

Neches River National Wildlife Refuge Draft Interim Habitat and Species Plan for Forested Habitats

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[Inside Front Cover

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Neches River National Wildlife Refuge, Jacksonville, Texas, USA

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Introduction

This interim Habitat and Species Plan (HSP) establishes the detailed objectives and strategies related to the conservation of priority habitats and priority species that Neches River National Wildlife Refuge will implement to make progress toward achieving the vision and goals found in its Biological Priorities (USFWS, 2020). The HSP provides a strategic focus for conservation efforts to fulfill the Neches River National Wildlife Refuge purposes and to contribute to the Refuge System's mission and goals, including maintaining the Biological Integrity, Diversity, and Environmental Health (BIDEH) of the refuge and the National Wildlife Refuge System. This HSP identifies actions to correct or mitigate significant threats or problems that may adversely affect the populations and habitats of fish, wildlife, and plants to achieve long-term refuge vision and goals.

The Refuge System usually prepares HSPs concurrently with Comprehensive Conservation Plans (CCP) or after CCP development and before implementation of new actions for managing habitat and species (see 602 FW 3). HSPs are required when objectives, strategies, and actions for priority habitats or priority species are not in an existing CCP or other planning documents or need to be updated to address new significant threats. This HSP is thus required because Neches River National Wildlife Refuge does not have a CCP, but management actions are required to achieve the desired future conditions identified in the Biological Priorities. As the refuge does not have a CCP, this plan is an interim document until the CCP is prepared.

As part of the U.S. Fish and Wildlife Service, the mission of the National Wildlife Refuge System is to "administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Improvement Act of 1997). This act requires, in general, that refuges restore and maintain the biological integrity, diversity, and environmental health necessary to achieve this mission and the purposes established for each refuge. Hunting, fishing, wildlife observation, and environmental education in national wildlife refuges are generally compatible uses with sound natural resource management practices of wildlife habitats.

The established official purposes of Neches River NWR are:

- . . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds (16 U.S.C. sec. 715d, Migratory Bird Conservation Act)
- . . . for the conservation of the wetlands of the Nation to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions (16 U.S.C. sec 3901[b], 100 Stat. 3583; Emergency Wetlands Resources Act of 1986)
- ". . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . ." (16 U.S.C. sec. 742f[a][4])
- ". . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . ." (16 U.S.C. sec. 742f[b][1], Fish and Wildlife Act of 1956)
- ". . . shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements . . . and in accordance with such rules and regulations for the

conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon.” (16 U.S.C. 664, Fish and Wildlife Coordination Act of 1934).

Neches River NWR was established to:

- protect nesting, wintering, and migratory habitat for migratory birds of the Central Flyway;
- protect the bottomland hardwood forests for their diverse biological values and wetland functions of water quality improvement and flood control assistance; and
- provide for compatible wildlife-dependent recreation opportunities in accordance with the National Wildlife Refuge System Improvement Act of 1997.

The refuge meets the Service mandate for the conservation of declining wetlands habitats, including bottomland hardwood forests, and the restoration and enhancement of biodiversity of wetland and upland habitats which have both been designated as priorities in the Texas Bottomland Hardwood Preservation Program (USFWS, 1985) and Land Protection Plan for North Neches River National Wildlife Refuge (USFWS, 2005a).

Scope

Through habitat and species planning, we develop the specific objectives and strategies necessary to fulfill the long-term refuge vision and goals. The following sections describe the scope of this planning effort.

Past Management

Past management practices have resulted in forest composition and structure that will require management to place stands on a trajectory toward desired forest conditions. Common concerns found are misaligned silviculture practices (i.e., diameter cuts or high grading), plantation-style management (short rotation, 30 years or less), and missing disturbance regimes (i.e., prescribed fire, mimicking natural disturbances in bottomland hardwood communities – tornados, high wind events that create canopy gaps).

Our Goals

Neches River NWR was established in 2006 to 1) protect nesting, wintering and migratory habitat for migratory birds of the Central Flyway; 2) protect the bottomland hardwood forests for their diverse biological values and wetland functions of water quality improvement and flood control assistance; and 3) provide for compatible wildlife-dependent recreation opportunities (USFWS, 2005).

The highest biological priority for the Refuge is to manage areas with a potential vegetation of forestland to provide high quality habitat for focal species. In the bottomlands, the focal species require structural diversity, large trees, and frequent gaps in the canopy. In the uplands, the focal species require habitat that is consistent with desired conditions for the red-cockaded woodpecker (*Dryobates borealis*, hereafter RCW) (USFWS, 2017).

Achieving Goals

By using the guidance of forestry and wildlife-based plans and documents, this Plan will provide timelines for forest and habitat assessments, discuss management actions to best achieve desired conditions and focus both on sustainable forest health and wildlife habitat.

What is the Planning Unit for the Purposes of this Plan?

This Plan has been prepared for Neches River National Wildlife Refuge (NWR) in northeastern Texas. The Refuge is located in eastern Anderson County and western Cherokee County, Texas, approximately 12 miles west of Jacksonville, Texas, and 17 miles east of Palestine, Texas (Figure 1). The Neches River flows through the refuge from north to south. The refuge acquisition area is upstream of the Davy Crockett and Angelina National Forests and adjoins the Fairchild State Forest. At present, the Service owns approximately 10,500 acres in fee title. The acquisition boundary is approximately 27,261 acres. This plan will address habitat management for land currently owned in fee title.

Neches River National Wildlife Refuge
Anderson and Cherokee Counties, Texas

March 10, 2026

What is the Relationship between this Plan and Other Plans?

The North Neches River National Wildlife Refuge Establishment Proposal, Environmental Assessment (2005 EA), Conceptual Management Plan (CMP), and Land Protection Plan identify various step-down plans that must be developed to direct the management of this refuge (USFWS, 2005a). Among others, the 2005 EA and CMP identify the need for developing and implementing a forest habitat management plan for this refuge which is incorporated into this HSP. Developing such a plan and implementing the required silvicultural management actions was identified as an element to achieving refuge and Service goals and objectives. The 2005 EA, developed with public involvement and participation during the planning process, provides habitat management direction and guidance for the operation and program development at this refuge. Specific goals, objectives, and strategies within the 2005 EA that set habitat objectives at this station are presented later in this plan. The CMP established the following goals for the refuge as a guide to its present and future habitat management direction:

- To fulfill our statutory duty to achieve refuge purpose(s) and further the System mission.
- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, inter-jurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- To foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high quality, and compatible wildlife dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

A strong concern for declining habitat for non-game forest dwelling birds is shared throughout agencies and organizations that manage bottomland hardwood and other forest communities. This plan will involve management actions to manipulate habitat to desired parameters, including a habitat evaluation system that will guide management decisions based on wildlife habitat parameters. Commercial timber harvesting is a method for implementing silvicultural management actions for habitat manipulation. Habitat enhancement for wildlife is the focus of silvicultural actions on this refuge. Economic gain will not be the driving interest of harvesting activities.

Located in the West Gulf Coastal Plain, Neches River NWR is a component of public lands needed to achieve the objectives of the North American Waterfowl Management Plan (NAWMP), Partners-In-Flight Plan for Landbirds, United States Shorebird Conservation Plan, and Waterbird Conservation for the Americas. It also is located within the West Gulf Coastal Plain Bird Conservation Region and the Lower Mississippi Valley Joint Venture, a component of the North American Bird Conservation Initiative (NABCI). The NAWMP identified the need for additional acquisition of public lands in this area for migratory bird management. The refuge not only contains habitat for waterfowl, but also for migratory non-game forest land birds, waterbirds, and shorebirds. Developing and implementing a refuge habitat management program designed to improve and maintain high quality migratory bird habitat directly contributes to the achievement of NAWMP objectives.

In 1985, the Fish and Wildlife Service identified this reach of the Neches River as important in its Texas Bottomland Hardwood Preservation Program (USFWS, 1985). The Service listed the “Neches River North” as a Priority 1 protection need. In 1988, the Service Directorate approved the Preliminary Project Proposal to proceed in the development of more detailed planning for a 25,281-acre refuge in the upper Neches area. At that time, land costs were estimated at approximately \$18 million. Those costs in 2005 increased to nearly \$33 million. The approval letter dated January 6, 1988, stated that the “waterfowl use numbers, when determined during the detailed planning phase, should determine whether Migratory Bird Conservation Funds, Land and Water Conservation Funds, or a combination of both shall be the funding source for this unit.” The proposal states:

The Neches River National Wildlife Refuge is being proposed to preserve bottom-land hardwoods that are important wintering habitat for mallards and wood ducks and production habitat for wood ducks. This proposal is designed to assist in meeting the habitat goals presented in the Ten-Year Waterfowl Habitat Acquisition Report (Category 3) and the North American Waterfowl Management Plan. The proposed area also protects a large number of other wildlife and plant species and will be of potential benefit to the federally endangered bald eagle and red-cockaded woodpecker, the threatened American alligator, and several State species of special concern.

Note: The bald eagle is no longer endangered but is still federally protected under two other authorities (USFWS, 2005a). Also, the American alligator is no longer threatened.

This excerpt from the 2005 EA communicates the purpose as articulated in planning in the 1980s for the establishment of the refuge and management of the resources.

Where will Habitat and Species Management Occur?

Neches River NWR consist of approximately 10,500 acres of fee title ownership. The acquisition boundary (25,261 acres) has been separated into 23 management units or compartments which range in size from 369 to 2,113 acres (Appendix A, Map 3). Currently, the Service owns acreage in 14 compartments. The highest priority resource of concern for Neches River National Wildlife Refuge is management of forested wetlands and uplands as habitat for focal species (USFWS, 2020). These forested ecosystems of the Neches River NWR are a part of the Southern Central Plains, or Pineywoods, of the Eastern Temperate Forests (Omernick and Griffith, 2014). Desired forest conditions within compartments vary by the potential plant communities for each ecological site and their extent (Table 1 and Appendix A Map 2).

Due to the absence of a CCP for the refuge, the following provides an in-depth description of the abiotic and biotic components of the lands covered by this HSP.

Physical and geographic settings

The refuge lies within the western edge of the West Gulf Coastal Plain physiographic area. The river basin has an overall flat to slight ridge swell. The basin topography has numerous stream channels, depressions, and a few poorly drained flats. Several sandy loam terraces exist in the basin that rarely flood. The overall ascent out of the river basin is generally moderate for much of the refuge and acquisition boundary. However, several abrupt elevation changes are encountered on the east side of the refuge in places upon leaving the basin. Four notable mountain ranges exist. Bowman and White Mountain ranges are quite steep for east Texas. Both ranges have elevation gains of 100 feet in less than

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Table 1. Area (acres) of ecological sites and permanent water by compartment at Neches River National Wildlife Refuge, Texas.

Compartment	Upland Forest	Bottomland Hardwood	Sandy Terrace	Permanent Water	Total Acres
2	0.0	87.0	169.2	2.0	258.2
3	1,513.0	322.5	99.6	0.0	1,935.1
4	0.0	753.2	343.6	115.0	1,211.8
5	22.6	647.0	307.8	167.4	1,144.8
6	1,077.2	17.8	29.6	0.0	1,124.6
7	36.5	508.4	55.6	41.3	641.8
8	32.2	114.5	4.8	14.4	167.3
9	20.2	91.0	73.7	5.6	191.5
10	3.8	219.9	2.0	1.9	227.6
16	192.2	1,365.4	17.7	60.0	1,635.3
17	5.9	431.3	0.0	4.2	441.6
18	7.0	94.1	0.0	0.0	101.1
20	283.1	823.2	0.0	22.0	1,137.5
21	271.0	86.5	1.7	0.8	359.9
Total	3,464.7	5,561.8	1,105.3	434.6	10,566.4

140 feet of distance. Bowman is higher at a benchmark of 649 feet above (mean sea level) MSL while White is just over 600 feet above MSL. The Service owns a portion of both ranges. The other two lie within the acquisition boundary, one to the north end and the other to the south tip of the boundary. There is a difference of 400 feet between the lower points along the banks of Neches River on the south acquisition boundary (elevation 240 feet above MSL), and the highest point on Bowman Mountain (which is Service owned) located in Cherokee County east of Deadwater Lake. The river basin is generally under 300 feet MSL through the acquisition boundary.

The refuge is in east Texas which has a subtropical humid climate noted for warm summers with frequent summer droughts and mild, wet winters (Larkin and Bomar, 1983; Carr, 1967). Both Anderson and Cherokee Counties are hot in summer and cool in winter with an occasional surge of cold air dropping the otherwise mild temperatures. Air masses from the Gulf of America play the dominant role in influencing the weather, although cool, moist air masses from the Pacific Ocean and cold, dry air masses from Canada and the Arctic Circle frequent the area during the winter months. Seasonal changes are gradual. The spring and autumn months are mild, with cool nights and warm days (USDA, 1959).

The average annual temperature (1981–2010) is approximately 66°F with an average monthly low of 55°F and an average monthly high of 77°F in Jacksonville, Texas (USNWS, 2020). The first killing frost is around November 16, and the last killing frost is approximately March 15 for a frost-free period of 246 days (USDA, 1959).

The total average annual precipitation for Jacksonville is 46.3 inches (USNWS, 2020). The wettest portion of the year is in winter and spring. Almost all the precipitation is rain with snowfall and ice storms being

rare. The prevailing wind is from the south; the wind is strongest in the spring, averaging about 13 miles per hour. Thunderstorms occur on an average of 44 days each year (Dolezel and Lane, 1997).

The area around Neches River NWR is rural with forests occurring on roughly 26.4% of Anderson County and 25.0% of Cherokee County. The two counties have 49.8% and 51.0% of the total land area in farms devoted to livestock and/or hay production respectively. Croplands usage for the counties is 18.7% and 21.0% of the total land area respectively (USDA, 2012, 2017).

Hydrology

Neches River rises just east of Colfax, Texas, in eastern Van Zandt County and flows southeast for 416 miles to its mouth on Sabine Lake. Two major reservoirs are located on the Neches: Lake Palestine just north of Cuneo, Texas, and Lake B. A. Steinhagen near Town Bluff, Texas. A small reservoir, Rhine Lake, is located above Lake Palestine. In its upper reaches the river traverses rolling terrain surfaced by deep sandy loams, loamy sands and sand.

Two highways, U.S. Highway 79 and U.S. Highway 84, provide access across the river along the refuge. Multiple county and refuge roads bring even more access to the river basin and river itself. At Rocky Point on the river, a concrete weir is present that pools water and restricts boaters from traversing the river without getting out to locate to the other side of the weir. This pool area provides water to the city of Palestine.

During significant rain events and high water, the Neches River will overbank and send flood water into tributaries. This is commonly seen below the bridge on US Highway 79. The river will overbank and flow east under and over Refuge Road. The overflow then turns south into Deadwater Lake. It flows through Deadwater Lake and under the wooden bridge into Buzzard Slough and into Twin Lakes along with pooling into Pine Lake. Once in Twin Lakes, the overflow goes west and then south flowing over Rocky Point Road and Cherokee County Road 1906 and then back into the river again.

One important aspect of the refuge is its large, functioning, forested ecosystem. Although many direct and indirect hydrologic alterations have occurred, the forested uplands and wetlands of the refuge are naturally dynamic and highly resilient to natural disturbances due to the natural ecosystem processes that maintain them. The river basin floods annually several times which promotes flushing and filtering of the system depending on the type of flooding.

Ecoregion description

The Refuge consists of two-level IV ecoregions: Floodplains and Low Terraces and the Tertiary Uplands (Omernick and Griffith, 2014.) The Floodplains and Low Terraces are complex and diverse networks of plants and animals created and maintained by a history of periodic flooding in the bottomland systems. These bottomlands are surrounded by mixed hardwood-pine and pine dominated forests in the uplands.

The bottomland and upland forests have been modified to varying degrees by past silvicultural activities. Today, refuge lands consist of a mosaic of bottomland forest, mixed hardwood-pine forest, and young to mature pine plantations with scattered acreages of mature pine forest. Given time, protection, and proper management, the refuge should regain much of the character of the former forest ecosystems, including a diverse assemblage of plants and animals.

Background and historic conditions

Native Americans settled in northeastern Texas and northwestern Louisiana around 12,000 years ago during the Paleo-Indian Period and existed as mobile hunters-gatherers and foragers (Perttula and Nelson, 1999; Cliff et al., 1996). Beginning about 1,200 years ago in what is sometimes referred to as the Early Ceramic Period, the art of ceramics was established, and the sophisticated culture of the Caddo tribe occupied portions of the four states. The Caddos were traders, horticulturists, and hunters that lived in grass and cane covered huts housed in dispersed villages. At the time of sustained European contact with the Caddos in the late 1600s, several thousand people lived around the Red River and central east Texas (Perttula and Nelson, 1999).

The Native American population peaked sometime after the arrival of the Caddos in about A.D. 780. The first Spaniards passed through the Neches Valley in 1542. It is estimated that there were thousands of Caddos hunting and farming when Hernando de Soto's expedition came into east Texas looking for a route to Mexico. The Spanish gave the Neches its name. It came from the Caddo Tejas Native Americans who called it Nachawi, their name for the bois d'arc tree (*Maclura pomifera*) (Donovan, 2007).

From the mid-1840s to the 1930s, farming and logging were common practices throughout East Texas. Steamboats traveled up the Neches River but would often encounter logs and logjams from sawyers/loggers rolling logs into the river to float to the mills downstream during moderate river flows. By 1900, trestles for trains were built crossing the Neches River to allow the steam engines to deliver numerous cars of virgin timber to the mills. By the 1920s, mills began having trouble keeping enough wood volume to run at full production. By 1930, much of the virgin pine trees had been harvested in the Neches River Valley ending an era.

In the early 1800s as settlers arrived in East Texas, the landscape was forested with a variety of both pine and hardwood species. Pines, for the most part, dominated the uplands while hardwoods were abundant in the bottomlands. The common pine species were shortleaf (*Pinus echinata*), loblolly (*P. taeda*), and longleaf (*P. palustris*). Longleaf is typically found further south in Texas. Although some overlap of pine species did occur, each species was generally restricted to specific geographical areas. Bottomlands along rivers, swamps, and associated drainages were interspersed through the area.

The shortleaf pine forest type occurred in the northern half of the pineywoods, including Anderson and Cherokee Counties. This area was generally bordered by the Red River to the north, the Louisiana border to the east, Hopkins County to the west, and Angelina and Houston Counties to the south. North of the Sabine River, from Longview, Texas, through Cass and Bowie Counties, shortleaf pine formed dense forests. The intensity and frequency of forest fires likely controlled the frequency of the less fire tolerant hardwoods (TPWD, 2005).

Since the first railroads transversed this area, the harvest of the shortleaf timber began earlier than that of the other pine timber. For the most part, very little reforestation of these harvested areas occurred, and hardwoods began to occupy many of the sites with some shortleaf regenerating successfully. Many sites were cleared for cultivation and grazing (TPWD, 2005).

Rich, fertile bottomland forest along rivers and drainages included oak, ash, hickory, gum, and cottonwood tree species. These hardwood trees grew very large with early accounts of oaks, ashes, and hickories up to diameters of 6, 4, and 3 feet, respectively. Settlers not only commercially harvested the

bottomland forest but also cleared the forest for settlement and agricultural production in the nutrient rich soils (TPWD, 2005).

Due to the demand for lumber and the abundant timber resource of east Texas in the late 1800s through the early 1900s, much of the old growth-forests in Texas had been harvested by 1915 (Texas Environmental Profiles, 2005). By 1940, much of the upland area which comprises the refuge today was cleared and cultivated for crops such as cotton.

The second growth pine forests were thinned and clearcut from the 1940s to the 1970s. By the 1980s, the typical pine plantation rotations consisted of 500 plus loblolly pine seedlings per acre, first thinning (13-15 years), second thinning (20-23 years), and a final clearcut harvest (30 years). For a brief time in the 1980s, hardwood trees that would not make a hardwood log would be injected with herbicide to promote the pine overstory and establishment of young pine seedlings. This mimicked a shelter wood cut with a high basal area. By the late 1980s, a merchantable paper product that consisted of hardwood pulpwood ceased the herbicide treatments of hardwood trees. During this time frame, clearcutting practices were used to clear and convert forested land to pasture lands for cattle grazing as well.

Current conditions

Soils

The soils at Neches River NWR are primarily covered by forest and consist of 75 mapped soil types. Soils in the uplands on the Cherokee County side are sandy soils with friable subsoils (Bowie, Lakeland, Eustis) and in the bottomlands are sandy and clayey soils of flood plains (Iuka, Bibb) (USDA, 1959). Soils in the uplands on the Anderson County side are sandy soils with friable subsoils (Bowie, Lakeland, Eustis) and in the bottomlands are sandy and clayey soils of floodplains (Iuka, Bibb) (USDA, 1959).

The Natural Resource Conservation Service (NRCS) has mapped 75 soil types for the Neches River NWR acquisition area. These soil types can be grouped into ecological sites, or ecosites, based on their ability to produce distinctive kinds and amounts of vegetation. The ecological sites in the acquisition area are Loamy Bottomland (34%), Loamy Stream Bottomland (11%), and uncategorized bottomlands (2%); Loamy Terrace (1%) and uncategorized terraces (8%); Clayey Upland (15%), Sandy Loamy Upland (13%), Deep Sandy Upland (7%), Loamy Upland (3%), Clayey Steep Upland (2%), and uncategorized uplands (2%); and water (2%). Grouping these, the acquisition area is comprised of bottomlands (47%), terraces (9%), uplands (42%), and water (2%; Appendix A, Map 2).

The following are the soil series, topography association, and common tree species occurring within the current refuge boundary and grouped by ecosite.

Dominant soil series within bottomland ecosites

- Bibb clay loam and fine sandy loam, floodplains frequently underwater – hardwood forest of sweetgum (*Liquidambar styraciflua*) and oaks.
- Hannahatchee fine sandy loam, narrow floodplains – less than 24-hour flood duration, 0 to 1% slope, pine, oak, pecan (*Carya illinoensis*), ash, sweetgum and elm.
- Iuka clay loam and fine sandy loam, floodplain, 0 to 1 % slopes – some pine, oak sweetgum, ash and pecan on the clay loam; sandy loam adds shortleaf pine and birch.

Dominant soil series within upland ecosites

- Boswell fine sandy loams, uplands slopes, 5 types represented from 1% slopes to 15% - shortleaf pine, post oak (*Quercus stellata*), sweetgum, and other hardwoods.
- Bowie fine sandy loam, upland, 3 to 8% slopes, mixed pine, and hardwoods.
- Cuthbert and Ruston fine sandy loams, upland, 8 to 15% slopes, mixed pine and hardwoods.
- Eustis loamy fine sandy, upland, 8 to 15% slopes, shortleaf and loblolly pine, blackjack (*Q. marilandica*), and post oak.
- Independence loamy fine sand, upland, 8 to 15% slopes, shortleaf pine and hardwood trees.
- Lakeland loamy fine sand, upland, 3 to 8 % slopes - forest.
- Magnolia fine sandy loam, upland, two types represented ranging from 3 to 15 % slopes, shortleaf pine mixed with oak, sweetgum, and hickory.
- Nacogdoches fine sandy loam, upland, two types represented ranging from 3 to 15 % slopes, eroded, forest.
- Ruston loamy fine sand, upland, 3 to 8% slopes - forest.

Dominant soil series within terrace ecosites

- Huckabee loamy fine sand; terraces along the river; 0 to 1% slope; sand, jack, blackjack, and post oak and shortleaf pine.

Vegetation

The forests on the refuge have been selectively harvested or totally cleared since settlement, with an exception perhaps of a few bottomland hardwood stands and bald cypress (*Taxodium distichum*)-lined banks of the river which appear uncut. Portions of the upland or pineywoods sites were harvested and cleared for agriculture, pastureland, and pine plantations. The demand for lumber by the mills altered harvests to select for certain tree species with higher quality and grade. This promoted harvesting in both the uplands and bottomland hardwood forest. Rail lines were established by the 1900s, and over the next 30 years much of the virgin pine timber in the Neches River Valley was harvested. Loblolly pine reforestation and hardwood eradication ensued through much of this region in the upland pineywoods portions of the Neches River Valley. By the 1940s until the 1970s, seed tree and shelterwood cuts were used to regenerate pines by many forest landowners. Around the 1980s, pine plantations became the new approach to regenerating pines. Site preparation prior to planting varied substantially from none to high intensity site preparation burns, bedding, herbicide use, and fertilization. Growing pine plantations had become the industry norm for upland forest around the 1980s.

Currently, the bottomlands of the refuge are composed of native hardwood species with the exceptions of loblolly pine plantations being removed in the mid-2000s from sandy terraces located in the river basin. One or two small plantations (approximately 10 acres) were not removed and have a high number of trees per acre in the river basin. Cruise data depicts that the sandy terraces are regenerating with a dominant water oak (*Q. nigra*) component along with other hardwood associates and a few pines. The steep transitions are still forested with either native forest or pine plantations. Many upland sites that were loblolly pine plantations were removed and planted with shortleaf pine through the late 2000s. Preliminary data shows a strong hardwood stand with a mix of loblolly and shortleaf pine.

Much of the land that was converted by forest industry companies to pine plantation occurred in the uplands. Temple-Eastex lead the industry in their care of the bottomlands. By 1971, hardwood logging on Temple lands ceased. However, by the late 1980s, Temple-Eastex, now Temple-Inland, returned to bottomland logging. They hired the company's first hardwood forester to ensure responsible stewardship of the bottomland forest and sustainable logging. What resulted was carefully selected 30-acre bottomland clearcuts with red oak replantings on a 60-year rotation with an emphasis on grade log production. As a result, larger hardwoods grew over time and extensive loblolly plantations were absent in the bottoms. Some of these Temple-Inland bottomlands now form the core of the Neches River NWR (Woche and Shackelford, 2019).

The forest community at Neches River NWR includes an abundance of oaks (water, willow – *Q. phellos*, overcup – *Q. lyrata*, southern red – *Q. falcata*, cherrybark – *Q. pagoda*, white – *Q. alba*, Shumard – *Q. shumardii*, blackjack, post) and hickories (water – *Carya aquatica*, pecan, shellbark – *C. laciniosa*, bitternut – *C. cordiformis*, mockernut – *C. tomentosa*, and black – *C. texana*). Other species present include bald cypress; loblolly and shortleaf pine; river birch (*Betula nigra*); red, Florida, and silver maple (*Acer rubrum*, *A. saccharum* var. *floridanum* and *A. saccharinum*); sweetgum; sycamore (*Platanus occidentalis*); blackgum (*Nyssa sylvatica*); sugarberry (*Celtis laevigata*); American elm (*Ulmus americana*); and green ash (*Fraxinus pennsylvanica*). The understory includes small trees and shrubs such as swamp and rough leaf dogwood (*Cornus alternifolia* and *C. drummondii*), American holly (*Ilex opaca*), buttonbush (*Cephalanthus occidentalis*), pawpaw (*Asimina triloba*), hornbeam (*Carpinus* spp.), and switch cane (*Arundinaria gigantea*). This above information was compiled from the 2016 forest inventory and staff observations.

In deriving a way to describe the diverse forested communities at Neches River NWR, the Society of American Forester stand types were considered. Across the refuge, seven stand types can be readily identified: 80 Loblolly Pine - Shortleaf Pine, 81 Loblolly Pine, 82 Loblolly Pine - Hardwood, 91 Swamp Chestnut Oak - Cherrybark Oak, 92 Sweetgum - Willow Oak, 96 Overcup Oak - Water Hickory, and 101 Baldcypress (Society of American Foresters, 1980). Stand type 75 Shortleaf Pine and 76 Shortleaf Pine - Oak, which historically forested the upland pineywoods, occurs, but only in small acreages. Due to the species diversity in the Neches River basin, these stand types were subsumed into stand type 92 Sweetgum - Willow Oak which represents this forest community with occasional loblolly and shortleaf pine stocking throughout terraces in the basin. Regarding species diversity, the decision was made to utilize the top three tree species that had the highest basal area present in the overstory and midstory to represent the stand type for any given location. Forest cover type maps are provided in the compartment summaries.

Fish and wildlife

Bottomland hardwood ecosystems are very productive habitats for a wide array of fish and wildlife species. The refuge and the surrounding area are no exception. The abundance of high-quality forested communities provides outstanding habitat for a diversity of fish and wildlife. In general, a thorough base-line inventory documentation of the population status of most species of wildlife in the refuge has not been conducted. Even so, omissions of certain wildlife species in this document may represent a lack of information rather than a lack of concern about those particular species.

Mammals

A total of 45 mammal species have been recorded in the bottomlands and associated wetlands of east Texas. Included are 11 species of bats, 15 species of rodents (including squirrels), 11 species of carnivores and 8 miscellaneous species (USFWS, 1985). Common species include the southern short-tailed shrew (*Blarina carolinensis*), cotton mouse (*Peromyscus gossypinus*), marsh rice rat (*Oryzomys palustris*), nine-banded armadillo (*Dasypus novemcinctus*), eastern gray squirrel (*Sciurus carolinensis*), swamp rabbit (*Sylvilagus aquaticus*), beaver (*Castor canadensis*), coyote (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*).

Important game species occurring on Neches River NWR include white-tailed deer and gray and fox squirrels (*Sciurus niger*). The Service currently conducts controlled hunts. The carrying capacity for deer in upland habitat could be increased by thinning pines and implementing prescribed burns.

Both gray and fox squirrels are abundant, particularly where suitable mast-producing hardwoods are available. Although the habitats of these two species overlap, gray squirrels prefer forest interior woods with thick midstory vegetation, whereas fox squirrels tend to favor small woodlots and the edges of larger forested tracts. Due to their high potential recruitment rates (directly associated with availability of mast) and high natural mortality rates, it is unlikely that any long-term changes in squirrel population densities have occurred within the available forest communities.

Cottontail rabbits (*Sylvilagus floridanus*) and, to a somewhat lesser extent, swamp rabbits, are common in this area. Their basic high recruitment and mortality rates coupled with significant amounts of early successional stage habitat created by the silvicultural actions of the previous landowners result in an abundant population of rabbits.

Several species of bats are native to this region. One species of concern is the Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). This bat is known to use large trees with cavities or hollow trees for nesting and brood chambers. The southeastern myotis (*Myotis austroriparius*) and tricolored bat (*Perimyotis subflavus*) are also found on the refuge and documented during mobile acoustical bat surveys (USFWS, 2015; Evans et al., 2021). Population statuses are unknown.

Several furbearers, including beaver, nutria (*Myocaster coypus*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), mink (*Mustela vison*), river otter (*Lontra canadensis*), coyote, red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*) and bobcat (*Lynx rufus*) are collectively abundant. Among this group, the beaver, nutria, muskrat and mink are usually associated with the more permanently inundated wetlands and riverine systems. The raccoon is well-adapted to all existing habitats, and the opossum, coyote, fox and bobcat are mostly associated with upland habitats. Most furbearers are distributed throughout the ecosystem.

Little or no information is available to provide population indices for these species. However, refuge staff have noticed beaver and raccoon population levels have become quite high in recent years, probably associated with depressed fur demands and a lack of natural predators. These two species are of major concern because of their potential to significantly impact ecosystem functions. An increased beaver population has altered the area's hydrology by causing more dams and beaver ponds to be built, inundating the bottomland forests and keeping them underwater for prolonged periods. In addition, beaver have become a greater nuisance problem for private landowners in the area. The negative

impacts of high raccoon populations include their effect in reducing populations of migratory and resident birds. Raccoons are usually nocturnal and feed primarily on acorns and crawfish with fruits, a few fish, birds and snakes being a part of their diet (Caire et al., 1989). With raccoon numbers higher than previous years, many more food sources are used to support the increase in population. Raccoon predation may be adversely affecting reproduction of breeding neotropical migratory birds (Cooper and Ford, 1993).

Free ranging feral hogs (*Sus scrofa*) on the refuge have become a concern for wildlife and land management. Hogs are highly adaptable, have high reproductive capabilities, and can be found in a wide range of habitat types. When feral hogs actively compete for mast food resources, resident wildlife may enter the winter with deficient fat reserves. Feral hogs have the potential to impact ground-nesting species, particularly quail and turkeys, through nest destruction and predation (USFWS, 2000).

Birds

A total of 273 species of birds occurs in the bottomland forest and associated wetlands in eastern Texas (USFWS, 1985). Included in the list are 38 waterfowl species; 29 colonial water birds (i.e., herons, gulls and terns); 20 hawks, vultures and owls; 37 rails and shorebirds; 8 woodpeckers; 130 passerine birds; and 11 miscellaneous species. A total of 101 species were known or believed to breed in eastern Texas. The refuge is of importance to several colonial water birds, raptors, woodpeckers, and passerine birds, particularly warblers, vireos, and flycatchers (USFWS, 1985). Much seasonal variation occurs in avian species composition and populations in the area because much of the bird use is by migratory species. Some neotropical migratory songbirds use these habitats for breeding in the spring and summer and others during migration in the spring and fall. The forested wetlands of Neches River NWR are also used by migrating and wintering waterfowl during the fall, winter and spring.

Waterfowl, primarily mallard (*Anas platyrhynchos*), gadwall (*Mareca strepera*), and wood duck (*Aix sponsa*), have traditionally used the seasonally flooded wetland habitats of the refuge. Other species of lesser occurrence include American wigeon (*Mareca americana*) and green-winged teal (*Anas crecca*). Flooded beaver ponds and sloughs provide excellent nesting and brood-rearing habitat for resident wood ducks. The hooded merganser (*Lophodytes cucullatus*), another cavity nester, is an uncommon breeding species in the region, and does not occur anywhere in large concentrations.

Many species of neotropical migratory songbirds are experiencing long-term declines because of widespread habitat loss and fragmentation. Bottomland hardwood forests and riparian woodlands have been identified as a top habitat conservation priority throughout the southeast (Hunter et al., 1992). Conservation of the critical bottomland forests on the refuge will enhance the breeding, wintering, and transitional habitats for many species of migratory and resident songbirds. Some of the more commonly occurring bird species include the Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), prothonotary warbler (*Protonotaria citrea*), northern cardinal (*Cardinalis cardinalis*), and white-throated sparrow (*Zonotrichia albicollis*). The forested wetlands of the refuge are also frequented by many species of wading birds, including the great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), green heron (*Butorides virescens*), western cattle egret (*Bulbulcus ibis*), snowy egret (*Egretta thula*), great egret (*Ardea alba*), anhinga (*Anhinga anhinga*), and yellow-crowned night heron (*Nyctanassa violacea*).

Pine savannas throughout the south provide a habitat for a suite of priority species such as the red-headed woodpecker (*Melanerpes erythrocephalus*), RCW, brown-headed nuthatch (*Sitta pusilla*), prairie warbler (*Setophaga discolor*), Bachman's sparrow (*Peucaea aestivalis*), and Henslow's sparrow (*Centronyx henslowii*). Restoring the open understory/midstory in the upland forest will provide pine savanna habitat with patches of overstory hardwood trees through the landscape for diversity. With the use of prescribed fire and timber harvesting, the upland communities will transition back to pine savannas.

The eastern wild turkey (*Meleagris gallopavo silvestris*) and northern bobwhite (*Colinus virginianus*) are the primary resident game birds in the ecosystem. Their population status is currently unknown although staff have observed both species while performing other activities. Due to predation on nests, primarily by raccoons and feral hogs, and lack of pine savannas population recovery may be problematic for these species.

Reptiles and Amphibians

Reptiles and amphibians require quality wetland habitat for their survival, and they may be an important indicator species of environmental well-being. The damp, forested bottomland hardwood habitat of the refuge is conducive to an abundance and diversity of reptiles and amphibians. As with the other wildlife groups, detailed information on the species of herpetofauna found on the refuge is lacking. The 2005 EA states that studies list 46 species of reptiles and 22 species of amphibians in the refuge's area (U. S. Fish and Wildlife Service, 2005a).

Some reptiles thought to commonly occur on Neches River NWR include five-lined skink (*Plestiodon fasciatus*), common snapping turtle (*Chelydra serpentina*), Mississippi mud turtle (*Kinosternon subrubrum*), American alligator (*Alligator mississippiensis*), red-eared slider (*Trachemys scripta elegans*), black rat snake (*Pantherophis obsoletus*), broad-banded water snake (*Nerodia fasciata confluens*), canebrake rattlesnake (*Crotalus horridus*), and western cottonmouth (*Agkistrodon piscivorus leucostoma*). Alligator snapping turtles (*Macrochelys temminckii*), the largest of the turtle group and attaining sizes of up to 200 pounds, were once more abundant and widespread throughout the southeast. However, due to recent exploitation, their numbers have been reduced in many areas. This species was proposed for listing as federally threatened in November 2021. Surveys in 2021 documented this species on the refuge. It is illegal to collect or possess alligator snapping turtles in Texas where it is protected as a state listed threatened species. TPWD encourages reporting of alligator snapping turtle sightings. Operation Game Thief offers rewards for information leading to the arrest of individuals involved in illegal turtle harvesting (TPWD, 2025).

Amphibian species thought to be common in the refuge area include the mole salamander (*Ambystoma talpoideum*), smallmouth salamander (*Ambystoma texanum*), dwarf American toad (*Anaxyrus americanus*), green tree frog (*Dryophytes cinereus*), bird voice tree frog (*Dryophytes avivoca*), and southern leopard frog (*Lithobates sphenoccephalus*). No threatened or endangered amphibian species are known to occur. However, recent research findings indicate that amphibian populations, particularly frogs, are undergoing significant population declines throughout the world (USGS, 2026).

Fish

The refuge lies in the middle of the Neches River Basin. Overall, 66 species of fish, 22 species of freshwater mussel, 32 aquatic macroinvertebrate taxa, and 8 species of crayfish were documented from the middle and lower Neches River Basin (Robertson et al., 2018). The river provides sportfishing opportunities for bass, bream, catfish, and crappie.

Both Highways 79 and 84 have primitive boat/canoe launching on the river near the refuge. Rocky Point, located at the concrete weir, also provides primitive boat launching.

Threatened, Endangered, and Candidate Species

Five species of concern are located or potentially located on the refuge or Neches River. The piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and RCW are threatened. These are the only federally avian listed species for the refuge area and the piping plover and red knot are not likely to use the refuge lands. The alligator snapping turtle was proposed for listing as federally threatened in November 2021; surveys in 2021 documented this species is common on the refuge. One insect, the monarch butterfly (*Danaus plexippus*), is proposed for listing as threatened. Two federally threatened flowering plants occur on the refuge: a species of tinytim, *Geocarpon minimum* and Neches River rose-mallow (*Hibiscus dasycalyx*). *Geocarpon minimum* has been detected on recently acquired property in Compartment 16. The Louisiana pigtoe (*Pleurobema riddellii*) is proposed for listing as federally threatened and the Texas heelsplitter (*Potamilus amphichaenus*) is proposed for listing as endangered.

Resources of Concern

The Resources of Concern for the refuge identified management of forested wetlands and uplands as the highest biological priority for the refuge (USFWS, 2020). For bottomlands, these areas will be managed to meet life history requirements of Louisiana waterthrush (*Parkesia motacilla*), Acadian flycatcher (*Empidonax virescens*), prothonotary warbler, yellow-throated warbler (*Setophaga dominica*), Kentucky warbler (*Geothlypis formosa*), Swainson's warbler (*Limnethlypis swainsonii*), wood thrush (*Hylocichla mustelina*), Rafinesque's big-eared bat, southeastern myotis, and tricolored bat. For uplands, these areas will be managed to meet life history requirements of RCW, brown-headed nuthatch, prairie warbler, red-headed woodpecker, and eastern wild turkey (USFWS, 2020).

In addition to the Resources of Concern and based upon the current conditions, the priority species of consideration for this refuge are those classified as threatened, endangered, and candidate species for listing (T&E species) and migratory birds (waterfowl, particularly mallards and wood ducks; non-game forest dwelling birds; colonial waterbirds; and shorebirds). All habitat management actions implemented under this plan will consider the maintenance and/or establishment of suitable habitat conditions, where practical, for these species and species groups as top priority. Habitat management actions, even if conducted specifically for a single species (e.g., a T&E species), will be designed within practical limits, to also benefit a wide diversity of wildlife and habitat.

Establishing and maintaining desirable habitat conditions for T&E species will be given top priority throughout the refuge when/where these species occur or where specific actions might benefit offsite populations.

Waterfowl, along with migratory non-game birds, are assigned a high priority in those elevations falling within the common floodplain (generally < 280' MSL). These areas experience seasonal flooding. Deadwater Lake, Buzzard Slough, Twin Lakes, Pine Lake, and beaver ponds all routinely provide habitat for wintering waterfowl. This area is forested with mixed species of floodplain hardwoods. This same general area has excellent potential for non-game bird utilization, and in fact, currently receives heavy use from this species group. Resident wildlife use is high, due in part to a high mast producing component in the various stands. Mast producing tree and shrub species will be favored in all management actions within the limits of compositions set in other parts of this plan. This area on the refuge has several sandy loam knolls generally found at 275' MSL and up. These areas are unique and are generally found on the Deadwater Tract. Combined, the floodplain, the sandy knolls scattered throughout the floodplain, and a gentle transition going upslope to the 300' MSL contour line (generally the base of the upslope for the uplands) result in approximately 4,250 acres of seasonally inundated habitat available to waterfowl during high water events.

The portion of the refuge $\geq 300'$ MSL contains 2,860.9 acres of upland habitat. This community typically is above the floodplain and rarely floods. It largely consists of younger loblolly pine plantations with native upland forest of shortleaf pine and upland hardwood species. These pineywoods communities will be managed to a late seral stage with management emphasis on creating a pine savanna. Shortleaf pine, where it occurs, will be promoted over other pines due to its historical significance. Groups and corridors of overstory hardwood trees are located throughout the upland communities usually associated with former house sites, perched depressions, fence rows, and drainages. These areas provide diversity and increase the habitat value in the upland communities. The areas are usually small in size (usually only several acres) and will be generally retained within the pine savannas.

[Competition between native and non-native plant species](#)

Silvicultural and farming activities by previous owners resulted in much of the shortleaf pineywoods sites being converted to a loblolly pine dominated pine composite. Although loblolly pine is a forest component on the stream terraces and transitions sites (between pineywoods and bottomland hardwoods) historically in this region, it did not normally occur as a dominant species. Loblolly pine is not usually considered a climax species but a transitional or early successional stage species that may establish itself on higher elevations following catastrophic events such as drought or storms and field abandonment. It may persist for long periods of time (up to 120 years) and individual stems can develop into truly impressive size if provided proper growing conditions. Between being heavily planted in plantations and natural seeding, loblolly pines have become well established in the uplands on the refuge. Now under Service ownership, the upland pine management can promote shortleaf pine over other pines species during silvicultural activities from thinning operations to reforestation efforts. This strategy allows the current forest to remain providing irreplaceable habitat.

Several non-native species occur on the refuge and can usually be observed along openings like roads and storm damaged areas. Chinese and Japanese privet (*Ligustrum sinense* and *L. japonicum*) and Chinese tallowtree (*Triadica sebifera*) are aggressive and present on the edge of forest stands, right of ways, and roadside ditches that are no longer maintained. Less aggressive species include chinaberry (*Melia azedarach*) and silk tree or mimosa (*Albizia julibrissin*) which occupies similar sites as privet but is more sporadic in dispersion.

Integrated pest management is a sustainable approach to managing pests that uses biological, cultural, physical and chemical tools in a way that minimizes health, environmental, and economic risks. By use of prescribed fire, privet and silktree can be set back and even killed if fire intensity is high in the uplands and on the terraces. The tallow tree and silktree are often found in areas where prescribed fire would not affect them such as roadsides and ditches.

The use of selected herbicides is frequently necessary to control exotic and invasive plant species. All chemicals will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1) and FWS Policy 517 DM 1 (USFWS, 2007). All herbicides will be applied according to the label. For trees such as chinaberry, Chinese tallow, and mimosa with a diameter at breast height (DBH) >4", hack and squirt with Garlon 4® (Element 4®) and bark penetrating oil throughout the year will be utilized. Effective mixtures contain 20% Garlon 4® (or Element 4) and 80% bark oil. For trees and shrubs with a DBH <4", a basal application 18" from the ground up will effectively control all trees species. Mechanical means will be used to remove invasive trees and shrubs but follow up treatments with Garlon 4® (or Element 4®) are necessary to ensure that stump sprouting does not occur.

Fire management

The southern yellow pine-savanna ecosystem developed because of periodic fires, either from lightning strikes or historically, the practices of Native Americans. Fires would spread across vast areas, driven by an abundance of highly flammable ground fuels, such as pine needles and grass, and lack of man-made barriers such as highways and lakes. In the absence of periodic fires, the grass community disappears and is replaced by shade tolerant hardwoods. The loss of this pine savanna type habitat has led to the decline of many species that were once associated with it. Examples include RCW, Louisiana pine snake (*Pituophis ruthveni*), northern bobwhite quail, eastern wild turkey, and Bachman's sparrow (TPWD, 2005).

Wildfire potential on Neches River NWR is currently very high due to heavy fuel loading associated with a lack of prescribed fire on over 3,400 acres of uplands consisting of pine plantations and native mixed hardwood-pine forests. Wildfire has and will continue to pose a serious threat to the refuge and its resources until these pine stands are thinned and fuel loading reduced by prescribed fire.

Periodic fires occurred historically over much of the refuge. The beneficial use of prescribed fire as a habitat management tool in pine savannas has been researched and accepted for years. Seasonal timing and fire intensity generally determine what effects fire has on forested communities. Using prescribed fire to set back stand succession will assist in restoring historic fire dependent species such as grasses, legumes, and ferns. Prescribed fire in a mature hardwood system on the refuge would be less beneficial due to 1) the understory and ground cover it would consume and 2) the risk of killing hardwoods that are not fire tolerant (i.e., thin-barked trees). All wildfires will be aggressively suppressed by refuge and/or cooperator wildland fire qualified resources.

Forest pests and diseases

Many forest pests are common throughout northeast Texas. Many forest pests are present in forest communities continuously but in such small quantities that they go undetected. When conditions begin to stress forest communities, forest pests may capitalize on the situation and become a problem.

Southern pine beetles (*Dendroctonus frontalis*), *Ips* beetles, and turpentine beetles are all common forest pests that usually attack stressed pine trees. Oak wood borers usually attack oak trees that are mature and possibly under stress. Oak trees are susceptible to several blights and galls that are common in east Texas and surrounding states. On a small scale, pests and diseases usually do not pose a problem, but when opportune conditions arise, they can spread and cause major habitat destruction through loss of trees.

Some of the pine plantations on the refuge are overstocked. When the basal area of a pine dominated stand exceeds 100 square feet per acre, it becomes very susceptible to southern pine beetle attacks. *Ips* beetles usually attack stressed trees, including lightning struck trees, and spread to other nearby pine trees. Black turpentine beetles (*Dendroctonus terebrans*) are usually attracted to wounded trees when the bark or roots are damaged. In all the above cases, lightning struck trees could very well begin an outbreak. Pest outbreaks, on the refuge, will be assessed and treated accordingly to prevent habitat loss. Late successional pine communities are becoming rare throughout the southeastern U.S. and promoting forest health is needed to preserve this habitat from preventable damage. Historically, the southeast needed outbreaks and natural events to set stand succession back. Today, we have so little of the historical late successional pine habitat that managing pine stands over a longer rotation (100-year versus a 30-year) will benefit numerous wildlife species requiring this limited habitat type.

[Habitat changes from historic to current](#)

Numerous changes have occurred to the habitat at the refuge. Logging practices started on a primitive approach of cutting the large trees for lumber in the uplands and river bottoms as discussed earlier. Better forest stewardship practices that benefit water quality and numerous wildlife species have been implemented that include establishing streamside management zones in reforestation of areas that are total harvested and limited the size of the reforestation areas. Oil and gas activities bisect the refuge creating corridors and fragmentation. Several offsite loblolly pine plantations still exist in the bottoms on the sandy knolls. On the east side of the Deadwater Tract, several areas were used as borrow pits to build roads throughout the Deadwater Tract. These areas are usually small and are cut into the side of hills versus being a pit. At Rocky Point on the Neches River, a weir is present holding water nearly to full banks. This weir makes the river impassable for boats without pulling out and putting back in. Fish can only go over the weir downstream. Fish and other wildlife confined to water have an obstacle here obstructing ingress/egress. The pool is used for water for the city of Palestine, Texas.

[Archaeological resources](#)

Literature reviews and extensive discussions with area professionals and amateur archaeologists have identified no cultural resource sites on Neches River NWR. Consisting of mostly Native American sites, farmsteads, and cemeteries, these areas are located on refuge maps and will be provided full protection as provided by Archaeological Resources Protection Act. These maps are not included in plans that will receive wide distribution to provide protection. There are no National Register of Historic Places (NRHP) site currently located on the refuge.

The Service's Regional Archaeological Officer will be provided draft copies of all management prescriptions and location maps for review/coordination with pertinent authorities prior to

implementing any silvicultural actions to assure protection of these sites. The Service will comply with the National Historic Preservation Act prior to the initiation of this plan.

Maps

Maps of land cover, ecological sites, and each refuge forest compartment with stand summaries and vegetative analysis are in Appendix A.

How Long will this Plan Guide Management Actions?

This plan will guide management actions for the next 15 years (2026–2041). A dynamic evaluation cycle will be used to incorporate newly acquired properties in the compartment assessment cycle at which time they will be assessed and managed to achieve desired forest conditions. A review will be conducted at least every 5 years to ensure that the objectives and strategies are still appropriate and to focus our actions on the highest priority needs. Compartment evaluations will follow a 14-year cycle.

Goals

This HSP lays out objectives and strategies designed to work towards the following high-level goals laid out in the Resources of Concern:

Manage areas with a potential vegetation of forestland to provide high quality habitat for focal species. The focal species for forested wetlands (i.e., bottomland hardwoods) are Louisiana waterthrush, Acadian flycatcher, prothonotary warbler, yellow-throated warbler, Kentucky warbler, Swainson's warbler (*Limnothlypis swainsonii*), wood thrush (*Hylocichla mustelina*), Rafinesque's big-eared bat, southeastern myotis, and tricolored bat. The focal species for upland forests are RCW, brown-headed nuthatch, prairie warbler, red-headed woodpecker, and eastern wild turkey.

Problems

Problems, or “threats” as they are commonly termed, are factors that impede our progress towards the desired conservation outcomes. These may include urbanization, climate change, pollution, and other anthropogenic stressors, or natural disturbances or predators. In developing this HSP, the Neches River National Wildlife Refuge planning team conducted a thorough examination of the full scope of potential problems as we understand them with the best available science and expert opinion of our staff and partners. Under this HSP, we have chosen to focus our attention and effort on the following selected list of threats affecting our top priority resources:

- Misaligned Silviculture: anthropogenic alteration of natural forest communities to conditions unsuitable as habitat for focal species due to historic silviculture and other activities.
- Plantation-Style Reforestation: anthropogenic reforestation that has altered forest structure and composition to states and vegetational succession trajectories that are unsuitable as habitat for focal species.
- Missing Disturbance Regimes: an inadequate disturbance regime in forestlands for sustainable desired habitat conditions at appropriate scale for focal species; these missing disturbances are fire and regenerative storm events such as tornados, windstorms, and other stochastic events capable of felling trees.

These threats degrade habitat for focal species, prevent natural regeneration of natural vegetation communities required by focal species, and reduce or eliminate early and mid-successional vegetation communities that are habitat for focal species.

Opportunities

In the context of an HSP, “opportunities” are possibilities or options to support the conservation of priority habitats and priority species and leverage other conservation efforts, funding, or collaborations at the local, regional, and landscape levels.

Threatened and endangered species and their habitat needs will be given top priority in all management actions. Most of the listed species and their associated home ranges overlap river systems or permanent water areas (Neches River rose-mallow) or occur in open pineywoods savannas (RCW). Opportunities to reduce negative impacts and benefit the aquatic species (Louisiana pigtoe and Texas heelsplitter) are limited to establishment of streamside management zones (SMZs) and adhering to Texas’ Forestry Best Management Practices (Texas A&M Forest Service, 2017; BMPs). Within SMZs, active forest management will be restricted to only essential actions addressing issues such as public safety or individual tree removal to achieve spot specific site requirements such as super dominant or emergent crown class development. Disturbance to ground conditions will be minimized to assure minimal offsite sedimentation. The nearest known RCWs are located < 2 miles southeast of the refuge on the I.D. Fairchild State Forest.

Red cockaded woodpeckers use mature, open pine forest that have a relative hardwood free midstory. These pine trees are usually over 60 years old and 14 inches in diameter. The stand of pine trees needs to be between 100 to 400 acres in size. The refuge contains roughly 2,860.9 acres of upland habitat. Using the 2016 cruise data, a combination of approximately 1,880.5 acres of pine plantations and smaller blocks of mature pine forest will likely be ready for foraging habitat for RCWs in 15 years. The cruise data delineates approximately 312 acres scattered within the 1,880 acres of suitable RCW habitat right now minus the understory/midstory considerations. The largest suitable blocks of habitat are only 56 and 48 acres in size. Much of the 1,880 acres (~1,500 acres) is likely loblolly pine plantations that are just over 15 years old with trees ranging from 8 to 12 inches dbh. Silvicultural treatment using a geometric thinning should result in trees in these stands growing both vertically and in diameter. This treatment should be followed in 7 years with a free thinning with low emphasis to again release the trees from stunting due to competition. At 15-18 years old now, plus another 15 years of growth and two thinnings; the plantation pines will be over 30 years old. Their diameters will be in the high teens. Implementation of a prescribed fire program will be designed to control the midstory. Tree heights should be around 60 to 70 feet tall at this age and would meet the specifications for RCW foraging habitat. However, descriptions of RCW habitat usually state that trees need to be 60 years old for foraging habitat and 80 years old to be used for cavity excavations.

The monarch butterfly has not had any critical habitat designated. They lay their eggs on milkweed (primarily *Asclepias* spp.) on which their larvae feed (USFWS, 2020).

Geocarpus minimum occurs in Compartment 16. It can occur in sandstone glades and saline prairies/barrens (USFWS, 2020).

Neches River rose-mallow occurs at the edge of woodlands in intermittently inundated soils of marshy habitats like sloughs, oxbows, river terraces, and sand bars (Texas Park Wildlife Department, 2021). The nearest known site is in the southeast portion of Cherokee County, Texas, about 25 miles away.

On September 13, 2022, the U.S. Fish and Wildlife Service announced a proposal to list the tricolored bat as endangered. The bat faces extinction due to the impacts of white-nose syndrome, a deadly disease affecting cave-dwelling bats across the continent. During the spring, summer, and fall – collectively referred to as the non-hibernating seasons – tricolored bats primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees. During the winter, tricolored bats hibernate – which means they reduce their metabolic rates, body temperatures, and the heart rate – in caves and mines. However, in the southern United States, where caves are sparse, tricolored bats often roost in road-associated culverts and trees and remain active and feed through winter. Tricolored bats exhibit high site fidelity with many individuals returning year after year to the same hibernaculum. Tricolored bats emerge early in the evening and forage at treetop level or above but may forage closer to the ground later in the evening. This species of bat exhibits slow, erratic, fluttery flight, while foraging and are known to forage most commonly over waterways and forest edges (USFWS, 2025). During mobile acoustic bat monitoring in 2014 and 2015, the tricolored bat was detected on the refuge (USFWS, 2015).

Rafinesque's big-eared bat is known to use large, hollow trees on the refuge for roosting and brood/nursery chambers. Subject-matter experts have visited the refuge to view existing habitat conditions and provided some minimal management recommendations. These recommendations included retention of all suitable den trees (> 24" dbh with full length cavities - hollow trunks - throughout the entire forest) and retention of a significant old age class component (≥ 75 years old) throughout the area for development of future den trees. Presence of adequate numbers of suitable den trees is viewed as a major limiting factor for this species throughout its range. Refuge staff were encouraged to protect bald cypress, sycamore, and blackgum along/in stream courses since these species in these site conditions tend to have the best chance of developing suitable cavities. Study proposals to examine on-site habitat utilization, population status, and habitat requirements for this elusive and relatively unknown species were discussed and efforts made to procure needed funding.

Bald eagles overwinter on or near the refuge where they extensively utilize the lake, river, and streams. Aerial surveys by refuge and partner organizations have not identified roost sites or nest locations on the refuge. Refuge use would typically involve feeding activities by individual birds. As with the riverine species group, habitat requirements for this species are such that few opportunities exist to provide positive habitat improvements through forest management actions. Some minor improvements may result through the development of emergent stem canopies on high terraces associated with stream systems which might serve as future nest trees. Refuge staff have observed bald eagles at Deadwater Lake and US Highway 79. No nests have been documented on the refuge.

As stated previously, forest management activities implemented at Neches River NWR to achieve the habitat needs for migratory birds and resident wildlife will fully consider native tree species and wildlife species compositions most suited to specific sites. Most upland pine communities at Neches River NWR are young merchantable plantations or in a young mixed pine/hardwood thicket. This condition provides an opportunity for manipulating habitat to develop and maintain the pine forests as an open pine woodland or savanna. Favoring shortleaf pine during silvicultural actions and implementing an aggressive prescribed fire program will promote the historic species diversity in the pine community.

Removal of the hardwood understory and midstory by both harvesting activities and fire management will promote fire dependent species in the ground cover. Groups and corridors of overstory hardwood trees that are located throughout the upland communities will be retained for their diversity and increase in habitat values. The areas are usually small in size (i.e., usually only several acres) and will be mosaiced within the pine savannas.

In bottomland hardwood and mixed hardwood-pine forests, emphasis will be placed upon development and maintenance of high forest tree species diversity within the constraints of what species generally occur within specific site conditions. Such diversity not only mimics natural forest diversity but provides a wide range of habitat conditions for the widest possible range of wildlife species. Both hard and soft mast producing tree species will be favored in silvicultural actions due to the high value of these species to a wide array of wildlife, including waterfowl and resident wildlife. Generally, composition of these species' groups (oaks, hickories, sugarberry, dogwoods, etc.) would be reduced to promote greater stand diversity where they occupy >50–60% of the stand composition. The presence of internal stand structure, both horizontal and vertical, along with the spatial arrangement within the stand, are critical habitat components for virtually all priority species for this refuge. Where internal stand structure, represented by forest floor vegetation, stand midstory, etc., is absent or lacking, immediate thinning to reduce overstory canopy closure is needed while continuing to focus on maintaining overstory species diversity. Patchiness, also a critical habitat element for many forest birds and game species, is typically measured in terms of spatial relationships of reproduction clumps or shrub clumps, coupled with early successional stage plants such as vines and herbaceous growth to closed canopy/more open stand conditions. These habitat conditions of patchiness, where absent, can be established through implementation of small group selection 'holes' ($\frac{1}{2}$ - 1 acre) where the overstory is removed. At the same time, these holes would serve a dual function of initiating regeneration to achieve uneven-age stand conditions. Retention of 10% of existing old age class stems (≥ 75 years) throughout each stand to deliberately create an old growth component by leaving older stems of long-lived species (oaks, cypress), will provide an abundance of cavities due to high levels of naturally occurring defects within these old age classes. The forest management program developed will not focus on arbitrary parameters such as establishing a predetermined "rotation age" of the forest community for management purposes. Rather, the need for treatment or implementing a silvicultural action will be solely dependent upon wildlife habitat needs of the area - not some assigned stand age structure as a trigger for treatment.

These generalization addresses the broad range of habitat conditions that meet the needs of priority species for the refuge. Two documents have been developed from years of data collection, data analysis and professional collaborations and serve as guiding documents for managing the priority habitats at the refuge. They are *Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat* (DFC- Desired Forest Conditions) (LMVJV, 2007) and *Open Pine Landbird Plan West Gulf Coastal Plain/Ouachitas* (OPLP) (LMVJV, 2011). These documents are efforts that were undertaken to further refine these general habitat requirements and develop specific habitat parameters that capture not only these generalities but also details specific guidance that will be used in all silvicultural actions. These specific guidelines, presented below, were developed by a team of refuge foresters and biologists from multiple refuges and Regions, Service WHM Division Biologists, Regional Foresters for the Southeast and Southwest Region, and non-Service scientists and researchers.

Desired forest conditions have been described for the bottomland hardwood forest communities (Table 2). These values describe optimum habitat conditions determined by subject matter experts for the wildlife priorities including the specific focal forest bird species. Thus, these values provide specific targets for management of forest stands that if achieved (identified through inventory data collection activities) would provide optimal conditions for priority species.

Mixed Hardwood-Pine

The mixed hardwood-pine communities are intermingled with either the bottomland hardwood on the sandy terraces or mixed into the upland portions of the refuge. Data indicated that much of the upland and transitional sites are generally smaller in size, scattered, and some are located along the steep or moderately sloped transitions between the bottoms and uplands. No acreage was determined for the habitat type since the sites are so infused into the other two forest types: bottomlands and uplands. Of the three major habitat types on the refuge, this is the one we know the least about as far as importance to migratory birds. The species composition is usually different from a bottomland hardwood community with the communities commonly sharing species such as willow oak and sweetgum. The mixed hardwood-pine communities at Neches River NWR are similar in species composition to that found at Little River NWR in high secondary bottoms (higher elevations in the floodplain). During the preliminary habitat planning in 2005 at Caddo Lake National Wildlife Refuge, a March Habitat Management Meeting occurred (USFWS, 2005b). One topic was mixed hardwood-pine stands. Several comments were made both verbally and in written letters later, suggesting that the mixed hardwood-pine viewed at the meeting did not need manipulation (refuge staff would agree that habitat viewed is currently in suitable conditions, but these forests are dynamic and will be cyclical to less desirable habitat in time). However, several comments were made for treating the habitat with hardwood guidelines and leaving the pine (usually loblolly) as a moderate to small component in the stand unless parameters dictated otherwise. Nearly all felt the pine had a role in the species importance and diversity to the community but should not dominate the community at a stand level.

Upland Pinewoods Forest

The upland pinewoods on the refuge are mostly in a younger age class (15-25 years old) and moderately to slightly overstocked. Smaller acreages of mature pines forest are scattered over the refuge uplands. Fire suppression has resulted in high fuel loads in a historic fire dependent habitat. The upland pinewoods should be managed for late seral stage open pine savannas. This type of management is readily identified as potential RCW habitat and will be managed for future conditions that will support this species. This pine savanna community existed at the time of European settlement with reoccurring fire controlling the hardwood understory and midstory encroachment. The following guidelines were derived from the U.S. Fish and Wildlife Service, Southeast Region, Red-cockaded Woodpecker (*Picoides borealis*) Recovery Plan, Second Revision ([RCWRP] USFWS, 2003) and the Open Pine Landbird Plan ([OPLP] LMVJV, 2011). Using these guidelines, and with reintroduction of prescribed fire into the pine upland communities, young pine plantations can be managed for future conditions suitable as RCW habitat. Groups and corridors of overstory hardwood trees are located throughout the upland communities usually associated with house places, perched depressions, fence rows, and drainages. These areas provide diversity and increase the habitat value in the upland communities and are usually small in size (typically only several acres).

These following guidelines are from the RCWRP (USFWS, 2003) and OPLP (LMVJV, 2011). The RCWRP is solely for RCW while the OPLP selects four indicator species with one being the RCW. Two of the species (RCW and brown-headed nuthatch) are refuge biological priorities for uplands. The OPLP draws from the RCWRP for the RCW portion. However, the OPLP provides great insight into desired forest conditions for the brown-headed nuthatch. The other three upland avian species in the biological priorities could thrive in the upland habitat once the following guidelines are implemented and maintained.

Important structural characteristics include (1) healthy groundcovers of bunchgrasses and forbs, (2) minimal hardwood midstory, (3) minimal pine midstory, (4) minimal or absent hardwood overstory, (5) a low to intermediate density of small and medium sized pines and (6) a substantial presence of mature and old pines.

Table 2. Desired stand conditions for wildlife habitat for bottomland hardwood forests in the Mississippi Alluvial Valley and West Gulf Coastal Plain.

Stand variables ¹	Desired stand structure	Conditions that may warrant management
Primary Management Factors		
Basal area	60-70 ft ² /acre with ≥25% in older age classes ²	>90 ft ² /acre or ≥60% in older age classes
Basal area variation	>20 ft ² /acre standard deviation	<15 ft ² /acre standard deviation
Overstory canopy cover	60-70%	>80%
Midstory canopy cover	25-40%	<20% or >50%
Secondary Management Factors		
Dominant trees ³	>2/acre	<1/acre
Understory canopy cover	25-40%	<20%
Reproduction ⁴	30-40% of area	<20% of area
Coarse woody debris (>10 inches in diameter)	≥200 ft ³ /acre	<100 ft ³ /acre
Den trees	≥2 stems ≥26 inches dbh/10 acres	<1 stem ≥26 inches dbh/10 acres
Standing dead and/or stressed trees ⁵	>6 stems/acre ≥10 inches dbh or ≥2 stems/acre ≥20 inches dbh	<4 stems/acre ≥10 inches dbh or <1 stem/acre ≥20 inches dbh

¹Promotion of species and structural diversity within stands is the underlying principle of management.

Management should encourage vines, cane, and Spanish moss within site limitations.

² "Older age class" stems are those approaching biological maturity. We do not advocate aging individual trees but use of species-site-size relationships as a practical surrogate to discern age.

³ Dominant trees (a.k.a. emergent trees) should have stronger consideration on more diverse sites, such as ridges and first bottoms.

Open Pine Landbird Plan:

- 1) 18 trees or more per acre, of pines that are at least 60 years in age and at least 14" dbh for RCW foraging habitat. Brown-headed nuthatches need mature pine stands with mean dbh of 10" or larger.
- 2) Basal area of all pines greater than 4" dbh between 40 to 80 square feet per acre for loblolly and shortleaf forests for RCWs. Brown-headed nuthatches need a mature pine stand, but no basal area parameters have been specified.
- 3) Nesting trees: RCWs – live pine trees usually > 80 years old; brown-headed nuthatch – secondary cavity nesters, using cavities in larger diameter snags that are less than 10 feet in height.
- 4) Both RCWs and brown-headed nuthatches benefit from growing season burns at intervals (2-5 years) that suppress understory and midstory woody growth.
- 5) No hardwood midstory or a sparse hardwood midstory that is less than seven feet in height for RCWs. Brown-headed nuthatches prefer the understory/midstory be <20 feet in height.
- 6) Habitat treatment response: RCWs have a very low rate of colonization. Brown-headed nuthatches respond in a short-time period.
- 7) Habitat size per pair: RCWs prefer larger acreage at 100 – 400 acres. It would need to be very good habitat for the lower acreages. Brown-headed nuthatches range at around 10 acres in this part of the U.S.

RCW Recovery Standard Guidelines:

- 1) 18 trees or more per acre, of pines that are at least 60 years in age and at least 14" dbh. Recommended minimum rotation ages apply to all land managed as foraging habitat.
- 2) Basal area of all pines greater than 4" dbh between 40 to 80 square feet per acre for loblolly and shortleaf forests.
- 3) Limit basal area of all pines 4 to 10" dbh less than 10 square feet per acre and less than 20 stems per acre.
- 4) Ground cover of native bunchgrass and/or other native, fire-tolerant, fire-dependent herbs totaling 40% or more of ground and midstory plants and dense enough to carry growing season fire at least once every two to five years.
- 5) No hardwood midstory or a sparse hardwood midstory that is less than seven feet in height.
- 6) Canopy hardwoods absent or less than 20% of canopy trees in loblolly and shortleaf forests.

Size, configuration, and juxtaposition of different habitats

There are several unique communities on the refuge. The Neches River is generally a smaller, narrow river channel that meanders through the basin. The river readily floods resulting in overbank flow into the tributaries with moderate rainfall. This provides the system the ability to flush and be rejuvenated with sediment deposits as the flood waters lose their turbidity. These events flow and flush through several lakes on the Deadwater Tract when this happens. Another significant community is the sandy terrace or knolls that are scattered between the river and the lakes. These terraces generally do not flood and support upland tree communities inside the flood basin of the river. More than 500 acres of these terraces are located throughout the 4,250-acres of bottomland floodplain.

With much of the refuge formerly owned by a timber organization, a network of roads exists promoting access to many areas. These roads are essential in providing refuge staff the ability to monitor and treat refuge habitat. Many of the roads need repairs such as culvert replacement, resurfacing with gravel, and vegetation management to allow passage.

The refuge has an array of features that displays the rich history of this area. From the meandering Neches River cutting its path through the basin to the steep terrain of Bowman and White Mountains, the refuge is unique. While driving County Road 1905 and looking west out over the refuge and river basin, you find a view seldom seen in East Texas.

Presence or absence of edge habitat

Previous sections of this plan provide detailed information on forest habitat types, size, and configuration. The reader is referred specifically to Maps 2 - 11, and corresponding compartment data summaries, Pp. 55-72.

Table 3. Key limiting habitat characteristics of four umbrella species, northern bobwhite (NOBO), red-cockaded woodpecker (RCWO), brown-headed nuthatch (BHNU), and Bachman's sparrow (BACS) in open pine habitats in the West Gulf Coastal Plain/Ouachita Bird Conservation Region.

Habitat factor	NOBO	RCWO	BHNU	BACS
Large patch size (>585 ac)	X	X		
Low pine basal area (<90 ft ² /ac)	X	X		
Low hardwood basal area (<20 ft ² /ac)	X	X		X
Low canopy cover (60%)	X	X		X
Snag density (1 snag per 2 acres over 20-inch dbh) ¹			X	
Large diameter (>14-inch dbh) pines		X	X	

¹Changed from 16 snags per acre with no regards to size per conversation with Cliff Shackelford, retired TPWD ornithologist.

Temporal distribution of required habitat elements or conditions based on cyclic life history needs of a species or species group

Fragmentation of some habitats occurs throughout the refuge. The Deadwater Tract (largest block) is contiguous connected to its south with three other blocks. With timber company ownership and timber investment management organization objectives, forests on higher ground were often managed by cutting timber and establishing loblolly pine plantations. This was done even in the flood plain or river basin on the Deadwater Tract on the high terrace sites. Around half of the plantations were removed and the upland sites planted back with shortleaf pine in the early and mid-2000s. Steep slopes along White Mountain and Bowman Mountains were left forested with loblolly pine. Now, with nearly 15 years of growth, a mixed forest of hardwoods and pine exist on the replanted sites. As previously stated, prior landowners and municipalities developed a simple network of roads to meet their objectives and transverse the larger two blocks.

One small town, Neches, Texas, is located a few miles from the refuge. Small family farms which typically consist of pastures, home sites, and relatively narrow strips of riparian vegetation along secondary stream courses scatter the county surrounding the refuge. Interspersed throughout these small family farms are commercial forest industry holdings consisting mainly of pine plantations.

The 2,740-acre I. D. Fairchild State Forest (Fairchild) is the closest public land holding to the refuge and is located 1.8 miles southeast of the refuge. The refuge is in the process of acquiring land within 0.25 miles of the state forest. This land was transferred to the Forestry Department of Texas A&M University in 1926 and was originally a part of the State Prison System. It was known as State Forest #3 until 1956 when the forest was dedicated to the late Senator I. D. Fairchild for his support of forestry in Texas. The Fairchild has a small population of RCWs. Their forest management activities focus on habitat protection for this important species of the southern yellow pine ecosystem (Texas A&M Forest Service, 2021).

The Davy Crockett National Forest (DCNF), owned by the U.S. Forest Service, is <20 miles downstream on the Neches River. It is over 160,000 acres and was established in 1936 by President Franklin Roosevelt. Red-cockaded woodpeckers are found throughout the national forest. Both Angelina and Sabine National Forests are located to the east of the DCNF and both have RCWs. They are nearly equal in size to the DCNF at 153,179 acres and 160,656 acres respectively.

Necessity of connectivity to other habitats in the landscape for dispersal of young, seasonal migration and genetic flow

Within the refuge, habitat corridors exist along drainages, forest cover types, and topographic features. The Refuge Road is wider and a powerline right of way parallels the road to refuge facilities on the west side of Deadwater Lake. Two underground gas lines bisect the Deadwater Tract as well. In some areas, land use changes outside the refuge have resulted in loss of connectivity with other high value habitats. The Fairchild and National Forests have several large tracts that are in or near the Neches River Basin to the south with similar plant communities. This basin likely serves as a corridor for many species.

Need for buffers from adjacent land uses or land cover negatively impacting refuge habitat

The refuge overall has remanent “edge” habitat due to past management of the forested communities. Primary edge habitats that affect neotropical migratory birds are those of adjacent landowners, past land management, and Deadwater Lake. Adjacent pastureland, clear-cuts, and the lakes create edges along the refuge’s forests. Electrical transmission lines, underground gas lines, and roads on the refuge create small linear edges that cross the refuge. Forest stands immediately along these areas will be maintained at basal areas to possibly reduce the potential for nest parasitism by brown-headed cowbirds. Natural edge habitats such as creeks and lakes tend to be static and are not likely to change over the life of this plan. While man-made edge habitat such as roads and utility right-of-ways are likely to decrease over time if not maintained or abandoned.

Existence of appropriate hydrologic, edaphic, climatic, and topographic conditions to support the resources of concern

Streamside management zones (SMZs) along the Neches River, Wells Creek, and the five lakes will be a high priority under the direction of this plan to assure no potential negative impact to water quality. Water quality preservation is important for many reasons and in this refuge particularly due to the listed species in these stream systems. Streamside management zones will be placed on all intermittent and perennial streams, rivers, and lakes. In SMZs, silvicultural actions are limited not restricted. Silvicultural activities if implemented in SMZs will be limited to single tree selection that improves wildlife habitat or the health of preferred stocking/trees. It is not the intent of this plan to promote harvesting activities inside SMZs but rather to allow activities to be conducted for habitat improvement while complying with Texas BMPs (Texas A&M Forest Service, 2017).

Several small rookeries are located on or near the refuge or along the lake that are mostly forested with cypress and shrubs. SMZs will be established around all such areas to protect them from disturbance. Actual harvest activities in the vicinity of these sites should be restricted from March to June to eliminate disturbance to nesting. Many rookeries are to some extent transitory and will be monitored before silviculture activities are performed. Rookeries are likely to be located in identified depressional or riverine wetlands that are not considered for any alterations in this plan. A few species that may nest in these rookeries are anhinga, great blue heron, and great egret.

Conservation of the remnant habitats supporting, or having the potential to support, native biological communities or processes

Work by Runkle (1991) showed that natural disturbance on a landscape scale (10,000-100,000 acres) occurs at a relatively constant rate of 1% a year across many different forest types. Disturbance adds greatly to the structure of forested communities across the landscape. Early explorers reported land conditions of open forests with large trees. In the refuge, these relatively small-scale and temporally constant disturbances are discontinuously distributed across an already complex forested mosaic. Forested ecosystems with intact natural processes do not proceed to a static climax condition or even a dynamic equilibrium; they exist in a fundamental state of dis-equilibrium and change.

More recently, roughly 50% of the refuge has experienced disturbance due to past timber harvesting practices with the most radical one being the establishment of pine plantations. The pine plantations lean to a single species forest which lacks plant diversity exhibited by a natural forest composed of multiple tree species.

Consequently, much of the refuge forested ecosystem is now skewed to a younger and more even age structure than existed historically in the uplands. Forest stand conditions in the uplands promoted a short 30-year rotation aimed at maximizing economic profit by producing smaller sawtimber. Refuge objectives will encourage a longer rotation of 100 years or more for the pines with an emphasis on producing quality wildlife habitat particularly for RCWs. This will provide the specific foraging and nesting habitat required by RCWs.

The refuge has potential for providing desirable habitat for the priority species. The size of the refuge allows for stratification of areas that may provide habitat while other areas are cycling back to a desired condition. Currently, the upland pines are likely 30–40 years from being sustainable RCWs habitat (60 years old). Many of the pine plantations need another 20 years to increase the tree diameters and tree heights and manage/maintain the basal area. The habitat should be suitable for other species like the brown-headed nuthatch within the next 10 years. These areas will be small compared to the whole refuge. The abundant habitat resources present and location within the Neches River Basin provide habitat for migrating forest dwelling birds and wintering waterfowl.

In habitat management of forested ecosystems, the most common conflict occurs when unique habitat requirements of a specific T&E species provides less than optimal conditions for other priority species, even occasionally other T&E species. Recognizing and quantifying the degree of this conflict frequently allows for modification of management actions to minimize negative impacts to another species or group of species.

In floodplain hardwood forests, most such conflict revolves around eliminating or restricting the scope of active management actions on specific areas where a sensitive species occurs. If these restrictions involve significant (percent of the total area available) and discreet limits to needed active management, overall level of conflict (e.g., trade-offs) elevates rapidly and management decisions must then be made on a continuum of least impact. At Neches River, preceding sections have described implementing SMZs along all major river and stream courses to minimize the potential for off-site sedimentation within water bodies. Furthermore, preceding sections detailed the establishment of buffer zones (a form of SMZs) around wet, depressional areas located throughout the lower fringes of refuge ownership to

protect possible rookery sites. Within these protection areas, long term habitat values for migratory birds and resident wildlife will undoubtedly be reduced due to the inability to implement needed management actions. Total area involved is less than 5% of the entire refuge forest and therefore should not result in a marked decrease in the ability to meet the habitat needs of migratory birds and resident wildlife. Beyond this instance, habitat needs of the priority species on this refuge and the management actions detailed in preceding sections to achieve optimum habitat conditions do not result in significant conflicts. Extensive experience in floodplain forest management has revealed that, as a rule, optimum forested habitat for waterfowl (mixed species stands with a good mast producing component, large crowned dominant and co-dominant crown class stems in mid to upper size and age classes, relatively low stand basal areas to perpetuate ground and understory vegetation, etc.) virtually always provides excellent conditions for most forest land birds and resident wildlife. Little productivity to waterfowl is lost by retaining culls and old age class components while such actions add significant value for forest land birds and many species of resident wildlife. Midstory components, a significant need for one group of forest land birds, within floodplain hardwood stands are frequently composed of high compositions of soft fruit producing species which waterfowl and resident wildlife use readily. In general, high-quality habitat at Neches River NWR for one group of priority species is also high-quality habitat for the other priority species.

In promoting upland pine savannas on the refuge, habitat manipulations would provide a forest community that is rarely found throughout the southeastern U.S. Conflicts in species usage would be considered insignificant in comparison to habitat restoration to the Neches River area. Current habitat conditions could be found in the transitional areas such as mixed hardwood-pine communities and on surrounding forested lands that are of similar habitat. Fire independent pine communities like that on the refuge are found scattered through much of east Texas where forested pine stands are managed by non-industrial private landowners. Reintroducing fire and removing the understory and midstory are the significant changes in the upland pine communities and some of the existing mixed hardwood-pine communities. Restoring a fire-dependent ecosystem would be a positive habitat achievement for many avian species.

Objectives

An objective is a concise statement of what we want to achieve, how much we want to achieve, and when and where we want to achieve it. Objectives in the HSP derive from goals and provide the basis for determining the most important strategies for management, monitoring refuge accomplishments, and evaluating the success of those strategies so that we can adjust and adapt. Objectives are Specific, Measurable, Achievable, Results-oriented, and Time-fixed (SMART) descriptions of what we want to accomplish through our conservation strategies. Objectives specify the desired future conditions for priority habitats, species, and ecosystems and are one of the most important elements of a step-down plan. In some cases, objectives may specify desired future conditions for problems or threats (sometimes known as threat-reduction objectives).

The overall goal is to manage the pineywoods and bottomland forest communities at Neches River NWR to benefit priority wildlife, including T&E species, migratory birds and resident wildlife.

The 2005 EA provided details of actions for habitat management. This document established major goals designed to achieve the desired future conditions. Several goals from the 2005 EA specifically address management direction for this plan.

- (1) Protect and enhance the bottomland hardwood forests for their diverse biological values,
- (2) Promote a diversity of bottomland hardwood-dependent migratory birds, and
- (3) Protect wetland functions of water quality improvement and flood control assistance.

The 2005 EA included a brief overview of the approved 1988 Service Directorate granting the Preliminary Project Proposal for the refuge in the upper Neches area. The proposal stated:

The Neches River National Wildlife Refuge is being proposed to preserve bottom-land hardwoods that are important wintering habitat for mallards and wood ducks and production habitat for wood ducks. This proposal is designed to assist in meeting the habitat goals presented in the Ten-Year Waterfowl Habitat Acquisition Report (Category 3) and the North American Waterfowl Management Plan.

The proposed area also protects many other wildlife and plant species and will be of potential benefit to the federally threatened RCW, *Geocarpus minimum*, and Neches River rose-mallow. Several proposed federally threatened species such as the tricolored bat, alligator snapping turtle, Louisiana pigtoe, Texas heelsplitter, and Monarch butterfly may potentially benefit from the refuge.

Completed in 2020, the Biological Priorities for the refuge (USFWS, 2017) provides biological goals and objectives for all refuge forestlands, including uplands. The primary biological goal from the Biological Priorities is to manage bottomland and upland forested land to provide high quality habitat for focal species (bottomlands – Louisiana waterthrush, Acadian flycatcher, prothonotary warbler, yellow-throated warbler, Kentucky warbler, Rafinesque big-eared bat, southeastern myotis, tricolored bat; uplands – RCW, brown-headed nuthatch, prairie warbler, red-headed woodpecker and eastern wild turkey).

Priority 1: Manage and enhance the bottomland forests for the diverse biological values and provide quality habitat for focal species.

Goal 1

Manage bottomland forest to provide quality habitat for focal species requiring structural diversity, large trees, and frequent gaps in the canopy. All focal breeding bird species for the refuge require large expanses of bottomland forest. These quality habitat conditions provide suitable forest for nesting, foraging, and escape cover and provide a sustainable blend of regeneration, mature, and dead trees (Wilson et al., 2007).

Objectives

1. Maintain and enhance large contiguous forested areas. At any point in time, a minimum of 35%, and optimally 50%, of the forest should meet the desired stand structure conditions (Table 2).
2. Actively manage and enhance 70-95% of the Refuge's bottomland forests via prescribed silvicultural treatments to meet desired stand conditions.

3. Passively manage 5-30% of the Refuge's bottomland forests – forested areas that are not subject to silvicultural manipulation.
4. Limit reforestation on the Refuge to no more than 10% of the Refuge's bottomland forest acreage in large (>7 acres) areas.
5. Limit shrub/scrub vegetation or thamnic woody vegetation (hydric or mesic) within bottomland forest to <5%, including forests in early seral (successional) stages.

Best Management Practices

1. Advocate the use of silvicultural prescriptions that result in 1) reduced basal area and tree stocking, 2) multi-layered canopies, and 3) increased midstory development, thereby addressing primary management factors. In addition, secondary management factors can be addressed through management by ensuring the prescribed treatments promote the development of dominant trees, cavity retention, understory development, and shade-intolerant regeneration.
2. Silvicultural treatments should optimally occur between August 1 and November 15. Disturbance should be minimized during the peak-breeding season for birds and for bats between March 1 and July 31. Thus, forest management that improves habitat may be undertaken between March 1 and July 31 when the alternative is undertaking no habitat improvement actions. Note: LMVJV (2007) proposed a time frame of August 1–February 28, while this plan proposes a time frame of August 1–October 31 due to the tricolored bat. Region 4 has a Biological Opinion that allows a time frame of July 1–October 31. The August 1–November 15 dates are susceptible to change as new guidance develops through endangered species IPaC consultations.
3. Diverse tree species composition in bottomland hardwood forest is important because it can provide heterogeneous vertical structure, a variety of hard and soft mast, and greater insect abundance. A diverse forest also supports trees that mature and senesce at different rates thus allowing for more continuous input of snags, canopy gaps, and coarse woody debris.
4. To maintain and encourage vertical structure development, treatments should encourage development of two to four trees/acre of species and individuals that will maintain or rapidly attain dominant crown positions.
5. Tree containing or likely to develop cavities are recommended for retention within stands.

Treatment Prescriptions

1. Mechanical thinning treatments typically using commercial timber sales.
2. Hazardous fuels management (understory thinning and edge treatments) and fire breaks.
3. Chemical treatments typically using Individual Plant Treatment (IPT) on non-native invasive species.

Priority 2: Manage and enhance the upland open pine forests for their historic diverse biological values and diversity of pine savanna-dependent avian species (both resident and migratory).

Goal 2

Manage areas with a potential vegetation of upland forest to provide quality habitat for focal species requiring open pine forest with large old pine trees. Some focal breeding bird species for the refuge require large expanses of upland pine forest while other species utilize smaller acreages. Optimize and

promote the maturity of the current and potential refuge habitat to fulfill biological priorities. Important structural characteristics include (1) healthy groundcovers of bunchgrasses and forbs, (2) minimal hardwood midstory, (3) minimal pine midstory, (4) minimal or absent hardwood overstory, (5) a low to intermediate density of small and medium sized pines, and (6) a substantial presence of mature and old pines.

Objectives

1. Maintain and enhance large contiguous open pine forested areas. Provide large patch size (>400–585 acres) where applicable.
2. Promote frequent prescribed fire (2–5 yr interval) in open pine forest to have the potential to sustain habitat which supports priority bird species.
3. Develop and implement a pine regeneration program that nurtures a longevity of an open pine forest on the refuge. Multiple age classes of pine, proportionally distributed on the landscape, to perpetuate a continual older age class of larger trees.
4. Promote 40% of the pine acreage in an older age class of 60 year plus for focal species. Promote at least 20% of the pine acreage in an age class of 80 years or more for focal species habitat requirements.

Best Management Practices

1. Advocate the use of silvicultural prescriptions that result in 1) low pine basal area (60-70 ft²/ac), 2) low hardwood basal area (<20 ft²/ac) and 3) low canopy cover (60%).
2. Silvicultural treatments should optimally occur between August 1 and November 15. Disturbance should be minimized during the peak-breeding season for birds and for bats between March 1 and July 31. Thus, forest management that improves habitat may be undertaken between March 1 and July 31 when the alternative is undertaking no habitat improvement actions.
3. Promote and retain 1) pine snags at a rate of 1 snag per 2 acres over 20-inch dbh and 2) pine trees that are large diameter (> 14-inch dbh).
4. Any pine regeneration efforts need to follow the RCWRP guidelines (USFWS, 2003:112) if applicable regarding acreage size.
5. Minimal pine and/or hardwood midstory in stands of mature, old pines.

Treatment Prescriptions

1. Mechanical thinning treatments typically using commercial timber sales and mowing/bush hogging the understory.
2. Hazardous fuels management (understory thinning and edge treatments) and fire breaks.
3. Chemical treatments typically using Individual Plant Treatment (IPT) on non-native invasive species.

Seven compartments have data that were used in developing this plan. Several tracts, totaling approximately 4,000 acres, have been added since the data were initially collected. If new land is acquired, it will be assigned to a compartment, assessed, and evaluated according to habitat type and condition. The assessment should be conducted with the refuge manager, biologist, and foresters.

Compartment boundaries are established along geographic features that can be easily identified on the ground (i.e., streams, roads, trails, etc.).

An inventory of the native forest communities and pine plantations was conducted by refuge staff in 2016, 2017, and 2020. These data were used to develop this plan and divide compartments into stands. Sampling intensity was around 2.5% of the total land area and was conducted on a grid-plot cruise using 1/5-acre plots and a 10-basal-area-factor prism. In addition to standard forest inventory data, additional parameters were measured at each plot (e.g., heights, vertical position, stem crown widths, densities, percent plant material occupancy, etc.) at upper, mid, and lower-level strata to assist in describing forest bird habitat conditions. These additional parameters corresponded, in part, to standard bird point count vegetative sampling techniques and were developed with extensive consultation/coordination of leading forest dwelling ornithologists in the southeast (LMVJV, 2007). Appendix B provides a copy of the data sheets developed and utilized in this effort.

Neches River NWR provides habitat for a broad array of wildlife species including many listed or candidate species and species of concern. Habitat needs, protection, and actions designed to enhance suitable habitat conditions for the species, to the extent practical, must be considered in all management activities.

Strategies

A strategy is a set of actions that we hypothesize will move us towards achieving one or more objectives. Strategies are a set of actions, tools, or conservation techniques that we believe will collectively correct or mitigate significant threats or problems that may adversely affect the populations and habitats of fish, wildlife, and plants, and ecosystem quality within the planning unit. Strategies selected in an HSP for implementation may include stewardship, resource protection, ecosystem or habitat management, ecological restoration, and species or population management.

Four alternatives were considered in the Neches River Habitat Management Plan Environmental Assessment which provides an in-depth discussion of these alternatives along with the environmental consequences of each.

Active forest management with no prescribed fire usage, selective harvest in pine uplands, uneven-age selective harvest in bottomland hardwood

Implementation of this strategy would seek to restore altered/degraded habitats through use of established Service timber sale procedures. This strategy would utilize silvicultural actions (individual tree selection techniques) designed to promote overall healthy stands in uplands and create uneven age, highly diverse stands in bottomlands based on site specific needs identified through review of current state of the art knowledge of priority wildlife species habitat requirements. This strategy would be implemented utilizing timber sales with special conditions incorporated to achieve needed restoration and would include gradual implementation of silvicultural actions across an eight-year entry cycle. Hardwood midstory removal from upland pine forests would allow pine savanna components to return.

Potential constraints associated with this strategy include: (a) short term habitat improvement due to lack of burning in the uplands; (b) minimal benefits to biological community due to short term gains in grasses and forbs (generally diminished after 3 years from silvicultural treatment); (c) failure to meet

public concerns, legal mandates, and refuge wildlife/habitat goals and objectives; (d) minimal environmental impacts associated with silvicultural activities (i.e. disturbance, siltation, soil compaction, short term loss of forest connectivity, etc.); and (e) modest increases in staffing and funding resources to administer customary Service timber sales.

Positive impacts that directly and indirectly affect fish, wildlife, and plants associated with this include increased habitat productivity on areas where management treatments are applied (i.e., an estimated 1,880 acres of 2,860 acres of upland pine forest and 3,188 acres of bottomland forest over the life of plan- 15 years).

Negative impacts include lack of fire restored to promote historic plant communities; negligible to no wildlife population increase, minimal soil compaction, rutting, and increased siltation, and wildlife disturbance risks through equipment use; and continued reduced forest diversity and regeneration long-term. Negative impacts associated with equipment use will be short-term and minimized through biological planning, seasonal constraints, and utilization of best management practices.

Active forest management with prescribed fire usage, selective harvest in pine uplands, uneven-age selective harvest in bottomland hardwood (preferred alternative)

Implementation of this strategy would seek to restore altered/degraded habitats through use of customary Service timber sale procedures. This strategy would utilize silvicultural actions (individual tree selection techniques) designed to promote overall healthy stands (uplands) and create uneven age, highly diverse stands (bottomland hardwoods) based on site specific needs identified through review of current state of the art knowledge of priority wildlife species habitat requirements. This strategy would be implemented utilizing timber sales with special conditions incorporated to achieve needed restoration and would include gradual implementation of silvicultural actions across an eight-year entry cycle. Hardwood midstory removal from upland pine forests would allow pine savanna components to return with the use of prescribed fire. These approaches are believed to be the most feasible and likely to have the best potential to restore significant percentages of habitat to regain forest diversity and habitat productivity necessary to achieve biological objectives.

Potential constraints associated with strategy include: (a) modest increases in staffing and funding resources to administer customary Service timber sales and to implement a prescribed fire program; (b) minimal environmental impacts associated with silvicultural activities (i.e. disturbance, siltation, soil compaction, short term loss of forest connectivity, etc.).

Positive impacts that directly and indirectly affect fish, wildlife, and plants associated with this strategy include: increase in historic pine savanna habitat due to hardwood midstory removal and fire restored to promote historic plant communities; increase in habitat productivity due to management actions on most of refuge forest habitats during life of plan; significant wildlife benefits and greatest potential for population increases; and increase in forest diversity and regeneration (over 5,068 acres over life of plan; over 1,880 acres of uplands and 3,188 acres of bottomlands). This strategy provides the shortest time frame for realization of positive impacts.

Negative impacts include minor soil compaction, rutting, siltation risks, and disturbance to wildlife through silvicultural activities and equipment use. Negative impacts associated with silvicultural

treatments will be short-term and minimized through biological planning, seasonal constraints and utilization of best management practices.

Active forest management with prescribed fire usage, selective harvest in pine uplands, even-age management in bottomland hardwood

This alternative would provide a means to restore altered/degraded habitats through customary Service timber sale procedures. For the upland pine forests, utilize silvicultural actions (individual tree selection techniques designed to reduce the hardwood midstory and provide adequate spacing between pine trees) based on site specific needs identified through forest inventory reviews. In the mixed hardwood-pine habitat, utilization of silvicultural treatments, through commercial entity assistance, that develop even-age stand conditions within forested habitats. This method relies upon using clear-cuts as the preferred silvicultural technique. Application of this technique would be based on strict area control established through a 100-year rotation age with small clear-cuts (15 acres) used to achieve uniform stands of similar habitat within the stands evenly distributed throughout the forest.

Potential constraints associated with this strategy include: (a) minimal habitat improvement annually and reduced ability to maintain improvements made; (b) modest increases in staffing and funding resources to administer customary Service timber sales; (c) increased potential for environmental impacts associated with silvicultural activities (i.e. disturbance, siltation, soil compaction, short term loss of forest connectivity, etc.); (d) moderate short-term loss of aesthetics due to clear-cut management approach in mixed hardwood-pine (15 acres annually); (e) decrease of forest connectivity and increase in nest parasitism; and (f) only partially addresses legal mandates and refuge habitat/wildlife objectives.

Positive impacts that directly and indirectly affect fish, wildlife, and plants associated with this strategy include: increase in historic pine savanna habitat due to hardwood midstory removal; increase in habitat productivity in some bottomland hardwood stands where management clearcut treatments are applied (over 1,880 acres in the upland pine forest and less than 1,000 acres of bottomland hardwood forest over the life of plan).

Negative impacts include prolonged existence of low productivity habitats on significant portion of the refuge forest; minimal to negligible wildlife population increase, minimal soil compaction, rutting, increased siltation and wildlife disturbance risks through equipment use; prolonged lack of forest diversity and regeneration, some loss of forest connectivity due to clear-cutting, and increased nest parasitism. Negative impacts associated with silvicultural treatments will be short-term and minimized through biological planning, seasonal constraints, and utilization of best management practices.

Natural succession (no action)

This approach provides for no active silvicultural activities and relies upon natural successional processes. Altered/degraded habitat conditions generated through forest practices conducted prior to Service ownership would not be addressed through active management. Biological parameters identified as necessary to achieve optimum wildlife habitat conditions would exist on only a small percentage (10–20%) of forested habitats at any given time and be the result of events such as storms, fires, or disease outbreaks.

Potential constraints associated with this strategy include: (a) virtually no long-term improvement in pineywoods habitat conditions from current state; (b) long-term loss of aesthetics due to prolonged existence of hardwood midstory in pineywoods habitat, excessive gain in basal area in both upland and bottomland forest communities; and (c) failure to meet legal mandates and refuge wildlife habitat goals and objectives.

Positive impacts that directly and indirectly affect fish, wildlife, and plants associated with this strategy include: no risk of disturbance to wildlife, siltation, rutting, soil compaction, or loss of forest connectivity.

Negative impacts include perpetual existence of low productivity habitats on greater than 80% of forested habitats; hardwood midstory in pineywoods remain and prescribed fire never implemented which would alter habitat from historic fire dependency and reduced wildlife population levels long-term.

Management strategy selection

The **active forest management with prescribed fire usage, selective harvest in pine uplands, uneven-age selective harvest in bottomland hardwood (preferred alternative)** was selected as the preferred strategy. This strategy best meets the concerns addressed by the public concerning the management of habitats on Neches River NWR and habitat issues identified in the 2005 EA, meets legal mandates and will make the most significant contribution to accomplishing refuge wildlife/habitat objectives. The strategy has only minimal potential impacts on forest and cultural resources and is economically feasible. This approach will provide for maximum habitat productivity through silvicultural restoration and enhancement in an acceptable time frame. The approach also provides a means for maintenance of habitat improvements long-term. This strategy combines: 1) prescribed fire for the upland habitats, 2) silvicultural treatments in the pine uplands to maintain pine densities and control hardwood midstory, and 3) silvicultural treatments for the bottomland hardwoods to promote canopy and species diversity.

Management strategy prescriptions

The following management strategies for the preferred alternative are summarized below. The overall management strategy is to provide multiple forest communities for a broad array of species that are listed throughout this document. Timber harvesting considerations in the spring are intertwined with both breeding bird season and bat pupping season and then followed with a fall hibernation. Burning may be considered year-round depending on the burn objectives and desired outcome.

Open Pine Savannas

- Use commercial harvest operations to manipulate 2,860 acres of upland pine stands by treating one compartment per year (approximately 500–600 acres annually). Basal area would be usually reduced to 60–70 square feet per acre depending on stand objectives. This will allow the stands to be treated possibly twice over the life of the plan.
- Regenerate efforts should follow the RCWRP guidelines for pine. Current age classes of pine forests on the refuge will likely suggest cycling through the first entry for the eight compartments and assess age classes and acreages for the uplands.
- Retain canopy hardwoods at a rate of at least two to three per acre to 30% of the canopy trees except in areas where groups or corridors of canopy hardwoods are present (house place, depression, fence row, drainage, etc.), promote the continuance for habitat diversity.

- Re-establish native shortleaf and loblolly pine and fire tolerant hardwood species (i.e., southern red oak, post oak, and white oak) by planting (hand or machine) nursery grown seedlings in the seedtree/shelterwoods cuts used for regeneration purposes. This could be accomplished by including a stipulation in the timber harvest special use permit requiring the permittee to re-establish native pine/hardwoods as “conditions of sale.” The cost would be absorbed into the price of the timber and not directly incurred by the service.
- Implement a prescribed fire program that address around 1/3 (nearly 1,000 acres) of the upland forest communities on a two-to-five-year rotation – average of three-year rotation might be considered since it would entail 1/3 of the upland acreage. An annual burn of roughly 100–300 acres could be established when fire plan is prepared. Special consideration will be involved in the location of this site.

Bottomland Hardwoods

- Use commercial timber harvest conditions to create (one to two acres) regeneration openings (removing all merchantable stems) where advanced oak regeneration or switch cane is present at a rate of one opening per ten acres for each entry cycle, and to thin the overstory and midstory trees to attain the desired effects (overstory, midstory, understory, and ground cover percentages) for migratory birds and resident wildlife. Recent data gathered by research and presented at the Southern Hardwood Group meetings suggested openings as large as seven acres to promote oak regeneration. Obviously, this would not be implemented on a 10-acre basis as presented above. Guidance will be presented in an updated report that is being revised (LMVJV, 2007).
- Utilize chemical and/or mechanical methods to control understory/midstory species (i.e., American holly, hornbeam, etc.) to promote vertical diversity. Utilize timber harvest “conditions of sale” clauses requiring reduction of these species in conjunction with the timber sale to minimize cost. These methods can also be used for invasive tree species listed previously.
- Establish SMZs as described in the document Texas A&M Forest Service Best Management Practices (2017) to protect water quality, provide potential roosting/den habitat for the Rafinesque’s big-eared bat and Louisiana black bear, provide aesthetically pleasing opportunities for the public, and to provide another habitat condition (higher basal area and reduced midstory, understory, and ground cover) thus enhancing diversity. These SMZs will also double as buffer zones around colonial bird rookeries.
- Provide areas of permanent and semi-permanent water in and along streams (creeks and sloughs, etc.) lined with cypress and buttonbush, old stream meanders/oxbow lakes with scattered cypress and wetland scrub shrub areas, or “beaver ponds” usually with a significant component of buttonbush. There are also some of these areas that are open and more representative of a marsh or wetland grass habitat. All these areas provide habitat for a myriad of wetland species including warm water fish, the American alligator, waterfowl, wading birds, frogs, snakes, salamanders, etc.
- Promote development of switch cane on suitable sites using silvicultural techniques such as reduction of tree basal areas through commercial timber harvest, allowing sunlight to penetrate to the forest floor, a major factor in promoting switch cane.
- To achieve the objective of providing a broad array of hard and soft mast species of forage for a diverse cadre of faunal species, using commercial timber harvest, when possible, to maintain a component no greater than 50–60% (# of stems) of any one species or genus.

Location

Under 620 FW 1 1.3, an excerpt from the National Wildlife Refuge Improvement Act of 1997 is cited, “each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for

which that refuge was established.” The Neches River NWR forest habitat management program will adhere to the approved procedures, principles, and techniques listed in 620 FW 1 and the Refuge Manual.

Timing

The application of forest management practices must be consistent with available funds and manpower. Most forest management practices on the refuge can be accomplished by commercial harvests, which prove to be cost effective as well as manpower efficient. Commercial harvesting will be used when it is an effective means of achieving refuge objectives, and when timber volumes are sufficient to make a commercial operation feasible. Again, the intent of this plan is not to develop a commercial timber harvesting program, but a habitat evaluation system that will guide silviculture decisions based on wildlife habitat parameters. General restrictions and regulations that apply to commercial harvest operations may be found in Appendix C, Conditions Applicable to Timber Harvest Permit. When commercial operations are not feasible, refuge personnel, contractors, youth program enrollees, approved volunteers, or educational institutions under cooperative agreements may administer forest habitat improvement treatments.

Frequency

The following process will be adhered to before application of any silvicultural treatments. First, stands will be inventoried in a uniform manner to evaluate habitat conditions as they apply to the objectives of the refuge. Next, inventory data will be evaluated, and a determination made as to the best course of action to accomplish habitat objectives. Finally, regional office approval will be necessary before any treatment is applied to the stand. Concurrences from Section 7 Consultation, 106 Consultations (archeological – tribal and SHPO) and Corps of Engineers will all be obtained before conducting operations. All original documents pertaining to the stand treatment (i.e., inventory data, prescriptions, approvals, volumes removed, contracts, etc.) will be kept in the refuge office files.

Intensity

The refuge has been divided into 14 compartments and will be evaluated on a 14-year cycle as follows unless habitat needs of an area dictate early or immediate action (Table 4). Since many of the upland pine stands are pine plantations and located throughout many compartments, the inventory review cycle was developed by basal area and past entry cycles.

The compartment prescription procedure will be to delineate stands within the featured compartment or compartments of the corresponding year. Stands should be limited in size so that application of treatments can be accomplished in one season or two. Stand boundaries should follow distinct or recognizable features on the ground and should encompass similar habitat to facilitate expediency in management applications.

Each stand will be systematically inventoried with respect to habitat objectives. At a minimum, inventory designs will incorporate timber volumes, measurements of habitat structure, and measurements of stand development (i.e., regeneration and stand succession, see data collection sheet, Appendix B). Timber cruise data and detailed maps will be kept on file by stand and compartment in the refuge office. The results will be evaluated to develop a prescription to achieve desired forest conditions by a team consisting of the Refuge Forester, Refuge Wildlife Biologist, and Refuge Manager. The prescription will

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Table 4. Compartment prescription cycle.

Year	Compartment	Type		¹ Total (ac)
		Upland (ac)	Bottomland (ac)	
2026	6	1,077.2	17.8	1,124.6
2027	3	1,513.0	322.5	1,948.5
2028	20	283.1	823.2	1,137.5
2029	21	271.0	86.5	359.9
2030	16	192.2	1,365.4	1,635.3
2031	2	0.0	87.0	258.2
2032	4	0.0	753.2	1,211.8
2033	5	22.6	647.0	1,144.8
2034	7	36.5	508.4	641.8
2035	8	32.2	114.5	167.3
2036	9	20.2	91.0	191.5
2037	10	3.8	219.9	227.6
2038	17	5.9	431.3	441.6
2039	18	7.0	94.1	101.1
2040	6	1,077.2	17.8	1,124.6

¹Terrace and open water not displayed.

evaluate the results of the inventory, and if any action is necessary, describe in detail the specific treatment(s) that would best accomplish the Refuge's objectives of forest habitat management.

Management strategy documents

Desired forest habitat manipulation can often be facilitated by use of carefully implemented commercial sales. All timber sales will be conducted in accordance with the requirements listed in the Refuge Manual (5 RM 17) guidelines established in this plan, and specifications detailed in the compartment prescriptions. Timber sales will be specifically designed to meet the Refuge's forest habitat management objectives.

Necessary resources

Little River National Wildlife Refuges Complex currently entails four refuges: Caddo Lake, Little River, Little Sandy and Neches River. Current staffing at Neches River NWR consists of a refuge manager, refuge forester, and a maintenance worker. Caddo Lake NWR (101 miles away) has a refuge manager, administrative technician, refuge forester, wildlife biologist, and engineering equipment operator. Little River NWR (190 miles away) staff consist of a refuge manager and engineering equipment operator. Management of the forest habitat to meet the objectives under this plan will require additional staff and equipment. The annual staff requirements to implement forest management on Neches River NWR are in Tables 5 and 6.

A total of 650 annual staff days are needed to accomplish the activities in the habitat objectives. The biologist, biological technician, engineering equipment operator, and forestry technician are essential staffing additions needed to fully implement forest habitat management on Neches River NWR. Although Neches River CCP has not been completed, it needs to include a fire management officer, biologist, biological technician, engineering equipment operator, and a forestry technician for habitat

activities (they will be necessary to implement the HSP). These desired positions will be stationed at Caddo Lake and Neches River NWRs which are a part of the Little River National Wildlife Refuge Complex. The Neches River CCP is scheduled to be completed in 2026 which should include these positions in the staffing chart. Annual funding needs are summarized in Table 7.

Salary cost is prorated for all staff positions identified in the previous table. Equipment and maintenance costs include the purchase of a new 4-wheel drive truck, UTVs, and other purchases of forestry supplies, including computers, etc. Forest habitat management expenses involve funding of any non-commercial treatments or other forestry operations, or improvement of roads for forestry management. Operating expenses include purchase of fuel, high explosives for beaver dam removal, marking paint, computers, office supplies, etc.

Documentation of special uses (sale appraisal)

Appraisal of forest products for each commercial sale will be kept on file at the refuge. Consideration will be given to volume, species, and grade of products removed. Also factors such as logging costs or special conditions of the contract will be considered. This information will be used to ensure the Fish and Wildlife Service receives the fair market value for timber products removed from the refuge. The process is discussed further in the following compliance portion.

Documentation of compliance (bid invitations)

All timber sales will be conducted in accordance with the requirements listed in the Refuge Manual (5 RM 17) guidelines established in this plan, and specifications detailed in the compartment prescriptions. Timber sales will be specifically designed to meet the refuge forest habitat management objectives. Before a silviculture prescription is implemented on the refuge, several issues need to be addressed. A Service intra-section 7 form, Clean Water Act Section 404 silvicultural exemption concurrence, and archeological clearance all need to be obtained, completed, and approved before any activities are implemented.

Small sales (estimated receipts less than \$2,500) will be negotiated. The Refuge Forester will make a reasonable effort to obtain at least three bids from potential buyers. These bids will be documented, and a special use permit will be issued to the successful high bidder.

Larger timber sales (estimated receipts more than \$2,500) will be conducted through a formal bid procedure or will be negotiated. Invitations to bid will be prepared and administered by refuge personnel.

Formal bid invitations will be mailed to all prospective bidders (Appendix D). Bid invitations will contain the following information:

- 1) A Formal Bid Information Form containing sales information.
- 2) Timber sale volume information.
- 3) Maps detailing all sale units.
- 4) Conditions applicable to timber harvesting permit.
- 5) Certificate of Independent Price Determination.
- 6) Equal Employment Opportunity Clause (Form 3 176).
- 7) Timber tour trip information if applicable.

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Table 5. Staffing requirements.

Staff Position	Forest Staff Days
Refuge Manager	10
Forester	260
Forestry Technician	130
Refuge Biologist	50
Biological Technician	130
Equipment Operator	20
Refuge Law Enforcement Officer	10
Clerical Staff	40

Table 6. Staff days by duties and position.

Position	Administration	Inventories	Prescriptions	Treatments	Pest Management	Boundary Marking	Other	Leave	Total
Forester	20	50	30	50	30	10	30	40	260
Forestry Technician		40		30	20	20		20	130
Refuge Biologist		15	15	15			5		50
Biological Technician		25		25	25	40	15		130
Equipment Operator				20					20
Law Enforcement				5		5			10
Clerical Staff	5	30					5		40

Table 7. Forestry program funding needs.

Description	Cost
Salaries	\$300,000
Equipment & Maintenance	\$100,000
Forest Habitat Improvement	\$20,000
Operating Expenses	\$60,000
Total Annual Cost	\$480,000

For all bid sales, a bid opening date and time will be set to occur at the refuge headquarters. All bids received prior to the opening time will be kept, unopened and locked, in the refuge safe until the specified opening time. Any bids received after the specified opening time will not be accepted. The refuge retains the right to reject any and all incomplete or otherwise unacceptable bids.

A \$500 bid guarantee must accompany all bids received through the formal bid process. This deposit is to ensure the sincerity of the bidder's intention to purchase the offered sale at the bid price. In the event the successful bidder chooses not to purchase the offered timber, the bid deposit will be forfeited to the government. When the successful bidder is named, all unsuccessful bidders' deposits will be immediately returned. The successful bidder's deposit will be returned when a performance guarantee is

submitted. The performance guarantee is a deposit of 10% of the estimated value of the sale up to a maximum of \$20,000 and must be received before any activities proceed. Depending on the size of the sale or potential for damage, more than 10% of the appraised value may be justified as a deposit; the amount of the deposit will be stipulated in the bid invitation. The performance guarantee will be retained by the government in a holding account to cover any damages caused by the successful bidder, their agents, employees, or their producers. The balance of the deposit will be refunded to the successful bidder when the sale is completed.

Small sales made through the negotiation process will also require a performance guarantee deposit to be received by the government prior to any timber harvest.

Upon selection of a successful bidder by the Refuge Manager, a harvesting permit will be issued. The harvesting permit will include the following:

- 1) Special Use Permit All information required on a special use permit will be completed, including information applicable to the specific sale (i.e., methods and amounts of payments).
- 2) Maps locating all sale units.
- 3) A copy of the Conditions of Sale applicable to timber harvesting.

In the case of lump sum sales, the successful bidder (hereafter referred to as the permittee) will have ten days after receipt of the harvesting permit to make total payment, or in the event of a consumer scale sale (pay as cut), the performance guarantee will be considered as prepayment for the first two week (or less) operating period. However, at the end of the first operating period and after each subsequent operating period, payment will be made to the government in the amount indicated by actual scale tickets for that period. In no case will harvesting operations begin prior to payment. The purpose of an advance payment is to encourage the permittee to begin harvesting operations as quickly as possible and is department policy. All payments will be in the form of a registered check, Cashier's Check, or money order payable to U.S. Fish and Wildlife Service.

In some cases, such as salvage sales, where speed is essential and volumes are difficult to determine, timber products may be sold by mill scale. That is, the products will be sold according to the volume of products delivered to a mill, as scaled by that mill. In mill scale sales, payment will be made according to the units scaled at a negotiated price per unit. Payments will be made on a time schedule specified on the Special Use Permit. All payments will be accompanied by mill scale tickets or other documentation confirming the volume of forest products removed from the refuge. In dealing with salvage sales, the timber products that are damaged may be subject to insects, fungi, etc. The value of all salvage timber declines rapidly over short periods of time. Hardwood sawlog timber develops woodborer, ambrosia beetle, and stain problems within 8 to 12 weeks. Soft rot fungi are a problem for all downed timber inside the first six months on the ground depending on climatic conditions (Ham, 1989; Anon, 1996).

Volumes and receipts will be properly recorded and filed for various refuge reports. Receipts for forest products, along with proper documentation, will be forwarded to the Fish and Wildlife Service Finance Center. Any receipts, which cannot be processed the same day received, will be stored in the refuge safe until processing can be completed.

To confirm harvest procedures and address any questions, a meeting will be held prior to entry between the Refuge Forester and the permittee. The permittee will be required to notify the refuge staff prior to initiating harvesting operations and upon completion.

Close inspection and supervision of all timber sales is necessary to ensure that harvesting operations meet the conditions of the permit and refuge objectives. Frequent inspections of harvesting operations will ensure that only designated trees are cut, and that problems are rectified before becoming major issues. Timber harvesting operations may be suspended or restricted any time that continued operation might cause excessive damage to the forest stands, soil, or wildlife habitat. Reasons for suspension or restriction may include but are not limited to: excessive disturbance to wildlife during breeding, nesting, or young rearing season; periods of high wildfire danger, insect, or disease hazard; times when harvesting activities may interfere with essential refuge operations; during periods of heavy rains or wet conditions which may cause soil rutting, erosion, or flooding; or when harvesting operations present a safety hazard. Typically, harvest activities would not be conducted January–June due to wet ground conditions and to minimize disturbance to nesting birds. However, new operational guidance is ongoing with overlapping breeding birds and pupping bats in the spring and hibernating bats in the fall, with current guidelines suggesting a harvest period of August 1–November 15. Pre-harvest IPaC consultation will determine the window of operations as it may vary from year to year with new guidance.

When harvesting is complete, the Refuge Forester will inspect the site for compliance with all requirements of the contract. If any deficiencies are found, the permittee will be notified and given reasonable time to achieve compliance. If full compliance is achieved, the permittee's performance deposit will be returned in full. If not, an amount to mitigate damages will be deducted from the performance deposit and the remaining amount returned.

Evaluation

Evaluation is a key component of wildlife and habitat conservation because it fosters learning and improvement. The Service is increasingly emphasizing these practices as a means to document our learning and continue to improve and to help us to be more strategic in moving toward our conservation objectives (052 FW 1: Strategic Habitat Conservation). Adaptive management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. The evaluation section describes what will be monitored to determine progress towards achieving objectives and how Refuge Managers will determine if an adjustment to objectives or strategies is necessary. It may make sense to adjust or completely change an objective or strategy, depending on how conditions, threats, and opportunities evolve in light of new lessons learned, or based on the observed outcomes of the strategy. [Please also see the Inventory and Monitoring Plan for Neches River National Wildlife Refuge where monitoring protocols referred to in this section will be developed in greater detail.]

As discussed previously, pre-harvest sampling was conducted on a grid-plot cruise to assess forest conditions on Neches River NWR. Cruise data is then compared to desired forest conditions to generate a prescription and timber harvest if necessary. Upon completion of prescribed timber harvest operations, post-harvest sampling is necessary to assess the efficacy of the timber harvest to alter habitat conditions to within the objectives. Post-harvest monitoring will consist of the forester walking through the treated area and taking basal area measurements at several plots. Post harvest monitoring is less intensive than pre-harvest monitoring but will help the refuge staff to determine what changes, if

any, may be needed for future forest management prescriptions through an adaptive management process.

Despite prior emphasis on the evaluation and monitoring of habitat conditions, the primary goal is sustainable wildlife populations, and particularly avian species, through management of habitat. Therefore, it is imperative to monitor wildlife response to activities that move habitat toward Desired Forest Conditions for Wildlife. Currently, no coordinated monitoring effort exists to assess the effect of forest management on wildlife species in the MAV and WGCP (LMVJV, 2025). Bird point counts are used to monitor trends of relative use by focal bird species in habitat managed by silvicultural treatment. Point counts conducted in 2021–2023 (USFWS, 2021) followed Appendix 5 of Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat (Wilson et al., 2007) and provided a baseline inventory of species present on the refuge. Future bird monitoring efforts will be described in detail in the Neches River National Wildlife Refuge Inventory and Monitoring Plan. All habitat and wildlife population monitoring data will be kept on file at the refuge and ServCat.

The effectiveness of management actions in this plan will be evaluated using ocular observations and bird surveys that will measure species occupancy and habitat conditions for the stand. Bird plot monitoring, forest prescriptions, and documentation for the stands will be kept on file and ServCat.

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Glossary

Acquisition boundary: Perimeter around existing property boundary that is under consideration for acquirement.

Aesthetics: Of or pertaining to the sense of beauty.

Avifauna: The birds of a region.

Basal area: The cross-sectional area (in square feet at breast height) of all trees on a per acre basis.

Bottomland: Refers to low-lying, fertile alluvial land, typically found along river floodplains, characterized by periodic flooding.

Buffer zones: A strip of varying size and shape preserving or enhancing aesthetic values along roads, trails or water.

Compatible use: A wildlife-dependent recreational use or any other use on a refuge that, in the sound judgement of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge.

Connectivity: Forested stands with only minor breaks caused by relatively narrow roads and water bodies.

DBH: Refers to diameter at breast height, a standard method of measuring tree diameter, usually taken at 4.5 ft above the ground.

Game: Wild animals and birds legally hunted or fished for food, sport or recreation, often managed through hunting seasons and licenses.

Ground cover: Forest stand vegetation less than three feet in height.

Habitat corridors: Narrow passages of similar vegetation between larger areas of habitat.

Horizontal stand structure: The structural change in condition of forest stand on a horizontal plane.

Internal stand structure: Forest floor vegetation, understory, mid-story, and overstory that make up a stand community.

Mid-story: Forest vegetation usually greater than ten feet and consisting of overtopped and intermediate trees and vegetation below the overstory.

Overstory: Forest vegetation above the mid-story consisting of dominant and co-dominant trees and vegetation.

Neches River Environmental Assessment: A document that describes the proposed actions and outlines of stewardship needs and resources conservation priorities and option within the refuge's project area.

Neotropical Migratory Bird: Over 350 species that breed in North America during the summer and migrate to the "Neotropics" – Mexico, Central/South America, and Caribbean – for the winter.

Non-game: Animals without a defined legal hunting season, included protected, threatened or endangered wildlife.

Patchiness: Typically measured in terms of spatial relationships between reproduction clumps or shrub clumps, comprised of early successional stage plants such as vines and herbaceous growth, to closed canopy/more open stand conditions.

Pine Savanna: A pine ecosystem that are typically thought of as transitional landscapes between forest and prairie containing a sparse overstory and well-developed herbaceous understory, including grasses, wildflowers and occasional understory shrubs.

Preferred alternative: The Service's selected alternative identified in the Neches River NWR Interim Forest Habitat Management Plan.

Remnant habitats: Several small areas of late seral stage communities that are found scattered throughout the refuge and exist probably due to inaccessibility, such as being surrounded by drainage systems.

Rotation age: The planned number of years between the formation of a stand and its final cutting at a specified stage of maturity.

Silvicultural practices: The art and science of controlling forest establishment, composition, structure and growth.

Stand: A contiguous community of trees sufficiently uniform in species composition, age, structure and condition to be managed as a single unit.

Terrace: Ecological sites formed on glaciofluvial deposits, characterized by very deep, well-to-excessively drained sandy soils, often with a spodic horizon.

Understory: A horizontal layer of forest vegetation usually between three to ten feet of the ground.

Upland: Forest ecosystems located on higher ground, slopes, and ridges, characterized by well-drained soils and an absence of regular flooding.

Uneven-aged communities: Three or more age classes of tree species within the same locality.

Vertical stand structure: The condition of a forest stand viewed vertically.

Waterfowl: Ducks, geese or other large aquatic birds, especially when regarded as game.

Appendices

Appendix A. Maps and summary forest statistics by stand for each compartment

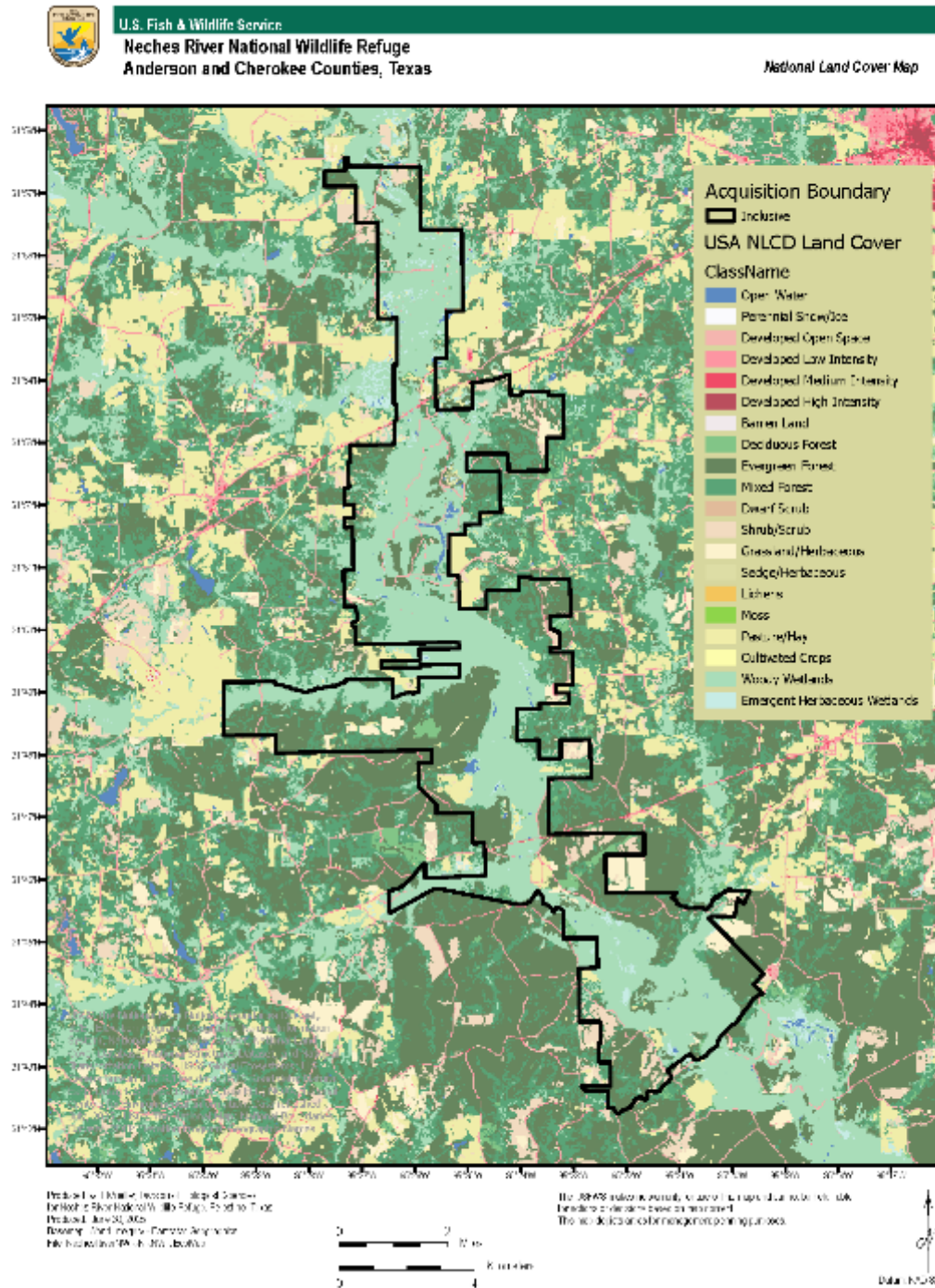
Appendix B. Data Collection Sheet and Instructions

Appendix C. Conditions Applicable to Timber Harvest Permit

Appendix D. Formal Bid Invitation

Appendix A: Maps and summary forest statistics by stand for each compartment

Neches River National Wildlife Refuge
Draft Interim Habitat and Species Plan for Forested Habitats



Map 1. National Land Cover, Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Generalized Ecological Sites

Map 2. Generalized ecological sites on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Refuge Forest Compartment Map

Map 3. Refuge forest compartments on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Compartment 2

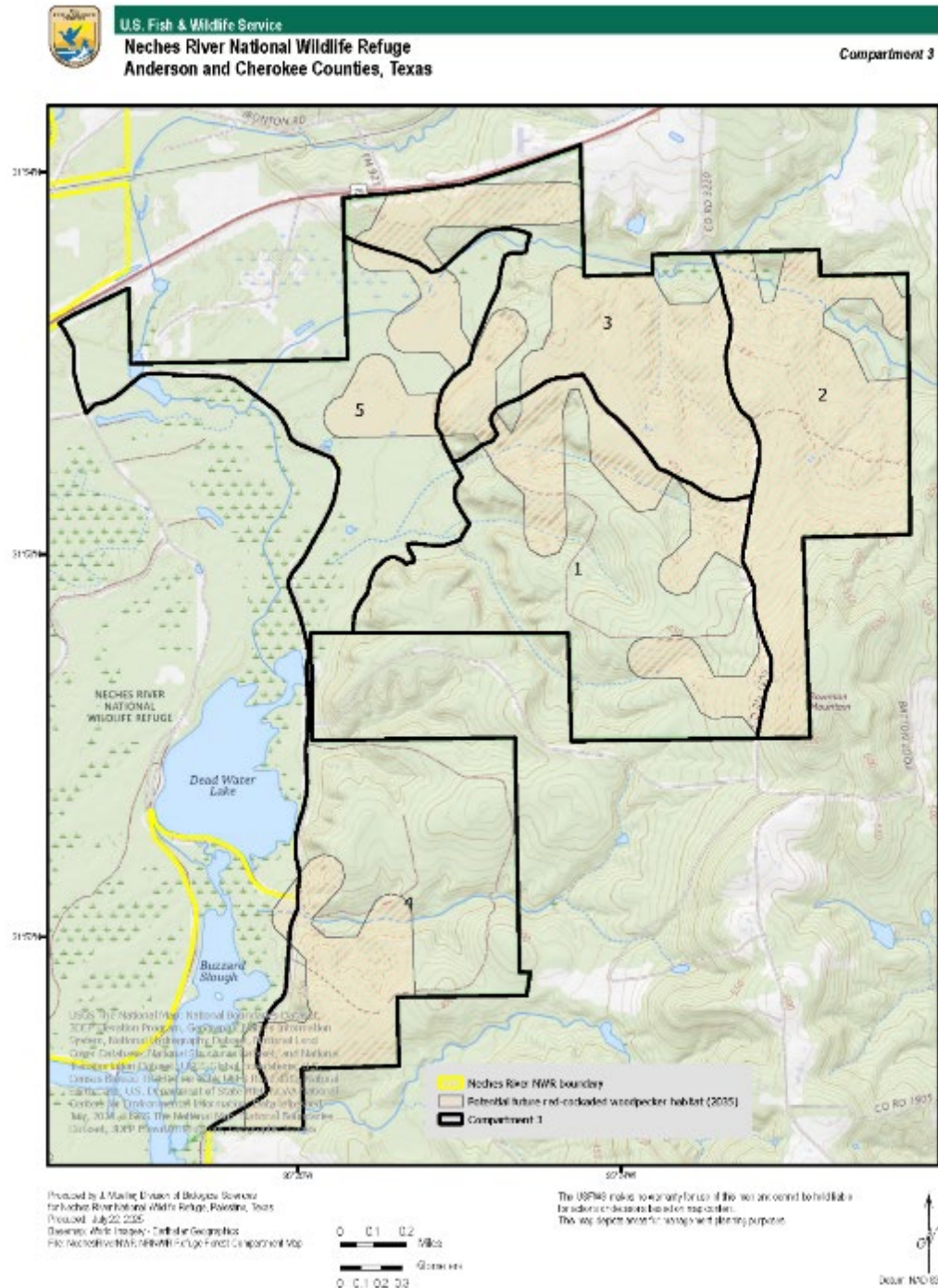
Map 4. Compartment 2 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 8. Summary forest statistics by stand for Compartment 2, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

Compartment 2 Summary

Volume per acre					Total Volume				
Stand	Time Since Last	Time CWS	Time Twp	Time Twp	Time CWS	Time Twp	Time Twp	Time Twp	Time Twp
Stand 1	88.9	585.8	7.3	411.3	5.4				
Stand 2									
Stand 3									
Stand 4									
Stand 5									
Stand 6									
Stand 7									
Stand 8									
Stand 9									
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Neches River National Wildlife Refuge
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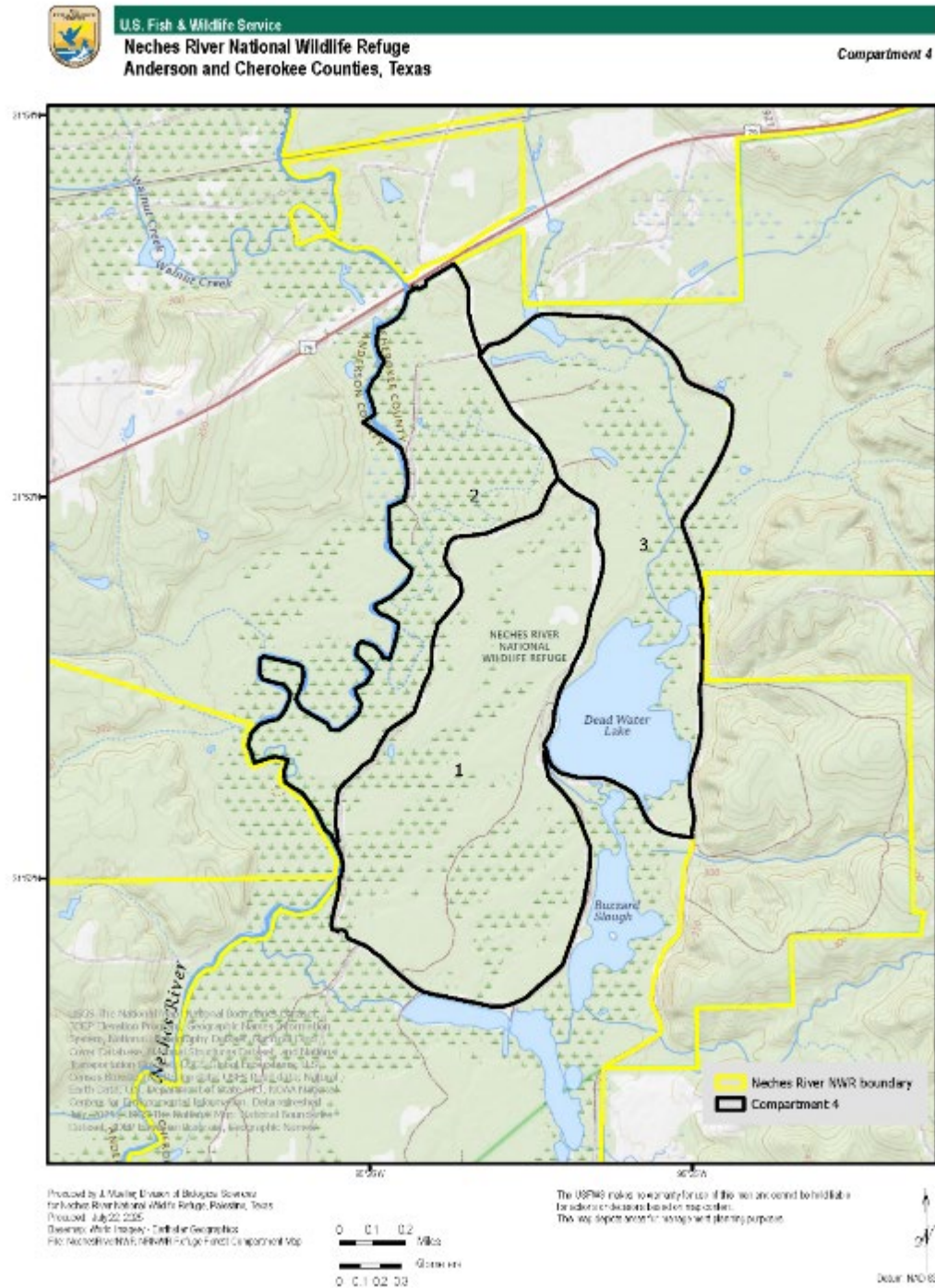
Map 5. Compartment 3 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 9. Summary forest statistics by stand for Compartment 3, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

Neches River National Wildlife Refuge
Compartment 3 Summary

Total Volume									
Time Saw	Time CMS	Time Pulp	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P
Stand 1	377.6	396.2	396.2	396.2	396.2	396.2	396.2	396.2	396.2
Stand 2	1,098.9	421.7	421.7	421.7	421.7	421.7	421.7	421.7	421.7
Stand 3	1,375.2	577.3	577.3	577.3	577.3	577.3	577.3	577.3	577.3
Stand 4	968.2	1,077.2	1,077.2	1,077.2	1,077.2	1,077.2	1,077.2	1,077.2	1,077.2
Stand 5	396.9	179.9	179.9	179.9	179.9	179.9	179.9	179.9	179.9
Sum	3,816.8	2,352.3	2,352.3	2,352.3	2,352.3	2,352.3	2,352.3	2,352.3	2,352.3
Trunks per acre									
Time Saw	Time CMS	Time Pulp	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P
Stand 1	2.1	8.5	33.8	3.7	22.6	100.6			
Stand 2	24.3	5.1	139.7	4.6	33.1	227.3			
Stand 3	23.2	7.7	96.2	4.7	40.7	173			
Stand 4	5.3	1.7	33.7	3.0	99.3				
Stand 5	1.9	3.5	18.3	1.4	13.1	122.4			
Sum	76.8	26.5	397.7	17.4	306.8	623.4			
Basal Area per acre									
Time Saw	Time CMS	Time Pulp	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P
Stand 1	2.42	8.11	13.4	4.34	11.51	1.83	0.25	0	43.4
Stand 2	32.44	5.33	45.78	7.23	13.78	0.89	1.36	0	93.11
Stand 3	22.27	7.39	34.77	6.82	12.2	2.73	0	0	87.95
Stand 4	8.67	1.33	8	1.64	13.26	2	1.13	0.77	46.76
Stand 5	9.13	3.13	8.32	19.71	29.21	6.22	1.89	0.27	77.3
Sum	74.93	25.77	106.27	49.74	59.95	12.74	3.63	0.27	260.56
Hardwood DFC									
Acres	Coverage	Mild story	Understory	Canopy	Tallow	Palmetto	Vines Poles	Basal Area	W-D BA
Stand 1	489.0	29	47	27	0	0	0	42.7	0.8
Stand 2	328.7	67.3	33.9	29	784.7	0	0	95.16	1.36
Stand 3	270.7	61.2	36.4	28.9	944.7	0	0	173.23	1.70
Stand 4	407.9	33.5	64.4	28.3	647.5	0	0	17.71	1.38
Stand 5	167.9	22.8	35.2	23.8	145.2	0	0	17.23	1.38
Sum	1,244.2	256.3	256.3	256.3	2,562.8	0	0	477.23	5.82
Target	60/70	25/60	25/60	>20% of plot				60/70	5.82
Fine DFC Average									
Time Saw	Time CMS	Time Pulp	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P
Stand 1	8.1	162.8	152.8	152.8	152.8	152.8	152.8	152.8	152.8
Stand 2	46.29	295.2	295.2	295.2	295.2	295.2	295.2	295.2	295.2
Stand 3	85.12	275.5	275.5	275.5	275.5	275.5	275.5	275.5	275.5
Stand 4	32.56	106.52	111.2	111.2	111.2	111.2	111.2	111.2	111.2
Stand 5	8.14	81.4	74.6	74.6	74.6	74.6	74.6	74.6	74.6
Sum	110.24	921.22	921.22	921.22	921.22	921.22	921.22	921.22	921.22
Target	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5
Bottomland NWID DFC									
Acres	Stand 5	W-D BA	W-D BA	W-D BA	W-D BA	W-D BA	W-D BA	W-D BA	W-D BA
Stand 5	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Target	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Tree Stocking									
Time Saw	Time CMS	Time Pulp	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P	Time S&P
Stand 1	8.1	162.8	152.8	152.8	152.8	152.8	152.8	152.8	152.8
Stand 2	46.29	295.2	295.2	295.2	295.2	295.2	295.2	295.2	295.2
Stand 3	85.12	275.5	275.5	275.5	275.5	275.5	275.5	275.5	275.5
Stand 4	32.56	106.52	111.2	111.2	111.2	111.2	111.2	111.2	111.2
Stand 5	8.14	81.4	74.6	74.6	74.6	74.6	74.6	74.6	74.6
Sum	110.24	921.22	921.22	921.22	921.22	921.22	921.22	921.22	921.22
Target	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5

Neches River National Wildlife Refuge
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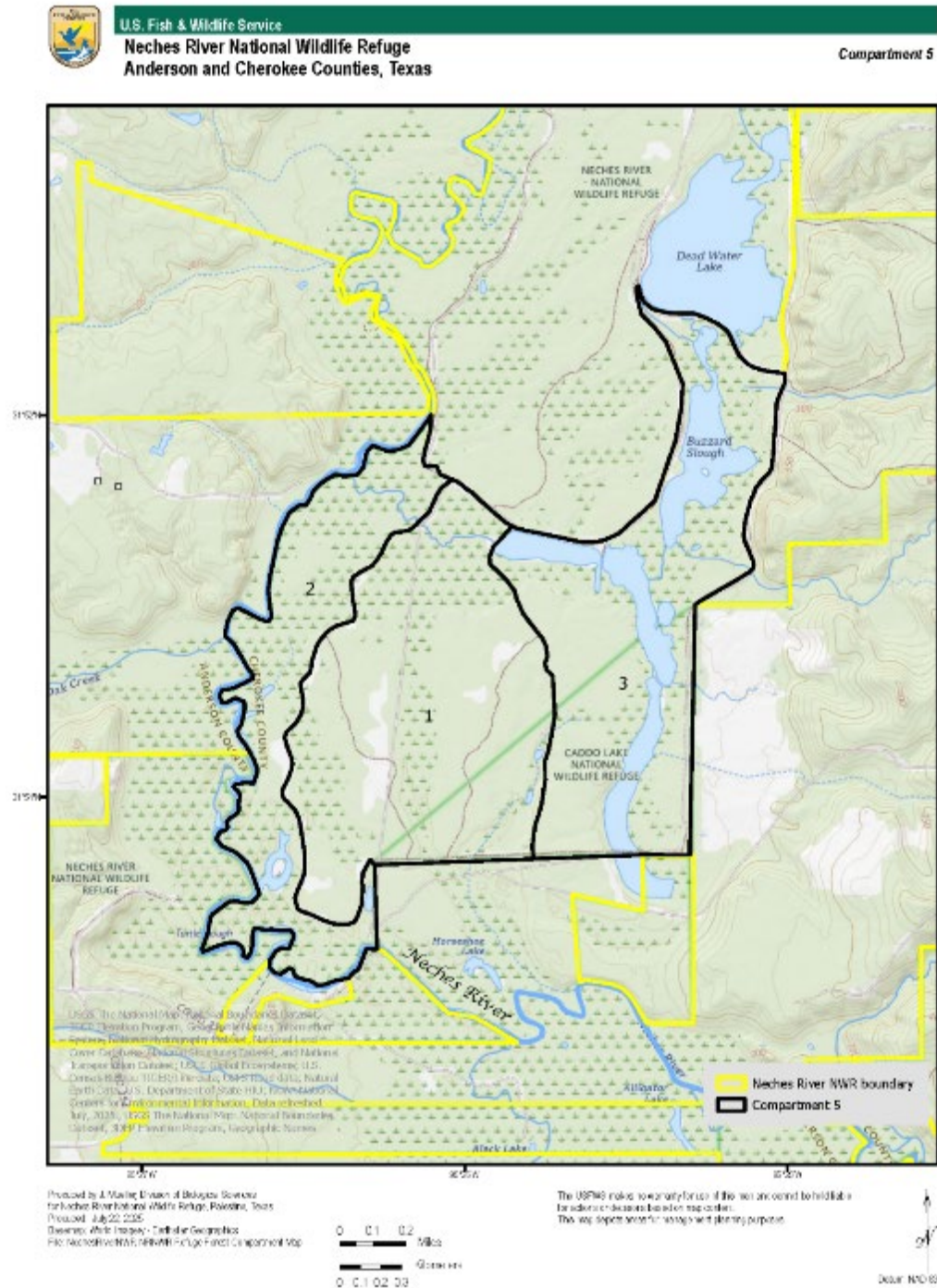
Map 6. Compartment 4 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 10. Summary forest statistics by stand for Compartment 4, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

NECHES RIVER NATIONAL WILDLIFE REFUGE
Compartment 4 Summary

Volume per acre									
Pine Saw 14'	Pine C&S 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'
Stand 1	170.9	85.5	1.0	1,001.8	5.9				
Stand 2	208.6	29.0	1.8	1,396.9	5.1				
Stand 3	897.9	201.7	1.9	597.0	8.6				
Stand 4									
Stand 5									
Trees per acre									
Pine Saw 14'	Pine C&S 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'
Stand 1	1.6	0.3	9.3	8.8	71.2	0.0			
Stand 2	0.9	0.3	6.3	10.8	46.3	64.7			
Stand 3	2.9		5.5	7.3	53.3	70.5			
Stand 4									
Stand 5									
Total Volume									
Pine Saw 14'	Pine C&S 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'
Stand 1	85,556.20	24,496.20	518.00	529,186.50	5,055.20				
Stand 2	61,516.14	8,492.10	510.92	470,921.91	1,402.99				
Stand 3	318,939.07	80,039.06	7,396.2	390,600.60	3,936.28				
Stand 4	0.00	0.00	0.00	0.00	0.00				
Stand 5	0.00	0.00	0.00	0.00	0.00				
Sum	468,992.79	131,087.96	1,806.62	1,399,713.21	7,998.47				
Unit/acre	4,700.97	1,297.19	721.98	11,889.38	2,666.36				
Volume/acre	525.00	515.60	55.30	513.30	513.00				
Volume/acre	510,000.38	515,000.27	54,340.26	529,226.35	525,661.37	5456,200.35			
Basal Area per acre									
Pine Saw 14'	Pine C&S 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'
Stand 1	2	0.22	5.09	27.36	13.21	0			
Stand 2	2	0.22	5.09	16.67	1.67	4			
Stand 3	12		5.94	15	36.69	5.21			
Stand 4									
Stand 5									
Total - 56,277									
Pine Saw 14'	Pine C&S 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'	Pine Pulp 14'	Pine Saw 14'
Stand 1	318	bottom/vert	57	45	168	158	17	11	11
Stand 2	254	bottom/vert	63	38	179	12	49	49	49
Stand 3	369	bottom/vert	12	12	169	12	12	12	12
Stand 4									
Stand 5									
Sum	1,222.7								
Hardwood BFC									
Acres	Overstory	Mid-story	Understory	Canopy	Tallies	Palmetto	Vines/Poles	Real Area	Seed SA
Stand 1	105.5				105.5	0	0	105.5	105.5
Stand 2	187.2				187.2	0	0	187.2	187.2
Stand 3	211.6				211.6	0	0	211.6	211.6
Stand 4	305.5				305.5	0	0	305.5	305.5
Sum	609.8				609.8	0	0	609.8	609.8
Bottomland HWD BFC									
Acres	Overstory	Mid-story	Understory	Canopy	Tallies	Palmetto	Vines/Poles	Real Area	Seed SA
Stand 1	105.5				105.5	0	0	105.5	105.5
Stand 2	187.2				187.2	0	0	187.2	187.2
Stand 3	211.6				211.6	0	0	211.6	211.6
Stand 4	305.5				305.5	0	0	305.5	305.5
Sum	609.8				609.8	0	0	609.8	609.8
Pine BFC Average									
Present	15 yrs later	RCM-2015	RCM-2015	RCM-2015	RCM-2015	RCM-2015	RCM-2015	RCM-2015	RCM-2015
Stand 1									
Stand 2									
Stand 3									
Stand 4									
Stand 5									
Sum									
Percent									
Acres	Target	Percent	Target	Percent	Target	Percent	Target	Percent	Target
Stand 1	105.5	21.0%	105.5	21.0%	105.5	21.0%	105.5	21.0%	105.5
Stand 2	187.2	24.5%	187.2	24.5%	187.2	24.5%	187.2	24.5%	187.2
Stand 3	211.6	41.4%	211.6	41.4%	211.6	41.4%	211.6	41.4%	211.6
Stand 4	305.5	50.1%	305.5	50.1%	305.5	50.1%	305.5	50.1%	305.5
Sum	609.8	100.0%	609.8	100.0%	609.8	100.0%	609.8	100.0%	609.8
Goal 0.75-0.8 in Target or 31C									
Acres	Target	Percent	Target	Percent	Target	Percent	Target	Percent	Target
Stand 1	105.5	21.0%	105.5	21.0%	105.5	21.0%	105.5	21.0%	105.5
Stand 2	187.2	24.5%	187.2	24.5%	187.2	24.5%	187.2	24.5%	187.2
Stand 3	211.6	41.4%	211.6	41.4%	211.6	41.4%	211.6	41.4%	211.6
Stand 4	305.5	50.1%	305.5	50.1%	305.5	50.1%	305.5	50.1%	305.5
Sum	609.8	100.0%	609.8	100.0%	609.8	100.0%	609.8	100.0%	609.8

Neches River National Wildlife Refuge
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Map 7. Compartment 5 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 11. Summary forest statistics by stand for Compartment 5, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

Neches River National Wildlife Refuge
Compartment 5 Summary

Volume per acre					Total Volume				
Pine Saw Inf	Pine C&S Inf	Pine Pulp Inf	Pine Saw Inf	Pine Pulp Inf	Pine Saw Inf	Pine C&S Inf	Pine Pulp Inf	Pine Saw Inf	Pine Pulp Inf
Stand 1	85.0	0.0	0.0	1,318.7	85.0	0.0	0.0	1,318.7	85.0
Stand 2	29.2	75.0	0.0	1,126.1	29.2	75.0	0.0	1,126.1	29.2
Stand 3	164.7	140.2	1.2	230.1	164.7	140.2	1.2	230.1	164.7
Stand 4									
Stand 5									
Trees per acre					Value/acre				
Pine Saw	Pine C&S	Pine Pulp	Pine Saw	Pine Pulp	Pine Saw	Pine C&S	Pine Pulp	Pine Saw	Pine Pulp
Stand 1	1.1	2.7	0.0	0.0	1.1	2.7	0.0	1.1	2.7
Stand 2	1.2	0.0	7.1	3.4	1.2	0.0	7.1	3.4	1.2
Stand 3	2.1	11.4	6.5	8.3	2.1	11.4	6.5	8.3	2.1
Stand 4									
Stand 5									
Basal Area per acre					Total - 56,294				
Pine Saw	Pine C&S	Pine Pulp	Pine Saw	Pine Pulp	Pine Saw	Pine C&S	Pine Pulp	Pine Saw	Pine Pulp
Stand 1	1.5	1.75	18	36	1.5	1.75	18	36	1.5
Stand 2	1.85		12.5	17.3	1.85		12.5	17.3	1.85
Stand 3	4.26	6.05	12.62	43.23	4.26	6.05	12.62	43.23	4.26
Stand 4									
Stand 5									
Average DBH inches					Tree Stocking				
Stand 1					Stand 1				Stand 1
Stand 2					Stand 2				Stand 2
Stand 3					Stand 3				Stand 3
Stand 4					Stand 4				Stand 4
Stand 5					Stand 5				Stand 5
Hardwood BFC					Bottomland HWD BFC				
Acres	Overstory	Mid-story	Understory	Canopy	Acres	Overstory	Mid-story	Understory	Canopy
Stand 1	454.1 bottomland	30	27	42	1889/1245	1711/253/1			
Stand 2	260.1 bottomland	27.4	35.2	45.7	1889/1245	1711/253/1			
Stand 3	21.5 bottomland	0.7	30.8	39.3	1889/1245	1711/253/1			
Stand 4									
Stand 5									
Sum	1,145.7								
Pine BFC Average					Bottomland HWD BFC				
Present	15 yrs later	RCM-2015	RCM-2015	RCM-2015	Present	15 yrs later	RCM-2015	RCM-2015	RCM-2015
Stand 1					Stand 1				Stand 1
Stand 2					Stand 2				Stand 2
Stand 3					Stand 3				Stand 3
Stand 4					Stand 4				Stand 4
Stand 5					Stand 5				Stand 5
Sum	0	0	0	0	Sum	0	0	0	Sum
Pine BFC Average					Bottomland HWD BFC				
Present	15 yrs later	RCM-2015	RCM-2015	RCM-2015	Present	15 yrs later	RCM-2015	RCM-2015	RCM-2015
Stand 1					Stand 1				Stand 1
Stand 2					Stand 2				Stand 2
Stand 3					Stand 3				Stand 3
Stand 4					Stand 4				Stand 4
Stand 5					Stand 5				Stand 5
Sum	0	0	0	0	Sum	0	0	0	Sum

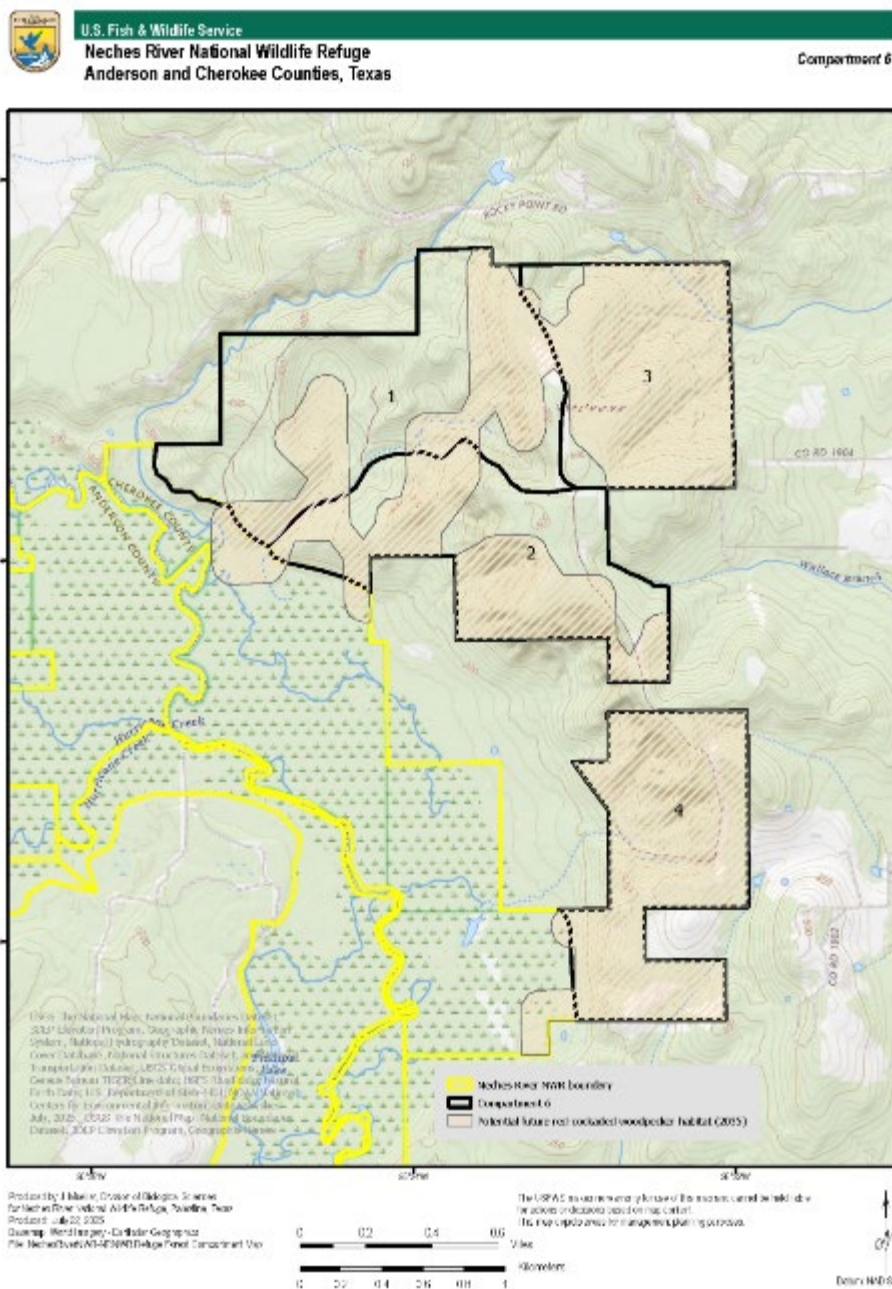


Table 12. Summary forest statistics by stand for Compartment 6, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

Neches River National Wildlife Refuge
Compartment 6 Summary

Volume per acre									
Pine Saw bf	Pine C&S bf	Pine Pulp cd	Hard Saw bf	Hard Pulp cd	Total Volume				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Pine Saw bf	Pine C&S bf	Pine Pulp cd	Hard Saw bf	Hard Pulp cd
73.74	73.74	812.7	10.3	280.7	30,571.82	2,737,053.02	2,732.95	129,936.33	3,722.59
1,906.1	812.7	10.3	280.7	4.7	272,512.74	2,333,566.78	3,765.28	75,624.58	1,275.58
5,018	828.2	12.2	397.2	2.1	207,689.80	2,057,994.99	2,983.29	67,032.29	2,908.85
408.5	1,063.7	7.4	187.6	2.1	72,074.68	432,135.62	1,795.24	55,807.76	5,807.66
					0.00	0.00	0.00	0.00	0.00
					218,842.74	1,151,363.37	9,977.77	207,738.87	3,728.24
					6,469.48	13,361.37	3,991.09	2,420.41	1,236.38
					897.00	517.00	50.00	527.00	530.00
					\$461,927.23	\$135,420.55	\$23,944.55	\$60,010.18	\$12,360.77
									\$413,475.29

Trees per acre									
Pine Saw	Pine C&S	Pine Pulp	Hard Saw	Hard Pulp	Total				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Pine Saw	Pine C&S	Pine Pulp	Hard Saw	Hard Pulp
1.2	8.1	35.7	2.3	31.8	72.3				
3.4	7.9	88.2	1.9	67.2	140				
1.6	6.7	146.1	1.3	83.2	155.1				
1.1	49.5	99.1	0.7	32.6	150.7				

Basal Area per acre									
Pine Saw	Pine C&S	Pine Pulp	Hard Saw	Hard Pulp	Total				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Pine Saw	Pine C&S	Pine Pulp	Hard Saw	Hard Pulp
3.1	9.29	16.5	4.53	17.05	0	0.48	0	0	0
8.24	8.12	36.41	3.82	17.65	0	1.18	0	0	0
4.62	8.46	44.62	2.31	9.62	0	0	0	0	0
2.41	36.25	31.72	1.72	10.68	0.68	1.29	1.38	86.19	85.78

Basal Area per acre									
Pine Saw	Pine C&S	Pine Pulp	Hard Saw	Hard Pulp	Total				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Pine Saw	Pine C&S	Pine Pulp	Hard Saw	Hard Pulp
3.1	9.29	16.5	4.53	17.05	0	0.48	0	0	0
8.24	8.12	36.41	3.82	17.65	0	1.18	0	0	0
4.62	8.46	44.62	2.31	9.62	0	0	0	0	0
2.41	36.25	31.72	1.72	10.68	0.68	1.29	1.38	86.19	85.78

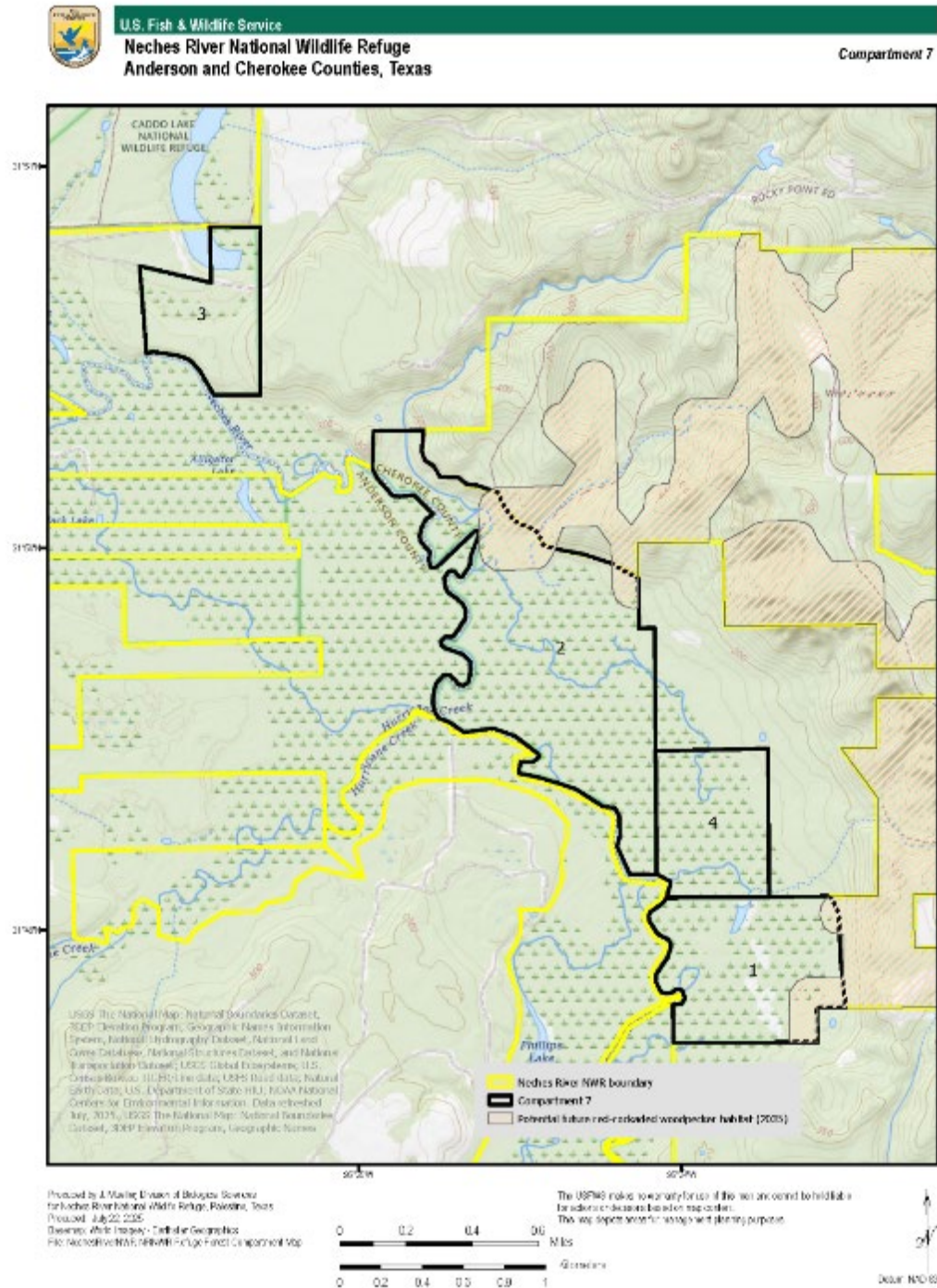
Average DBH inches									
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Tree Stocking Target 100-100				
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Bottomland HWD DFC									
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Bottomland HWD DFC				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Stand 1	Stand 2	Stand 3	Stand 4	Stand 5
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Hardwood DFC									
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Hardwood DFC				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Stand 1	Stand 2	Stand 3	Stand 4	Stand 5
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Pine DFC Average									
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Pine DFC Average				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Stand 1	Stand 2	Stand 3	Stand 4	Stand 5
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

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Map 9. Compartment 7 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 13. Summary forest statistics by stand for Compartment 7, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

Neches River National Wildlife Refuge
Compartment 7 Summary

Volume per acre					Total Volume				
Pine Saw	Pine CMS	Pine Pulp	Hard Saw	Hard Pulp	Pine Saw	Pine CMS	Pine Pulp	Hard Saw	Hard Pulp
Stand 1	2,692.4	765.7	1.7	3,459.7	387,553.26	107,450.13	244.52	421,738.92	1,079.25
Stand 2	1,317.2	1,011.0	1.4	2,328.3	323,429.72	323,913.19	448.34	746,048.23	2,937.21
Stand 3	2,295.4	3,471.9	0.9	9,356.6	106,127.39	309,473.13	0.00	71,019.77	779.30
Stand 4					0.00	0.00	0.00	0.00	0.00
Stand 5					0.00	0.00	0.00	0.00	0.00
Sum					912,315.36	740,738.42	692.77	1,397,797.80	4,796.76
Imperial	8,228,147	6,646,477	2,472.31	11,116,299	1,398,260				
Value from	575,000	5,330	56.00	525,000	510,000				
Valuation	\$205,235.46	\$59,866.89	\$1,662.53	\$275,903.03	\$45,230.60	\$603,972.72			

Trees per acre					Total				
Pine Saw	Pine CMS	Pine Pulp	Hard Saw	Hard Pulp	Pine Saw	Pine CMS	Pine Pulp	Hard Saw	Hard Pulp
Stand 1	4.3	4.9	19.8	8.0	147.5				
Stand 2	1.9	13.3	5.6	13.4	56.2				
Stand 3	6.6	27.6	3	7.1	53.7				
Stand 4					120.9				
Stand 5									

Basal Area per acre					Total				
Pine Saw	Pine CMS	Pine Pulp	Hard Saw	Hard Pulp	Pine Saw	Pine CMS	Pine Pulp	Hard Saw	Hard Pulp
Stand 1	14.25	7.77	6.36	33.61	32.71	0	0	91.73	92.73
Stand 2	3.83	12.3	2.33	25.17	42.3	3.33	5.67	135.66	96.65
Stand 3	36.67	30.67	3	12.21	39.22	3.22	1.0	113.66	103.93
Stand 4									
Stand 5									

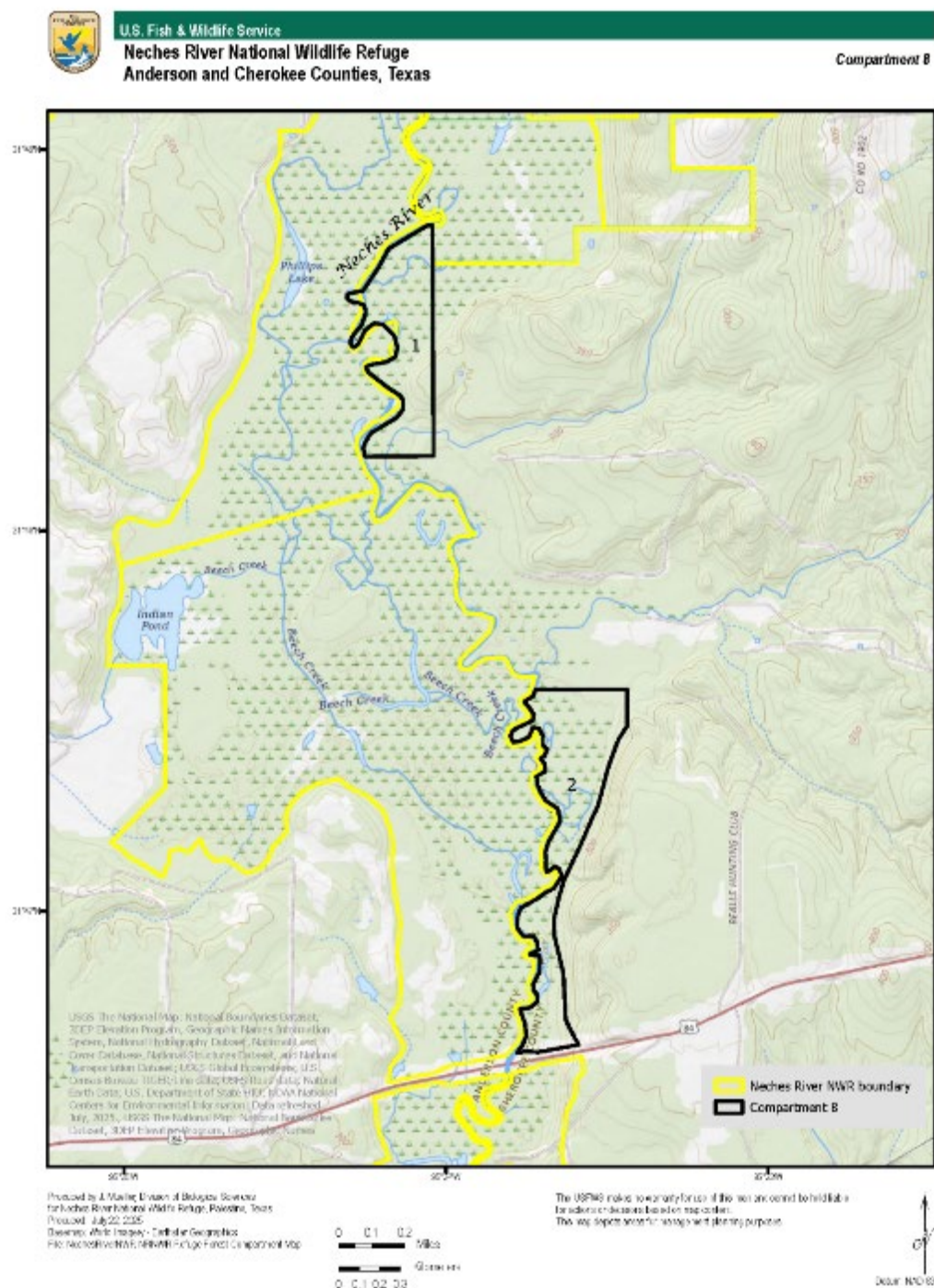
Average DBH inches					Tree Stocking				
Stand 1	Stand 2	Stand 3	Stand 4	Stand 5	Stand 1	Stand 2	Stand 3	Stand 4	Stand 5
					Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw
					Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw
					Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw
					Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw
					Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw	Ready to Saw

Herdwood BFC					Bottomland Hard BFC				
Area	Deciduous	Mildew	Canopy	Canopy	Area	Deciduous	Mildew	Canopy	Canopy
Stand 1	143.9	143.9	143.9	143.9	Stand 1	143.9	143.9	143.9	143.9
Stand 2	300.1	300.1	300.1	300.1	Stand 2	300.1	300.1	300.1	300.1
Stand 3	82.7	82.7	82.7	82.7	Stand 3	82.7	82.7	82.7	82.7
Stand 4					Stand 4				
Stand 5					Stand 5				
Sum	546.7	546.7	546.7	546.7	Sum	546.7	546.7	546.7	546.7

Fire BFC Average					Fire BFC Average				
Area	Deciduous	Mildew	Canopy	Canopy	Area	Deciduous	Mildew	Canopy	Canopy
Stand 1	143.9	143.9	143.9	143.9	Stand 1	143.9	143.9	143.9	143.9
Stand 2	300.1	300.1	300.1	300.1	Stand 2	300.1	300.1	300.1	300.1
Stand 3	82.7	82.7	82.7	82.7	Stand 3	82.7	82.7	82.7	82.7
Stand 4					Stand 4				
Stand 5					Stand 5				
Sum	546.7	546.7	546.7	546.7	Sum	546.7	546.7	546.7	546.7

Fire BFC Average					Fire BFC Average				
Area	Deciduous	Mildew	Canopy	Canopy	Area	Deciduous	Mildew	Canopy	Canopy
Stand 1	143.9	143.9	143.9	143.9	Stand 1	143.9	143.9	143.9	143.9
Stand 2	300.1	300.1	300.1	300.1	Stand 2	300.1	300.1	300.1	300.1
Stand 3	82.7	82.7	82.7	82.7	Stand 3	82.7	82.7	82.7	82.7
Stand 4					Stand 4				
Stand 5					Stand 5				
Sum	546.7	546.7	546.7	546.7	Sum	546.7	546.7	546.7	546.7

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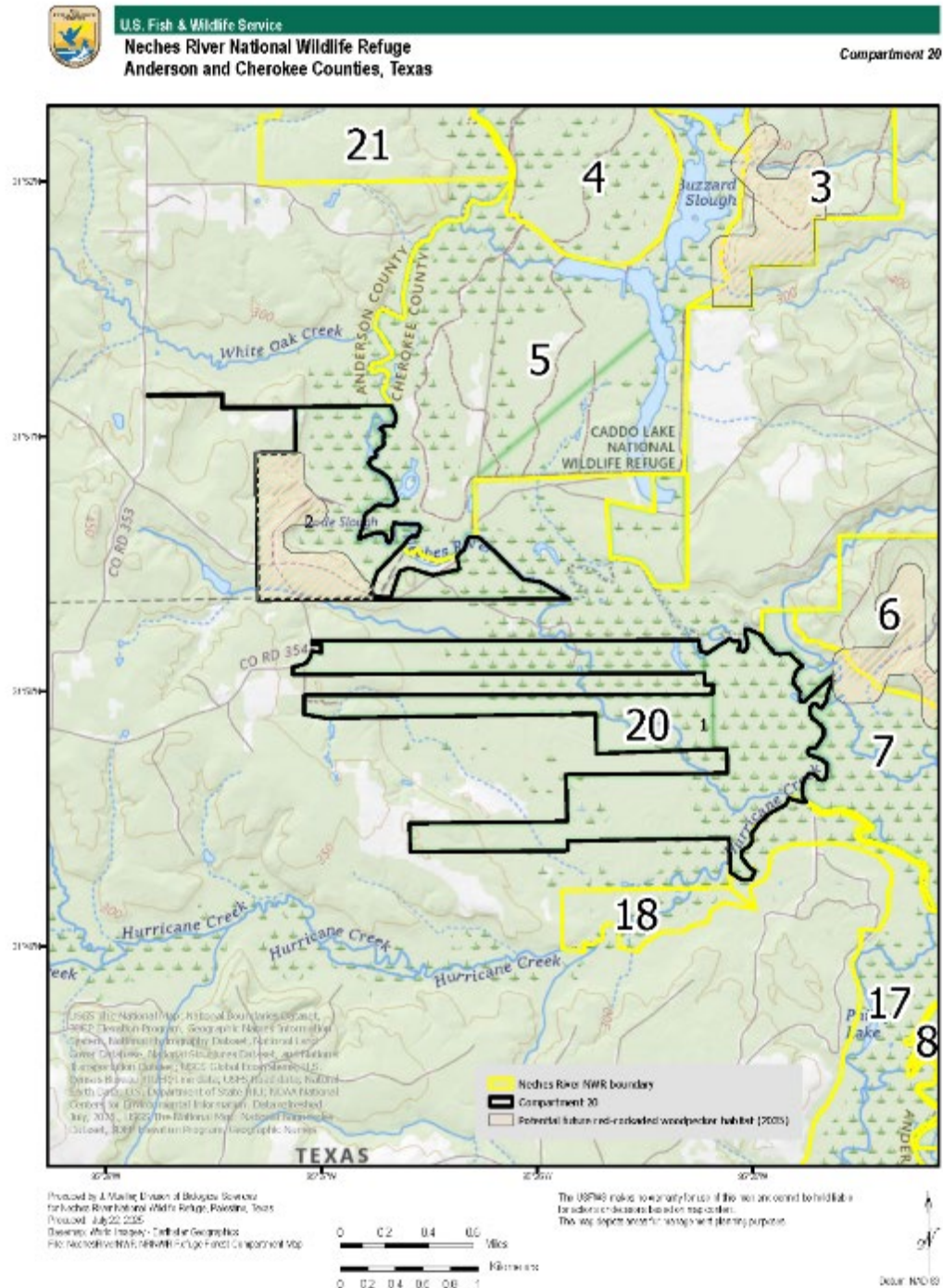


Map 10. Compartment 8 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 14- Summary forest statistics by stand for Compartment 8, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

No data collected.

Neches River National Wildlife Refuge
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Map 11. Compartment 20 on Neches River National Wildlife Refuge, Anderson and Cherokee Counties, Texas.

Table 15. Summary forest statistics by stand for Compartment 20, Neches River National Wildlife Refuge, Anderson and Cherokee counties, Texas.

[illegible]

Timber Cruise Data Collection Instructions
1/5 acre plot radius = 52.79'~ (52.8') using a 10-factor prism

Refuge:	Self explanatory
Crew:	Crew member name
Crown dia.:	Measure the crown diameter (in feet) of a dominant tree nearest plot center
Comp#:	Compartment designation
Stand#:	Self explanatory
Line#:	Identify line number corresponding to lines on map
Plot#:	List plot numbers consecutively corresponding to direction of travel.
SAF Type:	Society of American Foresters stand type
% Density:	Percent of foliage coverage using a densiometer at plot center
Growth:	Measure in tenths of inches the newest 10 years growth.
Age:	Predominant age of stand; list two ages if the stand has two distinctive ages. Age midstory on plots that end in "5". Age overstory on plots that end in "0".
GPS/UTM:	Record casting and northing of plot center
Overstory:	Trees with crowns that are by definition "the overstory" Species: letter designation as provided, write "snag" if tree is dead DBH: inches, to the nearest 2" DBH class Height: Total tree height (in feet), write "cull" if tree is not merchantable. Merchantable height in appropriate product units. Crown class: choose from 5 options on the tally sheet Tree condition: choose from 8 options on the tally sheet Epicormic branch: choose from 3 options on the tally sheet Bark disfiguration: choose from 3 options on the tally sheet % cover: percent of occupied overstory as compared to 100%. 100% being the densest crown closure possible for southern hardwood forests. This is a subjective measurement and is independent of all the other percentage measurements. For Overstory, Midstory and Understory in increments of 10.
Midstory:	Measure trees down to 4.0" DBH and over 10 feet tall. The upper limit for DBH/height will be determined by you deciding if the tree's crown is in the midstory or not.
Understory:	List up to three of the most predominant species between 3 feet and 10 feet in height.
Herbaceous Ground Cover:	Same as for understory except vegetation is less than 3 feet in height.
Reproduction:	Check listed species if present.
Cane percent:	Estimate the percent of the plot covered and density of coverage combined.
Palmetto:	Estimate the percent of the plot covered and density of coverage combined.
Vines:	Choose from 3 options on the tally sheet
Tallow:	List species if not tallow and estimate percent of the plot covered.

Note: If no data is present for a category, put a diagonal slash through the entry box. This allows the end user to know that it was not omitted, i.e., no palmetto put a / in the data entry box.

Appendix C: Conditions Applicable to Timber Harvest Permit

Page 1 of 3

02/04/25

NECHES RIVER NATIONAL WILDLIFE REFUGE
JACKSONVILLE, TEXAS

CONDITIONS APPLICABLE TO TIMBER HARVEST PERMIT: Sale: #

1. Except where specifically authorized by a Special Use permit, all regulations governing activities on national wildlife refuges in general and specific public use regulations for Neches River NWR (including littering, possession and use of firearms, and protection of wildlife) apply.
2. All logging will be within the boundaries specified (see attached map) and coordinated with the Refuge Forester or his designee.
3. Trees shall be cut so as to leave a stump not more than six inches above root collar for sawtimber and six inches high for pulpwood on the side adjacent to the highest ground. Trees are painted at eye level and at the stump; ground level paint spot must be visible after tree has been cut. All marked trees must be cut. In the event any marked trees are not cut by permittee, refuge personnel will have the trees cut and will withhold from the permittee's performance guarantee a sufficient amount to cover the cost incurred.
4. Logging will not be permitted when the ground is wet and subject to rutting or severe soil compaction. The permittee and his employees will do all in their power to prevent rutting and erosion. Permittee will be required to fill any ruts made as a result of his/her operation.
5. Only marked or designated trees shall be cut. Utmost care shall be exercised to protect all other trees and vegetation from damage. **Additional trees marked by refuge personnel for roads or loading sites will be paid for at bid price.** Unmarked trees which are cut or injured through carelessness shall be paid for at **double** the stumpage price bid in the contract.
6. No loading sites will be permitted within 300 feet of public roads. A refuge forester must approve the location of all loading sites and temporary roads.
7. Trees will be limbed and topped where they fall.
8. Trees and tops cut shall not be left hanging or supported by any other living or dead tree or brush. Any tree that becomes lodged when cut shall be immediately rendered unlodged and felled flush to the ground. All treetops and other logging debris will be removed from roads, roadside ditches, trails, firebreaks, fields, streams, and drainages immediately after felling. All treetops felled within a designated zone along any improved road (see attached map) will be topped and scattered to lie within two feet of the ground.
9. Vehicles and other equipment will be operated in a safe manner at all times. Both the refuge personnel and the visiting public also use refuge and public roads.

10. The permittee and his employees will do all in their power to prevent and suppress forest fires. Permittee shall be liable for all fire suppression cost resulting from his/her operations.
11. The Refuge Manager or his/her designee, i.e. Refuge Forester shall have the authority to stop timber harvesting operations anytime justifiable reasons develop.
12. The normal operating season on this sale will be June 1 through November 15. Any operations outside the normal season must be approved in advance by the Refuge Forester. For safety reasons and to minimize conflict, the permittee will cease logging operations during refuge deer muzzleloader and gun hunting seasons.
13. A pre-entry conference between the Refuge Forester (or designee) and the Permittee (successors or assigns) and logging contractor representative will be required before beginning logging operations to insure understanding of the permit conditions and thus avoid serious conflicts.
14. Doyle scale is used to estimate all hardwood sawtimber and pine sawtimber volumes. Tonnage conversion factors: pine sawtimber 8 tons/MBF Doyle, pine pulpwood 2.6 tons/cord, and hardwood pulpwood 3.0 tons/cord.
15. Maintenance of all roads on Neches River NWR used in the logging operation will be the responsibility of the permittee. To access the sale you will have to traverse miles of gravel roads and refurbish miles of wood roads. These roads must be maintained to pre-harvest condition.

General constraints and specifications for haul route improvement are as follows:

Use old travel ways as much as possible to minimize stump and rootwad removal and refilling.

Maintain a maximum 20-foot-wide roadbed.

Crown the road to 6 inches by pulling shallow "V" ditches where necessary.

Place "B" stone in drainages to facilitate crossing but at a level that will not impede water flow.

Place pit-run gravel as necessary to firm up the roadbed and in conjunction with culvert placement.

If necessary, disc and grade to fill in ruts after completion of the sale or by November 15 of each year - whichever comes first.

Grade all access roads as necessary to maintain a reasonably smooth road surface.

19. Should previously unrecorded cultural resources or human remains be discovered on Service land, construction or harvest activities will be halted immediately at that location.

The Regional Archaeologist and the Refuge Manager are to be contacted at once.

20. The permittee shall protect all known and identified archeological sites against disturbance, destruction, or damage during harvesting operations. If, during the course of the harvest activity, the permittee notices illegal excavation or archaeological resource removal activities; this information shall be immediately provided to the Refuge Manager.
21. If, during the harvest activity, the permittee deliberately damages a recorded site, the permittee will be responsible for the resultant site damage assessment and mitigation.

Appendix D: Formal Bid Invitation

NATIONAL WILDLIFE REFUGE TIMBER SALE FORMAL BID INVITATION

Sale Number NR-X-YR
Product Multiple

Compartment

Formal sealed bids will be received in the office of Neches River National Wildlife Refuge (NWR), Jacksonville, Texas, until 1:00 P.M. Month/Day/Year for the sale of quality loblolly and shortleaf pine sawtimber, pine pulpwood and hardwood pulpwood contained in marked trees in Compartment X Of the Neches River NWR, Texas, located in Anderson County, OK., east of Palestine, Texas. The compartment is south of Road, north and south of the pipeline, east of Creek and north of the River. All bids must be securely sealed in a suitable envelope and plainly marked "Timber Bid, NR-X-YR-C, ?" on the outside of the envelope.

The sale material is located on approximately acres. This material consists of quality loblolly and shortleaf pine sawtimber, pine pulpwood and hardwood pulpwood marked at eye level and at the stump with blue paint. Only a portion of the sale area is presently marked. The remaining area will be marked as the timber harvest progresses to avoid as much remarking as possible due to high water obliteration of paint marks on the trees. Volume estimated to be removed is approximately board feet of pine sawtimber, cords of pine pulpwood and cords of hardwood pulpwood. No volumes are guaranteed. The bidder is responsible for determining volumes from which to base his/her bid.

A show me trip will be conducted by staff on . The staff and potential bidders will meet at at A.M. and then travel to the sale. The sale location is shown on the attached map. Additional information may be obtained at the Refuge Office. An ATV can be used to examine the sale area after receiving permission from the Neches River NWR office (903-679-9144).

Operations must be completed in the most expeditious time frame possible. The sale will expire on Month, Date, Year.

Each bidder will submit with his/her bid, a bid guarantee in the amount of \$500.00 payable to the U.S. FISH AND WILDLIFE SERVICE IN THE FORM OF A DRAFT OR CERTIFIED CHECK. The deposits of the unsuccessful bidders will be returned after a determination has been made regarding the bidder who will be awarded the permit.

The bid guarantee of the successful bidder will be retained by the Government and applied to the PERFORMANCE GUARANTEE which will be calculated at ten percent (10%) of the total value of the sale based on the estimated volume as shown in the bid invitation and the per unit bid of the successful bidder to cover any damages or claims the Government may have against the permittee as a result of this operation under the terms and conditions of the permit-agreement.

Payment of the performance guarantee will be in the form of a BANK DRAFT, CERTIFIED CHECK, or IRREVOCABLE LETTER OF CREDIT due within ten (10) days of purchaser's receipt of the timber sale permit. Upon satisfactory completion of the timber operation, the performance guarantee will be returned.

TIMBER MUST BE PAID FOR IN ADVANCE OF CUTTING. The successful permittee shall remit a bank draft or certified check for initial advance payment payable to the U.S. Fish and

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Wildlife Service. The above advanced payment will be determined by the value of the timber that the successful bidder can harvest in a two-week period. (If the performance guarantee is of sufficient amount, a portion of that amount may be delineated as the initial advanced payment.) Timber will be paid for every two weeks by bank draft or company check. The value of the timber will be based on actual scale tickets provided with the payment. Weather and logging conditions permitting, START HARVEST OPERATIONS WITHIN THIRTY (30) DAYS of the bid opening.

A copy of applicable special harvesting conditions and map is attached to this bid invitation.

A sample copy of the permit agreement is available from the refuge manager at the above address. The right to reject any or all bids hereunder is reserved.

Item 1: Pine Sawtimber \$ _____ per ton.
Item 2: Pine Pulpwood \$ _____ per ton.
Item 3: Hardwood Pulpwood \$ _____ per ton.
Lump Sum Total for sale \$ _____
For sale number NR-X-YR; C.?

Name of Bidder (Company)
(PRINT)

Submitted by

Address
Signature

City, State, Zip

Date

for Refuge use below line

Accepted by

Date

Witnessed by

Date