Mississippi Valley Division,
Regional Planning and Environment Division South

St. Tammany Parish, Louisiana Feasibility Study

Appendix I Attachment 4 – Monitoring and Adaptive Management – Constructed Refuge Pine Savanna Project

February 2024

CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION 1
Refuge Pine Savanna Mitigation Site

1.1 PROJECT LOCATION

The proposed refuge pine savanna mitigation site (PSR-1) is located entirely within the Big Branch Marsh National Wildlife Refuge (BBMNWR) in St. Tammany Parish Louisiana, (Figure I4:1-1). The site is located south and east of Bayou Bonfouca, west of the Norfolk Southern and Pontchartrain Drive (state highway 11) and north of the Lake Pontchartrain Northshore, Louisiana. The site would provide 9 acres (7.4 AAHUs) of pine savanna habitat for the red-cockaded woodpecker (RCW) and 50 acres (2 AAHUs) for the pine warbler (PW) within the BBMNWR to compensate for unavoidable wetland impacts from implementation of the restore up to (~)70 acres of degraded wet Long-leaf Pine Savanna Forest as compensatory mitigation for coastal zone Pine Savanna impacts from construction of the South and West Slidell levee and floodwall system under the St. Tammany Parish, Louisiana Feasibility study.

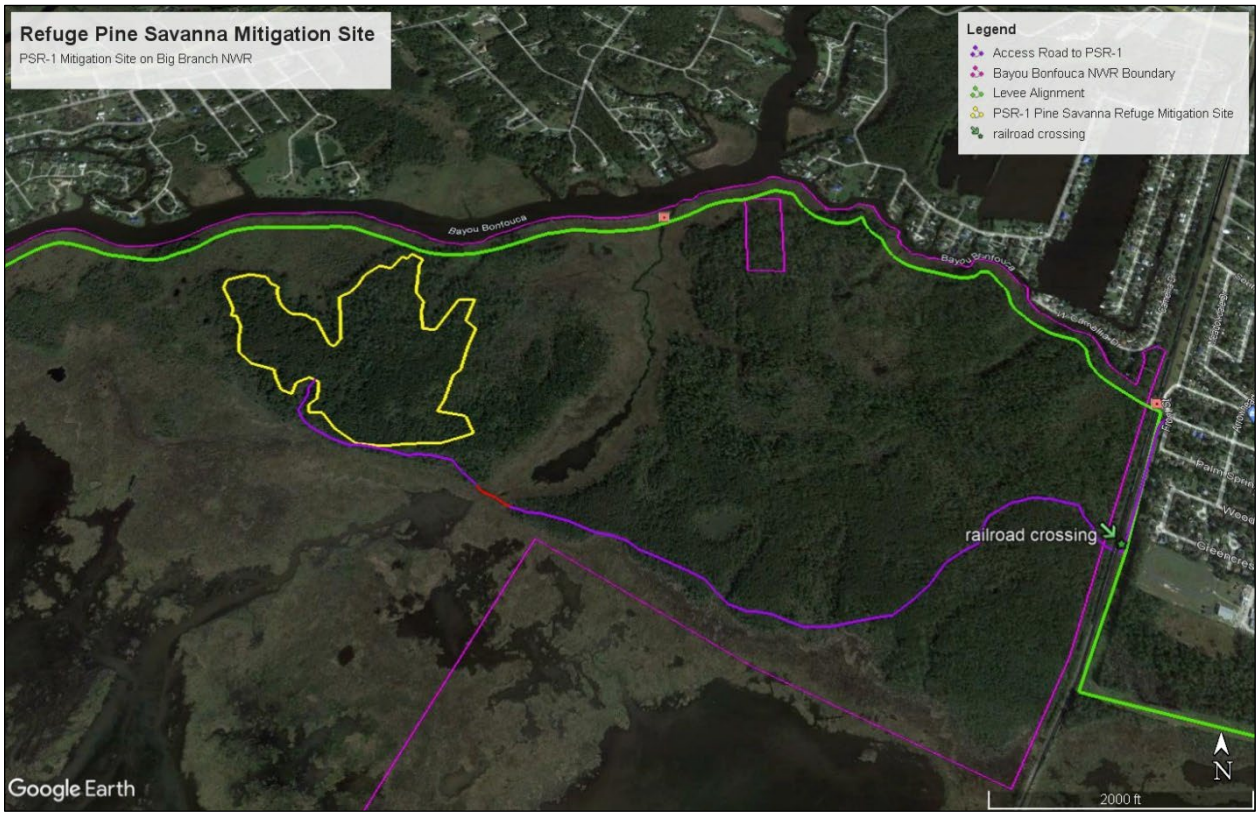

Figure I4:1-1. Refuge Pine Savanna Mitigation Site Location

1.2 PROJECT DESCRIPTION

The project includes eradication of invasive species such as Tallow. Removal of undesirable hardwood species, and reintroduction of fire across the entire site. Removal of undesirable hardwood species coupled with the reintroduction of frequent fires can be effective in restoring ground cover in remnant longleaf pine savannas.

Potential earthwork activities include establishing/improving an existing access road, across the existing railroad crossing westward to the PSR-1 mitigation site. A staging area would be established within areas identified for the proposed levee work in proximity to improvement of the NWR access road.

1.2.1 Site Access

Access to the project work limits would be as follows:

Access to the site from the Northeast would be from the intersection of Front Street and Sun Valley Drive, Slidell, Louisiana to be made via route LA-11 (Pontchartrain Drive). At the intersection of Front Street and Sun Valley Dr equipment/vehicles would traverse along the existing Slidell-Oak Harbor levee south parallel to the railroad and cross at the established railroad crossing. Access from the southeast can be made via route LA-11 to the existing Slidell-Oak Harbor levee traveling east and then north to the existing railroad crossing. Once across the railroad, access to the mitigation site would be via an existing dirt road traversing in a westerly direction approximately 1.8 miles the PSR-1 mitigation site.

1.2.2 Staging

A staging area for improvement of the access road to the mitigation site could be established just northeast of the existing railroad crossing within an already established/disturbed area.

1.2.3 Maintenance/Management Activities

After completion of all excavation, grading, and soil preparation activities, herbicides may be applied to the mitigation areas to help control invasive and nuisance plant species. Herbicide applications may also occur to help suppress undesirable vegetation. Throughout this period, access/maintenance roads would be maintained as necessary.

The first monitoring event would occur in the fall of the year of the initial plantings. Thisreport could show additional plantings are needed or it may not. Regardless, various mowing events and herbicide application events would take place during the period from the first monitoring event to the second monitoring event. It is assumed that the second monitoring event would show success criteria for the plantings had been achieved as were success criteria about control of invasive and nuisance plants. In thiscase, the Non-Federal Sponsor would take over the project including all management and maintenance work.

1.2.4 **Equipment**

Equipment to be used for the respective work is assumed as follows:

- Herbicide Spraying: ATVs and/or UTVs, back-packsprayers and/or boom sprayers;
- Controlled Burns: ATVs and/or UTVs, back-packsprayers and/or boom sprayers.

1.3 AQUATIC RESOURCE TYPE AND FUNCTIONS TO BE RESTORED

An assessment was conducted to determine if there would be significant resources (Table I4:1-1) impacted by implementation of the proposed project. This assessment assists teams in understanding the ecosystem impacts of the parent project and the linkages of the resources to other parts of the system or watershed. The impacted resources are recognized as significant across institutional, public, and technical perspectives.

The St. Tammany Feasibility Study proposed project includes features that would impact the BBNWR. As a result, a Compatible Use Determination will be required. The National Wildlife Refuge (NWR) System Improvement Act of 1997 authorized that no new or expanded use of a refuge may be allowed unless it is first determined to be compatible. A compatibility determination is a written determination signed and dated by the Refuge Manager and Regional Refuge Chief, that determines whether a proposed action is either compatible with the existing use of the NWR or is not a compatible use. A compatible use is defined as a proposed or existing wildlife-dependent recreational use or any other use of a NWR that, based on sound professional judgement, would not materially interfere with or detract from the fulfillment of the NWR System mission or purposes of the NWR.
A Compatibility determination would include a public review period before issuing a final determination. It is highly unlikely that a major levee and associated structures would be found compatible with the purposes of BBMNWR. Without a positive compatibility determination, ROE to BBMNWR for construction would not be granted. The compatibility determination would occur conducted during PED.

The Final Policy on the NWR System and Compensatory Mitigation Under the Section 10/404 Program (federal register notice (64 FR 49229) for mitigation on refuge lands: (https://www.govinfo.gov/content/pkg/FR-1999-09-10/html/99-23627.htm) stipulates that the Service would not allow compensatory mitigation for off-refuge habitat losses authorized through the Section 10/404 program to be implemented on lands and waters within the NWR System, except under limited and exceptional circumstances. At this time, the Refuge does not support pursuing waivers to the mitigation policy for the St. Tammany Feasibility Study. A land exchange would be required for any direct impacts associated with the project that occur on refuge lands. In other words, the USACE would be required to purchase land in the refuge acquisition boundary, exchange and donate those properties to the refuge to offset the direct impacts on the refuge associated with the proposed project. The USACE would then own the land in which the project would cause direct impacts. The USACE would then be required to provide compensatory mitigation for the habitats impacted as off

refuge impacts. In a refuge land exchange, land is not swapped on an acre for acre basis, but rather it is swapped on a value for value based as determined by the appraised value so, tracts of land larger or smaller than the acres impacted may be exchanged. USFWS has indicated that the land exchanged should be of similar habitat and quality as the habitat impacted and the lands must be within the approved refuge acquisition boundary. In addition, any indirect impacts on the Refuge associated with implementation of the project would be mitigated for on refuge property.

Table I4:1-1. Significance of Habitat Type Impacted

Habitat Type	Significance of Resource	Significance – Is the Resource Scarce or Unique at Various Levels?		
		National	Regional	State
Pine Savanna	High diversity plant, mammal, reptile, amphibian, and avian habitat. Stabilizes the soil and stores carbon.	Longleaf pine once occupied over 90 million acres in the southern U.S. and are now considered globally imperiled. Pine flatwood habitat has been reduced to less than 3% of their historic range due to development, fire suppression, forest conversion and logging.	Longleaf pine habitats are scarce and unique for Louisiana.	Rarity rank S1G1 (imperiled in state; critically imperiled globally) assigned by LDWF.

1.3.1 **Existing Conditions**

The refuge mitigation site is ideally situated (geologically, topographically, hydrologically, etc.) to support a restoration and enhancement effort.

1.3.2 **Geology**

The site lies primarily in what has been called the “pine flatwoods region” of Louisiana’s southeastern Florida Parishes but is immediately adjacent to and abuts the pine hills region that lies generally to northwest of the site. It is located primarily on the Pleistocene Prairie Terraces geologic formation, the terraces that underpin the pine flatwoods region. There is a hill complex in the south central portion of the property that represents a disjunctive outlier of the Pleistocene High Terraces geologic formation (the high terraces underpin the pine hills region). Materials of the Prairie Terraces were deposited 10,000 to 75,000 years ago (USDA/NRCS, Soil Survey of St. Tammany Parish, LA, March 1990), with soils developing on these terraces since that time.

1.3.3 **Soils**

The most recent soil survey of the parish (USDA, NRCS, Soil Survey of St. Tammany Parish, LA, March 1990) (Exhibit 2) indicates that soils present in the pine flatwoods zone include the following series classified as non-hydric: Abita silt loam, Latonia fine sandy loam, Prentiss fine sandy loam (both 0 – 1% slopes and 1 – 3% slopes), and Stough fine sandy loam (note that soils mapped as Stough series are often hydric). Soil series classified as hydric that are mapped in the pine flatwoods zone include: Myatt fine sandy loam, Myatt fine sandy loam – frequently flooded, Guyton silt loam – occasionally flooded, and Ouachita and Bibb – frequently flooded.

1.3.4 **Soils/Hydrologic Plan**

A detailed work descriptions and written specifications for all work that is intended to affect the current hydrology of the project site will be developed including but not limited to the following:

1. Complete description of all construction methods used with timing and sequence. If work is to be performed in phases provide an explanation of the reason for such decision as well as a map depicting the different phases.
2. Complete description of all work. This description shall include a preparatory plan that discusses any clearing, grading, and pre-planting burns.
3. Provide plan views and cross-sectional views of all work, with appropriate legends on the drawings to depict the work that is being done.
4. Maps that identify the location of adjacent waterways and are referenced in this section.
5. Proposed grading plan, including elevations and slopes of substrates with drawings that depict such work.
6. Soil management and erosion control measures.
7. An explanation of how the completion of such work will support this restoration project.]

1.3.5 **Vegetation Plan**

1. List of plant communities to be established. Typical PF/S woody species include longleaf pine (*Pinus palustris*), slash pine (*P. elliottii*), swamp black gum (*Nyssa biflora*), blackjack oak (*Quercus marilandica*), laurel oak (*Quercus laurifolia*) and pond cypress (*Taxodium ascendens*). Typical PF/S herbaceous species include broomsedges (*Andropogon* spp.), little bluestem (*Schizachyrium scoparium*),slender bluestem (*S. tenerum*), panic grasses (*Panicum* spp.), three-awn grasses (*Aristida* spp.), toothache grass (*Ctenium aromaticum*), hairawn muhly (*Muhlenbergia capillaries*), plume-grasses (*Erianthus* spp.), jointgrasses (*Coelorachis* spp.), beak-rushes (*Rhynchospora* spp.), yellow-eyed grasses (*Xyris* spp.), umbrella grasses (*Fuirena* spp.), nut-rushes (*Scleria* spp.), and white top sedge (*Dichromena latifolia*).

2. Complete species list and the percentage of each species planted. (Note: For an initial longleaf pine planting there must be present an initial density of 300trees per acre. Seedlings can be planted in cohorts or patches where a well- developed grassy ground cover is in place, averaging 25-50 trees per cohort, or may be planted in a linear fashion in areas lacking a well-developed grassy ground cover where follow-up chemical release of seedlings will be necessary.)

3. Methodology used for the establishment of desired plant communities.

4. Discussion of regeneration.

5. Species distribution.

6. Planting methods.

7. Herbivory minimization and control plan.

8. Weed species minimization and control plan.

9. Exotic nuisance vegetation control and management plan.

1.3.6 **Maintenance Plan**

A detailed description and schedule of the perceived maintenance requirements for the project will be provided, throughout the different work phases, to support the restoration efforts. This information should reflect the maintenance (including a burn plan) that is required to ensure the continued viability of the resource once initial construction is completed and before the long-term milestones have been achieved.

SECTION 2

USACE Guidance

U.S. Army Corps of Engineers (USACE) monitoring and adaptive management policy is required by the Water Resources Development Act of 2007 and presented in planning guidance (Engineering Regulation (ER) 1105-2-100, Engineering Circular (EC) 1105-2-409, and Memorandum on Implementation Guidance for Section 2036 of the Water Resources Development Act of 2007). Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management will be needed to attain project benefits. Adaptive management addresses the uncertainties about a project's actual performance that exist when implementation decisions are made to undertake a water resources project. This technique allows decision making and implementation to proceed with the understanding that outputs will be assessed and evaluated and that some structural or operational changes to the project may be necessary to achieve desired results. At the heart of adaptive management is an appropriate monitoring program to determine if the outputs/results meet the required mitigation need, and to determine if any adjustments are needed.

The purpose of this plan is to demonstrate ecological success of the project. This success is determined by monitoring metrics that are specifically tied to project objectives, and success criteria. In addition, the plan identifies what adaptive management (contingency) is proposed if the performance targets are not met. This plan presents the framework for the above methodology, and will be refined as the project proceeds into Pre-construction, Engineering, and Design (PED) phase in collaboration with the non-Federal sponsors, as well as other stakeholders who may take responsibility for monitoring ecological variables in the watershed.

SECTION 3

Mitigation Success Criteria

In order for the Mitigation project to be considered acceptable for mitigating wetland impacts associated with the St Tammany Parish Feasibility Study, the selected mitigation site will be restored in accordance with the Mitigation Plan such that it meets wetland criteria as described in the 1987 Corps of Engineers Wetland Delineation Manual (the 1987 Manual) as well as the November 2010 Regional Supplement for the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0. Performance standards (success criteria) used to measure the success of the Mitigation project are provided below.

Ecological enhancement of pine flatwoods/savanna and related habitats is measured by the progress from its current state (as described in the baseline conditions) towards an open, highly species diverse pine flatwood/savanna ecosystem. Elements that can be measured to show this progression include basic hydrologic information, longleaf pine seedling survival and growth data, vegetation composition and structure (including overstory species and percent (%) cover, midstory woody composition and percent (%) cover, and groundcover composition and percent (%) cover). The control of woody shrubs and hardwood encroachment or lack of encroachment into savanna areas can be used to measure the success of management in moving the site to a high quality ecosystem. The following criteria use these elements to measure success.

3.1.1.1 Initial Success Criteria

1. *Hydrology*: Ground surface elevations must be conducive to establishment and support of hydrophytic vegetation, and re-establishment and maintenance of hydric soil characteristics. To that end, all alterations of the natural topography (ditching, spoil mitigation projects, land leveling, bedding, fire breaks, etc.) that have affected the duration and extent of surface water have been removed or otherwise rendered ineffective in accordance with this Mitigation Plan.

2. *Vegetation*: Floristic survey of current site conditions completed. During dry season, non-indigenous hardwood overstory species within the savanna areas would be removed to a level below 10% canopy coverage and non-indigenous pine species would be thinned to below 40% canopy coverage. Controlled burns must have occurred throughout the site including along the margins of and into bayheads.

3.1.1.2 Interim Success Criteria

1. *Hydrology*: By Year 5 (**four** years following attainment of the one-year survivorship criteria) site hydrology will be restored such that the Property meets the wetland criterion as described in the 1987 Manual as well as the November 2010 Regional Supplement to the Corps of Engineers wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0. Data demonstrating that wetland hydrology has been re-established is to be

collected by the Sponsor and submitted to CEMVN in the monitoring report for the interim success criteria.

2. Vegetation and Vegetative Plantings:

a. A minimum of 40 longleaf pine seedlings/saplings per acre have survived through 3 growing seasons. These must exhibit at least 4 consecutive years (after 1 year survivorship) of annual increase in stem ground diameter or height from ground to bud tip.

b. Plant composition of pine flatwoods/savanna and related habitats. Vegetative monitoring data should indicate that:

(1) The diversity of desirable indigenous herb species shows progress toward the long-term standard of 10+ species on average per square meter (10.75 sq. feet) with a minimum average of 5 desirable species per square meter, and;

(2) Undesirable species have become less prominent, averaging less than 1 undesirable species present per plot**,** and;

(3) Woody shrub height and density are managed such that the average height is less than five feet and cover is less than 20%. The Mitigation project and the perimeter will be virtually free (approximately 5% or less on an acre-by-acre basis) of exotic/invasive vegetation.

c. At least two prescribed burns should have occurred throughout the pine flatwood/savanna habitat and at least once along the margins of and into bayheads and/or flatwood ponds.

3.1.1.3 C. Long-Term Success Criteria (Year 5 and beyond)

1. Vegetative cover (Table I4:3-1) for high quality rehabilitated longleaf pine flatwood wetland savanna will fall within the following ranges:

Table I4:3-1. Vegetation Strata and Percent Cover

Vegetation Strata	Estimated Total Percent Cover
Longleaf pine overstory	10-50%
Total overstory (longleaf pine plus various hardwoods)	15-55%
Woody understory (shrubs/small trees)	<20%

Herbaceous groundcover	90-100%

2. Pine flatwoods/savanna vegetation composition should consist of a variety of indigenous species with a predominance of longleaf pine in the overstory, and additional age classes of longleaf pine in the understory. Undesirable species will be maintained at a minimum level. General goals (Table I4:3-2) are:

Table I4: 3-2. Vegetation and Species/ Type Composition

Vegetation Composition	Species/type Composition
Overstory (>10 ft. ht.)	70-90%* longleaf pine
Understory (2-10 ft. ht.)	>50%* longleaf pine; at least 4 species of indigenous-shrubs/hardwood trees in pine flatwood wetlands.
Herbaceous groundcover (<2 ft.)	50-90%* grasses/sedges; 10-50%* forbs; >10 native species/meter square; >50 herbaceous species/site; undesirable **species <1%***

*Percent of total cover of designated strata

Select one of the appropriate success criteria for habitat inclusions below:

3. Vegetative composition of flatwood ponds dominated by obligate and facultative wet graminoids and virtually free (<1%) of undesirable species.

4. Prescribed burns throughout the pine flatwood/savanna habitat as well as along the margins have occurred at a frequency of once every 2-3 years.

6. The Mitigation project and the perimeter will be virtually free (approximately 1% or less on an acre-by-acre basis) of exotic/invasive vegetation.

SECTION 4
Mitigation Monitoring Guidelines

The activities necessary to monitor the Mitigation project to demonstrate compliance with the success criteria are established in this Mitigation Plan. The Mitigation project will be monitored in the fall of each year using the guidelines within this section of this Mitigation Plan. No deviation from the Mitigation Plan may occur without prior approval from the USACE and Interagency Environmental Team (IET). The monitoring reports will include a discussion of the coordination with USACE, NFS and IET members, a description of and reasons for any approved deviation.

Surveys of permanent monitoring stations will occur in the following time frame:

1. A baseline report, prior to beginning of site restoration, to be provided in conjunction with the work schedule to establish baseline information.

2. An "as-built report" providing documentation that vegetative plantings (if needed) and the work necessary to restore site topography and wetland hydrology of the mitigation project have been completed.

3. An initial success criteria report documenting successful completion of the construction work as specified in this MWP (Description of Work) and in the P&S and in conjunction with initial success criteria as stated in this MWP. This report will be provided the first fall of 1 year after planting.

4. An interim success criteria report (3-4 years after successfully meeting the initial success criteria as stated in this MWP).

5. Long-term success criteria report (5 years after meeting the interim success criteria or when the long-term success criteria have been met**,** and every fifth year thereafter).

If monitoring for any given year determines that the Mitigation project is not progressing as expected, monitoring will continue on an annual basis until the Mitigation project successfully meets or exceeds established milestones. After achieving the initial success criteria, monitoring will occur as stated above.

Surveys will include a summary and map of where, when and percent coverage of burns that have occurred since the previous monitoring report. Data collected for initial, interim and long-term monitoring will be the same as for baseline conditions using the same sample plots.

The survey of the permanent monitoring stations will collect data to evaluate the survival and growth rates of planted vegetation. In addition to planted seedlings, surveys will include the number by species of volunteering trees, shrubs and woody vines. Surveys will also collect information regarding colonizing plant species, the wetland plant status (scaled from obligate (OBL) to upland (UPL)) of each, and the number of undesirable species.

6. Beyond Long-term success the number of monitoring plots can be reduced to half the number, and surveys will include a summary and map of where, when and percent coverage of burns have occurred since the previous monitoring report. Data will be collected to evaluate the survival and presence of appropriate vegetation, and a map will be submitted with the data to show the location of the monitoring plots as well as burn history of those particular plots, photos of those plots (as well as general photos of the overall mitigation project), and overall description of what is taking place with the plots and the mitigation project. Other information may be requested by the IET if necessary.

4.1 MANAGEMENT UNITS

Prior to any restoration work on the site of the Mitigation project, the management units will be established by dividing the site to account for habitat types present and areas with management histories that are significantly different from each other or divided as necessary for logistical management of the site. A map and discussion shall be provided defining/labeling these divisions and providing supportive information for the establishment patterns of such units.

4.2 PERMANENT CIRCULAR MONITORING PLOTS

The establish plots shall be established randomly located across each management unit in a manner to ensure that they capture the variation in habitat conditions across each unit. Plot locations will be permanently marked with fire-resistant materials (e.g., rebar or aluminum conduit poles). GPS coordinates shall be recorded for each plot and plot locations shall be depicted on maps and drawings submitted.

Two types of permanent monitoring plots or stations will be established, one type for general vegetation structure and composition monitoring and one type for tree survival and growth monitoring.

1. General Vegetation Plots

- A minimum of 1 set of permanent circular nested vegetation structure and composition monitoring plots (plots with a common center point, 10.75 sq. feet and 1/40th acre) per 20 acres will be randomly located in each management unit.
- At least one set of sampling plots shall be placed in non-jurisdictional buffer areas to gauge progress in those areas where present.
- Plot size and data to be collected from plots for vegetative structure and composition monitoring are listed below. Additional plant species noted outside sample plots will also be reported to obtain a total species list for the site. This

information will be provided in tabular form. Cover will be determined from sample plots as shown in the table 3 below.

2. Tree Survival and Growth Monitoring Plots

Tree Survival Monitoring Plots will be established according to the following methodology (Table I4:4-1).

- One permanent circular (1/4th acre plots (1000 sq. meters)) plot per 20 acres will be randomly established in each management unit to monitor longleaf seedling survival and growth.
- The survey of the permanent monitoring stations will collect data to evaluate the survival and growth rate of planted longleaf seedlings. Growth rate will either be gauged by measuring stem diameter at ground level, or increase in height from ground to bud tip, for each seedling present in plots.

Tree Survival Monitoring Plots Methodology

Plot size	Strata	Data Collected
10.75 sq. feet (1 M²)	Groundcover (herbaceous) and woody plants <2 feet	Species present Cover by species Total cover (undesirable species) Total cover (all species) Total cover (all species minus undesirable species) Percent cover grasses/sedges (excluding undesirable species) Percent cover forbs (excluding undesirable species
1/40th of an acre (1089 sq. feet)	Understory (woody plants 2-10 feet tall)	Species present Cover by species Total cover all species Total cover undesirable species

1/40th of an acre (1089 sq. feet)	Overstory (>10 ft.)	Species present Cover by species Total cover all species Total cover undesirable species
1/40th of an acre (1089 sq. feet)	Groundcover (<2ft)	Additional species not found in 10.75 sq. feet (1 M^2) plots

4.3 WETLAND DELINEATION

At year 5, a wetland delineation will be required to demonstrate that the Property meets the wetland criterion as described in the 1987 Manual as well as the Regional Supplement of the Corps of Engineers Wetland Delineation Manual Atlantic and Gulf Coastal Plain Region Version 2.0.

To submit the information for a wetland delineation the necessary data for the Mitigation project will be collected and provide it to CEMVN and the IET for review and verification.

4.4 FLORISTIC SURVEY

To document the attainment of the long-term success criteria a comprehensive floristic survey will be completed for the Mitigation project as part of the monitoring requirements.

4.5 PHOTOGRAPHS

Digital images shall be taken from ground level at each monitoring station and from elevated positions throughout the Mitigation project to document overall conditions. These ground level images should provide a North, South, East and West image for each station.

4.6 QUALITATIVE ANALYSIS

The entire extent of the Mitigation project (or phase of the Mitigation project that this report represents) should be evaluated and provided observations. These observations will include: general estimates of the average percent cover by native plant species in the canopy, midstory, and understory strata; general estimate of the average percent cover by invasive and nuisance plant species;

- general estimates concerning the growth of planted canopy and mid-story species;
- general observations concerning the colonization by volunteer native plant species;
- general observations made during the course of monitoring will also address potential problem zones, general condition of native vegetation,

trends in the composition of the plant communities, wildlife utilization as observed during monitoring, and other pertinent factors.

- and any other information that is pertinent to achievement of initial success criteria.

4.7 HYDROLOGIC CONDITIONS

A description of the condition of any applicable hydrology altering features (culverts, ditches, plugs, etc.) and a general discussion of hydrologic conditions at monitoring stations.

A summary of rainfall data will be collected during the year preceding the monitoring report based on rainfall data recorded at a station located on or in close proximity to the mitigation site. Once all hydrology success criteria have been achieved, reporting of rainfall data will no longer be required.

SECTION 5

Monitoring Reports

Independent of the baseline and as-built report monitoring reports will be submitted documenting monitoring efforts at the Mitigation project to the CEMVN by fall/winter of the year in which monitoring occurs. The monitoring reports will follow the guidelines listed below:

The monitoring report will include data sufficient for comparison to the success criteria/performance standards found in this Plan and include the items outlined in the Monitoring Requirements Section of this Mitigation Plan. These reports shall also include a discussion of all activities which took place at the Mitigation project. All monitoring reports generated after the Baseline Monitoring Report will be called As Built, Initial, Intermediate or Long-Term Success Criteria Monitoring Reports and shall be numbered sequentially based on the year in which the monitoring occurred (i.e., Initial Success Criteria Monitoring Report 2026). If monitoring for any given year determines that the mitigation project is not progressing as expected, monitoring will continue on an annual basis until the project successfully meets or exceeds established milestones. After achieving the success criteria, monitoring will occur as stated below.

5.1 BASE LINE DATA REPORT

To demonstrate site rehabilitation through management, a Floristic Survey would be performed using an acknowledged scientific methodology and collect vegetative monitoring data from the permanent plots prior to performing any site management. This baseline data would be collected at each sample plot. In addition, a report detailing the hydrologic disturbances that need attention and a plan identifying work necessary to accomplish hydrologic restoration will be provided. Report shall include a description of the various features and habitats within the mitigation site. Various qualitative observations will be made to document existing conditions and will include, but not be limited to, potential problem zones, general condition of native vegetation, and wildlife utilization as observed during monitoring. See Monitoring requirements Section.

5.2 AS-BUILT REPORT

An as-built report will be submitted to CEMVN within 60 days following completion of all final construction activities (e.g., eradication of invasive and nuisance plants, planting of native species, completion of earthwork, grading, wetland rating, surface water management system alterations/construction, etc.) required to restore or enhance special aquatic sites. The as-built report will describe in detail the work performed and provide a list of species planted, the number of each species, and the wetland rating. No deviation from the Mitigation Plan may occur without prior approval from CEMVN and the IET. The as-built

report will include a discussion of the coordination with IET members, a description of and reasons for any approved deviation. The as-built report shall provide:

a. A survey showing finished grades and plantings (if needed) with written documentation, plan view and cross-sectional drawings of all construction and establishment work implemented on the mitigation project.

b. Quantitative survey data collected from the permanent monitoring stations and the transects as described in the Monitoring Requirements Section of this MWP. This survey data should include the number of species planted, timing of all work events, and maps showing the location (including latitude/longitude) of all monitoring stations as described in this Plan.

c. Detailed descriptions of site preparation, planting procedures, etc.

Photographs as described within the Monitoring Requirements Section

d. A detailed discussion of all mitigation activities completed. A brief description of maintenance and/or management and/or mitigation work performed since the previous monitoring report along with a discussion of any other significant occurrences.

e. A description of the various features and habitats within the mitigation site. Various qualitative observations will be made to document existing conditions and will include, but not be limited to, potential problem zones, general condition of native vegetation, and wildlife utilization as observed during monitoring.

f. A plan view drawing and shapefiles of the mitigation site showing the approximate boundaries of different mitigation features including planted areas, planted rows, areas involving eradication of invasive and nuisance plant species, surface water management features, access rows, proposed monitoring transects locations, sampling plot locations, photo station locations, and if applicable, piezometer and staff gage locations.

- A detailed inventory of all canopy and midstory species planted (if plantings are determined to be necessary, including the number of each species planted and the stock size planted. In addition, provide an itemization of the number of each species planted and correlate this itemization to the various areas depicted on the plan view drawing of the mitigation site.

5.3 FIRE MANAGEMENT REPORTING

For burn events, the following information will be reported in the as-built, initial, interim and long-term monitoring reports: dates of burn, percentage coverage burn by unit, and a map showing the location of the area burned. This information will also be provided on any reports subsequent to the long-term monitoring report. Surveys will include a summary and map of where, when and percent coverage of burns that have occurred since the previous

monitoring report. Data collected for initial, interim and long-term monitoring will be the same as for baseline conditions using the same sample plots.

5.4 INITIAL SUCCESS CRITERIA REPORT

The following will be submitted at the end of the first year after planting.

The report shall provide details on any maintenance/management work conducted on the Mitigation project after submission of the As-Built Report. The report shall provide a brief description of any anticipated maintenance/management work to be conducted prior to attainment of interim success criteria.

5.4.1 **Vegetation**

5.4.1.1 Permanent Monitoring Plot Data

The report shall provide plot data summarized in tabular form for general vegetation monitoring plots and seedlings survival/growth monitoring plots as described and as established in accordance with the Monitoring Requirements Section of this Mitigation Plan.

A description of the general condition of the seedlings, including the number and species of surviving seedlings in each monitoring plot**,** and a discussion of likely causes of mortality for the non-survivors, and a description of the generalized degree and distribution of exotic/invasive species will also be provided. This vegetative monitoring data will be compared to baseline data to demonstrate rehabilitation and/or maintenance of the pine flatwoods/savanna and related habitats.

5.4.2 **Hydrologic Data**

The report shall provide a description of the condition of any applicable hydrology altering features (culverts, ditches, plugs, etc.), a general discussion of hydrologic conditions at monitoring stations and date(s) of activities documentation (fire and roadside berm restoration which will be returned to natural grade) demonstrating unimpeded sheet flow.

5.4.3 **Photographs**

The Sponsor must submit digital photographs in accordance with the Monitoring Requirements Section of this Mitigation Plan.

5.4.4 **Qualitative Analysis**

The Sponsor must provide a qualitative analysis of the site as described in the Monitoring Requirements Section. of this Mitigation Plan.

5.4.5 **Management Report**

A summary Fire Management Report will be provided with the Initial Success Criteria Report in accordance with specifications given in the Monitoring Report Section of this Mitigation Plan.

5.5 INTERIM SUCCESS CRITERIA REPORT

5.5.1 Vegetation

Vegetation monitoring data (see Monitoring Requirements Section) will be provided. In addition, documentation will be provided on the percentage of seedling survival and increase in growth of planted seedlings (if plantings are deemed necessary)**.** This vegetative monitoring data will be compared to the initial success criteria report to demonstrate rehabilitation and/or maintenance of the pine flatwoods/savanna and related habitats.

5.5.1.1 Permanent Monitoring Plot Data

The report shall provide plot data summarized in tabular form for general vegetation monitoring plots and seedlings survival/growth monitoring plots as described and as established in accordance with the Monitoring Requirements Section of this Mitigation Plan. Documentation will be provided that shows seedling growth has occurred for 3 consecutive years for the minimum number of seedlings per acres. A description of the general condition of the longleaf seedlings, including the number and species of surviving seedlings in each monitoring station, the tag number (if appropriate) and a discussion of likely causes of mortality for the non-survivors will be provided. In addition, a description of the generalized degree and distribution of undesirable species and whether they are seed bearing trees or seedlings will also be provided.

5.5.2 Hydrologic Data

By Year 3, two years following attainment of the one-year survivorship criteria, **a wetland determination will be required.** A wetland delineation report will be submitted and a request for a jurisdictional determination to CEMVN as described in the 1987 Manual as well as the November 2010 Regional Supplement to the Corps of Engineers wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2. Hydrologic restoration information will also include photographic documentation (fire break and roadside berm restoration) demonstrating unimpeded sheet flow.

5.5.3 Photographs

Digital photographs in accordance with the Monitoring Requirements section of this Mitigation Plan will be submitted.

5.5.4 Qualitative Analysis

The report must provide a qualitative analysis of the site as described in the Monitoring Requirements Section of this Mitigation Plan. The report shall provide details on any maintenance/management work conduction on the Mitigation project after submission of the Initial Success Criteria Report. The report shall provide a brief description of any anticipated

maintenance/management work to be conducted prior to attainment of long-term success criteria. Note: By year 5, four years following successful attainment of the one-year survivorship criteria, the developing community must exhibit characteristics and diversity indicative of a viable native pine flatwoods/savanna wetland community commensurate with stand age and site conditions; the Mitigation project and the perimeter will be virtually free (approximately 5% or less on an acre-by-acre basis) of exotic/invasive vegetation.

5.5.5 **Fire Management Reports**

A summary Fire Management Reports will be provided with the Interim Success Criteria Report in accordance with the specifications given in the Monitoring reporting section of this mitigation plan.

5.6 LONG TERM SUCCESS CRITERIA REPORT

the Mitigation project shall be monitored five years following attainment of the interim success criteria for the Mitigation project, and every five years thereafter. This long term success criteria report will document the attainment of the long term success criteria. Should information in any of these reports indicate that the long-term success criteria are not attained, an Adaptive Management Plan should be submitted to CEMVN. This plan should identify and describe the problem(s) and provide a plan of action on solving these problems.

5.6.1 **Vegetation**

The vegetative monitoring data will be compared to the interim success criteria report to demonstrate rehabilitation and/or maintenance of the pine flatwoods/savanna and related habitats.

5.6.1.1 Permanent Circular Plot Data

The report shall provide plot data in tabular form for each permanent circular monitoring plot as described and as established in accordance with Monitoring Requirements of this Mitigation Plan. A description of the generalized degree and distribution of exotic/invasive species and whether they are seed bearing trees or seedlings will also be provided.

5.6.2 **Hydrologic Data**

The report must provide documentation to verify that the restored hydrology of the site as achieved in the Interim Success Criteria is still in place.

5.6.3 **Photographs**

Digital photographs in accordance with section Monitoring Requirements Section of this Mitigation Plan must be included in the report.

5.6.4 **Qualitative Analysis**

The report must provide a qualitative analysis of the site as described in the Monitoring Requirements Section of this Mitigation Plan. The report shall provide details on any

maintenance/management work conducted on the Mitigation project after submission of the Interim Success Criteria Report.

5.6.5 Fire Management Reports

Fire Management Reports will be provided for each burn event.

5.7 BEYOND LONG TERM SUCCESS CRITERIA REPORT

the Mitigation project shall be monitored for five years following attainment of the long-term success criteria for the Mitigation project, and every five years thereafter. This long-term success criteria report will document the maintenance of the long term success criteria. Should information in any of these reports indicate that the long-term success criteria is no longer met, an Adaptive Management Plan should be submitted to CEMVN. This plan should identify and describe the problem(s) and provide a plan of action on solving these problems.

5.7.1 Vegetation

5.7.1.1 Permanent Circular Plot Data

The report shall provide plot data in tabular form for half of the number of permanent circular monitoring plots as described and as established in accordance with this Mitigation Plan. A description of the generalized degree and distribution of exotic/invasive species and whether they are seed bearing trees or seedlings will also be provided.

5.7.2 Hydrologic Data

The report must provide documentation to verify that the restored hydrology of the site as achieved and shown for Long-term Success Criteria is still in place.

5.7.3 Photographs

The report must submit digital photographs in accordance with the Monitoring Requirements Section of this Mitigation Plan.

5.7.4 Qualitative Analysis

The report must provide a qualitative analysis of the site as described in IX.F. of this Mitigation Plan. The report shall provide details on any maintenance/management work conducted on the Mitigation project after submission of the Interim Success Criteria Report.

5.7.5 Fire Management Reports

Fire Management Reports will be provided for each burn event

Monitoring Reports Following Re-Planting Activities (if plantings are deemed necessary)

Re-planting of certain areas within the mitigation site may be necessary to ensure attainment of applicable native vegetation success criteria. Any monitoring report submitted following completion of a re-planting event must include:

- an inventory of the number of each species planted and the stock size used;
- a depiction of the areas re-planted, cross-referenced to a listing of the species and number of each species planted in each area;
- documented GPS coordinates for the perimeter of the re-planted area. If single rows are replanted, then GPS coordinates should be taken at the end of the transect; and
- all requirements listed under “Additional Monitoring Reports” of the Mitigation Monitoring Guidelines.

SECTION 6

Mitigation Monitoring Schedule and Responsibilities

Monitoring will be dependent upon site conditions but may be delayed until later in the growing season due to site conditions or other unforeseen circumstances. Monitoring reports will be submitted by December 31 of each monitoring year to the USACE, NFS, and the IET. The various monitoring and reporting responsibilities addressed in this section are all subject to the provisions set forth in the Introduction section.

The USACE and the NFS will be responsible for conducting the monitoring events and preparing the associated monitoring reports until such time that the following initial success criteria are achieved (criteria follow numbering system used in success criteria section):

1. Hydrology – 3.1.1.1 (1) and 3.1.1.2 (1)
2. Vegetation – 3.1.1.1 (2) and 3.1.1.2 (2)

Monitoring events associated with the above will include the first or baseline monitoring event plus annual monitoring events thereafter until the monitoring responsibilities are transferred to the NFS.

The NFS will be responsible for conducting the required monitoring events and preparing the associated monitoring reports for all other required years after the CEMVN has demonstrated the initial success criteria listed above have been achieved. The responsibility for management, maintenance, and monitoring of the non-structural components of mitigation project (vegetative) will typically be transferred to the NFS during the first quarter of the year immediately following submittal of the monitoring report that demonstrates attainment of the initial success criteria. Once monitoring responsibilities have been transferred to the NFS, the next monitoring event (intermediate) should take place 2 growing seasons after initial success has been met. After intermediate success has been met, monitoring will be conducted every 5 years throughout the remaining 50-year period of analysis.

If the native vegetation success criteria are not achieved, a monitoring report will be required for each consecutive year until two annual sequential reports indicate that these criteria have been satisfied. The NFS will be responsible for conducting this additional monitoring and preparing the monitoring reports. The NFS will also be responsible for the purchase and installation of supplemental plants needed to attain these success criteria.

If timber management activities are conducted by the NFS, the NFS will be responsible for conducting the additional monitoring and preparing the associated monitoring reports necessary for such activities (e.g., one monitoring event and report in the year immediately preceding timber management activities and one monitoring event and report in the year that

timber management activities are completed). Management activities conducted should be documented in the monitoring report.

Once monitoring responsibilities have transferred to the NFS, the NFS will retain the ability to modify the monitoring plan and the monitoring schedule should this become necessary due to unforeseen events or to improve the information provided through monitoring. Twenty years following completion of initial success criteria, the number of monitoring plots and/or monitoring transects that must be sampled during monitoring events may be reduced substantially if it is clear that mitigation success is proceeding as anticipated. Any significant modifications to the monitoring plan or the monitoring schedule must first be approved by the CEMVN in coordination with the IET.

Table I6:6-1. Monitoring Activities Refuge Pine Savanna

Year	Activity	Data	Responsible Entity
-1	Pre-construction surveys	Water-depth, hydrology, land cover	USACE
0	Pre-construction monitoring	Baseline ecological data; vegetation composition and structure	USACE
1	As-Built Surveys and Construction Completion Report	Confirm project is built to P&S	USACE and construction contractor
1	Bathymetric survey	ground elevation	USACE and Non-Federal Sponsor
1	Hydrologic monitoring	elevations must be conducive to establishment and support of hydrophytic vegetation	USACE and Non-Federal Sponsor
1	Vegetation survey	Invasive species removal needs; vegetation composition and structure	USACE and Non-Federal Sponsor
5	Hydrologic monitoring	demonstrating that wetland hydrology has been re-established	Non-Federal Sponsor
5	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
10	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
15	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
20	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
30	Vegetation survey	invasive species removal needs; vegetation composition and structure;	Non-Federal Sponsor

		long leaf pine growth data	
40	Vegetation survey	invasive species removal needs; vegetation composition and structure; long leaf pine growth data	Non-Federal Sponsor
50	Final monitoring report	Comprehensive report	Non-Federal Sponsor

SECTION 7
Adaptive Management

Adaptive Management prescribes a process (Figure I4:7-1) wherein management actions can be changed in response to monitored system response, as to maximize restoration efficacy or achieve a desired ecological state. For this project Adaptive Management will be used to ensure that the required AAHUs needed for compensatory mitigation are met. The basic steps include:

- Plan: Defining the desired goals and objectives, evaluating alternative actions, and selecting a preferred strategy with recognition of sources of uncertainty.
- Design: Identifying or designing a flexible management action to address the challenge.
- Implement: Implementing the selected action according to its design.
- Monitor: Monitoring the results or outcomes of the management action.
- Evaluate: Evaluating the system response in relation to specified goals and objectives.
- Adjust: Adjusting (adapting) the action if necessary to achieve the stated goals and objectives.

Figure I4:7-1. Adaptive Management Process

7.1 ADAPTIVE MANAGEMENT PLANNING

Adaptive management planning elements included: 1) development of a Conceptual Ecological Model (CEM), 2) identification of key project uncertainties and associated risks, 3) evaluation ofthe mitigation project as a candidate for adaptive management and 4) the identification of potential adaptive management actions (contingency plan) to better ensure the mitigation projectmeets identified success criteria. The adaptive management plan is a living document and will be refined as necessary as new mitigation project information becomes available.

7.2 CONCEPTUAL ECOLOGICAL MODEL

A CEM was developed to identify the major stressors and drivers affecting the proposed mitigation project (see Figure I4:7-2). The CEM does not attempt to explain all possible relationships of potential factors influencing the mitigation site; rather, the CEM presents only those relationships and factors deemed most relevant to obtaining the required

acres/average annual habitat units (AAHUs). Furthermore, this CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available.

A Conceptual Ecological Model (CEM) was developed to identify the major stressors and drivers affecting the proposed project.

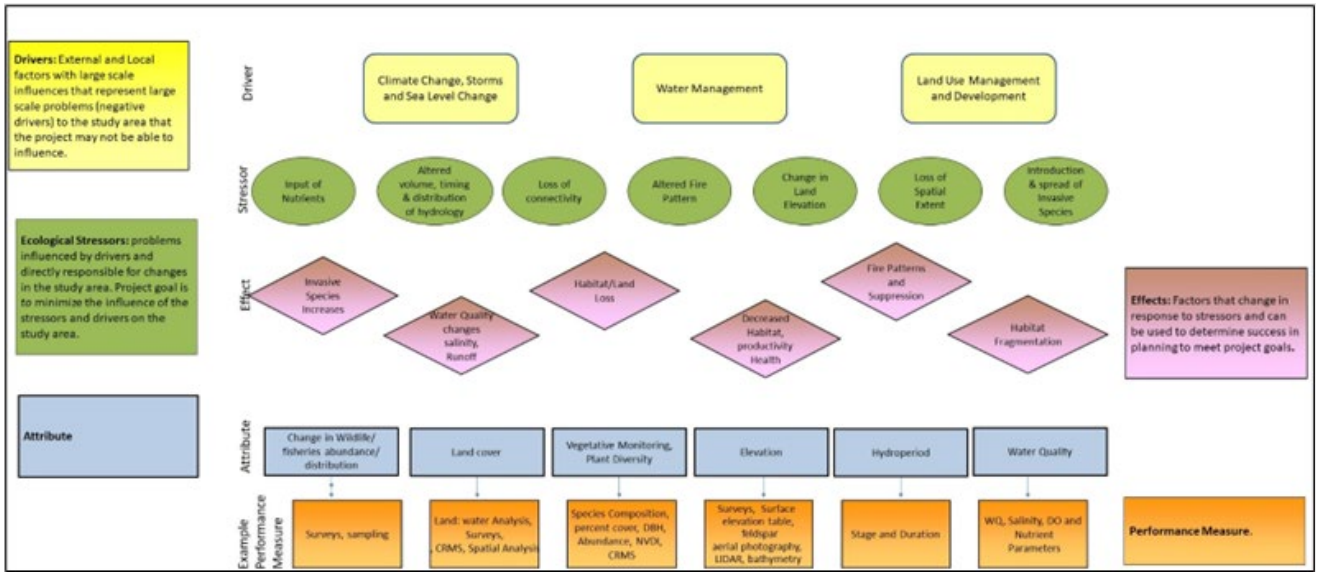

Figure I4:7-2. Conceptual Model St. Tammany Parish Pine Savanna Habitat

7.3 SOURCES OF UNCERTAINTY AND ASSOCIATED RISKS

A fundamental tenet underlying adaptive management is decision making and achieving desiredproject outcomes in the face of uncertainties. There are many uncertainties associated with restoration of the coastal systems. The project delivery team identified the following uncertainties during the planning process.

Climate change, such as relative sea level rise, drought conditions, and variability of tropical storm frequency, intensity, and timing

Subsidence and water level trends at the mitigation sites

Uncertainty Relative to Achieving Ecological Success:

Water, sediment, and nutrient requirements for Riparian/BLH

Magnitude and duration of wet/dry cycles

Nutrients required for desired productivity

Growth curves based on hydroperiod and nutrient application

Tree litter production based on nutrient and water levels

Tree propagation in relation to management/regulation of hydroperiod

Loss rate of vegetative plantings

Long-Term Sustainability of Project Benefits

7.4 ADAPTIVE MANAGEMENT EVALUATION

The project site was evaluated and planned to develop a project with minimal risk and uncertainty. The items listed below will be incorporated into the mitigation project implementation plan and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) plan to minimize project risks.

- Specified success criteria (i.e., mitigation targets)
- Detailed planting guidelines for BLH
- Invasive species control
- Supplementary plantings as necessary (contingency)
- Corrective actions to meet topographic and hydrologic success as required (contingency)

Adaptive Management Evaluation

Subsequently, as part of the adaptive management planning effort the mitigation project features were re-evaluated against the CEM and sources of uncertainty and risk were identified to determine if there was any need for additional actions and costs under the adaptive management plan to ensure that the project meets the required success criteria. Based on the uncertainties and risks associated with the project implementation the following contingency actions have been identified to be implemented if needed to ensure the required AAHUs are met.

Table I4:7-2. Adaptive Management Actions Refuge Pine Savanna

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for sustainable growth	Site frequently flooded	Modify water depth and frequency and or

	of targeted vegetation		increase land elevation to reduce flooding
Vegetation community composition	Healthy vegetative communities free of invasive species.	Invasive species dominance, poor tree survival, sub-optimal tree growth , incorrect community composition	Invasive species control, replanting larger tree for targeted species, canopy thinning or other forest management practices including controlled burns

The CEMVN would be responsible for the proposed mitigation construction and monitoring until the initial success criteria are met. Initial construction and monitoring would be funded in accordance with all applicable cost-share agreements with the NFS. The CEMVN would monitor (on a cost-shared basis) the completed mitigation to determine whether additional construction, invasive/nuisance plant species control, and/or plantings are necessary to achieve initial mitigation success criteria. Once the CEMVN determines that the mitigation has met the initial success criteria, monitoring would be performed by the NFS as part of its OMRR&R obligations. If after meeting initial success criteria, the mitigation fails to meet its intermediate and/or long- term ecological success criteria, the CEMVN would consult with other agencies and the NFS to determine the appropriate management or remedial actions required to achieve ecological success. The CEMVN would retain the final decision on whether or not the project's required mitigation benefits are being achieved and whether or not remedial actions are required. If structural changes are deemed necessary to achieve ecological success, the CEMVN would implement appropriate adaptive management measures in accordance with the contingency plan and subject to cost-sharing requirements, availability of funding, and current budgetary and other guidance.

SECTION 8
References and Resources

USACE 1987 Wetland Delineation Manual

USACE November 2010 Regional Supplement for the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region Version 2.0. Performance standards

USDA/NRCS, Soil Survey of St. Tammany Parish, LA, March 1990

Websites:

The Final Policy on the NWR System and Compensatory Mitigation Under the Section 10/404 Program (federal register notice (64 FR 49229)

(https://www.govinfo.gov/content/pkg/FR-1999-09-10/html/99-23627.htm)