or require clarification, please contact A. Frank Servello at (817) 978-6384.

Sincerely,

Michael G. Ensch
Chief, Environmental Division

Enclosure

Concurrence:

Texas Historic Preservation Officer _____ Date _____

CONCUR

Department of Antiquities Protection
Texas State Historic Preservation Office

By _____
James E. Bruseth, Ph.D

Date 6/26/95

DRAFT REPORT ACCEPTABLE
PLEASE SUBMIT FINAL REPORT COPIES

By _____
James E. Bruseth, Ph.D., DSHPO

Date 6/26/95

TEXAS HISTORICAL COMMISSION

George W. Bush • *Governor*
John L. Nau, III • *Chairman*
Curtis Tunnell • *Executive Director*

The State Agency for Historic Preservation

EV-E

DIVISION OF ARCHITECTURE

July 20, 1997

Mr. William Fickel, Jr.
U.S. Army Corps of Engineers
Fort Worth District, Environmental Division
P.O. Box 17300
Fort Worth, Texas 76102-0300

Attn: Joseph Murphey

Re: *Big Cypress Bayou Railroad Bridge, Jefferson, Marion County, Texas (COE-FW/106)*

Dear Mr. Fickel:

Thank you for your letter and the documentation regarding the subject project. Texas Historical Commission has reviewed the proposed undertaking, and requests some additional information in order to complete our review. Please provide plans for the proposed new handrail design and attachment detail. We recommend that the design be as simple as possible, and that the railing be painted to match the color of the bridge.

After review of proposed plans that meet the *Secretary of the Interior's Standards for Rehabilitation*, we expect to be able to concur with your determination of effect for this undertaking. We look forward to receiving and reviewing the additional information requested.

Thank you for the opportunity to comment on this federally funded project in accordance with the National Historic Preservation Act, as amended. If you have any questions or concerns about this review please contact Linda Roark in the Division of Architecture at 512/463-9122.

Yours truly,

Stan Graves, AIA, DSHPO
Director
Division of Architecture

SG/LR
c: Marion County Historical Commission

P. O. Box 12276 • Austin, TX 78711-2276 • 512/463-6100 • Fax 512/475-4872 • TDD 1-800-735-2989

CITY OF JEFFERSON

Fratangelo
Mayor

James J. Stokes
City Administrator

Anita Perot
City Secretary

February 11, 2000

Eli Kangas
Programs and Project Management Division
Fort Worth District, Corp of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Mr. Kangas:

I have reviewed the draft Big Cypress Bayou Fish and Wildlife Habitat Ecosystem Restoration Report and Integrated Environmental Assessment. We concur with the development of the recommended plan, and now state our support for the implementation of the recommended plan. I request the final project design including plans and specifications be initiated.

I have also reviewed the draft Project Cooperation Agreement – Appendix H. We understand and accept the provisions of the PCA including project cost-sharing, the provision of all lands, easements, rights-of-way, relocations and disposal areas (LERRD), and operation and maintenance responsibilities. It is our intent to act as the non-Federal sponsor during project implementation. I have also reviewed the "Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability (Appendix E), and concur with its findings and recommendations.

We further acknowledge the current estimated total project cost and contribution of $1,898,887, and $527,327. It is my understanding, the City's share will be comprised of $225,000 as work in kind (railroad bridge), $194,870 in lands, easements, rights-of-way, relocations, and disposal areas, and $107,457 in cash. It is anticipated our cash payment will come various grants in support of the project. We further acknowledge the estimated annual operation and maintenance cost of $21,000.

Sincerely,

Ned Fratangelo
Mayor

NF/js

102 North Polk Street • Jefferson, Texas • 903 665-3922 • FAX 903 665-1002

April 7, 2000

Ms. Marcia Hackett
CESWF-EV-EE
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Re: Big Cypress Bayou Fish and Wildlife Habitat Restoration
Jefferson, Texas

Texas Parks and Wildlife Department staff have reviewed the Ecosystem Restoration Report and Integrated Environmental Assessment for the referenced project dated January, 2000. Staff concur that the project would have a significant positive impact on fish and wildlife resources of the area. The planning and materials selection are appropriate for the region and should help restore valuable natural resources that are diminishing overall. The recreational and educational opportunity provided are also important for the community and the region in general. Any temporary; adverse impacts from the project should be minimal and would be more than compensated as the project is completed. Implementing best management practices for erosion control and restoring disturbed areas as the project progresses should help reduce potential minor impacts.

We appreciate the opportunity to provide comments on this project. Any questions or additional coordination on this project can be directed to Tom Heger in Austin (512-389-4583).

Sincerely,

Thomas G. Heger

for Robert W. (Bob) Spain
Assistant Director, Resource Protection Division

RWS:TGH

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

Bat Conservation International, Inc.
Post Office Box 162603 • Austin, Texas 78716 • 512/327-9721 • FAX 327-9724

April 28, 2000

Marcia Hackett
U.S. Army Corps of Engineers
CESWF-EV-EE
P.O. Box 17300
Fort Worth, Texas 76102

RE: The value of bat habitat in the Jefferson, Texas railroad bridge.

Ms. Hackett:

I would like to commend you on your efforts to include bat habitat into the Big Cypress Bayou Fish and Wildlife Habitat Restoration project. The ecologic and economic value of a colony of bridge bats to a community has been demonstrated in several instances. For example, the 1.5 million bats living in the Congress Avenue bridge in Austin, Texas attracts tens of thousands of tourists each year. A recent study estimates the bridge tourists add $8 million to the Austin economy and the bats consume an estimated 10-15 tons of insects each night, many of which are agricultural pests. Throughout the country, even bridges modified for small colonies of bats are proving beneficial to local communities by providing tourist attractions, demonstrating pro-active conservation measures, generating good publicity for those involved, and of course, impacting local populations of insect pests.

Installing bat roosts into the Jefferson railroad bridge has the potential to provide all of these benefits. In fact, during my short 1998 site visit, I learned that not only are there bats using buildings in the town, but also that Jefferson citizens emphatically supported providing alternative roosts in the bridge rather than having bats remain in their buildings. Local news articles about the bats have already demonstrated the potential for positive publicity. And, ecologically, there are at least 5 species of bats in the area documented to use bridges as roosts and 2 of these are considered rare.

Additionally, the abandoned railroad bridge is an ideal site for incorporating bat habitat. The materials and the design of this particular bridge will facilitate the ease of attaching the recommended bat roost designs and most importantly, the past 5 years of studies indicate that bridges actually attract bats due to their exposure to solar radiation and ability to retain heat throughout a 24-hour cycle. Creating roosts in this bridge will greatly increase your chances of successfully attracting bats over placing bat houses on poles, buildings or trees.

During the course of the Jefferson City process, I have since completed the Bats in American Bridges project. I encourage you to visit the project report on our web-site <http://www.batcon.org/bridge/ambatsbridges/>. Please note that U.S. Corps of Engineers is listed in the acknowledgments as result of your and my collaborative efforts with this project. This document may also prove useful in answering additional questions that arise.

I am committed to help you succeed with this project. If there is anything further I can assist you with, please be sure to contact me.

Sincerely

Brian Keeley
Bats and Bridges Project Coordinator

APPENDIX B - INCREMENTAL COST ANALYSIS

INCREMENTAL ANALYSIS

Cost effectiveness analysis techniques (Robinson et al. 1995) were used to determine the most cost effective plans and levels of restoration in terms of costs per habitat unit gained. The computer model used to run these cost effective and incremental cost analyses was IWR-Plan: Decision Support Software, Beta Version 1.5. This appendix contains the complete incremental analyses for each section of land within the study area.

Cost effectiveness and incremental analyses are valuable tools that help decision makers make efficient use of limited resources. These analyses provide ways of thinking about outputs resulting from various levels of expenditures. Although incremental analysis does not provide a discrete decision criterion (such as maximizing of net benefits in NED analysis), it provides for the explicit comparison of the relevant changes in costs and outputs on which such decisions should be made.

The following tables represent the results of the cost effectiveness and incremental cost analyses run for all the alternatives and/or levels of alternatives identified in the report using annualized habitat unit gains versus annualized cost estimates (including those for operations and maintenance).

Big Cypre u – West Area Restoration

WETLAND C. .. LEX ALTERNATIVES
Scale 0 - No Action
Scale 1 - Construction of .35 acre wetland cell
Scale 2 - Construction of 2.36 acre wetland cell
Scale 3 - Construction of connecting .19 acre wetland cell

FOREST MANAGEMENT ALTERNATIVES
Scale 0 - No Action
Scale 1 - 20- one inch caliper containerized trees, 10- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning
Scale 2 - 10- one inch caliper containerized trees, 5- one gallon containerized shrubs and 100 seedlings per acre with appropriate selective thinning
Scale 3 - 150 seedlings per acre and appropriate selective thinning

BALD CYPRESS PLANTING ALTERNATIVES
Scale 0 - No Action
Scale 1 - 100 seedlings per acre and appropriate selective thinning
Scale 2 - 250 seedlings per acre and appropriate selective thinning

NESTING BOXES
Scale 0 - No Action
Scale 1 - 2 wood duck boxes per wetland acre and 1 per 225 linear feet of bayou edge

BENEFITS BY RESTORATION ALTERNATIVE

WETLAND COMPLEX ALTERNATIVES	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
Scale 0 - No Action	0.00	0.00	0.00	0.00	0.00	0.00	
HU/Acre	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Scale 1 - Construction of .35 acre wetland cell	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.70	0.95	0.95	0.95	0.95	
	0.00	0.35	3.30	19.00	23.75	23.75	0.92

Scale 2 - Construction of 2.36 acre wetland cell	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.70	0.95	0.95	0.95	0.95	
	0.00	0.35	3.30	19.00	23.75	23.75	0.92

Scale 3 - Construction of connecting .19 acre wetland cell	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.70	0.95	0.95	0.95	0.95	
	0.00	0.35	3.30	19.00	23.75	23.75	0.92

FOREST M MENT ALTERNATIVES

Scale 0 - No Action

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.55	0.55	0.58	0.60	0.62	0.65	
	0.55	0.55	2.26	11.80	15.25	15.88	0.60

Scale 1 - 20- one inch caliper containerized trees, 10- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.55	0.60	0.70	0.80	0.90	0.95	
	0.55	0.58	2.60	15.00	21.25	23.13	0.82

Scale 2 - 10- one inch caliper containerized trees, 5- one gallon containerized shrubs and 100 seedlings per acre with appropriate selective thinning

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.55	0.60	0.65	0.80	0.90	0.95	
	0.55	0.58	2.50	14.50	21.25	23.13	0.82

Scale 3 - 150 seedlings per acre and appropriate selective thinning

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.55	0.60	0.60	0.70	0.80	0.95	
	0.55	0.58	2.40	13.00	18.75	21.88	0.74

BALD CYPRESS PLANTING ALTERNATIVES

Scale 0 - No Action

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Scale 1 - 100 seedlings per acre and appropriate selective thinning

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.00	0.25	0.40	0.70	0.85	
	0.00	0.00	0.50	6.50	13.75	19.37	0.53

Scale 2 - 250 seedlings per acre and appropriate selective thinning

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.00	0.30	0.45	0.75	0.90	
	0.00	0.00	0.60	7.50	15.00	20.63	0.58

NESTING BOXES

Scale 0 - No Action

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Scale 1 - 2 wood duck boxes per wetland acre and 1 per 225 linear feet of bayou

	TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
HU/Acre	0.00	0.50	0.75	0.95	0.95	0.95	
	0.00	0.25	2.50	17.04	23.80	23.75	0.89

Big Cyp Bayou – Section 1135
Environ. Restoration (West Area)
COST AN. SIS

INVESTMENT COST	O	C	I	F0	F1	F2	F3	B0	B1	B2	N0	N1
FIRST COST	$29,681	$8,814	$8,824	$67,346	$175,398	$156,759	$139,537	$0	$870	$1,365	$0	$700
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	75	75	75	75	75	75	75	75	75	75	75	75
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTIO	$1,133	$337	$337	$2,572	$6,698	$5,986	$5,329	$0	$33	$52	$0	$27
INVESTMENT COST	$30,814	$9,151	$9,161	$69,918	$182,096	$162,745	$144,866	$0	$903	$1,417	$0	$727
AVERAGE ANNUAL CHARGES												
INTEREST	$2,196	$652	$653	$4,982	$12,974	$11,596	$10,322	$0	$64	$101	$0	$52
AMORTIZATION	$13	$4	$4	$29	$75	$67	$59	$0	$0	$1	$0	$0
OPERATIONS & MAINTENANCE	$2,000	$1,000	$1,000	$4,500	$4,500	$4,500	$4,500	$0	$700	$1,000	$0	$200
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$4,208	$1,656	$1,656	$9,510	$17,549	$16,162	$14,881	$0	$765	$1,102	$0	$252
INCREMENTAL ANALYSIS												
AAHU GAIN BY PLAN	2.17	0.32	0.18	13.08	17.88	17.88	16.13	0	1.59	1.74	0	2.67
AAHU GAIN BY NO ACTION	0	0	0	11.99	11.99	11.99	11.99	0	0	0	0	0
AAHU GAIN OVER NO ACTION	2.17	0.32	0.18	1.09	5.89	4.14	4.14	0	1.59	1.74	0	2.67
ANNUAL COST/AAHU GAIN	$1,939.26	$5,174.18	$9,202.67	$8,725.10	$2,979.48	$3,903.97	$3,594.48	N/A	$480.96	$633.08	N/A	$94.41

ENARIO STATISTICS

SCENARIO:	West Area	West Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs includiung O M	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 11:39:11 A	**EDITED:**	**ANALYZED:** 11/29/99 11:39:28 A

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Dependency
S I
N I
S O
S C
N O
N C
C O

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
1	F0 B0 N0 I0 O0 C0	13.08	9,510.00	727.0642
2	F0 B0 N0 I1 O0 C0	13.26	11,166.00	842.0814
3	F0 B1 N0 I1 O0 C0	14.85	11,931.00	803.4343
4	F0 B2 N0 I1 O0 C0	15.00	12,268.00	817.8667
5	F0 B0 N0 I0 O1 C0	15.25	13,718.00	899.5410
6	F0 B0 N0 I1 O1 C0	15.43	15,374.00	996.3707
7	F0 B0 N0 I0 O1 C1	15.57	15,374.00	987.4117
8	F0 B0 N0 I1 O1 C1	15.75	17,030.00	1,081.2698
9	F0 B0 N1 I1 O0 C0	15.93	11,418.00	716.7608
10	F3 B0 N0 I0 O0 C0	16.13	14,881.00	922.5666
11	F3 B0 N0 I1 O0 C0	16.31	16,537.00	1,013.9178
12	F0 B1 N0 I0 O1 C0	16.84	14,483.00	860.0356
13	F0 B2 N0 I0 O1 C0	16.99	14,820.00	872.2778
14	F0 B1 N0 I1 O1 C0	17.02	16,139.00	948.2374
15	F0 B1 N0 I0 O1 C1	17.16	16,139.00	940.5012
16	F0 B2 N0 I1 O1 C0	17.17	16,476.00	959.5807
17	F0 B2 N0 I0 O1 C1	17.31	16,476.00	951.8198
18	F0 B1 N0 I1 O1 C1	17.34	17,795.00	1,026.2399
19	F0 B2 N0 I1 O1 C1	17.49	18,132.00	1,036.7067
20	F0 B1 N1 I1 O0 C0	17.52	12,183.00	695.3767
21	F0 B2 N1 I1 O0 C0	17.67	12,520.00	708.5456
22	F2 B0 N0 I0 O0 C0	17.88	16,162.00	903.9150
23	F1 B0 N0 I0 O0 C0	17.88	17,549.00	981.4877
24	F3 B1 N0 I1 O0 C0	17.90	17,302.00	966.5922
25	F0 B0 N1 I0 O1 C0	17.92	13,970.00	779.5759

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
26	F3 B2 N0 I1 O0 C0	18.05	17,639.00	977.2299
27	F2 B0 N0 I1 O0 C0	18.06	17,818.00	986.6002
28	F1 B0 N0 I1 O0 C0	18.06	19,205.00	1,063.3998
29	F0 B0 N1 I1 O1 C0	18.10	15,626.00	863.3149
30	F0 B0 N1 I0 O1 C1	18.24	15,626.00	856.6886
31	F3 B0 N0 I0 O1 C0	18.30	19,089.00	1,043.1148
32	F0 B0 N1 I1 O1 C1	18.42	17,282.00	938.2193
33	F3 B0 N0 I1 O1 C0	18.48	20,745.00	1,122.5649
34	F3 B0 N0 I0 O1 C1	18.62	20,745.00	1,114.1246
35	F3 B0 N0 I1 O1 C1	18.80	22,401.00	1,191.5426
36	F3 B0 N1 I1 O0 C0	18.98	16,789.00	884.5627
37	F0 B1 N1 I0 O1 C0	19.51	14,735.00	755.2537
38	F2 B1 N0 I1 O0 C0	19.65	18,583.00	945.6997
39	F1 B1 N0 I1 O0 C0	19.65	19,970.00	1,016.2850
40	F0 B2 N1 I0 O1 C0	19.66	15,072.00	766.6328
41	F0 B1 N1 I1 O1 C0	19.69	16,391.00	832.4530
42	F2 B2 N0 I1 O0 C0	19.80	18,920.00	955.5556
43	F1 B2 N0 I1 O0 C0	19.80	20,307.00	1,025.6061
44	F0 B1 N1 I0 O1 C1	19.83	16,391.00	826.5759
45	F0 B2 N1 I1 O1 C0	19.84	16,728.00	843.1452
46	F3 B1 N0 I0 O1 C0	19.89	19,854.00	998.1900
47	F0 B2 N1 I0 O1 C1	19.98	16,728.00	837.2372
48	F0 B1 N1 I1 O1 C1	20.01	18,047.00	901.8991
49	F3 B2 N0 I0 O1 C0	20.04	20,191.00	1,007.5349
50	F2 B0 N0 I0 O1 C0	20.05	20,370.00	1,015.9601

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
51	F1 B0 N0 I0 O1 C0	20.05	21,757.00	1,085.1372
52	F3 B1 N0 I1 O1 C0	20.07	21,510.00	1,071.7489
53	F0 B2 N1 I1 O1 C1	20.16	18,384.00	911.9048
54	F3 B1 N0 I0 O1 C1	20.21	21,510.00	1,064.3246
55	F3 B2 N0 I1 O1 C0	20.22	21,847.00	1,080.4649
56	F2 B0 N0 I1 O1 C0	20.23	22,026.00	1,088.7790
57	F1 B0 N0 I1 O1 C0	20.23	23,413.00	1,157.3406
58	F3 B2 N0 I0 O1 C1	20.36	21,847.00	1,073.0354
59	F2 B0 N0 I0 O1 C1	20.37	22,026.00	1,081.2960
60	F1 B0 N0 I0 O1 C1	20.37	23,413.00	1,149.3864
61	F3 B1 N0 I1 O1 C1	20.39	23,166.00	1,136.1452
62	F3 B2 N0 I1 O1 C1	20.54	23,503.00	1,144.2551
63	F2 B0 N0 I1 O1 C1	20.55	23,682.00	1,152.4088
64	F1 B0 N0 I1 O1 C1	20.55	25,069.00	1,219.9027
65	F3 B1 N1 I1 O0 C0	20.57	17,554.00	853.3787
66	F3 B2 N1 I1 O0 C0	20.72	17,891.00	863.4653
67	F2 B0 N1 I1 O0 C0	20.73	18,070.00	871.6836
68	F1 B0 N1 I1 O0 C0	20.73	19,457.00	938.5914
69	F3 B0 N1 I0 O1 C0	20.97	19,341.00	922.3176
70	F3 B0 N1 I1 O1 C0	21.15	20,997.00	992.7660
71	F3 B0 N1 I0 O1 C1	21.29	20,997.00	986.2377
72	F3 B0 N1 I1 O1 C1	21.47	22,653.00	1,055.1001
73	F2 B1 N0 I0 O1 C0	21.64	21,135.00	976.6636
74	F1 B1 N0 I0 O1 C0	21.64	22,522.00	1,040.7579
75	F2 B2 N0 I0 O1 C0	21.79	21,472.00	985.4061

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
76	F1 B2 N0 I0 O1 C0	21.79	22,859.00	1,049.0592
77	F2 B1 N0 I1 O1 C0	21.82	22,791.00	1,044.5005
78	F1 B1 N0 I1 O1 C0	21.82	24,178.00	1,108.0660
79	F2 B1 N0 I0 O1 C1	21.96	22,791.00	1,037.8415
80	F1 B1 N0 I0 O1 C1	21.96	24,178.00	1,101.0018
81	F2 B2 N0 I1 O1 C0	21.97	23,128.00	1,052.7082
82	F1 B2 N0 I1 O1 C0	21.97	24,515.00	1,115.8398
83	F2 B2 N0 I0 O1 C1	22.11	23,128.00	1,046.0425
84	F1 B2 N0 I0 O1 C1	22.11	24,515.00	1,108.7743
85	F2 B1 N0 I1 O1 C1	22.14	24,447.00	1,104.2005
86	F1 B1 N0 I1 O1 C1	22.14	25,834.00	1,166.8473
87	F2 B2 N0 I1 O1 C1	22.29	24,784.00	1,111.8887
88	F1 B2 N0 I1 O1 C1	22.29	26,171.00	1,174.1140
89	F2 B1 N1 I1 O0 C0	22.32	18,835.00	843.8620
90	F1 B1 N1 I1 O0 C0	22.32	20,222.00	906.0036
91	F2 B2 N1 I1 O0 C0	22.47	19,172.00	853.2265
92	F1 B2 N1 I1 O0 C0	22.47	20,559.00	914.9533
93	F3 B1 N1 I0 O1 C0	22.56	20,106.00	891.2234
94	F3 B2 N1 I0 O1 C0	22.71	20,443.00	900.1761
95	F2 B0 N1 I0 O1 C0	22.72	20,622.00	907.6585
96	F1 B0 N1 I0 O1 C0	22.72	22,009.00	968.7060
97	F3 B1 N1 I1 O1 C0	22.74	21,762.00	956.9921
98	F3 B1 N1 I0 O1 C1	22.88	21,762.00	951.1364
99	F3 B2 N1 I1 O1 C0	22.89	22,099.00	965.4434
100	F2 B0 N1 I1 O1 C0	22.90	22,278.00	972.8384

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
101	F1 B0 N1 I1 O1 C0	22.90	23,665.00	1,033.4061
102	F3 B2 N1 I0 O1 C1	23.03	22,099.00	959.5745
103	F2 B0 N1 I0 O1 C1	23.04	22,278.00	966.9271
104	F1 B0 N1 I0 O1 C1	23.04	23,665.00	1,027.1267
105	F3 B1 N1 I1 O1 C1	23.06	23,418.00	1,015.5247
106	F3 B2 N1 I1 O1 C1	23.21	23,755.00	1,023.4813
107	F2 B0 N1 I1 O1 C1	23.22	23,934.00	1,030.7494
108	F1 B0 N1 I1 O1 C1	23.22	25,321.00	1,090.4823
109	F2 B1 N1 I0 O1 C0	24.31	21,387.00	879.7614
110	F1 B1 N1 I0 O1 C0	24.31	22,774.00	936.8161
111	F2 B2 N1 I0 O1 C0	24.46	21,724.00	888.1439
12	F1 B2 N1 I0 O1 C0	24.46	23,111.00	944.8487
113	F2 B1 N1 I1 O1 C0	24.49	23,043.00	940.9147
114	F1 B1 N1 I1 O1 C0	24.49	24,430.00	997.5500
115	F2 B1 N1 I0 O1 C1	24.63	23,043.00	935.5664
116	F1 B1 N1 I0 O1 C1	24.63	24,430.00	991.8798
117	F2 B2 N1 I1 O1 C0	24.64	23,380.00	948.8636
118	F1 B2 N1 I1 O1 C0	24.64	24,767.00	1,005.1542
119	F2 B2 N1 I0 O1 C1	24.78	23,380.00	943.5028
120	F1 B2 N1 I0 O1 C1	24.78	24,767.00	999.4754
121	F2 B1 N1 I1 O1 C1	24.81	24,699.00	995.5260
122	F1 B1 N1 I1 O1 C1	24.81	26,086.00	1,051.4309
123	F2 B2 N1 I1 O1 C1	24.96	25,036.00	1,003.0449
124	F1 B2 N1 I1 O1 C1	24.96	26,423.00	1,058.6138

ENARIO STATISTICS

SCENARIO:	West Area	West Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs includiung O M	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 11:39:11 A	**EDITED:**	**ANALYZED:** 11/29/99 11:39:28 A

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Dependency
B I
N I
B O
B C
N O
N C
C O

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
1	F0 B0 N0 I0 O0 C0	13.08	9,510.00	727.0642
2	F0 B0 N0 I1 O0 C0	13.26	11,166.00	842.0814
3	F0 B0 N1 I1 O0 C0	15.93	11,418.00	716.7608
4	F0 B1 N1 I1 O0 C0	17.52	12,183.00	695.3767
5	F0 B2 N1 I1 O0 C0	17.67	12,520.00	708.5456
6	F0 B0 N1 I0 O1 C0	17.92	13,970.00	779.5759
7	F0 B1 N1 I0 O1 C0	19.51	14,735.00	755.2537
8	F0 B2 N1 I0 O1 C0	19.66	15,072.00	766.6328
9	F0 B1 N1 I0 O1 C1	19.83	16,391.00	826.5759
10	F0 B2 N1 I0 O1 C1	19.98	16,728.00	837.2372
11	F3 B1 N1 I1 O0 C0	20.57	17,554.00	853.3787
12	F3 B2 N1 I1 O0 C0	20.72	17,891.00	863.4653
13	F2 B0 N1 I1 O0 C0	20.73	18,070.00	871.6836
14	F2 B1 N1 I1 O0 C0	22.32	18,835.00	843.8620
15	F2 B2 N1 I1 O0 C0	22.47	19,172.00	853.2265
16	F3 B1 N1 I0 O1 C0	22.56	20,106.00	891.2234
17	F3 B2 N1 I0 O1 C0	22.71	20,443.00	900.1761
18	F2 B0 N1 I0 O1 C0	22.72	20,622.00	907.6585
19	F2 B1 N1 I0 O1 C0	24.31	21,387.00	879.7614
20	F2 B2 N1 I0 O1 C0	24.46	21,724.00	888.1439
21	F2 B1 N1 I0 O1 C1	24.63	23,043.00	935.5664
22	F2 B2 N1 I0 O1 C1	24.78	23,380.00	943.5028
23	F2 B1 N1 I1 O1 C1	24.81	24,699.00	995.5260
24	F2 B2 N1 I1 O1 C1	24.96	25,036.00	1,003.0449

ENARIO STATISTICS

SCENARIO: West Area — West Area Restoration Alternatives

COST VARIABLE: Costs — Annualized Costs includiung O M — **SENSITIVITY:** Typica

OUTPUT VARIABLE: AAHU — Average Annualized Habitat Units — **SENSITIVITY:** Typica

CREATED: 11/29/99 11:39:11 A **EDITED:** **ANALYZED:** 11/29/99 11:39:28 A

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Dependency
B I
N I
B O
B C
N O
N C
C O

Counter	Combo Code	AAHU (AAHU)	Costs (dollars)	Average Cost dollars / AAHU
1	F0 B1 N1 I1 O0 C0	17.52	12,183.00	695.3767
2	F0 B1 N1 I0 O1 C0	19.51	14,735.00	755.2537
3	F2 B1 N1 I0 O1 C0	24.31	21,387.00	879.7614
4	F2 B2 N1 I0 O1 C0	24.46	21,724.00	888.1439
5	F2 B2 N1 I0 O1 C1	24.78	23,380.00	943.5028
6	F2 B2 N1 I1 O1 C1	24.96	25,036.00	1,003.0449

URBAN V. _IFE ALTERNATIVES
Scale 0 - No Action
Scale 1 - Remove boat ramp and parking lot; riparian corridor restoration using 40- three inch caliper containerized trees; turfing 3 acres with native grasses
Scale 2 - Remove boat ramp and parking lot; riparian corridor restoration using 40- three inch caliper containerized trees; remaining 3 acres planted with native understory tree, shrub and herbaceous vegetation
BAT HABITAT ALTERNATIVES
Scale 0 - No Action
Scale 1 - construct and place 3 bat houses on 20' poles.
Scale 2 - construct optimal bat habitat super support structure over bayou
Scale 3 - utilize the existing abandoned railroad bridge as a super support structure for 12 Oregon Bridge Wedges, 7 Texas-Bat Abodes and 2 Big-eared Bat-Abodes.
EMERGENT WETLAND ALTERNATIVES
Scale 0 - No Action
Scale 1 - Divert drainage; plant quality wetland plants; eliminate cultivated grasses; plant native grasses

BENEFITS BY RESTORATION ALTERNATIVE

URBAN WILDLIFE ALTERNATIVES
Scale 0 - No Action
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.00	0.00	0.00	0.00	0.00	0.00	
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Scale 1 - Remove boat ramp and parking lot; riparian corridor restoration using 40- three inch caliper containerized trees; turfing 3 acres with native grasses
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.00	0.30	0.40	0.65	0.65	0.65	
0.00	0.15	1.40	10.50	16.25	16.25	0.59

Scale 2 - Remove boat ramp and parking lot; riparian corridor restoration using 40- three inch caliper containerized trees; remaining 3 acres planted with native understory, shrub and herbaceous vegetation (HU/Acre)

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.00	0.60	0.75	0.95	0.95	0.95	
0.00	0.30	2.70	17.00	23.75	23.75	0.89

BAT HABITAT ALTERNATIVES
Scale 0 - No Action
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.20	0.20	0.17	0.15	0.12	0.10	
0.20	0.20	0.74	3.20	3.38	2.75	0.14

Scale 1 - construct and place 3 bat houses on 20' poles.
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.20	0.40	0.65	0.65	0.65	0.65	
0.20	0.30	2.10	13.00	16.25	16.25	0.63

Scale 2 - constructure optimal bat habitat super support structure over bayou
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.20	0.25	0.90	0.95	0.95	0.95	
0.20	0.23	2.30	18.50	23.75	23.75	0.90

Scale 3- utilize the existing abandoned railroad bridge as a super support structure for 12 Oregon Bridge Wedges, 7 Texas-Bat Abodes and 2 Big-eared Bat-Abodes.
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.20	0.95	0.95	0.95	0.95	0.95	
0.20	0.58	3.80	19.00	23.75	23.75	0.93

EMERGE[illegible]WETLAND ALTERNATIVES

Scale 0 - No Action

HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.20	0.20	0.20	0.20	0.20	0.20	
0.20	0.20	0.80	4.00	5.00	5.00	0.20

Scale 1 - Divert drainage; plant quality wetland plants; eliminate cultivated grasses; plant native grasses

HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.20	0.65	0.80	0.80	0.80	0.80	
0.20	0.43	2.90	16.00	20.00	20.00	0.78

Big Cypress Bayou – Section 1135
Environmental Restoration (Core Area)
COST ANALYSIS

INVESTMENT COST	W0	W1	W2	B0	B1	B2	B3	E0	E1
FIRST COST	$18,932	$302,801	$390,801	$10,000	$15,000	$333,960	$242,113	$1,456	$11,573
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	75	75	75	75	75	75	75	75	75
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTIO	$723	$11,563	$14,924	$382	$573	$12,753	$9,246	$56	$442
INVESTMENT COST	$19,655	$314,364	$405,725	$10,382	$15,573	$346,713	$251,359	$1,512	$12,015
AVERAGE ANNUAL CHARGES									
INTEREST	$1,400	$22,398	$28,908	$740	$1,110	$24,703	$17,909	$108	$856
AMORTIZATION	$8	$129	$167	$4	$6	$142	$103	$1	$5
OPERATIONS & MAINTENANCE	$5,000	$3,000	$5,000	$0	$500	$250	$250	$0	$250
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$6,409	$25,528	$34,075	$744	$1,616	$25,096	$18,263	$108	$1,111
INCREMENTAL ANALYSIS									
AAHU GAIN BY PLAN	0	1.92	2.89	281.34	1266.05	16277.76	16820.35	0.05	0.195
AAHU GAIN BY NO ACTION	0	0	0	281.34	281.34	281.34	281.34	0.05	0.05
AAHU GAIN OVER NO ACTION	0	1.92	2.89	0	984.71	15996.42	16539.012	0	0.145
ANNUAL COST/AAHU GAIN	$0.00	$13,295.60	$11,790.49	$0.00	$1.64	$1.57	$1.10	$0.00	$7,662.06

ENARIO STATISTICS

SCENARIO:	Core Area	Core Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 11:19:54 A	**EDITED:**	**ANALYZED:** 11/29/99 11:20:08 A

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	W0 B0 E0	281.39	7,261.00	25.8040
2	W0 B0 E1	281.54	8,264.00	29.3528
3	W1 B0 E0	283.31	26,380.00	93.1136
4	W1 B0 E1	283.46	27,383.00	96.6027
5	W2 B0 E0	284.28	34,927.00	122.8613
6	W2 B0 E1	284.43	35,930.00	126.3228
7	W0 B1 E0	1,266.10	8,133.00	6.4237
8	W0 B1 E1	1,266.25	9,136.00	7.2150
9	W1 B1 E0	1,268.02	27,252.00	21.4918
10	W1 B1 E1	1,268.17	28,255.00	22.2801
11	W2 B1 E0	1,268.99	35,799.00	28.2106
12	W2 B1 E1	1,269.14	36,802.00	28.9976
13	W0 B2 E0	16,277.81	31,613.00	1.9421
14	W0 B2 E1	16,277.96	32,616.00	2.0037
15	W1 B2 E0	16,279.73	50,732.00	3.1163
16	W1 B2 E1	16,279.88	51,735.00	3.1778
17	W2 B2 E0	16,280.70	59,279.00	3.6411
18	W2 B2 E1	16,280.85	60,282.00	3.7026
19	W0 B3 E0	16,820.40	24,780.00	1.4732
20	W0 B3 E1	16,820.55	25,783.00	1.5328
21	W1 B3 E0	16,822.32	43,899.00	2.6096
22	W1 B3 E1	16,822.47	44,902.00	2.6692
23	W2 B3 E0	16,823.29	52,446.00	3.1175
24	W2 B3 E1	16,823.44	53,449.00	3.1771

ENARIO STATISTICS

11/29/99 11:22:40 A

SCENARIO:	Core Area	Core Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 11:19:54 A	**EDITED:**	**ANALYZED:** 11/29/99 11:20:08 A

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	W0 B0 E0	281.39	7,261.00	25.8040
2	W0 B1 E0	1,266.10	8,133.00	6.4237
3	W0 B1 E1	1,266.25	9,136.00	7.2150
4	W0 B3 E0	16,820.40	24,780.00	1.4732
5	W0 B3 E1	16,820.55	25,783.00	1.5328
6	W1 B3 E0	16,822.32	43,899.00	2.6096
7	W1 B3 E1	16,822.47	44,902.00	2.6692
8	W2 B3 E0	16,823.29	52,446.00	3.1175
9	W2 B3 E1	16,823.44	53,449.00	3.1771

ENARIO STATISTICS

11/29/99 11:22:57 A

SCENARIO:	Core Area	Core Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 11:19:54 A	**EDITED:**	**ANALYZED:** 11/29/99 11:20:08 A

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

:remental And Cost Effectiveness Analysis - Plan

Best Buy Plans by Output

Scenario: Core Area

11/29/99 11:22:57 AM

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	W0 B3 E0	16,820.40	24,780.00	1.4732
2	W0 B3 E1	16,820.55	25,783.00	1.5328
3	W2 B3 E1	16,823.44	53,449.00	3.1771

-PLAN * Plan Of Interest

Big Cypress Bayou – East Area Restoration

FOREST MANAGEMENT ALTERNATIVES
Scale 0 - No Action
Scale 1 - 20- one inch caliper containerized trees, 20- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning
Scale 2 - 10- one inch caliper containerized trees, 10- one gallon containerized shrubs and 100 seedlings per acre with appropriate selective thinning

URBAN WILDSCAPE ALTERNATIVES
Scale 0 - No Action
Scale 1 - 30- three inch caliper trees; 15- one inch caliper trees; turf 2 acres with native grasses
Scale 2 - 15- three inch caliper trees; remaining 2 acres planted with native understory tree, shrub, and herbaceous vegetation

BENEFITS BY RESTORATION ALTERNATIVE

FOREST MANAGEMENT ALTERNATIVES
Scale 0 - No Action
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.40	0.40	0.40	0.40	0.40	0.40	
0.40	0.40	1.60	8.00	10.00	10.00	0.39

Scale 1 - 20- one inch caliper containerized trees, 20- one gallon containerized shrubs and 50 seedlings per acre with appropriate selective thinning
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.40	0.40	0.50	0.75	0.90	0.95	
0.40	0.40	1.80	12.50	20.63	23.13	0.77

Scale 2 - 10- one inch caliper containerized trees, 10- one gallon containerized shrubs and 100 seedlings per acre with appropriate selective thinning
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.40	0.40	0.50	0.73	0.87	0.95	
0.40	0.40	1.80	12.30	20.00	22.75	0.75

URBAN WILDSCAPE ALTERNATIVES
Scale 0 - No Action
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.00	0.00	0.00	0.00	0.00	0.00	
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Scale 1 - 30- three inch caliper trees; 15- one inch caliper trees; turf 2 acres with native grasses
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.00	0.30	0.50	0.65	0.75	0.75	
0.00	0.15	1.60	11.50	17.50	18.75	0.65

Scale 2 - 15- three inch caliper trees; remaining 2 acres planted with native understory tree, shrub, and herbaceous vegetation
HU/Acre

TYO	1 YR	5 YR	25 YR	50 YR	75 YR	AAHU
0.00	0.60	0.75	0.95	0.95	0.95	
0.00	0.30	2.70	17.00	23.75	23.75	0.89

Big Cypress Bayou – Section 1135
Environmental Restoration (East Area)
COST ANALYSIS

INVESTMENT COST	W0	W1	W2	F0	F1	F2
FIRST COST	$3,011	$70,932	$84,181	$7,527	$23,863	$28,688
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	75	75	75	75	75	75
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12
INTEREST DURING CONSTRUCTIO	$115	$2,709	$3,215	$287	$911	$1,096
INVESTMENT COST	$3,126	$73,641	$87,396	$7,815	$24,774	$29,784
AVERAGE ANNUAL CHARGES						
INTEREST	$223	$5,247	$6,227	$557	$1,765	$2,122
AMORTIZATION	$1	$30	$36	$3	$10	$12
OPERATIONS & MAINTENANCE	$1,000	$1,500	$3,000	$1,000	$2,500	$2,500
REPLACEMENTS	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$1,224	$6,777	$9,263	$1,560	$4,275	$4,634
INCREMENTAL ANALYSIS						
AAHU GAIN BY PLAN	0	1.3	1.78	2	3.85	3.75
AAHU GAIN BY NO ACTION	0	0	0	2	2	2
AAHU GAIN OVER NO ACTION	0	1.3	1.78	0	1.85	1.75
ANNUAL COST/AAHU GAIN	$0.00	$5,213.19	$5,203.84	$0.00	$2,311.00	$2,648.18

:ENARIO STATISTICS

SCENARIO:	East Area	East Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 3:11:07 PM	**EDITED:**	**ANALYZED:** 11/29/99 3:11:23 PM

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	F0 W0	2.00	2,784.00	1,392.0000
2	F0 W1	3.30	8,337.00	2,526.3636
3	F2 W0	3.75	5,858.00	1,562.1333
4	F0 W2	3.78	10,823.00	2,863.2275
5	F1 W0	3.85	5,499.00	1,428.3117
6	F2 W1	5.05	11,411.00	2,259.6040
7	F1 W1	5.15	11,052.00	2,146.0194
8	F2 W2	5.53	13,897.00	2,513.0199
9	F1 W2	5.63	13,538.00	2,404.6181

:ENARIO STATISTICS

SCENARIO:	East Area	East Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 3:11:07 PM	**EDITED:**	**ANALYZED:** 11/29/99 3:11:23 PM

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

:remental And Cost Effectiveness Analysis - Plan

ost Effective Plans by Output Scenario: East Area

11/29/99 3:13:02 PM

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	F0 W0	2.00	2,784.00	1,392.0000
2	F1 W0	3.85	5,499.00	1,428.3117
3	F1 W1	5.15	11,052.00	2,146.0194
4	F1 W2	5.63	13,538.00	2,404.6181

-PLAN * Plan Of Interest

ENARIO STATISTICS

SCENARIO:	East Area	East Area Restoration Alternatives	
COST VARIABLE:	Costs	Annualized Costs	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 3:11:07 PM	**EDITED:**	**ANALYZED:** 11/29/99 3:11:23 PM

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	F0 W0	2.00	2,784.00	1,392.0000
2	F1 W0	3.85	5,499.00	1,428.3117
3	F1 W1	5.15	11,052.00	2,146.0194
4	F1 W2	5.63	13,538.00	2,404.6181

Big Cypre u – Aquatic Habitat Restoration

AQUATIC HA. .T RESTORATION TECHNIQUES

Scale 0 - No action
Scale 1 - 300' gravel bar at island site
Scale 2 - 750' gravel bar at island site
Scale 3 - 1000' gravel bar at island site
Scale 4 - 300' gravel bar at railroad site
Scale 5 - 750 gravel bar at railroad site
Scale 6 - 1000' gravel bar at railroad site
Scale 7 - 300' gravel bar at shoal site
Scale 8 - 750' gravel bar at shoal site
Scale 9 - 1000' gravel bar at shoal site

BENEFITS BY RESTORATION ALTERNATIVE

Scale 0 - No action	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.20		0.20		0.20	0.20	
		0.20		0.20		0.80		2.00	2.00	0.20
Scale 1 - 300' gravel bar at island site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.40		0.40		0.40	0.40	
		0.20		0.30		1.60		4.00	4.00	0.39
Scale 2 - 750' gravel bar at island site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.60		0.60		0.60	0.60	
		0.20		0.40		2.40		6.00	6.00	0.58
Scale 3 - 1000' gravel bar at island site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.80		0.80		0.80	0.80	
		0.20		0.50		3.20		8.00	8.00	0.77
Scale 4 - 300' gravel bar at railroad site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.40		0.40		0.40	0.40	
		0.20		0.30		1.60		4.00	4.00	0.39
Scale 5 - 750 gravel bar at railroad site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.60		0.60		0.60	0.60	
		0.20		0.40		2.40		6.00	6.00	0.58
Scale 6 - 1000' gravel bar at railroad site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.80		0.80		0.80	0.80	
		0.20		0.50		3.20		8.00	8.00	0.77
Scale 7 - 300' gravel bar at shoal site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.55		0.55		0.55	0.55	
		0.20		0.38		2.20		5.50	5.50	0.53
Scale 8 - 750' gravel bar at shoal site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.75		0.75		0.75	0.75	
		0.20		0.48		3.00		7.50	7.50	0.72
Scale 9 - 1000' gravel bar at shoal site	TYO		1 YR		5 YR		15 YR		25 YR	AAHU
HU/Acre		0.20		0.95		0.95		0.95	0.95	
		0.20		0.58		3.80		9.50	9.50	0.91

Big Cyp ayou – Section 1135
Environ. Restoration (Aquatic Habitat)
COST AN. SIS

INVESTMENT COST	I1 S0 R0	I2 S0 R0	I3 S0 R0	I0 R1 S0	I1 R1 S0	I2 R1 S0	I3 R1 S0	I0 R2 S0	I1 R2 S0	I2 R2 S0	I3 R2 S0	I0 R3 S0
FIRST COST	$32,528	$51,320	$61,320	$22,528	$55,056	$73,848	$83,848	$41,320	$73,848	$92,640	$102,640	$51,760
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	25	25	25	25	25	25	25	25	25	25	25	25
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTI	$1,242	$1,960	$2,342	$860	$2,102	$2,820	$3,202	$1,578	$2,820	$3,538	$3,920	$1,977
INVESTMENT COST	$33,770	$53,280	$63,662	$23,388	$57,158	$76,668	$87,050	$42,898	$76,668	$96,178	$106,560	$53,737
AVERAGE ANNUAL CHARGES												
INTEREST	$2,406	$3,796	$4,536	$1,666	$4,073	$5,463	$6,202	$3,056	$5,463	$6,853	$7,592	$3,829
AMORTIZATION	$524	$827	$989	$363	$888	$1,191	$1,352	$666	$1,191	$1,494	$1,655	$834
OPERATIONS & MAINTENANCE	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$1,500	$3,000	$4,000	$5,000	$0
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$5,931	$8,624	$10,524	$2,030	$7,960	$10,653	$12,554	$5,223	$9,653	$12,346	$14,247	$4,663

INVESTMENT COST	I3 R3 S0	I2 R3 S0	I3 R3 S0	I0 R0 S1	I1 R0 S1	I2 R0 S1	I3 R0 S1	I0 R1 S1	I1 R1 S1	I2 R1 S1	I3 R1 S1	I0 R2 S1
FIRST COST	$84,288	$103,080	$113,080	$22,528	$55,056	$73,848	$83,848	$37,056	$69,584	$88,376	$98,376	$55,848
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	25	25	25	25	25	25	25	25	25	25	25	25
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTI	$3,219	$3,936	$4,318	$860	$2,102	$2,820	$3,202	$1,415	$2,657	$3,375	$3,757	$2,133
INVESTMENT COST	$87,507	$107,016	$117,398	$23,388	$57,158	$76,668	$87,050	$38,471	$72,241	$91,751	$102,133	$57,981
AVERAGE ANNUAL CHARGES												
INTEREST	$6,235	$7,625	$8,365	$1,666	$4,073	$5,463	$6,202	$2,741	$5,147	$6,537	$7,277	$4,131
AMORTIZATION	$1,359	$1,662	$1,823	$363	$888	$1,191	$1,352	$597	$1,122	$1,425	$1,586	$900
OPERATIONS & MAINTENANCE	$5,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$12,594	$13,287	$15,188	$2,030	$7,960	$10,653	$12,554	$3,338	$9,269	$11,962	$13,863	$5,032

INVESTM. COST	I1 R2 S1	I2 R2 S1	I3 R2 S1	I0 R3 S1	.3 S1	I2 R3 S1	I3 R3 S1	I0 R0 S2	I1 R0 S2	I2 R0 S2	I3 R0	I0 R1 S2
FIRST COST	$88,376	$107,168	$117,168	$66,288	$98,816	$117,608	$127,608	$41,320	$73,848	$92,640	$102,640	$55,848
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	25	25	25	25	25	25	25	25	25	25	25	25
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTI	$3,375	$4,093	$4,474	$2,531	$3,774	$4,491	$4,873	$1,578	$2,820	$3,538	$3,920	$2,133
INVESTMENT COST	$91,751	$111,261	$121,642	$68,819	$102,590	$122,099	$132,481	$42,898	$76,668	$96,178	$106,560	$57,981
AVERAGE ANNUAL CHARGES												
INTEREST	$6,537	$7,927	$8,667	$4,903	$7,310	$8,700	$9,439	$3,056	$5,463	$6,853	$7,592	$4,131
AMORTIZATION	$1,425	$1,728	$1,889	$1,069	$1,593	$1,896	$2,057	$666	$1,191	$1,494	$1,655	$900
OPERATIONS & MAINTENANCE	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$10,962	$13,655	$15,556	$5,972	$11,903	$14,596	$16,497	$3,723	$9,653	$12,346	$14,247	$5,032

INVESTMENT COST	I1 R1 S2	I2 R1 S2	I3 R1 S2	I0 R2 S2	I1 R2 S2	I2 R2 S2	I3 R2 S2	I0 R3 S2	I1 R3 S2	I2 R3 S2	I3 R3 S2	I0 R0 S3
FIRST COST	$88,376	$107,168	$117,168	$74,640	$107,168	$105,960	$135,960	$85,080	$117,608	$136,400	$146,440	$51,760
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	25	25	25	25	25	25	25	25	25	25	25	25
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTI	$3,375	$4,093	$4,474	$2,850	$4,093	$4,046	$5,192	$3,249	$4,491	$5,209	$5,592	$1,977
INVESTMENT COST	$91,751	$111,261	$121,642	$77,490	$111,261	$110,006	$141,152	$88,329	$122,099	$141,609	$152,032	$53,737
AVERAGE ANNUAL CHARGES												
INTEREST	$6,537	$7,927	$8,667	$5,521	$7,927	$7,838	$10,057	$6,293	$8,700	$10,090	$10,832	$3,829
AMORTIZATION	$1,425	$1,728	$1,889	$1,203	$1,728	$1,708	$2,192	$1,372	$1,896	$2,199	$2,361	$834
OPERATIONS & MAINTENANCE	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$10,962	$13,655	$15,556	$6,725	$12,655	$13,546	$17,249	$7,665	$13,596	$16,289	$18,193	$4,663

INVESTMENT COST	I1 R0 S3	I2 R0 S3	I3 R0 S3	I0 R1 S3	I1 R1 S3	I2 R1 S3	I3 R1 S3	I0 R2 S3	I1 R2 S3	I2 R2 S3	I3 R2 S3	I0 R3 S3
FIRST COST	$84,288	$103,080	$113,080	$66,288	$98,816	$117,608	$127,608	$85,080	$117,608	$136,400	$146,400	$95,520
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125	0.07125
PROJECT LIFE (years)	25	25	25	25	25	25	25	25	25	25	25	25
CONSTRUCTION PERIOD (months)	12	12	12	12	12	12	12	12	12	12	12	12
INTEREST DURING CONSTRUCTI	$3,219	$3,936	$4,318	$2,531	$3,774	$4,491	$4,873	$3,249	$4,491	$5,209	$5,591	$3,648
INVESTMENT COST	$87,507	$107,016	$117,398	$68,819	$102,590	$122,099	$132,481	$88,329	$122,099	$141,609	$151,991	$99,168
AVERAGE ANNUAL CHARGES												
INTEREST	$6,235	$7,625	$8,365	$4,903	$7,310	$8,700	$9,439	$6,293	$8,700	$10,090	$10,829	$7,066
AMORTIZATION	$1,359	$1,662	$1,823	$1,069	$1,593	$1,896	$2,057	$1,372	$1,896	$2,199	$2,360	$1,540
OPERATIONS & MAINTENANCE	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0	$3,000	$4,000	$5,000	$0
REPLACEMENTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL ANNUAL CHARGES	$10,594	$13,287	$15,188	$5,972	$11,903	$14,596	$16,497	$7,665	$13,596	$16,289	$18,190	$8,606

INVESTMENT COST	I1 R3 S3	I2 R3 S3	I3 R3 S3
FIRST COST	$128,048	$146,840	$156,840
ANNUAL INTEREST RATE (decimal)	0.07125	0.07125	0.07125
PROJECT LIFE (years)	25	25	25
CONSTRUCTION PERIOD (months)	12	12	12
INTEREST DURING CONSTRUCTI	$4,890	$5,608	$5,989
INVESTMENT COST	$132,938	$152,448	$162,829
AVERAGE ANNUAL CHARGES			
INTEREST	$9,472	$10,862	$11,602
AMORTIZATION	$2,064	$2,367	$2,529
OPERATIONS & MAINTENANCE	$3,000	$4,000	$5,000
REPLACEMENTS	$0	$0	$0
TOTAL ANNUAL CHARGES	$14,536	$17,229	$19,130

:ENARIO STATISTICS

SCENARIO:	Aquatic	Aquatic Habitat -- Gravel bar	
COST VARIABLE:	Costs	Annualized costs including O M	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 12:58:05 P	**EDITED:**	**ANALYZED:** 11/29/99 12:58:21 P

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	I0 R0 S0	341.82	0.00	0.0000
2	I0 R1 S0	450.06	2,030.00	4.5105
3	I1 R0 S0	450.06	5,931.00	13.1782
4	I0 R0 S1	529.82	2,030.00	3.8315
5	I1 R1 S0	558.30	7,961.00	14.2594
6	I0 R2 S0	558.31	5,223.00	9.3550
7	I2 R0 S0	558.31	8,624.00	15.4466
8	I0 R0 S2	638.06	3,723.00	5.8349
9	I0 R1 S1	638.06	4,060.00	6.3630
10	I1 R0 S1	638.06	7,961.00	12.4769
11	I0 R3 S0	666.55	4,663.00	6.9957
12	I3 R0 S0	666.55	10,524.00	15.7888
13	I2 R1 S0	666.55	10,654.00	15.9838
14	I1 R2 S0	666.55	11,154.00	16.7339
15	I0 R1 S2	746.30	5,753.00	7.7087
16	I1 R0 S2	746.30	9,654.00	12.9358
17	I1 R1 S1	746.30	9,991.00	13.3874
18	I0 R0 S3	746.31	4,663.00	6.2481
19	I0 R2 S1	746.31	7,253.00	9.7185
20	I2 R0 S1	746.31	10,654.00	14.2756
21	I1 R3 S0	774.79	10,594.00	13.6734
22	I3 R1 S0	774.79	12,554.00	16.2031
23	I2 R2 S0	774.80	13,847.00	17.8717
24	I1 R1 S2	854.54	11,684.00	13.6729
25	I0 R1 S3	854.55	6,693.00	7.8322

PLAN * Plan Of Interest

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
26	I0 R3 S1	854.55	6,693.00	7.8322
27	I0 R2 S2	854.55	8,946.00	10.4687
28	I1 R0 S3	854.55	10,594.00	12.3972
29	I2 R0 S2	854.55	12,347.00	14.4485
30	I3 R0 S1	854.55	12,554.00	14.6908
31	I2 R1 S1	854.55	12,684.00	14.8429
32	I1 R2 S1	854.55	13,184.00	15.4280
33	I2 R3 S0	883.04	13,287.00	15.0469
34	I3 R2 S0	883.04	15,747.00	17.8327
35	I0 R3 S2	962.79	8,386.00	8.7101
36	I1 R1 S3	962.79	12,624.00	13.1119
37	I1 R3 S1	962.79	12,624.00	13.1119
38	I3 R0 S2	962.79	14,247.00	14.7976
39	I2 R1 S2	962.79	14,377.00	14.9326
40	I3 R1 S1	962.79	14,584.00	15.1476
41	I1 R2 S2	962.79	14,877.00	15.4520
42	I0 R2 S3	962.80	9,886.00	10.2680
43	I2 R0 S3	962.80	13,287.00	13.8004
44	I2 R2 S1	962.80	15,877.00	16.4904
45	I3 R3 S0	991.28	15,187.00	15.3206
46	I1 R3 S2	1,071.03	14,317.00	13.3675
47	I3 R1 S2	1,071.03	16,277.00	15.1975
48	I0 R3 S3	1,071.04	9,326.00	8.7074
49	I3 R0 S3	1,071.04	15,187.00	14.1797
50	I2 R1 S3	1,071.04	15,317.00	14.3011

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
51	I2 R3 S1	1,071.04	15,317.00	14.3011
52	I1 R2 S3	1,071.04	15,817.00	14.7679
53	I2 R2 S2	1,071.04	17,570.00	16.4046
54	I3 R2 S1	1,071.04	17,777.00	16.5979
55	I1 R3 S3	1,179.28	15,257.00	12.9376
56	I2 R3 S2	1,179.28	17,010.00	14.4241
57	I3 R1 S3	1,179.28	17,217.00	14.5996
58	I3 R3 S1	1,179.28	17,217.00	14.5996
59	I3 R2 S2	1,179.28	19,470.00	16.5101
60	I2 R2 S3	1,179.29	18,510.00	15.6959
61	I3 R3 S2	1,287.52	18,910.00	14.6872
62	I2 R3 S3	1,287.53	17,950.00	13.9414
63	I3 R2 S3	1,287.53	20,410.00	15.8521
64	I3 R3 S3	1,395.77	19,850.00	14.2215

:ENARIO STATISTICS

SCENARIO: Aquatic	Aquatic Habitat -- Gravel bar		
COST VARIABLE: Costs	Annualized costs including O M	**SENSITIVITY:**	Typica
OUTPUT VARIABLE: AAHU	Average Annualized Habitat Units	**SENSITIVITY:**	Typica
CREATED: 11/29/99 12:58:05 P	**EDITED:**	**ANALYZED:**	11/29/99 12:58:21 P

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	I0 R0 S0	341.82	0.00	0.0000
2	I0 R0 S1	529.82	2,030.00	3.8315
3	I0 R0 S2	638.06	3,723.00	5.8349
4	I0 R0 S3	746.31	4,663.00	6.2481
5	I0 R3 S1	854.55	6,693.00	7.8322
6	I0 R3 S2	962.79	8,386.00	8.7101
7	I0 R3 S3	1,071.04	9,326.00	8.7074
8	I1 R3 S3	1,179.28	15,257.00	12.9376
9	I2 R3 S3	1,287.53	17,950.00	13.9414
10	I3 R3 S3	1,395.77	19,850.00	14.2215

:ENARIO STATISTICS

SCENARIO:	Aquatic	Aquatic Habitat -- Gravel bar	
COST VARIABLE:	Costs	Annualized costs including O M	**SENSITIVITY:** Typica
OUTPUT VARIABLE:	AAHU	Average Annualized Habitat Units	**SENSITIVITY:** Typica
CREATED:	11/29/99 12:58:05 P	**EDITED:**	**ANALYZED:** 11/29/99 12:58:21 P

CONSTRAINT GROUP: NONE

EXCLUDED SOLUTIONS

DERIVED VARIABLES

DEPENDENCY / NON-COMBINABILITY

:remental And Cost Effectiveness Analysis - Plan

ɔest Buy Plans by Output

Scenario: Aquatic

11/29/99 1:00:43 PM

Counter	Combo Code	AAHU (AAHU)	Costs (Dollars)	Average Cost Dollars / AAHU
1	I0 R0 S1	529.82	2,030.00	3.8315
2	I0 R0 S3	746.31	4,663.00	6.2481
3	I0 R3 S3	1,071.04	9,326.00	8.7074
4	I3 R3 S3	1,395.77	19,850.00	14.2215

APPENDIX C- CIVIL DESIGN & COST ESTIMATE

CIVIL DESIGN

GENERAL

The purpose of this section is to discuss the construction of two berm dikes that will act as detention dams for wetland cells. The dikes will be aligned parallel to the Big Cypress Bayou River set back approximately 75 feet from the river banks. Dike 1 is located adjacent to the abutment of the Polk Street Bridge (Business 59) and dike 2 is approximate 900 feet upstream from this bridge. In order to regulate the amount of water maintained in the cells, water control structures shall be placed at low points in the dike alignments. Because of the location of these berms adjacent to the river, access ramps will be required to maintain the berms as well as the control structures. In two areas east of the Polk Street Bridge, one adjacent and the other approximately 800 feet downstream, natural restoration systems shall be restored with plantings for wildlife restoration. This will be done on regraded terrain that will require small retaining wall structures.

EXISTING CONDITIONS

The locations for the two dikes were chosen due to the lay of the existing land. Two natural drainage swales leading to the river will be used as low points in the dikes to place a control structure that will regulate the amount of water to pond in the wetland cells. The area adjacent to Polk Street designated for natural wildlife restoration, will require removal of an existing parking lot and boat ramp. The other area downstream will only require backfill with stone protection to establish a flatter grade.

EFFECTS OF THE PROJECT

Dikes

Dike 1, which is just to the west of Polk Street, extends for a total length of 284 feet. The control structure to regulate the impounded water is located at its berm centerline station 10+93 as shown on the drawings. Dike 2, which is 900 feet upstream of Dike 1, extends for a total length of 70 feet with the water control structure located at its berm centerline station 10+45 as shown on the drawing. The top of both berms is set at elevation 178.0 NGVD and the broadcrest width dimension is 5 feet. The maximum height for Dike 1 will be 8 feet and an average height of 3 feet. The maximum height for Dike 2 will be 4 feet and an average height of 2 feet. Since the dikes will be overtopped during high flows from the river, the side slopes are different on each side. On the downstream sides or the sides closer to the river, the slope shall be a gradual slope of 10H:1V. The upstream side of the dikes or the sides that impounds the wetland cell, shall be sloped at 4H:1V to minimize changing or disturbing existing ground conditions. The wetland cell created by Dike 1 will back up water through an existing culvert crossing in an existing dirt road. In order to regulate the flows at this point, the existing culvert shall be removed by excavating the earth material and placing a new control structure in the same location. The road surface and backfill will be restored to its present elevation and grade.

Access to construct the dikes can be done through an existing dirt road that is currently used to access a canoe launch point. Clearing for an additional temporary access lane 10 feet wide to each berm, will be require from the existing road. Upon completing the dikes, the temporary access shall be restored to existing conditions.

Water Control Structures

The control structure consists of three major components; an inlet flashboard riser, a 24 inch galvanized corrugated metal pipe, and an outlet galvanized metal apron. The inlet structure will be placed at the upstream end of the berms to regulate the flows coming out of the wetland cell. Aluminum stoplogs can be stacked to set various elevations thus allowing only the required flows to go through. These stoplogs can be manually placed or removed. 12-inch thick riprap will be placed at both the inflow and outflow areas to prevent erosion as well.

Maintenance Access Ramps

Access for maintenance to the dikes, and the water control structures will be done from a ramp set at grade elevation of 180.0 feet, NGVD. In order to minimize disturbing existing lands, the ramp shall remain elevated at the 180.0 elevation which will be at a maximum height above existing ground of 8 feet and an average height overall of 3 feet. Footings for the ramp shall be 12-inch diameter cast in place reinforce concrete drilled shaft piers. Embedment of the piers will vary depending on the ground elevation. Piers placed where the ground elevation is 178 feet NGVD or below, shall be placed to a depth of 15 feet. Piers placed where the ground elevation is 178.0 feet NGVD and above, shall be placed to a depth of 10 feet. Treated wood of southern pine shall be used to complete the superstructure beams, joists, and stringers, as well as the decking surface for the access ramp.

Retention Walls

In the areas designated for wildlife restoration, the existing terrain shall be regraded in order to flatten the slope grades. To achieve this, a series of retention walls shall be placed making several terrace levels. Along major change in ground elevations, concrete steps will be place to facilitate access between the terrace levels. The maximum height for the wall closest to the river will be 3 feet above the ground with a concrete spread footing. The other walls will be set at a maximum height of 1.5 feet and made from structural reinforced concrete, faced with natural stone quarried in the immediate area.

GEOTECHNICAL CONSIDERATIONS

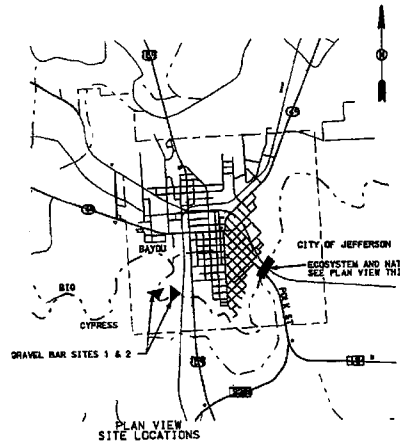
Materials to be encountered across the site consist of highly variable, alluvial soils (sands, silts, clays, and gravels) to depths of at least 25 feet to 30 feet. Exposed soil on the banks of the bayou, and in the banks of the tributaries which cross the site, consist primarily of fine, very light brown sand with a small amount of silt. In the wooded area of the flood plain, the surface soil was

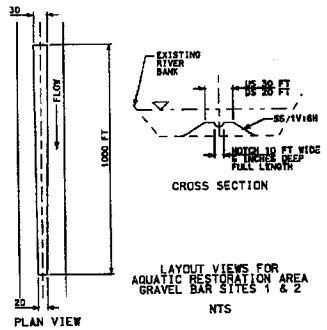
a light grayish brown and yellow sandy clay mixture with silt and scattered grayish clay nodules. Unpublished soil maps obtained from the Natural Resource Conservation Service (NRCS) show Mooreville-Mattex loam soil at the surface. The preceding description of the surface soil in the wooded area coincides with the Mooreville series as described by the NRCS. The Geologic Atlas of Texas, Tyler Sheet, published by the Texas Bureau of Economic Geology, mapped the proposed project on recent alluvium. Upland areas in the project vicinity are mapped as the Queen City Sand formation or as the Reklaw formation, which consists primarily of clay. Descriptions of both the Queen City Sand and Reklaw formations in the upland refer to frequent ironstone concretions and ledges within the formations. Based on reconnaissance of the site, and on the above-mentioned geology and soils maps, it is expected that the soils beneath the project, to depths beyond any foundation elements or expected excavations, will be variable sand and clay mixtures. Ground water is likely to be encountered within 5 feet of the ground surface, and may enter excavations quickly, depending on the actual conditions at any point on the project.

The following recommendations for tentative design of the foundation for the raised wooden walkways were provided: The walkways may be founded on treated wooden piling, either driven to full depth, or partially pre-drilled. In lieu of wooden piling, the walkways may be founded on minimum 12-inch diameter, cast-in-place, reinforced concrete drilled shafts. The above-ground portion of the shafts may be constructed of reinforced concrete formed in sonotubes. For a ground elevation of 178 National Geodetic Vertical Datum (NGVD) or below, embedment should be a minimum of 15 feet. For ground elevations above 178 NGVD, embedment should be a minimum of 10 feet. The structural foundation system should be designed to resist uplift of the boardwalk due to buoyancy when submerged, and should also provide sufficient depth beneath the expected depth of erosion/scour on any portions of the boardwalk exposed to flowing water. Additionally, the boardwalk should be designed to resist lateral loading, especially at high points above the ground level. The following soil parameters were provided for tentative design of the foundation for the walkway:

Allowable Bearing Capacity = 3 KSF
Phi = 25 degrees
Cohesion = 0
Skin friction = 0

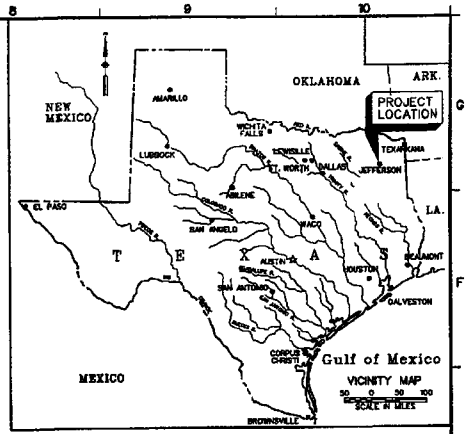
The above geotechnical recommendations are preliminary and were made based on information available at the time of this report. Prior to preparation of plans and specs, it is recommended that a more extensive investigation, to include drilling and laboratory testing, be performed along the alignment of the proposed walkway and as appropriate for other structures. It is not expected that the results of additional geotechnical investigations will materially affect the design or construction cost of the major project features.

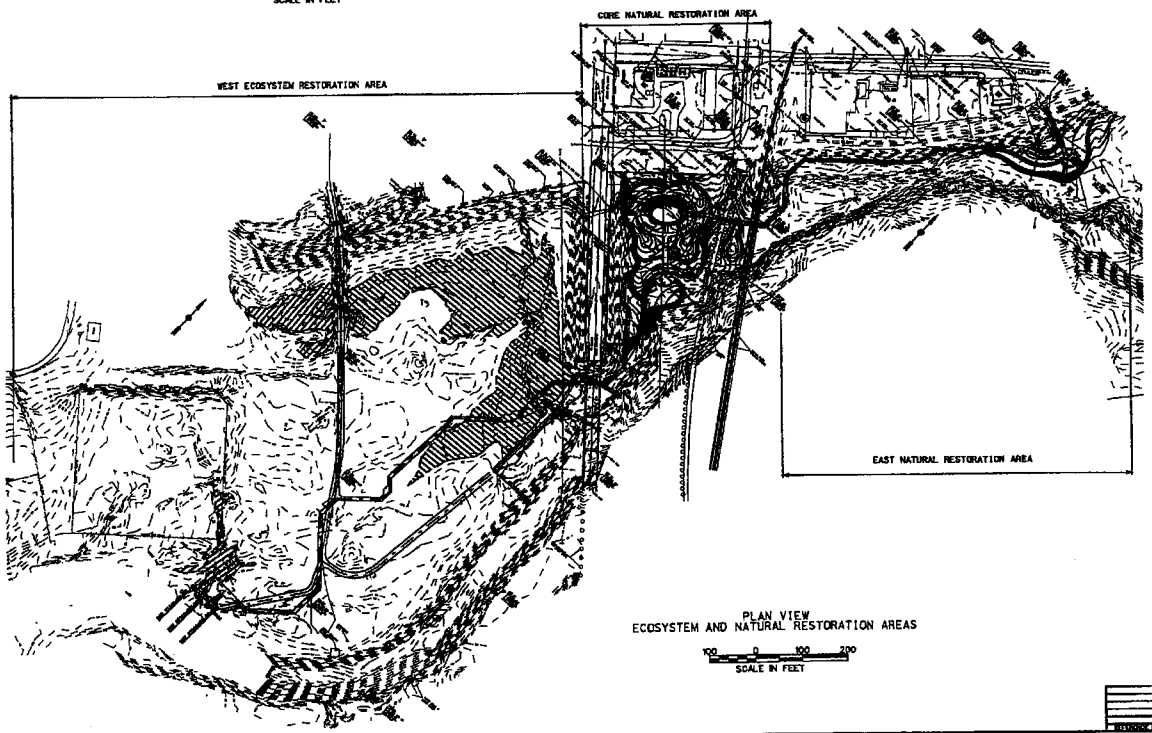




LAYOUT VIEWS FOR
AQUATIC RESTORATION AREA
GRAVEL BAR SITES 1 & 2

NTS





ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: S.LAWRENCE	BIG CYPRESS BAYOU JEFFERSON, TEXAS
DRAWN BY: S.MARTINEZ	FISH AND WILDLIFE HABITAT RESTORATION
REVISED BY: P. SMITH	SITE MAP, VICINITY MAP, PROJECT MAP
SUBMITTED BY: TERRIL NOLEN, P.E. CHIEF, SITE DEVELOPMENT SECTION	SOL. NO. DATE: CONTR. NO. DRAWING NUMBER SHEET NO. OF PLATE NO. 1

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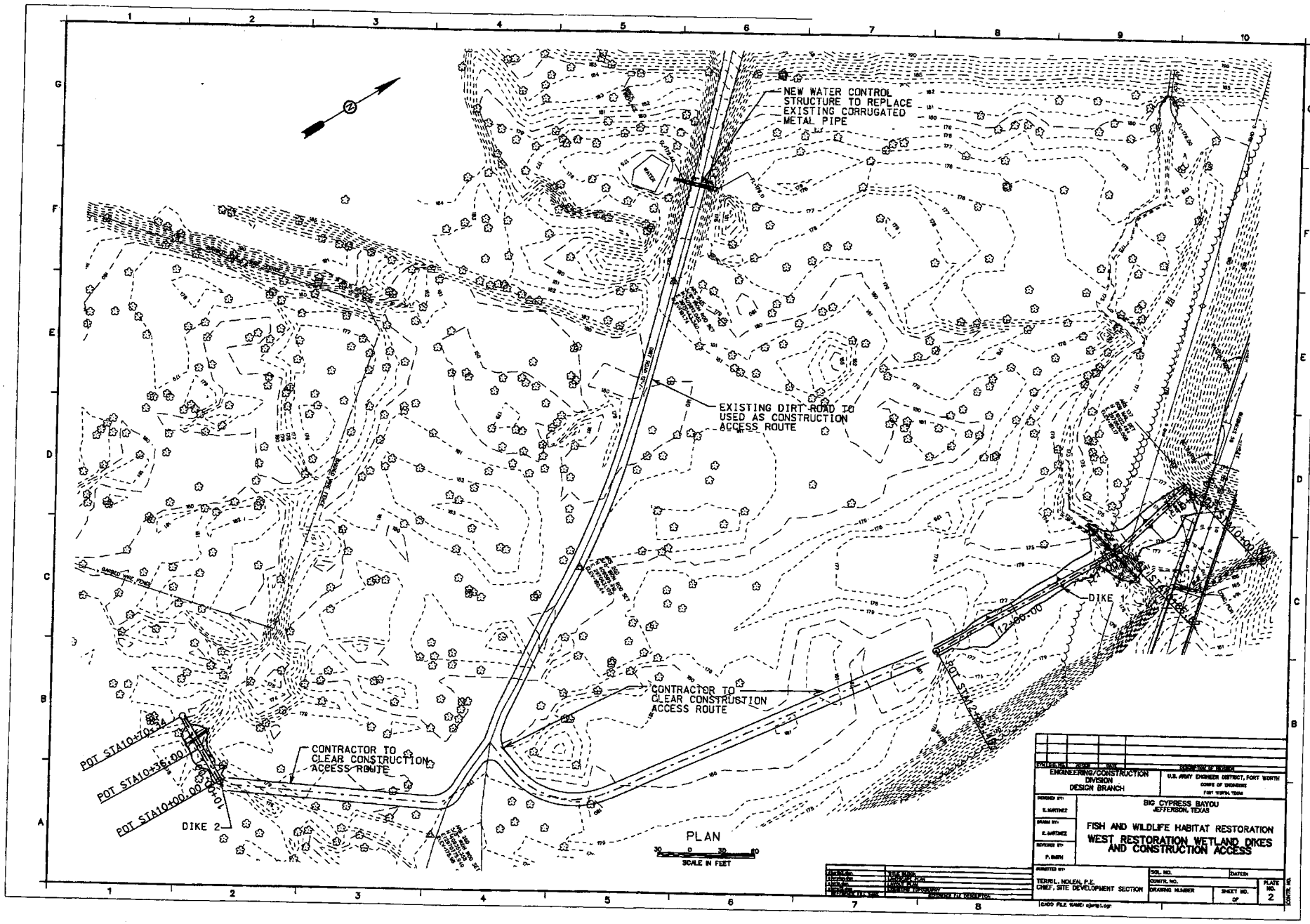
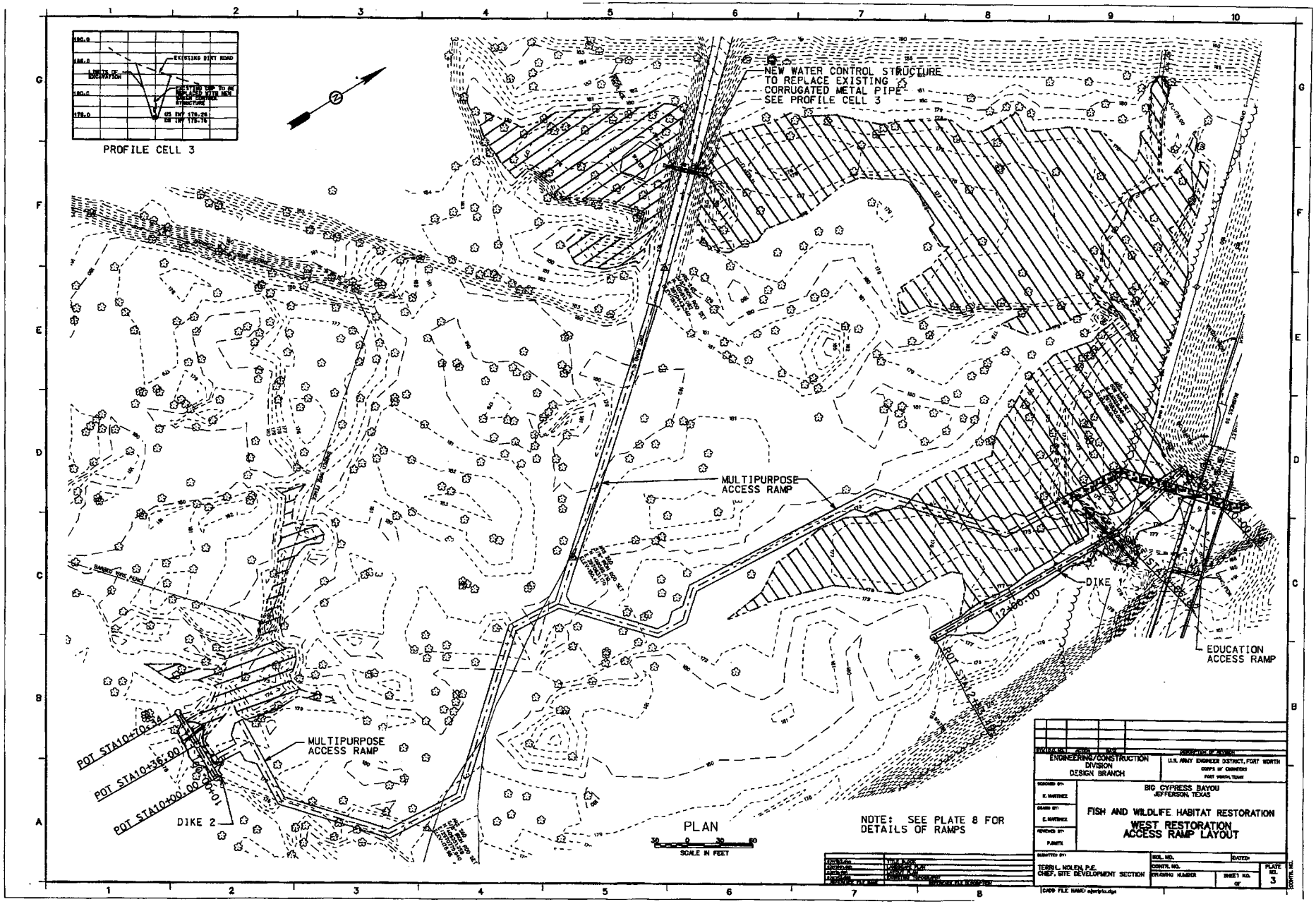
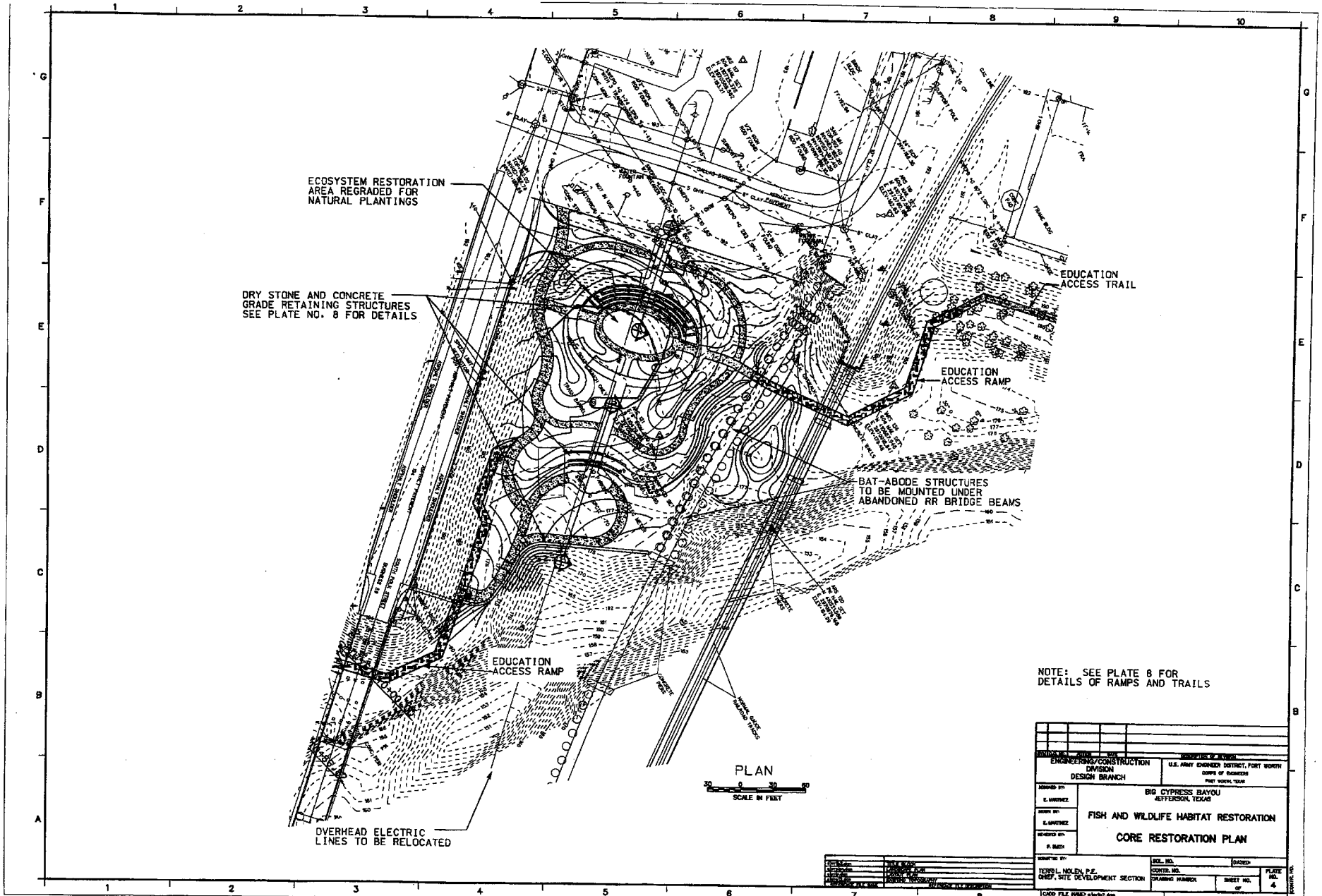
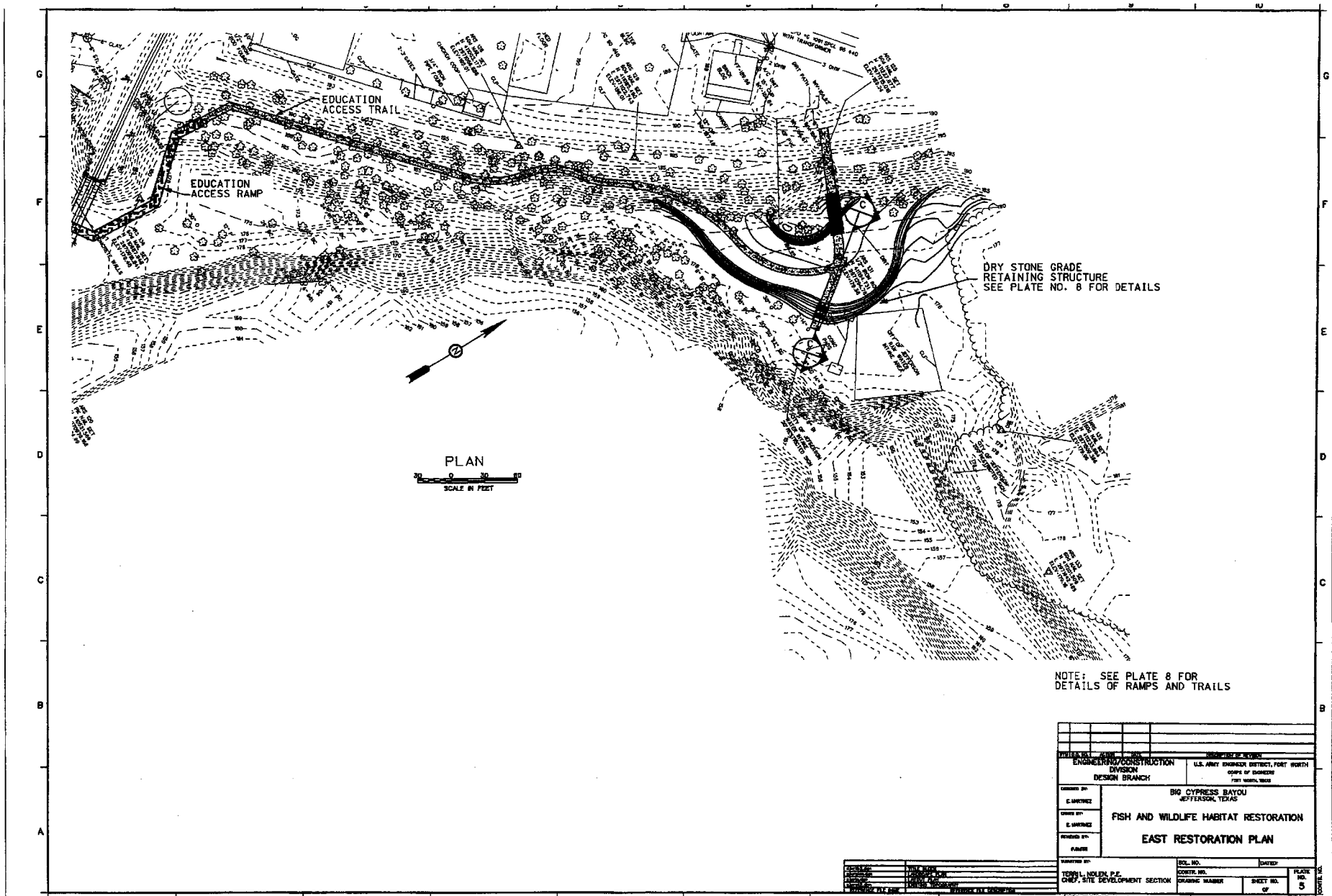
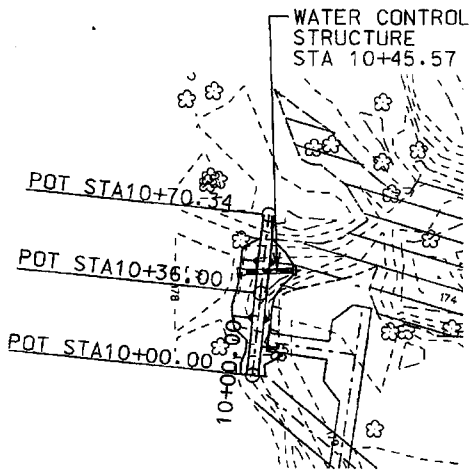

NEW WATER CONTROL STRUCTURE TO REPLACE EXISTING CORRUGATED METAL PIPE
EXISTING DIRT ROAD TO USED AS CONSTRUCTION ACCESS ROUTE
CONTRACTOR TO CLEAR CONSTRUCTION ACCESS ROUTE
CONTRACTOR TO CLEAR CONSTRUCTION ACCESS ROUTE
DIKE 1
DIKE 2
POT STA10+70+14
POT STA10+36+00
POT STA10+00+00
POT STA12+00+00
PLAN
SCALE IN FEET
ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
BIG CYPRESS BAYOU
JEFFERSON, TEXAS
FISH AND WILDLIFE HABITAT RESTORATION
WEST RESTORATION WETLAND DIKES AND CONSTRUCTION ACCESS
TERREL NOLEN, P.E.
CHIEF, SITE DEVELOPMENT SECTION
PLATE NO. 2


PROFILE CELL 3
NEW WATER CONTROL STRUCTURE TO REPLACE EXISTING CORRUGATED METAL PIPE SEE PROFILE CELL 3
MULTIPURPOSE ACCESS RAMP
DIKE
EDUCATION ACCESS RAMP
MULTIPURPOSE ACCESS RAMP
DIKE 2
POT STA10+70+34
POT STA10+36+00
POT STA10+00+00
PLAN
SCALE IN FEET
NOTE: SEE PLATE 8 FOR DETAILS OF RAMPS
ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
BIG CYPRESS BAYOU JEFFERSON, TEXAS
FISH AND WILDLIFE HABITAT RESTORATION
WEST RESTORATION ACCESS RAMP LAYOUT
TERRY L. HOLLEN, P.E. CHIEF, SITE DEVELOPMENT SECTION
PLATE NO. 3

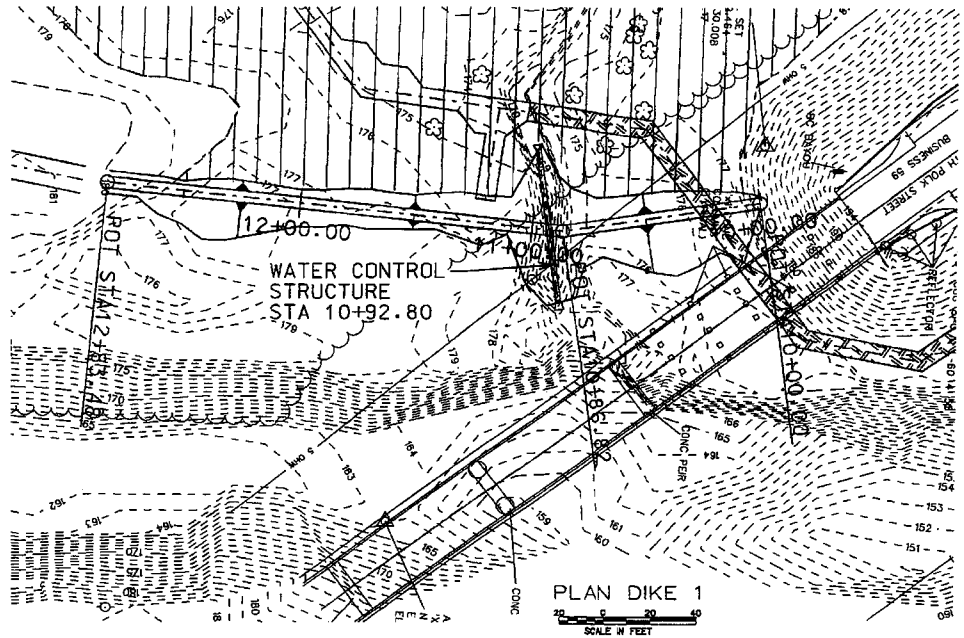

ECOSYSTEM RESTORATION AREA REGRADED FOR NATURAL PLANTINGS
DRY STONE AND CONCRETE GRADE RETAINING STRUCTURES SEE PLATE NO. 8 FOR DETAILS
EDUCATION ACCESS TRAIL
EDUCATION ACCESS RAMP
BAT-ABODE STRUCTURES TO BE MOUNTED UNDER ABANDONED RR BRIDGE BEAMS
EDUCATION ACCESS RAMP
OVERHEAD ELECTRIC LINES TO BE RELOCATED
PLAN
30 0 30 60
SCALE IN FEET
NOTE: SEE PLATE 8 FOR DETAILS OF RAMPS AND TRAILS
ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
BIG CYPRESS BAYOU JEFFERSON, TEXAS
FISH AND WILDLIFE HABITAT RESTORATION
CORE RESTORATION PLAN
TERRI L. NOLEN, P.E. CHIEF, SITE DEVELOPMENT SECTION
PLATE NO. 4


EDUCATION ACCESS TRAIL
EDUCATION ACCESS RAMP
DRY STONE GRADE RETAINING STRUCTURE SEE PLATE NO. 8 FOR DETAILS
PLAN
SCALE IN FEET
NOTE: SEE PLATE 8 FOR DETAILS OF RAMPS AND TRAILS
ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
BIG CYPRESS BAYOU JEFFERSON, TEXAS
FISH AND WILDLIFE HABITAT RESTORATION
EAST RESTORATION PLAN
TERRI L. NOLEN, P.E.
CHIEF, SITE DEVELOPMENT SECTION
PLATE NO. 5



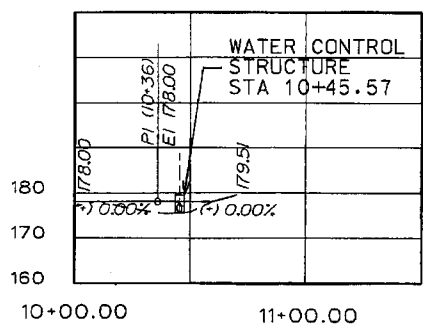
PLAN DIKE 2

SCALE IN FEET

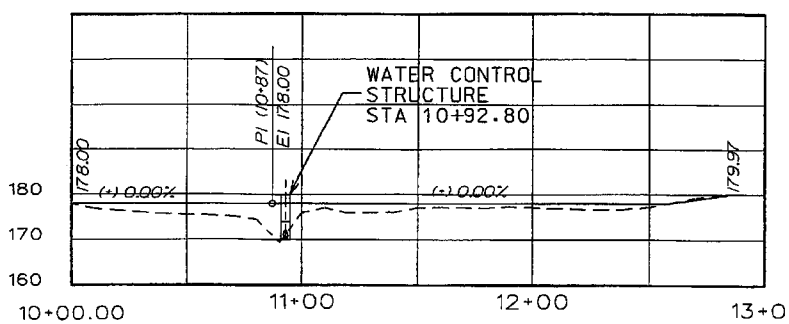


PLAN DIKE 1

SCALE IN FEET



CENTERLINE PROFILE DIKE 2



CENTERLINE PROFILE DIKE 1

ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

BIG CYPRESS BAYOU
JEFFERSON, TEXAS

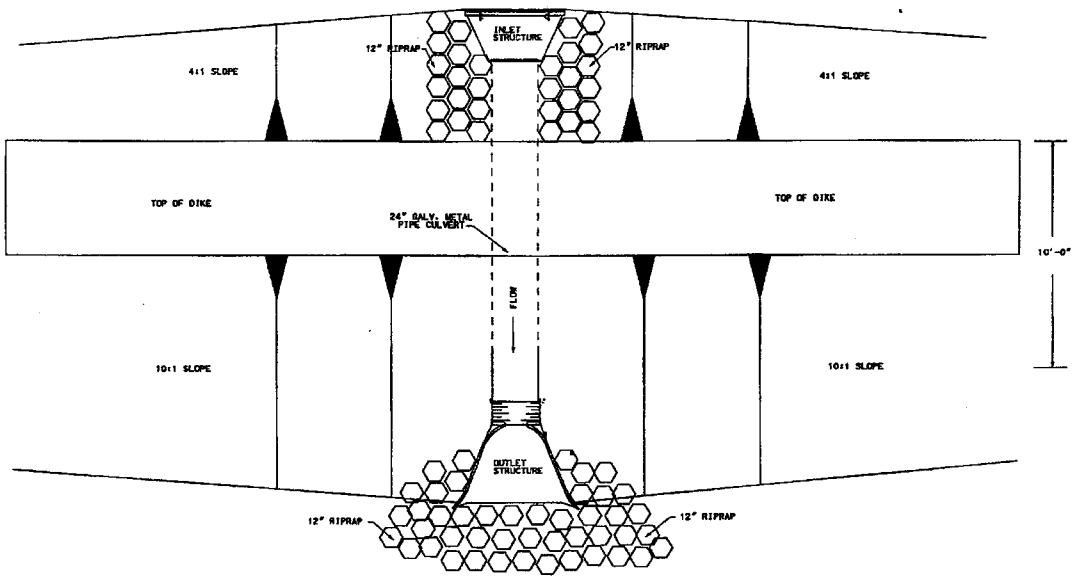
FISH AND WILDLIFE HABITAT RESTORATION

DIKES 1 AND 2
PLAN AND PROFILE

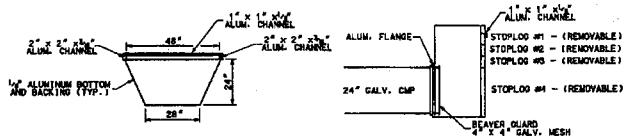
E. MARTINEZ
E. MARTINEZ
P. SMITH

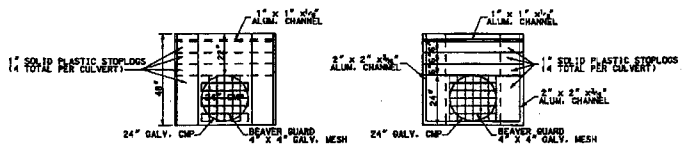
TERRY L. NOLEN, P.E.
CHIEF, SITE DEVELOPMENT SECTION

SCL. NO.
CONTR. NO.
DRAWING NUMBER
SHEET NO.
OF
PLATE NO. 6

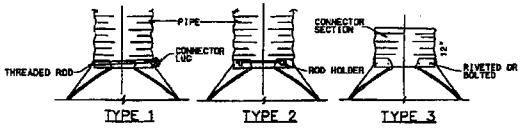


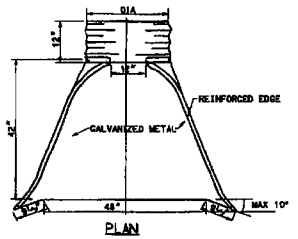
PLAN
CONTROL STRUCTURE





INLET STRUCTURE
ALUMINUM FLASHBOARD RISER (HEADER)



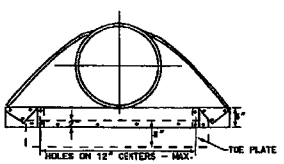


NOTES:

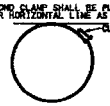
TOE PLATE, WHERE NEEDED, TO BE PUNCHED TO MATCH HOLES IN SKIRT LIP. 3/4" GALV. BOLTS TO BE USED. LENGTH OF TOE PLATE IS 88".

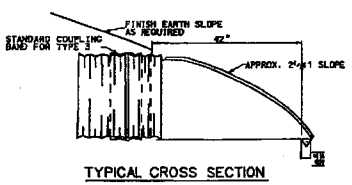
SKIRT SECTION TO BE MADE IN ONE PIECE.

CONNECTOR SECTION, CORNER PLATE AND TOE PLATE TO BE THE SAME GAGE AS SKIRT AND EACH TO BE GALVANIZED.



NOTE:
COUPLING BOND CLAMP SHALL BE PLACED SO AS TO CLEAR HORIZONTAL LINE AS SHOWN BELOW





OUTLET STRUCTURE
STD. END SECTION FOR ROUND
METAL PIPE (MIN. GAUGE 16)
NOT TO SCALE

USE OF THIS END SECTION DETAIL AUTHORIZED BY THE TEXAS DEPARTMENT OF TRANSPORTATION

20 0 20 40
SCALE IN FEET

ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

BIG CYPRESS BAYOU
JEFFERSON, TEXAS

FISH AND WILDLIFE HABITAT RESTORATION

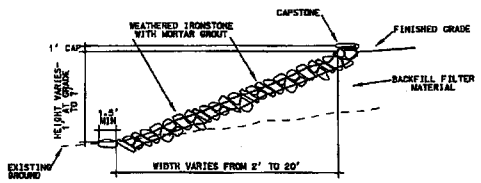
CONTROL STRUCTURES
INLET AND OUTLET DETAILS

DESIGNED BY: P. NATAN
DRAWN BY: P. NATAN
REVIEWED BY: E.MARTINEZ

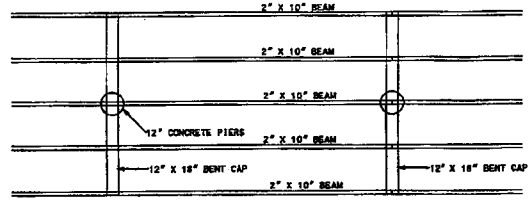
SUBMITTED BY: TERRELL NOLEN, P.E.
CHIEF, SITE DEVELOPMENT SECTION

SOL. NO.
CONTR. NO.
DRAWING NUMBER
SHEET NO. OF
DATE
PLATE NO. 7

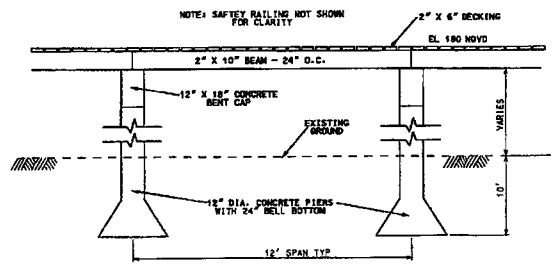
CADD FILE NAME: CJWRDNSLOOK



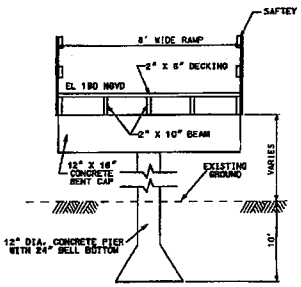
SECTION C: DRY STONE GRADE RETAINING STRUCTURE
EAST RESTORATION AREA
SCALE NTS



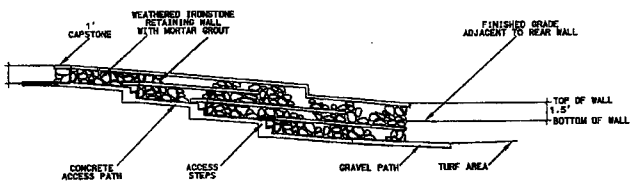
PLAN VIEW MULTIPURPOSE & EDUCATION ACCESS RAMP
WEST RESTORATION AREA
SCALE NTS



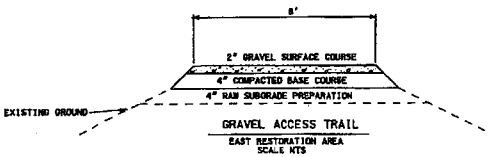
ELEVATION MULTIPURPOSE & EDUCATION ACCESS RAMP
WEST RESTORATION AREA
SCALE NTS



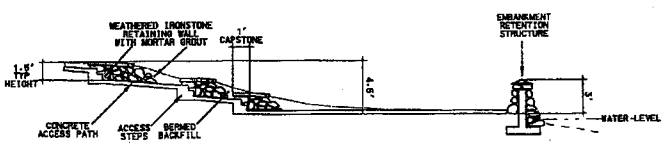
SECTION VIEW
WEST RESTORATION AREA
SCALE NTS



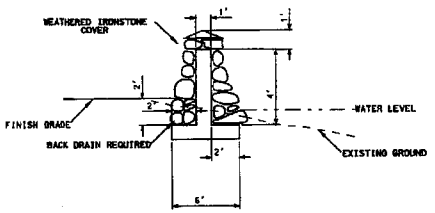
SECTION A: DRY STONE GRADE RETAINING STRUCTURE
EAST RESTORATION AREA
SCALE NTS



GRAVEL ACCESS TRAIL
EAST RESTORATION AREA
SCALE NTS



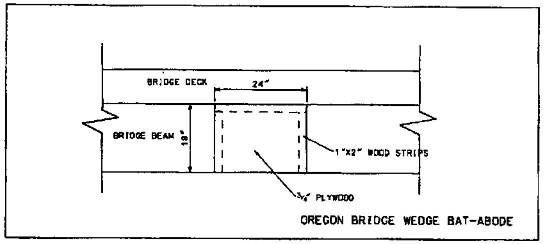
SECTION B: DRY STONE GRADE RETAINING STRUCTURE
CORE RESTORATION AREA AT WATER EDGE
SCALE NTS

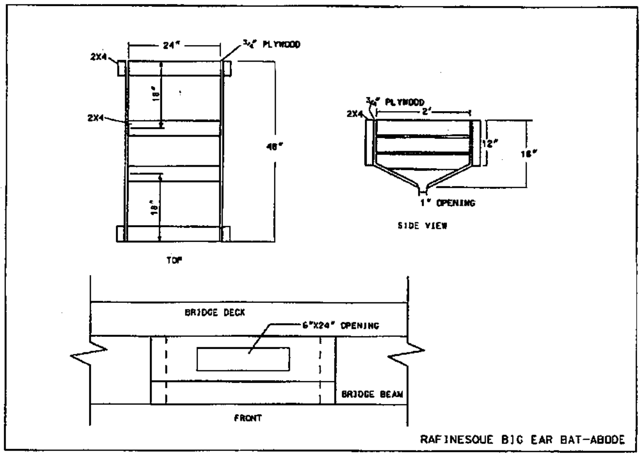


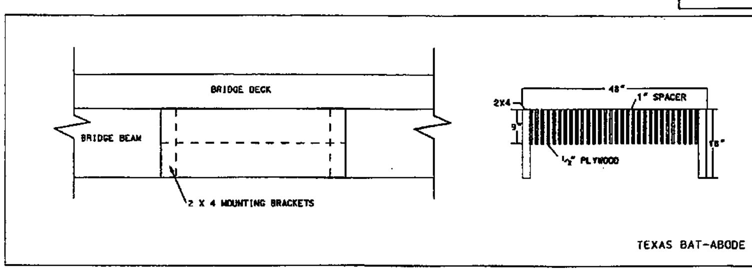
ELEVATION - EMBANKMENT RETENTION STRUCTURE
CORE RESTORATION AREA AT WATER EDGE
SCALE NTS

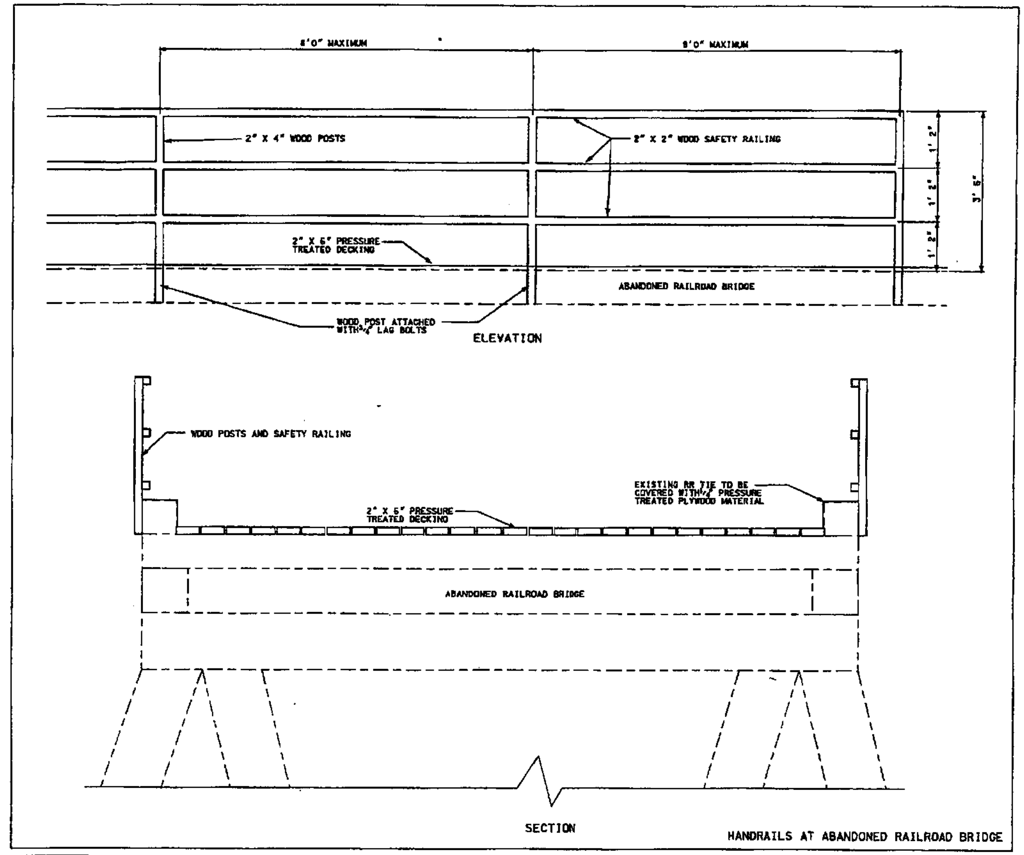
ENGINEERING/CONSTRUCTION DIVISION DESIGN BRANCH		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: E.MARTINEZ DRAWN BY: E.MARTINEZ REVIEWED BY: R.SMITH	BIG CYPRESS BAYOU JEFFERSON, TEXAS FISH AND WILDLIFE HABITAT RESTORATION RETENTION STRUCTURES AND ACCESS RAMP DETAILS		
SUBMITTED BY: TERRI L. NOLEN, P.E. CHIEF, SITE DEVELOPMENT SECTION		SOL. NO. CONTR. NO. DRAWING NUMBER	DATE: SHEET NO. OF
			PLATE NO. 8

CADD FILE NAME: e:\plate\pl8.dgn









ENGINEERING/CONSTRUCTION DIVISION
DESIGN BRANCH

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

DESIGNED BY: E. MARTINEZ
DRAWN BY: L. DELMURE
REVIEWED BY: E. MARTINEZ
SUBMITTED BY: TERRI L. NOLEN, P.E., CHIEF, SITE DEVELOPMENT SECTION

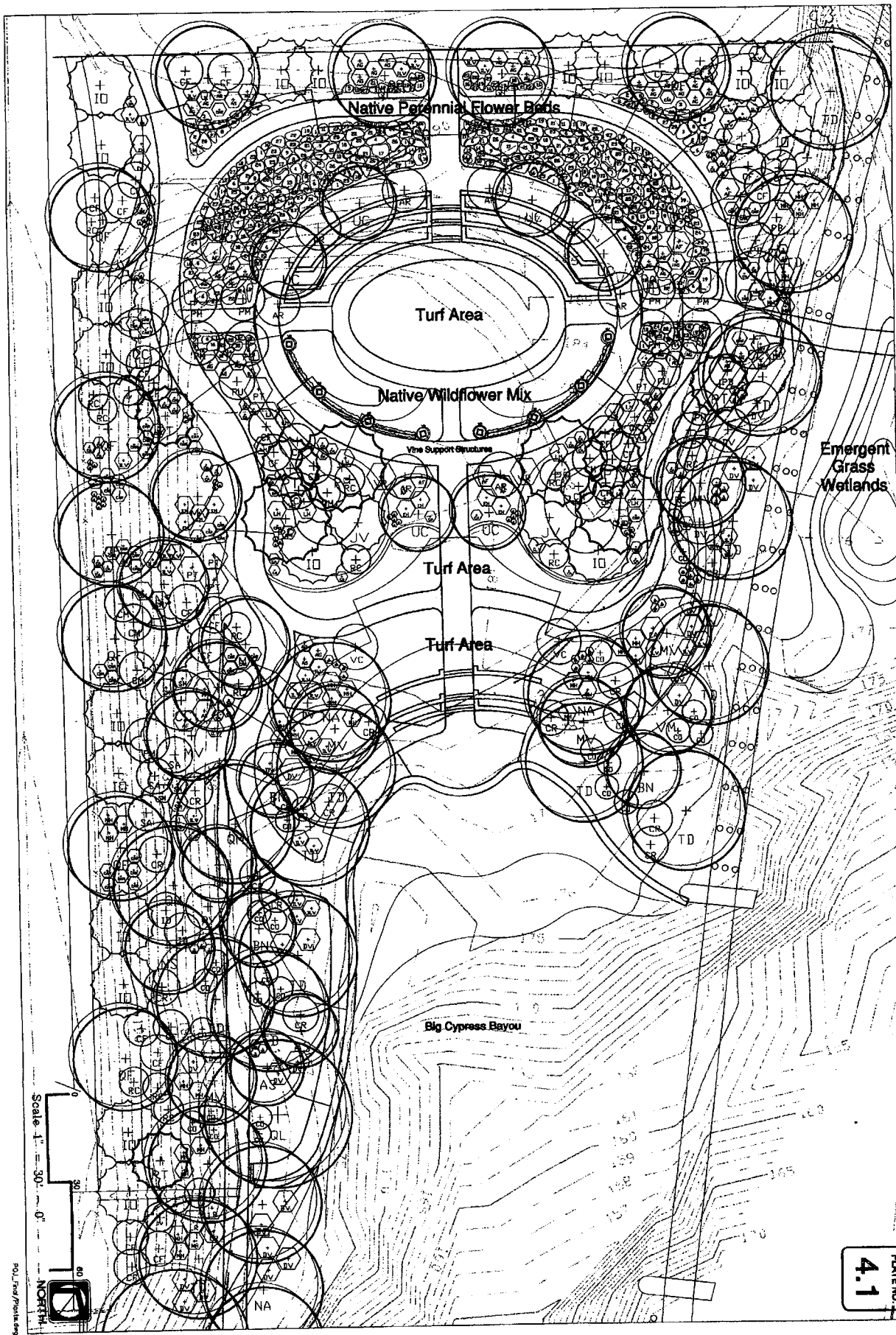
BIG CYPRESS BAYOU
JEFFERSON, TEXAS

FISH AND WILDLIFE HABITAT RESTORATION

BAT-ABODE BRIDGE DECKING DETAILS

SOL. NO.
CONTR. NO.
DRAWING NUMBER
DATED:
SHEET NO. OF
PLATE NO. 9

CADD FILE NAME

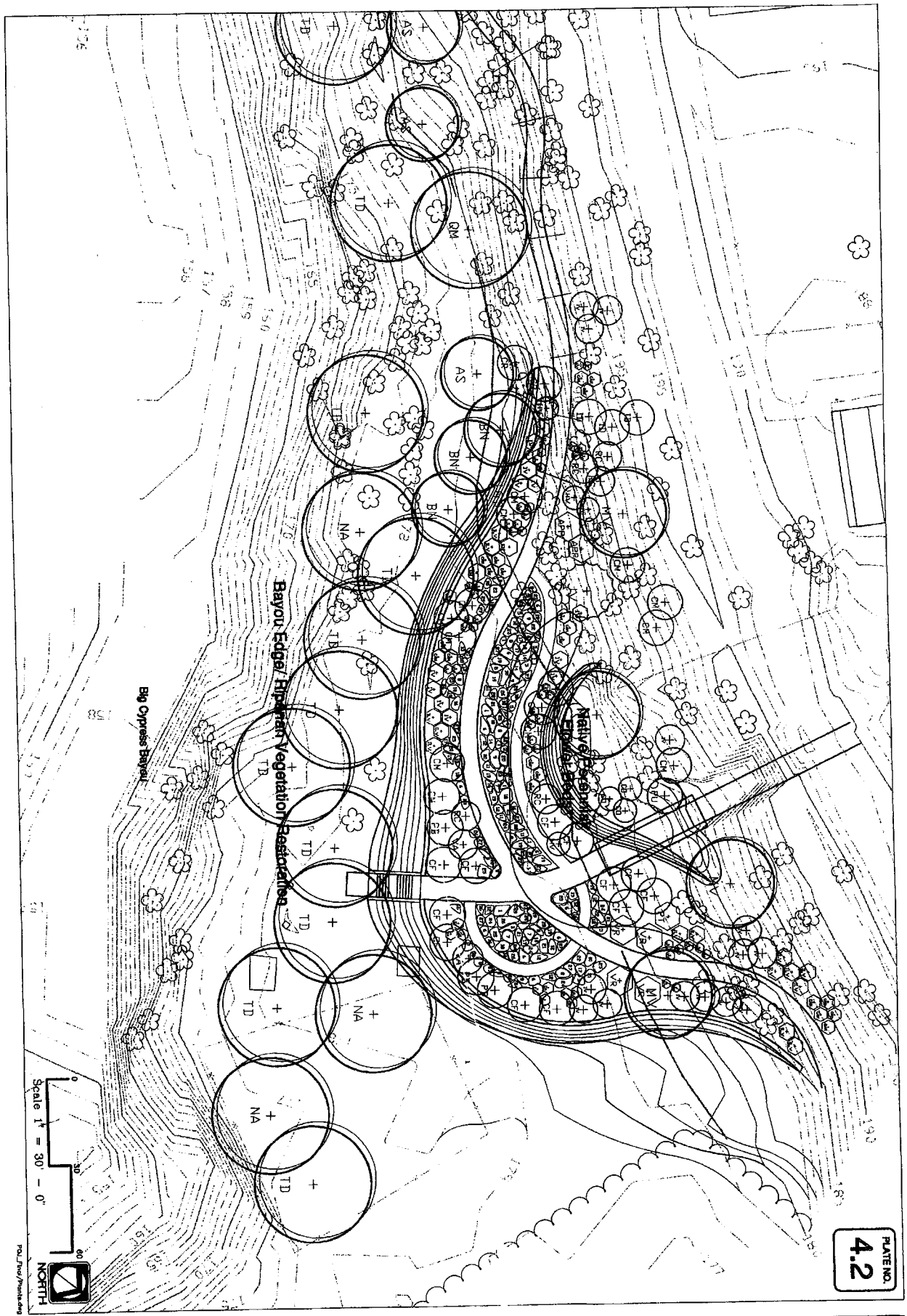


BIG CYPRESS BAYOU
Natural Resource Restoration Plan
Port of Jefferson, Texas

Planting Plan
Core Area

SHAPINS ASSOCIATES
PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

US Army
Corps of Engineers
FT. WORTH DISTRICT
PLANNING OFFICE



BIG CYPRESS BAYOU
Natural Resource Restoration Plan
Port of Jefferson, Texas

Planting Plan
East Area

SHAPINS ASSOCIATES
PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

US Army
Corps of Engineers
FT. WORTH DISTRICT
PLANNING OFFICE

QUANTITY	ABBREV.	BOTANICAL NAME	COMMON NAME	TYP.SPACING
		EVERGREEN TREES		
6	JV	Juniperus virginiana	Eastern Red Cedar	20'
4	PP	Pinus palustrus	Long-leaf Pine	30'
5	PT	Pinus taeda	Loblolly Pine	20'
19	IO	Ilex opaca	American Holly	25'
14	MV	Magnolia virginiana	Sweet Bay Magnolia	30'
		DECIDUOUS SHADE TREES		
9	AS	Alnus serrulata	Smooth Alder	15'
7	BN	Betula nigra	River Birch	20'
7	NA	Nyssa aquatica	Water Tupelo	30'
2	NS	Nyssa sylvatica	Black Gum	30'
5	QL	Quercus lyrata	Overcup Oak	50'
4	QM	Quercus michauxii	Swamp Chestnut Oak	50'
10	RO	Quercus falcata	Southern Red Oak	40'
38	TD	Taxodium distichum	Bald Cypress	12'
6	UC	Ulmus crassifolia	Cedar Elm	50'
		ORNAMENTAL TREES		
8	AR	Acer rubrum, "drummondii"	Drummond Red Maple	25'
1	CA	Cletera alnifolia	Summersweet Clethra	8'
6	CC	Cercis canadensis	Eastern Redbud	20'
41	CF	Cornus florida	Flowering Dogwood	15'
22	CM	Crataegus marshallii	Parsley Hawthorn	15'
28	CO	Cephalanthus occidentalis	Buttonbush	10'
16	CR	Cyrilla racemiflora	Titi	8'
5	DV	Diospyros virginiana	Common Persimmon	8'
4	HV	Hamamelis virginiana	Witchhazel	20'
5	ID	Ilex decidua	Possumhaw	10'
19	IV	Ilex vomitoria	Yaupon Holly	15'
6	PB	Persea borbonia	Red Bay	15'
9	PM	Prunus mexicana	Mexican Plum	15'
5	PU	Prunus umbellata	Flatwoods Plum	20'
19	RC	Rhamnus caroliniana	Carolina Buckthorn	15'
3	SA	Sassafras albidum	Sassafras	12'
2	VA	Vaccinium aboreum	Farkelberry	12'
2	VC	Vitex agnus-castus	Chaste Tree	10'
		SHRUBS		
10	AF	Amorpha futicosa	False Indigo	10'
41	AG	Abelia x grandflora	Glossy Abelia	2'
4	APP	Aesulus pavia var. pavia	Scarlet Buckeye	10'
76	CAM	Callicarpa americana	American Beauty berry	10'
65	CA	Ceonothus americanus	New Jersey Tea	10'
24	DV	Decodon verticillatus	Water Willow	6'
12	EH	Erythrina herbacea	Coral Bean	5'
57	ILV	Ilex veticalla	Dahoon Holly	5'
12	IV	Itea viginica	Virginia Sweetspire	7'
3	LR	Leucothoe racemosa	Grey-Sweetbells Leucothoe	6'
38	MC	Myrica cerifera	Wax Myrtle	3'
18	MP	Myrica pusilla	Dwarf Wax Myrtle	12'
6	PT	Ptelia trifoliata	Hop Tree	12'
2	RC	Rhus copallina	Flameleaf Sumac	2'
7	SM	Sabal minor	Dwarf Palmetto	2'
6	VR	Viburnum rufidulum	Rusty Blackhaw Viburnum	12'
43	YL	Yucca louisianensis	Louisianna Yucca	2'
		GROUNDCOVER		
207	1	Asclepias asperita	Antelope Horns	1'
99	2	Aster ericoides	Heath Aster	1'
90	3	Aster sp.	Wild Blue Aster	2'
12	4	Asclepias tuberosa	Butterfly Weed	3'
30	5	Crinum americanum	Crinum Lily	2'
351	6	Coreopsis lanceolata	Lance-leaf Coreopsis	1'
117	7	Diclipter brachiata	Perennial Diclipter	1'
279	8	Eupatorium coelestinum	Wild Blue Ageratum	1'
96	9	Echinacea pallida	Purple Coneflower	2'
180	10	Engelmannia pinnatifida	Engelman Daisy	1'
90	11	Gaillardia pulchella	Indian Blanket	1'
108	12	Hymenocallis liriosme	Spider Lilly	2'
50	13/HM	Hibiscus militaris	Halbert-leaf Rose-mallow	2'
129	14	Liatris pycnostahcya	Liatris sp.	3'
81	15	Lobelia cardinalis	Cardinal Flower	1'
351	16	Marshallia caespitosa	Barbara's Buttons	1'
48	17	Malvaviscus drummondii	Turk's Cap	4'
162	18	Monarda didyma, "Crofway Pink"	Beebalm	1'
306	19	Phlox divaricata	Louisiana Phlox	1'
99	20	Pentas lanceolata	Pentas	1'
315	21	Polytaenia nuttalii	Prairie Parsley	1'
208	22	Phlox pilosa	Fragrant Phlox	2'
414	23	Penstemmon tenuis	Gulf-Coast Penstemmon	2'
118	24	Ruellia brittonia	Ruellia	2'
288	25	Rudbeckia hirta	Brown-eyed Susan	3'
138	26	Salvia coccinea	Scarlet Sage	1'
300	27	Sedum spectabile, "Meteor"	Sedum	2'
44	WV	Woodwardia virginica	Virginia Chain Fern	2'
		VINES		
12	RS	Rosa setigera	Prarie Rose	1'
8	BC	Bignonia capreoleta	Cross Vine	6'
12	PI	Passiflora incarnata	Passion Vine	6'
8	WM	Wisteria macrostachya	Kentucky Wisteria	6'

PLATE NO.
4.3

SHAPINS ASSOCIATES
PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

US Army
Corps of Engineers
FT. WORTH DISTRICT
PLANNING OFFICE

Plant Materials
Core & East Wildscape Areas

BIG CYPRESS BAYOU
Natural Resource Restoration Plan
Port of Jefferson, Texas

CONSTRUCTION COST ESTIMATE
FOR
BIG CYPRESS BAYOU, JEFFERSON, TEXAS
ECOSYSTEM RESOTRATION

The construction cost was prepared in accordance with sound engineering practices and guidelines, and reflects the best estimate given the level of detail provided.

Lee Osborne — 28 APRIL 2000
Lee Osborne — Date
Chief, Cost and Specifications Section

Eli Kangas — 28 APRIL 2000
Eli Kangas — Date
Project Manager

Darrell Alverson — 28 April 2000
Darrell Alverson — Date
Chief, Design Branch

BIG CYPRESS BAYOU FISH AND WILDLIFE HABITAT RESTORATION
JEFFERSON, TEXAS

	Unit	Unit Price	Quantity	Cost
WEST AREA				
Wetland Complex (3 cells)				
Construction Access	STA	$370.00	14.16	$5,239.20
Clearing	SY	$1.00	1277.00	$1,277.00
Stripping	SY	$1.25	887.00	$1,108.75
Excavation	CY	$2.95	249.00	$734.55
Embankment Fill	CY	$7.90	506.00	$3,997.40
Backfill	CY	$3.90	235.00	$916.50
Flash Board Riser	EA	$1,055.00	3.00	$3,165.00
24" CMP	LF	$43.60	121.00	$5,275.60
Outlet Structue	EA	$1,320.00	3.00	$3,960.00
Bedding Material	SY	$60.00	26.00	$1,560.00
12" Riprap	CY	$75.00	24.00	$1,800.00
Turfing	SY	$0.55	1290.00	$709.50
Subtotal Wetland Complex				$29,743.50
Reforestation				
Selective Thinning	AC	$140.00	24.70	$3,458.00
Bottomland Trees & Shrubs	AC	$990.00	21.80	$21,582.00
Bald Cypress	AC	$315.00	3.00	$945.00
Subtotal Reforestation				$25,985.00
Access				
Maintenance/Education				
Ramp	LF	$40.75	1566.00	$63,814.50
12" - Drilled Piers - 10 ft	EA	$500.00	70.00	$35,000.00
12" - Drilled Piers - 15 ft	EA	$625.00	70.00	$43,750.00
Gravel	LF	$10.70	395.00	$4,226.50
Subtotal Maintenance/Education				$146,791.00
Education				
Ramp	LF	$40.75	155.00	$6,316.25
12" - Drilled Piers - 10 ft	EA	$500.00	7.00	$3,500.00
12" - Drilled Piers - 15 ft	EA	$625.00	7.00	$4,375.00
Subtotal Education				$14,191.25
Subtotal Access				$160,982.25
Wood Duck Boxes	EA	$50.00	14.00	$700.00
SUBTOTAL WEST AREA				$217,410.75

BIG CYPRESS BAYOU FISH AND WILDLIFE HABITAT RESTORATION
JEFFERSON, TEXAS

CORE AREA	Unit	Unit Price	Quantity	Cost
Urban Wildscape				
Grading and Filling	CY	$7.90	5500.00	$43,450.00
Grade Retention Structures	LF	$114.13	755.00	$86,168.15
Native Vegetation	LS	$87,000.00	1.00	$87,000.00
Subtotal Urban Wildscape				$216,618.15
Emergent Wetland				
Excavation	LS	$2,140.00	1.00	$2,140.00
Emergent Plants & Grasses	LS	$5,000.00	1.00	$5,000.00
Subtotal Emergent Wetland				$7,140.00
Riparian Cooridor	EA	$850.00	40.00	$34,000.00
Bat Habitat				
Support Structure	EA	$225,000.00	1.00	$225,000.00
Texas Bat Abode	EA	$300.00	7.00	$2,100.00
Big-Eared Bat Abode	EA	$300.00	2.00	$600.00
Oregon Wedge Bat Abode	EA	$100.00	12.00	$1,200.00
Support Planking	SF	$1.10	11325.00	$12,460.00
Handrail	LF	$9.25	1510.00	$13,965.00
Subtotal Bat Habitat				$255,325.00
Access				
Maintenance Only				
Gravel	LF	$10.70	1615.00	$17,280.50
Education Only				
Ramp	LF	$40.75	370.00	$15,077.50
12"-Drilled Piers - 10 ft	EA	$500.00	35.00	$17,500.00
Concrete	LF	$65.00	250.00	$16,250.00
Subtotal Education				$48,827.50
Subtotal Access				$66,108.00
Boat Ramp Relocation				
Removal	LS	$6,669.50	1.00	$6,669.50
New Boat Ramp	LS	$55,600.00	1.00	$55,600.00
Subtotal Boat Ramp Relocation				$62,269.50
Utility Relocation	LS	$20,264.00	1.00	$20,264.00
SUBTOTAL CORE AREA				$661,724.65

BIG CYPRESS BAYOU FISH AND WILDLIFE HABITAT RESTORATION
JEFFERSON, TEXAS

EAST AREA	Unit	Unit Price	Quantity	Cost
Urban Wildscape				
Construction Access	STA	$370.00	7.20	$2,664.00
Grading and Filling	CY	$7.90	280.00	$2,212.00
Grade Retention Structures	LF	$90.00	160.00	$14,400.00
Grade Retention -Stone	CY	$75.00	182.00	$13,650.00
Native Vegetation	LS	$44,750.00	1.00	$44,750.00
Subtotal Urban Wildscape				$77,676.00
Reforestation				
Selective Thinning	AC	$140.00	5.00	$700.00
Bottomland Trees & Shrubs	AC	$2,345.00	5.00	$11,725.00
Subtotal Reforestation				$12,425.00
Access				
Maintenance/Education				
Gravel	LF	$10.70	350.00	$3,745.00
Education				
Gravel	LF	$10.70	530.00	$5,671.00
Ramp	LF	$40.75	130.00	$5,297.50
12"-Drilled Piers - 10 ft	EA	$500.00	12.00	$6,000.00
Subtotal Education Access				$16,968.50
SUBTOTAL EAST AREA				$110,814.50
BIG CYPRESS BAYOU				
Aquatic Restoration				
Gravel Bar	LF	$47.76	2000.00	$95,520.00
SUBTOTAL BIG CYPRESS BAYOU				$95,520.00
TOTAL CONSTRUCTION COST				$1,085,469.90

SUMMARY CONSTRUCTION COST

West Area	
Wetland Complex	$29,743.50
Reforestation	$25,985.00
Access:	
Dual Purpose	$146,791.00
Education	$14,191.25
Subtotal Access	$160,982.25
Wood Duck Boxes	$700.00
Subtotal West Area	$217,410.75
Core Area	
Urban Wildscape	$216,618.15
Emergent Wetland	$7,140.00
Riparian Cooridar	$34,000.00
Bat Habitat	$255,325.00
Access:	
Maintenance	$17,280.50
Education	$48,827.50
Subtotal Access	$66,108.00
Relocations:	
Boat Ramp	$62,269.50
Utility	$20,264.00
Subtotal Relocations	$82,533.50
Subtotal Core Area	$661,724.65
East Area	
Urban Wildscape	$77,676.00
Reforestation	$12,425.00
Access:	
Maintenance/Education	$3,745.00
Education	$16,968.50
Subtotal Access	$20,713.50
Subtotal East Area	$110,814.50
Big Cypress Bayou	
Gravel Bar	$95,520.00
TOTAL CONSTRUCTION COST	$1,085,469.90

TOTAL PROJECT COST	
Environmental Restoration	$270,000.00
Plans and Specifications	$230,000.00
LERRD's:	
Land:	
Payments and Administration	$95,830.00
Relocations:	
Boat Ramp	$62,269.50
Utility	$20,264.00
E&D / S&A	$16,506.70
Subtotal Relocations	$99,040.20
Total LERRD's	$194,870.20
Construction:	
Environmental Restoration	$894,176.15
Education	$191,293.75
E&D and S&A	$108,546.99
Total Construction	$1,194,016.89
Monitoring	$10,000.00
TOTAL PROJECT COST	$1,898,887.09

PLANS AND SPECIFICATIONS	
Engineering and Design	$160,000.00
Planting Plan	$10,000.00
Environmental & Cultural Review Coordination and Compliance	$10,000.00
Cost Engineering	$7,500.00
Real Estate Review	$15,000.00
Construction Contract Award	$7,500.00
Project Management	$20,000.00
TOTAL PLANS AND SPECIFICATIONS	$230,000.00

COST APPORTIONMENT

Total Project Cost	$1,898,887.09
Environmental Restoration	$1,688,463.97
Education	$210,423.13
Federal Share	
Environmental Restoration	$1,266,347.97
Education	$105,211.56
Total Federal Share	$1,371,559.54
Jefferson Share:	
Environmental Restoration	
LERRD Credit:	
Lands and Payments	$95,830.00
Boat Ramp Relocation	$72,647.75
Utility Relocation	$26,392.45
Subtotal LERRD	$194,870.20
Work-in-Kind	$225,000.00
Subtotal Environmental	$419,870.20
Cash	$2,245.79
Total Environmental Restoration	$422,115.99
Education	
Cash	$105,211.56
Total Jefferson	$527,327.55
Jefferson Share Summary:	
LERRD	$194,870.20
Work in Kind	$225,000.00
Cash	$107,457.35
Total Jefferson	$527,327.55

PLANTING DESIGN

Planting designs were developed for the proposed wildscapes in the Core and the East sections during the course of this study. The plans were based on a program designed by the Texas Parks and Wildlife Department, called "Texas Wildscapes", which helps Texas homeowners establish and maintain wildlife habitat on their own lands and in their own yards. Research was conducted to determine the tree, shrub and herbaceous vegetation species native to East Texas. This species list was then cross-referenced to lists of plant species provided by TPWD that provide habitat for various wildlife species – either as sources of food, such as acorns, nuts, berries, buds, fruit, nectar and seeds or to provide protective cover for shelter and nesting. In addition, planting many types of vegetation results in various shapes, heights and densities to provide for a diverse habitat to accommodate a variety of wildlife and bird species.

CERTIFICATE OF AUTHORITY

I, _____, do hereby certify that I am the principal legal officer of the City of Jefferson, Texas, that the City of Jefferson, Texas, is a legally constituted public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the City of Jefferson, Texas, in connection with the Big Cypress Bayou Modification Project, and to pay damages in accordance with the terms of this Agreement, if necessary, in the event of the failure to perform, and that the persons who have executed this Agreement on behalf of the City of Jefferson, Texas, have acted within their statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this _____ day of _____ 19___.

_____

[SIGNATURE]

_____

[TYPED NAME]

_____

[TITLE IN FULL]

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

_____

[SIGNATURE]

_____

[TYPED NAME]

_____

[TITLE IN FULL]

DATE: _____

CESWF-PM-C 29 Nov 99

LIST OF DEVIATIONS
TO
SECTION 1135 MODEL AGREEMENT
FOR
THE BIG CYPRESS BAYOU
MODIFICATION PROJECT
LAKE O' THE PINES, TEXAS

1. The Big Cypress Bayou Modification Project, Lake O' The Pines, Texas, Section 1135 Project Cooperation Agreement (PCA) is based on the HQUSACE Model 1135 PCA and the Red River at Marshall, Minnesota, Flood Control Project Cooperation Agreement (Non-structural, Multi-purpose project) as approved by HQUSACE. Deviations to the Model PCA are indicated in the text of the PCA ("Strike-through/Highlighted").

CERTIFICATION OF LEGAL REVIEW

The Draft Section 1135 Agreement for the Big Cypress Bayou Modification Project has been fully reviewed by the Office of Counsel, USAED, Fort Worth District, Fort Worth, Texas, includes noted deviations, and is legally sufficient.

Barbara Chesdant Assistant District Counsel

for District Counsel

DATE: 12/13/99

APPENDIX E – REAL ESTATE

APPENDIX E

(17 Aug 99)

REAL ESTATE PLAN

PURPOSE

This Real Estate Plan (REP) describes the necessary acquisition of lands, easements and rights of way (LER) for the Big Cypress Bayou Environmental Restoration Project recommended plan, as presented in this Habitat Restoration Report. The project is being studied under authority of Section 1135 of the Water Resources Development Act of 1986, Public Law 99-662, as amended. No previous REP's have been prepared for this project. The term "project lands" or "LER", when used in this plan, refers to all lands and interests in real estate needed for construction, operation and maintenance of the environmental restoration features.

LANDS, EASEMENTS AND RIGHTS OF WAY FOR THE RECOMMENDED PLAN

Neighborhood

The project area is located in Marion County, Texas, within the City of Jefferson. The core areas are on the Southeast edge of the City at the intersection of Big Cypress Bayou and Business U.S. Highway 59.

Project Lands

TABLE E-1
LANDS, EASEMENTS AND RIGHTS OF WAY
BIG CYPRESS BAYOU HABITAT RESTORATION PROJECT
JEFFERSON, TEXAS

PROJECT PURPOSE: ENVIRONMENTAL RESTORATION

ESTATE	ACRES	OWNERSHIPS	ESTIMATED VALUE
PROJECT SEGMENT: West Core Area			
Fee	24.7	15	$15,555
PROJECT SEGMENT: Core Area			
Fee	3.5	Sponsor-owned	$4,550
PROJECT SEGMENT: East Core Area			
Fee	7.0	Sponsor-owned	$7,550
PROJECT SEGMENT: Aquatic Habitat Restoration			
Road Easement	2.0	1	$500

Table E-1 above displays the breakdown of project LER. All lands are to be acquired in fee, due to the project purpose of environmental restoration, except for the road right-of-way discussed below. For purposes of description and incremental analysis, the project has been divided into the three main segments listed in the table, plus the road. Figure E-1 shows the three core areas and Figure E-2 shows the proposed road easement.

Sponsor-owned Lands

The Core Area and East Core Area are owned in fee by the Non-federal Sponsor, the City of Jefferson. These sponsor-owned lands are available for project purposes and the fair market value should be creditable toward the sponsor's share of project costs. There are no special value considerations or crediting principles that are applicable.

Other LER Information

A road right-of-way which will need to be acquired from one property owner for the purposes of constructing the Paddlefish habitat improvements in the Big Cypress Bayou channel. This work will be done at a location upstream of the Core Areas.

There are no other Federal projects which overlap with the LER.

Navigation Servitude

Big Cypress Bayou is a navigable water and as such there is a servitude within the beds and banks of the stream up to the ordinary high water mark. However, the environmental restoration purpose of this project is not a purpose that has been commonly recognized as an aid to commerce. Thus, there is no authority to assert Servitude rights in this case.

IMPACTS ON FLOOD LEVELS

No work under this project will induce flooding.

RELOCATIONS OF UTILITIES OR FACILITIES

Boat Ramp

The existing boat ramp and parking area in the Core Area is proposed to be relocated to a downstream site on City-owned property. Land for this relocation is included in the baseline cost estimate. The ramp is owned by the State of Texas with the Texas Parks and Wildlife Department having primary long-term responsibility. It is located on State right-of-way administered by the Texas

Department of Transportation. The underlying fee estate and/or the adjacent land is owned by the City of Jefferson. The two State agencies have entered into a multiple-use agreement for the boat ramp. In addition, Parks and Wildlife has an agreement with the City of Jefferson for day to day operation and maintenance. A Fort Worth District staff attorney has prepared a preliminary opinion of compensability dated August 17, 1999. Based on this opinion, the facility appears to meet the tests for a relocation, warranting provision of a substitute facility, the costs of which would be part of total project cost. Parks and Wildlife staff have no objection to relocation of the facility.

Electric Line

Also, an aerial electric line in the Core Area, which is owned by Southwestern Electric Power Company, is proposed to be rerouted. Existing easements will be utilized for the new power line alignment. A preliminary opinion of compensability dated August 12, 1999 has been prepared for this utility. Based on this opinion, the facility appears to meet the tests for a relocation, warranting provision of a substitute facility, the costs of which would be part of total project cost.

Final Opinion

The Government will make a final determination of the necessary relocations after further analysis and completion of final attorney's opinions of compensability for each of the impacted utilities and facilities.

LANDS CONTAINING HAZARDOUS WASTE

None of the LER is known to contain hazardous, toxic or radiological waste.

DISPLACEMENT OF PERSONS, FARMS OR BUSINESSES

There will be no displacements of persons, farms or businesses.

MINERALS AND TIMBER

There are significant mineral resources in Marion County, especially oil and gas. The county also produces a large amount of timber including pine saw-timber and pulpwood. Since this is a project where environmental resources are to be restored, the Government's investment will best be protected by acquiring all mineral and timber rights. The value of minerals and timber is included in the LER value estimate.

NON-FEDERAL SPONSOR'S CAPABILITY TO ACQUIRE LER

The City of Jefferson has full legal authority to acquire and hold real estate,

including the power of eminent domain, under Texas law. Experience in Federal acquisitions is limited. However, there is strong, organized community support for the project through the Cypress Valley Alliance. A number of professional people, including real estate professionals are members of this group. Given the resources of the community as a whole, the City is characterized as moderately capable of acquiring LER. The requirements of P.L. 91-646 and crediting procedures have been fully explained to the sponsor. A capability assessment checklist is found at the end of this plan.

PROPOSED ZONING

There are no proposals to enact new zoning in lieu of, or to facilitate, LER acquisition.

BASELINE COST ESTIMATE FOR REAL ESTATE

Property values included in the cost estimate are based on a Gross Estimate dated December 29, 1997, prepared by a Fort Worth District Staff Appraiser. As documented by an update certificate dated August 11, 1999, it has been determined that the values in that estimate remain within a reasonable range for planning purposes. Administrative costs were estimated by Fort Worth District Planning and Control Branch staff. Contingencies have been added to the cost estimate as follows:

01.23.03.01. Real Estate Planning Documents, 10% based on extent and complexity existing ownerships

01.23.03.02. Real Estate Acquisition Documents, 10% based on reasonable certainty of costs

01.23.03.03. Real Estate Condemnation Documents, 10% based on expectation of at least one condemnation

01.23.03.05. Real Estate Appraisal Documents, 10% based on reasonable certainty of contract costs

01.23.03.15. Real Estate Payment Documents, 25% based on contingency assigned by the Appraiser in the Gross Estimate

01.23.03.17. Real Estate LERRD Crediting Documents, 10% based on reasonable certainty regarding crediting requirements

Estimates are presented in the standard Code of Accounts from the MCACES Models Database, October 1994.

TABLE E-2
REAL ESTATE COST ESTIMATE FOR PROJECT IMPLEMENTATION
BIG CYPRESS BAYOU HABITAT RESTORATION PROJECT
JEFFERSON, TEXAS

ACCOUNT	DESCRIPTION	ESTIMATE	CONTINGENCY
01	Lands & Damages		
01.23	Construction Contract Documents		
01.23.03	Real Estate Analysis Documents		
01.23.03.01	Real Estate Planning Documents		
	Planning by Local Sponsor	500	50
01.23.03.02	Real Estate Acquisition Documents		
	Acquisitions by Local Sponsor	30,000	3,000
	Review of Local Sponsor	1,500	150
01.23.03.03	Real Estate Condemnation Documents		
	Condemnations by Local Sponsor	10,000	1,000
	Review of Local Sponsor	500	50
01.23.03.05	Real Estate Appraisal Documents		
	Appraisals by Local Sponsor	3,000	300
	Review of Local Sponsor	2,000	200
01.23.03.15	Real Estate Payment Documents		
	Payments by Local Sponsor (Land)	28,155	7,039
	Payments by Local Sponsor (Damages)	1,605	401
	Review of Local Sponsor	800	80
01.23.03.17	Real Estate LERRD Crediting Documents	5,000	500
	TOTAL ADMIN & PAYMENTS	83,060	
	TOTAL CONTINGENCY		12,770
	GRAND TOTAL	95,830	

SCHEDULE FOR REAL ESTATE ACQUISITION.

It is estimated that this acquisition will require approximately 12 months to complete after execution of the Project Cooperation Agreement.

TABLE E-3
REAL ESTATE MILESTONE SCHEDULE
BIG CYPRESS BAYOU HABITAT RESTORATION PROJECT
JEFFERSON, TEXAS

ACTIVITY	COE INITIATE	COE COMPLETE	LS INITIATE	LS COMPLETE
Transmittal of ROW drawings to LS with instruction to acquire LERRD		Day 0		
Prepare mapping and legal descriptions			Day 10	Day 55
Obtain title evidence			Day 30	Day 90
Obtain tract appraisals			Day 30	Day 120
Review tract appraisals	Day 90	Day 130		
Conduct negotiations			Day 100	Day 210
Perform closings			Day 130	Day 240
Prepare condemnations			Day 160	Day 190
Perform condemnations			Day 190	Day 310
Obtain possession			Day 150	Day 350
Certify availability of LERRD	Day 365	Day 365	Day 350	Day 360
Prepare and submit credit requests			Day 365	Day 420
Review credit requests	Day 420	Day 430		
Approve or deny credit requests	Day 430	Day 430		
Establish value of LERRD credit in accounting records	Day 450	Day 450		

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY
BIG CYPRESS BAYOU HABITAT RESTORATION PROJECT
JEFFERSON, TEXAS

NON-FEDERAL SPONSOR: City of Jefferson, Texas

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES**

b. Does the sponsor have the power of eminent domain for this project? **YES**

c. Does the sponsor have "quick-take" authority for this project? **NO**

d. Are any of the lands / interests in land required for the project located outside of the sponsor's political boundary? **YES**

e. Are any of the lands / interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **NO**

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? **YES**

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? **THE NEED FOR TRAINING WILL BE ADDRESSED WITH THE SPONSOR.**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **NO. THE SPONSOR WILL NEED TO OBTAIN SERVICES FROM PROFESSIONALS OUTSIDE CITY STAFF.**

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? **NO. SEE PREVIOUS COMMENT.**

e. Can the sponsor obtain contractor support, if required, in a timely fashion? **YES**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **NO. CONTRACTORS WILL BE EMPLOYED.**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **YES**

b. Has the sponsor approved the project / real estate schedule / milestones? **YES**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **NO PREVIOUS PROJECTS HAVE BEEN UNDERTAKEN WITH THE SPONSOR.**

b. With regard to this project, the sponsor is anticipated to be: **MODERATELY CAPABLE**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **COORDINATION IS BEING ACCOMPLISHED ALONG WITH REVIEW OF THIS REPORT.**

b. Does the sponsor concur with this assessment?

Prepared by:

Randy Roberts
Realty Specialist, CESWF-RE-P

Reviewed and approved by:

Hyla J. Head
Chief, Real Estate Division, CESWF-RE

APPENDIX F – CULTURAL REPORT

CULTURAL RESOURCES INVESTIGATIONS IN THE PROPOSED BIG CYPRESS BAYOU ECOSYSTEM RESTORATION PROJECT AREA AT JEFFERSON, TEXAS

INTRODUCTION

In January, 1998, the US Army Corps of Engineers, Fort Worth District (CESWF) contracted with Historic Preservation Consulting Services (HPCS) to conduct a cultural resources reconnaissance survey of a tract of land along Big Cypress Bayou in downtown Jefferson, Texas (Figure 1). The CESWF was conducting a feasibility study for an environmental restoration project proposed along the north side of Big Cypress Bayou. As part of that work, the CESWF was compiling an environmental assessment and needed to include the results of a cultural resources survey for the project area. The complete report of findings is provided elsewhere (Moir 1998).

The proposed environmental restoration work, if implemented, would involve several coordinated phases to restore areas and construct related improvements. Appendix I has an artist's rendering of the study area after it has been fully developed. The work, if carried out as proposed, would result in minor impacts in most areas except for the following six tasks: (1) removal of existing boat ramp facilities, (2) construction of a new boat ramp, (3) construction of water retainment structures (weirs), (4) construction of raised maintenance access route (5) rerouting a few city drainage annels, (6) removal of an artificially raised dirt road and (7) construction of a public parking lot service the new boat ramp. Additional minor impacts can be anticipated from the construction of raised walkways, public paths, special interpretive areas, and the planting of some new vegetation or the selective removal of unwanted vegetation as part of the restoration efforts.

The work completed for this report has evaluated the archaeological and/or historical resources potential of the feasibility study area and assessed possible impacts that may result from the project if it were implemented as proposed. The study area encompasses about sixty acres and included all locations falling within the project's limits noted by CESWF staff (revised limits circumscribe about 45 acres). Tasks performed by HPCS included background literature searches, a review of historical maps, deed/title and related court records research, informant contacts and interviews, a reconnaissance survey, and a review of pertinent published and unpublished information. The field work involved two person days evaluating the study area and checking the nature of soil profiles using thin soil cores (i.e., 1-inch diameter tube cores), a steel probe and natural exposures. The field work was not restricted archaeological resources (both historic and prehistoric sites) and included historic structures, past man-made landscape changes and even natural features and resources with possible cultural heritage associations. It has involved a full cultural resources reconnaissance review to identify all historic properties more than 40 years old in the study area. As a result, potentially buried archaeological deposits (filled urban blocks), older surfaces buried under post-1880 fills, standing historic structures pre-dating 1950, natural landform features potentially containing sealed archaeological remains, and visible archaeological remains were identified.

nducting more intrusive archaeological, geological or urban-geomorphological testing was not practical, since it would extend beyond the scope needed for a feasibility level study. Instead, the

field and archival work established the range of potential archaeological investigations that may be required should the environmental restoration project proceed to the next stage beyond the feasibility phase. A formal program of archaeological testing would then be implemented by the CESWF based on the findings given here and coordinated with the appropriate historic preservation agencies (e.g., Texas Historical Commission).

DEFINITION AND SETTING OF THE STUDY AREA

The project is located along the left bank (or west bank) of Big Cypress Bayou adjacent to downtown Jefferson, Marion County, Texas. The bayou flows north to northeast along this section of its course. As a frame of reference, upstream is south, downstream is north and downtown Jefferson is just west of this section of the bayou.

The proposed restoration project area encompasses about 45 acres (ca. 18 ha) of bottomland, older floodplain and flanking terrace edges (Figure 2). It begins about 1,300 ft (396 m) upstream from the Polk Street Bridge (Business Route 59) and extends downstream or north past Polk Street and the standing two railroad bridges. It ends about 1,100 ft (335 m) downstream from the Polk Street bridge at the former location of a dismantled third railroad bridge. Big Cypress Bayou forms the project's eastern boundary and various urban streets form most of its other boundaries. Exact project limits and engineering plans for all the proposed restoration and improvements were not available at the beginning of this feasibility study. Consequently, the following general boundaries were provided by CESWF staff and were used to conduct the historical and archaeological studies described here. Subsequently, more precise information was provided for some of the proposed actions and it has been incorporated in this report.

The study area was defined by the following boundaries. Starting at the south end, the west side of the study area was bounded by a line running about 200 ft (61 m) west of Marshall Street and the Bayou northwest to the intersection of Marshall and Camp Streets. From there, it headed north diagonally across Block 73 to the intersection of Lake and Market Streets. Thereafter, it followed Lake Street northeasterly for one block, turns northwest on Vale Street and then back northeasterly along Dallas Street. It subsequently followed the projected line of Dallas Street from Vale Street northeasterly for four blocks before turning southeasterly to tie back into the Bayou. Most of the study area was undeveloped and located in the 100-year floodplain (Figure 3). Only a portion of the western edge is above the floodplain.

About 85% of the project area, therefore, consists of forested floodplain, low flanking terraces and the incised active channel of the bayou. The exceptions are the current boat ramp, three bridges spanning the bayou, elevated roads, man-made levees, the city parking lot south of the court house, and a private establishment on Block Q near the bayou at the southern end of St. Catherine's Island. The island is a relict landform dating from pre-1870 geographical references. It is no longer surrounded by water except at floodstage. Its name dates back to early historic maps and can be quite misleading today.

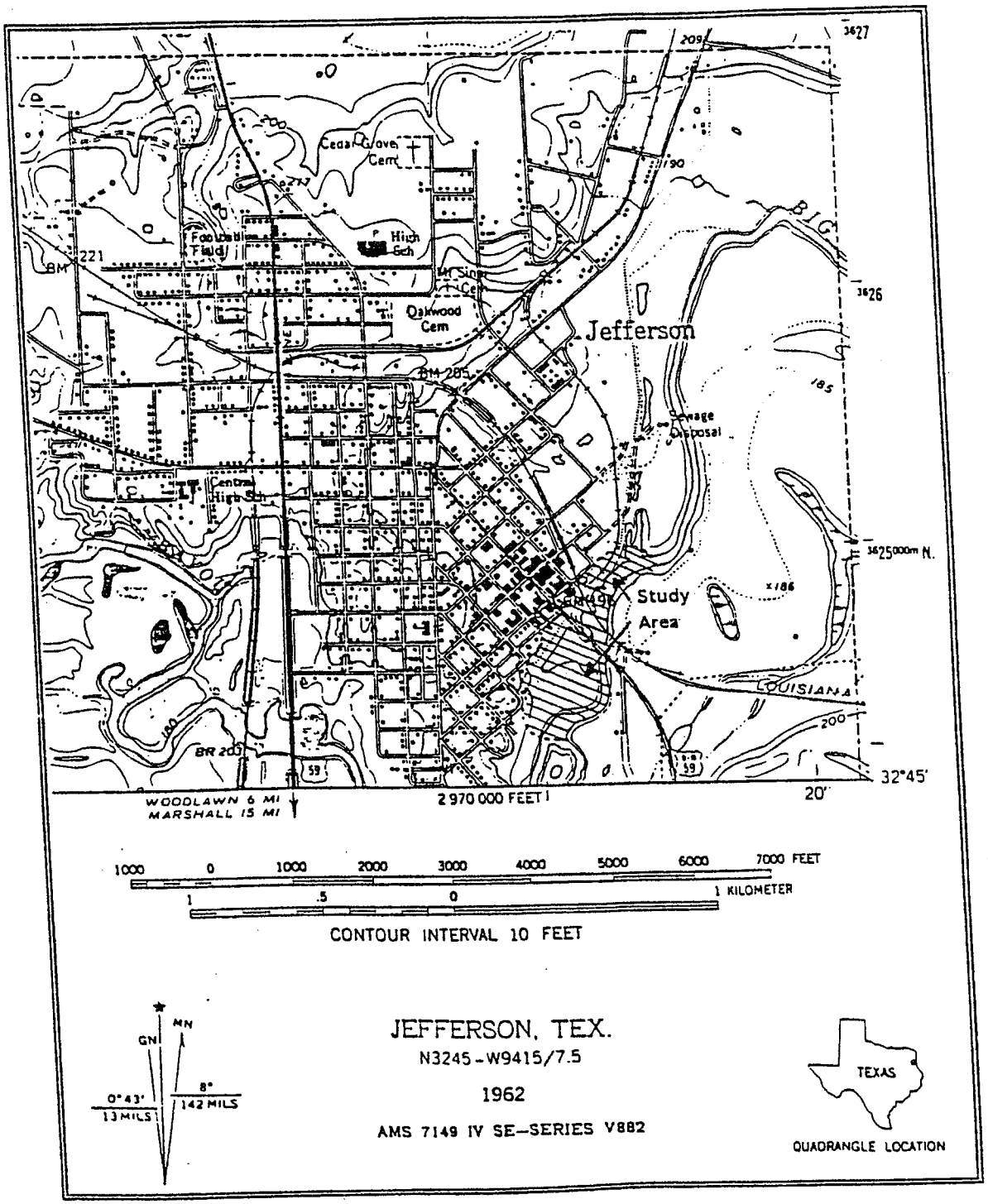


Figure 1. Location of the environmental restoration feasibility study area in Jefferson, Texas.

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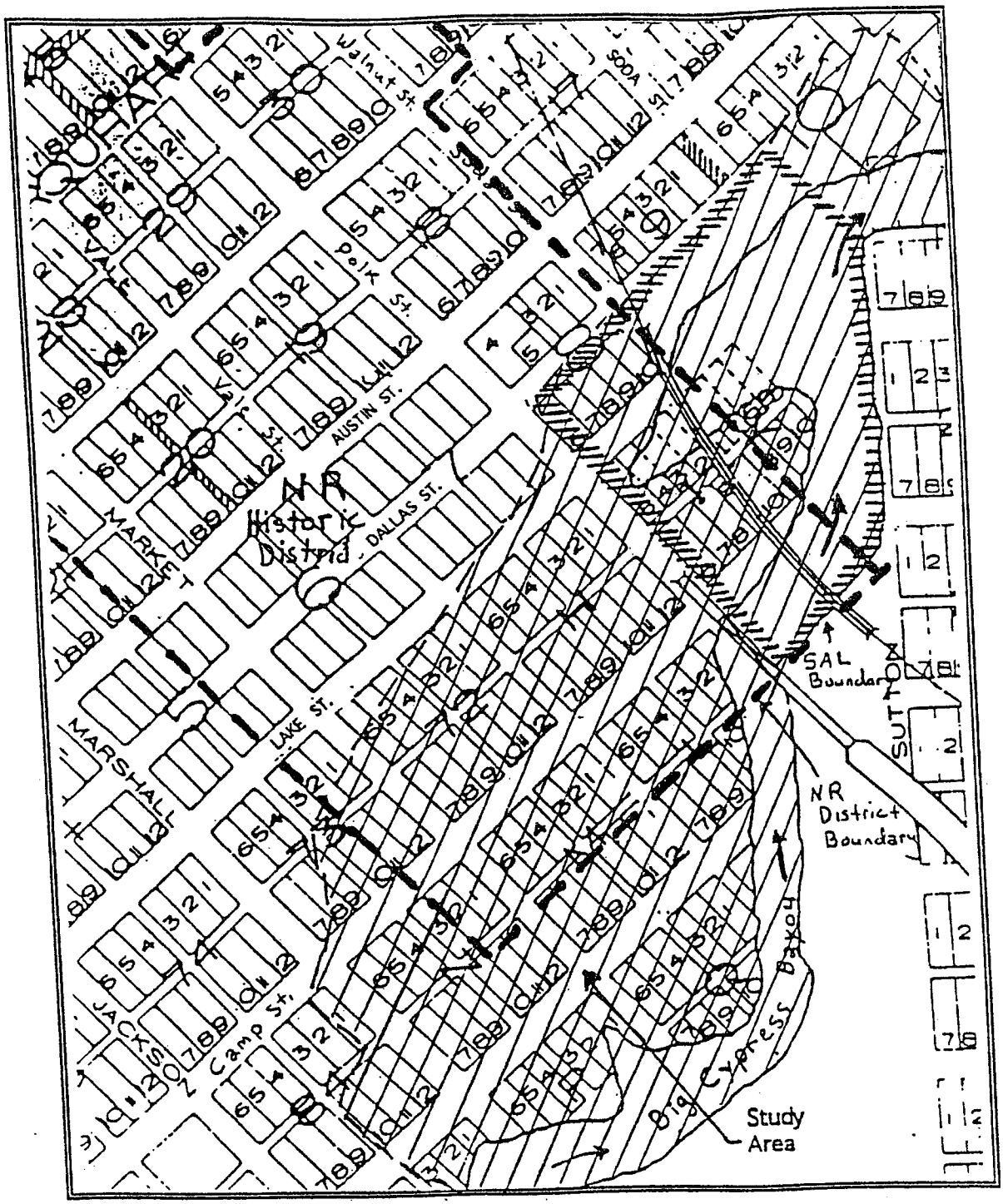

Figure 2. The environmental restoration feasibility study area delineated on a plat of Jefferson, Texas. The boundaries for both Jefferson's SAL designation (41MR73) and National Register Historic District are also shown.

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Major topographic features in the study area include the broad and undulating floodplain of Big Cypress Bayou, its incised active channel, small floodplain rises and the much older terrace deposits on which most of downtown Jefferson is situated. The many alluvial and fluvial features of the floodplain include relict and abandoned channels, natural levee rises, old flood scours, isolated rises and presumed relict channel bars. The elevation of the bayou under typical conditions is about 175-ft amsl (53.3 m amsl). At that level, most of the project area lies between 5 to 12 feet (1.5 to 3.6 m) above it.

Mixed hardwood and bottomland forests constitute over 80% of the vegetative cover of the project area. Vegetation surveys by the CESWF have identified small clusters of mature cottonwood, elm, sweet gum and pine. Several young bald cypress small stands were also recorded. A 19-inch (48 cm) diameter bald cypress was checked by tree ring coring and was at least 100 years old. Since bald cypress can live to be 400 to 800 years old, many of the specimens in the project area are true youngsters. A group of older cypress trees was encountered near a seep (older relict spring?). If they grew at the same rate as the cored specimen, they would be at least 250 years old.

The forest canopy throughout much of the study area varies considerably from lacking any understory in some areas to retaining thicket-like brush in others. Tree diameters larger than 40 inches (102 cm) were very infrequent and two of the largest examples (51 inch oak and 62 inch cottonwood; 129 cm and 160 cm, respectively) were cored to check their age. Final confirmation of their ages is currently pending.

Ground exposure and visibility of surface material was fair to poor across most of the study area. Leaf litter and surface vegetation covered about 95% of the ground. The small patches of bare soil, however, provided some surface visibility and several historic sites were located based on light amounts of surface material observed. Late winter field conditions and dormant leafy plant growth, however, provided the best conditions possible given the vegetation of the area.

Finally, the steep banks along the Big Cypress Bayou were inaccessible during the field work phase of this project. The water level in the bayou was extremely high from early January to early March when the field work was conducted. Flowing water covered the immediate banks along the bayou and also all of the low areas falling under 181 ft (55.1 m) amsl. In many of these same locations, however, fluvial levee sands and very recent fluvial sediments probably cover much of the ground based on other soil core observations taken nearby. Such alluvial material obscured more deeply buried older deposits and would require backhoe testing to penetrate them in many lower areas.

The study area has sustained some important geomorphological changes in the past 400 years that are not typically encountered along other streams beyond this section of the Red River drainage system. Consequently, the recent evolution of Big Cypress Bayou plays a valuable role in delineating landforms important in the very recent past for both historic and prehistoric people.

Local Environmental History and Geomorphology

First, the present hydrological regime of Big Cypress Bayou has been moderated by the various upstream dams constructed since 1950 (Lake O' The Pines or originally called Ferrell's Bridge

Reservoir, Lake Bob Sandlin, Lake Cypress Springs, etc.) and the construction of a weir (low dam) on Caddo Lake around 1914 later expanded in the late 1960s. Before 1870, the regime of Big Cypress Bayou was unimpeded upstream from Jefferson although it probably had been affected since 1850 by clear cutting forests and plowing farmland. The base level of the bayou has been controlled downstream by various natural restrictions and reportedly upper sections of the great raft along the Red River. After 1872, the cumulative impacts of new cuts made in the bayou's course in Caddo Lake and on upstream meanders, as well as removal of the last vestiges of the great raft impeding the flow of the Red River, caused the common level of water in the bayou to drop below what was needed to sustain year round access by most steamboats. Added to this was the completion of a major railroad through the drainage that offered year-round transportation for cotton and other products. As a result, the commercial growth of the City of Jefferson began a decline that stretched nearly 80 years before turning around.

The hydrological history of Big Cypress Bayou affects the location of early historic and much older prehistoric sites. Before the log jam on the Red River and the creation of Caddo Lake, Big Cypress Bayou at Jefferson may have been actively eroding the center of its valley while aggrading its annual floodplain. As Caddo Lake raised its base level some 200 to 400 years ago, this portion of Big Cypress Bayou would probably have been choked by the loss in grade as less sediment was carried downstream and more sediment was deposited laterally during periods of high water. Much of the present topography upstream from Polk Street exhibits this kind of recent ridge and swale relief related to alluvial deposition and floodplain aggradation. Under extremely high water, new scouring of the floodplain also would take place and some of these newer features probably from the ca. 1880 to 1950 period are still evident today.

Since 1907, the depositional history of the section of Big Cypress Bayou in the immediate study area has been altered several more times. In particular, the MKT railroad bridge that crosses the bayou created a narrower floodplain channel when extremely high water flowed through it. The construction of the Polk Street Bridge and the improvements to it after 1950 have further affected the flow regimes across St. Catherine's Island and in the old turning basin north of Walnut Street. Finally, the newest railroad bridge has created additional disruptions to the natural flow of the bayou. As a result, the sedimentological environment of Big Cypress Bayou has been altered.

For the past 40 years, the various embankments created by the roads and bridges in this area have restricted high water flows. The water artificially ponds behind the narrows created by these embankments and dumps more of its sediment in a smaller area than it would have otherwise. Furthermore, the current flowing under the bridges is stronger than it would have been in the natural channel and has deepened the channel. Finally, any sediment that is moved through the narrows is then deposited in the slower-energy backwater downstream of the bridges. It may be carried to the outside of the meander bend in the vicinity of the 19th century landing and dropped when the water spills out over the broader raised terrace and is slowed by the vegetation covered surface.

Consequently, a simple hydrological model creates depositional zones upstream and downstream of the bridge-induced narrows while enhancing the erosion of material at the bridges and the pushing of sediment through the narrows as the water gains energy due to ponding. The result over time is substantial deposition on the old landing site as well as covering some areas of St. Catherine's Island.

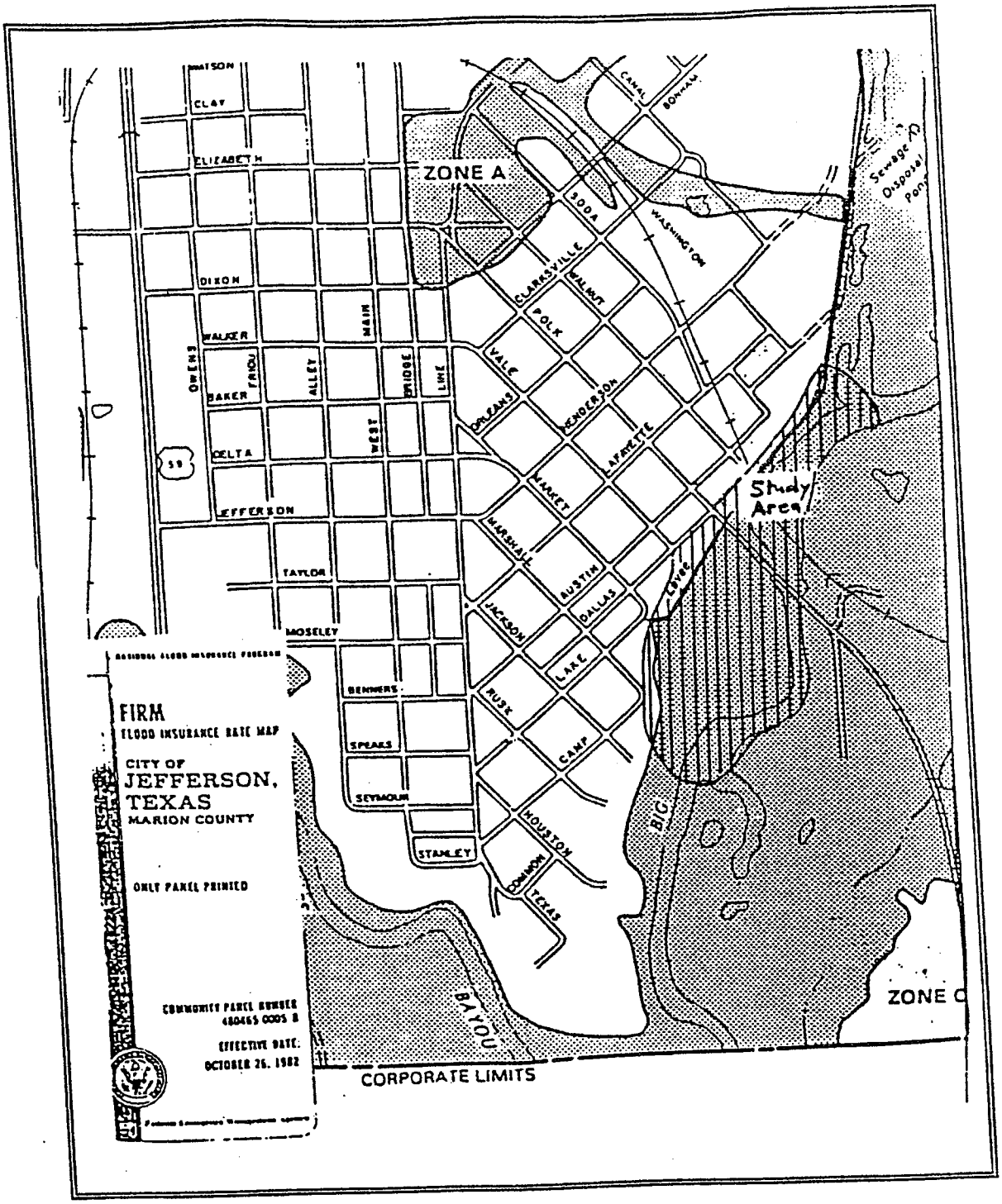

Figure 3. The environmental restoration feasibility study area and the boundaries for the 100 year flood zone in Jefferson, Texas.

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Evidence of recent sandy silts in these areas was noticed in soil cores and also covering post 1900 features (e.g., the current boat ramp after high water flows).

The above model is also supported by information gleaned from the excavations conducted by TAMU in 1989 (Carlson 1989: 21-25). They found four planks at a depth of 2.5 m below the existing surface that were "similar to those used in construction of the adjacent railroad trestle" dating from ca. 1901/07 (Carlson 1989: 23). Below the planks was the water table and mottled reddish sand and they stopped the trench at 3.2 m. In TAMU's hand dug unit (Unit N516E500), they also encountered a log (undescribed) at the top of the watertable. These two encounters with buried logs were each at about the same relative elevation, listed as about 99 m on TAMU's field map (Carlson 1989: 19). The wooden railroad trestle was constructed in about 1898/1900. The buried timbers suggest that the fill covering them may be no older than 1900 and could even be as recent as 1930.

This information suggests that the sediment clogged status of the turning basin has been greatly aggravated since 1900 by the various bridges and embankments in the vicinity of Polk and Walnut Streets. The location of Jefferson's 1872 wharf and even its older wharves may be buried beneath 2 to 3 m (6.5 to 10 ft) of alluvial sands and silts. Any physical remains of these structures ought to be preserved below post-1900 channel fills and alluvium. It appears that above the appropriate depth for their remains, one will generally encounter the water table indicating that it may be perched slightly as one moves away from today's actively flowing incised channel.

ARCHIVAL RESEARCH AND INFORMANTS

Archival research was conducted to identify historic settlement and land-use patterns for the study area. It consisted of both historical sources and important legal records reviewed prior to fieldwork. Primary and secondary materials were reviewed to gather information about local prehistoric and historic settlement patterns and to identify previously recorded archaeological sites in the study area. A variety of sources were examined to provide a review of previous research and assess prehistoric culture-chronology for the general area.

For the historic period, maps, legal records and local histories were checked to identify known or suggested historic resources in the study area. Other effort was focused on obtaining copies of important historical maps. A copy of the 1846 town plat of Jefferson, several notable 19th century historical maps and a complete set of all Sanborn Insurance maps containing the study area were obtained. Sanborn Insurance maps were by far the most detailed of any sources reviewed and provided information on specific structures and improvements in the area. Parts of Blocks 7, 8, 9, 10, 72 and 73 contained standing buildings depicted on the 1872 bird's-eye view of Jefferson. Some of these buildings dated from the 1860s and earlier.

The sites listed with the Texas Archeological Research Laboratory (TARL) in Austin, and information in the files of the Cypress Valley Alliance were reviewed to check on any historic properties or archaeological sites directly inside the study area. Only one site was found that was located inside the project: 41MR73 (see Figure 2). It was an unusual type of site and was the designated area set aside to recognize the mid-19th century Port of Jefferson based on minimal field

work and considerable oral history and archival research. Tribble (1983) investigated Jefferson's wharf area in the early 1980s to determine if any remains were still preserved underground. He also conducted archival research and located a very important contract on the 1872 wharf. Test excavations by Tribble exposed a low brick retaining wall that was not fully understood. In 1988-89, Texas A&M University (TAMU) tested a very narrow section of the Port of Jefferson to clear the way for a new railroad bridge to replace the ca. 1907 iron truss bridge (Carlson 1989). TAMU's results are discussed below in the section of SAL boundaries.

As for historic sites nearby, the next closest property listed with TARL is 41MR44. This historic property is a standing Confederate powder magazine. It is about 550 ft (167 m) east of the northern tip of the study area and located across the bayou on its east bank (refer back to Figure 1). The powder magazine is also formally listed on the National Register (NR) and is well outside of the area covered by this study. Much closer to the study area are numerous historic buildings in Jefferson's historic district. The boundaries for this project have avoided including any NR listed buildings inside the proposed environmental restoration area. The only structure considered eligible for the NR at this time is the iron truss railroad bridge dating from ca. 1907.

No prehistoric sites have been identified inside the project area, and none have been listed with TARL within a 0.5 mi (800 m) radius. Furthermore, a check with local informants did not identify any prehistoric sites in the study area. Two localities were noted, however, that had produced prehistoric artifacts within 2,000 ft (610 m) of the study area. One informant noted that he had found some prehistoric pottery about 1,000 to 1,500 ft (300 to 450 m) north of the study area when he was helping grade a ditch. It was near a late-19th century saw mill complex and had been disturbed by post-1870 mill activities. The author was not able to visit the area, as it was well outside this project's boundaries.

The same informant also noted that he had been told about prehistoric projectile points being found near the foot of Houston Street. This was second hand information and the informant noted that he had not visited the area were the material was found. Consequently, a precise location for this material is also neither available nor any clear description of the point types recovered. The foot of Houston Street is about a 1,000 ft (300 m) south of the southern end of the study area (Figures 1 and 2). Other informant contacts were also made and included several local citizens knowledgeable either of the study area, its history or the location of prehistoric sites in Jefferson. A list of these people is given in the acknowledgments.

NATIONAL REGISTER HISTORIC DISTRICT BOUNDARIES

The City of Jefferson's National Register Historic District boundaries are also depicted on Figure 2. The district covers parts of 47 blocks and contains 56 historic structures originally nominated in 1971. About 40% of the study area south of the old MKT railroad bridge lies in the NR District (equivalent to about 30% of entire project area south of Washington Street). The NR District boundaries within the study area are basically defined by Market Street (south side of NR district), Camp Street from Market up to Walnut Streets (east side) and then Walnut Street west to Dallas Street (north side). The NR District extends beyond the study area to the west. Within the study area, the District's boundaries are defined by Dallas Street, Vale Street, and then Lake Street back

.o Market Street (Figure 2).

A review of the NR District falling inside the study area suggests that only two twentieth century houses along the south side of Dallas Street and the ca. 1907 MKT iron truss bridge are located inside the proposed boundaries of the project. None of these structures are formally listed as contributing structures in the District. The iron truss railroad bridge was not specifically mentioned in the National Register District's nomination form compiled in 1971 (M. Dilmond, personal communication). It is, however, treated as potentially eligible by this study based upon its age, structural integrity and association with Jefferson's waterfront area after the end of steamboats. The last steamboat to reach Jefferson is reputed to have docked at the landing in 1903 (Dooley and Dooley 1986:255; Wright 1994). The railroad trestle across Big Cypress Bayou was constructed between 1897 and 1901 and the iron bridge was in place by 1907. A separate letter is being issued to the SHPO's office by the Corps of Engineers to provide additional details on the old MKT iron truss bridge (A. Frank Servello: personal communication).

In summary, a small section of Jefferson's 1971 National Register Historic District makes up about 30% of the entire study area. But within this overlap between the NR District and the proposed environmental restoration project area, there appears to be no major standing structures formally listed on the old National Register. The only potentially contributing structure is the old iron truss railroad bridge that was standing by 1907. But, on the other hand part of the NR District in the study area also includes some of the most archaeologically sensitive and historically important blocks in 'he project (i.e., the south half of Blocks 7 and 8). Consequently, the work done under this survey ılso has been focused on evaluating the archaeological potential of blocks in the old steamboat landing area and to its southwest. Fortunately, anticipated impacts from the proposed undertaking should it proceed to a construction phase are comparatively minor and many large areas will be left untouched.

THE CULTURE HISTORIC FRAMEWORK OF THE PROJECT AREA

The following subsections provide a brief review of the culture history for this part of northeastern Texas from earliest evidence of humans to the late 1800s. In particular, background information useful for understanding the archaeological resources of Marion County is touched upon. The alluvial setting of the project area and the importance of 19th century settlement activities have given it good potential to contain intact archaeological deposits sealed beneath recent fills and floodplain sediments. Late prehistoric use of small floodplain rises also can be potentially sealed beneath post-1900 alluvium caused in part of man-made constriction of the valley at Polk Street and the MKT rail line as noted previously. The following offers a brief look at the culture history useful for understanding some of the archaeological potential of the study area.

The primary periods applicable for both northeastern Texas and Marion County have been divided into the temporal grouping listed in Table 1. The prehistoric periods are based on the syntheses of various researchers (e.g., Bruseth 1987, 1991; Bruseth and Perttula 1981; Guy 1990; Harris et al. 1980; Johnson 1962, 1987; Krieger 1946; Pearce 1932; Perttula 1989, 1992, 1993, 1995; Schambach 1993; Scurlock 1962; Skinner et al. 1969; Story 1982, 1990; Thurmond 1985, 1990; Turner 1978, 1993, 1995; Webb 1969). The pertinent 19th century history of Jefferson has been summarized from

Bagur (n.d.), Moir (1994), Tarpley (1983) and Wright (1994). The primary research by Jacques Bagur is by far the most outstanding and substantive contribution to the history of Jefferson and the rise and fall of its riverboat commerce. A detailed discussion of the cultural sequence is provided by Moir (1998).

TABLE 1

CULTURE HISTORY FOR THE CYPRESS DRAINAGE, NORTHEASTERN TEXAS

Major Periods	General Dating Brackets
Paleoindian	11,000 B.C. - 6,000 B.C.
Archaic	6,000 B.C. - 200 B.C.
Early Ceramic	200 B.C. - A.D. 800
Formative	A.D. 800 - A.D. 1000
Early Caddoan	A.D. 1000 - A.D. 1200
Middle Caddoan	A.D. 1200 - A.D. 1400
Late Caddoan	A.D. 1400 - ca. A.D. 1600
Protohistoric & Exploration	A.D. 1542 - A.D. 1800/1837
Historic (Non-Aboriginal)	A.D. Post 1837 (see Table 2)

Most of Jefferson's importance in cultural development dates from the historic period. Historic occupation in East Texas before 1860 consists of two major categories: (1) Anglo-American, African-American and European-American settlers, and (2) semi-acculturated Native American groups pushed out of the eastern and southeastern United States. Much of our institutionalized history has addressed early Anglo- and Euro-American settlers and their contributions. Less well understood are the contributions of other non-Anglo groups. Historical research of an early community like Jefferson offers an opportunity to address many ethnic groups since this settlement initially grew as a major inland port.

Friction between Anglo-American settlers and Native Americans in the second quarter of the nineteenth century finally ends in the removal of the latter from eastern Texas. The distrust of immigrant Indian groups intensified in 1834 after the murder of Chief Fields in Rusk County, Texas. Although a treaty sponsored by Sam Houston in 1835 had specifically acknowledged Spanish land grants to the Cherokee, Caddo and other groups, the Republic of Texas withdrew its support for the measure in 1836. By this tactic, the Republic reduced some of the perceived threats from immigrant Indian groups. The Republic's newly won independence from Mexico soon opened up East Texas to Anglo-American settlers on a scale not seen previously.

Jefferson was not the first town or river landing created in the historic settlement of East Texas. Much earlier towns had been established along the Oklahoma-Texas portion of the Red River and elsewhere in eastern Texas. Some settlements went back to the Mexican Period (e.g., Clarksville) while others were even older and had been established during the Spanish Period (e.g., Jonesboro or Nacogdoches). What makes the early history of Jefferson stand above many of these other towns

as that Jefferson captured the commerce of a large section of northeastern and north-central Texas for about 30 years. Jefferson did this just after the Republic of Texas was annexed by the US and then held on to its broad hinterland region until the railroads recaptured it piece by piece.

Population Statistics for Jefferson

Much of the history of Jefferson before 1890 has been clouded in romantic myth and folk beliefs. For example, one can find local histories that place Jefferson's maximum residential population at 20,000 or 30,000. Hard facts suggest that the city's population never surpassed 8,000. The highest federal census estimate was 7,297 in 1872. The detailed research by Bagur (n.d.) has revealed that this was during Jefferson's peak or "golden era" and poor navigation along with encroaching railroads quickly reduced its prosperity and caused a major decline in its population. The Federal Census listed Jefferson's enumerate d population at 4,190 in 1870 and only 3,260 in 1880. The population since then has never exceeded even the 1880 figure. Thus, Jefferson's golden era spanned the short 1868 to 1872 period.

The enumerated (census counts) or estimated population of Jefferson from 1840 to 1993 is presented in Moir (1998: Table 2). The village's population grew slowly for the first 4 years after Texas was annexed. The population size for 1846 is probably too high since it likely includes transients and speculators passing through the town the year that statehood was awarded to Texas. A more realistic estimate was given in 1849 by an observer sent to record communities in eastern and northcentral xas. This later observer estimated the number of houses in Jefferson at "near sixty" (Bagur n.d.).

Timeline of Major Events Adapted for the Study Area

The study area contains a narrow geographical segment of nineteenth century Jefferson. As such, this report is focused on important events and historical resources that may be represented by archaeological deposits within the study area. Consequently, while the city of Jefferson reportedly had one of the earliest ice-making plants in Texas (Dooley and Dooley 1986:254), this historical footnote has little importance on evaluating the cultural resources in the study area. The following review of important events is heavily weighted toward those that either have some relevance to resources in the proposed restoration area or help assign importance to specific deposits suspected in the area.

Information on 19th century Jefferson was gathered from several sources (Wright 1994; Bagur n.d.; Moir 1994; Sanborn Insurance Maps, Deed/title Records, etc.). Table 2 lists some of the more notable events and historical information useful for examining the study area and gleaning insight on the development of Jefferson. It does not begin to cover the full social, industrial, ethnic and commercial history of the community, but rather it is focused on the immediate study area and Jefferson's in-town steamboat landing facilities. Finally, it can not begin to cover the detailed research contributions made by Jacques Bagur on the navigational history of Jefferson. His efforts have added substantially to our understanding of the development of Jefferson as an inland port and important role in Red River commerce.

Formation of Marion County

Marion County was formed comparatively late among counties created in northeastern Texas. It was split from Cass County in 1860 after being under rule by that county for about 14 years. Before Cass County formed in 1846, the Jefferson area had been under the jurisdiction of Bowie County from 1840 to 1846, and Red River County 1836 to 1840. Consequently, when the property was transferred by the state to Urquhart as one of his land grants, it was part of Bowie County.

TABLE 2

HISTORICAL PERIODS AND NOTABLE 19TH CENTURY EVENTS FOR JEFFERSON, TEXAS

Notable Events & Periods (Jefferson)	Historical Periods and Dates
Red River County Formed	1836
Early Pre-Settlement Activity.	1838 - 1841
Bowie Co. formed from Red River Co.	1840
Ferry Site and Urquhart's Land Grant	1841 - 1845+
Cypress Bayou Waterway Cleared	Late 1844 [1]
First Steamboat Reaches Townsite	March, 1845 [1]
Texas Congress Approves Annexation	June 21, 1845
Platting of Townsite and Initial Sales	1845 - 1848
US Congress Accepts Annexing Texas	December 29, 1845
First Texas Governor is Inaugurated	February 19, 1846
Cass County formed from Bowie County	1846
Incorporation of the Town	March 20, 1848 [1]
Initial Growth of Jefferson	1848 - 1860
Jefferson's Population less than 500	1850 Estimate
Major Drought	mid-1854 to end of 1855 [1]
Dam Constructed above Houston Street	September, 1854 [1]
Marion County formed from Cass Co.	1860
Railroad Link Started in Jefferson	Late1860
Jefferson's Population is 988	1860 Census [3]
War between the States	1861 - 1865
Great Flood at Jefferson	May 11, 1866
First Mention of a New Wharf	August 7, 1867 [1]
Post War Federal Troop Occupation	1866 - 1872
Major Fire in Downtown	Feb. 29, 1868 [1]
Jefferson Commercial Golden Era	1868 - 1873
First Mention of a Wooden Wharf	1869 [1]
Major Fire in Jefferson	August 26, 1870 [1]
Jefferson's Population is 4,190	1870 Census [3]
Major Fire along Austin Street	February 6, 1871 [1]

TABLE 2, (con't.)

Notable Events & Periods (Jefferson)	Historical Periods and Dates
Major Fire between Austin and Dallas St.	June 30, 1871 [1]
Jefferson's Dredge Boat at Work	Mid 1871
Major Fire in Jefferson	January, 1872 [1]
Major Fire in Jefferson	July, 1872 [1]
Major Fire in Jefferson	September, 1872 [1]
Water Level Drops at Jefferson	1872 - 1873 [1]
Construction of the New Wharf	Late 1872 4
Arrival of the Texas & Pacific RR	Mid-1873
Major Fire in Jefferson	April 23, 1873 [1]
Major Fire in Jefferson	July 16, 1873 [1]
Removal of Last Part of Red River Raft	December, 1873 [2]
Decline in Trade and Commerce	1874 - 1880+ [1]
Jefferson's Population is 3,260	1880 Census [3]
Intermittent River Traffic	1880 - ca. 1903
Jefferson's Population is 3,072	1890 Census [3]
Jefferson's Population is 2,850	1900 Census [3]
Last Steamboat to Reach Jefferson	1903 [2]
Kansas City Southern Railroad Bridge	ca. 1897-1900 3

[1]Information taken from comprehensive manuscript by Jacques Bagur (n.d.)
[2]Dooley and Dooley (1986:255)
[3]Texas Almanac (1969)
[4]Carlson (1989)

Initial Euro-American Settlement in Jefferson

Before Jefferson was established as a proposed townsite, it was first used as a ferry location for getting across Big Cypress Bayou. The ferry was operated by Berry Durham as early as 1842 under a business arrangement with Allen Urquhart. Urquhart had received rights to 1,280 acres (518 ha) from the Republic of Texas in 1841. He subsequently selected the Jefferson location to file for 640 acres (259 ha) in June 27, 1842. Urquhart was reportedly a surveyor (Wright 1994) and, thus, may have had access to inside information on the potential importance of the Jefferson location. Or maybe he had personally traversed enough of the East Texas terrain and simply saw the importance of the Jefferson location from a regional viewpoint.

But whatever was the case, Urquhart did not choose to settle at the Jefferson location. Instead, he selected Daingerfield (Morris County) for establishing his own homestead. The fledgling Daingerfield settlement was about 27 mi (43 km) further up Big Cypress Bayou and situated on a smaller tributary. Daingerfield had been laid out in 1841 and sat astride an upland prehistoric trace that also crossed several other early trails in northeastern Texas (e.g., Trammels Trace and the

Cherokee Trail; Dooley and Dooley 1986:133). Apparently Urquhart felt more comfortable with the future of these inland travelways and looked at his Jefferson holdings as a speculative venture. One of Urquhart's business ventures at Jefferson was obtaining a ferry license on Big Cypress Bayou from the Republic of Texas.

In 1844, the only resident at the Jefferson location was Berry Durham. He reportedly had a log cabin located near the foot of Houston Street on the north bank of the Big Cypress Bayou (Bagur n.d.: Ch. VI, p. 4). This location would be about 2,400 ft south-southwest of the natural boat landing at the foot of Polk and Dallas Streets. Durham operated the ferry and also assisted Urquhart in promoting the sale of Jefferson town lots starting in 1844.

Jefferson's early growth was slow until its bayou was opened for navigation by steamboats. Big Cypress Bayou was cleared of obstructions in December 1844. According to research by Bagur (n.d.), the first steamboat reached the primitive townsite in early 1845. The boat, named the *Lama*, probably made this historic trip in March of 1845 (Bagur n.d.: Ch. VI, p 13-27). Important from these initial landings, are recollections offered by some of the first travelers to Jefferson.

For example, in April, 1845, there was just one log house in Jefferson visible from the landing and several other log buildings under construction based on the recollections of Buck Barry (Bagur n.d.:Ch. VI, p 4). Mr. Barry reportedly arrived on the second steamboat to reach Jefferson; most likely the *Gazelle* according to Bagur's research (Bagur n.d.: Ch. VII, p 1). Barry obtained breakfast about 200 yards from the landing that morning and then acquired lodging that evening with a farmer living about 20 miles from Jefferson. Barry may have possibly eaten at a location in the study area when one considers the geographical setting of the places noted.

The proposed layout of the townsite of Jefferson was drafted by Hugh Henesy and submitted in January 1846. The plan was filed by Allen Urquhart and Berry Durham with the County Commissioners of Cass County on March 4, 1847 (Marion County Deed Book 1:193). Marion County was not split from Cass County until 1860 as noted earlier. The first town plat shows several interesting features including a possible early trail predating the plat (Figure 4). The trail starts at the Bayou's edge and Polk St. where they intersect with Lake St. It runs south along Lake St. until Vale St. and then cuts diagonally through Blocks 72 (north section), 73 (south section) and 84 (just north of its middle diagonal) before eventually returning to the Bayou at about Rusk St.

The trail follows amazingly close to the 100 year flood limit for the mid-twentieth century (Moir 1998: Fig. 3). Nearly the entire route seems to be intentionally located just beyond the upper limit of major floods. But because the path starts at the Bayou's edge and then returns to it again, it appears to show the way to the ferry located near the foot of Houston Street further up the bayou. Allen Urquhart had obtained the rights to operate a ferry at this location quite early and well before Jefferson was platted. The first operated was reportedly Barry Durham based on early historical accounts (Wright 1993; Bagur n.d. Ch. IV, p.4). Several additional documents were encountered during this study that suggest a more involved picture of the ferry operation.

For example, deed records filed on January 28, 1843 (MCDR Book 1:9) indicate that B. Durham and T. Weaver leased a ferry boat from Urquhart. On August 1, 1843 Durham and Urquhart filed a

ıutual agreement over the division of "ferriage money" (MCDR Book 1:12). By December 29, 1844, Urquhart had entered into an agreement with William N. Bishop concerning ferry rights whereas Urquhart reserved 1/3 interest in his own name. In particular, Bishop would have the right to operate the ferry for 12 months. In return, Bishop would give Urquhart 1/3 of all proceeds made from the ferry operation.

This latter agreement lasted up to the time that Jefferson's town plat was surveyed and laid out for interested purchases and speculators. The plat map filed in 1846, therefore, seems to suggests that people landing at the foot of Polk Street and who were wishing to travel south might simply follow this path to reach the ferry and then cross Big Cypress Bayou in order to head south toward Marshall, Texas. Of coincidental interest, lots 3 and 4 of Block 8 (north side of Dallas Street) were purchased by William Bishop prior to January, 1846 (Bagur 1997:2). Bishop's residence and gardens are placed on lot 4 as noted in a later transaction involving lot 5 to James French (Bagur 1997:3). The location of Bishop's dwelling on Block 8 appears to be compatible with the earliest landing at the foot of Polk Street since lot 4 also fronts on that road.

The early ferry at the Jefferson location seems to handle travelers seeking to head south toward Marshall, Texas. Marshall was the 7th largest town in Texas in 1850 with an estimated 1,189 residents. Of the six larger towns, three were port towns that owed their inland success to shipping commerce (e.g., Galveston, Houston and Victoria). Marshall was a growing center in the pre-1860 period and was much larger than other towns in the broader western region surrounding Jefferson. ?opulation estimates in 1850, for example, were about 400 for Jefferson, 700 for Clarksville, about 50 for Mt. Pleasant and about 300 for Dallas (Belo 1969:171-179).

Jefferson's Subsequent Growth and Development

The town of Jefferson was incorporated under the Texas legislature March 20, 1848, setting the stage for its rise as a regional steamboat and commerce center. By 1850, Jefferson was beginning to look like a true town. The account given by Edward Smith in 1849 praised the new settlement. Smith, an Englishman, was sent to assess potential sites for locating a new colony of settlers (Bagur n.d.: Ch. VII, p 14). He noted that:

> "Jefferson four years ago possessed only three log houses; now (was) well laid out, and has somewhat near sixty good houses, several large well-supplied stores, also one warehouse for the shipment of merchandise, and a small saw and grist steam mill". (Bagur n.d.: Ch. VII, p 10)

Smith's most glowing 1849 account about towns as far west as Dallas and McKinney was reserved for Marshall. Marshall was "the most flourishing place through which we traveled. An iron casting furnace, two saw mills, and other useful works and many stores, testify that enterprise and wealth abound ..." (Bagur n.d.: Ch. VII, p 15).

Steamboat Navigation and Jefferson's Landing

Bagur (n.d.) provides a detailed evaluation of the high and low water years and months affecting

navigation on Big Cypress Bayou and the connection to Jefferson from areas downstream. For example, low water was encountered during much of the 1854 to 1856 period, last half of 1859 and then frequently in the 1872 to 1874 period (Bagur n.d.: Ch. XIII). This last period corresponds with the dredging work done along Big Cypress Bayou and the removal of the last large section of the natural log jamb on the Red River above Shreveport. Whereas, the drought in northeastern Texas in 1854 enabled Jefferson citizens to construct a dam above Johnson's bridge near Houston Street (Bagur n.d.: Ch. X, p 10), one reference noted by Bagur that boats offloaded their cargo 200 yards downstream of the landing in the 1850s and 1860s when water levels were too low (Bagur n.d.: Ch. X, p 81). This low water location probably falls in the project area at its northern end.

An 1860 map of Jefferson shows the location of Johnson's bridge at the foot of Houston Street about 1,100 ft from the study area. An 1860 court settlement of a suit between Allen Urquhart (party of the first part) and the Town of Jefferson (party of the second part) also noted the bridge's location but left the street name off. This suggests that Houston Street was probably not formally laid out as it headed down to the floodplain and across the bayou at that date.

The lawsuit filed by Urquhart against the town and settled in 1860 must have extended back some months possibly years since it original was submitted in Cass County. Several notable items are mentioned in its settlement in September 12, 1860. First, Urquhart retained title to the bridge across the bayou at the foot of _____ (left blank and never filled in but probably either Houston or Rusk Streets) and any ferry privileges into or connected with Jefferson. Urquhart (party of the first part), however, would released all his claims and title to the contested land that consisted of wharf lots set apart by the town for wharf levy purposes. Urquhart would receive $1,150 compensation with interests paid over two years for turning full title of these wharf lots back over to the town. He would be paid out of collected wharfage fees levied on boats.

This settlement in 1860 does not describe any substantial wharf structures whose construction costs certainly would have been claimed by Urquhart if he had paid for them. The $1,150 is presumably for the value of the wharf land and not any buildings or structures since one presumes that such improvements would have been specifically mentioned in the lawsuit's settlement. After 1860, Jefferson actively sought to improve its wharf area and let out construction projects to build new structures and repair others.

Initial Expansion of the Railroad

The first railroad tracks in Texas were constructed in 1853, although railroad charters had been issued earlier. At the end of 1853, Texas had 20 miles (32 km) of track (Belo 1969:558). In 1855, this increased to 34 mi (55 km) and by 1859 to 273 mi (440 km). Although seldom recognized in local histories, Jefferson saw the value of railroads earlier and started its own rail line in October 1860 to enhance cotton shipments from regions just to the north. The Civil War abruptly ended this effort. At the end of 1861, there were 468 mi (755 km) of track in the entire state; a length unsurpassed until 1869. During the Civil War, some tracks were torn up and relocated while others were abandoned entirely. In 1870, there were 591 miles of track (953 km) and by 1873 there were over 1,549 mi (2,500 km) of active rails (Belo 1969:558). This is the same period that Jefferson's steamboat trade began to suffer greatly as rail lines reduced its commercial hinterlands (Bagur n.d.).

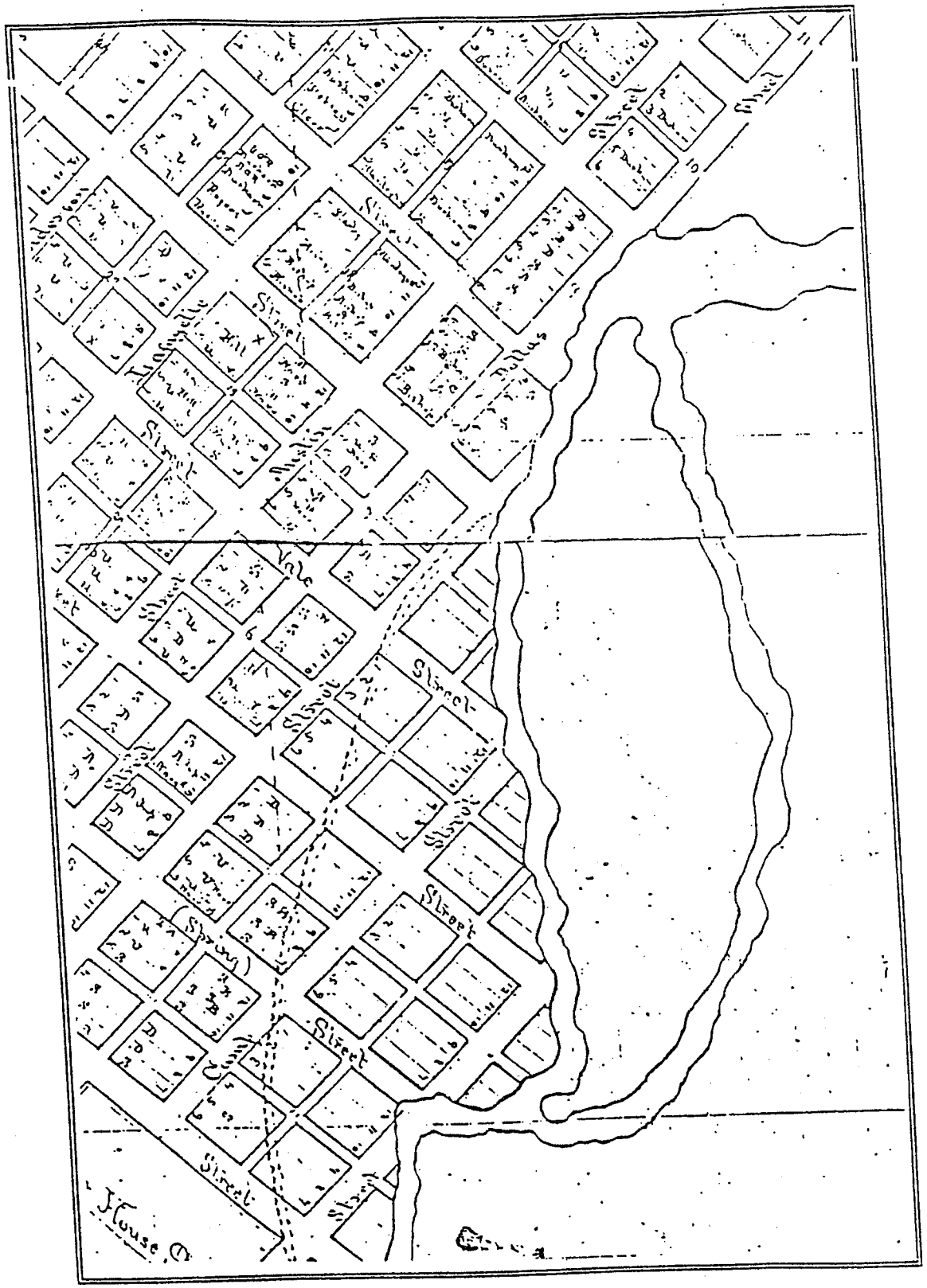

Figure 4. A section of the 1846 town plat of Jefferson and the environmental restoration feasibility study area.

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The Civil War: 1861-1865

After Abraham Lincoln was elected to the presidency in November 1860, many southern states called conventions to consider secession from the Union. Around the date Lincoln was inaugurated to the office, Governor Sam Houston reluctantly called a special session of the Texas legislature to consider the question. The legislature convened on January 21, 1861 and established a secession convention that met on January 28 and adopted an ordinance of secession on February 1, 1861. The legislature had established that the ordinance must be approved by the citizens of Texas through a special ballot. It was held on February 23, 1861 and passed by 76% of the voters (46,129 for and 14,697 against). Marion County, which was economically dominated by cotton, voted unanimously for secession and was one of only six counties in the state with no opposition votes tallied. The county had 3,977 residents in 1860 and reported that 467 voters favored secession on the February, 1861, ballot.

Only 19 of Texas' 122 counties reporting were opposed to secession and they clustered into two groups: a string of counties along the Red River from Lamar to Montague County settled by many midwesterners and a cluster of central Texas and hill country counties from Williamson to Uvalde County apparently dominated by recent European immigrants, mainly Germans (Stephens and Holmes 1989:39). Marion County sat deep in the middle of cotton producing lands. This alone sealed its fate in the upcoming civil conflagration. After the election, Governor Houston refused to ake an oath of allegiance to the Confederate States of America and was removed from office by onvention officials. Lieutenant Governor Edward Clark was appointed acting governor until Frank Lubbock was elected governor in November 1861.

Marion County stood to profit initially from the *War Between the States* mainly because of its regional role in shipping, iron production and commerce. But as the war waged on, this county, like all of Texas, paid a heavy price and was depleted of many resources. Jefferson, however was the seat of much confederate enterprise. Its port saw the disembarkation of troops and important military supplies and materials. Gun powder produced in Marshall, firearms made in Tyler and even troops were often transported out of East Texas through Jefferson's port. Three confederate ordnance magazines were constructed just downstream of Jefferson's landing for storing powder and munitions (Moir 1994). One is still standing today and was formally listed on the National Register in 1994.

Bagur (n.d.: Chapters XII-XVI) gives a detailed review of Jefferson's navigational commerce. The city's prosperity initially grew but was then interrupted by the harsh economic times brought on by the last years of the Civil War. The city quickly recovered after the war ended and was occupied by Federal troops soon after Texas surrendered. They brought some added economic benefits as soldiers spent cash in local establishments.

Rapid Expansion of the Railroads after 1865 and Jefferson's Golden Era

n 1865, the condition of Jefferson's wharf and landing area is presumed to have also suffered as the ar came to a close. Although some references to wharf improvements before 1867 have been encountered in secondary literature (e.g., Carlson 1989), no details from primary sources have been

located as noted by Bagur (n.d.). Bagur (n.d.) encountered the first reference to a new wharf in an 1867 newspaper account (August 7, 1867). He also noted the first mention of a wooden wharf was encountered in 1869. Soon thereafter, improvements were initiated in the early 1870s that also provided detailed records about the work. In 1870 according to Wright (1994), Lynch and Delevan repaired and extended the wharf. It has been suggested that a wharf initially was constructed along the water front beginning at the foot of Polk Street and extending downstream. How large the structure was is not known until 1872 after it had been extensively redesigned.

What emerges from bits and pieces of information is that Jefferson's first landing was probably a natural bank near the foot of Polk Street at Lake Street. Then in the 1850s, it was presumably improved and the landing extended to provide dry and secure footing for more steamboat activity. By 1867, this landing extended along the northern section of Block 8 where Lake Street would have passed. It may have even extended into Block 9 (south side of Dallas Street). By 1870, it may possibly even have extended beyond Walnut Street. However in 1872, the lowest section of the wharf was lowered in elevation by 2 ft (0.6 m) and an entirely new wharf was built. It extended from Walnut Street downstream to half-way between Soda and Washington Streets (Moir 1998: Fig. 8). This new wharf was 590 ft (180 m) long and 20 ft (6 m) wide. More details on the 1872 wharf are given in the *Finding Section* (see *Area #6* write-up).

Jefferson's trade expanded considerable as the 1860s came to a close. Its commerce included a range of commodities. Bagur (n.d.: Ch. XII, p. 21) noted a Corps of Engineer's report listing exports from Jefferson for the 1870-71 year. The data are given in Table 3 and show the diversity of export trade at the port near its peak of commercial navigation. The cityscape of Jefferson was captured at its

TABLE 3

EXPORTS FOR JEFFERSON, TEXAS 1870-71 (12 MONTHS)

Commodity	Amount
Cotton	76,328 bales
Dry Hides	84,762
Green Hides	18,471
Wool	87,623 lbs
Peltries	48,210
Bois d'Arc Seed	9,721 bushels
Cattle	5,381 head
Lumber	121,000 ft

From Bagur (n.d.; Ch. XII, p. 21)

Peak by the 1872 Brosius bird's-eye view. The section of the city along the study area is shown in Moir (1998: Fig. 9). It depicts five steamboats in the bayou and many businesses next to the steamboat landing.

Decline of Jefferson's Commercial Navigation

The success of Texas railroads noted above continued after the Civil War. They captured much of Jefferson's export trade by 1875. By 1885, there were 6,325 miles (10,202 km) of track in the state (Belo 1969:558). Tracks totaled 9,287 mi (14,979 km) in 1895, 11,745 mi (18,944 km) in 1905, 15,635 (25,218 km) in 1915 and peaked in 1921 at 16,120 mi (26,000 km). Thereafter, track mileage fluctuated with the largest number ever listed given in 1932 (17,078 mi or 27,545 km). Subsequently, track mileage has slowly declined ever since to reach only 10,430 active mi (16,823 km) by 1993 (Belo 1969:558; Ramos 1995:581-82). The interstate highway system has certainly helped accelerate the decline of rail service since 1960.

Jefferson was first tied into a major rail line when the Texas & Pacific passed through its city limits in 1873 west of the study area. Much later, the Missouri, Kansas and Texas Railroad completed an east-west link through Jefferson when it constructed the railroad bridge across Big Cypress Bayou and the study area at about Walnut Street between 1897 and 1900. Information on the MKT line and its bridge is given in the Findings Section (see Area #8 subsection) as well as in a separate letter report issued by the CESWF being issued to the Texas SHPO's office.

Jefferson in the Late Nineteenth Century

The decline of Jefferson is apparent in several types of evidence. First, the earliest Sanborn surance maps show many vacant and fire-gutted buildings in the old waterfront area. Actually, ajor fires in downtown Jefferson were very common in the low water period starting in 1872. In the 20 months between January 1872 and August 1873, Jefferson had five major fires in its commercial and business district. In comparison, the five years from 1867 to the end of 1871 had only four fires mentioned in the records reviewed by Bagur (n.d.). Probably what is most important from these fires is the potential evidence they left behind in the archaeological record. There should be visible stratigraphic evidence from some of the fires sealed beneath foundation rubble when destroyed buildings were razed to clear the way for new ones. The recent test excavations on the north side of Block 8 just adjacent to the project area certainly seem to support this position (Perttula 1998).

Although Jefferson lost its regional role as an important commercial center, it continued on as a small urban center and county seat. The Sanborn Insurance maps provide a picture of the businesses in some sections of the city as it shifted commercially to serving local farmers within about 10 to 15 miles. Some steamboat traffic continued, but never amounted to much after 1880. The last steamboat visit was reported for the year 1903 after the MKT had built its tracks across part of the oldest landing site.

A Glimpse of Twentieth Century Jefferson

The early 20th century was dominated by less prosperous times until the petroleum industry revisited e area. The 1930s saw the tapping of the largest oil field in Texas when independent drillers tiated the discovery in Rusk County. The reservoir eventually encompassed a broad area from Longview through Kilgore, Gladewater and into northern Cherokee County. Major oil companies

had previously bypassed this area after labeling it unproductive. The Jefferson area personally experienced some oil drilling activity when the Woodlawn Oil Field was discovered. It stretches across Big and Little Cypress Bayous near their confluence only about 2 miles east of Jefferson. This field brought some renewed prosperity to the declining town in the 1930s and 1940s.

Jefferson's history since 1930 is well beyond the focus of this study. A few post 1930 resources in the study area were noted and they are discussed in the finding section of this report. Probably one of the more interesting facts is that Jefferson's population has not fluctuated more than 500 either side of 2,800 residents from 1880 to 1990. In 1993, the city was estimated with 2,378 residents. Few other communities in Texas can claim this kind of demographic stability for over a century.

FIELD METHODS AND RECONNAISSANCE SURVEY APPROACH

Introduction

The methods employed during this study were designed to provide a preliminary assessment of major landforms and surficial alluvial deposits using nondestructive techniques. Previous excavations in the general vicinity have revealed extensive fills on both flood plain surfaces (Carlson 1989) and adjacent urban blocks (Bill Brannon personal communication; Jacques Bagur personal communication). The question, therefore, facing this study was to determine whether similar complex deposits potentially containing intact archaeological strata were expected in the project area. Detailed backhoe trenching or even judgmental shovel testing were not considered prudent or cost effective at this feasibility stage to answer the question. In fact, since most of the proposed actions would not impact large areas or disturb deep deposits, the methods most appropriate at this stage used other means to evaluate archaeological potential. Consequently, the field program was intentionally limited to (1) examining landform surfaces for evidence of archaeological resources, (2) identifying possible past disturbances and (3) assessing landform potential to contain possible buried surfaces or sealed deposits using non-intrusive methods.

An archival phase was implemented ahead of the field survey to provide information on the historical development of the area. When the field work was performed, a few simple field techniques were used to help assess the age of certain landforms (e.g., tree ring dating of important older trees, tube cores to determine soil characteristics, etc.). Other archaeological excavations conducted in the immediate area were reviewed and they provided data on the characteristics of some of the buried deposits anticipated within the project (Tribble 1983; Carlson 1989; Perttula 1998). Finally, informants provided information on the recent history of the project area and certain improvements. All of the information acquired from these disparate sources was combined to interpret the archaeological potential of the study area.

As noted, the field survey was designed to draw on various evaluation techniques for assessing complex urban landforms and alluvial deposits using non-intrusive methods. The author has designed special reconnaissance programs elsewhere that have proven to be very productive for evaluating archaeological potential using landform analysis and related data (e.g., Moir 1978, 1979, 1980, 1986, 1987, 1995). Typically, they have involved recognizing physical changes in landforms over time using a combination of archival information, geological and geomorphological processes,

.formant recollections and very limited field data.

Design for Field Survey

The archaeological field work performed for the Jefferson Environmental Restoration project was intentionally designed to match its feasibility stage. Field work included a pedestrian survey and reconnaissance level examination of all accessible areas, an inspection of accessible exposed surfaces and naturally cut banks, and limited soil coring to look at the characteristics of natural soils or man-made fills to a depth of 3 ft. The coring used one inch diameter stainless steel tube corers to check the depth and extent of recent levee sands, modern flood deposits, man-made fills, natural soils and alluvium.

Detailed plans of proposed environmental restoration work north of Polk Street comparable to the southern sector were not available during this study. However, tentative conceptual drawing of the entire project were used to identify many different adverse impacts. Actually, a final design for the proposed undertaking will only be determined upon successful completion of the *environmental assessment* currently being compiled for this project by the CESWF. Since the project involves both private and public property, its preliminary design requires proper approvals and clearances as it passes through the appropriate public review processes before it can be accepted.

Special Field Techniques

ne study area contains a mix of publicly owned land and privately owned parcels. Figure 2 given earlier showed the grid of platted streets and alleys across much of the project area. Recent land survey lines cleared by the CESWF were used to traverse most of the areas where thick vegetation was encountered. The freshly cut lines also provided access paths across various tracts. In other locations, the public right-of-ways platted across parcels upstream from Polk Street were used to gain access to tracts. Structures on private property were not entered without permission and only one parcels was posted "no trespassing". It was located partly in the Dallas Street right-of-way on Block 9 (south section unplatted area) and was not traversed. Future intrusive archaeological or architectural fieldwork will require, of course, the permission of any landowners when archaeological resources on private holdings are tested and/or any material remains removed.

The only intrusive field techniques employed were 1 inch diameter soil cores (tube corer up to 3 ft long) and a 1/4 inch steel probe (up to 44 inches long). They were used selectively to help understand the range of natural soils and man-made fills in the study area. They were not used to evaluate any recognizable archaeological resources visible on the surface or encountered in soil profiles. The extracted cores offered insight on some of the surficial deposits in the study area without investing the laborer necessary to open and profile a unit to the same depth of 3 ft (0.9 m). The soil cores helped in examining the depth of alluvial deposits, checking the thickness of man-made fills or looking more closely at the characteristics of the natural soil profile. They were not used to test archaeological remains or clear tracts of any further work. In one location, a steel probe as helpful in checking the horizontal extent of buried rubble deposits partly exposed along the erbank. Used together, they provided some additional information that could be obtained quickly while not disturbing any potential archaeological remains.

Field Methods Summary

The feasibility phase of this undertaking has included a preliminary assessment of all historic resources that might be located in the proposed restoration area. This cultural resources assessment has inventoried known or suspected historic resources using archival, informant and surface reconnaissance information. It has identified historic structures constructed before 1950 and assessed the extent of previous landform alterations and their potential for containing older surfaces and sealed deposits. Finally, the cultural resources tasks have included assessing typical urban settlement processes, such as expected demolition sequences and the filling of flood plain depressions along urban fringes to identify archaeological resources potential in the project area.

As a result, the cultural resources survey has made a preliminary assessment of the age and archaeological potential of the different landforms in the study area. This work provides an initial evaluation of the geological potential of various landforms to contain older sealed deposits or buried surfaces. The location of these possible buried deposits can be used to design an appropriate testing program for determining if potentially significant archaeological resources do, indeed, exist where final designs call for disturbing the ground or creating other adverse impacts. Such other adverse impacts might include sensitive locations where public access can be detrimental (e.g., exposing surface sites to public use without restricting access or activities) or higher flood plain locations where man-made wetlands can accelerate bioturbation and the destructive weathering of stratified archaeological deposits.

The archival data, landform assessments and pedestrian findings have been used to help determine the preliminary design of the proposed project. The findings have also been used to determine the general likelihood of possible historic and prehistoric archaeological resources and historic structures within its boundaries. In fact, the preliminary findings were used to refine proposed boundaries and adjust the location of some proposed improvements. They were also used to assess the kinds of possible adverse impacts likely should the restoration project move beyond the current feasibility stage. Last of all, the results of assessing the archaeological potential of the study area provide a data base for designing an appropriate and more comprehensive testing program for the project area. That program can be organized to better match possible adverse impacts when the final engineering design is implemented.

INTEGRATION OF FIELD SURVEY RESULTS AND ARCHIVAL DATA

Introduction

The following section lists the major cultural and historic features observed in the study area or gleaned from archival and informant sources. It addresses the identifiable portion of the built environment that may be of local historical significance along with known or expected buried surfaces that may contain sealed archaeological deposits and sites possibly important under National Register criteria. Although no evidence of prehistoric sites was encountered, this was predictable since deep fills have precluded the possibility of finding such remains on the surface. Thus, many of the land surfaces on which Native Americans would have walked have long since been buried by

alluvium over the past 6,000 plus years or covered by man-made fills since 1870. Consequently, recognition of these fill zones and an understanding of landform change across the study area provide keys to identifying locations where archaeological remains may be better preserved. The following text identifies locations that either already have shown evidence of archaeological deposits or are suspected of containing archaeological remains worthy of investigating further.

Reconnaissance Survey Findings

Table 4 lists the major cultural and historic features observed in the study area or suggested from archival and informant sources. It includes important resources from the built environment that may be of local historical significance. It also identifies areas where buried surfaces might contain sealed archaeological deposits potentially important under National Register criteria. Figures 5 and 6 give the location for each resource or area noted on Table 4. Additional observations are labeled as *Reference Points* and they are listed in Moir (1998: Table 6). They include notable natural resources, locations where modern fills may cover older remains, and certain modern improvements. When considered together, Tables 4 and Figures 5 and 6 reveal that most of the study area has good potential to contain buried archaeological deposits beneath alluvium or man-made fills. Several of the platted blocks had numerous standing buildings as the 1872 Brosius bird's-eye view clearly depicts (see Moir 1998: Fig. 9). The following entries review the known or suspected archaeological and architectural resources based on archival sources and the reconnaissance results.

Archaeological Resources Observed in the Field

Six resources falling under this group were observed in the study area (Table 4). Three of the archaeological resources displayed evidence of nineteenth century remains (Areas #1, #2, #3). They also had twentieth century debris on the surface. Three other resources entailed 20th century architectural ruins (Areas #10, #11, #12). Testing is recommended for Areas #1, #2, #3 and #11 to determining their site characteristics and possible impacts should the project move to the next stage. Each resource is discussed individually next.

TABLE 4

INVENTORY OF ARCHAEOLOGICAL AND ARCHITECTURAL RESOURCES AND LOCATIONS EXHIBITING GOOD ARCHAEOLOGICAL POTENTIAL[1]

Archaeological Resources Observed in the Field

Area #1: 19th Century Historic Site and Associated Landscape Features
Area #2 (Possible Site/Sites): Long Linear Band of Buried Building Debris
Area #3 (Possible Historic Site): Pre-1890 Buried Historic Debris

Locations With Good Potential To Contain Buried Archaeological Resources

Area #4 (Possible Site/Sites): Historic Town Block 7 (south section)
Area #5 (Possible Site/Sites): Historic Town Block 8 (south section)
Area #6 (Possible Site/Sites): South Section of Block 9 (original landing site)
Area #7 (Possible Site/Sites): Historic Town Block 10 (south section unplatted)

Architectural Ruins Observed in the Field (Treated as Archaeological Resources)

Area #10: (Architectural Ruin): Partly Fallen Twentieth Century Small Barn/Shed
Area #11 (Architectural Ruins): Pre-1940 Pilings/Piers (see also R11 & R22)
Area #12 (Architectural Ruins): Industrial Railroad Bridge Abutments (concrete)

Architectural Resources Observed in the Field (Structures with Structural Integrity)

Area #8 (Historic Structure): Iron Truss Railroad Bridge (ca. 1901/07)
Area #9 (Historic Structure): Reinforced Concrete Water Tank (ca. 1917)

Additional Locations With Good Potential For Buried Archaeological Resources

Area #13 (Possible Site/Sites): Historic Town Block 72
Area #14 (Possible Site/Sites): Historic Town Block 73
Area #15 (Possible Site/Sites): Historic Town Block 84

Natural Features or Landforms with Archaeological Potential[2]

Locality A: Man-made Depression and Non-Native Cultural Vegetation
Locality B: Small Rise Protruding about Four Feet (ca. 1.2 m) above floodplain
Locality C: Enhanced Drainage Channel
Locality D: Historic St. Catherine's Island
Locality E: Buried Portions of the Pre-1880 Turning Basin
Locality F: Big Cypress Bayou's Stranded West Channel

[1] All localities and areas listed above are also shown on Figures 10 and 11.
[2] Twenty-two additional field observations and reference points are listed in Table 6.

Historic Site (<1930 architectural remains & possible early house site; Area #1)

The remains of older fences, a possible well, piled corrugated tin, pre-1885 bricks and early 20th century refuse were noted near the middle of Block 73. The precise location for these features is

ar the north end of lots 9 and 10 and the alley running between them (see Figure 5). An informant mentioned an old house standing in this area in the 1950s. At that date, it had been abandoned for quite some time and was being reused for storing feed. The verbal description by the informant indicated that it had a shed roof and was divided into 5 or 6 rooms reminiscent of a domicile. Upon further reflection, the informant was not sure if it was an old business or warehouse given its unusual design.

The 1872 Brosius map shows two small houses (?) near the center of Block 73 and another structure to their southeast (Moir 1998: Fig. 9). A very large two-story building is also depicted on the far eastern edge of the north side of the block. It is about 150 ft long, 30 or 40 ft wide and looks like a residential tenement possibly for businesses nearby. The Sanborn maps do not extend this far and, thus, they offer no information on the area. The archaeological features observed in the field (well shaft, old fence lines) may be associated with some of the 1872 buildings, although the refuse discarded around them is much more recent. A formal testing program would be recommended to determine the age and extent of buried remains in this area should the proposed project be implemented. At the same time, a more expanded testing program could be used to check the adjacent sections of Block 73 given its early historical development and the potential attractiveness of a possible nearby spring. Finally, a very early road once crossed this Block. It was depicted on the 1846 town plat as noted earlier in this report (see Figure 4).

Linear Band of Building Debris (Area #2)

rick and concrete debris was encountered along the river beyond the toe of the levee (Figure 6, see Area #2). It involved debris of several different ages. Some of the brick was definitely newer than 1910 while most of it was older than 1900. There were even pre-1885 bricks observed, as well as concrete pier fragments and concrete footings that could possibly date from the last quarter of the nineteenth century. In some areas, pieces of articulated pre-1900 brick walls were also visible in the rubble matrix. The debris seemed to have been used to build up the river bank and reduce the westward migration of Big Cypress Bayou when it was flowing at flood stage. The debris also seemed to predate the 1947 levee and was covered by 0.5 to 2 ft of flood sediments and silty sands.

The brick rubble and occasional concrete fragments stretched along the bayou bank for about 90 m (300 ft) at an elevation of about 181+/-1 ft amsl. Labeled "Area #2", the debris band may be a remnant of fill used to bury the steamboat landing after it was no longer used. The rubble was exposed at the edge of the high water in February 1998, and was observable in the eroded bank where the active flood plain intersected a slightly higher and older raised fill with current levee. A steel probe showed that the rubble band often was 3 to 5 m wide and at least 0.5 m thick. Exposed sections of the rubble also showed that it formed a layer about 0.5 to 0.8 m thick. No shovel testing was performed. Observations were made from exposed banks or inferred from probes and soil cores.

The origin of the debris appears to be multi-component based on the few observations made so far. It is possible that the demolished post-1911 building shown on Sanborn maps contributed some bble to the area (see Post-1911 Building entry; Reference Point R21 on Figure 6). It also seems ghly plausible that the erosion had been an ongoing problem for some time and that much older building debris had been carted to this location, possibly as long ago as the 1880s. Certainly, the

many buildings destroyed by fires in downtown Jefferson since 1870 also may have provided some of the debris carted to this area. Conversely, it seems unlikely that any single source contributed all of the debris, but answering this kind of question is only relevant concerning the age and integrity of the older deposits capped by this material.

The rubble band should be tested to see if it is covering any other important remains. An assessment of the age of the debris and the kinds of deposits it has capped would be helpful in delineating where remains of Jefferson's 1872 wharf may be best preserved. The rubble's age is not fully understood and it might represent debris placed on the decaying wharf when erosion threatened to push the bank westward after 1885. In fact, the northern end of the brick rubble band contains architectural materials that could very well date from the 1870s. Consequently, there may be a half dozen sources behind the rubble band with its oldest section deposited more than 100 years. Only careful sectioning at three or four locations and proper examination of the stratigraphy and contents would help resolve these kinds of questions.

Possible Early Historic Site (Area#3)

One of the more prominent small rises in the flood plain about 150 ft east of the dirt road that crosses Blocks 72 and M yielded historic architectural debris (Figures 2 and 5). The rise is about 25 by 35 feet and stands about 3 ft higher than the surrounding flood plain. It sits on an elevated ridge that is nearly 300 ft long and stands another 2 to 3 ft higher than the surrounding flood plain low areas. Part of the ridge extending toward the dirt road may have been removed as fill to raise the road bed.

Fragments of pre-1885 bricks were noticed on the highest part of the rise (see Figure 5). Also, several large shards of thick window glass were observed on its summit. Five soil cores scattered across the top of the rise revealed obvious red debris at a depth of about 25 inches beneath the surface. Some cores revealed flecks and small pieces of charcoal. The red debris appeared to form a horizontal floor or lens within the rise. The red material looked consistent with debris from soft, water-soaked hand-made brick that had decomposed over time. On the other hand, the red color and texture of the lens might represent burned clay-rich sediment placed on top of an older surface. In either case, the rise requires further attention to determine its archaeological importance. Some plans call for constructing a boardwalk across this area.

More historic brick fragments of about the same age were also encountered along the flattened ridge extending from the rise toward the current access road to the south. A sparse scatter of bricks was observed along this ridge and about 100 ft south-southwest of the rise (i.e., about 50 ft north of the dirt road). Consequently, a broad pattern of shovel testing along the flattened ridge should also be considered unless the source of the old brick can be more narrowly defined. As a final foot note, the relict high water channel that forms the northern side of St. Catherine's Island is located about 100 to 150 ft east of this ridge (see St. Catherine's Island entry).

Some of the earliest historic occupations expected in this general area may consist of very light scatters associated with short term camps pre-dating 1845. Their only definable features may be hearth pits. The Jefferson location was accessible by small boats and canoes well ahead of steamboats and some travelers and surveyors probably passed through this area before Allen

ɔrquhart petitioned for his land grant. In this regard, there may also be evidence of prehistoric travelers. Alluvial sediments from subsequent floods may have sealed these short term occupations within discrete strata. The National Register importance of transient occupation sites extends beyond their simple archaeological record (i.e., not just NR criterion D). It includes their local historical significance in Jefferson's early heritage and the public interest such deposits would attract (e.g., NR criterion A).

Twentieth Century Small Barn (Area # 10; treated as an archaeological resource)

A small partly collapsed outbuilding stands in Camp Street just east of Marshall Street (Figure 5). Camp Street is not an active street east of Marshall Street and is covered with brush and trees. The small barn or shed was made with wire nails and wood of several different ages. Some lumber was definitely recycled from an older structure while other elements were probably added to it after 1945 (i.e., post-1945 new materials). Part of the eastern side of the structure was recently severely damaged by a wind-toppled tree prior to this survey. The small building may have been used for storage or livestock purposes by residents living on Lots 7 and 8 (Block 73) before 1950. The structure is no longer intact and does not meet the criteria necessary to deem it potentially eligible as an architectural resource. It is also insignificant as an archaeological resource due to its recent age (post-1910) and unimportant design or material remains. No further work is recommended.

Pilings/Piers for a Pre-1950 Crossing (Area #11 and Reference Points R11 & R22)

ɪers used to construct a raised walkway were encountered in several parts of the project area (Area #11). Those at *Reference Point R22* (see Figure 5) contained large wire nails (up to about 50d) that appeared to date from at least 1910 or 1920. An informant indicated that the piers once supported a plank walkway that was used to cross the bayou before the Polk Street bridge was constructed. People living on the east side of the river used this walkway to get to downtown Jefferson before Polk Street was extended in the 1930s. It also included a cable hung across the bayou based on one informant to provide a bridge directly over the river. The piers were abandoned after a wooden bridge was made on Polk Street. The current cement bridge on Polk Street dates after 1960. The eligibility status of the ruins requires evaluating them as archaeological resources. Consequently, more information should be gathered to determine if they are NR eligibility in any locations where they may be impacted by proposed work should this project move to the next phase.

Industrial Railroad Bridge Abutments (Area #12; treated as an archaeological resource)

At the north end of the project area, two large concrete blocks at least 10 ft square rest on the flood plain near where Washington Street would cross the bayou if it was extended south (Figure 6, Area #12). According to an informant, the large blocks were supports or footings for an industrial railroad line constructed in the late 1930s to haul timber. Today, the blocks appeared to have been moved by flood waters since they no longer seem to be set square to each other. No railroad tracks or bridge is shown at this location on either the 1932 Sanborn map or the 1962 USGS map. Consequently, the ɔil line was short lived and was removed after it had served its purpose.

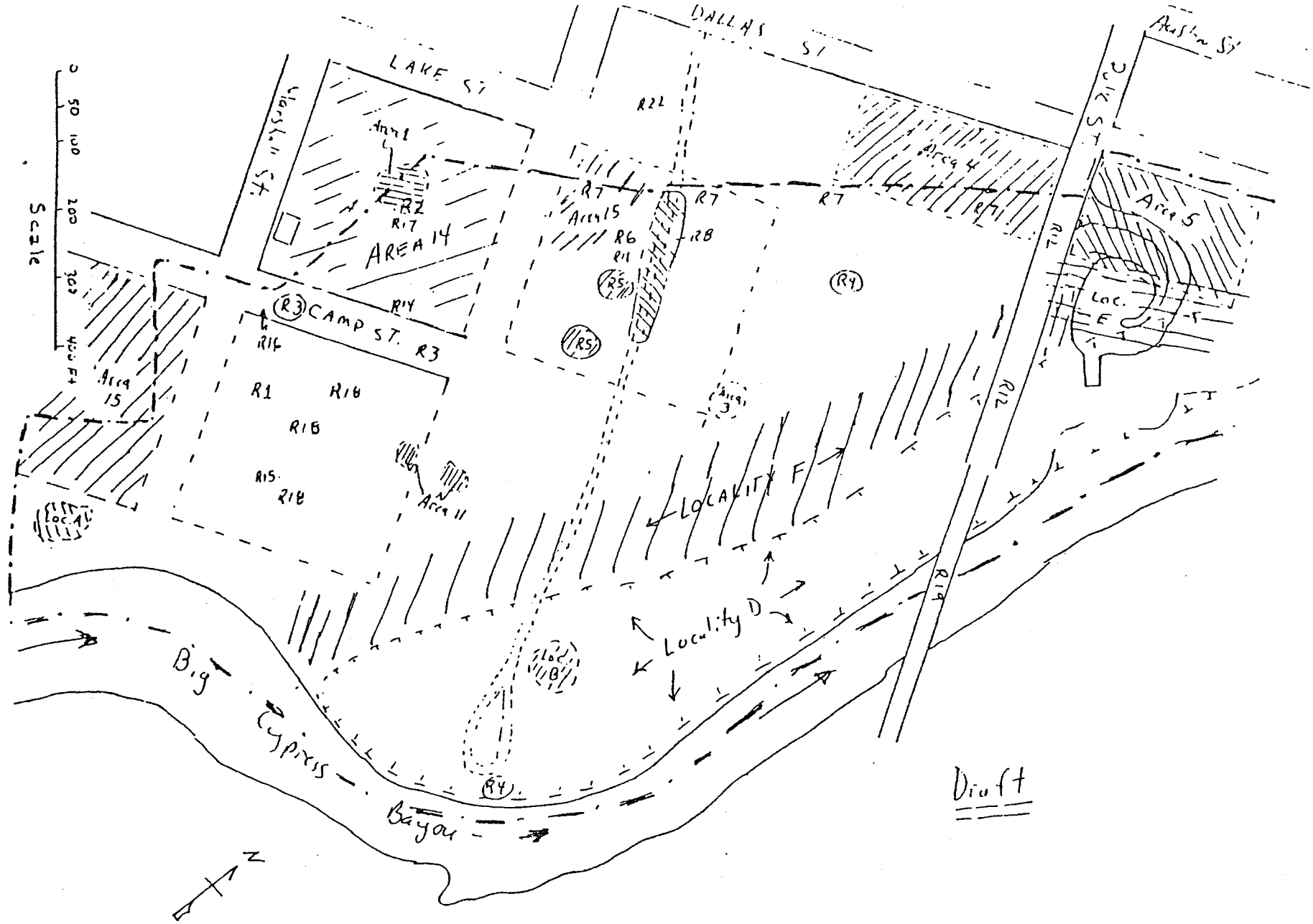

Figure 5. The southern section of the environmental restoration feasibility study area Jefferson, Texas. Resources, areas and localities noted on Tables 5 and 6 are delineated on this map. See Figure 11 for the northern section of the study area.

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The two concrete abutments are not considered NR eligible as archaeological resources due to their comparatively recent age. They are also not eligible as architectural resources because the bridge has no structural integrity left. Evidence of the approaches to the bridge has been erased by time. Consequently, no further work is recommended.

Architectural Resources

There were only two structures observed in the project area that were older than 1950. The two exceptions were an iron truss railroad bridge (Area #8; Figure 6) and a reinforced concrete water tank (Area #9; Figure 6). Each structure is discussed below.

Iron Truss Railroad Bridge (ca. 1901/07; Area #8)

The iron truss railroad bridge that crosses Big Cypress Bayou just north of Polk Street was constructed between 1897 and 1907 by the Missouri, Kansas and Texas Railroad (MKT). Its specific construction date has not been pinned down because of several events. First, the initial railroad bridge across the bayou was reportedly a wooden trestle and constructed between 1897 and 1900. It is first depicted on the 1901 Sanborn map. An informant mentioned that this first wood trestle was built quickly because it physical crossed over a navigable river. His grandfather had told him that the portion spanning the river was actually constructed in one night because of its potential controversy. Apparently the railroad only built a cheap structure, since it was not legally allowed to block a navigable river. Then, after some period of time had passed, the initial wood trestle bridge was replaced by the iron bridge that is still standing today. There is a date of 1907 in the concrete abutment on the east bank of the bayou. There is also some oral history that suggests that the iron truss bridge standing today was moved in from somewhere else. One version notes that the iron bridge was reused and was much older than the year it was moved to Big Cypress Bayou. The accuracy of this information cannot be verified at this time. It is possible that the railroad had the iron bridge moved to the crossing from somewhere else, since it would have saved time and minimized the interruption of rail service. Newspaper coverage of the event would provide first hand accounts and future research could be devoted to checking these kinds of records. The author checked the files of a local historian, Ms. Catherine Wise, several years ago and did not find any firm data on the iron bridge or when the first wooden trestle was constructed.

Finally, the iron truss bridge was replaced by a steel and concrete bridge in 1990. This new railroad bridge is just downstream (north) of the old iron bridge. An archaeological survey was conducted along the new railroad bridge's corridor by Texas A&M University (Carlson 1990).

Holding Tank (Town Water Supply Facilities ca. 1917; Area #9)

A circular concrete water storage tank was first depicted at this location in 1923 (Sanborn 1923). It was part of Jefferson's water system. The tank was not shown on the 1911 Sanborn map. Thus, it was probably constructed some time between 1912 and 1922. It still stands today and has a diameter of about 22 ft and a reservoir capacity (noted on the 1923 Sanborn) of 35,000 gallons. It rests on the ground and has a conical reinforced roof made of the same concrete material as its walls.

.here is an entry way on the west side of the roof and modern refuse has been thrown inside it.

The concrete tank was added to an existing water works at this location to provide greater storage. A pump house with a composition roof also once existed near this location since about 1903 (absent on 1901 and earlier maps but shown on the 1906 Sanborn). Only its brick walls were standing when TAMU conducted their testing program in 1989 (Carlson 1989). The structure was about 17 ft square and once contained pumping equipment. The pumps were listed in detail on Sanborn maps from 1906, 1911, 1923, and 1932 (see Moir 1998: Appendix II). The brick building was connected to the bayou by an eight inch diameter intake pipe that drew water directly from the bayou. The pump house fed an eight inch diameter water line that passed under the MKT tracks and then headed up Walnut Street. A circular well was depicted on the 1906 Sanborn about one-half way between the edge of the bayou and the brick pump house. The well was noted as 10 ft by 12 ft (width and depth?) and does not appear on maps after 1924 (it was last shown on the 1923 Sanborn). Finally, a 12 ft square wood frame railroad house (shed?) stood about 15 ft southwest of the brick pump house on the 1923 and 1932 Sanborn maps (it was absent on all earlier maps). The locations of this frame structure, the well and the brick pump house all have since been covered by the embankment of the new railroad bridge constructed in 1990. Only the concrete water tank is still standing today.

The historical importance of this concrete water tank unfortunately has been diminished by the loss of its associated structures. That is, the integrity of the entire early 20th century water works has been irreparably impacted. Consequently, should any future plans call for removal of this final water 'orks structure, photographs should be taken and sent to the consulting regulatory agency's historical ,chitects and historians to provide a determination of potential eligibility. Such work will probably also require a brief check on other existing early 20th century reinforced concrete public water tanks. It is presumed that this type of structure is not unique enough to warrant eligibility on its own merit. However, more specific information may be needed to make a final determination of its eligibility. At present, no impacts to the concrete structure have been identified in the proposed plans reviewed to date.

Locations with Good Potential for Buried Archaeological Deposits

Seven areas and seven localities with good archaeological potential were observed under this group (Table 4). They include eight town blocks (five half blocks and three full block) platted in 1846. All of the blocks were either occupied or improved (i.e., the town landing blocks) before 1872. Most of them may contain comparatively early historic archaeological resources buried beneath old fills used to raise the surface of the blocks. Two of the blocks also had early twentieth century debris on the surface. The following entries review the settlement history of each area possessing good archaeological potential. The oldest sealed surfaces also have good potential to contain prehistoric deposits and/or the remains of pre-1839 historic travelers and explorers.

Historic Block 7 (south section; Area #4)

Seven buildings are depicted on Block 7 south of Dallas Street in 1872. They are shown in Moir)98 (Fig. 9). Three buildings front Lake Street and four front Dallas Street. Only those building sites on the south end of lots 9, 10, 11 and 12 potentially fall inside the proposed project (Figure 5;

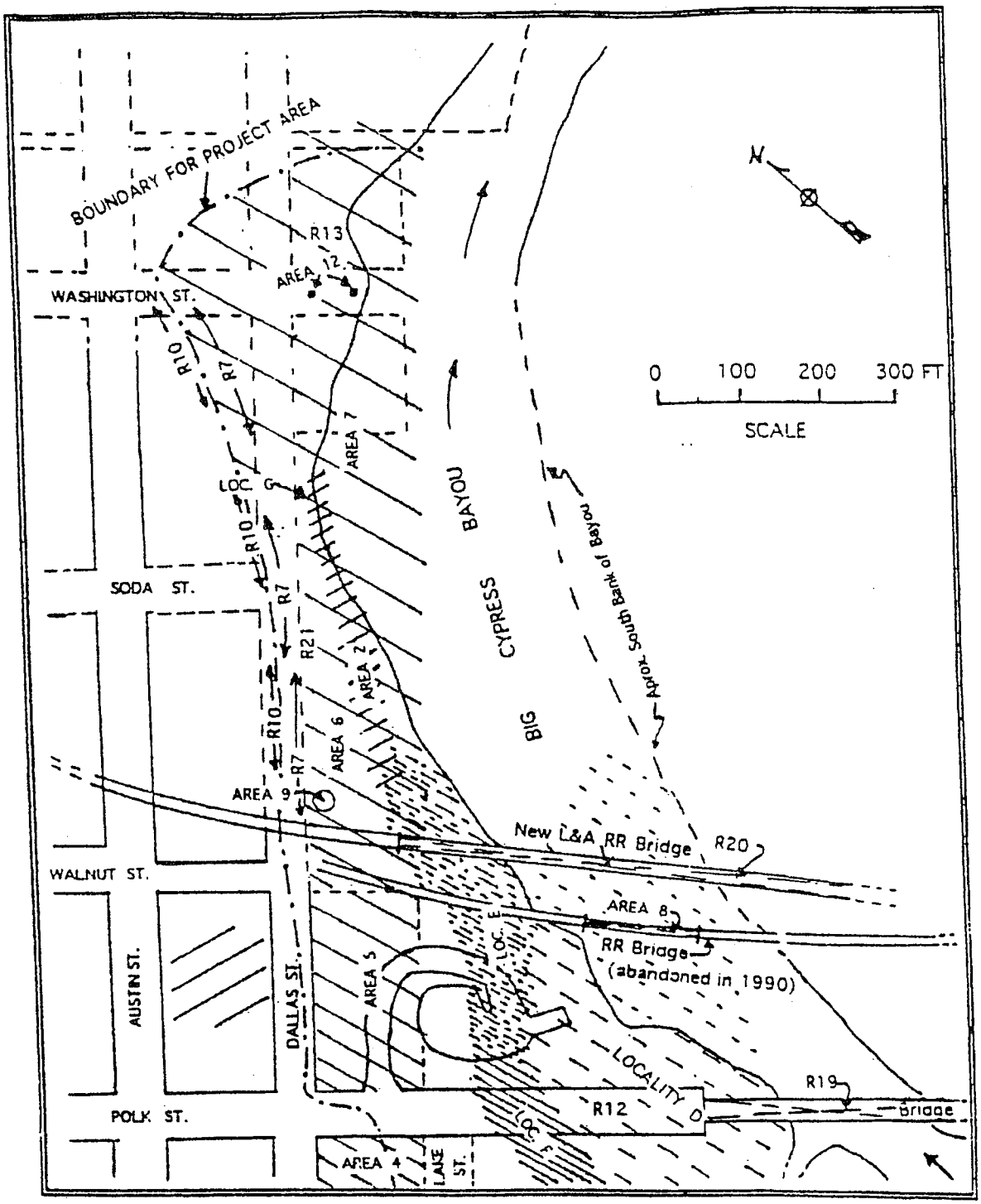

Figure 6. The northern section of the environmental restoration feasibility study area Jefferson, Texas. Resources, areas and localities noted on Tables 5 and 6 are delineated on this map. All hatch-marked areas dipping down to the reader's right (bottom of page) denote locations with good archaeological potential. Any hatch-marks dipping down to the reader's left denote locations that have produced evidence of buried archaeological remains (or have remains visible on the surface). See Figure 10 for information on the southern section of the study area.

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Area #4). The buildings drawn on lot 12 in the 1872 bird's-eye indicate that the topography dropped rapidly toward the bayou along both Lake and Polk Streets. The depiction of piers under the south end of the eastern most building suggests a drop of at least 7 or 8 ft over a span of about 50 ft. fronting Lake Street.

Thirteen years later, the first Sanborn maps still show the devastation caused by numerous fires. Only one small frame building possibly pre-dating 1872 is still standing on the south section of Block 7 in 1885. A new fire station housing a "steam fire engine" has been constructed in the center of the Block and "ruins" are depicted for the eastern side of the south part of the block. A slightly larger and older fire station is depicted on the north part of Block 7.

Historic Block 8 (south section; Area #5)

At least six different buildings were standing on the south part of Block 8 south of Dallas Street in 1872 (see Moir 1998: Fig. 9). They faced Dallas Street and had the bayou immediately to their back side (south face). The bayou was depicted coming within 10 to 20 feet of the back of the two longest buildings in the center of the Block. This placed the river bank only 130 ft from the south edge of Dallas Street. The eastern-most lot of Block 8 (south section), all of the south section of Block 9 and part of Block 10 (south section) form the late 19th century steam boat landing for the city (refer back Figure 2). The 1872 Brosius map depicts goods and materials stored on the sloping face of the landing and three moored steamboats. The port landing extended for about 400 to 600 ft along the river bank based on various maps although to date no clear visual delineation of that structure has been found.

The 1885 Sanborn map illustrates the commercial decline experienced by the Port of Jefferson. Four of the six buildings on Block 8 (south section) were listed as "vacant" in 1885 (Moir 1998: Appendix I). Many other vacant buildings stood on adjacent blocks surrounding the steamboat landing. A decline in population and in business establishments after 1875 occurred because of two principal elements. First, newly completed railroads captured much of the commercial shipping market for eastern Texas by 1875 and made transport by water less profitable. Second, there was a reduction in shipping to and from Jefferson aggravated by frequent periods of low water on Big Cypress Bayou (Bagurnd.). Together, these elements brought economic hard-times to Jefferson.

The hydrological regime of the Cypress basin already had been altered to a significant extent by 1873. It was caused by over-dredging portions of the natural channel, cutting shorter routes through Caddo Lake and removing vestiges of the Great Raft on the Red River. A law suit filed in 1873 described changes on St. Catherine's Island and indicated that commonly inundated land surrounding the island was no longer submerged (Civil Suit #1174, Marion County District Court Records). It is discussed in greater detail under the St. Catherine's Island entry (see Locality D).

The 1885 Sanborn maps depicted a railroad spur running east along Dallas Street that stopped just 30 ft short of Polk Street. A separate rail siding was also depicted adjacent to the steamboat landing and, possibly, was constructed for the Phoenix Oil Works that occupied most of Blocks 9 and 10. The 1890 Sanborn base map identified the all but abandoned steamboat landing by specific labeling (see Moir 1998: Figure 12). It ran from Walnut Street passed Soda Street and stopped halfway to

Washington Street. The rail line along Dallas Street was not shown on the 1890 Sanborn map, but this was probably an oversight since it was depicted once again on the 1896 Sanborn map. The 1890 map also indicated that there was a tenant occupying the lowest level at the back of the buildings on the south section of Block 8. The tenant apparently used the space beneath the ground floor of five of the buildings. The ground and upper floors of the buildings were also occupied. They were used for a grocery warehouse and wholesaler, agricultural feed supplies, a tailor and a dwelling.
While the use of the south section of Block 8 had turned around since 1885, many more vacancies were listed on the north section of Block 8 based on the 1890 Sanborn maps (north side of Dallas Street). The population of the city had peaked in the early 1870s, as noted previously, and by 1880 it had lost nearly 25% of its residents. By 1900, Jefferson's population was only 68% of its 1870 size. Consequently, the listing of vacant buildings on Sanborn insurance maps in the business sector is expected. All of the buildings on Block 8 south of Dallas Street were no longer depicted on the 1896 Sanborn. They apparently either had been torn down by 1896 or had succumbed to a fire. After 1896, the entire south section of Block 8 remained without any new structures through the 1932 Sanborn, except for one change. The construction between 1896 and 1901 of the MKT railroad bridge and rail line just grazed the southeast edge of Block 8 (see MKT railroad bridge entry under Area #8 entry). Since 1901, the only other major change was the filling in of the bayou below Block 8 (actually the part falling on Block I) and construction of the current boat ramp since 1960 (see Locality E entry on Buried Section of Pre-1880 Turning Basin).

In light of the fill on blocks adjacent to the steamboat landing and surrounding Block 8, it is expected that the original pre-1850 land surface on the south section of Block 8 is buried under at least 5 to 6 ft of fill close to Dallas Street. This has recently been verified by cores for the north section of Block 8 north of Dallas Street (J. Bagur personal communication; Bill Brannon personal communication; Perttula 1998). The south edge of the south section of Block 8 is estimated to have another 7 to 10 ft of fill. Adding these numbers together and subtracting for the drop in elevation, the depth of man-made fill covering the western bank of the 1872 steamboat landing at the edge of the bayou where it enters Lot 10 of Block 8 is estimated to be at least 7 ft, and possibly as much as 11 ft thick.

There is little doubt that complicated fill sequences and intact footings and piers from mid to late 19th century buildings are buried under Block 8 (c.f., Perttula 1998). Demolition fills created after major fires are also expected in this area. Some of the most interesting deposits associated with early activities in the port and steamboat landing at Jefferson may be preserved under Block 8. This position can be supported by the natural slope of the block depicted on an 1872 birds-eye view and the common practice of filling low areas in urban settings to help drainage and construct foundations. Consequently, the removal of the existing boat ramp, access road, parking lot and other landscape features may have little adverse impact on older archaeological deposits except where they breach post-1900 fills. This position, however, requires checking the depth of fill in selected areas and matching the testing program against detailed plans of proposed landscape alterations and new construction. Backhoe trenches are the most efficient way to check the depth of post-1890 fill since complicated stratigraphy will undoubtedly be encountered.

Unplatted South Section of Block 9 (original steamboat landing site; Area #6)

The original 1846 town plat for Jefferson left the section of Block 9 south of Dallas Street as public land (Figure 4). No lots were platted and the area was probably left open in anticipation of constructing a more sophisticated steamboat landing in the future. Thus, no buildings were standing on the south section of Block 9 in 1872 (Brosius Map 1872). Instead, the 1872 bird's-eye view shows three steamboats docked along the sloped landing site encompassing Blocks 9 and the southern half of Block 10. On the north side of Dallas Street, nine buildings covered the entire north section of Block 9.

The 1846 plat for Jefferson also indicated that the edge of the bayou cut into Dallas Street, probably about 5 to 8 ft from the middle of Block 9 up to the eastern side of Soda Street. As such, the plat placed the natural turning basin about 500 ft east of Polk Street and extending over to Soda Street. The later shape of the turning basin was the result of dredging and enlargements implemented after 1860. The 1872 Brosius depicted a floating steam-driven dredge (i.e., steam shovel) working in the general vicinity of the turning basin and removing sediment from the channel. As a result, the turning basin was enlarged so that it could easily accommodate multiple steamships. Some changes to the bank of the bayou in this area between 1840 and 1890 can be approximated by comparing several maps. The following is a preliminary assessment of these changes from a few of the maps.

Comparing maps from 1846, 1850, 1869, 1872, 1885, 1896, 1901, 1923, 1932, 1950 and the 1962 USGS map indicate that some of the following changes took place. Apparently, the steamboat landing and bayou edge was originally against the east side of Dallas Street in the middle of Block 9 before 1855. Sometime after that date but before 1872, the landing for steamboats was greatly enhanced. Consequently, by 1872 the water's edge at the landing along Block 9 was depicted near the back of the buildings on Block 8. The 1885 Sanborn Insurance map for Block 9 revealed that the edge of the bayou at the landing was 145 ft from the property line forming the east side of Dallas Street. It suggests that the landing had subsequently been built outward into the turning basin by more than 100 ft.

If the above is true and not a product of mapping differences or water level changes, then it may give some insight on the nature of Jefferson's "wharf". The label "wharf" is placed in quotes because there is no cartographic or photographic evidence of free-standing structures built out into the turning basin for mooring boats or loading/unloading cargo. Instead, the documentary evidence found so far clearly describes a *river bank type* wharf. That is, Jefferson had an enhanced river bank that included pilings set over dry land for mooring boats and plank decking for a dry working/loading/unloading surface. The only map found so far to identified the steamer landing area by name was the 1890 Sanborn base map (Moir 1998: Fig. 12). It labeled the north bank of the bayou running from Walnut Street passed Soda Street and stopping about half way to Washington Street as the "Steamer Landing" site. This cartographic reference is made at a point some 18 years after Jefferson's peak in commercial navigation activities. The 1872 Brosius bird's-eye map provides a view of the steamboat landing at the heyday of Jefferson's river boat traffic (Moir 1998: Fig. 9). In fact, five steamboats each about 200 ft long are shown in Jefferson's waterfront area making Big Cypress Bayou look quite capable of handling twice that number.

As noted previously, the easternmost buildings on Block 8 were built on piers making them look like commercial structures standing on a "wharf at low water". The bird's-eye perspective gives an approximate 6 to 7 degree slope to the landing area based on the buildings on Block 8. Since steamboats and other shallow-draft river boats were supplied with long gang ramps, the need for wharves built into the water to load/unload people and goods was unnecessary. Instead, a sloping landing with land-set pilings to tie down boats was all that was needed. The bird's-eye map shows no piers or decking built into the water beyond the edge of the bayou. Thus, the term "wharf" when applied to Jefferson refers to the special construction along the river bank used to facilitate the mooring of steamboats on a river that often fluctuated more than 3 to 6 ft in height. A sloped landing offered an easily means to achieve near level access for any boat at no matter what height the river flowed.

The archaeological deposits on Block 9 may hold the key to understanding the physical design and construction of Jefferson's steamboat landing and waterfront area. If one assumes that the unplatted portion of Block 9 along the south side of Dallas Street was level with the Bayou in 1850, then it would have been at an elevation of about 177 ft amsl (anywhere from 175 to 179 ft). This same part of Block 9 along Dallas Street today has an elevation of about 185 ft amsl just off the lower slope of the man-made levee (or 192 to 195 ft amsl if one uses the elevation of the man- made levee); suggesting that between 5 to 10 ft of fill may have been used to elevate the surface (Figure 6). The slope drops fairly quickly toward the bayou and levels off at about 173.5 ft amsl. This low area may be within a foot or two of the floor of the 1870s turning basin. It could also have been created by post-1900 flood as it scoured downstream of the MKT trestle. Trenches cross-sectioning the area would provide the stratigraphic information needed to identify its origin.

The elevation of this part of Jefferson's waterfront also can be suggested from historical records. The new "wharf" constructed in late 1872 was built following a very specific design noted by a contract filed in July, 1872 (MCD Book Vol. B:585-586). For example, the contract called for the "wharf" to be 20 ft wide and 590 ft long. The structure did not extend into the water, but rather ran parallel to the existing bank of the bayou. The wharf's southwestern end (north face or backside) was to start at a point 70 ft from the south side of Dallas Street at the west edge of Walnut Street. It would then extend toward the bayou 20 ft (i.e., it was 20 ft wide) and follow Dallas Street at an angle such that the wharf's north face would be only 30 ft from Dallas Street's south side and about 290 to 300 ft from the starting point noted above (i.e., west side of Walnut Street). From this mid-point to its far northeastern end 590 ft from its beginning, the "wharf" would curve slightly and end up with its north face 40 ft from Dallas Street (i.e., hence its south face or bayou side would be 60 ft from the south side of Dallas Street).

Among other specifications, the plans noted that the elevation of the front of the "wharf" was to be 2 ft lower than the old wharf. The wharf would slope toward the bayou at 11 to 15 degrees (MCD Book Vol. B: 586). If one compares the suggested slope of the old landing noted above (based on the bird's-eye map), the new "wharf" apparently was designed to match the back grade of the old wharf by increasing its sloping face and dropping the front another 2 ft to make the decking drop about 3.3 ft across the entire width of the new "wharf".

The southern 300-ft of the wharf, however may be more intact. This section may only be under 1

to 6 ft of fill depending on the particular location in question. Some insight is gained from the archaeological testing program by Texas A&M University (TAMU) in 1989 (Carlson 1989). The location of the 1872 wharf transposed on TAMU's base map suggests that the high magnetometer readings may be related to the iron hardware used to construct the wharf. The profile from TAMU's unit suggests that they had not excavated deep enough to uncover the tops of the pilings used to seat the wharf. The elevation for the top of this unit was about 177 ft amsl, although it is not possible to make a precise determination. If this is accurate, then the bottom of the unit reached just below 174 ft amsl and it seemed to follow the upper part of an older stratum at the top of the water table (Carlson 1989:21-25). A smaller section of the unit was taken down into the water table and stopped at about 172 ft amsl. This information suggests that the remains of the 1872 wharf may be buried beneath 4 to 7 ft of fill in this part of the former port area.

Construction of the new wharf in 1872 was timed with two important events. The water level of the bayou at Jefferson was extremely low in July 1872 and remained low for the next 10 months (Bagur n.d.). This would have made wharf construction much easier since it would be built on dry land while the river was well below normal flows. This is probably why the contract to build the 1872 "wharf" included the stipulation that construction would begin within 60 days on the northeasterly most section of the structure (a part that had no previous wharf construction). The second important event that probably helped in construction of the new "wharf" was the operation of a steam driven dredge in the port area. It starting removing river sediment in 1872 and may have helped shape the turning basin along the northeast section of the new "wharf". However, the precise role it had, if any, remains unexamined other than through coincidence, timing and conjecture.

The above briefly reviews some of the history of the unplatted south section of Block 9 from 1846 to 1900. After 1900, the MKT railroad bridge probably greatly added to the natural infilling of the wharves. The small section of the turning basin between Polk and Walnut Streets was landlocked after the rail line was constructed. It was apparently was filled in soon thereafter. The 1906 and later Sanborn base maps do not show this section of the turning basin any more suggesting that it had been filled in. Post-1900 floods also have filled most of the 19th century turning basin with sediment and today the bayou is only 120 ft wide under normal conditions.

Historic Block 10 (Area #7)

Block 10 has two parts that make up the south section, in addition to its north section (Figures 2 and 6). It has both an unplatted and platted part on the south side of Dallas Street. The section on the north side of Dallas Street was platted in 1846 and lies outside the study area's boundary. This entry is focused on all of the parts of the block since a parking lot may be built on the north section. There were no buildings shown standing on the south section of Block 10 in 1872. Archival records, however, indicate that structures had existed in this general area for quite some time prior to 1872. In a lawsuit filed in 1874, one witness noted the old cotton sheds and warehouses that once stood in the area. Consequently, this block has the potential to contain relatively early historic remains related to the port activities of Jefferson. On the north side of Dallas Street in 1872, Block 10 had four or five contiguous structures covering the entire west half of the block. They were one story each and appeared to have large entrances and oversize windows fronting Dallas Street. The east half of the north section of Block 10 had no standing structures.

By 1885, the west half of the north section of Block 10 was occupied by the Phoenix Oil Work's cotton seed oil facility. The plant was steam powered and had a 320 ft long 4 inch diameter pipeline running from under the building to the bayou to draw water for operations and fire protection. This plant continued to be used for the next 15 years. It was no longer standing on the 1906 Sanborn and the block shows few new buildings until after 1920. The Phoenix Oil Works was renamed Thomas M. Smedes on the 1890 Sanborn. The facilities in 1890, however, hadn't changed very much from the 1885 map. The plant's name was changed again on the 1896 map. It was then called the Jefferson Cotton Oil and Refining Companies. The interior layout of the cotton seed oil plant shows a number of differences when compared to the 1885 layout. The plant was not in operation in April 1890 when the Sanborn staff was visiting Jefferson to update their insurance maps.

The 1896, 1901, 1906, 1911, 1923 and 1932 Sanborn maps show no standing buildings on the unplatted south section of Block 10. The 1906 map shows the location of an isolated fire pump in Dallas Street near its intersection with Soda Street. This pump is not shown on the 1911 or any later Sanborn maps. The rail line on the north side of Dallas Street and within the R.O.W. is shown on all Sanborn maps from 1885 to 1932. It is also depicted on the 1962 USGS map. Scales were shown on the 1885 Sanborn map in Dallas Street on Block 10 in the middle of the cotton seed oil plant. A loading platform built into the street was also depicted along the entire front of plant.

Today, the man-made levee covers part of Dallas Street and flood deposits cover the old steam boat ınding on the west half of the south section of Block 10. Even the portion of the turning basin and ,872 wharf constructed along the south side of Block 10 have been filled since 1900. The depth of these deposits would require backhoe testing to check for possible archaeological remains. Since the area was also adjacent to the natural lake that formed before 1840, there may be older historic and even prehistoric cultural deposits beneath post-1890 fills and 20th century alluvium. Any major new construction should be preceded by a testing program that checks the characteristics of buried soils for archaeological remains, evidence of early warehouses, remains of the 1872 new wharf, prehistoric sites or sealed 19th century walking surfaces.

Historic Block 72 (Area 13)

This block has only one small frame building standing in 1872 (Brosius bird's-eye map). It was a one-story building located on the north end of lot 6. As such, it falls outside of the proposed project limit (see Figure 2). An early trail or road, however passed across the upper part of Block 72 and was shown on the first town plat of Jefferson issued in 1846 (see Figure 4). Other resources located on Block 72 have been discussed in the entries for Locality C (enhanced drainage channel), Reference Points R5, R6, R7, R8 and R9, and Areas #3 (possible pre-1890 historic remains buried on small rise) and #11 (pre-1940 pilings and piers). The ridge connected to the small rise at Area #3 extends along the southern edge of Block 72. The discussions devoted to each of the resources noted above should be reviewed in order to clear Block 72, should the project move to next phase.

Historic Block 73 (Area 14)

This block has several potentially important archaeological resources, in addition to natural

resources, that may have attracted historic and prehistoric occupations. Nine building are shown standing on the block in 1872. Not all of them fall inside the project limits. In fact only three stand within the proposed project area (Figure 2). The same early road noted for Block 72 also passed across the lower part of Block 73 (Figure 4). It ran just south of a seep observed near the center the block. Other resources located on Block 73 have been discussed in the entries for Locality C, Reference Points R2, R3, R14, and R17, and Areas #1 (19th century historic site, well, etc.) and #10 (small barn). The discussions devoted to each of the resources should be reviewed in order to clear Block 73, should the project move to next phase.

Historic Block 84 (Area 15)

Only the eastern portion of this block is in the project area (see Figure 2). As such, there is only one building standing in the project area in 1872. It is a large two story house with back addition or extension (Moir 1998: Fig. 9). Deed/Title information indicates that the house was built by A.B Gouldy in about 1871. The property became embroiled in a lawsuit in 1873 and a map was made of Gouldy's tract along with St. Catherine's Island. Figure 17 shows the premises occupied by Gouldy and documents note that the property contained a house and several barns. Test excavations should be conducted on Block 84 ahead of any impacts to check for and evaluate any buried archaeological deposits. The early road noted on Blocks 72 and 73 also passed through Block 84, but it is primarily outside the project area except for lots 1 and 2 (c.f., Figures 2 and 4). Finally, this block is close to the bayou and also has a small rise on a ridge overlooking the channel. This ridge has Locality A and testing has been recommended to check several anomalies noted in the field (see Locality A entry).

Natural Landforms or Topographical Features with Archaeological Potential

Table 4 lists seven localities (Localities A to G) that have potential to contain buried archaeological deposits. The following entries discuss the observations that led to these designations.

Depression Feature and Non-Native Cultural Vegetation (Locality A)

The small, but prominent knoll (Figure 5; Locality A) in this area has several non-natural features that ought to be examined in greater detail should any improvements be planned at this location. A rectangular depression about 3 by 4 m and at least 0.5 to 0.75 m deep has been cut into the northwest flank of the knoll. Three soil cores in the area did not reveal any buried cultural material or darkened strata, but a comprehensive check was not performed. About 7 to 12 m northeast along the crest of the knoll from the depression were prickly pear cacti and some other introduced old thorny plants (roses?). Soil probes did not reveal any darkened stains, but could only check the upper 87 cm (34 inches). Instead, all soil cores along the knoll revealed fairly homogeneous fine to medium sands without obvious evidence of any visual soil development. It is possible that very wet ground conditions at the time may have obscured minor soil color or texture differences. Near the bottom of several cores, highly saturated soil was present due to high water level in the nearby Big Cypress Bayou.

Small Rise in Floodplain (Locality B)

A small rise was noticeable on the floodplain toward the southern end of St. Catherine's Island (see Figure 5, Locality B). It rises about 4 ft above the surrounding terrain. A second small rise was noticed about 450 ft northwest of this one and was given the Area #3 designation since it contained historic artifacts on the surface (see Area #3 entry). The shape of the rise at Locality B and its proximity to the bayou give this feature the potential to contain archaeological deposits. It may have attracted the interest of prehistoric people, as well as early historic travelers passing through the area before 1840. A proposed haul road will pass by the rise at Locality B. Testing should be deep enough to address older prehistoric strata beneath the rise if it is a late Holocene landform.

Enhanced Drainage Channel (Locality C)

The well defined gully on the eastern side of Block 73 that widens and cuts diagonally across the Market Street location (Market Street is non-existent east of Block 73) does not look natural. It appears to have been widened where it cuts through the middle of Block 72 (Figure 5). By Block H (Figure 2), it appears to have been expanded to a width of nearly 150 ft. If this is the case, the depth of soil removal was probably no more than 3 to 4 ft from the area east of the current access road. The sediment may have been used to construct the 15 ft high flood protection levee constructed after 1947.

Soil cores extracted from the northern part of Block H and inside the man-made levee appeared to display natural alluvial sequences. They revealed inter-bedded sandy silts and clayey silts along the 182 to 186 ft contour surface. One soil core encountered very dark clay loam about 30 inches below the surface about 150 ft east of where Vale Street would cross Lake Street if each was extended (Reference Point R9). The color was reminiscent of occupation-induced and organic enriched soil indicative of a site. The core was taken at about 176.5 ft amsl and the buried band observed in the core was at about 174 ft amsl. No artifacts or other evidence of human occupation were observed and no test units were excavated.

The buried stratum at Reference Point R9 will likely be impacted by the proposed restoration work. In particular, the impounded wetland proposed for this area would certainly affect the long-term preservation and integrity of the stratum should it also contain important archaeological remains. Also, piers may be set for boardwalks in this area and they could create local impacts. Consequently, additional soil coring when the boardwalk is surveyed and staked on the ground should identify whether further testing may also be warranted (see concluding recommendations). Certainly, a few test units and backhoe trenches are needed in this area to determine if any potentially important archaeological deposits are present.

Delineation of St. Catherine's Island (Locality D)

The environmental history of St. Catherine's Island offers another small chapter in the evolution of Jefferson's waterfront and port. It is briefly noted in early legends and some have suggested that when Jefferson's main port was overload, smaller boats would use parts of it to moor or unload goods. Consequently, it offers yet another piece for building an interesting interdisciplinary outdoor

interpretive history and environmental program along the proposed boardwalks. It can be used to highlight pre-settlement and 19th century natural landscape feature of the area. The island may also contain some very ephemeral kinds of historic archaeological deposits related to brief encampments by travelers and boat crews before 1855. These kinds of remains may consist of hearth pits and small camp sites requiring carefully excavation due to their short term use. The alluvial sands on the remnants of the island today may have sealed sites under 1 to 3 ft of soil. While flood scouring is also expected, the island has a potential to contain very informative 19th century deposits and even prehistoric sites.

St. Catherine's Island is no longer demarcated by an active channel west of the present channel of Big Cypress Bayou (Figure 4). As late as 1896, however, it was shown on the Sanborn base map by dashed lines and the label "Old Course of Bayou Filled at High Water" (1896 Sanborn base map; see Moir 1998: Fig. 7). The channel was 200 ft wide and about 1,600 ft long running diagonally from Market Street and the bayou to about 200 ft beyond Walnut Street at about mid-way between Lake and Camp Streets. Today, few people realize that the northeastern most tip of the island extended about 240 ft downstream from the old MKT railroad bridge. Figure 7 given earlier shows the approximate course of the old channel and the approximate outline of the remains of St. Catherine's Island (see also Moir 1998: Fig. 5 and Fig. 6).

The earliest detailed outline of St. Catherine's Island is the 1846 town plat for Jefferson (Figure 4). It depicted a lenticular-shaped island as roughly 1,770 ft long (north-south axis) by about 400 to 450 ft wide along its middle section (east-west axis). An 1850 map shows the island in a similar form although its overall shape is more prismatic than curving (Moir 1998: Fig. 6). The island was formed by splitting the bayou channel into two channels just ahead of the turning basin. The western channel defined the west side of St. Catherine's Island and the main channel formed the east side of the island. When the water level of Big Cypress Bayou dropped in 1872, the western channel was left dry only to be filled with water when the bayou was high.

The northeastern tip of St. Catherine's Island on the 1846 plat protruded just beyond the middle of Block 9 if it was projected onto the north bank of the bayou parallel the street system. Comparing maps from 1846, 1850, 1872, 1885, 1896, 1901, 1923, 1950 and 1962 indicates that the northeastern 30% of the island has been the most severely altered section. Based on the mid-1800s maps, the island extended northeast beyond the Polk and Camp Street intersection by about 500 ft (see Fig. 4 and Moir 1998: Fig. 7). Today, the eastern side and northern end of the island appear to have been removed by dredging and channel migration (Figure 6). The western side of the island south of its northern tip and north of Polk Street may be preserved under 20th century fills in the vicinity of the current boat ramp and older MKT railroad bridge. Of course, a section of the island is also preserved beneath the embankment used to construct the Polk Street Bridge and nearly the entire island is intact south of Polk Street. The only major change to the large remnant of the island upstream from Polk Street is the loss of its southern-most tip and part of the eastern bank due to channel migration since 1870 (Figure 5).

As noted above, the island may contain early historic and even older prehistoric remains in its deposits. It may also contain some special kinds of historic sites related to water travel through the area using portable crafts and canoes before 1845 (see Area #3 write-up for further discussion of pre-

845 "transient" sites). Finally, the abandoned and filled channel along the relict island's west border may contain 19th century historic debris, well preserved in waterlogged silts. This channel may be the only section of Big Cypress Bayou used during the mid to late 19th century that was not subsequently greatly disturbed by dredging. Consequently, the construction of water retention weirs, boardwalks, and new buildings on piers within the former boundaries of St. Catherine's Island should be preceded by soil cores and selected testing to check for archaeological remains. All testing should exceed the depth of any proposed adverse impacts by at least 1 to 1.5 ft to account for subsequent compaction.

Buried Section of Turning Basin/Stranded West Channel of Bayou (Localities E and F)

The channel of Big Cypress Bayou formed a natural lake next to Jefferson in the early to mid-nineteenth century. The bayou was navigable from Caddo Lake and the Red River during normal flows except for fallen trees and small sections of debris clogged channel. Navigation upstream from Jefferson was not easily accomplished making the town site the logical head of navigation in the Cypress drainage basin. Furthermore, the natural lake at Jefferson offered an excellent place for turning steamboats around, which is why it soon became known as the turning basin.

The turning basin depicted on the 1896 Sanborn base map was roughly 510 ft wide (east-west axis) by 380 ft (north-south axis). The earliest outline of the water filled natural basin is found on the 1846 town plat for Jefferson. It was roughly 400 ft (east-west axis) by 180 ft (north-south axis). Before 1865, the bayou just upstream from the basin formed two separate channels each about 60 wide (Figures 5 and 6). The western channel defined the west side of St. Catherine's Island and the main channel formed the east side of the island. When the flow level of Big Cypress Bayou dropped in 1872, the western channel was left stranded and only filled with water during floods.

This stranding of the western channel along St. Catherine's Island has left several questions still unanswered today. That is, we do not know whether the stranded channel was, in fact, an older relict channel that was recaptured by the bayou in the very recent past (i.e. reactivated since 1770?) or if it was a newly forming channel started since the creation of Caddo Lake and only filled during high water? In either case, the western channel could help environmental historians understand better the post-1750 evolution of Big Cypress Bayou and its natural turning basin feature.

The nature and characteristics of the sediments buried beneath the western channel may hold the key to discriminating between the two hypotheses. If they consist of very old filled channel deposits much deeper than the 1850 channel thalweg for Big Cypress, then they would support the relict channel scenario. But, if they consist of fine alluvial sediments cut through by the much younger post-1770 shallow channel, then they would support the nascent channel scenario. Consequently, examination and delineation of the now abandoned channel could offer some additional information for creating an interdisciplinary outdoor interpretive program along the proposed boardwalks that discusses both flora and fauna, as well as the natural landscape and recent geomorphological evolution of the study area. As such, the abandoned channel offers a wonderful opportunity to enrich the outdoor interpretive program at little extra expense.

These areas may contain both intentionally discarded shore-related refuse, as well as debris cast from smaller boats traveling on the western channel of the river before 1870. Any heavier material

deposited in the turning basin would have been buried in its muddy bottom and sealed after the basin was filled. After 1870 and still continuing up to the present, the stranded channel has received additional sediment and possibly some new scouring during major floods. The cumulative effect, however has been the filling in of both the stranded western channel and the western part of the turning basin by alluvium and flood deposited sediments. Consequently, any landscape alterations in this area will require checking the nature, origin, depth and potential cultural contents of the filled stranded channel on the west side of St. Catherine's Island and the buried part of the turning basin.

Finally, the many alterations to Jefferson's boat landing and turning basin from the 1850s to 1900 do not rule out the use of common techniques used at other ports. Erosion along riverbanks at ports elsewhere has sometimes resulted in the use of very expedient techniques to stabilize problem areas. Worn out boats were commonly sunken in place to help solve navigation problems or even create temporary wharves. While there is no evidence to date that Jefferson's water front projects ever resorted to using these kinds of techniques, there is also very little known about the kinds of pre-1870 alterations made to the turning basin and bayou channel. At best, the waterlogged sediments of early port and landing projects may contain well preserved wooden materials and other organic debris seldom found in the soils of land-based archaeological sites.

Reference Points Denoting Other Field Observation

The field survey encountered other kinds of resources or natural features that are of interest. These are discussed in detail in Moir (1998). They include such features as natural springs, post 1920 refuse and the Camp Street fills, railroad spur lines, among others.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

A reconnaissance survey of the Jefferson environmental restoration study area yielded eight observable historic resources and 15 loci with good potential to contain buried archaeological deposits (Table 5). The identification of potential site loci was based on settlement information, landform characteristics, archival data and previous archaeological work in the area (Tribble 1983; Carlson 1989; Perttula 1998). Such data indicate that much of the project is blanketed with alluvium and post-1880 fills that cover older surfaces and deposits. Therefore, the proposed restoration actions will have little adverse impact unless they penetrate these recent deposits and disturb important archaeological remains. This section summarizes various potential impacts based on plans provided to date. Should there be design changes or an expansion of the project into adjacent areas, CESWF will address such revisions and apply the appropriate measures necessary to maintain compliance with historic preservation regulations.

Archaeological and Architectural Resources

Table 5 summarizes the resources and localities by category. They include two architectural resources (a 1901/07 iron truss bridge and a ca. 1917 water tank); three architectural ruins (remains of pre-1940 structures categorized as archaeological properties); three evident archaeological sites (i.e., areas with exposed archaeological remains); nine areas with good potential for buried archaeological deposits and/or sealed pre-1890 surfaces and six locations where natural landforms

ave good potential to contain associated archaeological deposits. The iron truss bridge is regarded to be eligible for the National Register (see separate letter from CESWF). The only other architectural resource, a ca. 1917 water tank, will require addressing eligibility concerns in future phases as noted elsewhere. The three pre-1940 architectural ruins lacking structural integrity have been treated as archaeological resources. They include a partly collapsed small barn/shed (recommended not eligible), two concrete abutments from a dismantled railroad bridge (recommended not eligible), and several clusters of piers presumably from a raised wooden walkway built before 1920 (NR status unknown at this time).

TABLE 5

INVENTORY OF ARCHAEO LOGICAL AND ARCHITECTURAL RESOURCES AND LOCATIONS EXHIBITING GOOD ARCHAEOLOGICAL POTENTIAL

Archaeological And Architectural Resources Observed in the Field

Archaeological Resources with Observable Remains (Potential Sites; n=6)

Area #1 19th Century Historic Site and Associated Landscape Features
Area #2 (Possible Site/Sites): Long Linear Band of Buried Building Debris
Area #3 (Possible Historic Site): Pre-1890 Buried Historic Debris
Area #10 (Architectural Ruins): Twentieth Century Small Barn/Shed
Area #11 (Architectural Ruins): Several Clusters of Pre-1940 Pilings/Piers
Area #12 (Architectural Ruins): Industrial Railroad Bridge Abutments (concrete)

Architectural Resources (Structures and Partial Ruins; n=2)

Area #8 (Historic Structure): Iron Truss Railroad Bridge (ca. 1901/07)
Area #9 (Historic Structure): Reinforced Concrete Holding Tank (ca. 1917)

Locations With Good Potential To Contain Buried Archaeological Resources

Areas with Good Potential for Buried Archaeological Deposits and Surfaces (n=9)

Locality A: Man-made Depression and Non-Native Cultural Vegetation
Area #4 (Possible Site/Sites): Historic Town Block 7 (south section)
Area #5 (Possible Site/Sites): Historic Town Block 8 (south section)
Area #6 (Possible Site/Sites): South Section of Block 9 (original landing site)
Area #7 (Possible Site/Sites): Historic Town Block 10 (south section unplatted)
Area #13 (Possible Site/Sites): Historic Town Block 72
Area #14 (Possible Site/Sites): Historic Town Block 73
Area #15 (Possible Site/Sites): Historic Town Block 84
Area #16 (Possible Site/Sites): Historic Town Block 10 (north section platted)

Natural Features or Landforms with Good Archaeological Potential (n=6)

Locality B: Small Rise Protruding about Four Feet (ca. 1.2 m) above floodplain
Locality C: Enhanced Drainage Channel
Locality D: Historic St. Catherine's Island
Locality E: Buried Portions of the Pre-1880 Turning Basin
Locality F: Big Cypress Bayou's Stranded West Channel

In addition to the three architectural ruins, archaeological resources also included three possible 19th century historic sites judging from surface evidence and nine other areas where possible 19th century historic archaeological remains or even older deposits may be buried. They include parts of five city blocks platted in 1846 and containing numerous standing buildings in 1872 (Blocks 7, 8, 10, 72, 73; Moir 1998: Fig. 9). Fortunately, only one block with good archaeological potential will be disturbed by proposed restoration actions (Block 8). Finally, six natural features or landforms with potential to contain archaeological remains also were identified and will require testing if they are impacted. Table 6 identifies known architectural and archaeological resources that might be adversely affected by environmental restoration tasks. Table 7 lists archaeologically sensitive areas/landforms where testing needs to be conducted to evaluate any possible adverse impacts to buried resources if present. Finally, Table 8 list resources or potentially sensitive locations not expected to be impacted by current design plans. Should the environmental restoration project move beyond the feasibility stage, then a comprehensive program to determine age, characteristics, integrity, site/resource boundaries, research significance and National Register status for sites, architectural ruins and standing structures is recommended. Areas with good potential to contain buried archaeological deposits should also be examined especially where proposed new construction will impact the landscape.

The archaeological resources and sensitive landforms can be divided into three categories: (1) resources/localities requiring formal evaluations in order to document them and assess their importance (Table 6), (2) resources/localities where there is good potential for buried archaeological remains based on archival data and landform setting (Table 7), and (3) resources/localities that may not be adversely affected by any currently proposed actions (Table 8). Future testing and evaluation procedures will be implemented to assess each resource/locality on a case-by-case basis should the project move beyond the current feasibility stage. The areas where the potential exists for deeply buried archaeological deposits or sealed surfaces are discussed next.

TABLE 6

IDENTIFIED CULTURAL RESOURCES AND PROPOSED PROJECTACTIONS RESULTING IN POTENTIAL IMPACT

RESOURCE CATEGORY	AREA/LOCALITY	PROJECT ACTION(S)
Archaeological	Area #2 (Historic)	Construction of raised access route[3]
	Area #3[3] (Historic)	Construction of raised access route[3]
	Area #5 (Historic)	Removal of existing boat ramp facilities[2]
	Area #10 (Historic Ruins)	Removal of non-essential structures
	Area #11 (Ruins: piers, etc.)	Construction of raised access route[3]; Construction of earthen berm weirs[1]; Creation of new raised wetlands behind weirs; Removal of current road to St. Catherine's Island
	Area #12 (RR bridge abutments)	Removal of non-essential structures; new boat ramp & facilities within & on levee.
	Locality D (St. Catherine's Is.)	Removal of existing boat ramp facilities[2]
	Locality E (Buried pre-1880 Turning Basin)	Removal of existing boat ramp facilities[2]
	Locality F (Stranded channel)	Removal of existing boat ramp facilities[2]
Architectural	Area #8 (Iron Truss Bridge)	Adaptive reuse of historic property

[1] Weir construction actions include weir-related haul roads and two earthen berm weirs. Ground preparation disturbances and cutting and filling may be expected. A special cut to the natural levee is also anticipated.

[2] Includes grading and recontouring the property and possibly the construction of new public landscape enhancement features.

[3] Possibly impacted based on conceptual designs for proposed development (Appendix F).

Potential for Buried and Sealed Archaeological Deposits

In addition to the visible archaeological resources identified, the study area has localities that have strong potential to contain important buried archaeological deposits and sealed surfaces. Previous test excavations in the general vicinity have revealed thick fill sequences covering older historic deposits (Tribble 1983; Carlson 1989; Brannon personal communication; Perttula 1998). Some of these fills were deposited by human activity while other sediments were the result of hydrological and fluvial-geomorphological processes affected by man-made landform alterations. For example, post-1895 man-made embankments (MKT railroad, Polk Street extension and bridge, Camp Street fill) constricted the width of Big Cypress Bayou in the study area and, thus, altered its hydrological regime during high water flows. As a result, these changes contributed to the deposition of stream-borne silts and sands on lower floodplain elevations and, in turn, added to the filling in of much of the turning basin.

TABLE 7

LANDFORMS WITH GOOD ARCHAEOLOGICAL POTENTIAL REQUIRING CLEARANCE PRIOR TO PROPOSED ACTIONS

CONSTRUCTION OF EARTHEN BERM WEIRS[1]
- Locality B: Small Rise Protruding about Four ft (ca. 1.2 m) above floodplain
- Locality D: Historic St. Catherine's Island
- Locality F: Big Cypress Bayou's Stranded West Channel

REMOVAL OF OLD ACCESS ROAD TO ST. CATHERINE'S ISLAND
- Locality B: Small Rise Protruding about Four ft (ca. 1.2 m) above floodplain
- Locality C: Enhanced Drainage Channel
- Locality D: Historic St. Catherine's Island
- Locality F: Big Cypress Bayou's Stranded West Channel

CONSTRUCTION OF RAISED WOODEN ACCESS RAMPS FOR WEIR
- Locality C: Enhanced Drainage Channel
- Locality D: Historic St. Catherine's Island
- Locality F: Big Cypress Bayou's Stranded West Channel

REMOVAL OF EXISTING BOAT RAMP FACILITIES[2]
- Locality D: Historic St. Catherine's Island
- Locality E: Buried Sections of the Pre-1880 Turning Basin

Locality F: Big Cypress Bayou's Stranded West Channel
Area #5: Historic Town Block 8 (south part; also reputed first landing area)

NEW PARKING LOT FOR BOAT RAMP (OUTSIDE OF LEVEE)
Area #7 (Historic Archaeological): Historic Town Block 10 (north section)

CREATION OF NEW RAISED WETLANDS BEHIND WEIRS
Locality C: Enhanced Drainage Channel
Locality D: Historic St. Catherine's Island
Locality F: Big Cypress Bayou's Stranded West Channel

CONSTRUCTION OF OTHER RAISED ACCESS WALKWAYS[3]
Area #5 (Historic Site/Sites): Historic Town Block 8 (south section)
Area #6 (Historic Site/Sites): South Section of Block 9 (original landing site)
Area #7 (Historic Site/Sites): Historic Town Block 10 (south section)
Locality B: Small Rise Protruding About Four ft (ca. 1.2 m) above floodplain
Locality C: Enhanced Drainage Channel
Locality D: Historic St. Catherine's Island
Locality F: Big Cypress Bayou's Stranded West Channel

[1] Weir construction actions include weir-related haul roads and two earthen berm weirs. Ground disturbances and cutting and filling may be expected.
[2] Includes grading and recontouring the property and possibly the construction of new public landscape enhancement features.
[3] Possible impacted resources based on conceptual designs for proposed development.

A preliminary comparison of nineteenth century maps and the bayou today indicates that about 50% of the late nineteenth century turning basin has been filled by sediments. Topographical maps compiled for the feasibility study suggest that much of the turning basin is buried under 4 to 9 ft of alluvial sediment, channel fill and major flood deposits. In addition, alluvial sediments and levee sands appear to cap St. Catherine's Island and also cover many older floodplain surfaces in the lower elevations of the study area. In addition to the alluvial fills, several parts of the study area have been raised by man-made fills deposited since 1860 (e.g., see Pertulla 1998). A number of the blocks and lots along Lake and Dallas Streets have had their ground surface raised to make them less prone to seasonal flooding. As such, original walking surfaces and older foundations have been buried by three to ten feet of fills since Jefferson was platted in 1845. Archival records and maps indicate that some of these blocks once had 5 to 10 buildings standing on them in the 1870s (e.g., Blocks 7, 8, 72 and 73 on the 1872 Brosius map).

TABLE 8

OBSERVABLE SITES, POSSIBLE SITE AREAS AND ARCHITECTURAL RESOURCES NOT IMPACTED BY ANY PROPOSED DEVELOPMENT BASED ON CURRENT PROJECT INFORMATION

Areas with Visible Archaeological Remains
Area #1: 19th Century Historic Site and Associated Landscape Features

Localities with Good Potential for Buried Archaeological Sites
Locality A: Man-made Depression and Non-Native Cultural Vegetation
Area #4 (Possible Site/Sites): Historic Town Block 7 (south section)
Area #6 (Possible Site/Sites): South Section of Block 9 (original landing site)
Area #7 (Possible Site/Sites): Historic Town Block 10 (south section)
Area #9 (Architecture): Reinforced Concrete Holding Tank (ca. 1917)
Area #13 (Possible Site/Sites): Historic Town Block 72
Area #14 (Possible Site/Sites): Historic Town Block 73
Area #15 (Possible Site/Sites): Historic Town Block 84

Localities Where Natural Resources Have/May Have Related Associations
Locality G: Cottonwood Tree

ese kinds of landscape changes underscore the need to use a special backhoe/trenching program to unravel urban land surface sequences and micro-stratigraphy. The program would search for and evaluate buried surfaces and sealed deposits in those parts of the study area that will be adversely impacted. Field work would require recording and interpreting detailed stratigraphic profiles, identifying buried surfaces, finely dating historic fills and recognizing major flood sequences. It is possible that pre-1840 surfaces and depositional units may contain prehistoric artifacts and intact prehistoric sites.

Anticipated Adverse Effects Based on Current Restoration Plans

A summary statement of anticipated construction measures along with conceptual design schematics for restoration improvements conceived in 1996 were received from CESWF staff as a part of the scope of work for this study. These preliminary plans provided information on several proposed construction items (e.g., habitat restoration areas, weirs, possible dredge/fill area, proposed ox-bow restoration and maintenance roads) and delineated an approximate boundary for the project. More detailed plans were received subsequently and the following subsections take into account these latest planning documents. The entries identify potential adverse impacts anticipated in the vicinity of archaeological sites, historic structures and areas with good potential to contain buried archaeological resources. It is also clear that design refinements and project changes may continue as a part of the feasibility process. They should be reviewed by CESWF technical staff (cultural ources personnel) to see if additional archaeological tasks are necessary where impacts occur in haeologically sensitive areas.

A review of the proposed restoration tasks has indicated the following. First, many of the proposed environmental improvements and alterations will probably have very limited to no adverse impacts on intact buried cultural deposits, since the undertakings may not penetrate through modern fills or recent alluvium. In other cases, the land surface will not be physically altered. For example, some restoration tasks will involve thinning existing vegetation and removing exotic plants to enhance the quality of the plant communities and forests. This may entail opening up the existing canopy to encourage the growth of desirable trees (hard and soft mast varieties) and removing unwanted trees. A complete review of the methods for removing vegetation has not been performed. This kind of work will likely not be a major problem for buried resources unless haul roads are needed to remove materials or unwanted tree stumps are ripped out.

More significant adverse impacts are anticipated in several other areas of the proposed project. Special archaeological testing programs should be designed to match both deeper construction impacts (i.e., boat ramp removal, new boat ramp construction or weir construction areas) and locations where other types of adverse impacts are anticipated (e.g., wetland enhancement).

Removal of Existing Boat Ramp

Proposed plans call for removing the existing boat ramp between Polk Street and the iron truss railroad bridge. These changes would probably have limited adverse impact on older deposits since it is presumed that much of the ramp has been constructed on fill covering the southern end of the turning basin and a section of St. Catherine's Island. The depth and contents of these fills, as well as the existence of any remnants of St. Catherine's Island in this area are unknown. Consequently, a few properly placed backhoe trenches excavated to exceed the depth of any disturbances proposed in the area will provide the information needed to clear the area nearest the bayou.

Archaeological deposits, early man-made fills related to the first landing site and buried foundations from many pre-1880 buildings are expected to be preserved on the upper section of the existing boat ramp area, which includes portions of Block 8 (see subsection on Block 8 sites for details). The testing program for south side of Block 8, therefore, should be focused on determining whether the proposed demolition and new construction will adversely impact any significant archaeological remains. The answer requires checking several locations to measure the "buffer zone" created by existing post-1890 fills. One also needs to understand the widely varying original topography in this area and where it may intersect or come close to the land surface today. Accurate information on impact zones and the depth of proposed undertakings will be very important to check for possible adverse impact to buried resources.

Finally, the lowest section of the ramp where boats are currently launched may have very shallow fills or none at all. The flattened area at the bottom of the boat ramp may retain some of St. Catherine's Island. A detailed review of proposed landscape alterations and pre 1900 maps should indicate which areas need trenching to determine if older deposits will be impacted.

The Proposed New Boat Ramp

Construction of a new boat ramp is proposed for the north end of the project area. It would be

cated where the city's present water intake structures are found. Jefferson plans to abandon this intake facility in the near future. The new boat ramp location should be beyond the northern end of the 1872 wharf. The area may have contained some pre-1880 warehouse structures and sheds. Testing should be conducted in new construction areas to determine whether older intact cultural deposits exist below post-1900 alluvium inside the man-made levee.

In addition, a proposed parking lot for this new boat ramp will be placed west of the existing levee. Testing should also be done to clear that area when its final location is selected. Several major 19th century buildings once stood on the north side of Dallas Street and planners may wish to review the findings for Block 10 presented earlier in this report before making a final selection. There is also the possibility of prehistoric materials on the older and higher terrace edge along the bayou in this vicinity. The testing program, therefore, should involve units excavated to a depth that exceeds the proposed impacts, since compaction will affect any underlying cultural deposits.

Finally, a pre-1885 railroad spur was located on the levee flank, but it has since been covered by later rail beds and the modern man-made levee. A scale for weighing boxcars was shown on the 1885 Sanborn map and its location has since been covered by the west flank of the man-made levee. Consequently, the initial construction of the railroad spur in the 1880s would have buried the surface of the ground and sealed it from later disturbances and debris. Since it is located not far from the northern end of the 1872 wharf, the rail bed also may have sealed some important deposits related to steamboats and their cargo activities. Artifact densities would probably be light and one should look for important kinds of remains to recognize the special use of the property before 1880. Any artifacts from Jefferson's steamboat era, whether wharf or cargo related debris would be highly valued by local citizens as a tangible part of their river port heritage.

Weirs and Wetlands

Two weirs placed about 650 ft apart are proposed in the restoration project area. Plans call for construction of the longest weir just south of Polk Street and tied directly to its embankment. It will consist of a compacted earthen berm about 280 ft long designed to retain water and create waterlogged, marshy environments throughout the year. The wetland will cover about 3 to 4 acres and retain water for longer periods than what currently occurs naturally. Impacts associated with this weir include its physical construction (surface preparations, heavy equipment, and some minor cut or fill areas), related haul roads and the future bioturbation anticipated from crayfish and other wetland associated fauna. The weir may actually sit on an older truncated surface of St. Catherine's Island. It appears that the upper portion of this middle section of the island may have been removed when the Polk Street bridge was improved after 1950. A few test units and deeper trenches should provide a look at the stratigraphy of the island and the contents of its soil. Evidence of prehistoric use of the island may be encountered and testing should address this point as well.

The proposed large new wetland area requires some additional attention to clear its footprint. It may cover some older terrace deposits containing sealed surfaces or archaeological remains. A soil core encountered some suspicious looking stratigraphy along the northwest side of the proposed wetland linking the man-made levee. Also, the eastern-most wetland finger heading just along the west side of St. Catherine's Island should be cross-sectioned, since it may be the relict channel noted on mid-

19th century maps. The channel was abandoned by 1869 based on historic maps. Prior to that period, it was depicted on 1845 and 1850 maps with water in its channel. It is not known how deep the water was in the channel.

This abandoned channel may contain some well preserved pre-1870 archaeological debris sealed in its thalweg related to early steamboat and smaller watercraft activities. A couple of properly positioned backhoe trenches cross-sectioning the channel should reveal its filled profile and provide a sample of any buried contents. Based on such findings, a more thorough review of possible adverse impacts may be determined.

The smaller south weir should be similarly addressed. It presumably closes the southern end of the same relict channel discussed above. The short section to be closed will impact far less than its counterpart to the north. However, a trench will be dredged cutting through the natural levee in order to insure that the wetland is provided with adequate flow from the bayou. The haul roads, proposed levee cut and the footprint for this southern weir will need to be tested to determine whether any archaeological remains are present and/or may be disturbed.

Removal of Dirt Access Road and Embankment

The restoration proposal also calls for the removal of the existing dirt access road to St. Catherine's Island and any new construction-related roads after the weirs are built (the raised maintenance roads/walkways will, of course remain to service the weirs). The current and only access road to St. Catherine's Island has a 40 ft wide embankment that extends into the study area after leaving the man-made levee. The embankment rises up to 10 ft above the adjacent floodplain and then merges with the surface of the ground about 250 ft east of the man-made levee. The buried contents of the floodplain on either side of the access road's embankment have not been tested. It appears that the upper 3 ft of the floodplain just 50 ft southeast of the eastern toe of the levee has been removed for a linear section extending about 550 ft southwest of Polk Street. The alluvium may have been used in constructing part of the levee's skirt. The deeper gully that runs northwest toward the end of Market Street on the west side of the access road also seems to have been excavated and widened. If the floodplain truly has been truncated by post-1950 construction in this area in the past, it indicates that older deposits may be covered by a very thin veneer of recent alluvium.

A seep (relict spring?; see Locality D in Findings Section) was observed just about 400 ft from the embanked access road. It creates a natural resource that may have drawn the interest of prehistoric people, as well as early historic travelers through this area. Consequently, the floodplain and older terrace deposits on either side of the access road should be tested to determine if construction equipment would disturb any older deposits under the road. The depth of anticipated impacts should be increased to take into account potential wet conditions when the access road's ramp is removed. The removal of the dirt ramp may be implemented if no archaeological deposits worthy of greater investigation are encountered immediately adjacent to the road, then.

Raised Access Walkway for Maintaining and Servicing Weir

Nearly 2,000 linear feet of raised access walkway are planned upstream of Polk St. as a part of the

nvironmental restoration work (i.e., for weir maintenance). More raised walkways are also proposed downstream, but detailed engineering plans have not been completed. They may include observation platforms and special exhibit areas and some of these additional features also may be added to the walkways upstream from Polk Street. The impacts from any disturbances related to these walkways or the overall project in general will also be handled on a location-by-location basis.

Plans for the weir-maintenance walkways call for two (2) foot diameter piers placed about 8 ft apart and sunk about 5 ft into the ground. The walkways will be at elevations of about 181 to 182 ft amsl. Determining whether pier impacts are adverse or not requires knowing their locations and checking sensitive areas well ahead of construction. The design specifications and final locations for the construction of these walkways, observation platforms and exhibit areas will require detailed review to answer impact questions. Recent alluvial sediment and natural levee sands may extend deep enough to negate any adverse impacts on some landforms. On other more sensitive landforms, prior testing may identify buried archaeological remains that require evaluation and treatment prior to the setting of large piers. A case-by-case evaluation of pier locations coordinated with CESWF technical staff will determine the appropriate testing program for the proposed walkways once a design is finalized.

Final Comments

The cultural resources reconnaissance survey conducted by HPCS under the direction of the US Army Corps of Engineers, Fort Worth District has made an inventory of known and possible archaeological and architectural resources in the feasibility study area. Archival, informant and a pedestrian survey of the entire study area has produced a list of 30 historic resources predating 1950. In addition, previous excavations both in the study area (Carlson 1989, Tribble 1983) and recently adjacent to the earliest landing site (Brannon personal communication; Perttula 1998) have encountered post-1890 fills covering even older fills and earlier deposits.

The work performed has focused on archival data and an examination of current landforms to evaluate the potential of the project area to contain sealed surfaces and buried archaeological deposits. In the process, evidence of six archaeological sites and over 15 locations with good archaeological potential were identified in addition to the inventory of architectural properties. The next phase will require a comprehensive testing program in areas subject to impacts to check the contents and characteristics of both known site locations and likely areas containing archaeological deposits. It will require backhoe trenching, geomorphological assessments, additional historical research and the recovery of meaningful samples from archaeological deposits.

The next phase for cultural resources investigations should consist of three basic tasks. First, effort should be focused on National Register eligibility evaluations and anticipated adverse impacts on historic properties within the final boundaries of the project. Second, in areas where adverse impacts can be anticipated test trenches should be excavated in those locations where there is a high potential for sealed surfaces and/or buried historic and/or prehistoric sites. Third, archival research should be continued as support to the first two tasks at a level needed to resolve site eligibility issues and gather additional important contextual information.

Subsequent investigations will include Phase I and Phase II actions at sites. This step will require a limited testing program to determine site boundaries, assess site integrity and obtain a small sample of artifacts and features present at each effected site. A research design would be compiled to address proposed testing techniques and indicate the amount of coverage necessary to fulfill historic preservation regulatory compliance requirements. The Corps of Engineers would coordinate this phase with the Texas Historical Commission and the private sector should the project include any private property.

The site testing and historic structure evaluation programs would include the following tasks. For standing structures and standing architectural remains, the next phase would entail acquiring both "old" and "current condition" photographs to assess their integrity and historical associations. The materials would be used for determining the National Register eligibility of each structure by the CESWF (lead public agency) in coordination with the Texas Historical Commission.

Archaeological resources would be delineated and tested to determine their age, typical contents, integrity, historical associations, research potential and National Register status. The results would be compiled for determining consensus on NR eligibility. All work would be coordinated with the appropriate historic preservation regulatory agencies. The archaeological testing program should be designed to address all sites in the project area's final boundaries that may be impacted by implementing the project. The field work should focus on clearing the anticipated maximum limit of adverse impacts. Any sites in private ownership will require the landholder's permission and a written release of recovered remains.

Finally, the public use areas proposed under supplemental development in addition to the environmental restoration effort include outdoor exhibits and interpretive displays that review the history of the landscape and the evolution of landforms. A set of unobtrusive markers might be used to outline the 1845/50 shoreline of the bayou and the corners of important buildings to add realism to the landscape changes since that era. For example, certain markers might be set flush in high use areas while outlining the corners of buildings once standing in 1872 on Block 7 or 8. Other interpretive signs or displays might show the late outline of St. Catherine's Island or the relict channel that disappeared around 1865-72. Such material may also discuss the natural evolution of floodplain landforms and the uniqueness of Jefferson's natural turning basin based on fluvial geology and hydrological models. Yet another display might note the small seep on Block 73 and the location of one of the early historic roads in Jefferson that once passed through this part of the study area.

The opportunities to create an interdisciplinary outdoor program for optimizing the public interpretive programs in this area of Jefferson's old waterfront are broad and go beyond the immediate goals of the restoration project. Natural history, landforms and geomorphology, environmental change and human settlement, urbanization and subsequent abandonment, as well as flora and fauna of the area make the project an excellent setting to develop a synergistic perspective on its natural and cultural resources.

RECOMMENDED READING

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APPENDIX G – USFWS COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

March 21, 2000

Colonel James S. Weller
District Engineer
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Colonel Weller:

This letter constitutes the report of the U.S. Fish and Wildlife Service on the Big Cypress Bayou Ecosystem Restoration Study at Jefferson, Marion County, Texas. This report is prepared under the authority of, and in accordance with, the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) and is intended to accompany your Ecosystem Restoration Report. Our report has been coordinated with the Texas Parks and Wildlife Department, as noted in the enclosed letter from Dr. Ray C. Telfair, dated July 13, 1999.

Feasibility investigations on the restoration of Big Cypress Bayou at Jefferson were initiated in Fiscal Year 1997 following the Fort Worth District's basinwide reconnaissance evaluation of the Cypress Bayou Basin watershed. The reconnaissance study determined that adverse environmental impacts to the project area have occurred as a result of the construction and operation of Lake O'the Pines Reservoir upstream of the project site. Several measures were identified during the reconnaissance study which could potentially restore degraded fish and wildlife habitats and related natural resources. The current study on the feasibility of implementing these restoration measures was initiated under authority of Section 1135(b) of the Water Resources Development Act of 1986, as amended.

STUDY AREA

The project study area is located within and adjacent to the City of Jefferson, Marion County, Texas. The primary site consists of approximately 70 acres of floodplain lands along the west bank of Big Cypress Bayou about one-half mile upstream and downstream of Business Highway 59. A secondary project site for stream restoration is located along the southern portion of the city on the east and west sides of U.S. Highway 59 (Figure 1). The majority of the project area has been dramatically altered since its use as a river port in the mid-1980's. Changes in the level of Caddo Lake and Big Cypress Bayou, upstream reservoir development, dredging, siltation, filling, timber harvest, and the construction of levees, roads, railroads, and other man-made structures in the area have modified the vegetative and aquatic habitats of the floodplain.

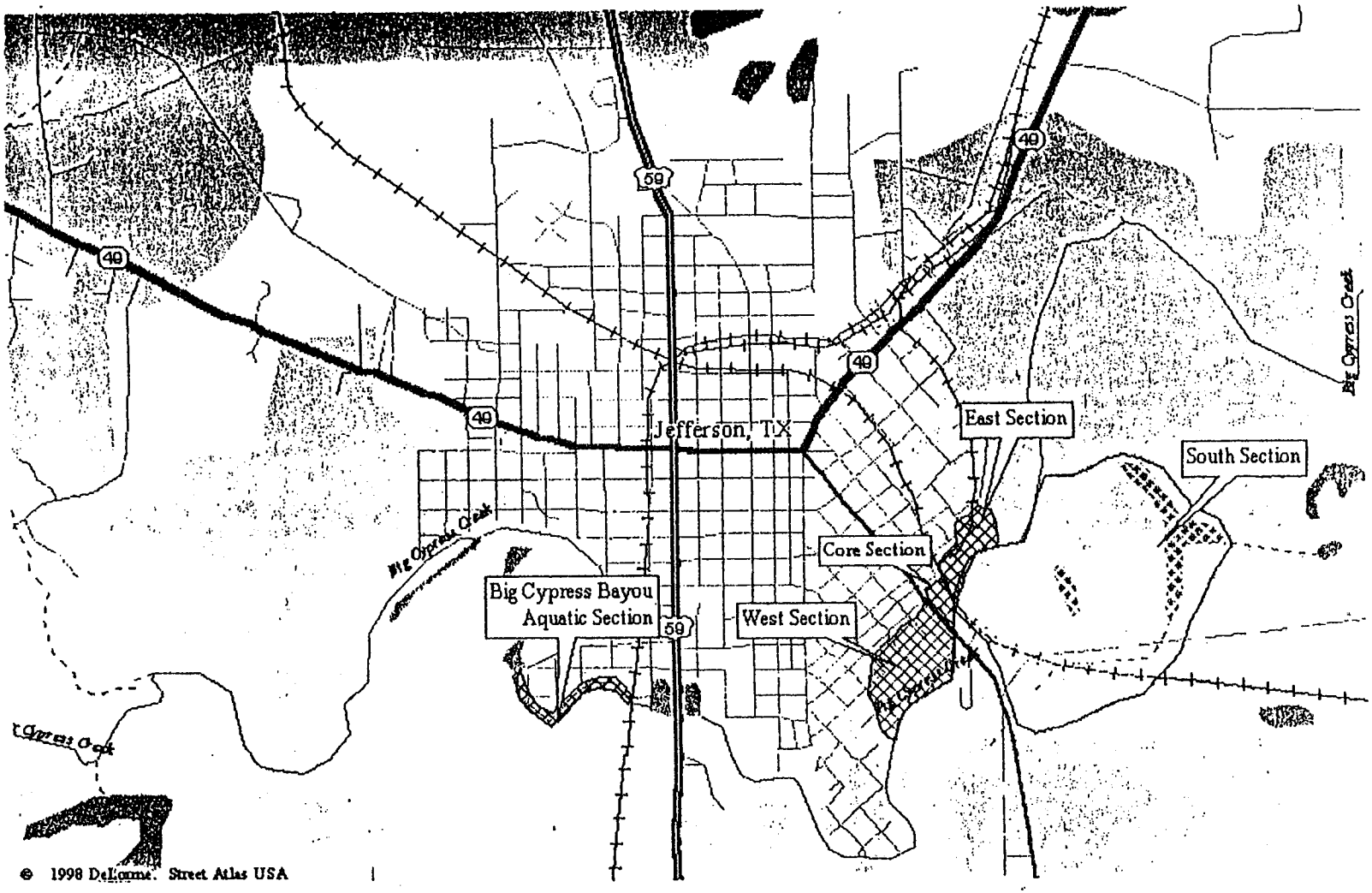


Figure 1. Detailed Study Area Map

The primary site in the vicinity of the highway and railway bridges is highly disturbed and consists entirely of pavement, parking lots, and mowed grasses. Downstream of these structures, a small levee separates developed portions of the city from the bayou. The area between the bayou and the levee, which was once the port area, has silted in and formed a floodplain terrace vegetated with relatively large hardwood trees. Upstream of the bridges, the floodplain is disected by backwater sloughs which are heavily vegetated by a diversity of bottomland hardwood trees and shrubs in varying stages of succession. The secondary, stream restoration site is less modified than the primary site, except in the vicinity of the U.S. Highway 59 and railroad bridge crossings. However, this location has been affected by siltation, scouring, and flow modifications which have reduced its value as a fish spawning area.

PLAN OF DEVELOPMENT

During the reconnaissance study, several habitat restoration measures were identified which would contribute to the recovery of damaged terrestrial and aquatic habitats within the project area. These included reestablishment of wetland habitats and bottomland hardwood vegetation, restoration of fish spawning habitat within Big Cypress Bayou, and development of swallow nesting and bat roosting structures associated with an abandoned railroad bridge within the project area. These restoration measures would be undertaken in conjunction with other features proposed by the local project sponsor to enhance the recreational use of the natural and cultural resources of the City of Jefferson and Big Cypress Bayou. Major recreational features proposed include relocation and improvement of the existing Jefferson boat ramp, development of a nature trail, vegetation and cultural displays, and other features associated with the restoration of the old Port of Jefferson.

Based on information provided by the District, the project proposes to restore approximately 30 acres of riparian and bottomland hardwood forests, 3.15 acres of emergent and forested wetlands within the oxbow sloughs, and 1.84 acres of in-stream fish spawning habitat within Big Cypress Bayou. In addition, bat roosting and swallow nesting structures would be provided on the supports and subdecks of an abanoned railroad bridge just downstream of U.S. Business Highway 59.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Aquatic Resources

Aquatic habitats within the project area consist of Big Cypress Bayou and some backwater sloughs and swales that have resulted from meandering of the bayou, flood flows within the floodplain, or localized runoff. These backwater areas provide important fish spawning and nursery areas, especially during spring high flow periods. The shallow backwaters are also important for production of invertebrates, such as insects and crayfish, and amphibians which provide a significant food source for both fish and wildlife species.

Within Big Cypress Bayou, aquatic habitat conditions are generally very good to excellent due to

the large amount of deadfall trees, brush, stumps, islands, deep pools, undercut banks, and other instream structures which provide abundant cover for fish. Average flow for the bayou, as gaged at Lake O'the Pines, is approximately 702 cubic feet per second (cfs) with most of this occurring in the winter and spring seasons. On occasion the bayou ceases to flow, however, conditions in the project area seldom become critical for the fish community unless low flow conditions persist for an extended period or the low flow condition is compounded by some type of introduced contaminant.

Surveys of Big Cypress Bayou indicate that its fish fauna is very diverse and representative of a high quality warm-water fishery. Major sport fish species in the bayou include largemouth and spotted bass, channel and flathead catfish, white bass, white and black crappie, and various sunfishes. Carp, freshwater drum, buffalo, and other species are also occasionally taken by anglers. Some unique or rare species which occur in the bayou include bowfin, chain and grass pickerel, freshwater eel, paddlefish, and several species of darters and minnows. The overall quality of the fishery is dependent upon the amount of flow, instream cover, depth of water, and water quality which is maintained in the bayou.

Terrestrial Resources

Wildlife habitats within the project area are dominated by forested wetlands and bottomland hardwood forests in various stages of succession due to their proximity to Jefferson and past development actions. Some herbaceous areas occur adjacent to the roadways and bridges within the project area, but these provide substantially no habitat values for wildlife.

Floodplain forested habitats within the project area consist of a diversity of hardwood trees and shrubs. Dominant overstory trees include water oak, willow oak, overcup oak, baldcypress, sweetgum, sugarberry, American elm, and cottonwood, while black willow, river birch, water elm, winged elm, and swamp privet are abundant in the understory. Greenbriar, wild grape, poison ivy, and rattan also provide a major component of the understory cover. Major herbaceous species within the project area include giant ragweed, goldenrod, curly dock, inland seaoats, bermudagrass, and various sedges.

Numerous wildlife species common to the east Texas bottomlands occur within the project area. White-tailed deer, gray squirrel, beaver, raccoon, wood duck, great blue heron, barred owl, red-eared turtle, and rat snake are just a few of the species commonly observed at the site. The area is especially important for neotropical migratory songbirds which depend upon large tracts of closed canopy riparian and bottomland habitats for escape cover during their critical spring and fall migration periods.

Baseline habitat data on floodplain forested sites of the project area was collected in October 1997 utilizing the Services' *Habitat Evaluation Procedures* and a draft *Bottomland Hardwood Community Model*. This information was provided to the Corps of Engineers in our planning report, dated January 8, 1998. The results of our habitat analyses indicate that a wide range of habitat conditions exist between sites within the project area which is reflective of past and current disturbances. Some forested sites were dominated by smaller, early successional plant species

such as black willow, sweetgum, and river birch, while other sites contained more mature, hardwood species such as overcup oak, willow oak, and bald cypress. A summary of the major structural habitat components of the bottomland hardwood sites is provided in Table 1. This information confirms the wide range of habitat quality between sample sites and provides basic information for the formulation of potential habitat improvement measures which could be implemented within the project area.

Table 1. Structural habitat composition of bottomland hardwood forests within the Big Cypress Bayou restoration site.

Habitat Component	Avg. Value	Range of Values
Overstory canopy closure (%)	65	40 - 80
Canopy closure of mast-producers > 6 in. dbh (%)	51	20 - 80
Height of overstory trees (ft)	57	30 - 80
dbh of overstory trees (in)	16.4	6 - 25
Shrub canopy cover (%)	41	10 - 60
Snags < 10 in. dbh (no/ac)	3.4	1 - 5
Refuge sites (no/ac)	6	5 - 10

Overall, bottomlands within the project area provide moderate to high quality habitat for wildlife because of the habitat's structural diversity and vegetative composition. However, our analysis also indicates that some sites within the project area lack sufficient quantity and quality of hard-mast producing trees, such as oaks and pecans, to provide the highest quality habitats for forest dwelling wildlife species.

Resource Category Determination

Our evaluations of the aquatic and terrestrial habitats of Big Cypress Bayou within the project area were used to assign them "resource categories" in accordance with the Service's *Mitigation Policy*. Resource categories are utilized by the Service to identify the level of mitigation which would be required to offset the adverse impacts of a development action on fish and wildlife resources. Resource categories are usually assigned based on the overall value of the habitat to representative evaluation species and the relative abundance of the habitat on a national or ecoregion basis.

Big Cypress Bayou and its associated floodplain forests generally provide high quality habitat values for the aquatic and terrestrial evaluation species used during our baseline assessments. Several studies have also noted that these habitat types are becoming scarce in Texas and the nation due to increased development pressures, such as urbanization, agricultural conversion, oil and gas development, and timber harvesting. Therefore, both the aquatic habitats of Big Cypress

Bayou and terrestrial habitats provided by its associated floodplain forests have been classified as Resource Category 2 under the *Mitigation Policy*. The mitigation planning goal for these habitats is no net loss of in-kind habitat values.

Threatened and Endangered Species

Our records indicate that the only Federally-listed species likely to occur within the project area is the threatened bald eagle (*Haliaeetus leucocephalus*). Bald eagles nest, roost, and perch in tall trees near water and feed primarily on fish, waterfowl, and carrion. Winter habitat includes reservoirs, lakes, rivers, and marshes. Wintering bald eagles have been observed at nearby Caddo Lake and Lake O'the Pines. Due to its disturbed nature and proximity to commercial and residential developments, it is very unlikely that the bald eagle could be found within the proposed project area.

FISH AND WILDLIFE RESOURCES WITH THE PROJECT

Aquatic Resources

Current project plans do not involve any significant actions which would adversely impact aquatic resources within the study area. Some minor bank stabilization may be required in the vicinity of the civil war powder magazine, relocated boat ramp, and water control structures; however, impacts in these areas would be minor and involve primarily short-term water quality degradation due to turbidity and sedimentation. These minor impacts could be easily controlled with appropriate stabilization and containment techniques.

A major component of the proposed Big Cypress Ecosystem Restoration project involves the development of fish spawning habitat within an approximately 2,000-foot (1.84 acre) section of the bayou upstream and downstream of the U.S. Highway 59 bridge. This restoration feature would consist of the replacement of gravel and small rock within the channel which has been scoured by releases from Lake O'the Pines and removed by past dredging operations within the project area. The lack of suitable, gravel spawning bars is believed to be a major factor limiting the reproduction of paddlefish and other riffle-dependent fish species within Big Cypress Bayou. Placement of the gravel bar in Big Cypress Bayou would result in an improvement in aquatic habitat conditions, thus no mitigation would be required for this activity.

Terrestrial Resources

Approximately 30 acres of bottomland hardwoods and riparian vegetation (i.e., floodplain forests) would either be replanted in desirable hard-mast producing trees and fruiting shrubs or selectively thinned in order to release desirable hardwood species from competition with less productive plants. In addition, two water control structures would be developed on the oxbow slough running through the restoration area. These structures would permit the slough to hold more permanent water for the production of wetland dependent vegetation, since the slough's inlet and outlet has been silted-in by sediment deposits from Big Cypress Bayou. The slough now receives water only

during high flows in the bayou or from local run-off. Other wildlife restoration and enhancement features proposed include providing bat roosting and swallow nesting structures on an abandoned railroad bridge, placement of wood duck nest boxes within the restored oxbow slough, and planting of native grasses and forbs in disturbed areas. Implementation of these environmental restoration alternatives would have a positive effect on terrestrial wildlife habitats and species within the project area. Thus, no negative impacts would occur to terrestrial wildlife habitats within the project area requiring mitigation.

DISCUSSION AND RECOMMENDATIONS

As currently proposed, the ecosystem restoration plan for Big Cypress Bayou in the vicinity of Jefferson would have a very positive influence on the area's fish and wildlife resources. Therefore, no significant adverse impacts would occur which would result in the need to provide mitigation. Restoration of wetland, bottomland hardwood forest, and stream habitats within the project area would create a valuable and diminishing natural resource, while providing an outstanding recreational and educational opportunity for the local community and northeast Texas.

Minimal impacts associated with the relocation of the public boat ramp, bank stabilization of the old Civil War ammunition bunker, and other actions could potentially result in short term water quality degradation; however, these minor impacts could be substantially reduced or eliminated through the application of appropriate sediment and erosion control techniques. Temporary construction and staging areas should also be revegetated immediately with native herbaceous and woody vegetation in order to stabilize the soil and prevent erosion and sedimentation.

We recommend that the Corps and local project sponsor acquire the services of an experienced wetland ecologist and forester to assist in the development of detailed operation and management plans for the wetland and bottomland hardwood units of the restoration project. In the long-term, this could potentially reduce the costs of the project and improve its success by eliminating costly errors or mistakes during the early phases of the project. We also request that our agency continue to be consulted during preparation of the project Master Plan and design specifications.

The opportunity to provide our evaluation and comments on this project is appreciated. Please contact Ms. Carol Hale of this office at the above address or telephone (817) 277-1100 if you have any questions or require additional assistance.

Sincerely,

Tom Cloud

Thomas J. Cloud, Jr.
Field Supervisor

enclosure

cc: Executive Director, TPWD, Austin, TX (Attn: Resource Protection Division)
Dr. Ray Telfair, TPWD, Tyler, TX
Mr. Mike Ryan, TPWD, Marshall, TX
Executive Director, Cypress Valley Alliance, Jefferson, TX

TEXAS
PARKS AND WILDLIFE DEPARTMENT
4200 SMITH SCHOOL ROAD • AUSTIN, TEXAS 78744 • 512-389-4800

July 13, 1998

Mr. Robert M. Short
Field Supervisor
United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Stadium Centre Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

Dear Mr. Short:

Staff biologists have reviewed your June 18, 1998 draft Fish and Wildlife Coordination Act (FWCA) report on the Big Cypress Bayou Ecosystem Restoration project at Jefferson, Texas. We concur with the ecosystem restoration plan for Big Cypress Bayou in the vicinity of Jefferson. The plan includes several habitat restoration measures and recreational features as well as recommendations. These are:

Habitat Restoration Measures

1. Restore about 35 acres of riparian and bottomland hardwood forests.

2. Restore 3 acres of emergent and forested wetlands within oxbow sloughs.

3. Restore 2000 linear feet of fish spawning habitat.

4. Provide bat roosting and swallow habitat on an abandoned railroad bridge.

Recreational Features

1. Relocation and improvement of the existing Jefferson boat ramp.

2. Development of a nature trail.

3. Vegetation and cultural displays.

Summary and Recommendations

The proposed plan will have a very positive influence on the area's fish and wildife resources. No significant adverse impacts will occur that would require mitigation. Only minimal impacts will be associated with these projects.

An experienced wetland ecologist and forester would reduce costs of the project and improve its success by eliminating costly errors or mistakes during early phases of the project.

We appreciate the opportunity to provide comments on your report concerning the planning of the Big Cypress Bayou Ecosystem Restoration project in Jefferson.

Sincerely,

Ray C. Telfair II

Ray C. Telfair II, Ph.D.
Conservation Scientist
Wildlife Division

cc: Thomas J. Cloud, Jr., Project Biologist, USFWS, Arlington
Roy G. Frye, TPWD, Wildlife Division, Austin
Mike Ryan, TPWD, Fisheries Division, Marshall

APPENDIX H – PROJECT COORPERATION AGREEMENT

MODEL PROJECT COOPERATION AGREEMENT FOR
SECTION 1135, PROJECT MODIFICATIONS
FOR THE IMPROVEMENT OF THE ENVIRONMENT

****

PROJECT COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
THE CITY OF JEFFERSON, TEXAS
FOR MODIFICATION OF THE
BIG CYPRESS BAYOU

THIS AGREEMENT is entered into this _____ day of _____, 19 __, by and between the DEPARTMENT OF THE ARMY (hereinafter the "Government"), represented by the U.S. Army Engineer for the Fort Worth District (hereinafter the "District Engineer") and the city of Jefferson, Texas (hereinafter the "Non-Federal Sponsor"), represented by the Mayor, city of Jefferson, Texas.

WITNESSETH, THAT:

WHEREAS, the Secretary of the Army completed construction of the Lake O' The Pines (hereinafter the "Existing Project", as defined in Article I.A. of this Agreement) in 1959;

WHEREAS, modification of the Existing Project is authorized by Section 1135 of the Water Resources Development Act of 1986, Public Law 99-662, as amended;

WHEREAS, the Government and the Non-Federal Sponsor desire to enter into a Project Cooperation Agreement for implementation of the Big Cypress Bayou Project Modification (hereinafter the "Project Modification", as defined in Article I.B. of this Agreement);

WHEREAS, Section 1135 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, specifies the cost-sharing requirements applicable to this Project Modification for the costs relating to environmental restoration costs; and Section 103 of WRDA 1986, Public Law 99-662, specifies the cost-sharing requirements applicable to this Project Modification for costs relating to project recreation costs;

WHEREAS, the Non-Federal Sponsor desires to perform certain work (hereinafter the "work-in-kind", as defined in Article I.M. of this Agreement) which is a part of the Project Modification;

WHEREAS, the Government and Non-Federal Sponsor have the full authority and capability to perform as hereinafter set forth and intend to cooperate in cost-sharing and financing of the implementation of the Project Modification in accordance with the terms of this Agreement.

NOW, THEREFORE, the Government and the Non-Federal Sponsor agree as follows:

ARTICLE I DEFINITIONS AND GENERAL PROVISIONS

For purposes of this Agreement:

A. The term "Existing Project" shall mean Lake O' the Pines located on Cypress Creek, Red River Basin, in Marion, Harrison, Upshur, Morris, Camp and Titus Counties, Texas. The project was authorized by the Flood Control Act of July 1946. The lake contains a flood control pool of 587,200 acre-feet with an area of 38,200 acres, and a water supply pool of 251,100 acres feet with an area of 18,700 acres. Total lake capacity is 842,100 acre-feet. The top of the flood control pool is 249.5 feet msl; the top of the conservation pool is 230.0 feet msl.

B. The term "Project Modification" shall mean restoration of fish and wildlife habitat along Big Cypress Bayou downstream of Lake O' the Pines, consisting of the construction of a wetland complex, reforestation of bottomland hardwoods and riparian corridor, an urban wildscapes, an emergent wetland, bat habitat, aquatic habitat, and access features. The wetland complex is comprised of three cells totaling 2.9 acres. The cells will be constructed using an earthen embankment and water control structures. Reforestation includes the selective thinning of

undesirable species, and planting 30 acres of bottomland hardwoods and shrubs. Five acres of urban wildscape will be constructed by appropriate grading and filling of the landscape, construction of grade retention structures, and the planting of native vegetation. A local drainage will be relocated to provide water to a natural depression replanted with wetland vegetation to restore a quarter (1/4) acre emergent wetland. Three separate types of bat habitat, totaling 21 abodes will be affixed to the abandoned railroad bridge. In-stream aquatic habitat, consisting of 2,000 feet of gravel bar will be placed within Big Cypress Bayou. Approximately 1,615 linear feet of gravel maintenance and recreation access paths are included. Lastly, a boat ramp and overhead utility lines are to be relocated. In addition, the project modification includes approximately 1,435 linear feet of recreational (educational) access consisting of an elevated wooden ramp, as well as concrete and gravel materials. Further, approximately 1,916 linear feet of an elevated wooden ramp will be included which has a dual purpose, i.e., both a maintenance and recreation purpose. This project modification is as generally described in the Big Cypress Bayou Fish and Wildlife Habitat Restoration, Jefferson, Texas, Ecosystem Restoration Report and Integrated Environmental Assessment, dated _____, 2000 and approved by the Commander, Southwestern Division, on _____, 2000. The Project Modification includes the work-in-kind described in Article I.M. of this Agreement.

C. The term "environmental restoration features" shall mean restoration of fish and wildlife habitat along Big Cypress Bayou downstream of Lake O' the Pines, consisting of the construction of a wetland complex, reforestation of bottomland hardwoods and riparian corridor, an urban wildscapes, an emergent wetland, bat habitat, aquatic habitat, and access features. The wetland complex is comprised of three cells totaling 2.9 acres. The cells will be constructed using an earthen embankment and water control structures. Reforestation includes the selective thinning of undesirable species, and planting 30 acres of bottomland hardwoods and shrubs. Five acres of urban wildscape will be constructed by appropriate grading and filling of the landscape, construction of grade retention structures, and the planting of native vegetation. A local drainage will be relocated to provide water to a natural depression replanted with wetland vegetation to restore a quarter (1/4) acre emergent wetland. Three separate types of bat habitat, totaling 21 abodes will be affixed to the abandoned railroad bridge. In-stream

aquatic habitat, consisting of 2,000 feet of gravel bar will be placed within Big Cypress Bayou. Approximately 1,615 linear feet of gravel maintenance and recreation access paths are included. Lastly, a boat ramp and overhead utility lines are to be relocated.

D. The term "recreation features" shall mean construction of approximately 1,435 linear feet of recreational (educational) access consisting of an elevated wooden ramp, as well as concrete and gravel materials. Further, approximately 1,916 linear feet of an elevated wooden ramp will be included which has a dual purpose, i.e., both a maintenance and recreation purpose.

~~C.~~E. The term "total project modification costs" shall mean all costs incurred by the Non-Federal Sponsor and the Government in accordance with the terms of this Agreement directly related to implementation of the Project Modification. Subject to the provisions of this Agreement, the term shall include, but is not necessarily limited to, feasibility phase planning costs; all engineering and design costs, including those incurred in the feasibility phase; the costs of investigations to identify the existence and extent of hazardous substances in accordance with Article XV.A. of this Agreement; the costs incurred by the Government for clean-up and response in accordance with Article XV.C. of this Agreement; costs of historic preservation activities in accordance with Article XVIII.A. and B. of this Agreement; actual implementation costs; the credit amount for the work-in-kind performed by the Non-Federal Sponsor in accordance with Article II.D.4. of this Agreement; supervision and administration costs; costs of participation in the Project Coordination Team in accordance with Article V of this Agreement; costs of contract dispute settlements or awards; the value of lands, easements, rights-of-way, relocations, and suitable borrow and dredged or excavated material disposal areas for which the Government affords credit in accordance with Article IV of this Agreement; and costs of audit in accordance with Article X of this Agreement. The term does not include any costs for operation, maintenance, repair, replacement, or rehabilitation; any costs due to betterments; or any costs of dispute resolution under Article VII of this Agreement.

F. The term "total project environmental restoration costs" shall mean that portion of the total project costs that the Government assigns to the environmental restoration features.

G. The term "total project recreation costs" shall mean that portion of the total project costs that the Government assigns to the recreation features.

~~D.~~H. The term "financial obligation for implementation" shall mean a financial obligation of the Government or a financial obligation of the Non-Federal Sponsor for work-in-kind, other than an obligation pertaining to the provision of lands, easements, rights-of-way, relocations, and borrow and dredged or excavated material disposal areas, that results or would result in a cost that is or would be included in total project modification costs.

~~E.~~I. The term "implementation" shall mean all actions required to carry out the Project Modification including all actions required for modification in operations of the Existing Project.

~~F.~~J. The term "non-Federal proportionate share" shall mean the ratio of the Non-Federal Sponsor's total cash contribution required in accordance with Article II.D.2. of this Agreement to total financial obligations for implementation as projected by the Government.

~~G.~~K. The term "period of implementation" shall mean the time from the effective date of this Agreement to the date that the District Engineer notifies the Non-Federal Sponsor in writing of the Government's determination that implementation of the Project Modification is complete.

~~H.~~L. The term "highway" shall mean any public highway, roadway, street, or way, including any bridge thereof.

~~I.~~M. The term "relocation" shall mean providing a functionally equivalent facility to the owner of an existing utility, cemetery, highway or other public facility, or railroad when such action is authorized in accordance with applicable legal principles of just compensation. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, or replacement and attendant removal of the affected facility or part thereof.

~~J.~~N. The term "fiscal year" shall mean one fiscal year of the Government. The Government fiscal year begins on October 1 and ends on September 30.

~~K.~~O. The term "functional portion of the Project Modification" shall mean a portion of the Project Modification that is suitable for tender to the Non-Federal Sponsor to operate and maintain in advance of completion of the entire Project Modification. For a portion of the Project Modification to be suitable for tender, the District Engineer must notify the Non-Federal Sponsor in writing of the Government's determination that the portion of the Project Modification is complete and can function independently and for a useful purpose, although the balance of the Project Modification is not complete.

~~L.~~P. The term "betterment" shall mean a change in the design and construction of an element of the Project Modification resulting from the application of standards that the Government determines exceed those that the Government would otherwise apply for accomplishing the design and construction of that element.

~~M.~~Q. The term "work-in-kind" shall mean contribution to the project modification by the city of Jefferson of the abandoned railroad bridge as a support structure for the bat habitat, as approved by the Commander, Southwestern Division, as generally described in a Big Cypress Bayou Fish and Wildlife Habitat Restoration, Jefferson, Texas, Ecosystem Restoration Report and Integrated Environmental Assessment, dated _____, 2000. The work-in-kind includes implementation of the authorized improvements as well as planning, engineering, design, supervision and administration, and other activities associated with implementation, but does not include the implementation of betterments or the provision of lands, easements, rights-of-way, relocations, or suitable borrow and dredged or excavated material disposal areas associated with the work-in-kind.

ARTICLE II OBLIGATIONS OF THE GOVERNMENT AND THE NON-FEDERAL SPONSOR

A. The Government, subject to the availability of funds and using those funds and funds provided by the Non-Federal Sponsor, shall expeditiously implement the Project Modification, applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

1. The Government shall afford the Non-Federal Sponsor the opportunity to review and comment on the solicitations for all contracts, including relevant plans and specifications, prior to the Government's issuance of such solicitations. The Government shall not issue the solicitation for the first contract for implementation until the Non-Federal Sponsor has confirmed in writing its willingness to proceed with the Project Modification. To the extent possible, the Government shall afford the Non-Federal Sponsor the opportunity to review and comment on all contract modifications, including change orders, prior to the issuance to the contractor of a Notice to Proceed. In any instance where providing the Non-Federal Sponsor with notification of a contract modification or change order is not possible prior to issuance of the Notice to Proceed, the Government shall provide such notification in writing at the earliest date possible. To the extent possible, the Government also shall afford the Non-Federal Sponsor the opportunity to review and comment on all contract claims prior to resolution thereof. The Government shall consider in good faith the comments of the Non-Federal Sponsor, but the contents of solicitations, award of contracts, execution of contract modifications, issuance of change orders, resolution of contract claims, and performance of all work on the Project Modification (whether the work is performed under contract or by Government personnel), shall be exclusively within the control of the Government.

2. Throughout the period of implementation, the District Engineer shall furnish the Non-Federal Sponsor with a copy of the Government's Written Notice of Acceptance of Completed Work for each contract for the Project Modification.

B. The Non-Federal Sponsor may request the Government to accomplish betterments. Such requests shall be in writing and shall describe the betterments requested to be accomplished. If the Government in its sole discretion elects to accomplish the requested betterments or any portion thereof, it shall so notify the Non-Federal Sponsor in a writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The Non-Federal Sponsor shall be solely responsible for all costs due to the requested betterments and shall pay all such costs in accordance with Article VI.C. of this Agreement.

C. When the District Engineer determines that the entire Project Modification is complete or that a portion of the Project Modification has become a functional portion of the Project Modification, the District Engineer shall so notify the Non-Federal Sponsor in writing and furnish the Non-Federal Sponsor with an Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (hereinafter the "OMRR&R Manual") and with copies of all of the Government's Written Notices of Acceptance of Completed Work for all contracts for the Project Modification or the functional portion of the Project Modification that have not been provided previously. Upon such notification, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project Modification or the functional portion of the Project Modification in accordance with Article VIII of this Agreement.

D. The Non-Federal Sponsor shall contribute 25 percent of total project modification costs assigned to environmental restoration features in accordance with the provisions of this paragraph.

1. In accordance with Article III of this Agreement, the Non-Federal Sponsor shall provide all lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Government determines the Non-Federal Sponsor must provide for the implementation, operation, and maintenance of the environmental restoration features of the Project Modification, and shall perform or ensure performance of all relocations that the Government determines to be necessary for the implementation, operation, and maintenance of the environmental restoration features of the Project Modification.

2. If the Government projects that the value of the Non-Federal Sponsor's contributions under paragraph D.1. of this Article and Articles V, X, ~~and~~ XV.A., and XVIII.A. of this Agreement will be less than 25 percent of total project modification costs assigned to the environmental restoration features, the Non-Federal Sponsor shall provide an additional cash contribution, in accordance with Article VI.B. of this

Agreement, in the amount necessary to make the Non-Federal Sponsor's total contribution equal to 25 percent of total project modification costs assigned to the environmental restoration features.

3. If the Government determines that the value of the Non-Federal Sponsor's contributions provided under paragraphs D.1. and D.2. of this Article and Articles V, X, ~~and~~ XV.A., and XVIII.A. of this Agreement has exceeded 25 percent of total project modification costs assigned to the environmental restoration features, the Government, subject to the availability of funds, shall reimburse the Non-Federal Sponsor for any such value in excess of 25 percent of total project modification costs assigned to the environmental restoration features. After such a determination, the Government, in its sole discretion, may provide any remaining ~~Project Modification~~ environmental restoration feature lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas and perform any remaining Project Modification relocations on behalf of the Non-Federal Sponsor. Notwithstanding the provision of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or performance of relocations by the Government under this paragraph, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of cleanup and response in accordance with Article XV.C. of this Agreement.

4. The Government has determined that the work-in-kind is compatible with the environmental restoration features of the Project Modification and has approved a credit in the estimated amount of $225,000 for implementation of such work by the Non-Federal Sponsor. The affording of such credit shall be subject to an on-site inspection by the Government to verify that the work was accomplished in a satisfactory manner and is suitable for inclusion in the Project Modification. The actual amount of credit shall be subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. To afford such credit, the Government shall apply the credit amount toward any additional cash contribution required under paragraph D.2. of this Article. The Non-Federal Sponsor shall not receive credit for any amount in excess of such additional cash contribution, nor shall the Non-Federal Sponsor be entitled to any reimbursement for any excess credit amount. In no event shall

the Non-Federal Sponsor perform work-in-kind that would result in either the credit afforded under this paragraph exceeding 80 percent of the Non-Federal Sponsor's share of total project modification costs assigned to the environmental restoration features or the credit afforded under this paragraph, plus the value of lands, easements, rights-of-way, relocations, and suitable borrow and dredged or excavated material disposal areas for which the Government affords credit in accordance with Article IV of this Agreement, exceeding 25 percent of total project modification costs assigned to the environmental restoration features.

E. The Non-Federal Sponsor shall contribute 50 percent of the total project modification costs assigned to the recreational features.

~~E.~~F. The Non-Federal Sponsor may request the Government to provide lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or perform relocations on behalf of the Non-Federal Sponsor. Such requests shall be in writing and shall describe the services requested to be performed. If in its sole discretion the Government elects to perform the requested services or any portion thereof, it shall so notify the Non-Federal Sponsor in a writing that sets forth any applicable terms and conditions, which must be consistent with this Agreement. In the event of conflict between such a writing and this Agreement, this Agreement shall control. The Non-Federal Sponsor shall be solely responsible for all costs of the requested services and shall pay all such costs in accordance with Article VI.C. of this Agreement. Notwithstanding the provision of lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas or performance of relocations by the Government under this paragraph, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of cleanup and response in accordance with Article XV.C. of this Agreement.

G. The Government, in accordance with Federal laws, regulations, and policies, shall assign all costs included or to be included in total project costs to either total environmental restoration costs, or total recreation costs.

~~F.~~H. The Government shall perform a final accounting in accordance with Article VI.D. of this Agreement to determine the contributions provided by the Non-Federal Sponsor in accordance with paragraphs B., D., and E. of this Article and Articles V, X, ~~and~~ XV.A., and XVIII.A. of this Agreement and to determine whether the Non-Federal Sponsor has met its obligations under paragraphs B., D., and E. of this Article.

~~G.~~I. The Non-Federal Sponsor shall not use Federal funds to meet its share of total project modification costs under this Agreement unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

ARTICLE III LANDS, RELOCATIONS, DISPOSAL AREAS, AND PUBLIC LAW 91-646 COMPLIANCE

A. The Government, after consultation with the Non-Federal Sponsor, shall determine the lands, easements, and rights-of-way required for the implementation, operation, and maintenance of the Project Modification, including those required for relocations, borrow materials, and dredged or excavated material disposal. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions, including maps as appropriate, of the lands, easements, and rights-of-way that the Government determines the Non-Federal Sponsor must provide, in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with acquisition of such lands, easements, and rights-of-way. Prior to the end of the period of implementation, the Non-Federal Sponsor shall acquire all lands, easements, and rights-of-way set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each construction contract, the Non-Federal Sponsor shall provide the Government with authorization for entry to all lands, easements, and rights-of-way the Government determines the Non-Federal Sponsor must provide for that contract. The Non-Federal Sponsor shall ensure that lands, easements, and rights-of-way that the Government determines to be required for the operation and maintenance of the Project Modification and that were provided by the Non-Federal Sponsor are retained in public ownership for uses compatible with the authorized purposes of the Project Modification.

B. The Government, after consultation with the Non-Federal Sponsor, shall determine the improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the implementation, operation, and maintenance of the Project Modification. Such improvements may include, but are not necessarily limited to, retaining dikes, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and de-watering pumps and pipes. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions of such improvements in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with construction of such improvements. Prior to the end of the period of implementation, the Non-Federal Sponsor shall provide all improvements set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the Non-Federal Sponsor shall prepare plans and specifications for all improvements the Government determines to be required for the proper disposal of dredged or excavated material under that contract, submit such plans and specifications to the Government for approval, and provide such improvements in accordance with the approved plans and specifications.

C. The Government, after consultation with the Non-Federal Sponsor, shall determine the relocations necessary for the implementation, operation, and maintenance of the Project Modification, including those necessary to enable the removal of borrow materials and the proper disposal of dredged or excavated material. The Government in a timely manner shall provide the Non-Federal Sponsor with general written descriptions, including maps as appropriate, of such relocations in detail sufficient to enable the Non-Federal Sponsor to fulfill its obligations under this paragraph, and shall provide the Non-Federal Sponsor with a written notice to proceed with such relocations. Prior to the end of the period of implementation, the Non-Federal Sponsor shall perform or ensure the performance of all relocations as set forth in such descriptions. Furthermore, prior to issuance of the solicitation for each Government construction contract, the Non-Federal Sponsor shall prepare or ensure the preparation of plans and specifications for, and perform or ensure the performance of, all relocations the Government determines to be necessary for that contract.

D. The Non-Federal Sponsor in a timely manner shall provide the Government with such documents as are sufficient to enable the Government to determine the value of any contribution provided pursuant to paragraphs A., B., or C. of this Article. Upon receipt of such documents the Government, in accordance with Article IV of this Agreement and in a timely manner, shall determine the value of such contribution, include such value in total project modification costs, and afford credit for such value toward the Non-Federal Sponsor's share of total project modification costs.

E. The Non-Federal Sponsor shall comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 C.F.R. Part 24, in acquiring lands, easements, and rights-of-way required for the implementation, operation, and maintenance of the Project Modification, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and shall inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV CREDIT FOR LANDS, RELOCATIONS, AND DISPOSAL AREAS

A. The Non-Federal Sponsor shall receive credit toward its share of total project modification costs assigned to the environmental restoration features for the value of the lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas that the Non-Federal Sponsor must provide pursuant to Article III of this Agreement for the environmental restoration features, and for the value of the relocations that the Non-Federal Sponsor must perform or for which it must ensure performance pursuant to Article III of this Agreement for the environmental restoration features. However, the Non-Federal Sponsor shall not receive credit for the value of any lands, easements, rights-of-way, relocations, or borrow and dredged or excavated material disposal areas that have been provided previously as an item of cooperation for another Federal project, including the Existing Project. The Non-Federal Sponsor also shall not receive credit for the value of lands, easements, rights-of-way, relocations, or borrow and dredged or excavated

material disposal areas to the extent that such items are provided using Federal funds unless the Federal granting agency verifies in writing that such credit is expressly authorized by statute.

B. For the sole purpose of affording credit in accordance with this Agreement, the value of lands, easements, and rights-of-way, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, shall be the fair market value of the real property interests, plus certain incidental costs of acquiring those interests, as determined in accordance with the provisions of this paragraph.

1. Date of Valuation. The fair market value of lands, easements, or rights-of-way owned by the Non-Federal Sponsor on the effective date of this Agreement shall be the fair market value of such real property interests as of the date the Non-Federal Sponsor provides the Government with authorization for entry thereto. However, for lands, easements, or rights-of-way owned by the Non-Federal Sponsor on the effective date of this Agreement that are required for the construction of the work-in-kind, fair market value shall be the value of such real property interests as of the date the Non-Federal Sponsor awards the first construction contract for the work-in-kind, or, if the Non-Federal Sponsor performs the implementation with its own labor, the date that the Non-Federal Sponsor begins implementation of the work-in-kind. The fair market value of lands, easements, or rights-of-way acquired by the Non-Federal Sponsor after the effective date of this Agreement shall be the fair market value of such real property interests at the time the interests are acquired.

2. General Valuation Procedure. Except as provided in paragraph B.3. of this Article, the fair market value of lands, easements, or rights-of-way shall be determined in accordance with paragraph B.2.a. of this Article, unless thereafter a different amount is determined to represent fair market value in accordance with paragraph B.2.b. of this Article.

a. The Non-Federal Sponsor shall obtain, for each real property interest, an appraisal that is prepared by a qualified appraiser who is acceptable to the Non-Federal Sponsor and the Government. The appraisal must be prepared in accordance with the applicable rules of just compensation, as specified by

the Government. The fair market value shall be the amount set forth in the Non-Federal Sponsor's appraisal, if such appraisal is approved by the Government. In the event the Government does not approve the Non-Federal Sponsor's appraisal, the Non-Federal Sponsor may obtain a second appraisal, and the fair market value shall be the amount set forth in the Non-Federal Sponsor's second appraisal, if such appraisal is approved by the Government. In the event the Government does not approve the Non-Federal Sponsor's second appraisal, or the Non-Federal Sponsor chooses not to obtain a second appraisal, the Government shall obtain an appraisal, and the fair market value shall be the amount set forth in the Government's appraisal, if such appraisal is approved by the Non-Federal Sponsor. In the event the Non-Federal Sponsor does not approve the Government's appraisal, the Government, after consultation with the Non-Federal Sponsor, shall consider the Government's and the Non-Federal Sponsor's appraisals and determine an amount based thereon, which shall be deemed to be the fair market value.

b. Where the amount paid or proposed to be paid by the Non-Federal Sponsor for the real property interest exceeds the amount determined pursuant to paragraph B.2.a. of this Article, the Government, at the request of the Non-Federal Sponsor, shall consider all factors relevant to determining fair market value and, in its sole discretion, after consultation with the Non-Federal Sponsor, may approve in writing an amount greater than the amount determined pursuant to paragraph B.2.a. of this Article, but not to exceed the amount actually paid or proposed to be paid. If the Government approves such an amount, the fair market value shall be the lesser of the approved amount or the amount paid by the Non-Federal Sponsor, but no less than the amount determined pursuant to paragraph B.2.a. of this Article.

3. Eminent Domain Valuation Procedure. For lands, easements, or rights-of-way acquired by eminent domain proceedings instituted after the effective date of this Agreement, the Non-Federal Sponsor shall, prior to instituting such proceedings, submit to the Government notification in writing of its intent to institute such proceedings and an appraisal of the specific real property interests to be acquired in such proceedings. The Government shall have 60 days after receipt of such a notice and appraisal within which to review the appraisal, if not previously approved by the Government in writing.

a. If the Government previously has approved the appraisal in writing, or if the Government provides written approval of, or takes no action on, the appraisal within such 60-day period, the Non-Federal Sponsor shall use the amount set forth in such appraisal as the estimate of just compensation for the purpose of instituting the eminent domain proceeding.

b. If the Government provides written disapproval of the appraisal, including the reasons for disapproval, within such 60-day period, the Government and the Non-Federal Sponsor shall consult in good faith to promptly resolve the issues or areas of disagreement that are identified in the Government's written disapproval. If, after such good faith consultation, the Government and the Non-Federal Sponsor agree as to an appropriate amount, then the Non-Federal Sponsor shall use that amount as the estimate of just compensation for the purpose of instituting the eminent domain proceeding. If, after such good faith consultation, the Government and the Non-Federal Sponsor cannot agree as to an appropriate amount, then the Non-Federal Sponsor may use the amount set forth in its appraisal as the estimate of just compensation for the purpose of instituting the eminent domain proceeding.

c. For lands, easements, or rights-of-way acquired by eminent domain proceedings instituted in accordance with sub-paragraph B.3. of this Article, fair market value shall be either the amount of the court award for the real property interests taken, to the extent the Government determined such interests are required for the implementation, operation, and maintenance of the Project Modification, or the amount of any stipulated settlement or portion thereof that the Government approves in writing.

4. Incidental Costs. For lands, easements, or rights-of-way acquired by the Non-Federal Sponsor within a five-year period preceding the effective date of this Agreement, or at any time after the effective date of this Agreement, the value of the interest shall include the documented incidental costs of acquiring the interest, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such incidental costs shall include, but not necessarily be limited to, closing and title costs, appraisal costs, survey

costs, attorney's fees, plat maps, and mapping costs, as well as the actual amounts expended for payment of any Public Law 91-646 relocation assistance benefits provided in accordance with Article III.E. of this Agreement.

C. After consultation with the Non-Federal Sponsor, the Government shall determine the value of relocations in accordance with the provisions of this paragraph.

1. For a relocation other than a highway, the value shall be only that portion of relocation costs that the Government determines is necessary to provide a functionally equivalent facility, reduced by depreciation, as applicable, and by the salvage value of any removed items.

2. For a relocation of a highway, the value shall be only that portion of relocation costs that would be necessary to accomplish the relocation in accordance with the design standard that the State of Texas would apply under similar conditions of geography and traffic load, reduced by the salvage value of any removed items.

3. Relocation costs shall include, but not necessarily be limited to, actual costs of performing the relocation; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with performance of the relocation, but shall not include any costs due to betterments, as determined by the Government, nor any additional cost of using new material when suitable used material is available. Relocation costs shall be subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs.

D. The value of the improvements made to lands, easements, and rights-of-way for the proper disposal of dredged or excavated material shall be the costs of the improvements, as determined by the Government, subject to an audit in accordance with Article X.C. of this Agreement to determine reasonableness, allocability, and allowability of costs. Such costs shall include, but not necessarily be limited to, actual costs of providing the

improvements; planning, engineering and design costs; supervision and administration costs; and documented incidental costs associated with providing the improvements, but shall not include any costs due to betterments, as determined by the Government.

ARTICLE V PROJECT MODIFICATION COORDINATION TEAM

A. To provide for consistent and effective communication, the Non-Federal Sponsor and the Government, not later than 30 days after the effective date of this Agreement, shall appoint named senior representatives to a Project Modification Coordination Team. Thereafter, the Project Modification Coordination Team shall meet regularly until the end of the period of implementation. The Government's Project Manager and a counterpart named by the Non-Federal Sponsor shall co-chair the Project Modification Coordination Team.

B. The Government's Project Manager and the Non-Federal Sponsor's counterpart shall keep the Project Modification Coordination Team informed of the progress of implementation and of significant pending issues and actions, and shall seek the views of the Project Modification Coordination Team on matters that the Project Modification Coordination Team generally oversees.

C. Until the end of the period of implementation, the Project Modification Coordination Team shall generally oversee the Project Modification, including issues related to design; plans and specifications; scheduling; real property and relocation requirements; real property acquisition; contract awards and modifications; contract costs; the Government's cost projections; final inspection of the entire Project Modification or functional portions of the Project Modification; preparation of the proposed OMRR&R Manual; anticipated requirements and needed capabilities for performance of operation, maintenance, repair, replacement, and rehabilitation of the Project Modification; and other related matters.

D. The Project Modification Coordination Team may make recommendations that it deems warranted to the District Engineer on matters that the Project Modification Coordination Team generally oversees, including suggestions to avoid potential sources of dispute. The Government in good faith shall consider the recommendations of the Project Modification Coordination

Team. The Government, having the legal authority and responsibility for implementation of the Project Modification, has the discretion to accept, reject, or modify the Project Modification Coordination Team's recommendations.

E. The costs of participation in the Project Modification Coordination Team shall be included in total project modification costs assigned to the environmental restoration features and cost shared in accordance with the provisions of this Agreement.

ARTICLE VI METHOD OF PAYMENT

A. The Government shall maintain current records of contributions provided by the parties and current projections of total project modification costs, costs assigned to environmental restoration features, costs assigned to recreation features, and costs due to betterments. At least quarterly, the Government shall provide the Non-Federal Sponsor with a report setting forth all contributions provided to date and the current projections of total project modification costs, of costs assigned to environmental restoration features, of costs assigned to recreation features, of total costs due to betterments, of the components of total project modification costs, of each party's share of total project modification costs, of the Non-Federal Sponsor's total cash contributions required in accordance with Articles II.B., II.D., and II.E. of this Agreement, and of the non-Federal proportionate share. On the effective date of this Agreement, total project modification costs are projected to be $1,898,887, ~~and~~ the Non-Federal Sponsor's cash contribution required under Article II.D. of this Agreement is projected to be $2,246, and the Non-Federal Sponsor's cash contribution required under Article II.E. of this Agreement is projected to be $105,211. Such amounts are estimates subject to adjustment by the Government and are not to be construed as the total financial responsibilities of the Government and the Non-Federal Sponsor.

B. The Non-Federal Sponsor shall provide the cash contribution required under Article II.D.2. and II.E. of this Agreement in accordance with the following provisions: Not less than 60 calendar days prior to the scheduled date for issuance of the solicitation for the first construction contract, the Government shall notify the Non-Federal Sponsor in writing of such scheduled date and the funds the Government, after consideration of any credit afforded pursuant to Article II.D.4.

of this Agreement, determines to be required from the Non-Federal Sponsor to meet its projected cash contribution under Article II.D.2. of this Agreement. Not later than such scheduled date, the Non-Federal Sponsor shall provide the Government with the full amount of the required funds by delivering a check payable to "FAO, USAED, FORT WORTH DISTRICT" to the U.S. Army Corps of Engineers Finance Center, CEFC-AD-C EROC M2, 5720 Integrity Drive, Millington, TN 38054-5005. The Government shall draw from the funds provided by the Non-Federal Sponsor such sums as the Government, after consideration of any credit afforded pursuant to Article II.D.4. of this Agreement, deems necessary to cover: (a) the non-Federal proportionate share of financial obligations for implementation incurred prior to commencement of the period of implementation; and (b) the non-Federal proportionate share of financial obligations for implementation as they are incurred during the period of implementation. In the event the Government determines that the Non-Federal Sponsor must provide additional funds to meet the Non-Federal Sponsor's cash contribution, the Government shall notify the Non-Federal Sponsor in writing of the additional funds required. Within 60 calendar days thereafter, the Non-Federal Sponsor shall provide the Government with a check for the full amount of the additional required funds.

C. In advance of the Government incurring any financial obligation associated with additional work under Article II.B. or II.~~E.~~F. of this Agreement, the Non-Federal Sponsor shall provide the Government with the full amount of the funds required to pay for such additional work by delivering a check payable to "FAO, USAED, FORT WORTH DISTRICT" to the U.S. Army Corps of Engineers Finance Center, CEFC-AD-C EROC M2, 5720 Integrity Drive, Millington, TN 38054-5005. The Government shall draw from the funds provided by the Non-Federal Sponsor such sums as the Government deems necessary to cover the Government's financial obligations for such additional work as they are incurred. In the event the Government determines that the Non-Federal Sponsor must provide additional funds to meet its cash contribution, the Government shall notify the Non-Federal Sponsor in writing of the additional funds required. Within 30 calendar days thereafter, the Non-Federal Sponsor shall provide the Government with a check for the full amount of the additional required funds.

D. Upon completion of the Project Modification or termination of this Agreement, and upon resolution of all relevant claims and appeals, the Government shall conduct a final accounting and furnish the Non-Federal Sponsor with the results of the final accounting. The final accounting shall determine total project modification costs, each party's contribution provided thereto, ~~and each party's required share thereof~~ total costs assigned to environmental restoration features, and total costs assigned to recreation features, each party's contribution provided to total costs assigned to environmental restoration features, and to costs assigned to recreation features, and each party's required share of total costs assigned to environmental restoration features and to costs assigned to recreation features. The final accounting also shall determine costs due to betterments and the Non-Federal Sponsor's cash contribution provided pursuant to Article II.B. of this Agreement. Nothing in this paragraph precludes the Government from conducting interim accountings or refunding any excess to the Non-Federal Sponsor determined thereby.

1. In the event the final accounting shows that the total contribution provided by the Non-Federal Sponsor is less than its required share of total project modification costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement, the Non-Federal Sponsor shall, no later than 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet the Non-Federal Sponsor's required share of total project modification costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement.

2. In the event the final accounting shows that the total contribution provided by the Non-Federal Sponsor exceeds its required share of total project modification costs plus costs due to any betterments provided in accordance with Article II.B. of this Agreement, the Government shall, subject to the availability of funds, refund the excess to the Non-Federal Sponsor no later than 90 calendar days after the final accounting is complete. In the event existing funds are not available to refund the excess to the Non-Federal Sponsor, the Government shall seek such appropriations as are necessary to make the refund.

ARTICLE VII DISPUTE RESOLUTION

As a condition precedent to a party bringing any suit for breach of this Agreement, that party must first notify the other party in writing of the nature of the purported breach and seek in good faith to resolve the dispute through negotiation. If the parties cannot resolve the dispute through negotiation, they may agree to a mutually acceptable method of non-binding alternative dispute resolution with a qualified third party acceptable to both parties. The parties shall each pay 50 percent of any costs for the services provided by such a third party as such costs are incurred. The existence of a dispute shall not excuse the parties from performance pursuant to this Agreement.

ARTICLE VIII OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

A. Upon notification in accordance with Article II.C. of this Agreement and for so long as the Project Modification remains authorized, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project Modification or the functional portion of the Project Modification, at no cost to the Government, in a manner compatible with the Project Modification's authorized purposes and in accordance with applicable Federal and State laws as provided in Article XI of this Agreement and specific directions prescribed by the Government in the OMRR&R Manual and any subsequent amendments thereto.

B. The Non-Federal Sponsor hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor owns or controls for access to the Project Modification for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project Modification. If an inspection shows that the Non-Federal Sponsor for any reason is failing to perform its obligations under this Agreement, the Government shall send a written notice describing the non-performance to the Non-Federal Sponsor. If, after 30 calendar days from receipt of the notice, the Non-Federal Sponsor continues to fail to perform, then the Government shall have the right to enter, at reasonable times and in a reasonable manner, upon property the Non-Federal Sponsor owns or controls for access to the Project Modification for the

purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project Modification. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Government shall operate to relieve the Non-Federal Sponsor's obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to ensure faithful performance pursuant to this Agreement.

ARTICLE IX INDEMNIFICATION

The Non-Federal Sponsor shall hold and save the Government free from all damages arising from the implementation, operation, maintenance, repair, replacement and rehabilitation of the Project Modification, and any Project Modification-related betterments, except for damages due to the fault or negligence of the Government or its contractors.

ARTICLE X MAINTENANCE OF RECORDS AND AUDIT

A. Not later than 60 calendar days after the effective date of this Agreement, the Government and the Non-Federal Sponsor shall develop procedures for keeping books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement. These procedures shall incorporate, and apply as appropriate, the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 C.F.R. Section 33.20. The Government and the Non-Federal Sponsor shall maintain such books, records, documents, and other evidence in accordance with these procedures and for a minimum of three years after the period of implementation and resolution of all relevant claims arising therefrom. To the extent permitted under applicable Federal laws and regulations, the Government and the Non-Federal Sponsor shall each allow the other to inspect such books, documents, records, and other evidence.

B. Pursuant to 32 C.F.R. Section 33.26, the Non-Federal Sponsor is responsible for complying with the Single Audit Act of 1984, 31 U.S.C. Sections 7501-7507, as implemented by Office of Management and Budget (OMB) Circular No. A-133 and Department of Defense Directive 7600.10. Upon request of the Non-Federal Sponsor and to the extent permitted under applicable Federal laws

and regulations, the Government shall provide to the Non-Federal Sponsor and independent auditors any information necessary to enable an audit of the Non-Federal Sponsor's activities under this Agreement. The costs of any non-Federal audits performed in accordance with this paragraph shall be allocated in accordance with the provisions of OMB Circulars A-87 and A-133, and such costs as are allocated to the Project Modification shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement.

C. In accordance with 31 U.S.C. Section 7503, the Government may conduct audits in addition to any audit that the Non-Federal Sponsor is required to conduct under the Single Audit Act. Any such Government audits shall be conducted in accordance with Government Auditing Standards and the cost principles in OMB Circular No. A-87 and other applicable cost principles and regulations. The costs of Government audits performed in accordance with this paragraph shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement.

ARTICLE XI FEDERAL AND STATE LAWS

In the exercise of their respective rights and obligations under this Agreement, the Non Federal Sponsor and the Government agree to comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulations 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army, and Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of flood plain management plans.

ARTICLE XII RELATIONSHIP OF PARTIES

A. In the exercise of their respective rights and obligations under this Agreement the Government and the Non-Federal Sponsor each act in an independent capacity, and neither is to be considered the officer, agent, or employee of the other.

B. In the exercise of its rights and obligations under this Agreement, neither party shall provide, without the consent of the other party, any contractor with a release that waives or purports to waive any rights such other party may have to seek relief or redress against such contractor either pursuant to any cause of action that such other party may have or for violation of any law.

ARTICLE XIII OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, nor any resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XIV TERMINATION OR SUSPENSION

A. If at any time the Non-Federal Sponsor fails to fulfill its obligations under Article II.B., II.D., II.E., VI, or XVIII.C. of this Agreement, the Assistant Secretary of the Army (Civil Works) shall terminate this Agreement or suspend future performance under this Agreement unless he determines that continuation of work on the Project Modification is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with the Project Modification.

B. If appropriations are not available in amounts sufficient to meet the Government's share of Project Modification expenditures for the then-current or upcoming fiscal year, the Government shall so notify the Non-Federal Sponsor in writing, and 60 calendar days thereafter either party may elect without penalty to terminate this Agreement or to suspend future performance under this Agreement. In the event that either party elects to suspend future performance under this Agreement pursuant to this paragraph, such suspension shall remain in effect until such time as the Government receives sufficient appropriations or until either the Government or the Non-Federal Sponsor elects to terminate this Agreement.

C. In the event that either party elects to terminate this Agreement pursuant to this Article or Article XV of this Agreement, both parties shall conclude their activities relating to the Project Modification and proceed to a final accounting in accordance with Article VI.D. of this Agreement.

D. Any termination of this Agreement or suspension of future performance under this Agreement in accordance with this Article or Article XV of this Agreement shall not relieve the parties of any obligation previously incurred. Any delinquent payment shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent rate of the 13week Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3month period if the period of delinquency exceeds 3 months.

ARTICLE XV HAZARDOUS SUBSTANCES

A. After execution of this Agreement and upon direction by the District Engineer, the Non-Federal Sponsor shall perform, or cause to be performed, any investigations for hazardous substances that the Government or the Non-Federal Sponsor determines to be necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (hereinafter "CERCLA"), 42 U.S.C. Sections 96019675, that may exist in, on, or under lands, easements, and rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the implementation, operation, and maintenance of the Project Modification, except for any such lands, easements, or rights-of-way that are owned by the United States and administered by the Government, and except for any such lands that the Government determines to be subject to the navigation servitude. The Government shall perform, or cause to be performed, all investigations on lands, easements, or rights-of-way that are owned by the United States and administered by the Government. For lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the District Engineer provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction. All actual costs incurred by the Non-Federal Sponsor or the Government for such investigations for hazardous substances shall be included in total project modification costs and cost shared in accordance with the provisions of this Agreement, subject to an audit in accordance with Article X.C. of

this Agreement to determine reasonableness, allocability, and allowability of costs.

B. In the event it is discovered through any investigation for hazardous substances or other means that hazardous substances regulated under CERCLA exist in, on, or under any lands, easements, or rights-of-way, that the Government determines, pursuant to Article III of this Agreement, the Non-Federal Sponsor must provide for the implementation, operation, and maintenance of the Project Modification, the Non-Federal Sponsor and the Government shall provide prompt written notice to each other, and the Non-Federal Sponsor shall not proceed with the acquisition of the real property interests until both parties agree that the Non-Federal Sponsor should proceed.

C. The Government and the Non-Federal Sponsor shall determine whether to initiate implementation of the Project Modification, or, if already in implementation, whether to continue with work on the Project Modification, suspend future performance under this Agreement, or terminate this Agreement for the convenience of the Government, in any case where hazardous substances regulated under CERCLA are found to exist in, on, or under any lands, easements, or rights-of-way that the Government determines, pursuant to Article III of this Agreement, to be required for the implementation, operation, and maintenance of the Project Modification. Should the Government and the Non-Federal Sponsor determine to initiate or continue with implementation after considering any liability that may arise under CERCLA, the Non-Federal Sponsor shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of clean-up and response, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination on lands, easements or rights of way that the Government determines, pursuant to Article III of this Agreement, to be required for the implementation, operation, and maintenance of the Project Modification, except for any such lands, easements, or rights-of-way owned by the United States and administered by the Government. Such costs shall not be considered a part of total project modification costs. In the event the Non-Federal Sponsor fails to provide any funds necessary to pay for clean up and response costs or to otherwise discharge the Non-Federal Sponsor's responsibilities under this paragraph upon direction by the Government, the Government may, in its sole discretion, either terminate this Agreement for the

convenience of the Government, suspend future performance under this Agreement, or continue work on the Project Modification. The Government shall be responsible, as between the Government and the Non-Federal Sponsor, for the costs of clean-up and response, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination on lands, easements, or rights of way owned by the United States and administered by the Government. All costs incurred by the Government shall be included in total project modification costs and cost shared in accordance with the terms of this Agreement.

D. The Non-Federal Sponsor and the Government shall consult with each other in accordance with Article V of this Agreement in an effort to ensure that responsible parties bear any necessary cleanup and response costs as defined in CERCLA. Any decision made pursuant to paragraph C. of this Article shall not relieve any third party from any liability that may arise under CERCLA.

E. As between the Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the Project Modification for purposes of CERCLA liability. To the maximum extent practicable, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the Project Modification in a manner that will not cause liability to arise under CERCLA.

ARTICLE XVI NOTICES

A. Any notice, request, demand, or other communication required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and either delivered personally, or by telegram, or mailed by first-class, registered, or certified mail, as follows:

If to the Non-Federal Sponsor:

Mayor
City of Jefferson
102 North Polk Street
Jefferson, Texas 75657-2214

If to the Government:

District Engineer
U.S. Army Corps of Engineers
Fort Worth District
P.O. Box 17300
Fort Worth, Texas 76102-0300

B. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

C. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at the earlier of such time as it is actually received or seven calendar days after it is mailed.

ARTICLE XVII CONFIDENTIALITY

To the extent permitted by the laws governing each party, the parties agree to maintain the confidentiality of exchanged information when requested to do so by the providing party.

ARTICLE XVIII - HISTORIC PRESERVATION

A. The costs of identification, survey and evaluation of historic properties shall be included in total project modification costs assigned to environmental restoration features and cost shared in accordance with the provisions of this Agreement.

B. Pursuant to Section 7(a) of Public Law 93-291 (16 U.S.C. Section 469c(a)), the costs of mitigation and data recovery activities associated with historic preservation shall be borne entirely by the Government and shall not be included in total project modification costs, up to the statutory limit of one percent of the total amount the Government is authorized to expend for the Project Modification.

C. The Government shall not incur costs for mitigation and data recovery that exceed the statutory one percent limit specified in paragraph B. of this Article unless and until the

Assistant Secretary of the Army (Civil Works) has waived that limit in accordance with Section 208(3) of Public Law 96-515 (16 U.S.C. Section 469c-2(3)). Any costs of mitigation and data recovery that exceed the one percent limit shall be included in total project modification costs and shall be cost shared in accordance with the provisions of this Agreement.

ARTICLE XIX LIMITATION ON GOVERNMENT EXPENDITURES

Notwithstanding any other provisions of this Agreement, the Government's financial obligations are limited to $5,000,000. The Non-Federal Sponsor shall be responsible for all total project modification costs that exceed this amount.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the Department of the Army.

THE DEPARTMENT OF THE ARMY

BY:_____
JAMES S. WELLER
Colonel, Corps of Engineers
District Engineer
Fort Worth District

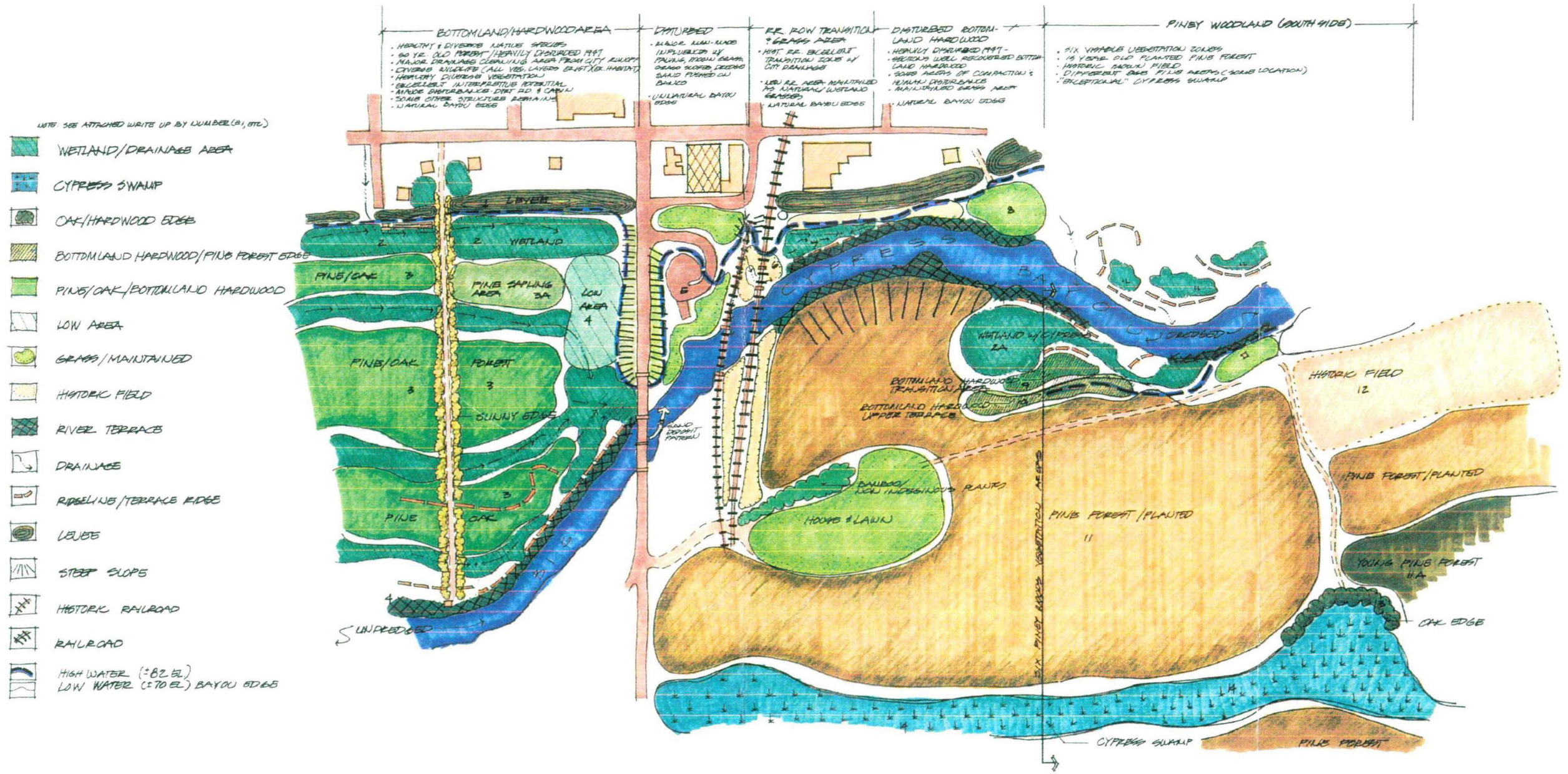
DATE:_____

THE CITY OF JEFFERSON, TEXAS

BY:_____
CAREY B. HEASTER, JR.
Mayor

DATE:_____

EXISTING CONDITIONS



BIG CYPRESS BAYOU

FISH AND WILDLIFE HABITAT RESTORATION PLAN

0 100 200 300 400

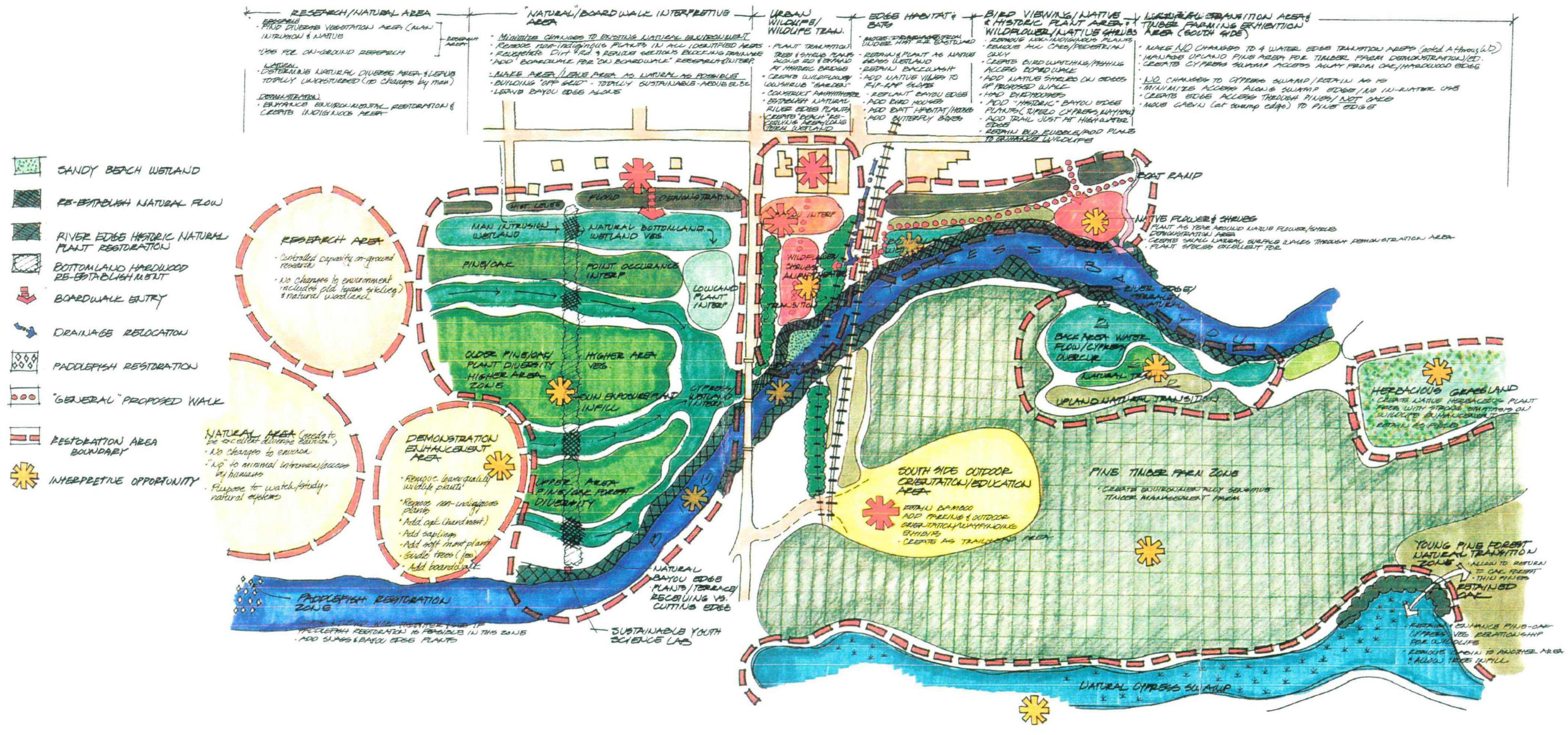
JEFFERSON TEXAS

Prepared by SHAPINS ASSOCIATES PLANNERS-LANDSCAPE ARCHITECTS

Prepared for U.S. Army Corps of Engineers

FIGURE 3

RESTORATION OPPORTUNITIES PLAN



BIG CYPRESS BAYOU

FISH AND WILDLIFE HABITAT RESTORATION PLAN

0 100 200 300 400

JEFFERSON TEXAS

Prepared by SHAPINS ASSOCIATES PLANNERS-LANDSCAPE ARCHITECTS

Prepared for U.S. Army Corps of Engineers Fort Worth District Planning Office

FIGURE 4

West Area
Habitat Restoration

Bottomland Hardwood &Wetland Restoration

Habitat Restoration
- Remove lower quality non-indigenous vegetation
- Add hard mast vegetation
- Add soft mast /wildlife beneficial vegetation
- Selectively girdle trees for wildlife habitat
- Bottomland Cypress-Tupelo vegetation restoration

Features
- Wetland habitat improvement through water retention structures
- Combination maintenance and recreation access throughout

Core Area
Wildscape

Bottomland Hardwood Restoration

Habitat Restoration
- Remove lower quality non-indigenous vegetation
- Add hard mast vegetation
- Add soft mast /wildlife beneficial vegetation
- Selectively girdle trees for wildlife habitat

East Area
Wildscape

Wildscape

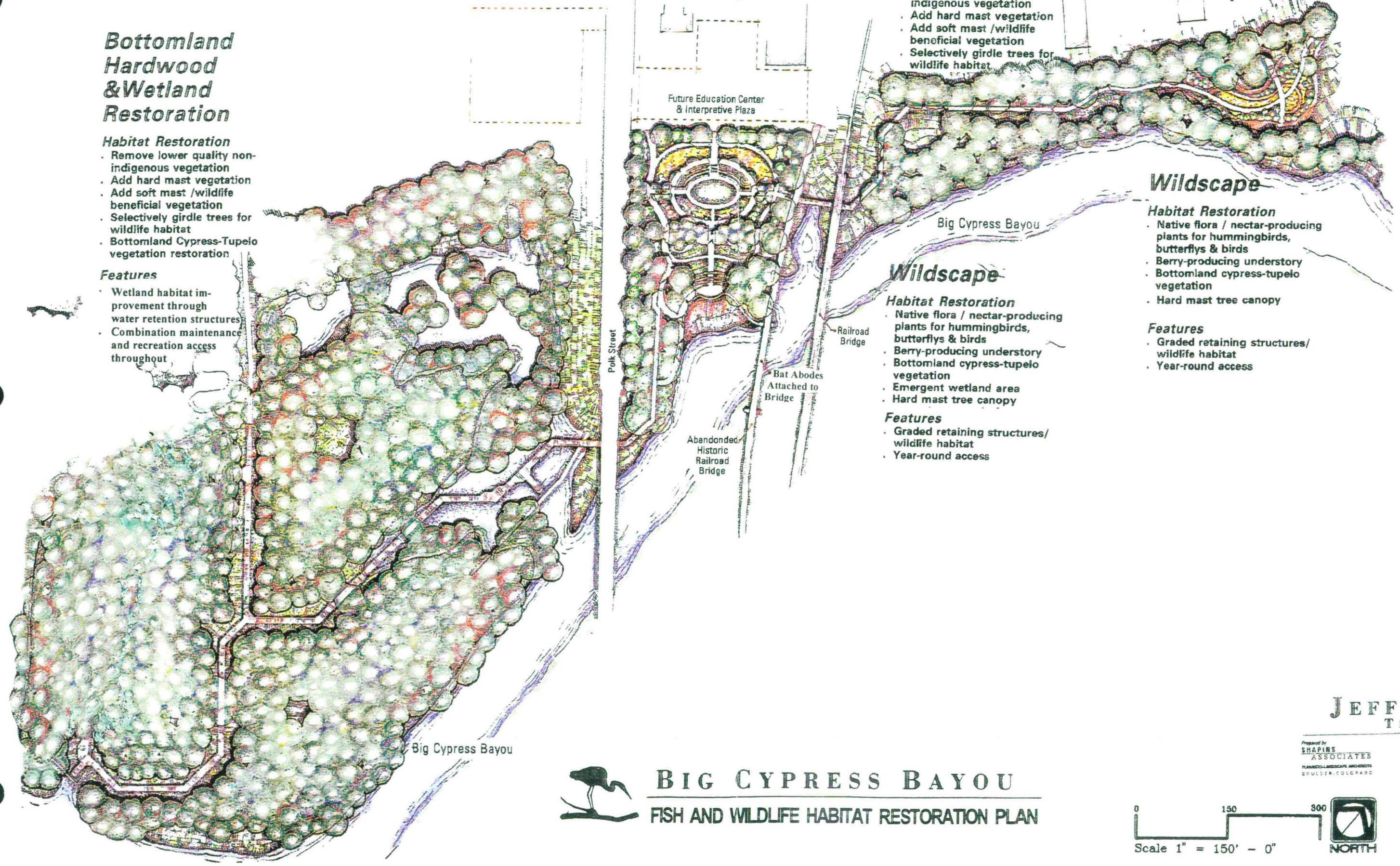
Habitat Restoration
- Native flora / nectar-producing plants for hummingbirds, butterflys & birds
- Berry-producing understory
- Bottomland cypress-tupelo vegetation
- Hard mast tree canopy

Features
- Graded retaining structures/ wildlife habitat
- Year-round access

Wildscape

Habitat Restoration
- Native flora / nectar-producing plants for hummingbirds, butterflys & birds
- Berry-producing understory
- Bottomland cypress-tupelo vegetation
- Emergent wetland area
- Hard mast tree canopy

Features
- Graded retaining structures/ wildlife habitat
- Year-round access



BIG CYPRESS BAYOU
FISH AND WILDLIFE HABITAT RESTORATION PLAN

JEFFERSON
TEXAS

Prepared by SHAPINS ASSOCIATES PLANNERS-LANDSCAPE ARCHITECTS BOULDER, COLORADO

Prepared for U.S. Army Corps of Engineers Fort Worth District Planning C

0 150 300
Scale 1" = 150' - 0"
NORTH

FIGURE 5