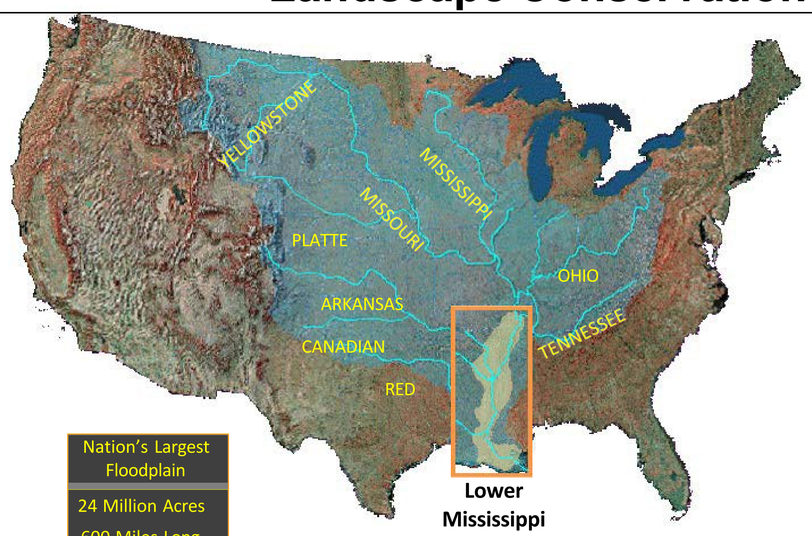
U.S. Fish & Wildlife Service

Lower Mississippi Alluvial Valley Landscape Conservation

Landscape Level Overview

Map Sheet 1 of 5



Vulnerability and Resiliency

Anthropogenic climate change, a result of elevation of atmospheric carbon dioxide levels from fossil fuel consumption and widespread deforestation, and the release of other "greenhouse gases" such as methane from various sources, must be considered in the context of conservation design. Numerous well-designed studies have implicated human activities in elevation of greenhouse gases and other known causes of global climate change (CCSP, 2009). Recent observed changes including elevated mean temperatures, shifts in precipitation patterns, and sea level rise could be indicators that negative impacts to habitat could worsen (IPCC, 2007).

Within the LMAV geography, mean temperatures are predicted to increase by 5-7.5° F by 2080 (the more extreme changes would occur inland). Annual precipitation totals may not change much (though seasonal shifts are predicted) within the footprint of the LMAV geography, but within the watershed of the Mississippi River, climate models generally predict a 10-25% increase in total precipitation (Girvetz et al., 2009; Girvetz et al., 2013).

Connected habitat is more resilient to the effects of climate change because intact connections allow organisms to migrate as conditions change. It is known that stressors such as land-use changes, habitat loss and degradation, urbanization, invasive species, and contaminants will exacerbate the effects of climate change. By protecting, restoring, and connecting large blocks of forest, which may provide for emigration corridors and refugia for displaced species, the negative outcomes of climate change in the Lower Mississippi Alluvial Valley may be somewhat offset.

Freshwater conservation is an integral part of conservation in the Lower Mississippi Valley. All of the projects described below have significant freshwater components. Conserving aquatic habitat and the lands that surround it will contribute to freshwater conservation by continuing to promote natural or semi-natural flow regimes on large blocks of forested wetlands and by reducing sediment and agricultural chemical inputs by restoring riparian areas to forest. Reducing sediment and agricultural runoff in the Mississippi River watershed will help mitigate the 6,700-sq. mi. hypoxia ("dead") zone which forms in the Gulf of Mexico each summer.

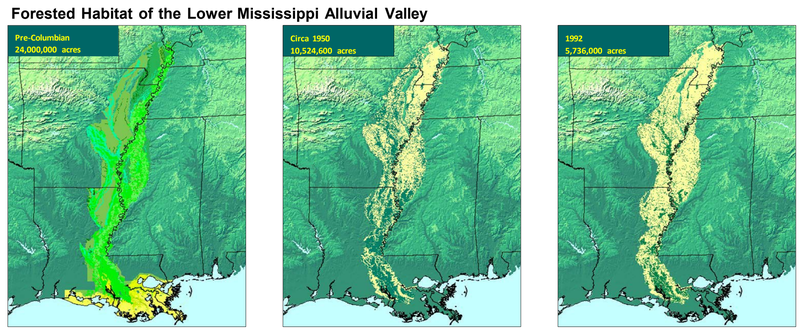
The Lower Mississippi Alluvial Valley

The Lower Mississippi Alluvial Valley (LMAV), which stretches from the confluence of the Ohio and Mississippi Rivers to the Gulf of Mexico, once supported 24 million acres of floodplain forest, swamps, sloughs, and riverine habitat. However, this region's fertile soils have proven to be its undoing; it now has the distinction of being the Southeast's most deforested region. More than 75% of its forest has been lost since European settlement, mostly to agriculture, but increasingly, to urban sprawl. Timber resources were exploited beginning in the late 19th Century and through the first half of the 20th Century with little thought of sustainable product flow or conservation. Conversion of timberlands to agriculture accelerated during the 1960s and 1970s in response to marked increases in crop prices, which were the result of changes in U.S. government export policy and global demand. Today, of the original 24 million acres of bottomland hardwood forest in the LMAV, only about five million remain.

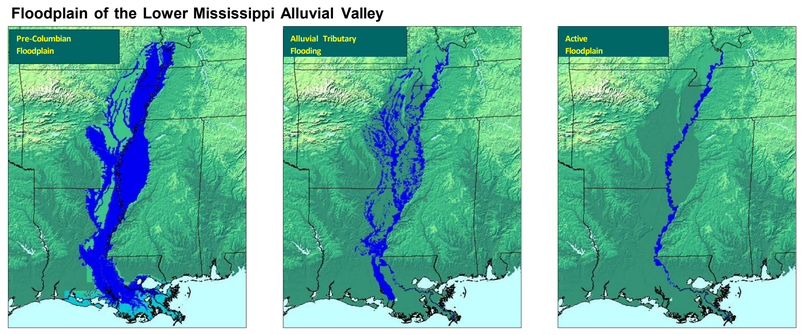
Legal Provisions That Stopped This Trend

In response to these alarming rates of deforestation and land use changes, the 1985 Farm Bill Swampbuster Provision was passed, and the pace of wetland draining and land use conversion began to slow. Then, in 1990, Congress authorized the Wetland Reserve Program, which encourages reforestation on cultivated wetland areas. As a result of these and other conservation programs, forest restoration has begun in the LMAV and the land-clearing push of the 1970s is being slowly reversed as wetlands, waterways, fields, and forests are reclaimed through the actions of private conservation organizations and public agencies.

Forested Habitat of the Lower Mississippi Alluvial Valley



Floodplain of the Lower Mississippi Alluvial Valley



US Fish and Wildlife Service Priorities in LMAV Landscape

The Service has identified three overarching aims of its land protection and restoration efforts: recovery of threatened and endangered species, implementation of the North American Waterfowl Management Plan, and conserving migratory birds in decline. The LMAV geography, including associated uplands, is critically important to all three of these objectives and the species they represent; over 40% of the waterfowl which breed in North America use the LMAV as migration stopover, wintering, or breeding habitat. At least 107 species of landbirds breed in the LMAV geography; 70 of those depend upon bottomland hardwood forests for most or all of their life cycle needs. Threatened and endangered species depend as well on these valuable habitats: pallid sturgeon, Interior Least Tern, and others.

Implementing the North American Waterfowl Management Plan

Habitat protection and management for wintering waterfowl is a priority for all of the refuges in the LMAV geography. Step-down objectives for habitat acreage and food (Duck Energy Days (DEDs)) have been provided by the Lower Mississippi Valley Joint Venture (LMVJV).

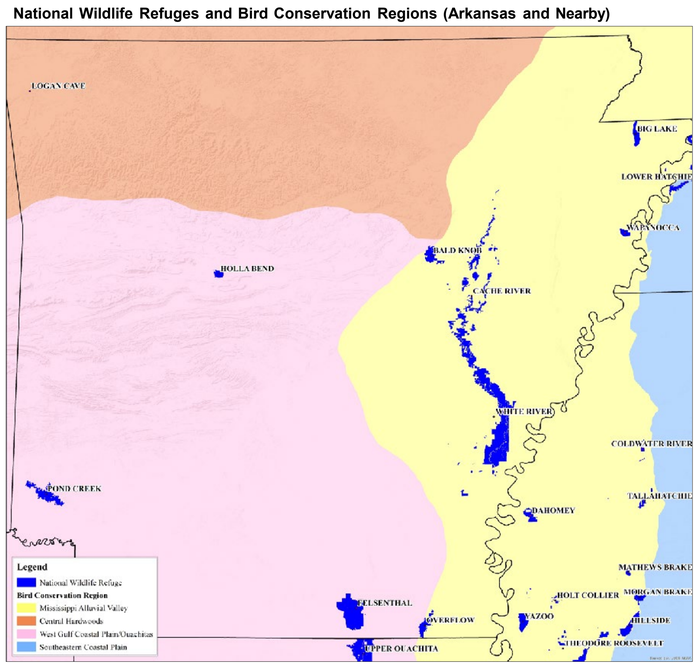
MAV

Federal	Maintenance Goal	Aspirational Goal
Arkansas	≥ 33.3 million	40.0 million
Mississippi	≥ 23.6 million	0.9 million

WGCPO

All Public Land	Maintenance	Aspirational
Arkansas	13,981,489	4,347,793

National Wildlife Refuges and Bird Conservation Regions (Arkansas and Nearby)

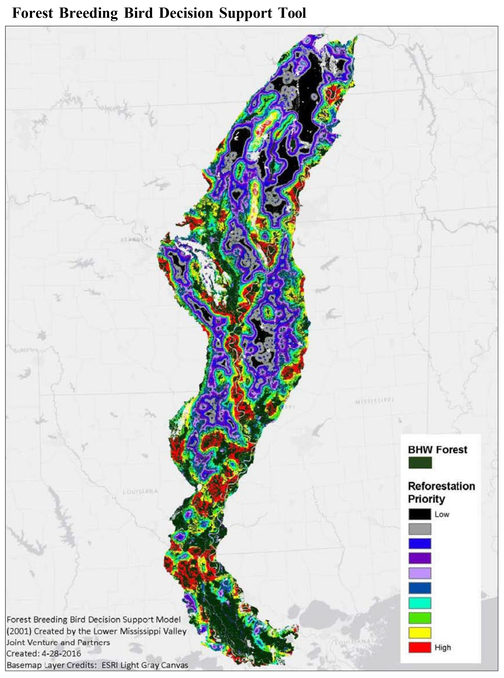


Conserving Migratory Birds in Decline

The LMAV geography is among the most important regions in North America for migratory birds. Restoration, protection, and management of the lands would contribute towards goals identified in the **Partners in Flight Bird Conservation Plan** for the Mississippi Alluvial Valley (Twedt et al., 1999). This plan identified 87 high priority Bird Conservation Areas for forest protection and restoration containing 101 habitat blocks which could be restored to minimum sizes of 10,000, 20,000, or 100,000 acres to accommodate the range of area-sensitive breeding migratory birds found in the region. A more recent, data-driven modeling effort to identify high priority areas for reforestation in the LMAV identified most of the same areas, and produced the Forest Breeding Bird model (Twedt et al., 2006).

Like landbirds, shorebirds have declined significantly in North America, including the LMAV. Much of the population declines have been driven by habitat loss and degradation. Within the LMAV, the impact has been most severe on migration and non-breeding habitats such as sandbars, mudflats, and shallow-flooded lands (Elliott & McKnight, 2000). Continued habitat enhancement and restoration practices by the Service and its partners will provide opportunities to conserve vital habitat for this group of migratory birds.

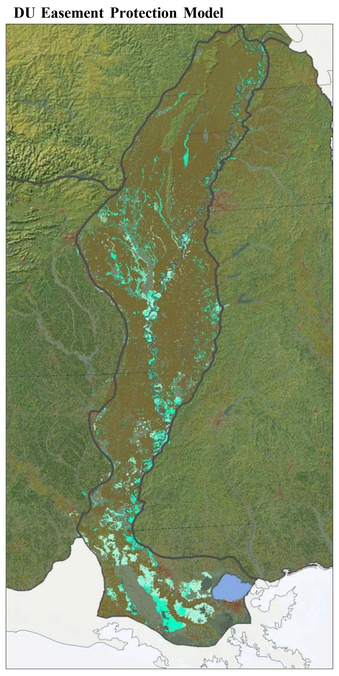
Forest Breeding Bird Decision Support Tool



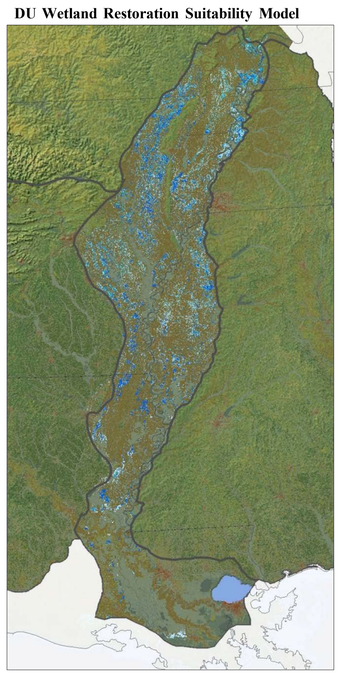
Prioritizing Areas in LMAV for Restoration, Protection, and Management

The *Forest Breeding Bird model* emphasizes increasing the size and number of existing forest core areas, and therefore the priority areas in that model tend to be located adjacent to large areas of forested habitat. While this model was devised to benefit interior-breeding (area-dependent) forest birds, it also identifies high priority restoration lands for the benefit of species such as Louisiana black bear. The Ducks Unlimited *Wetland Restoration Suitability Model* is primarily based on hydrology (flooding probability, soil hydricity, topography, riparian zones), and identifies low and wet places on the landscape where wetlands could most easily be restored. This model focuses on areas that have been cleared since 1972. It was developed as a response to the general deficiency of suitable habitat for wintering waterfowl within the LMAV geography which was highlighted by the identification of statewide and step-down goals for DEDs and acreage developed by the LMVJV. Ducks Unlimited's other model, *the Easement Protection Priority Model*, like the Forest Breeding Bird model, is focused on increasing the size of protected areas, and therefore identifies high priority areas that are in natural vegetation and would enlarge existing protected areas.

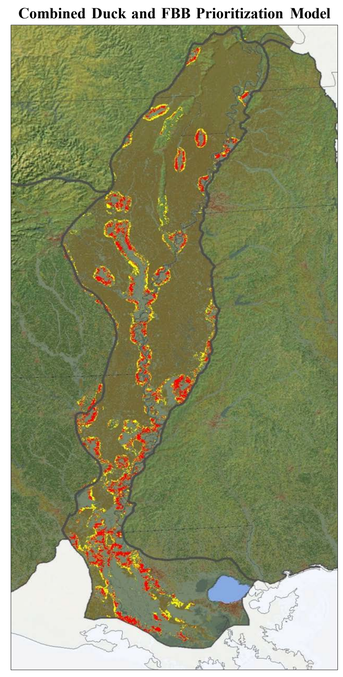
DU Easement Protection Model



DU Wetland Restoration Suitability Model



Combined Duck and FBB Prioritization Model

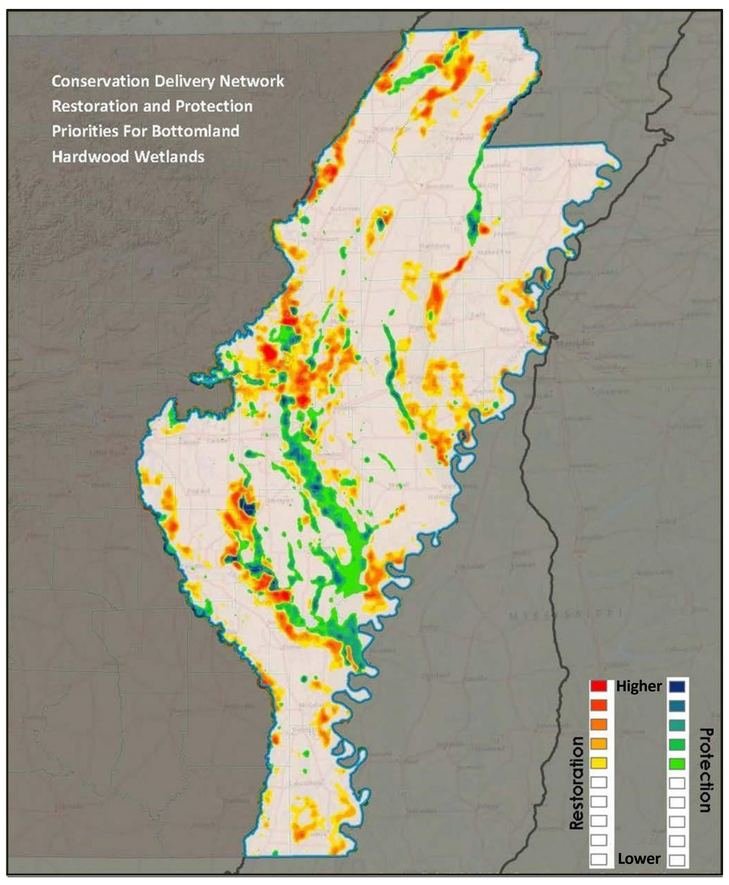


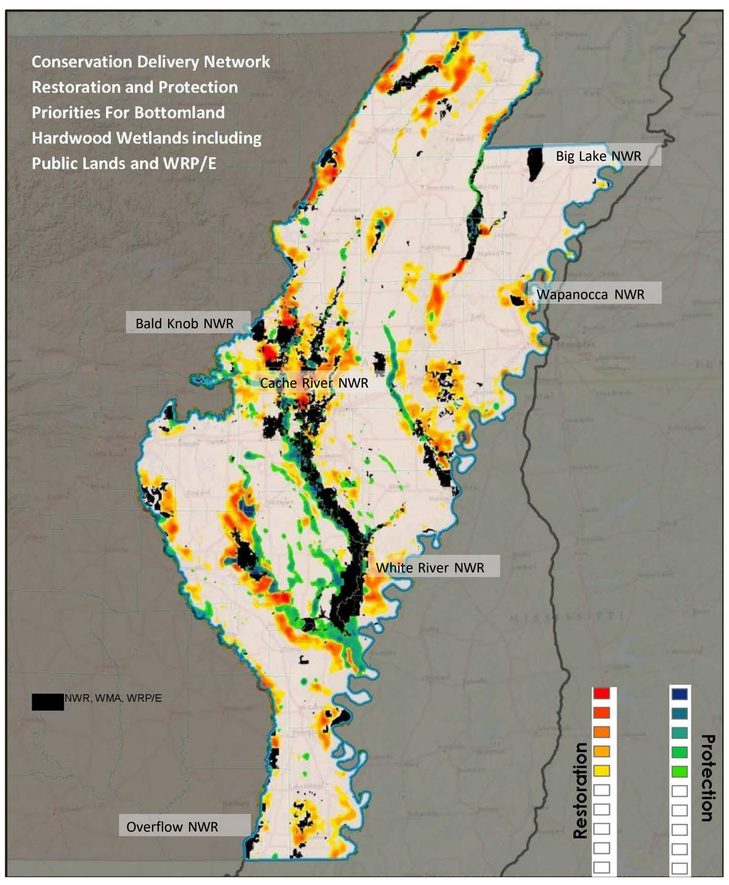
Comprehensive Prioritization for Restoration, Protection, and Management

Partner-based organizations operating in Louisiana, Mississippi, and Arkansas called Conservation Delivery Networks (CDN) have taken the outputs from these three models and combined them into project prioritization tools. These tools integrate the science into a comprehensive prioritization of conservation areas in those three states.

By combining the output from this CDN tool and practical considerations such as proximity of existing refuges and threat levels, we identified the Service's highest priority areas for restoration, protection, and management in the LMAV geography.

The LMVJV has also published Desired Forest Conditions and management guidelines for bottomland hardwood forests to optimize habitat for breeding birds, Louisiana black bear, and other priority species (LMVJV Forest Resource Conservation Working Group, 2007). Protection and restoration of bottomland hardwood forests must be followed by proper management to realize the full value of the habitats.





U.S. Fish & Wildlife Service

Overflow National Wildlife Refuge

Ashley County, Arkansas

Refuge Overview

Map Sheet 2 of 5

Establishing Authorities and Purposes

Overflow NWR is located in Ashley County, Arkansas, 5 miles west of Wilmot, Arkansas . There is no direct highway access to the refuge, except by Highway 173. From Highway 165 take Highway 173W, to the parking lot at the end of pavement.

The purpose and establishing authorities of Overflow NWR are: 16 U.S.C. 715d (Migratory Bird Conservation Act)"for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

16 U.S.C. 460k-1 "suitable for incidental fish and wildlife oriented recreational development; the protection of natural resources; and the conservation of endangered species or threatened species"

16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended) "the Secretary …may accept and use…real…property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors"

16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act) "conservation, management, and …restoration of the fish, wildlife, and plant resources and their habitats…for the benefit of present and future generations of Americans"

Vision

The South Arkansas National Wildlife Refuge Complex provides a diversity of habitats for wintering waterfowl, migratory birds, threatened and endangered species, and resident wildlife, and provides enhanced wildlife-dependent public use opportunities. The Complex protects, manages, and restores an intricate system of rivers, creeks, sloughs, buttonbush swamps, and lakes throughout a vast bottomland hardwood forest that gradually rises to an upland forest community.

The Complex will continue to serve the American people by continuing opportunities for compatible, wildlife-dependent recreation such as hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. In addition, the Complex will seek partnerships that promote environmental stewardship, foster research opportunities to enhance resource management and restoration efforts, and protect historical and cultural resources of the Complex.

Special Designations

- Overflow NWR was designated as an "Important Bird Area" by Audubon Arkansas.

Soil Types

Where the bottomland hardwoods have not been cleared, the primary soil type is Perry Clay, a hydric soil, highly impervious to water percolation. There are inclusions of silty clays on the higher elevations such as Portland Clay and as elevation increases. Perry and Portland soils are poorly drained soils. They are found in level, clayey and loamy soils on bottom lands. Perry soils have clay surface texture, and Portland soils have silt loam or silty clay loam surface texture. Hebert silt clay is also prominent. On the highest elevations, Rilla sandy loam is the dominant soil type. Herbert and Rilla soils are somewhat poorly drained and well drained soils, respectively. They are found in level to undulating, loamy soils on bottom lands. The Perry and Portland soil series are both in the Inceptisols order, Aquepts suborder, and Epiaquepts great group. The Rilla soil series is in the Alfisols order, Udalfs suborder, and Hapludalfs great group. The Herbert soil series is in the Alfisols order, the Adalfs suborder, and the Ochraqualfs great group (Figure 5).

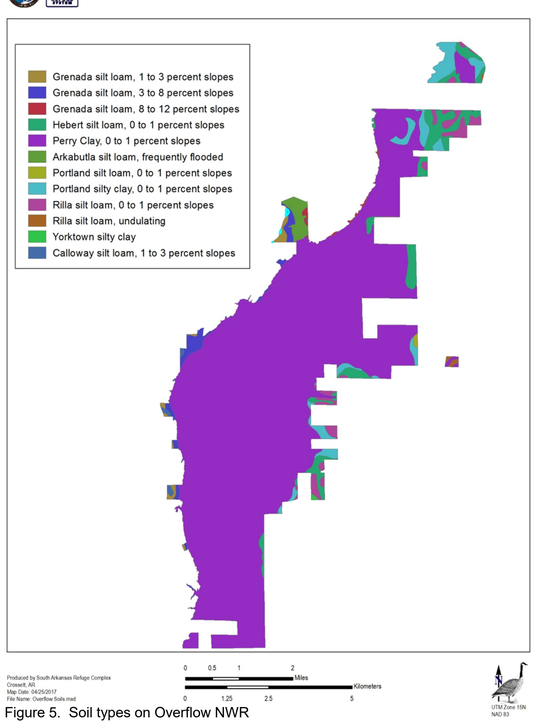


Figure 5. Soil types on Overflow NWR

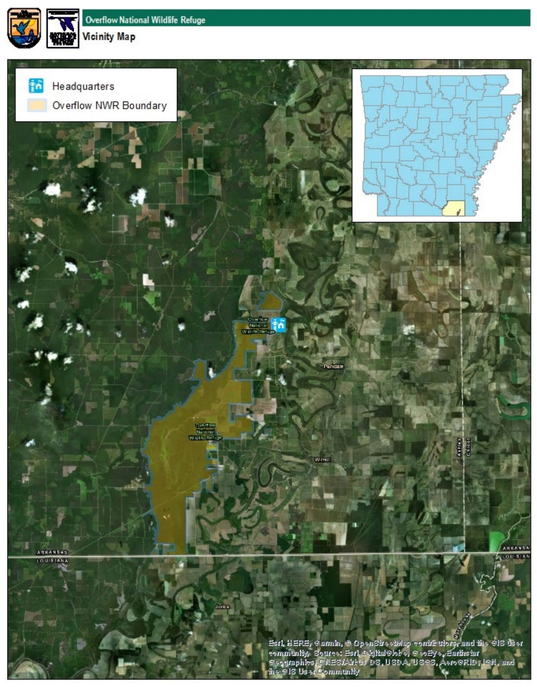


Figure 1. Vicinity map of Overflow NWR

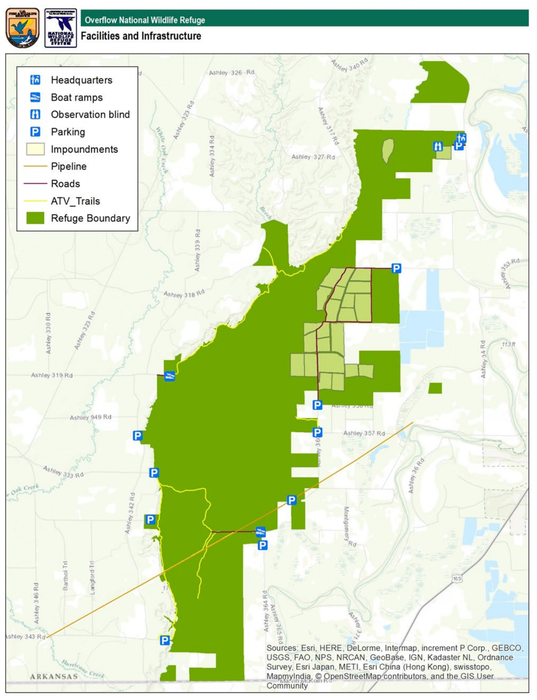


Figure 2. Facilities and infrastructure on Overflow NWR

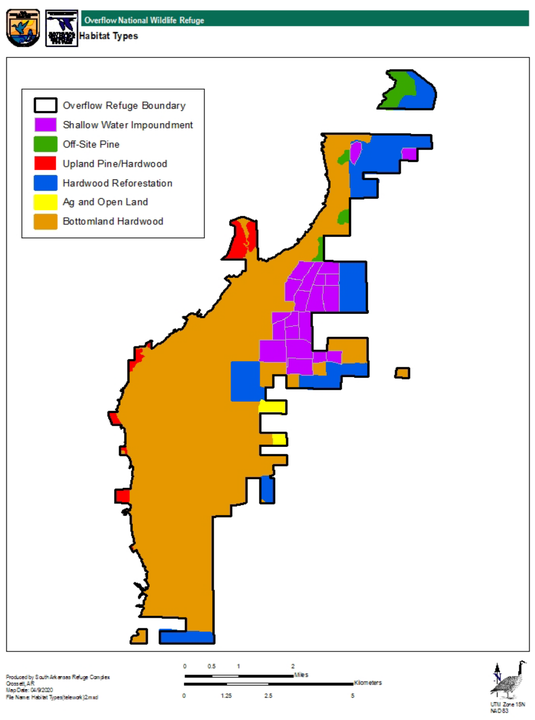


Figure 3. Habitat types on Overflow NWR

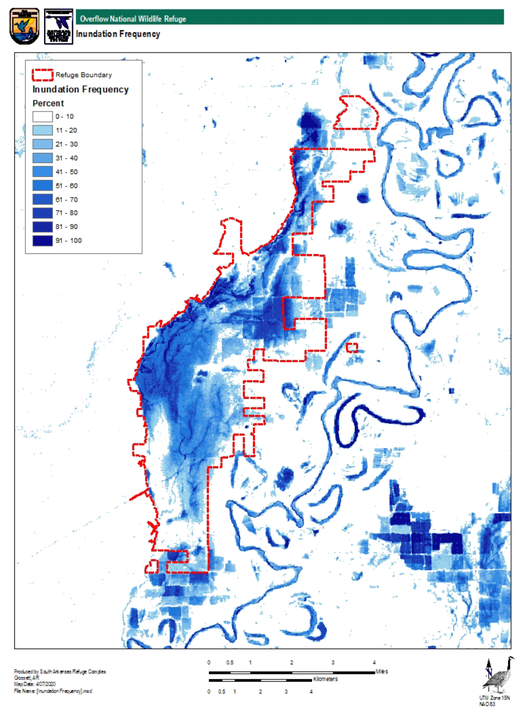


Figure 4. Inundation frequency (percent of time inundated) on Overflow NWR

Habitat Types

Habitat/land use types represented on Overflow NWR are as follows (update numbers based on 2020):

Overflow NWR habitat types and their acreages

Habitat Types	Acres
Shallow Water Impoundments	1,244
Off-Site Pine	230
Upland Pine/Hardwood	312
Hardwood Reforestation	1,820
Ag and Open Land	148
Bottomland Hardwood	9,804
Administrative	21
TOTAL	**13,579**

Hydrology

The Ouachita River basin which drains Overflow NWRs is part of the dynamic Surficial Aquifer and the Mississippi Embayment Aquifer hydrological system that includes interactions between aquifers, streams, reservoirs and wetlands. Overflow NWR lies within the Lower Ouachita River watershed. Located in the southern portion of the Mississippi Alluvial Valley, Overflow Creek and Bayou Bartholomew are the primary sources of freshwater for Overflow NWR. Overflow Creek provides the principal drainage to Overflow NWR. It runs the length of the refuge from north to south and ultimately to its confluence with Bayou Bartholomew, a short distance below the Louisiana state line. The Overflow Creek watershed encompasses approximately 98 square miles. Beech Creek on the north end, Hill Slough on the south end, and Billotis Slough, Flat Slough, Oxbone Slough, and Gaines Slough on the east side are the major tributaries of Overflow Creek within the refuge. Besides Overflow Creek, a major source of water flowing into the refuge comes from Flat Slough Ditch. This ditch was dug in the 1960s to provide agricultural drainage.

Geomorphology

The landforms in the Mississippi Alluvial Plan area of the refuge are level or depressional to very gently undulating alluvial plains, backswamps, oxbows, natural levees, and terraces. River terraces, swales, and levees provide limited relief. Nearly flat, clayey, poorly drained soils are widespread and characteristic. Streams and rivers have very low gradients and fine-grained substrates. Many reaches have ill-defined stream channels. Landform shapes range from convex on natural levees and undulating terraces to concave in oxbows. Landform shapes differentiate water-shedding positions from water-receiving positions, both of which affect soil formation and hydrology. Elevations generally vary from 90 to 110 feet above mean sea level. In the hilly areas near Beech Creek, elevations up to 150 feet are common. Maximum local relief is about 10 feet, but relief is considerably lower (slopes less than 1 percent) in most of the area east of the West Gulf Coastal Plain escarpment.

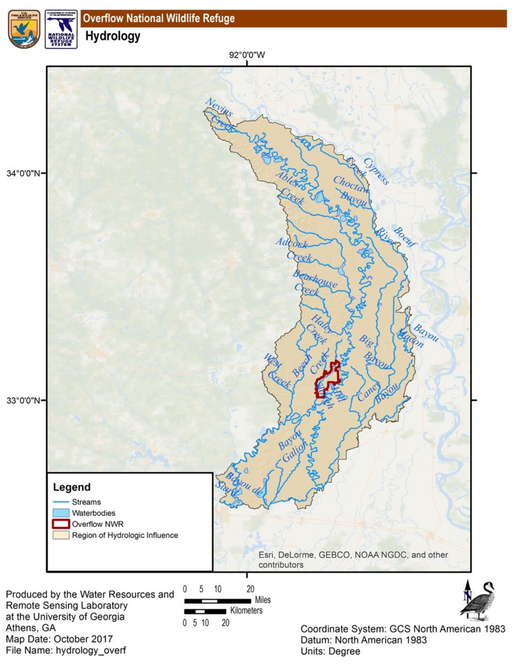


Figure 6. Drainages within the watershed of Overflow NWR

U.S. Fish & Wildlife Service

Overflow National Wildlife Refuge

Ashley County, Arkansas

GTR Water Management

Map Sheet 3 of 5

Water Management Strategies

Manage the 4,000-acre green-tree reservoir (GTR) on a three-year cycle. In year one, attempt to raise the water level beginning December 15 to maximum pool and initiate a drawdown January 15, slowly dewatering the pool by the end of January. In year two, attempt to maintain half of the pool level between December 15 and January 15, slowly dewatering the pool by the end of January. On year three no water will be artificially impounded within the GTR.

The GTR impounds water with a large concrete structure on Overflow Creek with four openings where stop-logs are utilized for management of the GTR. The openings are 6 feet wide x 9 feet deep. Before water reaches the top of the structure it begins to flow around the end of the levee. This relief prevents any levee washouts. The levee is 1-mile-long with two concrete overflow spillways.

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Management Strategies - Invasive/Nuisance Plant and Animal Control in all Units

Determine the need for site-specific control, based on the potential to negatively affect wildlife and habitat management objectives on the refuge.

- Control or contain large established infestations
- Prevent introduction of potential invaders
- Eradicate new or small infestations
- Prior to the initiation of invasive species control efforts, refuge staff must understand the biology of the species to be controlled.
- Early Detection and Rapid Response
- Prioritize Invasive Plant Control Efforts
- Mechanical Control.
- Chemical Control
- Biological Control
- Prescribed Fire
- Use a multifaceted approach and approved current technologies to remove feral swine through staff and/or contractors

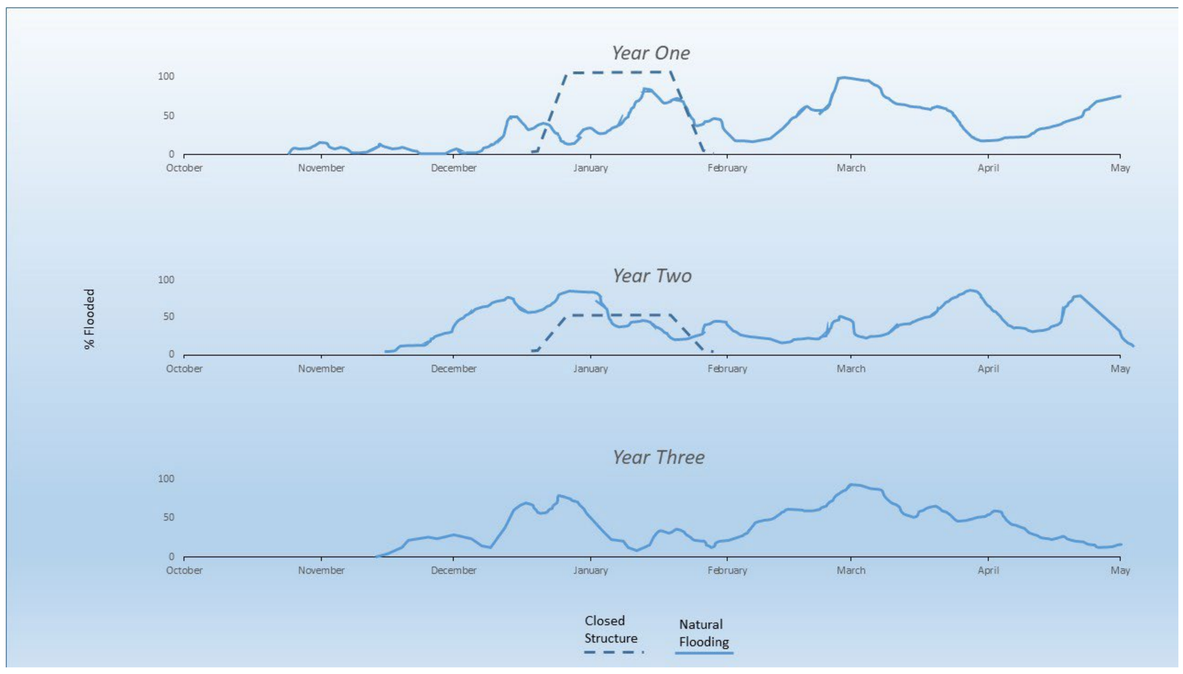

Figure 7. Hypothetical diagram illustrating natural flooding and managed flooding over a three-year period. GTR structure will be closed two years of a three-year cycle, attempting to maintain full pool in year one and half pool in year two.

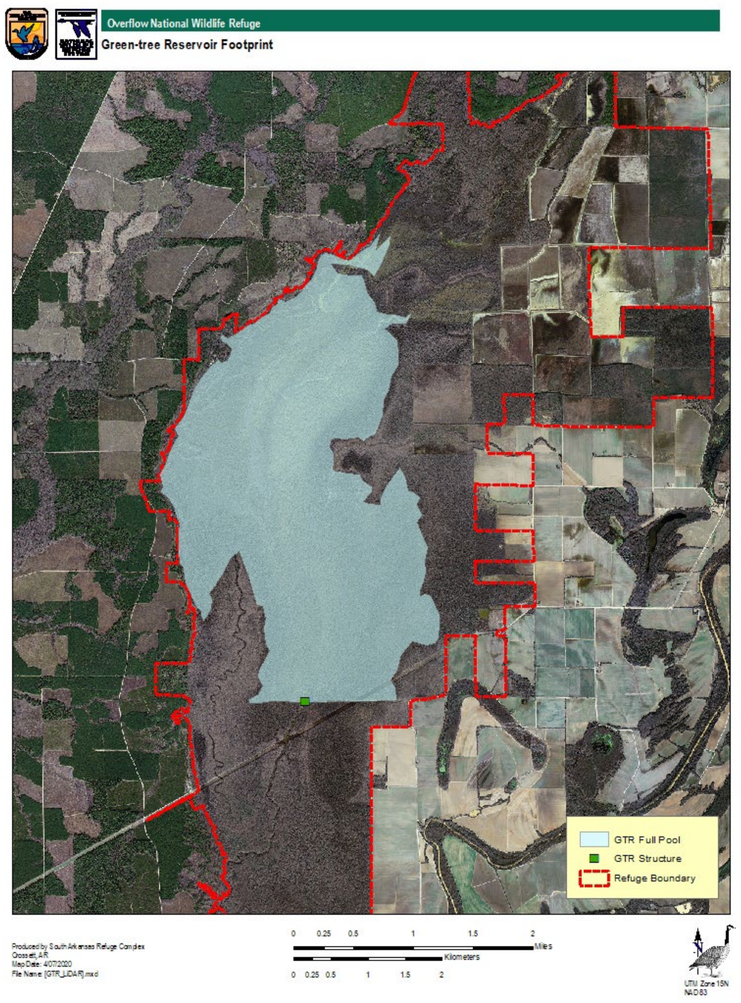

Figure 8. Extent of area flooded by the GTR structure on Overflow NWR

Table 1. Resources of concern, management objectives, response variables, and assessment methods for three evaluated Alternatives.

Overflow NWR HMP Objective Habitat Type	**Greentree Reservoir HMP Objective (*Modifies CCP Objective 2-2*).**
Resource of Concern	Migratory and Resident Waterfowl and Forest Breeding Birds
Overflow NWR CCP Goal 2:	Protect, maintain, enhance, and where appropriate, restore suitable habitat for the conservation and management of migratory birds, resident wildlife, fish, and native plants, including all federal and state threatened and endangered species endemic to the Complex.
HMP Management Objective (See Figure Above)	Manage the 4,000-acre green-tree reservoir (GTR) on a three-year cycle. In year one, attempt to raise the water level beginning December 15 to maximum pool and initiate a drawdown January 15, slowly dewatering the pool by the end of January. In year two, attempt to maintain half of the pool level between December 15 and January 15, slowly dewatering the pool by the end of January. On year three no water will be artificially impounded within the GTR. The 3-year cycle will be implemented for the 15-year term of this HMP, providing flexibility for research to inform management decisions based on a strategic adaptive management decision making process.
Primary Habitat and Wildlife Response Variables	• Forest Composition, structure, and regeneration • Forest habitat components (snags, coarse woody debris, cavities) • Forest stand distribution • Forest breeding birds (species composition and abundance) • Wintering waterfowl use • % Herbaceous Cover • Waterfowl use, composition, and abundance
Probable Assessment Methods	• Forest Inventory sampling (traditional cruise parameter and habitat components) • GIS stand mapping and harvest records • Regeneration plots • Breeding landbird surveys (point counts) • Waterfowl counts (bi-weekly Nov-Feb) • Hydrology (ground water, flow, and water level) monitoring

U.S. Fish & Wildlife Service

Overflow National Wildlife Refuge

Ashley County, Arkansas

Forest Management

Map Sheet 4 of 5

Forest Management Potential and Selected Strategies to address Forest Habitat HMP Objectives

- ***Delineate Manageable Compartments and Stands***
- ***Inventory and determine stand baseline data***
- ***Analyze data and determine stand-specific strategies***

Commercial Timber Harvest Strategies

Intermediate Treatments
- Crown Thinning (thinning of dominants and co-dominants)
- Low Thinning (thinning of suppressed and intermediates)
- Free Thinning (combination of crown and low)
- Variable Density Thinning (varied target residual stocking)
- Thinning by Rules (BA, diameter, species, spatial, etc.)
- Salvage/Sanitation Cutting

Regenreration Harvest Methods

a.) unevenaged
- Individual Tree Selection
- Group Selection
- Patch Selection
- Femelschlag (expanding gaps)

b.) evenaged
- Shelterwood
- Seed Tree
- Clear-cuts (all variations)

Non-commercial Forest Stand Improvement Strategies
- Pre-commercial Thinning
- Wildlife Stand Improvement
- Salvage/Sanitation Cutting
- Prescribed Fire
- Hydrological restoration
- Mulching

Mechanical Management (Site Prep and within Stand Manipulations)
- Disking
- Mowing
- Girdling
- Mulching
- Ripping/Subsoiling
- Hydrological Restoration

Chemical Management (Site Prep, Treatment of Invasives, and within Stand Manipulation)
- Pre-emergent
- Hack and squirt
- Stem injection
- Cut stump
- Basal spray
- Streamline
- Foliar spray
- Fogging

Stand Regeneration Strategies
- Site Prep for Natural Regeneration
- Planting seedlings or cuttings
- Underplanting Existing Forest Stands
- Direct seeding
- Coppice

Utilize State Best Management Practices when Conducting Forestry Operations
Monitor Future Vegetation Community Trends

(Note: for general definitions of treatment and strategy terms used in this section see e.g., Smith (1962)

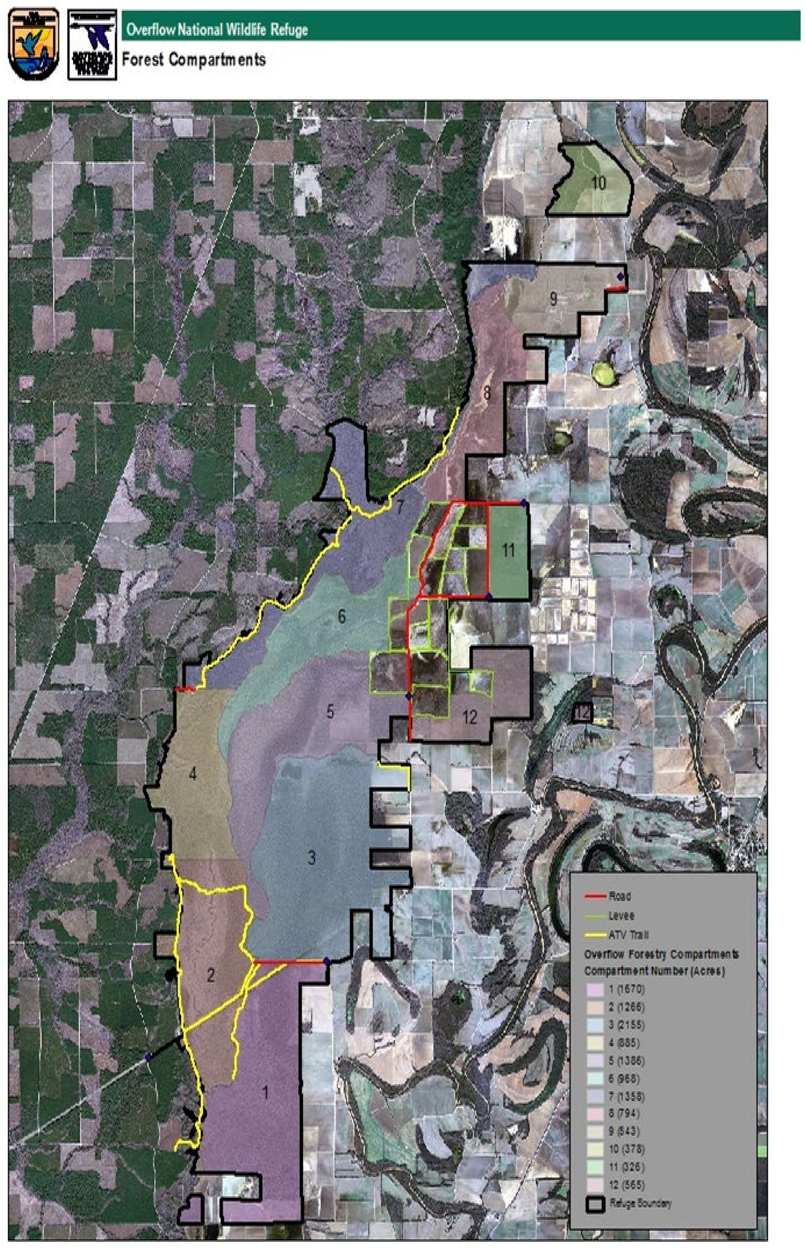

Figure 9. Forest management compartments on Overflow NWR.

Forest variables	Desired stand structure	Conditions that may warrant management
Primary Management Factors		
Overstory canopy cover	60 – 70 %	>80%
Midstory cover	25 – 40 %	<20% or >50%
Basal area	60 – 70 ft^2 / acre with ≥25% in older age classes^2	>90ft² / acre or ≥60% in older age classes
Tree stocking	60 – 70 %	<50% or >90%
Secondary Management Factors		
Dominant trees	>2 / acre	<1 / acre
Understory cover	25 – 40%	<20%
Regeneration	30 – 40% of area	<20% of area
Coarse woody debris (>10 inch diameter)	≥200 ft³ / acres	<100ft³ / acre
Small cavities (<10 inch diameter)	>4 visible holes / acre **or** >4 snag stems ≥4 inch dbh **or** ≥2 stems >20 inch dbh	<2 visible holes / acre **or** <2 snags ≥4 inch dbh **or** <1 stem ≥20 inch dbh
Den trees/large cavities (>10 inch diameter)	1 visible hole / 10 acres **or** ≥2 stems ≥26 inch dbh (≥8 ft² BA ≥26 inch dbh)	0 visible holes / 10 acres **or** <1 stem ≥26 inch dbh (<4 ft² BA ≥ 26 inch dbh)
Standing dead and/or stressed trees	>6 stems / acre ≥10 inch dbh **or** ≥2 stems ≥20 inch dbh (>4 ft² BA ≥ 10 inch dbh)	<4 stems ≥10 inch dbh / acre **or** <1 stem ≥20 inch dbh (<2 ft² BA ≥ 10 inch dbh)

Table 2. LMVJV Desired Forest Conditions (USFWS 2007)

Methodology to Prioritizing Forest Habitat Treatments

The first step in determining management priority locations and timing is to conduct an inventory of approximately 9,804 acres of mature forest located on Overflow NWR (ONWR). The forest inventory is used in conjunction with LIDAR data in order to create a forest cover type map. This inventory will collect a subset of the primary management factors listed in table two on this map sheet. This map along with the results of the forest inventory are used to direct the timing and locations for forest management activities by the South Arkansas Refuge Complex Staff. The forested habitat on ONWR may be considered in need of treatment as it has been more than 30 years since any forest management treatments were conducted on ONWR. Hardwood plantation treatments will take into account the age of the plantations as well as a subset of the management factors listed in table two. Treatments of offsite pine stands will target the complete removal of pine and reestablishment of a native hardwood forest. The staff will take additional items into consideration such as available access, location in proximity to other treatments, local forest product markets, other complex priorities etc.

Invasive Plant / Nuisance Animal Control: Potential Strategies

1.) **Plant**

The following strategies will be utilized in Forest Habitat Management and Afforestation to control invasive plant species.

Prior to the initiation of invasive species control efforts, refuge staff must understand the biology of the species to be controlled
- Control or contain large established infestations; eradicate if possible
- Prevent introduction of invasive species
- Eradicate new or small infestations
- Employ early detection and rapid response actions
- Prioritize Invasive Plant Control Efforts
- Monitor results and adjust strategies if warranted
- Potential control methods:
  - a.) Habitat Manipulation/Mechanical Control
  - b.) Chemical Control
  - c.) Biological Control
  - d.) Prescribed Fire (USFWS 2010)

2.) **Animal**
- Employ integrated pest management techniques when a species is having a significant impact on an area resulting in major habitat replacement or damaging rare species.
- Determine the need for site-specific control, based on the potential of the nuisance animals to negatively affect wildlife and habitat management objectives on the refuge.
- Monitor results and adjust strategies if warranted
- Potential control methods:
  - a.) Trapping
  - b.) Shooting
  - c.) Habitat Manipulation/Mechanical Control
  - d.) Chemical Control
  - e.) Biological Control

Water Management

Water management in the growing season is a number one priority for the health of the forest on Overflow NWR. Due to intense beaver activity in combination with spring floods and agricultural irrigation runoff, growing season water has proven to be problematic as it relates to forest health. The health of this forest is dependent on the ability to remove water as much as possible throughout the growing season. Priority should be given to remove beaver dams and improve access routes in order to make dam removal as efficient as possible. A high priority must be placed on beaver removal as well. (see nuisance animal control)

Overflow NWR HMP Objective Habitat Type	**Bottomland Hardwood Forest Management HMP Objective - (clarifying *CCP Objectives 2.1, 2.2, and 2.12, 2.13*).**	**Reforestation HMP Objective - (clarifying *CCP Objectives 2.1, 2-2, 2.12, 2.13*).**	**Upland Hardwood/Pine HMP Objective - (clarifying *CCP Objectives 2.1, 2.2, and 2.12, 2.13*).**
Resource of Concern	Migratory and Resident Waterfowl, Forest Breeding Birds, Bat Species		
Overflow NWR CCP Goal 2:	Protect, maintain, enhance, and where appropriate, restore suitable habitat for the conservation and management of migratory birds, resident wildlife, fish, and native plants, including all federal and state threatened and endangered species endemic to the Complex.		
HMP Management Objective	In Compartments 1-5 and 7-12, manage approximately 8,836 acres of bottomland hardwood forest on Overflow NWR according to the desired forest conditions (LMVJV 2007) (Table 2) to provide a natural diversity of plant and animal species found in the MAV to fulfill the mission and purposes of the refuge. Compartment 6 contains approximately 968 acres where the bottomland hardwood forest will be passively managed.	Approximately 1,820 acres of former marginal cropland has been reforested in portions of Compartments 1, 3, 5, 8, 9, 10, 11, and 12 (Mapsheet Forest Habitat Management, Figure 9) as of 2017. Silvicultural techniques to remove the loblolly pine component will be used to restore site appropriate hardwood species diversity on off-site pine plantations in compartments 8 and 10 (LMVJV 2007). As lands are acquired that could be feasibly added to the forest habitat management program, use reforestation or silvicultural techniques to achieve site appropriate hardwood species diversity. Long-term goals are to develop the stands into a diverse, mature forest utilizing desired forest conditions (LMVJV 2007) . In some cases where significant natural regeneration is present or adjacent seed sources abundant, natural regeneration may be allowed to take its course.	During the next 15 years, maintain, enhance and restore approximately 312 acres of upland pine/hardwood in Compartments 7 and small portions of 1, 2, and 4 to conserve focal species (e.g. Kentucky warbler, worm-eating warbler, and wood thrush) using sound silvicultural practices to achieve desired forest conditions (LMVJV 2007). Upland hardwood habitat is characterized by the following attributes: • Dominated by hard mast species (hickories, southern red oak, post oak, water oak, etc.) • Diversified forest canopy structure • Dense patches of ground cover • Patchy midstory
Primary Habitat and Wildlife Response Variables	• Forest Composition, structure, and regeneration • Forest habitat components (snags, coarse woody debris, cavities) • Forest stand distribution • Forest breeding birds (species composition and abundance) • Bat use of forests and cavities • Wintering waterfowl use • % Herbaceous Cover • Waterfowl use, composition, and abundance		
Probable Assessment Methods	• Forest Inventory sampling (traditional cruise parameter and habitat components) • GIS stand mapping and harvest records • Regeneration plots • Breeding landbird surveys (point counts) • mobile acoustical bat surveys • Waterfowl counts (bi-weekly Nov-Feb)		

Table 3. Management objectives, resources of concern, habitat and wildlife response variables, and assessment methods.

U.S. Fish & Wildlife Service

Overflow National Wildlife Refuge

Ashley County, Arkansas

Impoundment and Sanctuary Management

Map Sheet 5 of 5

Shallow Water Impoundment Description

Overflow NWR has a system of 24 separate units in the north sanctuary and two small units west of the office where water level management takes place. The infrastructure in place for managing water, consists of overflow spillways, metal water control structures, numerous levees, ditches and wells, and one stationary and one portable relift pump to utilize surface water. A concrete structure is situated on the Flat Slough Ditch that is capable of flooding much of the sanctuary by backing excess water through water control structures in the appropriate fields and then closing off the structures when the desired water level is reached. The majority of the impoundments are located within the sanctuary to allow migrating birds the ability to complete life cycle requirements during wintering, breeding, and/or migration (Figure 11).

The water management system at Overflow NWR allows management opportunities for many species of migratory birds including shorebirds, waterfowl, wading birds, and marshbirds. It is the discretion of the biologist/manager to design and implement the plan for emphasis on the various species in the most advantageous locations. Due to the constraints of weather, written plans have to be modified almost every year in order to achieve desired conditions for selected bird groups in the planned location. Flexibility is essential and the biologist should be adaptive to deal with abnormal or unexpected weather conditions.

Potential and Selected Management Strategies For Impoundment Management

Drawdown and flood-up schedule techniques (Fredrickson and Taylor 1982):

1.Season of drawdown (early-March/April, mid-May/June, late-July/August;

2.Speed of the drawdown (fast drawdowns only occur during early season and slow drawdowns are staggered over a longer period of up to a month;

3.Variation of drawdowns for plant diversity; and

4.Timing of flood-up (Efforts should be made to provide newly flooded moist-soil habitat throughout the fall migration and wintering period).

Irrigation - flush moist-soil or irrigate crops as appropriate
- Surface water extraction
- Groundwater extraction
- Rainwater utilization

Water Delivery and Control Infrastructure
- Groundwater well - electric, diesel, or propane powered
- Surface water pumps - electric, diesel, or propane powered
- Levees, canals/ditches, and water control structures

Mechanical Management - (3-year rotation)
- Disking
- Mowing
- Fire (See Fire Management Plan and Prescribed Fire Plan)
- Farming (Utilize Farming Strategies)

Chemical Management (Utilize Farming Strategies)

Potential and Selected Management Strategies For Farming

Cooperative and Force-Account Farming
- Utilize rice, milo, soybeans, corn, millet, etc. for farming program.
- Wheeled tractors, aircraft, broadcast seeders, floats, fertilizer buckets, disks, seed drills, harvesters, grain semi-trucks, sprayers, levee plows, relift pumps and wells, rollers of various sorts, bush hogs, and various other farming equipment.

Chemical Treatments
- All chemicals will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1).
- Herbicide treatments allow for very selective removal of plant species or groups of species, with little or no damage to crops that are considered desirable. Insecticides and fungicides reduce the impacts of insects and fungal diseases on crops, protecting the crops and increasing the yield potential. Pesticides will be applied according to the directions on the label, and used solely for the purpose for which the chemical was designed. A list of permissible herbicides is maintained within the Pesticide Use Permit Database.

Water Management (See Impoundment Management strategies)
- Flooding crops similar to moist-soil management

Potential and Selected Management Strategies Migratory Bird Sanctuary

Protect high-use wintering waterfowl habitat from human disturbance by closing roads, lands, and waters to public access in designated waterfowl sanctuary areas from November 1 to April 1 for wintering waterfowl and other migratory birds and from July 1 to August 31 for shorebirds (Figure 10).
- No public entry and use is permitted in waterfowl sanctuaries at any time.
- Minimize disturbance due to refuge operational activities.
- Sanctuary areas should be available in all waterfowl habitat types across the refuge in order to provide the important resources needed by waterfowl throughout the wintering period.

Management Strategies - Invasive/Nuisance Plant and Animal Control in all Units

Determine the need for site-specific control, based on the potential to negatively affect wildlife and habitat management objectives on the refuge.
- Control or contain large established infestations
- Prevent introduction of potential invaders
- Eradicate new or small infestations
- Prior to the initiation of invasive species control efforts, refuge staff must understand the biology of the species to be controlled.
- Early Detection and Rapid Response
- Prioritize Invasive Plant Control Efforts
- Mechanical Control.
- Chemical Control
- Biological Control
- Prescribed Fire (USFWS 2010)
- Use a multifaceted approach and approved current technologies to remove feral swine through staff and/or contractors

Potential and Selected Management Strategies Open Grassland Management

Habitat Manipulation
- Disk
- Mow
- Burn
- If applicable, utilize agriculture to set back succession

Rotation
- Set back succession of open grassland habitat every 1-3 years, not to exceed 5 years using methods above

Timing
- Disk (spring (before April 1st), late summer (after July 15th) or fall)
- Mow (after July 15th)
- Burn (spring (before April 1st), late summer (after July 15th) or fall)

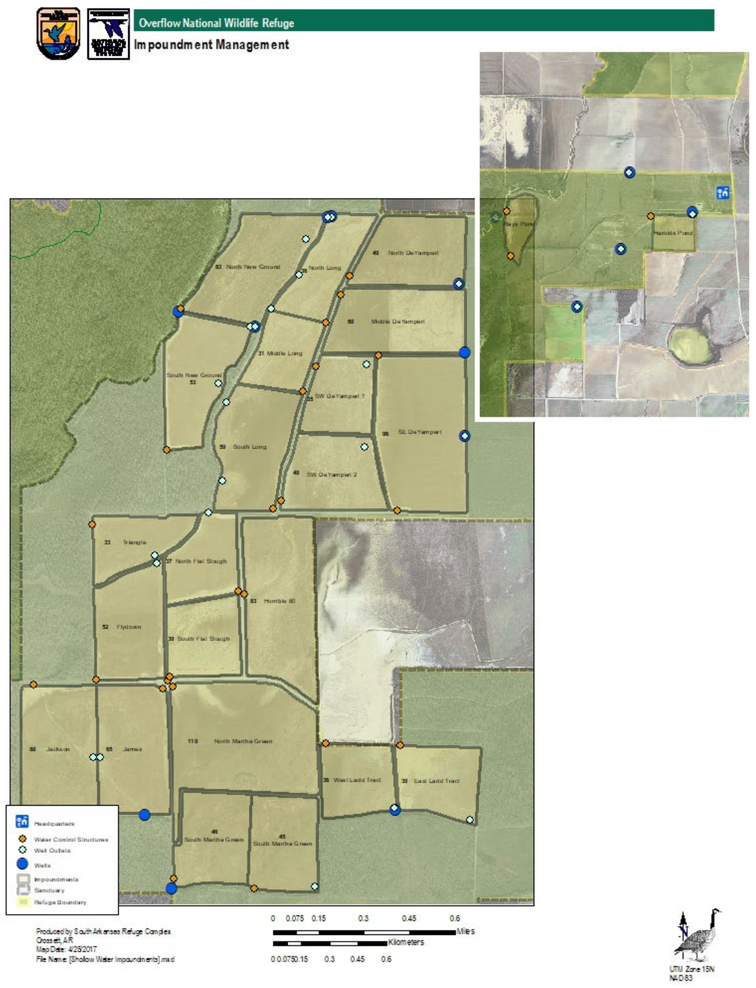

Figure 10. Shallow water impoundments are used to manage for waterfowl, shorebirds, wading birds, and marsh birds

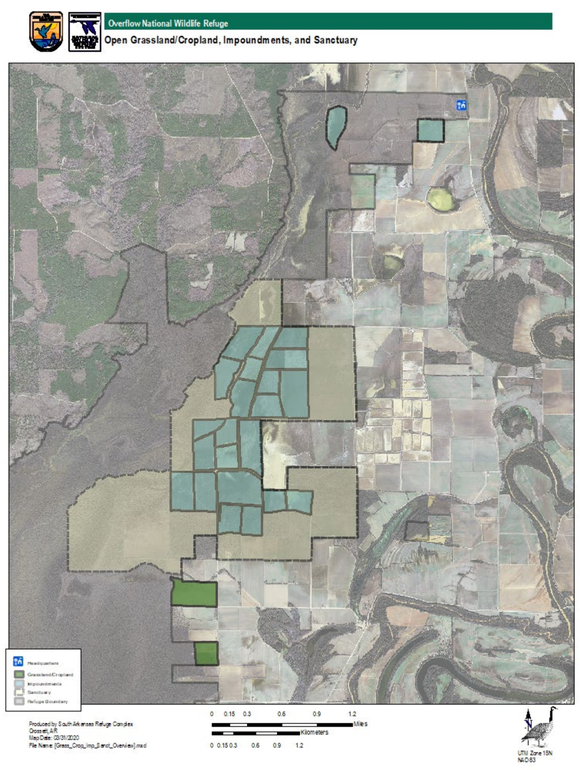

Figure 11. The waterfowl sanctuary on Overflow NWR encompasses 3,200 acres of several habitat types. The shallow water impoundments are approximately 1,244 acres and the additional grassland/cropland fields are approximately 115 acres.

Table 4. Habitat management objectives, resources of concern, response variables, and assessment methods for open lands, shallow water impoundments, and sanctuary on Overflow NWR.

Overflow NWR HMP Objective Habitat Type	**Open Grassland/Crop Land HMP Objective – (Clarifying CCP Objectives 2.3, 2.4, 2.5 2.6, 2.7, 2.8, 2.9, and 2.12, 2.13)**	**Shallow Water Impoundment Management HMP Objective (Clarifying CCP Objectives 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.12, 2.13)**	**Migratory Bird Sanctuary HMP Objective (Clarifying CCP Objectives 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.12, 2.13)**
Resource of Concern	Wintering and Migratory Waterfowl, Wading birds, Shorebirds, Marshbirds, Grassland birds	Wintering and Migratory Waterfowl, Shorebirds, Wading birds, Marshbirds	Wintering and Migratory Waterfowl, Shorebirds, Wading birds, Marshbirds
Overflow NWR CCP Goal 2:	Protect, maintain, enhance, and where appropriate, restore suitable habitat for the conservation and management of migratory birds, resident wildlife, fish, and native plants, including all federal and state threatened and endangered species endemic to the Complex.		
HMP Management Objective	Maintain approximately 115 acres of existing open land for agriculture or early successional grassland management (Figure 11). These open grassland/cropland units along with the shallow water impoundments can be utilized as a land base within a cooperative farming program. When not being utilized for farming, allow open grassland units to provide early successional grassland habitat (primarily herbaceous ground cover intermixed with shrubs). Early stages post-disturbance should provide habitat for woodcock shifting to habitat more appropriate for grassland birds as percent herbaceous cover increases. These units should be disked, mowed, or burned on a 1-3 year rotation.	Within the 1,244 acres of impoundments, provide and maintain moist-soil habitat on approximately 920 acres (1.7 million WEDs). To meet current WEDs objectives (3.4 million WEDs), provide an additional acres (1.7 million WEDs) of unharvested high energy food (e.g. rice, millet, corn etc) (Regional Waterfowl Strategic Plan, 2020) within the 24 shallow water impoundments using moist-soil and cropland rotational management. Per future objectives set by the LMVJV or the Regional Waterfowl Strategic Plan, adjust (-/+) acres of high energy foods to meet any new objectives. Utilizing a portion of the 1,244 acres, during summer months, provide approximately 100 acres of wading bird habitat characterized by shallow water, approximately 100 acres of late-summer/fall migrant shorebird shallow water/mudflat habitat, and approximately 100 acres of late-successional marsh bird habitat (NAWMP, LMV/WGCP Shorebird Management Plan, NAWCP, USFWS 2010)(Figure 10).	Protect approximately 3,200 acres of high-use wintering waterfowl and shorebird habitat from human disturbance by closing roads, lands, and waters to public access (sanctuary) from approximately November 1 to April 1 and July 1 to August 31 (See Figure 11). During the sanctuary period minimize disturbance by refuge staff, contractors, and partners conducting inspections, environmental education, maintenance, and management operations as much as possible, and as lands are acquired that could be feasibly added as sanctuary, increase sanctuary areas as appropriate.
Primary Habitat and Wildlife Response Variables	% Herbaceous Cover and seed/crop yield Waterfowl, Shorebird, Wading bird, and Marshbird, Grassland bird Use, composition, and abundance		
Probable Assessment Methods	· Herbaceous cover plots · Waterfowl, shorebird counts (biweekly Nov-Feb) · Wading bird, Marsh bird, and Rookery Monitoring	· Waterfowl and shorebird counts (biweekly Nov-Feb)	· Herbaceous cover plots · Waterfowl, shorebird counts (biweekly Nov-Feb) · Wading bird, Marsh bird, and Rookery Monitoring