

# Information Sheet on Ramsar Wetlands (RIS)

## – 2006-2008 version –

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Designation date

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Site Reference Number

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**2. Date this sheet was updated:** February 2007

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**3. Country:** USA

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**4. Name of the Ramsar site:** Caddo Lake

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**5. Designation of new Ramsar site or update of existing site:**

**This RIS is for** (tick one box only):

- a) Designation of a new Ramsar site ; or  
b) Updated information on an existing Ramsar site

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**6. For RIS updates only, changes to the site since its designation or earlier update:**

a) Site boundary and area

The Ramsar site boundary and site area are unchanged:

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

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**7. Map of site:**

a) A map of the site, with clearly delineated boundaries, is included as:

- i) a hard copy (required for inclusion of site in the Ramsar List): ;  
ii) an electronic format (e.g. a JPEG or ArcView image) ;  
iii) a GIS file providing geo-referenced site boundary vectors and attribute tables .

b) Describe briefly the type of boundary delineation applied:

The original Caddo Lake Ramsar site was designated in 1993 by the Texas Parks and Wildlife (TPWD) Wildlife Management Area. Seven "First Enlargement" wetlands were added in 1996-1997 including 565 ha owned by the U.S. Army and leased to Caddo Lake Institute, another 148 ha. parcel owned by TPWD, three wetland parcels of submerged lands owned by the Texas General Land Office and two private ownerships (Jones/Henley) totalling 1416 ha.

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**8. Geographical coordinates:**

32°42' - 32°47'N, 94°5' - 94°10' W

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**9. General location:**

Caddo Lake is located on the border of Texas and Louisiana, in northern Harrison County and southern Marion County in Texas and western Caddo Parish in Louisiana. It is approximately 24 km (15 mi.) northeast

of Marshall, Texas (pop. 23,935) and 40.2 km (25 mi.) west of Shreveport, Louisiana (pop. 198,364). Caddo Lake lies at the bottom of the Cypress Bayou Basin.

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**10. Elevation:** average 52 m (170 ft.) amsl.

**11. Area:** Approx. 7,977 ha

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**12. General overview of the site:**

Caddo Lake drainage area is approximately 2,800 square miles (7,250 Km<sup>2</sup>). The site includes the shallow, heavily-vegetated waters of Caddo Lake, associated backwaters, sloughs, swamps, and bottomland hardwood forests. The majority of the area is either permanently flooded by backwater influences of Caddo Lake or is inundated for extended periods during the growing season by overbank flooding of Cypress Bayou. Located in the Mississippi flyway, Caddo Lake's wetlands provide important habitat for wintering migratory waterfowl and neotropical birds which winter in Central and South America and the Caribbean. Caddo Lake is one of the best examples in the southern United States, of a mature Bald Cypress community. They contain a rich bio-diversity of plants and animals, including species that are rare, endangered or of special concern to state and federal governments and the conservation community generally.

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**13. Ramsar Criteria:**

1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9

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**14. Justification for the application of each Criterion listed in 13 above:**

**Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region:**

This wetland area includes some of the highest quality and most representative old-growth bottomland hardwood forests in the southeastern United States. The palustrine forested areas are primarily baldcypress (*Taxodium distichum*) swamps and flooded hardwood forests. The Cypress forests in and around Caddo Lake may be the largest such forest in the United States. The mixed hardwood forest along one of Caddo Lake's tributaries, Harrison Bayou, is one example of unique near-natural wetlands in the Ramsar site. These wetland forests have unique morphological and physiological adaptations to the submerged environment such as trunk buttressing and pneumatophores (knees). They depend on water for seed dispersal (Winemiller et al. 2005).

**Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities:**

The area in and around Caddo Lake is home to several animals, plants or plant communities considered rare, threatened or endangered by national and international legislation. These species include the peregrine falcon (*Falco peregrinus tundrius*) and mallard duck (*Anas platyrhynchos*), listed under CITES Appendix I (UNEP-WCMC 2007); the cerulean warbler (*Dendroica cerulea*), alligator snapping turtle (*Macrolemys temminckii*), red-cockaded woodpecker (*Picoides borealis*), eastern big-eared bat (*Plecotus rafinesquii*) and the paddlefish (*Polyodon spathula*) are all listed as vulnerable in the IUCN Red List. In addition, species considered endangered at the state and national levels are listed in Appendix A. For other species see Section 22.

**Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region:**

Approximately 216 bird, 47 mammal, and 90 reptile and amphibian species occur in the project area, many of which depend on the highly productive, specialized habitats provided by the wetlands of Caddo Lake. The wetlands are especially well-noted as habitat for waterfowl, colonial waterbirds, migratory passerines, and restrictive wetland species such as the American alligator (*Alligator mississippiensis*) and river otter (*Lutra canadensis*). According to the Texas Parks and Wildlife Division (TPWD), the wetlands of Caddo Lake also support some of the highest densities of furbearing animals in the State.

Bottomland hardwood forests, especially forested wetlands such as the baldcypress stands of upper Caddo Lake, are very fragile because of their limited distribution and restrictive site requirements. Studies indicate that baldcypress growth, reproduction, and survival are directly related to the frequency of substrate exposure. Inventories of bottomland hardwood forests in East Texas indicate that they support at least 189 species of trees and shrubs, 42 woody vines, 75 grasses, and 802 other herbaceous plants. The State of Texas considers 73 of these species to be of special concern. Forty-eight species are found in or are restricted to bottomland hardwood forests and associated wetlands.

**Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions:**

The wetlands of Caddo Lake are also very important to a variety of migratory game bird species, as well as the many nongame bird species, within the Central Flyway. The Pineywoods region itself accounts for approximately 2% of the estimated wintering ducks in Texas, and mallards (*Anas platyrhynchos*) and other waterfowl species depend heavily upon the resting cover of Caddo Lake while mature hardwoods provide critical nesting and foraging habitat. The area supports one of the highest breeding populations of wood ducks (*Aix sponsa*) in Texas (Gregg 1993). The forested wetlands of Caddo Lake provide specific conditions that meet the habitat requirements of certain species of wood warblers, including the prothonotary warbler (*Protomotaria citrea*) (Cloud 1993).

**Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity:**

Surveys of Caddo Lake indicate that it supports Texas' most diverse fish fauna, with as many as 86 species listed in one study (Hubbs 2002). Cloud recorded references to 71 species (within classes *Agnatha* and *Osteichthyes*) (Cloud 1984). Significant among the restricted aquatic species occurring in the project area are species such as the paddlefish (*Polyodon spathula*), the American eel (*Anguilla rostrata*) and southern brook lamprey (*Ichthyomyzon gagei*). None of the fish species are endemic. There are at least 18 species of game fish that are present and important to the sports fisheries activity at Caddo Lake (Appendix B).

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## 15. Biogeography

### a) biogeographic region:

Caddo Lake lies within Ecoregion 35b—South Central Plains, Floodplains and Low Terraces; the ecoregion is also called Subtropical; Caddo Lake is in the Pineywoods natural region of Texas, characterized by pine-hardwood forest in upland areas and bottom land hardwoods in flood plain areas.

### b) biogeographic regionalisation scheme:

Griffith, G.E., Bryce, S.A., Omernik, J.M., Comstock, J.A., Rogers, A.C., Harrison, B., Hatch, S.L., and Bezanson, D., 2004, Ecoregions of Texas (color poster with map, descriptive text, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:2,500,000);

Ecoregions-Bailey-Divisions from US Geological Survey (Bailey and Cushwa 1981); "Natural Regions of Texas" Map compiled by Texas Parks and Wildlife Department GIS Lab, 31 May 2001.

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## 16. Physical features of the site:

*Geology and geomorphology:* Caddo Lake is approximately 26,800 surface acres (10,800 ha), increasing up to 43,000 surface acres (17,400 ha) at maximum capacity. Elevations of the Caddo Lake wetlands range from about 51.35m (168.5 feet) to 53.34m (175 feet) mean sea level (U.S. Fish & Wildlife Service 1993b) rising to just above the summits of scattered bluffs. The watershed's topography is considered irregular with rolling, hilly, uplands dissected by broad flat floodplain (Cloud 1995).

The alluvium in the valley of Big Cypress Bayou ranges from 20 to 50 feet (6-15m) in thickness and consists of a fining upward sequence of gravel, sand, silt, and clay.

The Carrizo-Wilcox Aquifer occurs over the entire basin and consists of the Wilcox Group and the overlying Carrizo Formation of the Claiborne Group. The aquifer is made up of fine- to medium-grained sand and sandstone interbedded with clay and silt, and minor amounts of lignite in the Wilcox Group. The Queen City Aquifer occurs in a wide band across the central part of the Cypress Basin and consists of interbedded fine- to medium-grained sand, clay, glauconite, and lignite. The Carrizo-Wilcox and Queen City geologic units are hydrologically connected (TWC 1989).

*Soil type and chemistry range:* The soils of the area were formed mainly under forest vegetation. Upland soils are lightly colored, generally with loamy or sandy surface areas and dense subsoils. Flood plain soils along major drainages dominated by clays and subject to frequent flooding. The soil types underlying the wetland parcels consist mostly of Cypress Clay loam, submerged (Cy), Metcalf silt loam (MiA) 0 to 2 percent slopes, Eastwood very fine sandy loam, (EaB, EeD, EeE), Sardis-Mathiston complex, frequently flooded (Sm), Scottsville very fine sandy loam, 0 to 2 percent slopes (SvA) (Web Soil Survey 2006).

*Sediment characteristics:* Studied from 1993 to 1995, Caddo Lake sediments were found to contain lead and mercury levels which exceeded the State chronic aquatic life criteria. Aliphatic hydrocarbon compounds and polycyclic aromatic hydrocarbons were detected in low concentrations (Giggleman, et. al. 1998)

Modern sedimentation rates (1963 to present) were measured using gamma ray spectroscopy at seven sites within Caddo Lake (Lisanti 2001), yielding sedimentation rates ranging from 0.22 cm/year to 0.56 cm/year. Similar sedimentation rates were also determined from cores taken for contaminant studies by the USGS (Wilson 2003).

*Origins:* Caddo Lake and its associated wetlands were originally formed by massive log jams on the lower Red River; however, water elevations in the lake are now maintained by a weir constructed in the early 1900s following removal of the log jam.

*Hydrology:* The main inflow to Caddo Lake is Big Cypress Bayou, the floodplain of which contains pint bars, levees and in abandoned channels as well as oxbow lakes, characteristic of a lowland meandering river. Big Cypress Bayou contributes only 32% of the total average inflow to Caddo Lake, with the remaining 68% coming from smaller tributaries that are unimpounded and flows that are uncontrolled. The majority of these wetland areas are either permanently flooded by backwater influences or inundated for extended periods during the growing season by overbank flooding of Cypress Bayou.

*Water Quality (physio-chemical characteristics):* Water quality in Caddo Lake shows increasing eutrophication (Paul Price Assoc. 2000). Water quality monitoring, which has been sponsored by both the Texas Commission on Environmental Quality (TCEQ) and the Caddo Lake Institute (CLI), has found that dissolved oxygen and pH in the lake are below levels that are optimal for supporting fish and other aquatic life. Samples taken between 1998 and 2005 suggest that the riverine and lake sites in and around Caddo Lake meet most of the Texas water quality standards but that much of the wetland habitat at Caddo Lake is anoxic during the summer months. The summer months typically have low flow into the Lake and high temperatures, both factors are conducive to low DO values. The low DO values usually begin in May or June and last until at least August.

Caddo Lake is an acidic lake which is typical of east Texas water bodies. The mean pH during the period from 1998 to 2005 was 6.30 with the lowest mean pH found in the river (6.15) and the wetland sites (6.18). Alkalinity at Caddo Lake is generally low with an overall mean of 17.7 mg/l compared to other water bodies in east Texas. Alkalinity is highest at the wetland sites and lowest at the riverine site. Sulfate concentrations at Caddo Lake were fairly stable during the time period with an overall mean of 13.8 mg/l.

All three habitat-types at Caddo Lake indicate turbid water with secchi depths of less than 1 m. The open water portion of the lake has the most turbid water with a secchi depth of 0.79 m, while the wetland sites have the least turbid water with a secchi depth of 0.85 m. Bacteria levels tend to be low at Caddo Lake, and there seems to be no increasing or decreasing trend over time. The wetland sites are the most variable sites for bacteria with some months being high and others non-detectable (Darville 2006). While nutrients are seen as a problems in parts of the Lake, some studies of nutrients have concluded that the overall nutrient concentrations in Caddo Lake are not excessive (Darville 2002) and that water quality indexes categorize the Lake in the "good" category (Paul Price Assoc. 2003, Darville 2006).

Rampant growth of macrophytes in the upper reaches of Caddo Lake are problematic in that decay of this accumulated biomass also leads to conditions of low dissolved oxygen and may fuel summer phytoplankton blooms.

Caddo Lake, State of Texas Segment 0401, has also been on the Clean Water Act 303(d) list for not meeting designated use due to contamination exceedances from dissolved mercury and other contaminants in water, and for exceedances of pH and temperature criteria (TCEQ 2004).

*Depth, fluctuations and permanence of water.* Included in the Caddo Lake wetland area are the shallow, heavily-vegetated waters of Caddo Lake, associated backwaters, sloughs, swamps, and bottomland hardwood forests. The majority of the area is either permanently flooded by backwater influences of Caddo Lake or is inundated for extended periods during the growing season by overbank flooding of Cypress Bayou. Inflows and lake levels are influenced by releases from Lake o' the Pines upstream on Big Cypress Bayou. In the period from 1998 to 2005, the highest inflow (1,843,774 dsf) was in 2001 and the lowest (403,527) in 2005 (Darville 2006).

*Climate:* see Number 17, "Physical features of the catchment area" below.

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### 17. Physical features of the catchment area:

*Surface Area:* The Cypress Basin is a sub-basin of the Red River Basin, a multi-state basin that drains an area of approximately 6,000 square miles in 11 Texas counties and 1 Louisiana Parish. The Texas portion of the catchment that lies within the Cypress basin is approximately 2,800 square miles in area. Big Cypress Creek is approximately 70 miles in length and its average annual flow is 493,700 acre-feet (TWDB 2006). Major tributaries that make up this catchment basin include Big Cypress, Little Cypress, Black Cypress, and Jim's or James' Bayous. Smaller tributaries include Kitchen's Creek and Harrison Bayou.

*Geology & Geomorphological Features:* see "Physical Features of the site" above.

*General Soil Types:* see "Physical Features of the site" above.

*Climate:* The climate is subtropical, characterized by hot humid summers and mild winters with an average summer temperature of 81°F (27 °C) and an average winter temperature of 46°F (8 °C). Sunshine prevails 75 percent of the time during the summer and 55 percent during the winter. Total annual precipitation in Harrison County, Texas averages 47 inches (1,194 mm). Of this, about 50 percent (23.5 inches or 597 mm) usually occurs in April-September, which spans the growing season for most crops. In two years out of ten, rainfall in the period is less than 19 inches (482 mm). Annual rainfall was highly variable with a range of 30.42 inches (773 mm) to maximums of 66.31 inches (1,684 mm) in 2004 and 57.30 inches (1,455 mm) in 2001 (Darville 2006).

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### 18. Hydrological values:

Caddo Lake's wetlands are predominantly classified as palustrine forested under the U.S. Fish and Wildlife Service's National Wetlands Inventory classification system. These wetlands provide important hydrological and biological functions to the Cypress Bayou and lower Red River Drainages (USFWS 1993). There is a direct relationship between the bottomland hardwoods and the hydrologic regime. Some of the most important functions of the bottomlands area, besides wildlife habitat, are floodpeak reduction, water storage and groundwater recharge and water quality improvement.

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### 19. Wetland Types

#### a) presence:

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

Inland: L • M • N • O • P • Q • R • Sp • Ss • Tp • Ts • U • Va •  
Vt • W • Xf • Xp • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • Zk(c)

**b) dominance:**

List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

Freshwater Tree-Dominated Wetlands (Xf), Permanent Freshwater Lake (O), Permanent Freshwater marshes/pools (Tp), Seasonal/intermittent freshwater marshes/pools (Ts), Shrub-dominated wetlands (W), Permanent rivers/streams/creeks (M), Seasonal/intermittent freshwater lakes (P), Human-made type 6.

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**20. General ecological features:**

The palustrine forested wetlands are interspersed with a smaller amount of palustrine emergent, lacustrine, and riverine wetland types. The palustrine forested areas are primarily baldcypress swamps and flooded hardwood forests. The vegetation composition of these habitat types, as with most palustrine forested systems in the southern United States, is correlated to existing hydrological conditions and water regimes.

The structural components of the baldcypress swamp community provide very good habitat conditions, refuge, perch sites, food and building materials for a variety of wetland species. The mature hardwoods within the Caddo Lake area are especially vital to the survival and productivity of the Neotropical migrant birds, providing critical nesting habitat during the spring and summer breeding season.

In shrub swamp areas containing permanent water, floating and submersed aquatic plants (e.g., water primrose, American lotus, duckweed, etc) are common. The diversity and abundance of plant materials in the shrub wetlands makes them excellent wildlife habitat, especially valuable to the wood duck for brood-rearing habitat and to reptiles and amphibians. In marshy wetlands, emergent vegetation has reestablished on much of the spoil material placed along various boat canals within Caddo Lake. The composition of food-producing wetland plants in this habitat makes the emergent wetland a productive foraging site for waterfowl, wading birds and small mammals (Cloud 1995).

A highly diverse collection of wildlife species depend on the highly productive, specialized habitats provided by the wetlands of Caddo Lake. Field assessments conducted by the Fish and Wildlife Service indicate that habitat conditions are near optimum for many of the representative wetland wildlife species of the area.

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**21. Noteworthy flora:**

The aquatic plant which dominates the vistas of Caddo Lake is the southern baldcypress (*Taxodium distichum*). This large, broad-based coniferous tree is characterized as an ecological pioneer of southern wetlands. It has demanding regeneration requirements, which are dependent upon appropriate flooding and drying patterns in areas which are free from competitive tree species. Other species, such as the swamp tupelo (*Nyssa sylvatica* var. *biflora*) and water tupelo (*Nyssa aquatica*) are also dependent on flood waters for seed dispersal. These species are of concern when considering the impacts of human development and the controlled releases from upstream reservoirs in the basin. Baldcypress trees are slow growing, but once they establish themselves they are able to occupy permanently flooded areas. Trees of 250 to 350 years of age are not uncommon in the Caddo Lake ecosystem.

The palustrine forested areas of Caddo Lake comprise one of the most floristically diverse areas in the State. Inventories of east Texas hardwood bottomlands, including Caddo Lake, indicate that they support at least 189 species of trees and shrubs, 42 woody vines, 75 grasses, and 802 other herbaceous plants. The overcup oak (*Quercus lyrata*) – bitter pecan (*Carya aquatica*) association is the characteristic vegetation of the lowest moist soil sites. Higher elevation bottomland hardwoods consist primarily of willow oak (*O. phellos*) -water oak (*O. nigra*) - sweetgum (*Liquidambar styraciflua*) associations.

Mid and understory woody vegetation on the shallow flooded sites, where present, is dominated by stands of swamp privet (*Forestiera Poir*), buttonbush (*Cephalanthus occidentalis* L) and water elm (*Planera aquatica*). The most common emergent herbaceous species observed in the wooded swamps included smartweed (*Polygonum lapathifolium*), lizard's tail (*Saururus cernuus*), arrowhead (*Sagittaria* L.) and various sedges as well as numerous floating and submersed species such as American lotus, water primrose, spatterdock, arrowhead, elodea, and coontail.

Non-invasive aquatic macrophytes in Caddo Lake include Duckweeds (*Lemna* sp., and *Spirodela polyrrhiza*, American Lotus (*Nelumbo Lutea*) and waterlilies (*Nymphae odorata* and *Nuphar luteum*) (Caddo Lake Institute,

1995). Invasive species will be discussed below in Number 26, “Factors adversely affecting the site’s ecological character”.

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## 22. Noteworthy fauna:

Ingold and Hardy’s 1996 studies of Caddo Lake’s indigenous species identified those which are “endangered, threatened or of special concern” to some responsible agency. These included 6 mammals, 18 birds, 4 reptiles, 1 amphibian, 8 fishes, 1 insect, 8 mussels and 7 plants. Federal listed species include: the bald eagle (*Haliaeetus leucocephalus*), red-cockaded woodpecker (*Picoides borealis*), Arctic peregrine falcon (*Falco peregrinus tundrius*), piping plover (*Charadrius melodis*), and interior least tern (*Sterna antillarum athalassos*). The Louisiana black bear (*Ursus americanus*), considered a “threatened” species in Texas, is making a gradual comeback in East Texas and may come to re-inhabit the region.

The mature hardwoods within the Caddo Lake area are especially vital to the survival and productivity of neotropical migrant bird species, providing critical nesting habitat during the spring and summer breeding season. The prothonotary warbler (*Protonotaria citrea*) requires cavities which occur in the cypress and hardwood trees for nesting, while the cerulean warbler (*Dendroica cerulea*) commonly occupies the canopy of the tallest trees. The parula (*Parula americana*) and yellow-throated (*Dendroica dominica*) warblers are dependent upon Spanish moss (*Tillandsia usneoides*) in the cypress canopy for nesting material. All of these wood warblers are very specific in their habitat requirements and need large, relatively undisturbed tracts of forested woodlands for optimum habitat conditions. Such conditions are provided by the forested wetlands of Caddo Lake (Cloud 1993).

The Caddo Lake wetlands area provides important wintering habitat for waterfowl, especially mallards (*Anas platyrhynchos*) and has one of the highest populations and reproduction areas for wood ducks (*Aix sponsa*) in the state of Texas. Mallards are known to use the flooded forest areas to forage and feed starting in early fall. Wood ducks use overcup oak, cypress/tupelo forest types and scrub/shrub habitats during fall courtship and coupling and wintering habitat (USFWS 1993).

In addition to the important function provided to the wintering waterfowl, the habitat of the Caddo Lake basin is likely to be used by two of the state’s threatened bird species—whitefaced ibis (*Plegadis chibi*) and woodstork (*Mycteria Americana*).

The giant alligator snapping turtle (*Macrolemys temminckii*) is of special interest. This turtle has been proposed for federal listing but it was declined. Its range is vast, as it covers those parts of the central and southern United States which drain into the Gulf of Mexico (Pritchard 1989). Sightings of this turtle are not uncommon in the Caddo Lake region. Reliable sightings have occurred with regularity in the Harrison Bayou and Caddo Lake National Wildlife Refuge areas (Caddo Lake Institute 1995). This suggests an opportunity to support the recovery of one of the world’s many stressed or endangered giant turtle species -- well before federal listing causes costly regulation and recovery or becomes a source of potential consternation to private land owners throughout this vast historic range.

The high quality and large expanse of baldcypress swamps, bottomland hardwoods, emergent wetlands, and shallow vegetated flats at Caddo Lake constitute excellent habitat for restricted wetland species such as the American alligator, mink, and river otter. These habitats provide cover for abundant prey species such as fish, crayfish, turtles, birds, small mammals, amphibians, reptiles and invertebrates. Populations of American Beaver (*Castor canadensis*) and an introduced species of Nutria (*Myocastor copus*) are unconstrained by effective predation and are regarded as “nuisance animals” and potential risks to healthy generation and regeneration of old-growth and baldcypress forest remnants (Caddo Lake Institute 1995).

Other Texas State species listed as endangered or threatened include: Rafinesque’s big-eared bat (*Plecotus rafinesquii* / *Corynorhinus rafinesquii*), Bachman’s sparrow (*Aimophila aestivalis*), American swallow-tailed kite (*Elanoides forficatus*), wood stork (*Mycteria americana*), northern scarlet snake (*Cemophora coccinea copei*), timber/canebrake rattlesnake (*Crotalus horridus atricaudatus*), Texas horned lizard (*Phrynosoma cornutum*), and Louisiana pine snake (*Pituophis melanoleucus ruthveni*).

In addition to the important gamefish species, Caddo Lake supports a variety of less common and specialized fish species such as paddlefish, American eel, bowfin, southern brook lamprey, chain pickerel, flier and bantam sunfish. Species like the American eel have been particularly affected by habitat alteration elsewhere,

since they breed and spawn in the sea and their upstream migrations have been blocked by dams and pollution sources (Shellman 1999).

Twenty-one species of mussels plus the Asian Clam (*Corbicula fluminea*) were identified in a U.S. Army Corps of Engineers (USACE) 1992 study of 22 sites in the western reaches of the Caddo Lake wetlands and the lower Cypress Basin catchment. Pre-historic and historic use of mussels included the Caddo Indians' use for jewelry (before and during early European occupation of the area) and a short-lived, but valuable, freshwater pearl industry (1909-1912). USACE investigators found mussel communities to be small and scattered with *Plectomerus dobreyanus* (one of three freshwater pearl mussels) being the most common, followed by *Corbicula fluminea* and *Lampsilis teres*.

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### 23. Social and cultural values:

a) The communities in and around Caddo Lake's and its associated wetlands use the system for a wide variety of outdoor recreation including sports fishing, hunting, bird watching and boating. The area is also visited by tourists coming for the same outdoor activities.

The archaeological resources of the area are significant, including many Caddoan Native American sites as well as the sites reflecting early European in-migration and settlement. Based upon the nature and distribution of Native American artifacts, one of the sites was likely occupied continuously for several hundred years, suggesting a high probability that further investigations will locate native American grave sites (Dr. Timothy Perttula, personal communication, 1998).

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning? Not applicable.

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### 24. Land tenure/ownership:

a) within the Ramsar site:

Substantially all of the state-owned lands within Caddo Lake and its wetlands are in the state park and wildlife management area and have been designated as Ramsar wetlands. The Harrison Bayou portion of the Caddo Lake National Wildlife Refuge is also part of the designated Ramsar wetlands. Very little of the Caddo Lake wetlands in Louisiana are in the Ramsar designation. Thirty-five percent of the total Ramsar site area is owned by the State of Texas (2,778 ha), forty percent by the Texas General Land Office (3,217 ha), seven percent by U.S. Fish & Wildlife Service (565 ha) and eighteen percent by private owners (1316 ha).

b) in the surrounding area:

Most of the land around Caddo Lake, as well as the catchment, is privately owned, in thousands of small and large parcels. A strong "private property rights" culture in Texas resists both state and federal land use restraints. Commercial interests which resist governmental regulation are well represented at state and local government levels.

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### 25. Current land (including water) use:

a) within the Ramsar site:

The Ramsar site area primarily consists of land that is used as wildlife refuge, State Park and Wildlife Management Area and private property. The designated site itself does not have commercial or agricultural uses. The refuge areas are and will continue to be used for continued research and expanded educational opportunities.

In the Wildlife Management Area of the Ramsar site, fishing, trapping and public hunting of white-tailed deer, feral hog, waterfowl, dove, other migratory game birds, squirrel, quail, rabbits, hares, predators, furbearers and frogs is permitted. Outdoor recreational opportunities include primitive camping, wildlife viewing, hiking, bicycling, and horseback riding.

The 2000 census shows about 1300 people residing in the unincorporated lake communities of Uncertain, Karnack and Pine Island Point in Harrison County, Texas. The resident population was expected to increase by 2.2% by the year 2005. Based on the number of water hookups in the area, the population inflates to about 1,900 during the summer months (U.S. Census 2000)

Both an industrial hazardous waste site and a federal superfund site are located on the southwestern shore at the Caddo Lake National Wildlife Refuge. The only urban center in this segment is Uncertain with a population of less than 3,000.

**b) in the surroundings/catchment:**

The Caddo Lake watershed is primarily rural with industrial uses including forestry, cattle, chickens, agriculture, oil and gas production. The primary commercial activities around the lake and the larger Cypress basin are manufacturing, retail and wholesale trade, mineral and petroleum production, silviculture, agriculture and agribusiness, notably cattle and poultry.

Major population centers and their population estimates for the year 2010 are Marshall (24,299), Mount Pleasant (15,201), Atlanta (5,849), Gilmer (5,940), Pittsburg (4,561), Winnsboro (4,208), Daingerfield (2,515), Linden (2,297), Hughes Springs (1,890) and Waskom (2,365) (Texas Water Development Board 2006).

Cities on Caddo Lake include Jefferson, Texas (pop. 2,024), Karnack, Texas (pop. 775), Uncertain, Texas (pop. 151), Mooringsport, Louisiana (pop. 833), and Oil City, Louisiana (pop. 1,219).

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**26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:**

Within the Ramsar site and in the surrounding area:

Caddo Lake National Wildlife Refuge was part of a "Superfund" site and is undergoing cleanup of military and industrial contaminants, and represents a potential source of contamination to surface waters and groundwater in and beneath Caddo Lake and Harrison Bayou.

**Past**

Removal of the Great Raft caused the original lake complex to shrink as water levels became quite shallow. The intended or unintended effect of this alteration was to relocate the western terminus of steamboats from Jefferson, Texas to Shreveport, Louisiana, 30 miles to the east. A major alteration of the natural flow regime in the basin occurred at Ferrell's Bridge Dam and Lake O' the Pines (LOP) was constructed on the main stem of the upper Big Cypress Bayou in the late 1950s. Flow regulation results in elimination of flood flows during late winter-early spring and greatly reduced pulse flows year-round. Although it provides about a third of the total inflow to Caddo Lake, flow regulation in Big Cypress Bayou probably has major effects on the lake ecosystem.

The annual hydrograph for post-dam conditions is very damped in comparison to pre-dam conditions. Peak flows are reduced significantly. Also low flows increased. Average annual inflow is reduced, and it is about 5% lower following dam construction. The flow regime of the major tributaries into Big Cypress Bayou, i.e. Little Cypress and Black Cypress Bayous, have not been altered significantly (Winemiller et al. 2005).

Historically, the region was covered by pine and hardwood forests. However, intensive forest harvesting for timber mill sale and clearing for agriculture and grazing has produced a mosaic of remnant forest and cleared land (Shellman 1999).

**Present**

*Factors affecting wetland hydrology and inundation:* LOP has changed frequency-magnitude relations of flow in Big Cypress Creek so that at present, little variation in flow magnitude exists, and maximum flows do not exceed ~3000 cfs (~85 m<sup>3</sup>/s). Floodplains are therefore not inundated under the present flow regime. Maximum flows of ~3000 cfs are also below the dominant discharge necessary to maintain equilibrium channel geometry. Construction of LOP has also likely affected sediment movement and delivery into Caddo Lake. As expected, sediment trapping by LOP has reduced sediment input into the downstream channel reach and

ultimately into Caddo Lake. Sediment transport capacity has been reduced by 50% for the 2-year flow. Study results indicate that the present flow regime is capable of entraining only silts and clays (Winemiller et al. 2005).

*Factors affecting wetland vegetation:* Hydrologic variability may be the single most important factor affecting the local distribution of bottomland tree species within their natural ranges. In alluvial settings such as the Big Cypress Creek floodplain, these forested wetlands receive periodic disturbances in the form of a flood pulse that is important in delivering nutrients and altering soil physio-chemical properties to the point that upland species are excluded. The high flows typical of these events are also important in scouring and dispersing many of the seeds produced in alluvial river swamps. Low flows in Big Cypress Creek during the historical dry summer may be needed to allow for the establishment (i.e. germination) of seeds and growth to a level at which many will be able to survive the following year's spring high water period. Periodic draw down in Caddo Lake will also be important in recruiting a new generation of bald cypress to this perennially lentic environment (Winemiller et al. 2005).

Caddo Lake has been invaded by a variety of exotic species including Eurasian watermilfoil, Hydrilla (*Hydrilla verticillata*), Water Hyacinth (*Eichornia crassipes*) and more recently by Giant Salvinia. Although hydrilla has experienced exceptional growth, as in 1997 when it expanded 10 fold to over 5,000 acres (2000 ha.), water hyacinth has been typically the most problematic plant on the lake. Water hyacinth had grown to cover approximately 5,000 acres before an unprecedented ice storm knocked it back during the winter of 2000. Since that time it has expanded again to large areas of the Lake and infested previously uninfested areas. Annually, at least 300 acres (121 ha.) of water hyacinth have been treated with herbicides, especially in areas of high public use (Texas Water Conservation Association 2006).

In May 2006, Giant Salvinia (*Salvinia molesta*) was observed in James Bayou (a tributary to Caddo Lake in Louisiana). A freshwater, floating, rootless, aquatic fern, Giant Salvinia is one of the world's most noxious aquatic weeds. It is notorious for dominating slow moving or quiet freshwaters, and its rapid growth, vegetative reproduction and tolerance to environmental stress make it an aggressive, competitive species known to impact aquatic environments, water use and local economies. (Jacono 2003)

*Factors affecting aquatic fauna:* The paddlefish (*Polyodon spathula*) has been greatly reduced in abundance and distribution throughout its range due to pollution and construction of LOP that block migration routes, regulate flow, and alter channel geomorphology and substrate composition. Spring floods have been greatly curtailed in Big Cypress Creek, and this may have eliminated cues and conditions needed for spawning. In addition, the lack of floods has likely resulted in the degradation of shoal habitats that are critical spawning habitat for this species.

Mercury has been detected in 13 fish species in the lake and the effects of fish age, size, trophic (food web) position, and habitat type on mercury accumulation are currently being examined (Chumchal et al. 2006). In addition, mercury levels up to 4 and 10 times higher than those found in fish have been detected in fish-eating snakes (Rainwater et al. 2005) and macroinvertebrates, great blue herons and other animal and plant species (Giggleman et al. 1998) from around the Lake. These data suggest that mercury is readily transported and accumulated within the Caddo Lake food web where it may present a health hazard to a variety of organisms, including people, and may have pronounced effects on the functions and stability of the Caddo Lake ecosystem as a whole.

*Factors affecting water quality:* Caddo Lake suffers from pollution of heavy metals and organic chemicals from multiple sources. This has led to warnings to lake recreational users to not eat certain fish caught in the Lake. In November, 1995, the Texas Department of Health issued a health advisory due to elevated levels of mercury in fish tissue. (Price & Darville 2002) More recent testing of fish in Caddo Lake has confirmed mercury concentrations still exceed levels considered safe for human consumption in a number of fish in the Lake (Price 2004).

## **Potential**

At this point in time it appears that little, if any, ammonium perchlorate or any of the other volatile organic chemicals from LHAAP sediments or groundwater are ending up in Caddo Lake, but this contamination is considered possible and may be monitored again in the future (Price & Darville 2002).

Further upstream alterations of inflows to the Caddo Lake ecosystem are a potential result of population growth in the region. These could take two forms: the construction of additional reservoirs that constrain or modify seasonal flow patterns into Caddo Lake's wetland or the upstream interception and export of Cypress basin waters to other basins.

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**27. Conservation measures taken:**

**a)** List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site. In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations:

1. The 1990-1992 assemblage of land options and grand funds by the Texas Nature Conservancy and Texas Parks & Wildlife Department which enabled the purchase of 3,327 acres which became the original Caddo Lake Ramsar site in 1993. Upon acquisition, these lands acquired protected status under Texas law as a State Park and Wildlife Management Area (Category IV).
2. The 1993 U.S. Fish and Wildlife Service's designation of Resource Category 1 habitat applied to Caddo Lake's wetlands from its spillway elevation of 168.5 ft msl (51.6 m) in Louisiana, to the lake intake point in Texas and all associated backwaters, sloughs, cypress swamps and bottomland hardwood forests to approximately 175.0ft (53.54 m) msl. This designation requires federally funded activities to achieve a "mitigation planning goal" that results in "no loss of existing habitat." (Category IV)
3. The 1995 purchase by the Caddo Lake Institute and resale to Texas Parks and Wildlife Department of 148 ha. (365 ac) Mossy Break wetlands for inclusion in the State Park and Wildlife Management Area. This parcel was included in the First Enlargement (Category IV).
4. On October 19, 2000 the U.S. Fish and Wildlife Service approved the establishment of the Caddo Lake National Wildlife Refuge on portions of the approximately 8,500-acre Longhorn Army Ammunition Plant in Harrison County, Texas. This refuge was established for the purpose of migratory bird and other fish and wildlife management, conservation, and protection. Initially, the designation gave USFWS permission to conduct migratory bird and other fish and wildlife protection and conservation activities. The Army is in the process of cleaning up those areas within the refuge that have environmental contaminants, approximately 2,000 more acres (approx. 800 ha.) are to be transferred as they are ready to the Caddo Lake National Wildlife Refuge (Category IV).
5. Caddo Lake Institute entered into a 30 year lease of 1,400 acres of old growth bottomland forest at Longhorn. This leased area, known as the Starr Ranch/Harrison Bayou lease tract, was included in the First Enlargement.

**b)** If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ; Ib ; II ; III ; IV ; V ; VI

**c)** Does an officially approved management plan exist; and is it being implemented?:

Describe management planning process for this site:

The Caddo Lake National Wildlife Refuge will be managed "to protect one of the highest quality old-growth bottomland hardwood forests in the southeastern United States." In addition, the refuge lands will be managed to protect migratory and resident waterfowl and neotropical migratory birds and mature pine forest dependent birds, such as the red-cockaded woodpecker, brown-headed nuthatch, Bachman's sparrow and other migratory songbirds (Kauffman 2005). At the Caddo Lake Wildlife Management Area, the land will be managed to support the growth of Bottomland hardwood forests.

**d)** Describe any other current management practices: Not applicable.

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**28. Conservation measures proposed but not yet implemented:**

1. Caddo Lake Institute (CLI) will assist with the work of the U.S. Fish & Wildlife Service to open the

Caddo Lake Wildlife Refuge and use the refuge as a base for education, including education on the role of wetlands,

2. CLI will develop and fund educational materials on threats to Caddo Lake, such as construction in floodplains and wetlands and introduction of exotic species of flora and fauna,
3. CLI will assist in the development of a management plan to respond to invasive non-native species of aquatic vegetation.
4. CLI will coordinate with other government and non-governmental organizations in identifying areas that could be added to the Caddo Ramsar site, the wildlife refuge, the state park or other preserves and protected areas.

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### **29. Current scientific research and facilities:**

Intensified agency research has been undertaken in the ecosystem, principally by the USACE, the US Bureau of Reclamation and the US Dept of Interior's National Wetlands Research Center in Lafayette, Louisiana.

Caddo Lake Institute sponsors ongoing wetland, water quality and environmental flows research. The Institute provides facilities on Caddo Lake as a staging facility for researchers who are active in the wetland. The facility includes a modest meeting area, equipment storage and boat dock facilities for a canoe and shallow draft "Go Devil" research boat. CLI also provides office space at the Caddo Lake National Wildlife Refuge for several university and non-profit organizations, that is used by researchers, staff and volunteers that assist the Fish & Wildlife Service and CLI activities.

**Mercury Studies:** A multidisciplinary team of scientists from universities in Texas, Louisiana, Oklahoma and Tennessee are receiving funding to conduct an Ecological Risk Assessment (ERA) of mercury in Caddo Lake. The problem formulation phase will provide a comprehensive literature review and identification of gaps in data. The analysis phase will focus on characterizing the overall risks from mercury in the Caddo lake system and identifying actions to reduce exposure and risks.

**Environmental Flow Protection:** Caddo Lake Institute is coordinating the on-going flows-ecology workshop process by managing and funding:

- an annual meetings of local stakeholders and scientists;
- applied scientific efforts to determine the flow regime needed for Caddo Lake and associated wetland areas;
- public education on the value of protecting wetlands with adequate flow;
- USGS Big Cypress biological and flow work, including the establishment of a new gage station on Big Cypress Bayou.;
- US Army Corps of Engineers flood plain study and consultant work on modeling results.

**Water Quality Improvement:** TCEQ, Northeast Texas Municipal Water District (NETMWD) and CLI are sponsoring meetings, activities and research for the State Watershed Protection Plan process for Caddo Lake. Research activities taking place as part of this process include:

- A water quality study by Paul Price at HDR Engineering;
- Water quality monitoring by TCEQ. CLI is subcontracting with TCEQ and NETMWD to do much of the water quality monitoring in the basin. CLI is using Roy Darville of East Texas Baptist University to do the water quality monitoring;
- Invasive species studies and control activities.

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### **30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:**

- Caddo Lake Institute is supporting the creation and operations of a local non-profit "Friends of the Refuge" organization.

- The Caddo Lake Ramsar Clearinghouse has a board that meets periodically to help guide the work on a number of projects. The Clearinghouse then sponsors meetings, at least quarterly, where an advertisement is printed in the newspaper and the public is invited. The Clearinghouse also uses a Scientific and Technical Review Panel (STRP) to assist with technical issues. The Clearinghouse is officially recognized as the community based Ramsar Committee for Caddo Lake by the US National Ramsar Committee.
- Greater Caddo Lake Association (GCLA).
  - Invasive Aquatic Plant Suppression Program.
- CLI is assisting with the work of the U.S Fish and Wildlife Service to open the Caddo Lake National Wildlife Refuge and used the refuge as a base for education, by providing education on the role of wetlands and assisting with development of displays at the Refuge.
- Ramsar Advancement: CLI is taking advantage of and supporting the opportunities afforded through the efforts of the National Ramsar Committee and the Ramsar programs of the U.S. Fish and Wildlife Service by:
  - Exchanging ideas and jointly preparing educational and display materials on Ramsar and the values of wetlands;
  - Hosting meetings of the Committee or for other Ramsar programs at Caddo Lake;
  - Assuring participation by representatives of the Caddo Lake area in the meetings of the Committee and other Ramsar programs; and
  - Assisting with the educational efforts of the Committee and other Ramsar programs through efforts at or for Caddo Lake.
- CLI is supporting efforts by state and federal agencies, including work of the Texas Historic Commission to develop public education materials and publicize tourism opportunities associated with the history and natural history of Caddo Lake.

### **31. Current recreation and tourism:**

Caddo Lake supports a modest but robust recreational hunting, fishing and visitor economy. The 480 acre (194 ha.) Caddo Lake State Park is located on the shores of Caddo Lake and Big Cypress Bayou. Activities at the park include camping, hiking, swimming, picnicking, nature study, fishing, and boating. The lake also supports quality bass, crappie and sunfish fisheries. Channel, blue, and flathead catfish are present and provide good seasonal fishing opportunities. Chain pickerel, a smaller cousin of the northern pike, is also present and frequently sought by anglers because of its sporting qualities.

At the Wildlife Management Area fishing, trapping and public hunting of white-tailed deer, feral hog, waterfowl, dove, other migratory game birds, squirrel, quail, rabbits, hares, predators, furbearers and frogs is or may be permitted. Primitive overnight camping is available. Outdoor recreational opportunities include wildlife viewing, hiking, bicycling, and horseback riding. Bicycling and horseback riding are permitted on designated roads/trails. In the area, residents offer riverboat excursions, horse-drawn tours, home tours, city trolley tours, train rides, horseback riding, souvenirs, gifts, and steamboat tours on Caddo Lake. Because the maze of channels can be confusing, the state has marked 42 miles of "boat routes" on Caddo.

### **32. Jurisdiction:**

As noted in section 33 below, Caddo Lake's wetlands fall within limited tasks assigned to multiple agencies of state and local agencies of Texas and Louisiana as well as the federal government.

### **33. Management authority:**

Due to its location in two states and its status as a navigable water body of the United States, Caddo Lake's management falls within the authorities of three general governments—the US Federal government and the state governments of Texas and Louisiana. Each of these exercises a number of limited purpose management roles, which are sometimes divided among several agencies of each government. As a result, there is no overall management plan for the Caddo Lake wetland or their catchment.

The US Army Corps of Engineers (USACE) is the federal agency with primary wetland conservation duties. USACE delineates wetlands which come under the US regulatory control, by virtue of its authority to grant or withhold federal permits for any activities which result in the dredging and filling of wetlands. USACE has historically conducted, and continues to carry out and propose major water development projects having great potential for significant hydrologic alteration. These powers are exercised under oversight from the US Environmental Protection Agency (EPA). US EPA has plenary regulatory authority over wetlands, as well as water quality, toxic and contaminant discharges to the wetlands, the lake and the watersheds of both states.

The US Fish and Wildlife Service (USFWS) and other federal agencies have limited program-based interests in the wetland habitats and flyways of Caddo Lake. USFWS is the agency which monitors compliance of the Caddo Lake Ramsar wetlands with the Ramsar Convention. USFWS also owns and operates the Caddo Lake National Wildlife Refuge.

**Names and addresses of local offices/agencies with name/title of person responsible for wetland**

|                                                                                                                         |                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <p>Caddo Lake Institute<br/> Richard Lowerre<br/> 44 East Ave., Suite 100<br/> Austin, TX 78701<br/> (512) 469-6000</p> | <p>U.S. Fish and Wildlife Service<br/> Mark Williams<br/> P.O. Box 230<br/> Karnack, Texas 75661<br/> (903) 679-9144</p>  |
| <p>Cypress Valley Navigation District<br/> Ken Shaw<br/> 1517 Dorough Rd<br/> Karnack, TX 75661</p>                     | <p>Texas Parks and Wildlife<br/> Todd Dickinson<br/> Caddo Lake State Park<br/> 245 Park Rd. 2<br/> Karnack, TX 75661</p> |

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**34. Bibliographical references:**

Caddo Lake Institute. 1995. Roy G. Darville and Dwight K. Shellman, Jr., principal investigators, Initial Species Inventory for Longhorn Army Ammunition Plant Karnack, Texas: Completion Report for Contract DACA56-94-M-0985, Tulsa District, Corps of Engineers. June 1995: Marshall, Texas, cited hereafter as Caddo Lake Institute, 1995.

Campbell, Linda. 2003. Endangered and Threatened Animals of Texas: Their Life History and Management. Texas Parks and Wildlife, Wildlife Division, revised and approved by USFWS, Austin, TX. Accessed via internet at [http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd\\_bk\\_w7000\\_0013.pdf](http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0013.pdf) on 22 February 2007.

Chapman, Jim and Texas Parks and Wildlife Department. 1993. "Press Summary: Caddo Lake and Associated Watershed, a Proposal for Environmental Protection and Sustainable Development." Congressman Jim Chapman and Texas Parks and Wildlife Department, October 22, 1993: Austin, Texas.

Chumchal, M.M., R.W. Drenner, B. Fry, D.J. Lutz-Carrillo, K.D. Hambright, W.C. McClain, and L. Newland. 2006. Mercury concentrations in fish from Caddo Lake, Texas. Joint Meeting of the Southern Division and Texas Chapter of the American Fisheries Society. San Antonio, Texas.

Cloud, T. 1984. Planning aid report on the aquatic resources of the Cypress Bayou Basin, Texas. USFWS, Ecological Services, Arlington, Texas.

Cloud, Thomas J. 1993. Caddo Lake, A Unique Wetland Ecosystem, a Delineation of Resource Category 1 Habitat under the U.S. Fish and Wildlife Service Mitigation Policy., US Fish and Wildlife Service, Arlington, TX.

Cloud, T.J. Jr. 1995. A Characterization of Habitats and Fish and Wildlife Management Opportunities at Cypress Bayou Basin, Texas and Louisiana. US Fish and Wildlife Service. Arlington, Texas. 86pp.

- Darville, R.G. 2002. A five-year water quality monitoring report on Caddo Lake. PowerPoint presentation, Caddo Lake Institute.
- Darville, Roy. May 2006. CLIP/RIB: An Analysis of Caddo Lake Water Quality 1998-2005.
- Giggleman, Craig M., Denise L. Baker, and Joel D. Lusk. 1998. A Contaminants Survey of Three Lentic Systems within the Cypress Creek Watershed, Texas, 1993-1995. U.S. Fish and Wildlife Service, Region 2. Arlington, TX.
- Gregg, Daniel. 1993. A waterfowl technical appendix for the Red River Waterway, Shreveport to Daingerfield Reach Reevaluation Study, US Fish and Wildlife Service, Vicksburg, MS.
- Hubbs, C. 2002. A Preliminary Checklist of the Fishes of Caddo Lake in Northeast Texas. Texas Journal of Science, 54: 111-124.
- Ingold, J. L. and L. M. Hardy. 1996. Web of Life, The Ecology and Biodiversity of Caddo Lake.
- IUCN - The World Conservation Union. 2006 IUCN Red List of Threatened Species. Accessed in March 2007 from: <http://www.iucnredlist.org/>
- Jacono, C.C. 2003. Giant Salvinia - *Salvinia molesta*. Retrieved August 10, 2006 from USGS, Salvinia identification website: <http://salvinia.er.usgs.gov/html/identification.html>
- Kauffman, Vanessa C. 2005. Wildlife Habitat Council and U.S. EPA Recognize U.S. Fish and Wildlife Service. Retrieved on September 5, 2006 from Wildlife Habitat Council, Member News website: <https://www.wildlifehc.org/news/membernews/Index.cfm?Page=1&NewsID=28208>
- Lisanti, J., 2001. Measuring modern sedimentation rates in Caddo lake (LA, TX) using 137Cs depth profile. Gulf Coast Association of Geological Societies Transactions, LI: 459-461.
- Paul Price Associates Inc., and Roy Darville, Caddo Lake Institute. 2000. Prepared for Northeast Texas Municipal Water District for submission to Texas Natural Resource Conservation Commission. Targeted monitoring in the Cypress Basin: Nutrient study in Lake O' the Pines. Paul Price Associates and Roy Darville Caddo Lake Institute. <http://www.netmwd.com/reports/reports.html>.
- Paul Price Associates and Dr. Roy Darville. 2002. Targeted Monitoring in the Cypress Basin: Study of Contaminants at Caddo Lake Associated with the Longhorn Army Ammunition Plant, Final Report, prepared for Northeast Texas Municipal Water District, Hughes Springs, Texas.
- Paul Price Associates Inc., 2003. Lake O' the Pines Watershed TMDL Project documentation report. Paul Price Associates Inc., prepared for Northeast Texas Municipal Water District, Hughes Springs, Texas. <http://www.netmwd.com/reports/reports.html>.
- Paul Price Associates, Inc. 2004. Cypress Creek Basin Clean Rivers Program 2004 Summary Report. Prepared for Northeast Texas Municipal Water District in cooperation with the Texas Commission on Environmental Quality. <http://www.netmwd.com/reports/reports.html>
- Perttula, Timothy K., et al. 1998. Caddo Lake Archaeology: Phase I of Archaeological Investigations along Harrison Bayou, Harrison County, Texas. Interim report to the Caddo Lake Institute, February 12, 1998.
- Pritchard, P.C.H. 1989. The alligator snapping turtle: biology and conservation. Milwaukee Public Museum, Wisconsin. 104p.
- Rainwater TR, Reynolds KD, Cañas JE, Cobb GP, Anderson TA, McMurry ST, Smith PN. 2005. Organochlorine pesticides and mercury in cottonmouths (*Agkistrodon piscivorus*) from northeastern Texas. Environmental Toxicology and Chemistry. 24:665-673.
- Sheffield, William J. 1995. A Summer-Fall Ecological Reconnaissance of the Big Cypress Bayou Watershed, Texas and Louisiana. Prepared for Texas Parks and Wildlife Department, Austin, Texas. In cooperation with and funding by the U.S. Army Corps of Engineers, Fort Worth District, Texas.
- Shellman, Dwight K. 1999. Caddo Lake: Helping Local People to Use Their Educational Infrastructure for Ecological Stewardship of Ramsar Wetlands, A case study in response to Brisbane 1996 Rec. 6.3 (Ramsar COP6). Caddo Lake Institute, April 1999.

- TCEQ (Texas Commission on Environmental Quality), DRAFT 2004 Texas 303(d) List published by Texas Commission on Environmental Quality (May 13, 2005).
- Texas State Data Center, 2005. Estimates of the Total Populations of Counties and Places in Texas for July 1, 2004 and January 1, 2005. Produced by: Population Estimates and Projections Program, Texas State Data Center, Office of the State Demographer, Institute for Demographic and Socioeconomic Research, The University of Texas at San Antonio, October 2005.
- TWC (Texas Water Commission). 1989. Groundwater Quality of Texas (Report 89-01). Texas Water Commission. Austin, Texas. 197 pp.
- Texas Water Conservation Association, 2006. Invasive Aquatic and Riparian Plants, retrieved on Sept. 3, 2006 from Texas Water Conservation Association website: <http://www.twca.org/waterday/2006/twd06-07-InvasiveAquaticandRiparianPlants.pdf#search='caddo%20lake%20aquatic%20plants'>)
- Texas Water Development Board. 2006 Regional Water Plan, Population & Water Demand Projections Data, from <http://www.twdb.state.tx.us/data/popwaterdemand/main.asp>
- UNEP-WCMC. 14 March, 2007. UNEP-WCMC Species Database: CITES-Listed Species . Accessed on the Internet on 12 February 2007 at [http://www.unepwcmc.org/isdb/CITES/Taxonomy/country\\_list.cfm/isdb/CITES/Taxonomy/country\\_list.cfm?country=US&col=all&source=animals&displaylanguage=eng](http://www.unepwcmc.org/isdb/CITES/Taxonomy/country_list.cfm/isdb/CITES/Taxonomy/country_list.cfm?country=US&col=all&source=animals&displaylanguage=eng)
- US Army Corps of Engineers, 1992. Mussel survey: Red River waterway project Shreveport, LA to Daingerfield, TX, Reach Reevaluation Study In-Progress Review (<http://clidata.org/reports.htm>)
- U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, 2000 Census of Population and Housing, 1990 Census of Population and Housing, Small Area Income and Poverty Estimates, County Business Patterns, 1997 Economic Census, Minority- and Women-Owned Business, Building Permits, Consolidated Federal Funds Report, 1997 Census of Governments  
Last Revised: Thursday, 08-Jun-2006 09:35:19 EDT
- US Fish and Wildlife Service (T. Cloud). 1993. Caddo Lake: A Unique Wetland Ecosystem. A Delineation of Resource Category 1 Habitat under the U.S. Fish and Wildlife Service Mitigation Policy, USFWS, Arlington, TX.
- US Fish and Wildlife Service (D. Gregg). 1993b. Waterfowl Technical Appendix for the Red River Waterway Shreveport to Daingerfield Reach Evaluation Study, USFWS, Atlanta, May 1993 (Appendix 6: Aquatic Resources).
- Web Soil Survey for Harrison, Marion and Cass Counties, Texas and Caddo Parish, Louisiana. Retrieved on June 21, 2006 from US Department of Agriculture, Natural Resources Conservation Science, Web Soil Survey website: <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>
- Wilson, J. 2003. Occurrence of and Trends in Selected Sediment-Associated Contaminants in Caddo Lake, East Texas, 1940-2002. Water Resources Investigations Report 03-4253, U.S. Geological Survey: Austin, Texas.
- Winemiller, Kirk O., Anne Chin, Stephen E. Davis, Daniel L. Roelke, Luz Maria Romero and Bradford P. Wilcox. 2005. Summary Report Supporting the Development of flow Recommendations for the Stretch of Big Cypress Creek Below Lake O' the Pines Dam. Texas A&M University, April 2005.

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## Appendix A

### Nationally Threatened and Endangered Species of the Caddo Lake wetland area:

| Common Name                    | Scientific Name                        | State Status | Federal Status                    |
|--------------------------------|----------------------------------------|--------------|-----------------------------------|
| Red-cockaded Woodpecker        | <i>Picoides borealis</i>               | Endangered   | Endangered                        |
| Interior Least Tern            | <i>Sterna antillarum athalassos</i>    | Endangered   | Endangered                        |
| American Peregrine Falcon      | <i>Falco peregrinus anatum</i>         | Endangered   |                                   |
| Arctic Peregrine Falcon        | <i>Falco peregrinus tundrius</i>       | Threatened   |                                   |
| Whooping Crane                 | <i>Crus americana</i>                  | Endangered   | Endangered                        |
| Bald Eagle                     | <i>Haliaeetus leucocephalus</i>        | Threatened   | Threatened-proposed for delisting |
| Brown Pelican                  | <i>Pelecanus occidentalis</i>          | Endangered   | Endangered                        |
| Bachman's Sparrow              | <i>Aimophila aestivalis</i>            | Threatened   |                                   |
| Piping Plover                  | <i>Charadrius melodus</i>              | Threatened   | Threatened                        |
| Swallow-tailed Kite            | <i>Elanoides forficatus</i>            | Threatened   |                                   |
| Wood stork                     | <i>Mycteria Americana</i>              | Threatened   |                                   |
| White-faced ibis               | <i>Pegadis chihi</i>                   | Threatened   |                                   |
|                                |                                        |              |                                   |
| Paddlefish                     | <i>Polyodon spathula</i>               | Threatened   |                                   |
| Shovelnose Sturgeon            | <i>Scaphirhynchus platorynchus</i>     | Threatened   |                                   |
| Blackside Darter               | <i>Percina maculata</i>                | Threatened   |                                   |
|                                |                                        |              |                                   |
| Louisiana Pine Snake           | <i>Pituophis melanoleucus ruthveni</i> | Threatened   | Federal Candidate for Listing     |
| Northern Scarlet Snake         | <i>Cemophora coccinea copei</i>        | Threatened   |                                   |
| Timber (Canebrake) Rattlesnake | <i>Crotalus horridus</i>               | Threatened   |                                   |
| Alligator Snapping Turtle      | <i>Macrochelys temminckii</i>          | Threatened   |                                   |
| Texas Horned Lizard            | <i>Phrynosoma cornutum</i>             | Threatened   |                                   |
|                                |                                        |              |                                   |
| Rafinesque's Big-eared Bat     | <i>Plecotus rafinesquii</i>            | Threatened   |                                   |
| Red Wolf                       | <i>Canis rufus</i>                     | Endangered   | Endangered                        |
| Louisiana Black Bear           | <i>Ursus americanus luteolus</i>       | Threatened   | Threatened                        |
|                                |                                        |              |                                   |
| Rock-pocketbook mussel         | <i>Archidens confragosus</i>           | Threatened   |                                   |

Sheffield (1995) and Campbell (2003)

## Appendix B

### List of Game Fish at Caddo Lake

| Common Name                                 | Species                                   |
|---------------------------------------------|-------------------------------------------|
| Black crappie                               | <i>Pomoxis nigromaculatus</i>             |
| Bluegill                                    | <i>Lepomis macrochirus</i>                |
| Bowfin                                      | <i>Amia calva</i>                         |
| Chain pickerel                              | <i>Esox niger</i>                         |
| Flathead catfish                            | <i>Pylodictis olivaris</i>                |
| Freshwater drum                             | <i>Aplodinotus grunniens</i>              |
| Gizzard shad                                | <i>Dorosoma cepedianum</i>                |
| Largemouth bass                             | <i>Micropterus salmoides</i>              |
| Palmetto Bass (striped X white bass hybrid) | <i>Morone chrysops x saxatilis</i>        |
| Paradise bass (Yellow bass X Striped bass)  | <i>M. saxatilis X M. mississippiensis</i> |
| Redear sunfish                              | <i>Lepomis microlophus</i>                |
| Smallmouth buffalo                          | <i>Ictiobus bubalus</i>                   |
| Spotted bass                                | <i>Micropterus punctulatus</i>            |
| Spotted sunfish                             | <i>Lepomis punctatus</i>                  |
| Warmouth                                    | <i>Lepomis gulosus</i>                    |
| White bass                                  | <i>Morone chrysops</i>                    |
| White crappie                               | <i>Pomoxis annularis</i>                  |
| Yellow bass                                 | <i>Morone mississippiensis</i>            |