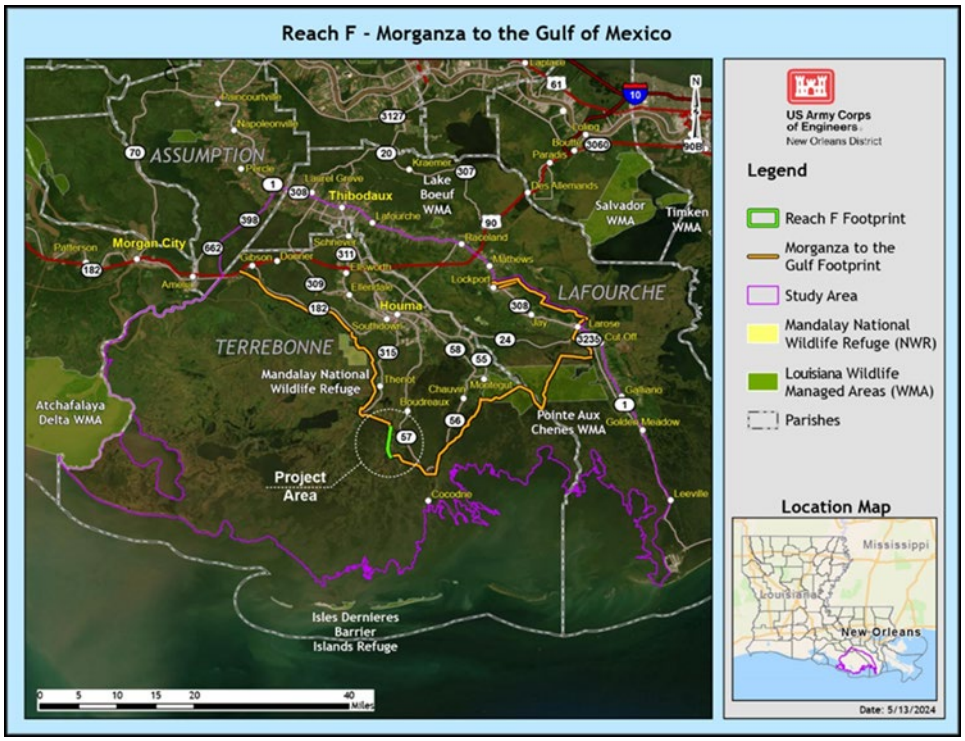
Mississippi Valley Division,
Regional Planning and Environment Division South

Hurricane and Storm Damage Risk Reduction Project Morganza to the Gulf, Terrebonne Parish, Louisiana



Appendix F: Attachment F.1 - Monitoring and Adaptive Management – Constructed Brackish and Saline Marsh Projects

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SECTION 1
Brackish and Saline Marsh Restoration Sites

West Terrebonne Marsh Creation Site

The West Terrebonne project consists of creating approximately 170 acres of brackish/saline marsh in Terrebonne Parish that would be implemented within a larger marsh creation area (MCA) of approximately 6,431 acres (Figure F.2: 1-1). This project would offset the 44 AAHUs of brackish/saline marsh impacts anticipated as a result of the construction of the Morganza to the Gulf (MTG) Reach F Project.

Figure F.2: 1-1. Project Location

1.1 PROJECT DESCRIPTION

This project alternative consists of a brackish and saline marsh creation project with potential to provide an anticipated 170 acres and 44 AAHUs. The project area is located in Terrebonne Parish approximately 8 miles south of Theriot, LA traveling down Bayou Dularge. The larger sites designed for the Overall MTG mitigation plan consists of two marsh creation areas separated by Caillou Lake. The first site, west of Caillou Lake, spans across

Bay Voisin and King Lake (MCA-1). The second site is on the east side of Caillou Lake, primarily located in Moncleuse Bay and extending north into Bay de L'Ouest (MCA-2). Construction of the 170-acre marsh project is anticipated to be implemented in northeast portion of King Lake; however, as advanced engineering proceeds, it could be relocated within the larger mitigation area if necessary.

Two borrow areas were considered, each consisting of multiple cells in an attempt to avoid known pipelines and oyster seed grounds. The identified borrow area (BA-1) located to the north of the MCAs, consists of three cells situated within Lake Mechant and Mud Lake. Access corridors from BA-1 to the two MCAs traverse Grand Pass and Caillou Lake. The second borrow area (BA-2) south of the MCAs, consists of two cells identified in Caillou Bay. Access corridors from BA-2 traverse open water and through the following bayous to reach the MCAs: Grand Bayou du Large, Bayou Banan, and Bayou Grand Caillou.

The smaller mitigation area developed for Reach F impacts is located in northeast portion of King Lake within the MCA-1 footprint. Borrow necessary to construct the 170-acre project would be taken from a borrow site of approximately 342 acres on the southern side of Lake Mechant. The site can be accessed from Bayou Du Large or through Grand Pass and Caillou Lake.

1.2 DESIGN AND CONSTRUCTION

1.2.1 Containment Dikes

The earthen perimeter dike will be fully-confined, constructed from onsite/interior borrow adjacent to the dikes. Construction of the containment dike includes a 5-foot crown width, 1V:5H side slopes that transition down to existing grade, and a +5.5’ NAVD88 crown elevation to contain dredge slurry and provided a minimum 2-foot freeboard. A 30% settlement assumption was applied to the dike height and incorporated in the volumetric calculation. An estimated 497,000 CYs of borrow material would be required for the perimeter dike construction, detailed in Table F.2: 1-1.

Table F.2: 1-1. Summary of Dike Parameter

West Terrebonne Containment Dikes	
Total Perimeter Length (LF):	12,660
Crown Width (FT):	5
Slope Run (1V: **X'** H):	5
Top of Dike Elevation (FT NAVD88):	+5.5
Base Elevation (FT NAVD88):	-2.8
Assumed Settlement (FT):	2.4
Dike Volume (CY):	497,000

1.2.2 Discharge Monitoring

Grade stakes will be placed throughout the project areas. Discharge location will be monitored against grade stakes to determine movement needed within the marsh platform to achieve the most uniform platform possible with little mechanical relocation of high points post construction.

Spill boxes will be strategically located along the limits of the perimeter dike adjacent to open water areas to serves as the effluent discharge points at each MCA. The intent is to capture most sediment suspended in the effluent discharge, but some material will still likely deposit in the adjacent open water locations. After marsh fill operations are completed and sufficient dewatering and compaction has occurred, the spill boxes will be removed.

1.2.3 Marsh Platform Lift

Once all perimeter containment dikes, cross dikes, and spill boxes are constructed, the marsh platform lift for each site will commence. To build the marsh platforms, it is proposed that sediment will be dredged from designated borrow areas in Lake Mechant and Caillou Bay using a hydraulic cutterhead. The sediment will then be pumped as slurry into the marsh creation area through a floating pipeline.

The contractor will be directed to fill the marsh creation area from the varying existing ground elevation to the max constructed fill elevation (final target elevation with the anticipated settlement), with the expectation the platform will ultimately settle into the necessary target elevation of +1.25' NAVD88. A +/- 0.5-foot tolerance during the fill operations will be allowable.

It's assumed only one (1) lift will be required for this project at this design stage, however this will need to be confirmed through field investigations and future geotechnical analysis. Subsidence, foundation settlement, fill compaction/shrinkage, dewatering, and construction losses were accounted for in the quantity calculations.

The selected parameters for the marsh fill operations are shown in the table below. The estimated total quantity of fill material includes the backfilling of internal dike borrow areas. Construction of the marsh platform would require approximately 2,596,000 CYs of borrow material. See Table F.2: 1-2 below for details on the marsh platform lift.

Table F.2: 1-2. Summary of Marsh Platform Lift

West Terrebonne Marsh Creation Fill Area	
Area (AC):	170
Max Slurry Elevation (FT NAVD88):	+3.50
Target Elevation (FT NAVD88):	+1.25

Water Bottom Elevation (FT NAVD88):	-2.80
Intermediate Subsidence (MM/YR):	12.09
Assumed Settlement (FT):	1.0
Marsh Fill Volume (CY):	2,596,000

1.2.4 Borrow Plan

The material for the construction of the MCA is to be hydraulically dredged sediment obtained at the proposed borrow location in Lake Mechant. It is assumed this borrow area will provide suitable material for the construction of the marsh platform, as the material is assumed to have mixed sediment content according to the Louisiana Sand Resources Database (LA-0161) and other neighboring projects in the region. The proposed borrow sites total to approximately 342 acres, and satisfies the overall volume needed by 106%. Required Contract Borrow Quantity for the West Terrebonne Marsh Creation Area: 5,191,000 CY. See Table F.2: 1-3 below for the details on each borrow area.

Table F.2: 1-3. Summary of Borrow

West Terrebonne Borrow (Lake Mechant)	
Area (AC):	915
Max Allowable BEC (FT NAVD88):	-20
Assumed Depth of Material (FT):	10
Available Borrow Volume (CY):	14,770,000
Percentage of Need Met:	400%

1.2.5 Dike Degrade/ Gapping

One to three years post-construction of the marsh platform, it is assumed that the sites will settle down to the desired target elevation. At this time the dikes will be degraded down to elevation +1.25’ NAVD88 (+/- 0.5-foot), in attempt to align with the surrounding marsh elevation. Gapping locations will also be included in this effort to enhance tidal exchange across the MCA. Excavated material will be disposed of within the marsh creation areas at any low locations within the project footprint or in shallow open water adjacent to the platform. The estimated excavation quantity for West Terrebonne is approximately 17,000 CY.

1.2.6 Relocations

This study did not conduct an in-depth pipeline locations/identification. Pipeline data for this marsh creation area and borrow location is assumed at a face value of what was shown on the DNR pipeline database. In addition, the proposed borrow area and marsh creation area within Lake Salvador may encounter wells and flowlines which have not been identified.

Prior to any formal design or construction, the proposed project site and borrow area will require an in-depth pipeline, well, and flowline review and identification.

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

The success (performance) criteria described herein are applicable to all proposed marsh habitats (fresh marsh, intermediate marsh, and brackish marsh restoration features), unless otherwise indicated.

3.1 GENERAL CONSTRUCTION

A. Complete all initial mitigation construction activities (e.g. construction of temporary retention/perimeter dikes, placement of fill (borrow material/dredged material), construction of permanent dikes if applicable, etc.) in accordance with the mitigation work plan and final project plans and specifications. Upon completion of construction, USACE or its contractor shall provide construction surveys to include all project features. These activities are classified as "initial construction requirements."

B. Approximately 1 year following completion of all initial mitigation construction activities (when the restored marsh feature has stabilized to the point that the containment berms are no longer required to prevent the loss of fill material from the project site), USACE or its contractor shall complete all final mitigation construction activities, in accordance with the mitigation work plan and final project plans and specifications. Such activities may include, but are not limited to: degrading temporary retention/perimeter dikes; completion of armoring of permanent dikes; "gapping" or installation of "fish dips"; soil testing; completion of plantings; and construction of trenasses or similar features within marsh features as a means of establishing shallow water interspersion areas within the marsh. Finishing the aforementioned construction activities will be considered as the "completion of final construction requirements".

3.2 TOPOGRAPHY[1]

A. Initial Success Criteria:

1. One year after completion of fill placement:

   - Demonstrate that at least 80% of each mitigation feature has a surface elevation that is within +0.5 to – 0.5 feet of the desired target surface elevation as determined by the settlement curve for that year.

2. Two years after completion of fill placement:

- Demonstrate that at least 80% of the mitigation site has a surface elevation that is within +0.5 feet to – 0.25 of the desired target surface elevation as determined by the settlement curve for that year.

B. Intermediate Success Criteria:

1. Two years following achievement of Topography Criteria A.2. —
   - Demonstrate that at least 80% of the mitigation site has a surface elevation that is within the functional marsh elevation range[2].
   - There are no additional monitoring or attainment requirements for topography beyond meeting the Intermediate Success Criteria for topography.

Notes:

[1]Elevation survey data and report will be provided to the IET for review in order to determine concurrence. The surveys must include water levels inside and outside the marsh creation site at locations representative of site conditions.

[2]The "functional marsh elevation range", i.e. the range of the marsh surface elevation that is considered adequate to achieve proper marsh functions and values, is determined during the final design phase.

3.3 NATIVE VEGETATION

A. Intermediate marsh and brackish marsh:

1. Initial Success Criteria (2 growing seasons following completion of initial construction activities in General Construction A.):
   - Initial plantings must attain at least 80% survival of planted species, or achieve a minimum average cover of 25% native herbaceous species (includes planted species and volunteer species). If site self-vegetates, the site must achieve a minimum average cover of at least 50% native herbaceous species.
   - Demonstrate that vegetation satisfies USACE hydrophytic vegetation criteria.

2. Intermediate Criteria (2 years following attainment of Native Vegetation Criteria A.1):
   - Achieve a minimum average cover of 60 percent, comprised of native herbaceous species (includes planted species and volunteer species).
   - Demonstrate that native vegetation satisfies USACE hydrophytic vegetation criteria.

3. Long-Term Success Criteria[3] (Every monitoring event after attainment of

Native Vegetation Criteria A.2.):

- Achieve a minimum average cover of 60 percent, comprised of native herbaceous species (includes planted species and volunteer species).
- Demonstrate that native vegetation satisfies USACE hydrophytic vegetation criteria.

Note:

[1]There is not a minimum average cover requirement for years 21 – 50. However, vegetation data will be collected throughout the 50-year project life[2].

[2]The 50-year period of monitoring begins once final construction of the project is complete.

- For projects that are NOT planted - at NCC if, at the end of the first growing season after all final construction activities are completed, the colonization of appropriate vegetation has begun to the satisfaction of CEMVN Environmental Branch (such that it is anticipated that the site is on track to meet initial success criteria).
- For projects that are planted - at NCC if, at the end of the first growing season after all final construction activities are completed (including planting), planting has been conducted to the satisfaction of CEMVN Environmental Branch (such that it is anticipated that the site is on track to meet initial success criteria).

3.4 INVASIVE AND NUISANCE VEGETATION (FOR ALL MARSH TYPES)

A. Initial, Intermediate, and Long-term[1] Success Criteria

- Maintain the project area such that the total average vegetative cover accounted for by invasive species and the total average vegetative cover accounted nuisance species each constitute less than 5 percent of the total average plant cover each throughout the 50- year project life. The list of invasive and nuisance species is found in Appendix A and will be tailored to reflect specific site needs.

Note:

[1]Yearly inspections to determine the need for invasive/nuisance control would be conducted until the long term success criteria for vegetation is achieved. After it is achieved, the frequency of inspections to determine the need for invasive/nuisance control would be adjusted based on site conditions.

SECTION 4
Mitigation Monitoring Guidelines

The guidelines for mitigation monitoring provided herein are applicable to all types of marshes being restored unless otherwise indicated.

4.1 BASELINE MONITORING REPORT (FIRST MONITORING REPORT)

A “baseline” monitoring report will be prepared upon completion of Final Construction Requirements B. and upon any re-plantings associated with construction. Information provided will typically include the following:

- A detailed discussion of all mitigation activities completed.
- A plan view drawing of the mitigation site showing the approximate boundaries of the restored marsh, significant interspersion features established within the marsh features (as applicable), proposed monitoring transect locations, proposed sampling plot locations, photo station locations and water level survey locations.
- Initial and final construction surveys of all project features (including but not limited to the fill area, fish dips, weirs, culverts, etc.) and an analysis of the survey data will be provided addressing attainment of topographic success criteria. If a project is immediately adjacent to existing marsh habitat, the topographic survey will include spot elevations collected within the existing marsh habitat near the restored marsh.
- Photographs documenting conditions in the project area will be taken at the time of monitoring. Photos will be taken at permanent photo stations within the restored marsh. At least two photos will be taken at each station with the view of each photo always oriented in the same general direction from one monitoring event to the next. The number of photo stations required and the locations of these stations will vary depending on the mitigation site. The USACE will make this determination in coordination with the Interagency Team and will specify the requirements in the Mitigation Monitoring Plan. At a minimum, 4 photo stations will be established within each marsh cell.
- For planted marsh only - A detailed inventory of all species planted, including the number of each species planted, the stock size planted, and where the species were planted will be documented. For mitigation sites that include more than one planted marsh cell/feature, provide a breakdown itemization indicating the number of each species planted in

each feature and correlate this itemization to the marsh features depicted on the plan view drawing of the mitigation site.

- As part of the as-built/final construction survey, water level surveys will be taken inside and outside the marsh creation site at predetermined locations identified in coordination with the IET and NFS. Each interior water level elevation should have a corresponding exterior water level elevation taken consecutively and within close proximity. If there appears to be disparity in water levels within the marsh creation site, additional shots may be required. The baseline monitoring report will provide the surveyed water level data and will compare it to mean high and mean low water elevation data collected from a tidal elevation recording station in the general vicinity of the mitigation site. The report will further address estimated mean high and mean low water elevations at the mitigation site based on field indicators.

- Various qualitative observations will be made in the mitigation site to help assess the status and success of mitigation and maintenance activities. These observations will include: general estimate of the average percent cover by native plant species; general estimates of the average percent cover by invasive and nuisance plant species; general observations concerning colonization of the mitigation site by volunteer native plant species; general condition of native vegetation; trends in the composition of the plant community; wildlife utilization as observed during monitoring (including fish species and other aquatic organisms); the condition of interspersion features (tidal channels, terrasses, depressions, etc.) constructed within the marsh features, noting any excessive scouring and/or siltation occurring within such features; the natural formation of interspersion features within restored marshes; observations regarding general surface water flow characteristics within marsh interspersion features; the general condition of “gaps,” “fish dips,” or similar features constructed in permanent dikes; if present, the general condition of any armoring installed on permanent dikes. General observations made during the course of monitoring will also address potential problem zones and other factors deemed pertinent to the success of the mitigation project.

- A summary assessment of all data and observations along with recommendations as to actions necessary to help meet mitigation and management/maintenance goals and mitigation success criteria.

- A brief description of anticipated maintenance/management work to be conducted during the period from the current monitoring report to the next monitoring report.

4.2 ADDITIONAL MONITORING REPORTS

All monitoring reports generated after the Baseline Monitoring Report will be called either Initial, Intermediate or Long-Term Monitoring Reports and shall include the year in which the monitoring occurred (i.e. Monitoring Report 2019). All Monitoring Reports shall provide the following information unless otherwise noted:

- All items listed for the Baseline Monitoring Report with the exception of: (a) the topographic surveys, although additional topographic surveys are required for specific monitoring reports (see below); and (b) the inventory of species and location map for all planted species.
- Quantitative data for all plants in each stratum. Data will be collected from permanent sampling quadrats established at approximately equal intervals along permanent monitoring transects established within each marsh feature. Each sampling quadrat will be approximately 1 meter X 1 meter in size (although the dimensions of each quadrat may be increased, if necessary, to provide better data in planted marsh features). The number of monitoring transects and number of sampling quadrats per transect will vary depending on size of the mitigation site and will be determined by the IET during the final design phase of the project. The resulting requirements, including quadrat dimensions, will be specified in the Final Mitigation Monitoring Plan for the project. Data recorded from the sampling quadrats will include but not be limited to: average total percent cover by native plant species; average total percent cover by invasive plant species; average total percent cover by nuisance plant species; percent cover of each plant species; the wetland indicator status of each species; and the average percent survival of each planted species (i.e. number of living planted species as a percentage of total number of plants installed), if discernable at the time of monitoring.
- One photograph shall be taken from the SE corner of each sampling plot to clearly capture the vegetation plot and must include a sign that indicates the plot number and sampling date.
- A brief description of maintenance and/or management work performed since the previous monitoring report along with a discussion of any other significant occurrences.

Topographic surveys of each marsh restoration feature for initial and intermediate monitoring events (at approximately 2 years and 4 years following completion of final construction activities (General Construction B.)). These surveys will cover the same components as described for the topographic survey conducted for the Baseline Monitoring Report. In addition to the surveys themselves, each of the two monitoring reports will include an analysis

of the topographic data in regard to the attainment of applicable topographic success criteria. If the surveys indicate topographic success criteria have not been achieved and supplemental topographic alterations are necessary, then another topographic survey will be required following completion of the supplemental alterations. This determination will be made by USACE and the IET.

4.3 MONITORING REPORTS FOLLOWING PLANTING OR RE-PLANTING ACTIVITIES

Planting or re-planting of certain areas within restored marsh habitats may be necessary to ensure attainment of applicable native vegetation success criteria. Any monitoring report submitted following completion of a planting event must include an inventory of the number of each species planted, the stock size used, and the locations for each species planted. It must also include a depiction of the areas re-planted or those planted, as applicable, cross-referenced to a listing of the species and number of each species planted in each area. The perimeter of re-planted area should be documented with GPS coordinates. If single rows are replanted, then GPS coordinates should be taken at the end of the transect.

SECTION 5
Mitigation Monitoring Schedule and Responsibilities

Monitoring will typically take place in mid to late summer during the required years for monitoring, 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 year of monitoring 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 will be responsible for conducting the monitoring events and preparing the associated monitoring reports until such time that the following mitigation success criteria are achieved (criteria follow numbering system used in success criteria section):

1. General Construction – A. and B.
2. Topography – A.1 and A.2.
3. Native Vegetation –For intermediate marsh and brackish marsh features, criteria A.1
4. Invasive & Nuisance Vegetation – A. until such time as monitoring responsibilities are transferred to the NFS.

The USACE will be responsible for conducting Baseline and Initial Success Monitoring events and preparing the associated monitoring reports.

The NFS will be responsible for conducting the required monitoring events and preparing the associated monitoring reports for all other required years after the USACE has achieved the initial success criteria listed above. The responsibility for management, maintenance, and monitoring of the non-structural components of the mitigation project (i.e. vegetation) 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 (Topography A.2 and Native Vegetation A.1) has been met. After Intermediate Success Criteria (Topography B and Native Vegetation A.2) has been met, Long-Term Success Criteria monitoring will be conducted every 5 years throughout the remaining 50- year period of analysis.

In certain cases, it is possible that the marsh mitigation features may be established along with other mitigation features, like swamp or bottomland hardwood habitats, at the same mitigation site. This scenario could require some adjustments to the typical monitoring schedule described above to develop a reasonable and efficient monitoring schedule that

covers all the mitigation features. Such adjustments, if necessary, would be made at the time final mitigation plans are generated. This schedule must be in general accordance with the guidance provided above and will be prepared by the USACE and the IET.

If certain success criteria are not achieved, failure to attain these criteria would trigger the need for additional monitoring events not addressed in the preceding paragraphs. The USACE would be responsible for conducting such additional monitoring and preparing the associated monitoring reports in the following instances:

A. For intermediate and brackish marsh features –
    - If the initial survival criteria for planted species or the initial vegetative cover criterion (A.1) are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable survival criteria or vegetative cover criteria have been satisfied. The USACE would be responsible for the purchase and installation of supplemental plants needed to attain the success criteria.

B. For all types of marsh features–
    - If initial topographic success criteria (A.1 and A.2) are not achieved, the IET would convene to determine whether corrective actions are necessary. If corrective actions are necessary additional surveys and a monitoring report will be required to indicate whether applicable criteria have been satisfied. The USACE would also be responsible for performing the necessary corrective actions.
    - If initial invasive and nuisance species criteria (A) are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The USACE would be responsible for the irradiation activities needed to attain the success criteria.

There could also be cases where failure to attain certain success criteria would trigger the need for additional monitoring events for which the NFS would be responsible:

A. For intermediate and brackish marsh features –
    - If the native vegetation intermediate success criteria (B.2) are not achieved, a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the native vegetation intermediate success criteria has been satisfied. The Sponsor would also be responsible for the purchase and installation of supplemental plants needed to attain the success criteria.

B. For all types of marsh features –
    - If the topographic intermediate success criteria (B.1) are not achieved, the IET would convene to determine whether corrective actions are

necessary. If corrective actions are necessary, additional surveys and a monitoring report will be required to indicate whether applicable criteria have been satisfied. The NFS would also be responsible for performing the necessary corrective actions if the IET determines such corrective actions are necessary.

- If the native vegetation long term success criteria (A.3) are not achieved, the IET would convene to discuss whether corrective actions would be necessary. If corrective actions are necessary, a monitoring report will be required for each consecutive year following completion of the corrective actions until two sequential annual reports indicate that the native vegetative cover criteria have been attained. The NFS would be responsible for performing the corrective actions, conducting the additional monitoring events, and preparing the associated monitoring reports.
- If the intermediate and long term invasive and nuisance species criteria (4.A) are not achieved a monitoring report will be required for each consecutive year until two sequential annual reports indicate that the applicable criteria have been satisfied. The NFS would be responsible for the irradiation activities needed to attain the success criteria.

Once monitoring responsibilities have been 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. Fifteen years following achievement of Long-Term Success Criteria, the number of monitoring transects and/or quadrats 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 USACE and the IET.

SECTION 6
Adaptive Management Plan

6.1 BRACKISH/SALINE MARSH

6.1.1 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 of the mitigation projects as a candidate for adaptive management and 4) the identification of potential adaptive management actions (contingency plan) to better ensure the mitigation project meets identified success criteria. The adaptive management plan is a living document and will be refined as necessary as new mitigation project information becomes available.

6.1.1.1 Conceptual Ecological Model

A CEM was developed to identify the major stressors and drivers affecting the proposed mitigation project (Table F.2: 6-1). 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.

Table F.2: 6-1. Conceptual Ecological Model

Alternatives/Issues/Drivers	Fresh/Intermediate Marsh
Subsidence	-
Sea Level Rise	-
Runoff	-
Storm Induced	+/-
Salinity Impacts	+/-
Wave Action	-
Storm Surge	-
Vegetative Invasive Species	-
Herbivory	-
Hydrology (water table; wet/dry days; soil inundation)	+/-
Topography (elevation)	+/-

Key to Cell Codes: - = Negative Impact/Decrease
+ = Positive Impact/Increase

+/- = Duration Dependent

6.1.1.2 Sources of Uncertainty and Associated Risks

A fundamental tenet underlying adaptive management is decision making and achieving desired project outcomes in the face of uncertainties. There are many uncertainties associated with restoration of the coastal systems. The project delivery team (PDT) 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
- Uncertainty relative to achieving ecological success
- Long-term sustainability of project benefits
- Adaptability

6.1.1.3 Adaptive Management Evaluation

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

- Detailed planting guidelines for intermediate marsh
- General monitoring guidelines for project success
- Specified success criteria (i.e., mitigation targets)
- Invasive species control
- Supplementary plantings as necessary (contingency)
- Corrective actions to meet topographic success as required (contingency)

Subsequently, as part of the adaptive management planning effort the 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 adaptive management actions.

Based on the uncertainties and risks associated with the project implementation the following contingency/adaptive management actions have been identified to be implemented if needed to ensure the required AAHUs are met (Table F.2: 6-2).

Table F.2: 6-2. Adaptive Management Actions Marsh

Element	Expected Condition	Potential Issue	Potential Corrective Action
Landscape characteristics	Bathymetry appropriate for sustainable growth of marsh vegetation	Water that is deeper or shallower than ideal conditions for targeted vegetations.	Modify land elevation; marsh renourishment to obtain elevations necessary for marsh establishment and maintenance
Connectivity	Obtain necessary hydrology	Limited water exchange or excessive flooding, wave action or salinity.	Modify channels to obtain necessary connectivity. adjust gapping in dikes in the future to maintain sufficient marsh hydrology and connectivity. Construction feature to reduce wave and salinity influences on the marsh restoration feature.
Vegetation community composition	Healthy vegetative communities free of invasive species, assuming natural colonization	Invasive species dominance, native species do not establish, poor marsh survival,	Invasive species control, marsh plantings

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.