NEW HAVEN HARBOR
CONNECTICUT
NAVIGATION IMPROVEMENT PROJECT

INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL IMPACT STATEMENT

APPENDIX O
MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR
SANDY POINT SALT MARSH

Monitoring and Adaptive Management Plan for the Sandy Point Salt Marsh

New Haven Harbor Navigation Improvement Project

NEW HAVEN HARBOR
NEW HAVEN, CONNECTICUT

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1.0 INTRODUCTION

This Monitoring and Adaptive Management Plan was prepared for the Sandy Point salt marsh creation site associated with the New Haven Harbor Navigation Improvement Project (NHHNIP). The Sandy Point salt marsh is being created with dredged material generated from the NHHNIP. This beneficial use alternative will create approximately 58 acres of salt marsh in the New Haven Harbor ecosystem.

Section 2039 of the Water Resource Development Act (WRDA) 2007 (as amended by Section 1161 of WRDA 2016) directs the Secretary of the Army (Secretary) to ensure, when conducting a feasibility study for a project (or component of a project) under the U.S. Army Corps of Engineers (USACE) ecosystem restoration mission, that the decision document include a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed.

Section 2039 of WRDA 2007 also directs USACE to develop an adaptive management plan for all ecosystem restoration projects. The adaptive management plan must be appropriately scoped to the scale of the projects. The information generated by the monitoring plan is used by the USACE in consultation with the federal and state resources agencies to guide decisions on adaptive changes that may be needed to ensure ecosystem restoration meets the project success criteria.

An effective monitoring program is necessary to assess the status and trends of ecological health and biota richness and abundance on a per project basis, as well as to report on regional program success within the United States. Assessing status and trends includes both spatial and temporal variation. Gathered information under this monitoring plan will provide insights in the effectiveness of the restoration project and adaptive management strategies, and indicate where goals have been met, if action should continue, and/or whether more aggressive management is warranted.

Created/restored salt marsh can take decades to reach a dynamic equilibrium conditions, therefore the monitoring period of up to 10 years will assess whether the structural template has been established, and if the site is on a trajectory toward success. Tracking environmental changes and distinguishing the changes caused by human actions and natural variations are difficult tasks, which is why a focused monitoring protocol tied directly to the planning objectives is necessary.

This monitoring and adaptive management plan describes the monitoring methods that will be utilized to assess the project. By reporting on environmental changes, this monitoring effort will assess whether measurable results have been achieved and whether the intent of the Sandy Point salt marsh creation beneficial use alternative using material from the NHHNIP is being met. The monitoring plan includes a description of the monitoring activities, the criteria for success, and the estimated cost.

1.1 Guidance

The following documents provide distinct USACE policy and guidance that are pertinent to this monitoring and adaptive management plan:
1. USACE. 2017, Implementation Guidance for Section 1161 of the Water Resources Development Act of 2016 (WRDA 2016), Completion of Ecosystem Restoration Projects.
2. USACE. 2009. Planning Memorandum. Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) - Monitoring Ecosystem Restoration
3. USACE. 2003. ER 1105-2-404. Planning Civil Work Projects Under the Environmental Operating Principles.
4. USACE. 2000. ER 1105-2-100, as amended, Guidance for Conducting Civil Works Planning Studies.

1.2 Salt Marsh Creation Description

The recommended plan for the project is described in detail in Section 5.2.8 of the Integrated Feasibility Report and Environmental Impact Statement (EIS) for the NHHNIP. The proposed plan would create approximately 58 acres of salt marsh within the New Haven Harbor ecosystem in the vicinity of Sandy Point (West Haven, CT). The goal of the Sandy Point marsh creation is to beneficially use dredged material within the ecosystem that it was generated from to aid in the reduction of dredged material placed in Long Island Sound.

In general, approximately 657,000 cubic yards (CY) of dredged material from the New Haven Harbor main channel would be placed in a containment structure(s) situated over approximately 58 acres of existing sand flat and shallow subtidal areas of the harbor to achieve a target salt marsh surface elevation of 3.6 feet (NAVD88). Several material containment options are under consideration to prevent the erosion of placed material prior to marsh vegetation establishment, including sediment filled geotubes and dikes. The dredged material will be distributed and contoured to create an intertidal salt marsh system with an elevation gradient that transitions from open water to salt marsh. Salt marsh vegetation, primarily saltmeadow cord grass (*Spartina patens*), will occupy the areas of high marsh. Smooth cordgrass (*Spartina alterniflora)* would occupy a slope of increasing elevation in the low marsh and at low tide, mudflat areas will be exposed along the edges of the interface of the salt marsh and open water area. A marsh creek will also be incorporated into the design of the salt marsh to allow for a hydrologic connection with New Haven Harbor as well as Old Field Creek to the south and the salt marsh system to the west of the created salt marsh area.

2.0 MONITORING AND ADAPTIVE MANAGEMENT – OBJECTIVES, STRATEGY, PROCEDURES

This section describes the components of the Monitoring and Adaptive Management program for the Sandy Point Salt Marsh site. Information is based on feasibility level data. During pre-construction engineering and design (PED), the USACE along with the project Non-Federal Sponsor will prepare a detailed monitoring plan in coordination with resources agencies. The detailed monitoring plan will verify the field variables to be evaluated, the most appropriate field measurement methods, the recommended frequency, and duration of each field effort, and confirm reporting requirements.

2.1 Objectives

The purpose of this monitoring and adaptive management program is to assess the progress toward, and the success or failure of, the restoration and the achievement of acceptable standards of salt marsh structure and function. The primary project objective is to reduce open water placement of dredged material in Long Island Sound by creating an intertidal salt marsh that maximizes the salt marsh functions and values of a marsh, yet allows for the maximum amount of dredged material to be contained within the created marsh.

The monitoring and adaptive management plan will focus on tracking the three ecological parameters that are the hallmarks of a functioning tidal marsh as per the *USACE Wetland Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Salt marsh Delineation Manual: Northcentral and Northeast Regions* (USACE 2012):

- Hydrophytic Vegetation
- Salt Marsh Soils
- Salt Marsh Hydrology

2.1.1 Monitoring Objective

Evaluating the success of the creation site will be based on the establishment of the targeted habitats within the restoration site and on the ecological functioning of those habitats. Monitoring objectives include:

- Support adaptive management of implemented projects
- Assess and justify adaptive management expenditures
- Determine “ecological success,” document and communicate success

2.1.2 Adaptive Management Objective

Adaptive management is a process by which the results of restoration activities are repeatedly monitored and evaluated to make decisions on necessary future restoration actions to achieve desired conditions. These measures are technical response actions to changes that adversely affect how the system was predicted to respond. Adaptive management recognizes that human knowledge regarding biological and physical systems is limited and that these systems may not always respond as expected. When a management or restoration project is implemented and

there is some uncertainty regarding the response of the system to particular actions, adaptive management provides a way to respond to feedback from the system.

2.2 Strategy

The site will be monitored following the completion of salt marsh construction activities to evaluate the success of the project and take corrective actions if necessary to ensure success.

2.2.1 Monitoring Strategy

Post-construction monitoring and management will be performed over a period of up to ten years. An initial monitoring event will immediately follow completion of salt marsh creation. This monitoring plan is based on feasibility level information. All monitoring components of the strategies will continue to be refined as design and construction progresses for the specific habitats restored.

The purpose of the monitoring plan for salt marsh creation is to:

- Assess baseline conditions for water quality, vegetation, invertebrates, and other bio-assessments;
- Evaluate the success for salt marsh creation; and
- Develop a better understanding of salt marsh restoration/creation opportunities and protection needs in the study area.

2.2.2 Adaptive Management Strategy

Adaptive management will be implemented if specific marsh creation standards are not met or if actual conditions diverge sufficiently far from the intended conditions to threaten the achievement of overall project goals. The adaptive management program will consider the following conditions identified by the monitoring reports that may be limiting potential success:

- Review of site hydrology and tidal influence
- Whether appropriate vegetation species are colonizing site or if additional plantings are needed
- Impact of invasive species and herbivory damage to vegetation and identification and evaluation of potential remedies.
- Review of restoration and enhancement designs to identify where design may not be appropriate to address the water resource problems.

2.3 Monitoring and Adaptive Management Procedures

As the site that the Sandy Point marsh creation effort will be located is currently open water and intertidal flat habitat, gathering baseline marsh data is not possible.

The monitoring protocol will assess appropriate colonization as well as coverage of any plantings of target hydrophytes (target hydrophytes are non-invasive saltmarsh native species). The protocol will also document the development of hydric soils and an improved hydrologic regime across the site. Monitoring will conclude with a field salt marsh delineation of the project based on the Federal Manual for Identifying and Delineating Jurisdictional Salt marsh (1989) showing the exact acreage of the created area. This delineation will also assess whether or not the salt marsh has settled to its target elevation and is a functioning tidally-driven system.A discussion of monitoring procedures will follow with information necessary to evaluate the success of the project. Further refinement of these procedures will be completed by the USACE and its sponsors during the PED phase of the project.

2.3.1 Hydrophytic Vegetation Monitoring

Timing and Performance Target:
Vegetation will be monitored biannually in both spring and fall to document progress toward the performance target of at least 85% coverage of planted vegetation of target hydrophytes. Sampling methods will include quadrat plot sampling for emergent vegetation.

Methods:
Quadrat Sampling. One square meter quadrat plots will be used along random transects no more than 15 meters apart. At each transect, one quadrat will be randomly placed within the marsh along the transect line and the existing vegetation of the plot would be monitored. Quadrats will be placed on either side (randomly chosen) within one meter of the measuring tape. The meter mark on the upper and lower edge of the each quadrat will be marked permanently with stakes and recorded on the measuring tape in meters. Plant species, plant height, stem density, flowering density, and percent cover data will be collected within each plot. A narrative description of plant health will also be collected. The exact location and side the quadrat will be placed on will be noted with a GPS unit. The will facilitate monitoring efforts on subsequent visits. Each transect line and 1.0 sq. m. quadrat will be photographed at the time of vegetation monitoring. All photographs must be taken at low tide, in the same location, and at the same height.

Adaptive Management:
If the created salt marsh site is not showing progress to meet the requirements of 85% vegetation cover, additional native vegetation would be planted to meet this goal. If a sustainable ecosystem cannot be established within two years at the site, changes and modifications will be initiated by restoration ecologists. The monitoring plan will be refined by USACE to accommodate these changes to monitor the success of the alteration.

2.3.2 Salt Marsh Soil Monitoring

Timing and Performance Target*:*

Hydric Soil. Investigations to track the progression of hydric soil formation will occur annually starting in year two. The performance target is for the site to show suitable development of salt marsh characteristics of hydric soils within the ten year monitoring period.
Soil Salinity. Investigation into soil salinity will occur bi-annually starting in year two. The performance target for the restoration area that is at or below mean tide level is to have soil salinity levels of at least 15 parts per thousand (ppt) to assist with saltmarsh development, for the duration of the ten year monitoring period.

Tidal Inundation. The performance target will be 100 % of the low marsh zone to be inundated during high water associated with a spring tide (MHHW). Monitoring will take place annually starting in year two.

***Methods**:*
Hydric Soil. The soil characteristics of texture, color, and structure will be used to help determine the presence or absence of groundwater and/or frequency of surface inundation. Soil texture will be estimated in the field using the U.S. Department of Agriculture (USDA) classification system. Other characteristics such as redoximorphic features, relative moisture content, and structure will also be noted. Color will be described using Munsell color charts. Necessary laboratory analysis will be performed to identify the existing characteristics of the surficial and subsurface soils at the site. Soil samples may be analyzed for the following parameters: standard fertility analysis for soils (P, K, Mg, Ca, Zn, Cu, Mn, Fe, and B), soil pH, and soil organic matter, appropriate details to be developed in PED.

Soil Salinity. Soil salinity will be sampled during low tide at various ground elevations along transects across the site. Sampling timing will be focused on plant growing seasons and location will be focused on critical rooting depths.

Tidal Inundation. Extent of inundation will be observed at spring high tide.

***Adaptive Management**:*
Management of salinity may include modifications to the soil elevation to increase or decrease the duration and/or intensity of tidal inundation. Soil amendments may also be considered as appropriate to improve vegetation growth.

2.3.3 Salt Marsh Hydrology Monitoring

***Timing and Performance Target*:**
Inundation Regime. Monitoring of salt marsh inundation will occur for the first two years after construction, when the greatest change is expected to occur. The performance target for optimal inundation regimes will be measures through degree of inundation in the constructed marsh platform. For a planned marsh with slopes of one percent, the goal for marsh construction is 100% inundation during high tide in the low marsh, and 50 % inundation during high tide in the high marsh.

Methods:
Inundation regime. Visual hydrologic surveys will be used to characterize tidal inundation regimes and evaluate the development of the site through changes in morphology, erosion, and sedimentation. Visual inspection of tidal circulation due to excavation of new channels and intertidal habitat will also be conducted. Depth and duration of tidal inundation will be measured with a tidal staff for selected tidal cycles prior to alteration and following salt marsh construction.

Adaptive Management:
The hydrological regime will be evaluated so that the depth and duration of flooding across the project sites is adequate to maintain salt marsh saturation levels. Changes may include altering tidal creeks to improve water flow velocities, volumes, duration, and inundation.

3.0 MONITORING RESPONSIBILITIES

The responsible parties for the ten year monitoring will be USACE and the Non-Federal Sponsor. Any standards presented above are to be used as guidelines for evaluation. It is anticipated that real-time observations performed by the monitoring team will be used to refine the monitoring plan.

Reporting Results:
A yearly monitoring summary report will be drafted by USACE that briefly summarizes the data collected and determines if adaptive management is needed. A final monitoring report will be drafted that details the outcomes of the constructed restoration project. Included in each report shall be the monitoring data, photographs, a brief summary of the collect data, and a discussion of the data collected.

4.0 ESTIMATED COST AND DURATION

The monitoring and adaptive management program for the Sandy Point Salt Marsh Creation Site is scheduled to begin following the construction of the site. USACE and Non-Federal sponsor will operate this program for ten years following construction of the wetland. The program will include monitoring at the site and implementation of any adjustments that may be needed to support successful salt marsh establishment.

Monitoring and Adaptive Management Cost:
The project estimate includes $250,000 (FY 20 price level) for the monitoring and adaptive management program implementation.

5.0 OPERATION AND MAINTENANCE

A detailed operation and maintenance (O&M) manual containing requirements will be provided to the non-federal sponsor after the construction is closed out. The O&M for the salt marsh project is expected to be minimal due to the self-sustaining nature of the project and design targets for sustainability. The O&M described here is different than the adaptive management described in the previous section.

O&M Costs:

There are no project features requiring operation. Minor maintenance may include some repairs to geotubes as appropriate and possible plant species maintenance (see below). Maintenance is estimated to be about $15,000 per year. Maintenance is 100% non-Federal cost.

Native Plant Community Maintenance. This is required to maintain species richness, abundance, and structure of the restored plant communities within the project area. Aside from minor re-plantings, it will be important to continue to protect plant communities from external changes by human activities, whether those are single incidents or chronic stressors. These can cause native plant communities to experience significant species richness declines event to the point of becoming monotypic stands.