Fire Island Inlet to Montauk Point, NY
Final General Reevaluation Report

APPENDIX J

MONITORING AND ADAPTIVE MANAGEMENT PLAN

U.S. Army Corps of Engineers
New York District

February 2020

Updated April 2020

FIRE ISLAND TO MONTAUK POINT REFORMULATION STUDY – FINAL GRR
Appendix J: Monitoring and Adaptive Management Plan

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1.0 INTRODUCTION

P.L. 113-2 provided $500,000 in the Investigations allocation to complete a Performance Evaluation Report to evaluate the effectiveness of USACE projects during Hurricane Sandy and include recommendations for further improvements, Hurricane Sandy Coastal Project Performance Evaluation Study (HSCPPES) (www.nan.usace.army.mil/Sandy/PPE). One of the recommendations was to include an adaptive management plan or strategy for changing design within the authorization to respond to external factors, such as changes in local weather patterns or sediment transport, shifts in development trends or public tolerance for storm risks, or changes in coastal flood risks due to climate change. This recommendation has been incorporated into the Fire Island to Montauk Point Coastal Storm Risk Management Project (FIMP).

This Monitoring and Adaptive Management Plan (MAMP) describes the goals, governance, and process for successful adaptive management of FIMP. It has been produced in collaboration with Federal and state resource agencies, including the Department of Interior (DOI) Office of Environmental Policy and Compliance (OEPC), National Park Service (NPS), New York State Department of Environmental Conservation (NYSDEC), New York State Department of State (NYSDOS), U.S. Fish and Wildlife Service (USFWS), and the U.S. Geological Survey (USGS). This MAMP is a living document and will be updated throughout the project life (50 years), in coordination with these and other collaborating agencies.

1.1 Purpose of the MAMP

The purpose of this MAMP is to provide a framework that will ensure long-term project success. Project success is determined by monitoring metrics that are tied to project objectives, targets, and thresholds. The goals, activities, and procedures outlined in this MAMP will be fully defined by the Adaptive Management Team (see Section 3.1 for the structure of the Team) during the Pre-construction Engineering and Design (PED) phase, prior to project construction. This document identifies and describes the monitoring and adaptive management activities proposed for the various features that comprise the project and where possible, estimates their cost and duration.

As a living document, this MAMP will be updated, added to, and refined as the project progresses over time. It is expected that adjustments to project design, implementation, monitoring, evaluations, and adaptive actions will occur as the Adaptive Management Team learns from the successes of the project, and as technology and science advance. This version of the MAMP includes a general process for adaptive management that is expected to be refined by the Adaptive Management Team over time. It reflects current agreements and understanding by members of the Team.

This MAMP incorporates recommendations received during agency coordination and the public comment period and has a two-fold purpose:

- Ensure that the project impacts are consistent with the February 2020 FIMP Environmental Impact Statement (EIS) and implement appropriate adaptive management measures, if needed, that are within the project authority.
- Identify any needed changes to project features as part of ongoing construction, including future periodic nourishment efforts, breach response activities, and sand placement at Coastal Process Feature (CPF) locations.

Please note, for USACE to recommend adaptive management changes, a Post Authorization Report (PAR) may be required. The scope of the PAR, and the approval authority of the report will vary, depending upon the scope of changes being recommended as adaptive management.

1.2 Defining Adaptive Management

Adaptive management is a rigorous approach for deliberately designing and implementing management actions to test hypotheses and maximize learning about critical uncertainties that affect management decisions, while simultaneously striving to meet multiple management objectives. It is an approach to management that involves synthesizing existing knowledge and identifying critical uncertainties, developing hypotheses related to those critical uncertainties, exploring alternative actions to test those hypotheses, making explicit predictions of their outcomes including level of risk involved with implementation, selecting one or more actions to implement, conducting monitoring and research to see if the actual outcomes match those predicted, and then using these results to learn and adjust further management and policy (Walters, 1986; Walters, 2007; Taylor et al., 1997; Murray and Marmorek, 2003; Williams et al., 2009; Smith, 2011). This sequence is summarized in a six-step process (Figure 1), although this is a simplification of a process which in practice does not flow so sequentially though the steps but is more often iterative between certain steps. The adaptive management cycle depicted in Figure 1 and the description below is in alignment with the US Department of Interior's technical guide to adaptive management (Williams et al., 2009).

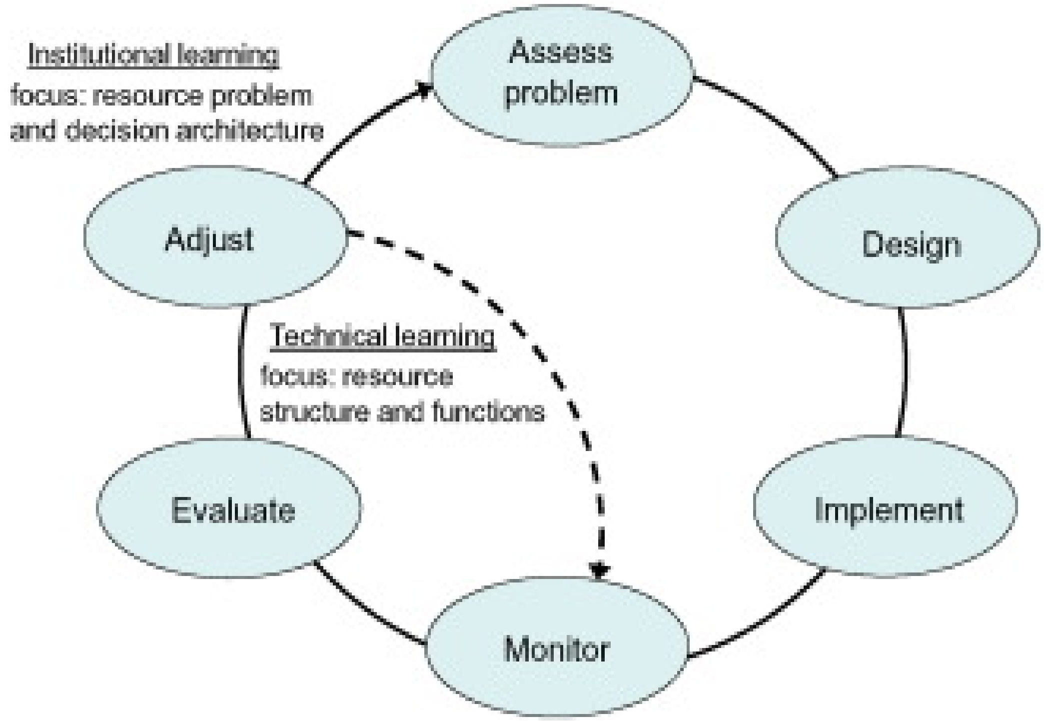

Figure 1. Adaptive Management Process

Adaptive management is not needed for all management situations but can be very useful where there is significant uncertainty about the effectiveness of policies and practices. Applying the rigor of adaptive management often requires a considerable commitment of effort and resources but can lead to better decisions more quickly than the status quo (illustrated in Figure 2). Unfortunately, the term ‘adaptive management’ has been widely misused and applied to largely ad hoc approaches, diluting its original rigorous intent. Common misconceptions about adaptive management include:

- It is the same as trail-and-error, or simply means adapting your policies as you go (whereas it is a very rigorous and systematic process).
- It requires sophisticated modeling skills and tools (which it may not for simpler problems over smaller spatial scales).
- It is something only scientists do (whereas scientists are essential, but managers and policymakers are also essential as it is their uncertainties that should drive adaptive management, and stakeholders must also be involved).
- It can solve all problems, or resolve all uncertainties (whereas it is only one tool for resolving uncertainty, best suited for questions about what management actions will best achieve management objectives at an operational scale where contrasts can be created and compared).

- It requires consensus from all stakeholders (whereas there should be agreement on desired outcomes, but it does not require agreement on how to achieve those outcomes – this is what adaptive management can help resolve).

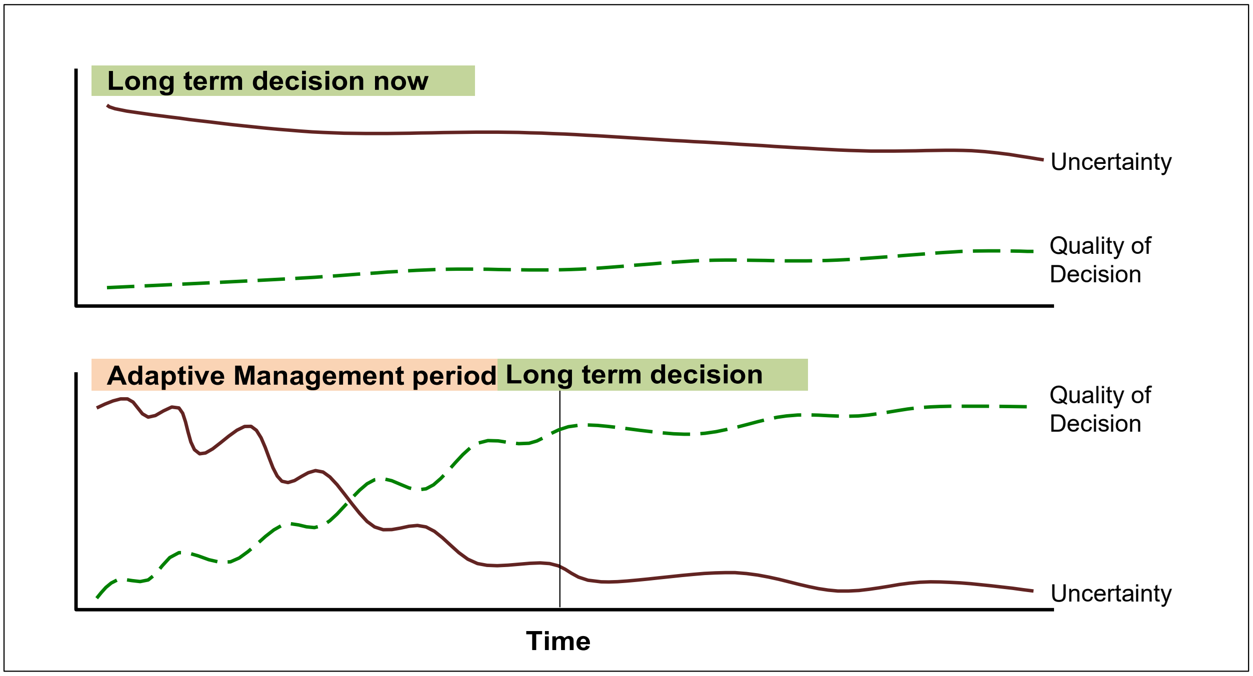

Figure 2. How adaptive management can lead to better decisions.
The graph on the top illustrates the status quo, when decisions for long-term management have inherent uncertainty but no formal mechanism is implemented to explicitly reduce this uncertainty (i.e., to learn). With no formal structured learning process, discoveries of what might work better will be serendipitous and slow, leading, at best, to very gradual improvements in the "quality of the decision" (the effectiveness of the outcomes when compared against objectives). The graph on the bottom shows an alternative approach where by adaptive management is used to actively probe the system and test competing hypotheses for the explicit purpose of learning what works best and improving decisions – learning and the resulting improvements to decisions occurs much more quickly. Better decisions are made at the end of the adaptive management period based on this active learning.

Table 1 lists the basic elements in each of the six steps in the adaptive management cycle. Inclusion of all listed elements in each step is ideal, although in practice some may be left out for reasons of feasibility or the specifics of the particular situation. However, each element has an important function and there are consequences for leaving any out. As more elements are dropped, the application of adaptive management becomes less rigorous and begins to move out of the domain of adaptive management into a less formal and potentially much less effective learning paradigm.

Table 1. Elements within each step in the adaptive management cycle. Modified from Marmorek et al. (2006).

Adaptive Management Steps	Ideal Elements Within Each Step
Step 1. Assess and define the problem	a. Clearly state management goals and objectives b. Review existing information to identify critical uncertainties and management questions c. Build conceptual models d. Articulate hypotheses to be tested e. Explore alternative management actions (experimental "treatments") f. Identify measurable indicators g. Identify spatial and temporal bounds h. Explicitly state assumptions i. State up front how what is learned will be used j. Involve stakeholders, scientists, and managers
Step 2. Design	a. Use active adaptive management b. When and where possible, include contrasts, replications, controls c. Obtain statistical advice, building on analyses of existing data d. Predict expected outcomes and level of risk involved e. Consider next steps under alternative outcomes f. Develop a data management plan g. Develop a monitoring plan h. Develop a formal adaptive management plan for all of the remaining steps i. Peer-review (internal, external) the design j. Obtain multi-year budget commitments k. Involve stakeholders
Step 3. Implement	a. Implement contrasting treatments b. Implement as designed (or document unavoidable changes) c. Monitor the implementation
Step 4. Monitor	a. Implement the Monitoring Plan as it was designed b. Undertake baseline ("before") monitoring c. Undertake effectiveness and validation monitoring
Step 5. Evaluate results	a. Compare monitoring results against objectives b. Compare monitoring results against assumptions, critical uncertainties, and hypotheses c. Compare actual results against model predictions d. Receive statistical or analysis advice e. Have data analysis keep up with data generation from monitoring activities
Step 6. Adjust hypotheses, conceptual models, & management	a. Meaningful learning occurred, and was documented b. Communicate this to decision makers and others c. Actions or instruments changed based on what was learned

For the purposes of this MAMP, adaptive management is defined as a formal but flexible, collaborative, science-based approach to undertaking goal-directed actions with uncertain outcomes and evaluating their results in order to determine better-informed future actions.

Not all FIMP activities *need* to be done using the adaptive management approach, such as those for which there is little uncertainty. Similarly, not all FIMP activities for which uncertainties exist *can* be done using the adaptive management approach, for practical reasons, because adaptive management at this scale takes considerable time and resources. Therefore, only a subset of the critical uncertainties facing FIMP should be addressed through adaptive management. Identifying this subset among the larger suite of possibilities is an important part of adaptive management planning.

Adaptive management is necessary for the project to achieve desired goals by reducing uncertainty, incorporating flexibility and robustness into project design, and using new information to inform decision making. Adaptive management will address engineering, policy, and socioeconomic sources of uncertainty.

1.3 Adaptive Management Implementation

There are two aspects of adaptive management: 1) data evaluation and decision making, and 2) implementation. Through evaluation, analysis and assessment of the monitoring data, the Adaptive Management Team will determine whether the project is functioning as intended and designed or whether changes or modifications are required to achieve project goals and objectives. They will also make recommendations for changes to "adaptively manage" the project in the future. This process of evaluation, assessment and recommendation of adaptive management by the Adaptive Management Team is a key component of the project. If the Adaptive Management Team determines that there is a need for adaptive management, a determination is made as to whether the recommended adaptive management is within the authority of the USACE New York District Commander to implement. Depending on the details of the recommendation, such as location, jurisdiction, aspect (i.e., change in renourishment, land use change, operation and maintenance measure, etc.,), etc., additional approvals may be necessary (e.g., approval by USACE North Atlantic Division [NAD] or HQUSACE, or congressional authorization) prior to implementation of the adaptive management action. Approvals may also be required if additional funding is needed for implementation.

USACE guidance will be followed in establishing the level of documentation and approval necessary for implementing adaptive management recommendations. Additional environmental compliance may be necessary, as well. Based upon current guidance, project design details for all construction activities will be documented in a Detailed Design Report (DDR). Project adaptations that are classified as minor design refinements will be documented in an Engineering Documentation Report (EDR), and will contain the appropriate environmental documentation. Project adaptations that are considered as a change in scope, or function would be documented in a Validation Report and will contain the appropriate environmental documentation. Major changes in the design would require evaluation in a General Reevaluation Report (GRR), and include the appropriate level of environmental coordination. The magnitude of change recommended within these reports would dictate the level of approval within USACE, and also determine if further congressional authorization is needed.

2.0 PROJECT FORMULATION

There is a long history of storms damaging human infrastructure, critical coastal habitat, and environmentally sensitive areas along the south shore of Long Island, such as Fire Island National Seashore and Smith Point County Park. FIMP was originally authorized by the River and Harbor Act of 1960. An EIS was prepared in 1978 to continue the construction of portions of the authorized project.

In response to a referral to the Council on Environmental Quality detailing deficiencies with the 1978 EIS, USACE agreed to reformulate the project with particular emphasis on identifying and evaluating alternatives that considers cumulative impacts on the overall coastal system. The project was reformulated ("Reformulation Study") to identify a long-term solution to manage the risk of coastal storm damages along the densely populated and economically valuable south shore of Long Island, New York in a manner which balances the risks to human life and property, while maintaining, enhancing, and restoring ecosystem integrity and coastal biodiversity.

A Draft Formulation Report was provided to key government partners and stakeholders in May 2009. This report identified problems, opportunities, objectives, and constraints; analyzed alternatives; and proposed several alternative plans for consideration. Subsequent to this report, a Tentative Federally Supported Plan (TFSP) that was jointly identified by USACE and DOI and was submitted to the New York State Department of Environmental Conservation (DEC), the non-Federal sponsor, in March 2011. The TFSP identified a plan that met the study objectives and the requirements of both the USACE and DOI, as required by the enabling legislation for FIIS that stipulates,

> *The authority of the Chief of Engineers, Department of the Army, to undertake or contribute to shore erosion control or beach protection measures on lands with in the Fire Island National Seashore shall be exercised in accordance with a plan that is mutually acceptable to the Secretary of the Interior and the Secretary of the Army and that is consistent with the purposes of this Act.*

In 2012, Hurricane Sandy caused severe coastal erosion and damages within the FIMP study area. Due to the severity of the erosion and damages from this storm, interim stabilization measures were subsequently implemented, utilizing funding from the Disaster Relief Appropriations Act of 2013 (P.L. 113-2). In addition, reanalysis of the TFSP was necessary and undertaken to account for changes to the landform, development patterns and risk.

The FIMP General Reevaluation Report (GRR) details the results of post-Hurricane Sandy plan formulation and selection, and provides a final recommendation for Federal action. It also details past efforts to mitigate the damages, including construction of several features of the authorized FIMP project that were constructed as part of the Westhampton Interim Project, Interim Breach Contingency Plan, and West of Shinnecock Inlet interim project that were approved between 1995 and 2002.

2.1 Project Goals and Objectives

During the plan formulation process, the USACE Project Delivery Team (PDT), with stakeholder input, developed restoration goals and objectives to be achieved by FIMP. These goals and objectives were subsequently refined through interactions with the non-Federal Sponsor and relevant stakeholders. FIMP has been planned to help achieve and sustain a larger-scale coastal risk management system that can maintain the protective features of the barrier island and reduce the resources at risk of coastal flooding in the back bay communities, while maintaining natural coastal processes in the study area and thereby contribute to the well-being of the Nation.

A "Vision Statement for the Reformulation Study" that integrates various agencies policies and practices was developed by the DOI team in 2004 and commits the partner agencies to recognize the following during the FIMP formulation process:

- Decisions must be based upon sound science, and current understanding of the system;
- Flooding will be addressed with site specific measures that address the various causes of flooding;
- Priority will be given to measures which both provide protection, and restore and enhance coastal processes and ecosystem integrity;
- Preference will be given to nonstructural measures that protect and restore coastal landforms and natural habitats;
- Project features should avoid or minimize adverse environmental impacts and address long-term demands for public resources;
- Balances dune and beach replenishment considering storm damage reduction and environmental considerations; and
- Consideration will be given to alteration of existing shore stabilization structures, inlet stabilization measures, and dredging practices.

The specific objectives for FIMP are to:

1. Reduce tidal flooding on the mainland and barrier islands and attendant loss of life, property and economic activity.
2. Reduce damages to structures due to beach and bluff erosion in critical areas.
3. Restore coastal processes and utilize coastal process measures to the maximum extent possible to provide resiliency and reduce storm damages.
4. Ensure that any plan within the jurisdictional boundaries of the National Park Service is compatible with the goals and objectives of the Fire Island National Seashore, and is mutually acceptable to the Secretary of the Army and Secretary of the Interior.

2.2 Coastal Storm Risk Management Features

The PDT performed a thorough plan formulation process to identify potential coastal storm risk management features, which include management measures and coastal storm risk reduction actions that address the project objectives listed above. Many alternatives were considered, evaluated, and screened in producing a final array of alternatives. The PDT, in coordination with DOI agencies, NYSDOS, and NYSDEC have identified the coastal storm risk management features that collectively are considered a mutually acceptable plan and is the Recommended Plan for FIMP. The Recommended Plan is shown in Figure 3 and Figure 4 and summarized in Sections 2.2.1 through 2.2.8 below. Details on specific monitoring methods and data analysis can be found in Sections 4.4 and 4.5 of this MAMP.

Additional details of the Recommended Plan for each of the project sub-reaches, the type of breach response plan, and the Life Cycle Plan following project construction for can be found in the GRR Main Report and Appendices.

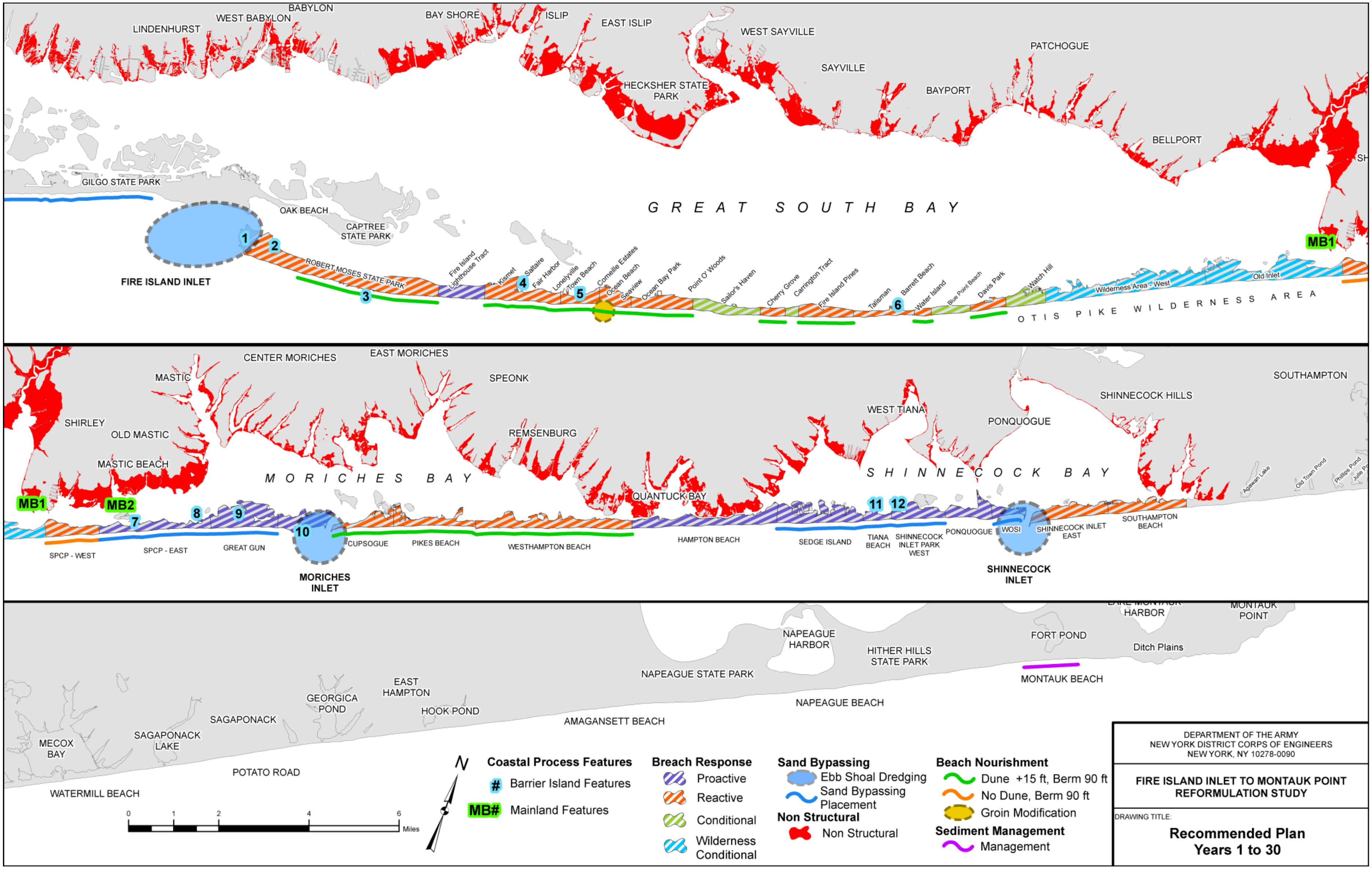

Figure 3. Recommended Plan (Years 1 to 30)

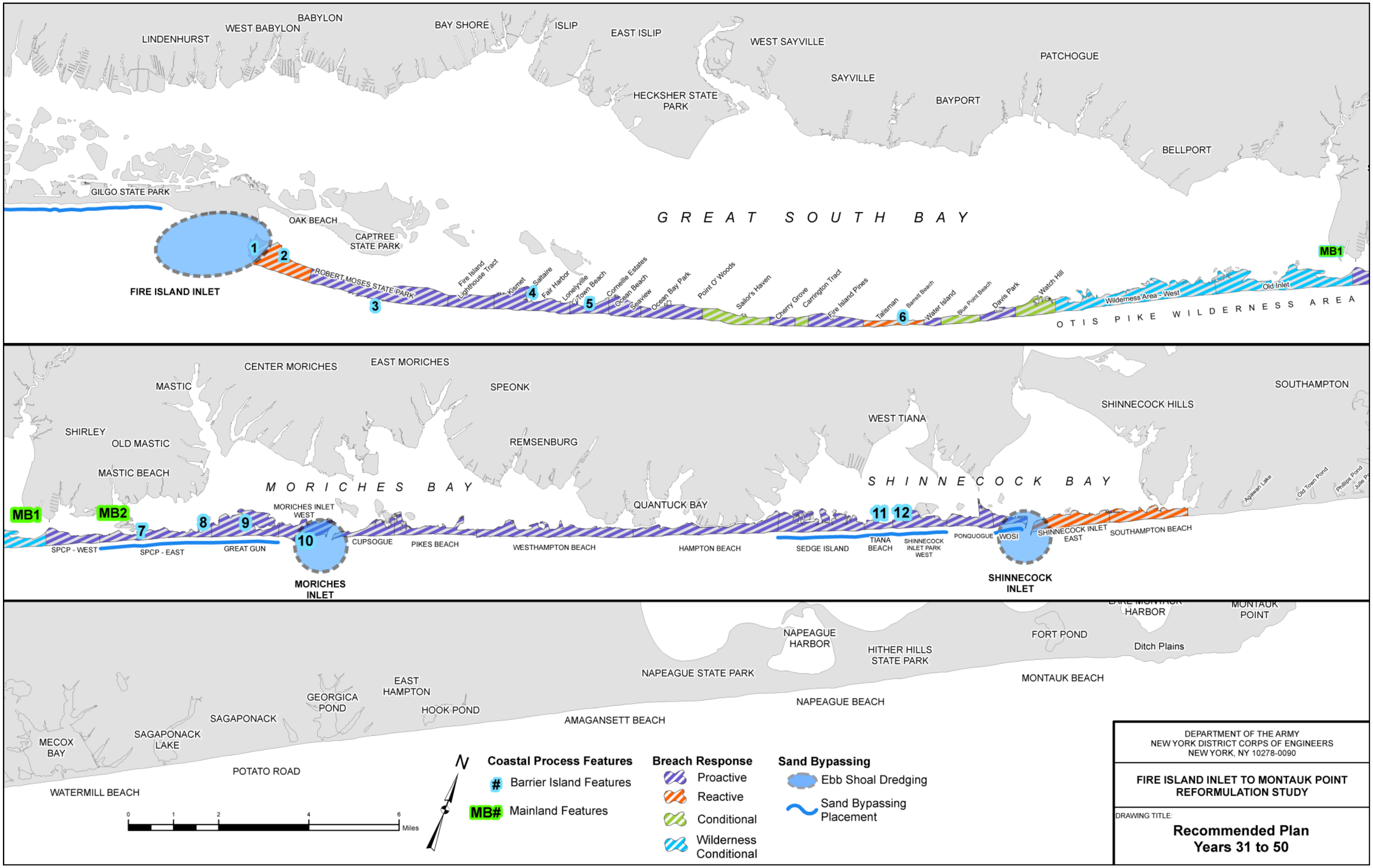

Figure 4. Recommended Plan (Years 31 to 50)

2.2.1 Inlet Sand Bypassing

- Provides for sufficient sand bypassing across Fire Island, Moriches, and Shinnecock Inlets to restore the natural longshore transport of sand along the barrier island for 50 years (see Section 6.2 of the FIMP GRR for estimated sand volumes by inlet). Scheduled O&M dredging of the authorized navigation channel and deposition basin with sand placement on the barrier island will be supplemented, as needed, by dredging from the adjacent ebb shoals of each inlet to obtain the required volume of sand needed for bypassing.
- The bypassed sand will be placed in a berm template at elevation +9.5 ft. NGVD in identified placement areas, which allows for overwash to the maximum extent practicable while also providing coastal storm risk management benefits.
- Monitoring is included to facilitate adaptive management changes.

2.2.2 Mainland Nonstructural

- Addresses approximately 4,432 structures within the current-year USACE modeled 10-year floodplain using nonstructural measures, primarily, structural elevations and building retrofits, based upon structure type and condition.
- Includes localized acquisition in areas subject to high frequency flooding, and reestablishment of natural floodplain function.

2.2.3 Breach Response on Barrier Islands – Provides for the following types of Breach Response

- <u>Proactive Breach Response</u> – is a response plan which is triggered when the beach and dune are lowered below a 4% level of performance (i.e., the 4% chance of annual exceedance, colloquially known as the “25-year level of risk management”), and provides for restoration of a dune at +13 ft NGVD and a 90 ft berm.
- <u>Reactive Breach Response</u> – is a response plan which is triggered when a breach has physically occurred, e.g. the condition where there is an exchange of ocean and bay water during normal tidal-cycle conditions. It is utilized, as needed, in locations that receive beach and dune placement, and also in locations where there is agreement that a breach should be closed quickly, such as Robert Moses State Park and the Talisman Federal tract. The Talisman area was recommended for this response due to high vulnerability, deep water in the back bay, and new infrastructure connecting communities to the east and west of the area.

- Conditional Breach Response – is a response plan that applies to the large, Federally-owned tracts within Fire Island National Seashore. During a conditional breach response the Breach Response Team, including the Superintendent of the National Seashore, determines whether the breach is closing naturally, and if found not to be closed at Day 60, that closure would begin on Day 60. Conditional Breach closure provides for restoration of a beach with a 90 ft. wide berm at elevation +9.5 ft. and no dune.
- Wilderness Conditional Breach Response – is a response plan that applies to the Otis Pike Fire Island High Dune Wilderness area of Fire Island National Seashore, where the Breach Response Team and Superintendent of the National Seashore determine whether a wilderness breach should be allowed to evolve, grow, or be closed, based upon natural barrier island processes and whether wilderness breach closure would prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas, as described in the National Seashore's enabling legislation.

2.2.4 Beach and Dune Fill on Shorefront

- Provides for a 90 ft. wide berm and +15 ft. dune along the developed shorefront areas on Fire Island and Westhampton barrier islands, for the purpose of coastal storm risk management.
- All dunes will be planted with dune grass except where otherwise as detailed in the Recommended Plan description as presented in the GRR. Sand fencing is not part of the proposed plans and specifications.
- On Fire Island, the post-Sandy optimized alignment of the dune is followed and includes overfill in the developed locations to minimize tapers into Federal tracts.
- Renourishment takes place approximately every 4 years for up to 30 years after project completion; while proactive breach response takes place from years 31 to 50.
- Provides for adaptive management to ensure the volume and placement configuration accomplishes the design objectives of offsetting long-term erosion.
- Provides for construction of a feeder beach every 4 years for up to 30 years at Montauk Beach.

2.2.5 Groin Modifications

- Provides for removal of the existing Ocean Beach groins.

2.2.6 *Coastal Process Features (CPFs)*

- Provides for 12 barrier island locations and two mainland locations (Figure 3 and Figure 4) as coastal process features.
- Includes placement of approximately 4.2 M CY of sediment in accordance with the Policy Waiver obtained by the ASA(CW) in order for FIMP to be a mutually acceptable plan between the Department of the Army and the Department of the Interior. Sediment will be placed along the barrier island bayside shoreline over the 50 year project period of analysis that reestablishes the coastal processes consistent with the agreement reached to achieve no net loss of habitat or sediment. The placement of sediment along the bay shoreline will be conducted in conjunction with other nearby beachfill or inlet bypassing operations to create efficiencies.
- The CPFs will compensate for reductions in cross-island transport and sediment input to the Bay, offset Endangered Species Act impacts from the placement of sediment along the barrier island oceanfront, augment the resiliency of the project area, and enhance the overall barrier island and natural system coastal processes.

2.2.7 *Adaptive Management*

- Provides for monitoring and the ability to adjust specific project features to improve effectiveness and achieve project objectives.
- Observed Climate change will be accounted for with the monitoring of climate change parameters, identification of the effect of climate change on the project design and identification of adaptation measures that are necessary to accommodate climate changes as it relates to all the project elements. The USACE Climate Preparedness and Resilience Community of Practice (CPR CoP), among other experts, will take part in adaptive management planning to help the Adaptive Management Team make informed, science-based recommendations for action.
- Sea level rise will be accounted for through comparison of actual sea level rise to the USACE projections used during project formulation, and adaptation measures necessary to accommodate sea level rise will be identified for all project elements. The Adaptive Management Team will consider at a minimum USACE sea level rise projections during adaptive management planning. The USACE CPR CoP and other experts will take part in adaptive management

planning to help the Adaptive Management Team make informed, science-based recommendations for action.

2.2.8 *Integration of Local Land Use Regulations and Management*

- Upon project completion, the USACE's Project's Annual Inspection of Completed Works (ICW) program provides for monitoring and reporting of any new development within the project area to the appropriate Federal, state, and local entities responsible for enforcing applicable land use regulations.

- USACE can discourage development within the project area through annual inspections and monitoring of the completed project in accordance with the project's Easement Language, Project Partnership Agreement (PPA) and Operation, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R) manual (legally binding agreements) that are prepared in cooperation and coordination with the non-Federal sponsor and cooperating agencies. Failure for these easements to remain undeveloped for the project life may result in the project being removed from the ICW program and also limit the Corps' ability to renourish the project. A project that is removed from the ICW program is not eligible for Federal disaster funding under Public Law 84-99 that provides for project repair (to design standards) as a result of a disaster declaration.

- Changes to local land use and land use regulations that impacts project features will be incorporated into the adaptive management of project features.

3.0 GOVERNANCE & MANAGEMENT STRUCTURE

This section describes the proposed structure for the Adaptive Management Team. The structure includes four groups which comprise the Adaptive Management Team: the Executive Steering Committee (ESC), Adaptive Management and Monitoring Oversight Committee, Technical Advisory Group (TAG), and Data Management Team. This section also establishes lines of communication that facilitates coordination between each group. See Figure 5 for a summary of the proposed team structure.

3.1 Adaptive Management Team

At a minimum, the Adaptive Management Team will include staff from the following Federal and state agencies:

- DOI OEPC
- NPS
- NYSDEC
- NYSDOS
- Suffolk County
- USFWS
- USGS
- USACE

At least one staff member will represent each of these agencies. For agencies with multiple offices or functions, it is expected that more than one representative from that agency will participate on the Adaptive Management Team, with members appropriately distributed throughout the groups described above. For example, the NPS may be represented by staff from both the Fire Island National Seashore office and Interior Region 1 office. Staffing is at each agency's discretion. It is expected that each representative will have an understanding of local coastal processes and ecological communities.

Local government agencies and/or stakeholder groups may participate on the Adaptive Management Team, as decided by team representatives, and in accordance with the Biological Opinion (e.g. Reasonable and Prudent Measure #4 requires that USACE meet with the Service and Landowners each year before and after the piping plover breeding season). Academic and research institutions may also participate on the Adaptive Management Team. These groups may include the USACE Engineering Research and Development Center, Stony Brook University, and Cornell University. As the Adaptive Management Team updates this MAMP, external stakeholders (e.g. municipalities, NGOs, etc.) will be identified and their appropriate place within the implementation structure will be identified.

A formal documentation of the Adaptive Management Team's organizational structure, communication methods, decision making processes, risk management, and reporting processes will be developed during PED. For the purposes of this MAMP, "charter" is used to define this document, though it could take another form (e.g., Memorandum of Agreement, Memorandum of Understanding); the Adaptive Management Team will decide which type of document is most appropriate. Where appropriate, the Communication Plan from the Programmatic Biological Opinion (see Attachment 4) will be incorporated into the charter.

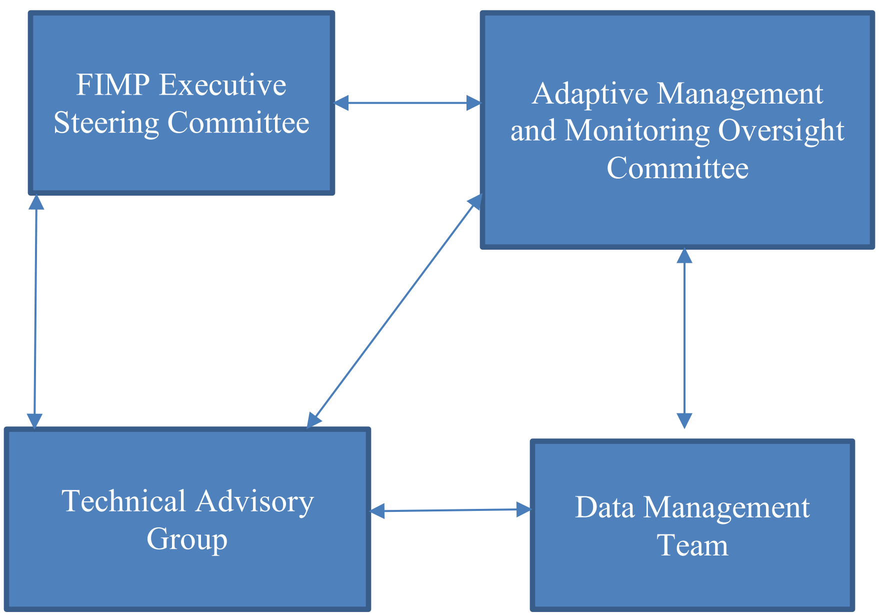

Figure 5. Adaptive Management Team Structure

The Adaptive Management Team will serve as the body overseeing the recommendation and implementation of monitoring and adaptive management actions. They will be responsible for overseeing the development of adaptive management policy, processes, and procedures.

The Adaptive Management Team will provide the following major functions:

- Recommending monitoring activities (i.e., scope, location, timing)
- Defining project performance objectives
- Defining project performance metrics, thresholds, and triggers
- Recommending adaptive management actions to decision makers
- Sharing information between agencies, academic institutions, stakeholder groups, and the public
- Coordinating public communication, as necessary

3.1.1 FIMP Executive Steering Committee

The FIMP Executive Steering Committee is an existing group that will continue into design and construction, and will include senior leaders from the following Federal and state agencies:

- DOI PPA
- NPS
- NYSDEC
- NYSDOS
- Suffolk County
- USFWS
- USGS
- USACE

The ESC will vet MAMP issues and consider recommendations for adaptive management or monitoring activities from the Adaptive Management and Monitoring Program Oversight Committee, the Technical Advisory Group, and the Data Management Team. The ESC will make determinations of whether monitoring or adaptive management actions are required. If the ESC determines that there is a need for adaptive management, a determination is made as to whether the recommended adaptive management is within the authority of the USACE New York District Commander to implement. Depending on the details of the recommendation, such as location, jurisdiction, aspect (i.e., change in renourishment, land use change, operation and maintenance measure, etc.), additional approvals may be necessary (e.g., approval by USACE North Atlantic Division [NAD] or HQUSACE, or congressional authorization) prior to implementation of the adaptive management action. Approvals may also be required if additional funding is needed for implementation.

3.1.2 Adaptive Management and Monitoring Program Oversight Committee

The Adaptive Management and Monitoring Program Oversight Committee will report to the ESC and provide progress reports as necessary on the status of monitoring efforts and project results. [see Attachment C for current team members]. The Committee will:

- Provide recommendations regarding the need for adaptive management actions to better meet expected goals and objectives.
- Identify additional monitoring or adaptive management requirements and set priorities for the TAG, as needed.
- Work with the TAG to establish the MAMP and determine scales for monitoring and adaptive management actions.
- Be responsible for administrating the implementation of adaptive management, monitoring and assessment processes detailed in the MAMP.
- Ensure that the monitoring data and assessments being produced are properly used to determine project success and to inform future decision-making.
- Lead the effort to compile lessons learned from monitoring and adaptive management and to assist the FIMP Team in making the best possible decisions regarding future design and implementation strategies.

3.1.3 Technical Advisory Group

The TAG will be involved in the pre-construction, during-construction, and post-construction monitoring and adaptive management activities. The purpose of the TAG is to bring together the necessary technical experts to develop monitoring and assessment protocols required to determine whether performance measures have been met and ecological success has been achieved. During pre-construction, the TAG will:

- Document the methods, procedures, and monitoring sampling design necessary to evaluate ecological success.
- Develop the potential adaptive management processes that could be implemented if the project is not performing as expected.
- Coordinate with and leverage other monitoring efforts where possible to reduce FIMP monitoring costs and design an approach consistent with other ongoing monitoring efforts.
- Develop a conceptual ecological model (CEM), using existing information where possible, including development of performance measures, success criteria and triggers which will be used to evaluate project performance.

- Develop the specific details of the protocols for processing, analyzing, and summarizing the data collected through the MAMP.
- Develop the methodology for assessments to evaluate project restoration progress and to determine if adaptive management is needed; including identification of potential adaptive management actions should a contingency plan be needed.

In addition to the pre-construction planning activities, the TAG will:

- Be involved during and post construction as the MAMP is implemented and the project is monitored and assessed to understand the responses of the system to project implementation and relative to the established performance measures.
- Work with the Oversight Committee to ensure that all monitoring data collection, processing, and analysis are consistent and in accordance with protocols developed in the MAMP. More specifically, the TAG will be responsible for actual project performance assessment and interpreting that performance based on data analyses.
- Produce periodic reports that measure progress towards project goals and objectives and make recommendations to the Adaptive Management and Monitoring Program Oversight Committee to improve MAMP performance.

The TAG is divided into Official TAG Team and Reach-back Tag Team members. The Official TAG Team will be responsible for producing future versions of the MAMP. A subset of the Official TAG Team is a core team that will be responsible for initially drafting work products and sending draft products to the rest of the team for review, as well as providing comments and additional input as necessary. Reach-back TAG Team members are a potential technical expert resource that may be needed and will be brought in as necessary to support Core and Official team members. [A list of TAG members will be documented in Attachment C.]

3.1.4 Data Management Team

A Data Management Team will be developed to facilitate the management of data and information available for FIMP. This includes data collected directly for the project and by outside agencies and organizations in support of the project, including historical datasets, ongoing monitoring collections and new data collections. The Data Management Team has representation on the TAG and will develop the data standards for inclusion in the MAMP. The Data Management Team will:

- Develop and provide the decision-support tools necessary to compare historical trends and management strategies within the FIMP area.
- Incorporate transparency into data and information delivery and visualizations, and this will facilitate determinations of restoration progress, adjustments to restoration strategies as needed, and demonstrations of lessons learned.

A list of Data Management Team members will be documented in Attachment C.

3.1.5 Technical Sub-Teams

The Adaptive Management Team may set up ad-hoc teams to coordinate on specific matters. For example, a sub-team focused on compliance with the Endangered Species Act (ESA) will be convened. These sub-teams will report to the Adaptive Management Team, or appropriately nested within one of the above groups.

3.2 Communication Structure

A charter defining the Adaptive Management Team's communication structure will be developed during PED. It is expected that the Adaptive Management Team will meet on a periodic basis virtually or at face-to-face meetings on Long Island or in New York City. Ad-hoc meetings may be held to facilitate problem solving, reporting, and pre- and post-disaster coordination.

3.3 Decision Making and Reporting Process

Decision making is the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions. Using a step-by-step decision-making process can help the Adaptive Management Team make more deliberate, thoughtful decisions by organizing relevant information and defining alternatives. A charter defining the Adaptive Management Team's decision making and reporting process will be developed during PED. Decision makers and reporting pathways will be clearly identified in the charter.

3.4 Management Decisions, Risk and Uncertainty

What makes adaptive management different from traditional research is the relevance to management: adaptive management focuses on operational-scale learning that is specific to enabling greater confidence in management decisions, answering questions of greatest importance in making management decisions. This is why the identification of critical uncertainties, and participation of senior managers, is so important in the adaptive management approach: successful and meaningful adaptive management requires understanding what it is that managers need to know to increase their confidence in decision-making. It also requires understanding their “decision space” – the range of decisions currently facing managers in the FIMP project area, and the degree of flexibility they have in making these decisions. Understanding the “decision space” pertaining to management affecting project goals is important when determining what critical uncertainties and underlying hypotheses will be the focus of learning through adaptive management as well as when designing how to test these hypotheses. It also helps clarify the intended audience for what is learned through the application of adaptive management.

A charter defining the Adaptive Management Team’s risk management process will be developed during PED. The Adaptive Management Team will use the Institute for Water Resources Report 92-R-1 “Guidelines for Risk and Uncertainty in Water Resource Planning” as a resource.

Risk is defined as a situation where the decision maker knows all the alternatives available but each alternative has a number of possible outcomes. Sources of risk and uncertainty that may affect project performance include:

- Climate change
- Relative sea level change
- Disasters such as coastal storms
- Storm frequency
- Breach formation and response
- Fill Effectiveness
- Effectiveness of CPFs
- Cross-island sediment transport
- Alongshore sediment transport
- Funding availability

4.0 ADAPTIVE MANAGEMENT PROCESS

As described in the previous sections, adaptive management was specifically identified as a project component to ensure that feature construction and maintenance over time continues to advance the study objectives in an efficient manner. Adaptive management recognizes that the variability of physical elements, storm risk, and human responses introduce uncertainty to a situation that is already uncertain due to the complexities of evaluating the system.

The overall Adaptive Management Process illustrated below is to be followed during the implementation of the project. It provides for monitoring of the various project features, evaluating the results of the monitoring in terms of meeting project objectives and making adjustments as appropriate and needed, that are consistent with project authority and funding limitations.

4.1 Adaptive Management Approach

The level of detail in this MAMP is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Components of the plan, including costs, were similarly estimated using currently available information. Uncertainties will be addressed in the PED phase. Additional details will be added to this MAMP as the design advances and coordination amongst the Adaptive Management Team continues. The approach to adaptive management will incorporate, to the extent feasible, the interagency recommendations related to adaptive management for climate change adaptation, namely: collaborative governance; scientific coordination forums; risk and uncertainty management; planning/design/implementation flexibility; and cost-effective adaptive management (USACE 2013a).

Uncertainties or variables that persist throughout the project study period include both environmental variables, such as sea level rise, storm frequency, and breach formation, and those related to processes that could be managed:

- Re-nourishment needs and timing (which is subject to the availability of funds);
- Inlet bypassing needs and timing;
- Breach management;
- Feeder beach needs and timing and interaction with adjacent structures;
- Voluntary participation and pace of completion of nonstructural program;

- Application of land use policies in at-risk communities.

Given these uncertainties and variables, the project provides an incremental adaptive management approach that allows for adaptive management of the project features as appropriate so as to achieve the project goals of storm risk management that is consistent with the overall natural coastal processes.

As part of the adaptive management approach, the Adaptive Management Team and/or its groups would meet on a regular basis to determine whether any of the plan features need to be adaptively managed.

Meetings of the Adaptive Management Team will be initiated at year 1 and will be held biannually through year 4, and every four years thereafter, as well as after every major storm. Additional meetings can be called as needed. Technical teams will confer upon the conclusion of each data assessment report. The ESA sub-team will meet more frequently, consistent with the schedule detailed in the Biological Opinion.

It may be appropriate to use a facilitator to guide Adaptive Management Team meetings. Ideally this individual would have knowledge of the FIMP area and experience with adaptive management.

4.2 Adaptive Management Framework

Adaptive management is a process of iterative decision making, based on best available data, best management practices for resource management, and informed learning. Pursuant to Federal agency policies and practices (USACE 2013b) the framework for adaptive management typically includes the following major elements:

- Recognition of uncertainty about the impacts of drivers (e.g., climate, land use change) and the effectiveness of managing their consequences;
- Monitoring and reporting of resource responses to management, with a focus on evaluating management effectiveness, gaining new knowledge, and improving future management actions;
- Data management and sharing;
- Decision support (e.g., vulnerability analysis, risk assessment, scenario planning) for decision making under uncertainty.

During implementation, monitoring is used to track changes in drivers and resource responses, so as to evaluate project success as demonstrated by achievement of identified project goals and improve management as information is accumulated. The monitoring data is important to improve understanding and increase knowledge about the resource system and thereby provide for informed decision making. Decision support is a means to promote sound decision making in the face of ongoing uncertainty, by way of a comparative analysis of management options' effects on program or project goals and objectives (USACE 2013a). The results of the data analysis are compared to the project objectives, design criteria and success metrics, as applicable, so that the Adaptive Management Team can assess whether implementation should proceed as per the original project design, or if management actions are needed to successfully achieve the objectives.

4.3 Adaptive Management Implementation

Adaptive management implementation for the project includes the following:

1. Monitoring: Physical and Biological Data Collection
2. Assessment: Data review and analysis by FIMP Adaptive Management Team to identify possible modifications or adaptations to a project feature in order to achieve project objectives.
3. Decision Support: Review of analyses and recommendations of Adaptive Management Team and determination of whether the authority and funding exists to adapt recommendation or whether further actions and approvals are required.

Figure 6 provides an example of a schematic of the Implementation Phase for USACE adaptive management.

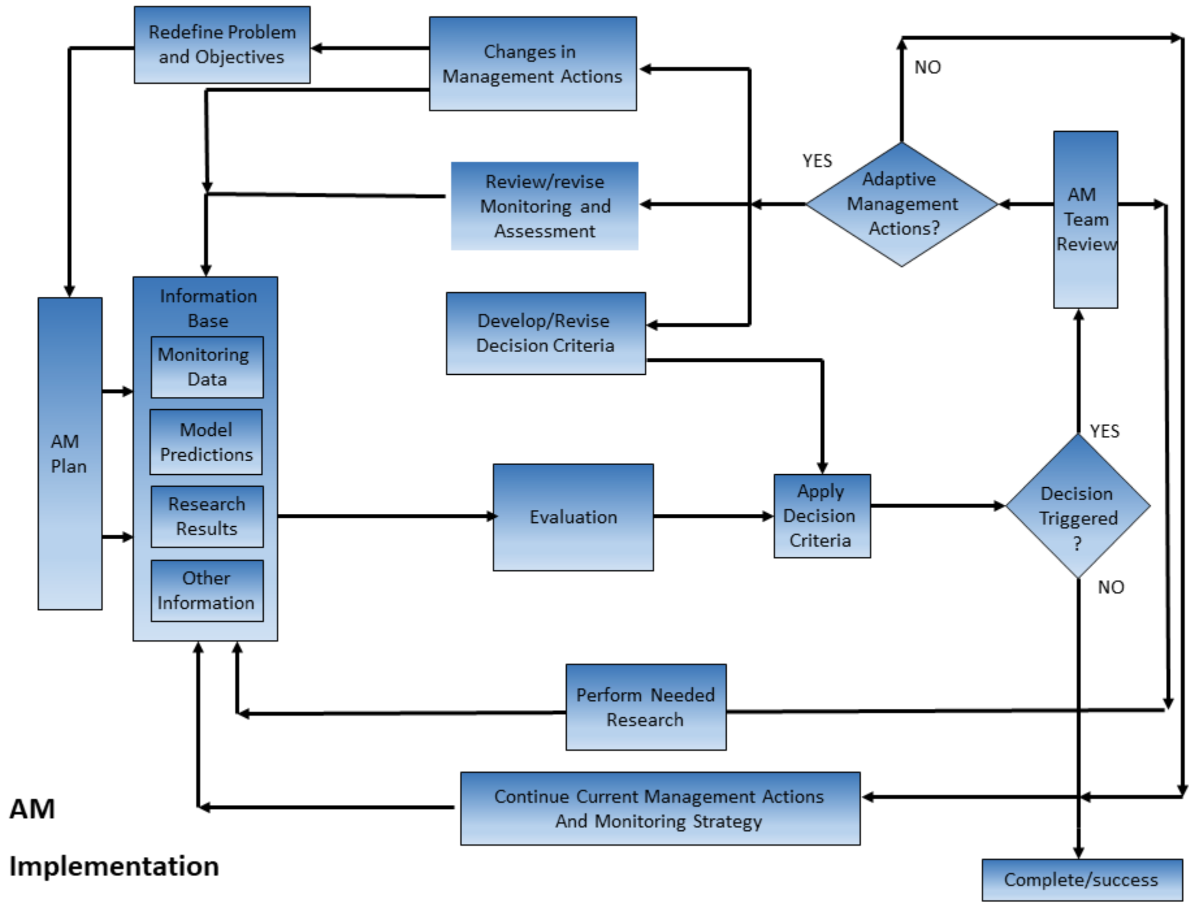

Figure 6. Schematic of the Implementation Phase for USACE adaptive management

4.4 Monitoring and Adaptive Management Objectives for Project Features

Overall the purpose of monitoring is to determine whether the project objectives are being met or whether modifications to the implementation (i.e., adaptive management) are necessary to achieve objectives. As highlighted previously, it is important to note that the scope of the proposed monitoring is two-fold, 1) to support continuing construction and adaptive management of the plan, and 2) to satisfy compliance requirements, and confirm the impacts as presented in the February 2020 FIMP EIS. As such, some monitoring activities may not directly contribute to adaptive management. The monitoring and adaptive management objectives for each project feature, as summarized in Attachment E (Table J-1), are as follows:

- Inlet Sand Bypassing. Determine if the scheduled O&M dredging in conjunction with the additional sand bypassing is adequately restoring natural longshore sediment transport or if further dredging of the adjacent ebb shoals or other measures are needed to restore this coastal process. Identify opportunities to utilize inlet material to accomplish other project features, specifically those associated with CPFs, such as ESA habitat improvements to meet conditions of the Biological Opinion and bay side sediment placement quantity commitments.

- Beach and Dune Fill on Shorefront. Assessment of beachfill performance, refinement of renourishment schedule and locations in consideration of allowable variability in design, accounting for alignment changes based upon nonstructural plan implementation, consideration of durations, changed structure inventory at risk, as well as available fill volume. Identify opportunities to achieve other project objectives, including meeting cross island sediment transport goals, and re-establishing CPFs, such as ESA habitat improvements to meet conditions of the Biological Opinion and bay side sediment placement quantity commitments.

- Proactive Breach Response and Dune Fill on Shorefront. Enable refinement of breach triggers and implementing procedures, optimization of maintenance requirements, and improved integration of habitat improvements. Identify opportunities to achieve other project objectives, including meeting cross island sediment transport goals and re-establishing CPFs, such as ESA habitat improvements to meet conditions of the Biological Opinion and bay side sediment placement quantity commitments.

- Reactive Breach Response (including Reactive, Conditional and Wilderness Breach Responses). The Breach Response Team has the lead in identifying the appropriate breach response. In developing the design of the breach response, the Adaptive Management Team will provide input as to opportunities to achieve other project objectives, including meeting cross island transport goals and re-establishing CPFs, such as ESA habitat improvements to meet conditions of the Biological Opinion and material placement quantities. Monitoring is undertaken to determine the appropriateness of breach response actions.

- Sediment Management at Montauk Beach. Assess the effectiveness of feeder beach and sediment management and the performance of the periodic renourishments over the sand bags placed at Montauk Beach as part of the Downtown Montauk Project, and modify as necessary to achieve project objectives. Evaluate the stability and functioning of the previously placed sand bags.

- Coastal Process Features – Barrier Island. Evaluate the relative effectiveness of the CPFs in reestablishing coastal processes to offset impacts associated with changes to cross island sediment transport and associated effects on endangered species habitats. Monitoring will enable tracking of the material placement volume as compared to the commitment quantity of 4.2 million cubic yards and will document that conditions of the Biological Opinion are being met. It is recognized that some CPFs, or components of some CPFs (e.g. living shoreline components) will require unique monitoring measures and evaluation criteria, which will be discussed in future versions of the MAMP.

- Coastal Process Features – Mainland. Evaluation of the relative effectiveness of the mainland CPFs in restoring natural floodplain function.

- Groin Fields. Evaluate the effect of the removal of the existing Ocean Beach groins on shoreline change and longshore sediment transport. Continued monitoring of Georgica Pond and Westhampton Groin fields to affirm function and impact to sediment budget.

- Borrow Areas. Assessment of borrow area biotic and abiotic conditions with repeated use and evaluation of the effects of repeated use on sediment transport. Refinement of the volume of suitable material in the borrow areas available for renourishment and, if necessary the need to identify alternative borrow areas.

4.5 Monitoring Parameters for Project Features

Monitoring of physical and biological parameters will be necessary to enable the evaluation and assessment of success of the various project features, and the overall achievement of the project goal. The various data and measurement parameters or metrics relevant to the assessment of the project features are summarized below and discussed in detail in the physical and biological monitoring sections of this document (Sections 7 and 8, respectively) and listed in Attachment E (Table J-2). To supplement the planned monitoring efforts, existing data and information collected by others will be identified and obtained. For example, sediment volumes removed from inlets and boat basins and subsequent bathymetry obtained during routine maintenance dredging will be acquired from the USACE New York District Operations Division. In addition, biological monitoring data collected by landowners, such as piping plover and least tern data will be obtained from the NPS, NYSDEC and Suffolk County.

- Inlet Sand Bypassing. LIDAR data and bathymetry will be used to generate shoreline profiles and inlet morphology. These can be used, along with current velocity and other parameters to: model sediment transport, and update sediment budgets; evaluate the influence of sea level change and erosion rates on inlets and sand bypassing; determine the available sand volume; and assess the success of this project feature.

- Beach and Dune Fill on Shorefront (including Proactive Breach Response Reaches). LIDAR and aerial photography and other physical parameters will be used to evaluate and monitor shoreline change and beach profiles. In addition, wave measurements and water levels, sediment transport modeling, as well as ESA habitat conditions and vegetation, will also be considered when assessing the success of the beach and dune fill project features.

- Reactive Breach Responses. LIDAR and aerial photography and other physical parameters will be used to evaluate and monitor shoreline change and beach profiles within the various breach response areas. In addition, wave measurements and water levels, as well as ESA habitat conditions, will also be considered when assessing the success of the breach response project features.

- Borrow Areas. Bathymetry data will enable an assessment of subaerial morphologic changes at the borrow areas. Together with grain size analysis, these data will enable quantification of suitable material available for renourishment and will provide input to the sediment transport model. Biological monitoring of the benthic community will allow assessment of the impact associated with repeated use of these locations for renourishment.

- Sediment Management at Montauk Beach. LIDAR and aerial photography and other physical parameters will be used to evaluate and monitor the effectiveness of the feeder beach and sediment management and the performance of the periodic renourishments over the sand bags placed at Montauk Beach as part of the Downtown Montauk Project, as well as the stability and functioning of the previously placed sand bags. Sediment compatibility will be monitored in accordance with the Conservation Measures in the BO.

- Groin Fields. LIDAR and aerial photography and other physical parameters will be used to evaluate and monitor the effect of the Ocean Beach Groin removal on shoreline change and longshore sediment transport, and the condition and functionality of the Georgica Pond and Westhampton Groin Fields.

- Coastal Process Features – Barrier Island. Both physical and biological parameters, including LIDAR, aerial photography, vegetation cover, and ESA species surveys, will be used to evaluate and monitor the functioning and success of CPFs. Sediment compatibility will be monitoring in accordance with the Conservation Measures in the BO.

- Coastal Process Features – Mainland. Physical parameters such as water level and hydrology, and biological parameters, such as vegetation cover, will be used to evaluate and monitor the functioning and success of mainland CPFs.

4.6 Evaluation and Adaptive Management of Project Features

Considering the complex and interrelated characteristics of the project features and monitoring parameters, the designation of a numerical threshold or "line in the sand" type of trigger for adaptive management is not realistic in most cases. The Adaptive Management Team will need to holistically consider the results and findings of the monitoring efforts and assessments and contributing factors. Potential conditions under which adaptive management would be applicable for each project feature are identified below, along with thresholds, if applicable. These considerations, factors and potential adaptive measures are also summarized in Attachment E (Table J-1).

- Inlet Sand Bypassing. Sea level change, erosion rate, shoreline condition and change, bathymetry and available material, as well as island and bay profiles and the results of sediment transport modeling will be considered when evaluating whether adaptive management is appropriate for the Inlet Sand Bypassing plan feature. If monitoring indicates that these parameters are consistent with predictions, Inlet Sand Bypassing would continue as planned. If these parameters differ substantially from expectations, then the Adaptive Management Team would need to consider whether divergence from the plan is necessary. Potential adaptive measures for Inlet Sand Bypassing include: altering dredge frequency, altering dredge depth and/or width, modifying the extent of ebb shoal dredging, altering sand placement locations or augmenting sand volume with material from other sources.

- Breach Response. The Breach Response Team would have primary responsibility for any adaptive management related to breach response. The frequency and severity of breaches, shoreline conditions, beachfill and dune profiles and endangered species presence will be considered when evaluating whether adaptive management is appropriate for the various Breach Response plan features. Conditions that differ substantially from predictions could necessitate adaptive management. Potential adaptive measures include: altering the triggers for action, beach/dune profile, bay shoreline configuration, prioritization of sand placement or re-evaluating the appropriateness of the designated breach response protocol for a location.

- Beach and Dune Fill on Shorefront. Sea level change, erosion rate, shoreline condition and change, bathymetry and available material, as well as island and bay profiles and the results of sediment transport modeling, wave measurements, oceanographic data and vegetation community mapping, as well as other appropriate metrics, will be considered when evaluating whether adaptive management is appropriate for the Beach and Dune Fill on Shorefront plan feature. If monitoring indicates that these parameters are consistent with predictions, and that the design levels can be maintained throughout the periodic re-nourishments as planned, adaptive management would not be necessary for this plan feature. If the parameters differ substantially from expectations, then the Adaptive Management Team would need to consider whether divergence from the plan is necessary. Potential adaptive measures for the Beach and Dune Fill on Shorefront include: altering the beach/dune profile, altering dune alignment, altering beachfill tapers, prioritizing sand placement locations or altering fill/renourishment frequency and volumes.

- Borrow Areas. Borrow area bathymetry, fill material quantity, suitability and compatibility, oceanographic data, sediment transport modeling results, as well as benthic community conditions and finfish and aquatic ESA monitoring results will all be taken into consideration when evaluating whether adaptive management may be required for the borrow areas. If all of these parameters and findings are consistent with expectations and predictions, adaptive management would not be required and the borrow areas would be used for renourishment as planned. If conditions differ from expectations, adaptive management may be required. Adaptive measures for the borrow areas may include: altering the borrow area profile and/or footprint, alternate use of individual borrow areas or identification of additional borrow areas.

- Sediment Management at Montauk Beach. The downdrift erosion rate, erosion rate of the feeder beach, sea level change, excessive downdrift accretion and the condition and effectiveness of the sand bags placed at Downtown Montauk will all be taken into consideration when evaluating whether adaptive management may be required for the Sediment Management at Montauk Beach plan feature. Alteration of the frequency and/or volume of material placement are potential adaptive measures.

- Groin Fields. Shoreline condition and change, and the beach profile will be considered during the detailed design phase for the Ocean Beach Groins Removal feature. Consequently, the need and type of potential future adaptive management will be re-assessed once the actual plan for this feature is identified. Shoreline condition and change, and the beach profile also be monitored for the Georgica Pond and Westhampton Groin Fields and the need and type of potential future adaptive management will be re-assessed.

- Coastal Process Features – Barrier Island. Endangered species presence and productivity, vegetation cover, and shoreline change monitoring are among the various factors that will be evaluated when assessing whether adaptive management is necessary for the CPFs. If the plover productivity goal is not met, adaptive management may be needed; however, the type of adaptive management would depend on the causes contributing to low productivity. Causes could include predation, human intrusion, weather, or excessive vegetation. Each would require different management measures, which may include predator management, human access management, vegetation management, altered material placement during renourishment or breach response protocol. Thresholds for ESA compliance, including vegetative cover thresholds, are fully detailed in the Biological Opinion, included in Appendix B to the February 2020 FIMP EIS. For reference, the adaptive management approach in from the Biological Opinion is summarized in Figure 7 and Table 2.

- Coastal Process Features – Mainland. Vegetation cover and water level will be evaluated when assessing whether adaptive management is necessary for the mainland CPFs. Adaptive measures may include vegetation management, hydrologic modifications or fill placement.

The preliminary adaptive management framework presented herein will be expanded upon and refined during the PED phase and will be continually updated by the Adaptive Management Team during construction and throughout the project life. Additional details that will be developed include identification of potential adaptations to plan features, such as potential adaptations to inlet management or nonstructural measures, as well as other changes that could be implemented based on the data, and evaluations gained through implementation of the monitoring efforts described herein.

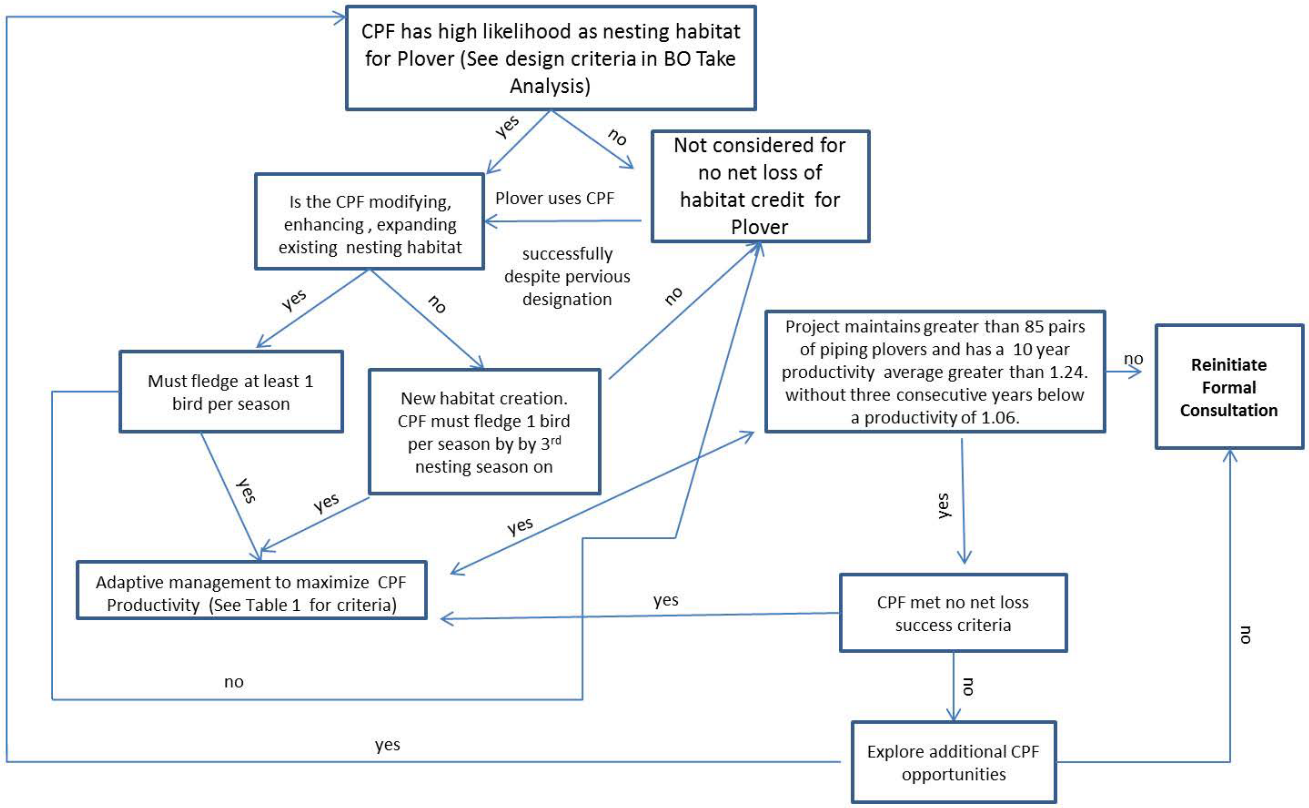

Figure 7: Piping plover no net loss success criteria credits and relationship to adaptive management. Note the reference to "table 1" is from the Biological Opinion. Table 2 below is the correct companion table to this figure. Source: Programmatic Biological Opinion – Effects of Fire Island Inlet to Montauk Point Coastal Storm Risk Management Project, Suffolk County, NY on Piping Plover (*Charadrius meiodus*) and Seabeach Amaranth (*Amaranthus pumilus*), Appendix D – Adaptive Management Plan

Table 2. CPF Monitoring, Success, Trigger and Thresholds

Source: Programmatic Biological Opinion – Effects of Fire Island Inlet to Montauk Point Coastal Storm Risk Management Project, Suffolk County, NY on Piping Plover (*Charadrius meiodus*) and Seabeach Amaranth (*Amaranthus pumilus*), Appendix D – Adaptive Management Plan

Criteria	Ocean	Bay	Fully successful	Minimally successful	Trigger - for adaptive management	Threshold for loss of Credit or Consultation Reinitiation
CPF success			Each CPF has greater than or equal to 1/2 pair per hectare with each nest fledging at least 1 bird each year of the nourishment cycle.	Each CPF fledges at least 1 bird per year	Trigger for each CPF: an individual CPF fledges less than 1 bird per year in nourishment cycle or vegetation exceeds 17% (Also see Table 2 for design criteria for other potential design failure)	An individual CPF fledges less than 1 bird per year in nourishment cycle or vegetation exceeds 30%; meet design criteria (Table 2)
Timing of CPFs and acreage			CPFs exceed no net loss for each nourishment cycle. Greater than 50% of acreage achieved within the first 15 years. Greater than 100% achieved in 30 years.	At least 1 new CPF created per nourishment cycle, 50% of acreage achieved within the first 15 years,100% achieved in 30 years	Less than 1 CPF created per nourishment cycle. CPFs do not continually meet design criteria (See Table 2)	Find alternative CPF or **re-initiate**
Project area Pairs			Combined project area is above 141 pairs annually.	Combined project area maintains or is above 141 pairs annually	Combined project area achieves between 86 pairs and 140 pairs annually	Project drops below baseline (baseline is average nesting pairs (141 pairs) from (2000-2017) minus allowable take (55 pairs)) = **85 pairs** for the project site. **Re-initiation necessary.**
Productivity			Project area maintains a productivity of greater than 1.5 fledglings per nest for at least 5 consecutive years.	Project area maintains productivity greater than 1.24 over 10 years and productivity does not fall below 1.06 for three consecutive years	Productivity falls below 1.06 in 3 consecutive years. And cause is either unknown or can be attributed to project activities.	Productivity falls below 1.06 for four consecutive years in the project area. And cause is either unknown or can be attributed to project activities. **Re- initiation necessary**. Productivity falls below 1.24 over 10 years. And cause is either unknown or can be attributed to project activities. **Reinitiation necessary.**
	Re-initiation trigger					
	CPF no credit					

The decision to implement adaptive management measures and the corresponding recommended action will also need to consider factors such as limitations related to project authorization, property ownership, and funding. Recommendations of the Adaptive Management Team may include implementation of actions that would need to be undertaken independently by team members or other entities.

A summary the adaptive management process for each plan feature is presented in Attachment E (Table J-2), including the metrics that will be measured and taken into consideration when evaluating the need for adaptive management, the considerations and constraints that would need to be factored into the assessment process, and potential adaptive measures that may be recommended and implemented. Thresholds that would “trigger” the need for adaptive management are also identified.

4.7 Analysis, Summary, and Reporting

Data analysis and reporting responsibilities will be shared between project and programmatic adaptive management efforts in order to provide reports for the FIMP Adaptive Management Team, project managers, and decision-makers. The Adaptive Management Team will formally establish the question and answer formats for analysis, summary and reporting of adaptive inquiries of the “with project” condition and feature functions.

5.0 DATA MANAGEMENT

Database management is an important component of the monitoring plan and the overall adaptive management program. Data collected as part of the monitoring and adaptive management plans for the project will be archived in accordance with the plan developed by the Adaptive Management Team. Any special data requirements for any specific feature of the plan should be noted in the feature-specific sub-section of this MAMP.

5.1 Designated Systems and Best Management Practice

The data management plan will identify the computing hardware and any specialized or custom software used in data management for an adaptive management program. To facilitate data use by the FIMP Assessment and Adaptive Management Team, a centralized data management system and document repository will be set-up with input from the FIMP Assessment and Adaptive Management Team during PED. Existing data management programs or systems will be utilized, with customization as needed. The data managers will determine which approach best suits the needs of the overall adaptive management program.

The data management plan will be incorporated into the overall MAMP, either in the main body of the plan or as an appendix.

6.0 MONITORING AND ADAPTIVE MANAGEMENT COSTS

Costs associated with the MAMP include the monitoring of the various project features, evaluating the results in terms of meeting project objectives, and making recommendations for adjustments to the project features, as appropriate and needed, consistent with project authority and funding limitations. If outside the project authority and funding, implementation of adaptive management recommendations may require supplemental approvals and authorizations.

A summary of the physical and biological monitoring efforts planned at this time, including the locations, duration and frequency of monitoring is presented in Attachment E (Table J-2). This table also identifies the plan features that are associated with the monitoring parameter or metric for consideration in the adaptive management process.

The costs of the monitoring are included in the Total Project Cost Summary (TPCS) and are summarized in Attachment 5 (Tables J-3 and J-4) for the physical and environmental monitoring components, respectively. The cost estimate includes the costs of data analysis and management, report preparation and meeting attendance by USACE staff. The cost estimate will be updated as additional information is available and the monitoring requirements are refined during the PED phase. Much of the monitoring will provide information regarding the status of multiple plan features. Whenever feasible, monitoring results (such as aerial photography and LIDAR survey data) will be shared across disciplines and between technical specialists to assess different plan features most cost effectively. Significant uncertainties remain as to the exact project features, monitoring elements, and the nature and extent of adaptive management actions to be recommended.

Included in data management will be to track the sand placement throughout the project, including the initial construction and renourishments. The material origin location details (i.e., inlet, ebb shoal or borrow area) placement location details (i.e., breach response areas, beach and dune fill areas and CPFs) and volumes will be documented and tracked. In addition the data management plan will track and report on progress in meeting the commitment to place 4.2 MCY of sand in CPF's on the bayside of the barrier island to offset the anticipated reduction in cross island transport due to the reduced frequency of breaches and overwash with the project in place.

7.0 PHYSICAL MONITORING

This section presents the Fire Island to Montauk Point (FIMP) Reformulation Feasibility Study physical monitoring plan. In general, coastal storm risk management projects are periodically monitored in order to:

- Establish baseline pre-project conditions;
- Document as-built conditions;
- Measure project performance;
- Track physical changes over time;
- Plan the timing and volumetric requirements of renourishment or other required maintenance;
- Evaluate the need for adaptive management and identify potential measures.

Monitoring can, in the long run, reduce project costs by optimizing future renourishment, maintenance and mitigation procedures. Moreover, a comprehensive engineering monitoring program can greatly increase knowledge of basic physical processes within the project area. Due to the vast size of the area covered by FIMP, monitoring of the project is, in fact, monitoring of the physical processes of the entire southeastern region of Long Island. The monitoring area includes ocean, bay, coastal ponds, and inlet coastal processes. It is intended that the project post-construction monitoring will become a useful component in intelligent management of the overall Fire Island to Montauk Point region. The monitoring parameters and the duration of the monitoring program will enable the monitoring of factors influenced by climate change and correspondingly, will allow for adaptive management to accommodate climate change as it relates to the project elements. Much of the physical monitoring elements will relate to multiple project plan features or elements; this inter-relatedness is captured in Attachment E (Table J-2). For example, the recommended frequency and schedule for physical monitoring activities is presented in Attachment E (Table J-2), with detailed discussion in the following sections.

7.1 Monitoring Elements

The Physical Monitoring Plan includes inspection, measurement and analysis of the following physical phenomena and coastal processes within the project boundary and project life:

a. General:
    - Periodic site inspection of shoreline condition and structure functionality
    - LIDAR topography and aerial photography
    - Shoreline changes and sediment budget update
    - Ocean wave height, period and direction
    - Water level measurement
    - Borrow area infilling
    - Monitoring elevation change

b. Beachfill:
    - Beach fill/dune profile evolution
    - Sediment sample collection and analysis
    - Post-placement fill characterization
    - Fill compatibility analysis for each renourishment

c. Inlet Management:
    - Inlet morphology evolution
    - Ebb/Flood shoal evolution
    - Deposition basin in-filling rate
    - Water level and current velocity
    - Updrift and downdrift topobathymetric change analysis

d. Groin Field Monitoring:
    - Shoreline and dune evolution including one mile both updrift and downdrift
    - Volume changes
    - Regional sediment budget

e. Breach Response Plan:
    - Storm, overwash and breach impacts
    - Cross-sectional volume
    - Updrift and downdrift topobathymetric change analysis

f. Sediment Transport Modeling:
    - Inner-shelf bathymetric changes
    - Sub aerial morphologic change
    - Wave, current, bed load and suspended sediment concentration measurements
    - Sediment transport modeling between the inner shelf and western Fire Island

g. Coastal Process Features:
   - Sand placement/feature profile changes
   - Erosion and overwash impacts

7.2 Monitoring Items and Methodology

The procedures and level of details of each monitoring elements are discussed in the following sections. More detailed scope of works will be prepared for individual monitoring elements during the PED phase.

a. <u>General</u>

1) Site Inspections. Site inspections will be performed regularly for on-the-ground evaluation of the condition of all project elements; all project shoreline fronting ocean and bay, and shoreline vicinity of project elements. Prior to initial construction, a thorough site visit will be performed to document pre-construction baseline conditions. Site inspections will be repeated immediately after completion of construction, and seasonally (every three months) for the first year post-construction. Site visits will be performed a minimum of twice a year (March-April and Sept-October time frame) for the second through fourth years post-construction which will coincide with the duration of the first full nourishment cycle. Following the first nourishment cycle, site inspections will be performed annually, in the March-April time frame. Additional site visits will be performed following major storm events as needed. For cost estimating purposes, one post-storm site visit per year is assumed. Both shoreline and structures are inspected with the following procedure:

- <u>Shoreline Inspection</u>. Site visits will document the general condition of all shoreline reaches, and will note observable erosion or accretion of beaches and dunes. Changes to bay shoreline will be observed and documented. Inspections will document any unusual conditions (e.g., erosion escarpment, other evident erosion or accretion that deviates noticeably from design), newly observed phenomena, or incursions into the project that are either natural or man-induced. Brief memoranda of all observations including still photographs will be compiled following each site inspection, distributed to the Adaptive Management Team, and kept as part of the project records. Recommendations will be included for any required maintenance, or more detailed investigation.

- <u>Structure Inspection</u>. All hard structures included in the project such as the groins, inlet jetties, and bulkheads as well as other shore protection elements will be visually inspected and documented. Structures will be inspected for both condition and functionality. Stone structures will be examined for any settlement, shifting or breakage of stone units, loss of interlocking, scour, overtopping, vandalism, etc. Structure function will be evaluated by examining the nearby beach and shoreline for evidence of impoundment, flanking, change in fill elevation, slope or width, up or downdrift impacts, etc. Recommendations will be made for further investigation or appropriate maintenance actions.

2) LIDAR. Topographic LIDAR will be used to examine beach characteristics between measured profiles, including plotting Mean High Water shoreline evolution over time. Beach profile surveys and LIDAR need to be coordinated in time to accurately correlate the two types of data. LIDAR will also capture visible portions of ebb and flood shoal formations at inlets. LIDAR will be acquired preconstruction, and twice each year, concurrent with semi-annual beach profile surveys during years 1- 4 (first nourishment cycle). Following the first nourishment cycle, one post-winter (late February-early March) LIDAR survey per year will be performed at the fourth year after each nourishment cycle. LIDAR will be taken at the time of low tide. Additional details on the flight requirements will be developed during the PED phase of the project. Note that the NY State program of controlled orthophotography is anticipated to continue to be flown at four-year intervals. The state orthophotography will be available to augment project obtained data. An example Scope of Work (SOW) for LIDAR is shown in Attachment A.

In the event that LIDAR is unavailable, georeferenced aerial photography is also acceptable, but shall meet the following requirements. Each over flight mission will be a single flight line with 60% overlap stereo coverage including the entire project area shoreline, including both ocean and bay. Bay shoreline will be included as separate single flight lines where the width of landforms requires more than a single flight line. Aerial coverage of inlets will include complete flood shoal and ebb shoal formations. Color film with a 9-inch x 9-inch format is recommended with a scale such that shoreline features are readily identifiable (e.g. 1 inch = 800 feet). All images shall be georeferenced to New York State Plane Lambert projection, Long Island Zone, NAD83 with units in feet. Digital scans of each 9x9 will be provided at a minimum of 300 dpi resolution.

3) Shoreline Change Monitoring. Mean High Water shorelines will be extracted from spring (late February-early March) LIDAR topography and plotted in overlays to show shoreline evolution over time within the project and immediately up and down drift. Plotting successive shorelines will illustrate the extent of erosion or accretion and will provide a means of measurement of the rate of loss or gain of littoral material. Comparative shoreline plots will be prepared for the entire length of the oceanfront, bay, pond, and island shorelines within the project boundaries. The sediment budget will be updated based on combined shoreline evolution and measured beach profiles;

4) Wave Measurements. Directional wave gages will be deployed in two locations, one in waters off of Fire Island Inlet, and a second off the Westhampton Beach shore. Gages will be deployed prior to construction and will remain in place for the length of the first nourishment cycle (project years 1-4). The primary purpose of wave measurement is to assist in quantifying the driving forces behind changes to the native and constructed beach, as well as providing records of storm data. Wave gages will also provide information on wave conditions during construction, as well as for user communities such as homeowners, surfers, fishermen, environmental scientists, etc. during the instrument deployment period. Wave height data will be obtained under storm conditions over the deployment period and will be compiled to develop more accurate wave height-frequency relationships.

The wave gages should be deployed in a nearshore water depth of –25 to –35 ft. NAVD and should be cabled to shore. If cabling to shore is precluded, internal recording gages will be utilized. Data will be posted in real time on a project internet site for cabled gages and following data recovery for internal recording gages and archived to a web-accessible database. Both the bulk wave parameters, mean currents and wave spectra should be displayed and archived in the database, along with links to water level data from nearby USGS tide gages and wind/wave data from NOAA Buoy #44025, as well as other buoys in the vicinity, if any.

Short term collection of near shore data will be utilized to confirm that borrow area dredging is not changing wave patterns or beach erosion.

5) Water Level Measurements. A total of 13 long term water level gages will be installed. Locations include: Great South Bay (3 gages), Moriches Bay (2 gages), Shinnecock Bay (2 gages), Fire Island Inlet (2 gages), Moriches Inlet (2 gages) and Shinnecock Inlet (2 gages). All gages will be tied in to verified bench marks (bench marks to be established if needed) for accuracy. At the inlets, gages will be installed inside and outside the inlet feature. Subsurface gages will be installed in the nearshore area. Real-time data will be recorded and posted on the project monitoring web server. Water level data will be used to record still water levels for confirmation of economic damage projections and to provide calibration data for any future modeling work. Water level data obtained under storm conditions will be compiled to develop more accurate water level-frequency relationships. Water level measurements will be obtained pre-construction and throughout the project life (50-years).

Water level data from the existing tide stations will also be obtained and incorporated into the adaptive management data reporting and associated decision making. The following existing tide stations have been identified:

- NOAA at Montauk (station ID 8510560)
- USGS: Great South Bay at Lindenhurst (station ID 01309225)
- USGS: Great South Bay at West Sayville (station ID 0130642)
- USGS: Great South Bay at Watch Hill (station ID 01305575)
- USGS: Moriches Bay at East Moriches (station ID 01304920)
- USGS: Shinnecock Bay at Panquogue (station ID 01304746)
- USGS: Georgica Pond near Apaquoque (station ID 01304705)
- USGS Hook Pond at East Hampton (station ID 0130469525)

6) Borrow Area Monitoring. Offshore borrow areas will be monitored to document material removal, and to determine borrow area infilling rates for possible borrow area reuse. As part of construction, pre- and post- dredge hydrographic survey will be taken at the designated borrow areas. Some nearby, similar area outside the designated borrow area will be included in the survey to serve as a control (i.e. to document naturally occurring bottom changes). Computations will be done to verify quantity and location of material removed from the borrow areas during initial construction and renourishment operations. For cost estimating purposes, it is assumed that pre- and post-construction survey of the borrow areas will be included in the construction costs.

Midway through the life of the project, hydrographic surveys will be repeated to determine pattern and depth of material accumulation to date. Vibracores will be taken and subbottom seismic profiling will be performed to obtain sediment layering and grain size distribution curves in the in-filled areas. Thirty (30) cores, twenty feet in length are assumed for cost estimating purposes. The actual number and length will be determined based on bathymetry and subbottom survey results. Vibracore data analysis will include a representative number of material samples taken from each core, determined by an experienced geologist, that will be used to characterize each core and sub area within the borrow region. All lab analyses and operations on cores will be standardized as to description of sediment type and grain size distribution. All surveys will be mapped to indicate spatial changes in the borrow area both horizontally and vertically. Suitability of material taken from the cores as beachfill material will be determined. Areas dredged for initial construction or earlier renourishment operations will be examined for possible reuse in future renourishment cycles based on material suitability and available quantities.

b. Beachfill

Placed beachfill will be monitored to measure its evolution over time. The beach berm and dune will be measured to record characteristics including:

- Berm width and elevation
- Dune crest and base widths and elevations
- Dune ocean side and land side slopes
- Dune baseline

Measurement will be done to aid in determining how the construction profile evolves towards a more stable long-term profile, at what rate erosion or accretion of the advanced nourishment and/or design berm occur, and any changes that occur to the dunes including sand loss or dune growth. Beachfill monitoring will aid in identifying areas of greater than normal erosion ("hot spots") as well as any locations that experience sand buildup (accretion). Shoreline updrift and downdrift of the placed fill will be examined for any excessive sand losses or gains due to construction of the project or other causes. Other phenomena including but not limited to beach scarping, offshore bar changes, sand wave migration, overwash, etc. will be documented and quantified. Information gained from beachfill monitoring will be used in design of any future construction activities including renourishment.

Beachfill monitoring is also a critical component in expanding the understanding of coastal processes affecting the project area. Measurements of sand loss and/or gain will allow refinement of local and regional sediment budgets. Greater understanding of coastal processes will allow regional sediment management to be performed effectively. Ultimately, greater understanding of coastal processes will allow more accurate prediction of sediment accumulations and deficits on ocean side shorelines, within the bays, in navigation channels, and in the vicinity of inlets. The beachfill monitoring data will be used in the sediment transport model, discussed in Sub-section 7.2 f.

- Beach Profiles. Beach profiles will be one of the primary measurement techniques for beachfill monitoring. Beach profiles will be surveyed before and after initial construction to establish pre-fill baseline conditions, and conditions immediately following placement. Under the monitoring program beach profiles will be surveyed twice per year throughout the first nourishment cycle (four years). One survey will capture the characteristics of the beach following winter condition, and will be surveyed in late February-early March, before endangered shorebird nesting season. The second survey will capture the characteristics of the summer beach and will be surveyed in September-October, following departure of nesting shorebirds. Following the first nourishment cycle, one post-winter (late February-early March) profile survey per year will be performed at the fourth year after each nourishment cycle. Should the design four-year cycle need adjustment, timing of profile surveys will be adjusted accordingly. Note that endangered plant species (e.g. seabeach amaranth) may also be present, and surveys should be performed in such a way as to not disturb rare plants.

A total of 122 long-range profiles will be surveyed over the entire project area in each survey. This includes 102 long ranges at 1500 ft. spacing in the areas where fill is to be placed, plus 20 additional control profiles in non-fill areas. Profiles shall extend from a location landward of the dune and berm, along a repeatable line normal to the shoreline, and seaward out to closure depth (-31 ft. NAVD) or a minimum of 2500 feet in length from the landward starting point. Profiles will be taken from established benchmarks that are documented and recoverable. Each monitoring survey will cover the same profile locations, unless observations of phenomena indicate that a change in profile locations is warranted. Repetitive surveys of profiles will be the basis for estimates of erosion and accretion volumes. Changes observed in beach profiles will help track the movement of placed fill alongshore and offshore.

- Beach Sediment Grab Samples. Beach sediment grab samples will be collected concurrently with beach profile measurements on 30 long-range profiles (every fourth long range). Samples will be taken at a minimum of nine (9) locations per profile: the seaward and landward edges of the berm, three subaerial locations (Mean high water, mid-tide level, and mean low water), and at three locations offshore (-7 ft. NAVD or bar crest, -13 ft. NAVD, –19 ft. NAVD, and –31 NAVD). Beach sediment sampling will provide pre- and post- construction sediment color and grain size distribution data that will allow comparison of native and placed fill material. Beach sediment sampling during subsequent surveys will aid in determining sediment redistribution after placement.

  Beach sediment grab samples will be taken concurrent with the pre- and post-construction profile surveys, to obtain baseline information and a measure of placed material characteristics. Sediment samples will be taken concurrent with profile surveys before each nourishment placement to aid in material compatibility analyses for each nourishment operation.

In addition to sediment sampling along profile lines, which will capture characteristics of borrow area material, sediment grab samples will be taken and grain size distribution curves prepared of inlet dredged material when it is placed on the beach. Samples of placed inlet material will be taken at the time of placement. For cost estimating purposes, it is assumed that funds will be added to the dredging & placement contract for obtaining and analyzing up to 50 samples per operation, and that inlet dredging with beachfill placement will occur every other year at Fire Island Inlet and every third year at Shinnecock and Moriches Inlets.

c. Inlet Management

Bathymetry measurement will be obtained to measure morphological changes over time at Fire Island, Moriches and Shinnecock inlets. Measurements will cover the entire flood shoal area, ebb shoal area, and inlet throat. This will allow evaluation of inlet modification performance and will provide a basis for future actions, if any. Accurate, full-inlet bottom surface data will also improve the quality of any modeling efforts performed over the course of the project life. Hydrographic multibeam surveys will be performed at each inlet to include the entire flood shoal, ebb shoal, and inlet throat. All surveys will be performed with kinematic GPS and referenced to Geographic NAD83 (horizontal) and NAVD88 (vertical). Inlet multibeam surveys will be performed prior to construction and at 10-year intervals thereafter. In-filling rates at deposition basins will be analyzed based on periodic hydrographic survey data. The profile surveys described previously will be used to evaluate cross shore transport.

Pre-construction and, thereafter, every 10 years in conjunction with inlet bathymetry surveys, Acoustic Doppler Current Profilers (ADCP) will be installed at each inlet to monitor current velocity. Water level data collected from the inside and outside of each inlet (as presented in Section 7.a.5) will also be applied to the assessment and evaluation of inlet function and condition.

d. Groin Fields

LIDAR topography and beach profiles collected during the monitoring program will be used to estimate the effects of removal of the Ocean Beach groins and the effectiveness of the Westhampton and Georgica Pond Groins. The information to be analyzed includes initial and annual sand volumes released, updrift and downdrift shoreline impact, and dune and shoreline evolution vicinity of the project site.

e. Breach Response Plan

Baseline condition of bay bottom elevations will be obtained during the pre-construction period in those areas identified as most likely to experience overwash & breaching. Overwashes and breaches will be documented after they have formed by project aerial photography. Regular project aerial photography will allow comparison of pre- and post-storm conditions, computation of surface disturbance acreage, and evolution of the overwash landforms through time. Site visits will include observation of any overwash and breach locations. At the time of significant overwashes and/or breaches, elevations will be obtained in profile line form extending across the overwash/breach area(s) and affected bay bottom, as well as sand thicknesses in the dry areas.

It is assumed that physical monitoring of breach and overwash areas will occur over the entire project length, whether or not the overwash is fronted by constructed improvements. For cost estimating purposes, 30 bayside overwash/breach profiles per major storm event have been assumed at 10-year intervals, through year 50, having a minimum length of 2500 ft., plus a similar baseline survey pre-construction. Additionally, one set of post-storm beach profiles and one additional post-storm LIDAR topography flight have been assumed for cost estimating purposes at 10-year intervals, through year 50. Refinement and additional details of this monitoring will be developed during the PED phase.

f. Sediment Transport Modeling

It has been hypothesized that the shoreface-attached ridges offshore of western Fire Island potentially facilitate transport from the inner shelf to the surfzone and the shoreline. If this transport does occur, the processes are thus far unknown, although they would be likely to be very complex, varying in space and time. Sediment transport modeling will be performed in order to increase our ability to predict the effects of alterations in the ridge system (by borrow area dredging) on the shoreline. Additional details of the model will be developed during the PED phase of the project.

- (f1) Inner-shelf bathymetric changes. A high resolution bathymetric survey will be collected using interferometric sonar swath and RTK-GPS techniques within the following boundaries: Fire Island Inlet to the west, Old Inlet to the east, the -8 m NAVD contour to the north, and a line 10km seaward of the -8 m contour. Repeated nearshore-surf zone grid bathymetry will be collected using the Coastal Carolina BERM system (reconfigured for launching from the beach) with the same east and west boundaries, and between the shoreline and the -8 m NAVD contour.

- Sub aerial morphologic changes. Repeated surveys of the beach and dune system in western Fire Island will be collected (preconstruction, and in project years 1 and 2) using the U.S.G.S. beach buggy system incorporating RTK-GPS and potentially LIDAR in a grid pattern to produce a 3-Dimesional surface. This data, along with previous conventional topographic data will be compiled to produce a time series of beach/dune changes.

- Wave, current, bed load and suspended sediment concentration measurements. The above oceanographic data will be collected by internally-recording equipment mounted on tripod frames. A total of six tripods will be deployed on the ocean bottom: four offshore of the western portion of Fire Island where the shoreface-attached ridge system is present; and two offshore in areas having no attached ridge system. All six gages will record surface waves, currents, pressure, conductivity and temperature; two will also record bottom stress and suspended sediment concentration. Some will be placed in the offshore, and some closer to shore. The offshore ones are expected to remain in place for several months, the nearshore ones for several weeks.

- Sediment transport modeling between the inner shelf and western Fire Island. The U.S.G.S. ROMS-SWAN modeling system will be used to investigate how the morphology of the inner-shelf and shoreface influence beach behavior on western Fire Island, with and without the borrow areas. Outputs will include wind-driven waves, regional circulation patterns, nearshore/surf zone wave-driven currents, and the resulting sediment transport due to bed load and suspended sediment processes.

7.3 Analysis and Reports

A data analysis report will be prepared each year for the first nourishment cycle (four years). The first year report will also include pre-construction conditions as surveyed and post-construction data, and will establish the project baseline condition for all subsequent evaluations. The data analysis report will be a complete compilation of all monitoring data taken, plus analysis of the data with trends as observed, evaluation of project performance, and recommendations for future actions including both monitoring and construction actions as appropriate. Analyses to be performed include but are not limited to:

- All site inspection reports;
- Summary of construction activities including estimates of volumes placed on the beachfront and in the CPFs
- Comparison of assumptions made in design with monitoring data;
- Profile volume change;
- Profile shape adjustment;
- Volume of fill remaining in the project, volume of fill moving updrift, downdrift, offshore, and into inlet storage;
- Assessment of alongshore transport and cross-shore fill movement from the beach and nearshore areas with updates to the sediment budget;
- Grain size distribution curves and statistics pre- and post- construction;
- Seasonal responses;
- Repetitive shoreline change plots;
- Wave data recorded and statistical analysis;
- Water level data recorded;
- Borrow area bathymetry pre- and post-construction, plus seismic and vibracore data when applicable;
- Site visit inspection results including structure condition reports;
- Overwash and breach monitoring results;
- LIDAR survey of the project area as available;
- Inlet and bay bathymetry data, with plots of changes between survey intervals;
- An event log of occurrences within the project boundaries including record of all construction activities, storms, high water events, and other observed phenomena that may affect project performance;
- Nearshore and sub aerial change plots in western Fire Island;
- Wave, current, bed load and suspended sediment concentration data recorded in western Fire Island;
- With and without-project wind driven waves, circulation, nearshore currents and sediment transport modeling results in western Fire Island.

Following the first nourishment cycle, a data analysis report will be prepared once each nourishment cycle. The data analysis report will cover all of the various project reaches and features, such as the conditional and reactive breach response areas and the barrier island CPFs. The analysis will include an evaluation of the feature conditions as compared to the renourishment and other measures implemented and the monitoring results. A final summary report will be prepared in the last year of the project life.

7.4 OMRRR—Project Operation, Maintenance, Repair, Replacement, and Rehabilitation

As part of the Project Cooperation Agreement, an Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR) Manual will be prepared which will outline the responsibilities of the local sponsor over the course of the project life. Among the requirements is an Annual Project Inspection that takes place in conjunction with the USACE Inspection of Completed works program. As stated in Section 6.3.8 of the Final GRR, it is anticipated that the Annual Inspection program will be the mechanism for monitoring and reporting of any new development or land use changes within the project area to the appropriate Federal, state, and local entities responsible for enforcing applicable land use regulations. The current version of the OMRRR Manual is included as an appendix to the General Reevaluation Report for the project. Updates will be made as necessary and applicable during the PED phase

8.0 BIOLOGICAL MONITORING

Biological monitoring will be undertaken to evaluate project related effects on the biological resources in the study area, the success of the Coastal Process Feature (CPF) components of the Selected Plan, and to enable assessment of any adaptive management measures that may be warranted to augment the success of, or to minimize impacts of, the project on biological resources.

8.1 Biological Monitoring Elements

The proposed biological monitoring elements are organized by project feature and location. As noted in the Biological Opinion specific construction plans for the CPFs still need to be developed further in the context of the design criteria and project success criteria.

The monitoring will consist of direct monitoring for piping plover location, abundance, suitable habitat, and productivity; and seabeach amaranth location, abundance, and plant size, as well as monitoring of habitat characteristics. Specific annual monitoring to track incidental take needs to be developed and the CPFs is required as per Reasonable and Prudent Measure 3 and Term and Conditions 4 in the Biological Opinion. In addition to the monitoring and data collection efforts conducted specifically for biological elements, the relevant data, such as LIDAR collected during the physical monitoring described in Section 7 will be utilized in the evaluation of the biological resources. Overall, as noted in the Service's Final FWAR, we anticipate further development of habitat and species that will be monitored and the techniques that will be used, and these would be the subject of future reports. Specifically, the Service noted, "The Corps has indicated that the CPF designs described in Appendix I of the Final GRR (USACE 2019b) are preliminary and conceptual and will be further developed as the design phase proceeds. Accordingly, additional coordination during subsequent planning, engineering, design, and construction phases of the project will be required which should be coordinated with the Service and could be documented through supplemental 2 (b) reports/letters…The Service looks forward to working with the Corps in gathering this information and completing our analysis of this project."

Biological monitoring of the borrow areas that have been identified for use as part of the recommended plan will be conducted, with possibility of two borrow areas being monitored each year for the parameters as described below. In addition, to facilitate potential future adaptive management new alternative borrow areas, as yet not located, will also be identified.

8.2 Vegetation Communities

Vegetation communities will be monitored yearly at each of the barrier island and mainland CPF locations. Monitoring for terrestrial and wetland vegetation will include generation of aerial photo based vegetation cover type maps, field monitoring of vegetation plots, and photo stations. In addition preconstruction delineation of the CPF wetland boundaries will be conducted, as well as post-project delineation, as described below.

8.2.1 Cover Type Mapping

Vegetation and cover type mapping and analyses methods will be determined by the TAG. The approach provided below may be applicable for non-plover habitat CPFs that may be designed.

Cover type mapping will be generated in GIS using georeferenced aerial photo imagery taken in the mid to late growing season. A sample SOW for the aerial photography is provided in Attachment B. Mapping of vegetation types at the CPFs will be done utilizing the annual CIR and true color aerial photography acquired for vector mapping and digital orthophotograph production. CIR photography is a three layer (cyan, yellow and magenta) film that has been widely used for crop and natural vegetation studies because image color formation is dependent upon reflected energy in the red and green portion of the visible spectrum as well as the near-infrared. An object that reflects only infrared energy will expose the cyan layer of the film, leaving the yellow and magenta layers that combine in a subtractive mixture to form a red image when viewed by transmitted light.

A team of scientists familiar with the vegetation and physical features of the sites will interpret the CIR and true color aerial photography by identifying color/texture characteristics (i.e., signatures) of the various cover types present. The various areas of species-dominated polygons or other site features (e.g., unvegetated sand or mud flats) identified on the CIR aerial photography will be delineated digitally while viewing the orthophotograph on the computer monitor. On-screen digitizing of cover type boundaries will be performed using ArcGIS™. In order to be identified as a given cover type, it is generally necessary that the vegetative cover of the polygon exceed 30 percent. Thus areas mapped as “unvegetated” may support vegetation below the 30 percent mapping threshold. This is consistent with the approach utilized by the US Fish & Wildlife Service in the preparation of National Wetland Inventory maps, where areas supporting less than 30 percent cover are identified as unvegetated. Where it is critical to have a higher level of accuracy of vegetation cover (i.e., piping plover habitats), field verification of the percent coverages will be conducted to augment the vegetation cover maps.

For each CPF location, a summary of acreage for each cover type will be generated. The acreages and areas of cover types will be compared annually. The MAMP TAG will determine how changes in vegetation coverage will be evaluated to determine the need for adaptive management.

8.2.2 Vegetation Plots and Photo Stations

Vegetation plots at each CPF location will be established either along transects or using grid pattern, depending on the shape and size of the area. For example, plots for CPF locations with roughly equidistant sides (i.e., oval or square outlines) will be located using a grid pattern, whereas those that are more linear in shape will use transects. If previously monitored, prior sampling methods could be utilized.

Prior to each monitoring event, plot locations will be randomly chosen and coordinates will be uploaded to a GPS unit. The exact number will be based on the overall acreage of the CPF location; a minimum of five plots per acre will be sampled each year. Additional plots can be added as necessary based on diversity of vegetation communities and need for more ground truthing to support the aerial photo based vegetation community mapping.

Within each plot a one meter square quadrat will be used to define the plot location. The vegetation species present within the plot and percent aerial coverage of each will be recorded on field data sheets. In addition to vegetation, incidental observations of wildlife presence or use of the site (e.g., tracks, scat, nests) will be noted on the data sheets.

In addition, during the first monitoring year, 4 to 6 photo stations will be established at each of the CPF locations; locations will be recorded using a GPS unit. Photos will be taken from the same locations throughout the monitoring, with photo number, location and description recorded. Photos will be compared annually and used to illustrate the transition of vegetation conditions over time and to identify any corresponding need for vegetation management.

8.2.3 Wetland Delineation

The wetland boundary at each mainland and barrier island CPF location will be delineated during the PED phase and will be factored into the detailed design for each location. Delineation will be conducted in accordance with procedures described in the USACE Wetland Delineation Manual (USACE 1987) and associated regional supplement (USACE 2002). In addition to the delineation of the upland-wetland boundary, the boundary between tidal and non-tidal wetlands will be delineated, if applicable. The delineated wetland boundary will be surveyed by a New York State licensed professional land surveyor (PLS) for inclusion on the project plans. Data sheets and photographs will document the field delineation efforts and will be compiled in a delineation report.

The wetland boundaries will be re-delineated at year 5 to document post-construction conditions.

8.3 Offshore Borrow Areas

The purpose of monitoring the offshore borrow areas is to assess the potential impacts of offshore dredging activities and to identify whether the dredging operations are being conducted so as to minimize or preclude long-term adverse biological and physical impacts to the environment. The primary elements of the biological monitoring of the borrow areas are: 1) characterize pre-dredging benthic ecological conditions, using existing data sets and data collected from prior field work, in and around the proposed sand borrow sites; 2) evaluate benthic infauna present in the proposed sand borrow sites post-dredging, and assess the potential effects of offshore sand dredging on these organisms; and 3) develop a schedule of best and worst times for offshore sand dredging in relation to transitory pelagic species.

Two borrow areas will be sampled annually, with two benthic sampling events per year, one in the spring and one in the fall. The borrow area sampling program will be begin pre-construction, prior to dredging and will be conducted biannually over the project life (50-years).

Details on the planned borrow area monitoring are presented in the following paragraphs.

8.3.1 Fall and Spring Benthic Sampling

The number of benthic samples per borrow area will be determined based on the union of several standards and criteria in order to maximize statistical power within the project's constraints. This action will be conducted twice a year (spring and fall) in the identified borrow areas. The number of samples collected in the borrow area and borrow area pit will be dependent on the size of the area and calculated as the BOEM/NOAA standard for benthic sampling intensity and multiplied by a factor of 2 to increase the reliability of the study. All sampling locations will be surveyed (GPS unit) in order to replicate sampling locations in the future and locate them on a project. Samples will be collected with a Smith Mac (0.1m^2) or similar instrument, sieved (.5mm), packaged (bagged and placed in a 5 gallon bucket) and shipped to a lab. To facilitate sorting of the animals, a few grains of vital stain "Rose Bengal" will be added to the sediment-seawater before adding 4% formalin or 2% au lcohol to the mixture. The animals will stain red, while the sediment particle remain unstained.

- Two foundational assumptions are:
  - o The sediment and benthic communities are homogenous within each borrow area prior to dredging events.
  - o There is no meaningful (pre-construction) spatial heterogeneity on spatial scales smaller than 1 borrow area.

The central objective is to develop a comprehensive biological inventory of the project borrow areas which will assist in the establishment of a baseline for sedimentology and infilling, fish and benthic organisms within the borrow areas as compared to reference site and assess any changes to these areas post dredging.

The BOEM/NOAA standard for benthic sampling intensity in habitat that is equivalent to the LI borrow areas is approximately 1 sample per 1-2 square kilometer within potentially affected areas (BOEM 2019).

The plan is to exceed this BOEM standard by at least a factor of 2 in order to increase the reliability of the study.

The primary criteria for increasing the sampling intensity is to achieve approximately one sample per 500 linear meters within each borrow area. This could be viewed as a hypothetical grid-like arrangement of samples, though in practice any arrangement of samples within the borrow area limits would be random with respect to the benthos.

A secondary criteria for increasing the sampling intensity is to achieve a minimum of approximately 20 samples per borrow area. This brings the total level of effort within a single borrow area to approximately the same sampling intensity of different historical projects in-and-near the project area. The benefit of approximately matching the historical level of effort is more robust analyses of change over time.

The ultimate arrangement of sample locations within each borrow area will be:

- Random with respect to the seafloor
- Non-overlapping

- No assumption of repeated sampling because it is statistically irrelevant (given our assumptions) and logistically impossible to sample the same location multiple times.
- Allocated within borrow areas to approximately 50% primary effect and 50% secondary effect (i.e., dredged areas and non-dredged but likely exposed secondary effects). In practice the size and geometry of dredged versus non-dredged portions of each borrow area may force an allocation that is not approximately 50%, but approximately equal allocation post-construction is a goal.
- The plan is to add samples outside each borrow area to achieve approximately 20% of the total effort as references. The ultimate arrangement of reference samples will be on the periphery of the borrow areas in a band greater than 500 m but less than 1000 m from the borrow area boundary.

Overall, this sampling strategy will allow for statistically defensible analyses at spatial scales equal to or greater than one borrow area:

- Before versus after
- Control versus impact
- Separately including primary versus secondary effects
- Time-series analysis potentially incorporating historical data to the newly collected series of pre- and post-construction data
- Non-parametric statistical tests (e.g., Fisher exact, ANOSIM, SIMPROF, and visualizations such as cluster dendrogram and MDS ordination) will be applicable to all scenarios, and parametric tests (e.g., the two-sample t-test or Pearson correlation) will be applicable to most scenarios.

8.3.2 Grain Size Analysis

In conjunction with the benthic grab samples, a sub-sample will be taken for grain size analysis. Sediment samples will be collected out of each of the benthic grabs taken at each station during both planned sampling periods and placed into a small Whirl Pacs®. These samples will be sent to a laboratory for analysis. Grain size of sediment at each station will be determined using sieve analysis. Sediment will be classified, by percentage, as gravel, sand, clay or silt. Samples will be sifted through a 3-mm screen to remove large shell fragments and dried in a 40 + 5 C oven for 48 + 12 hours until they were dry, then cooled and weighed. Samples will then be deposited on nested sieves (2, 1, 0.5, 0.25, 0.125, and 0.0625 mm) and vibrated in a reciprocating sediment shaker for 10 minutes or until there was no further change in the amount of material found on each sieve. Materials collected on the sieves were then weighed to the nearest 0.1 g and the percentage of material (percent of total) calculated for each sieve size. Sediment statistical parameters (mean grain size, etc.) will be calculated using Gradistat 4.0 software (Blott 2000 and Blott and Pye 2001).

8.3.3 Offshore Fishing

To determine species composition and abundance of the demersal fish community, bottom trawls will be conducted offshore in the borrow area during the months of April–October. Finfish and macrobenthic invertebrates will be collected by towing a 30-foot otter-trawl (1/4 inch mesh cod end) from an ocean-going research vessel. The net will be towed at a speed of 2 to 3 knots for a distance of 0.25 nautical miles. Transects will be sampled in the borrow area and a reference site over a 2 day period. Bottom time for each trawl will be approximately 8-10 minutes. Trawl contents will be processed on board the vessel. The catch will be separated by species and identified to the Lowest Practical Identification Level (LPIL). All species are weighed and enumerated. When the catch of a particular species is extremely large and on-board enumeration proves impractical, an estimate of abundance was made by weighing and measuring 30 randomly encountered specimens then weighing the remaining catch. For each trawl result, standard lengths will be measured for 30 individuals per species for all finfish the same protocol will apply to squid species. Total weight by species (of up to 30 individuals) is to be recorded for biomass estimates. All specimens will be measured to the nearest millimeter (mm) for total length (the distance from the closed mouth the extreme tip of the caudal fin) using measuring boards. Biomass was measured in grams (g) using various Pesola® spring scales. The contractor will be provided the protocols for handle any threaten and endangered species which might be captures while trawling.

8.3.4 Physical Parameters

While on station a YSI Model 85 or equivalent instrument will be used to determine the temperature, salinity, dissolved oxygen, and pH. Readings will be taken from the surface and bottom of the water column. Water quality measurements as described above will be collected at the end or the start of each trawl.

8.3.5 Sturgeon Monitoring

VEMCO or equivalent receivers will be deployed prior to dredge activity (when possible) to detect sturgeon presence near the borrow areas to assess sturgeon presence before, during and after borrow area dredge events. The number and location of receivers will be dependent on size of the borrow area and the range of coverage of the receivers, which is about 500 meters. Receiver data will be uploaded to the ACT Network; raw data and appropriate summaries will be provided to the NYSDEC. VEMCO receivers are anchored to a 500 pound concrete block, attached by a chain, and a rope to a surface float equipped with a 600 lb swivel breakaway whale link. VEMCO VR2W receivers will be equipped with batteries with an operational life of 15 months. Biofouling can also affect detection ranges of receivers. To help reduce negative effects caused by biofouling organisms, receivers will be painted with 2 types of anti-fouling paint (West Marine Bottom Shield on the body and INTERLUX ablative paint on the top of the receiver). Bottom water temperature will be recorded with HOBO Pro v2 (U22-001) or Pendant (UA-001) data loggers. Data retrieval and receiver replacement will be done twice a year. Divers will be used to recover receivers and bring them to the research vessel. Once on the vessel, receivers will be downloaded, maintained (cleaned, downloaded, firmware and mapcode upgrades, batteries/o-rings replaced, repainted) and then redeployed.

8.3.6 Surf Clams

Surf clams are known to occur in substantial numbers south of Long Island in the nearshore waters. The commercial harvest of these clams is regulated by the NYSDEC which regularly surveys the south shore waters. It is anticipated that the monitoring of surf clam populations in the borrow area will be surveyed once each year prior to the utilization of the borrow area or when possible. Samples will be collected utilizing a local commercial clam dredge in accordance with procedures established by the NYSDEC for their surf clam sampling program. This would include the use of modified commercial gear to ensure the collection of sub-legal clams. Documentation of each tow’s position (utilizing the ship’s on-board navigational system) will be recorded.

8.3.7 Offshore Borrow Area Analysis Report

A data report will be produced after each sampling year, which will describe the physical and biological characteristics of the borrow area including the delineation of habitat, sediment and species types within each transect, capture methods, and transect locations. The report will also include the data tables which will represent monthly and combined abundance, length, weight, diversity and CPUE. The report will compare (when available) pre and post assessments comparing the abundance diversity and physical characteristics of each borrow area. Using basic statistical analysis the report will briefly describe any observed trends in captured species in relationship to seasonality and physical location and habitat type. Summary biological indices (number of taxa, number of animals, Shannon-Weiner Diversity Index (H’loge), and Pileou’s

Evenness Index) will be calculated for all finfish and benthic invertebrate samples using PRIMER (Version 6.0 or newer) statistical software. The indices will then be analyzed by two-way Analysis of Variance (ANOVA) to test for differences among various time periods. The finfish data will be tested for differences between years and months, while the benthic data will be tested for the differences between years and seasons. All data will be examined for normality and homogeneity of variance prior to testing and either square root or log10 (X+1) transformed where necessary.

Multivariate statistical techniques including hierarchical clustering and Non-Metric Dimensional Scaling (NMDS) will be employed to explore the data for potential differences in community species composition and structure for fish and benthos species. Hierarchical clustering associates pairs of samples based on the similarity of their species composition and abundances. Analysis proceeds in a series of steps during which samples with the highest degree of similarity are successively combined. The final result will be presented as a dendrogram (tree diagram) in which the degree of similarity is indicated by how samples are linked. A Bray-Curtis Index will be used as the similarity index and samples combined by group averaging. All data will be logarithmically transformed (Log10 X+1) prior to analysis to reduce the influence of extremely abundant species. SIMPROF (Similarity Profile), a bootstrapping technique, will be performed on the sample groups produced by the clustering to determine the likelihood that individual groups were generated by chance alone.

NMDS is an ordination technique that also compares species composition among sample pairs (using Bray-Curtis Index). NMDS results will be interpreted by examining the degree of difference in the spread of data points across axes on a 2- or 3-dimensional plot. The proximity of any two data points on the plot is a measure of the degree of similarity between those two samples. The goodness-of-fit of the plot is measured by a stress value. Plots with stress values of 0.1 or less indicate a high degree of fit and therefore can be interpreted with relatively high confidence, while those with stress levels ranging between 0.1 and 0.2 should be interpreted with more care. Plots with stress values of 0.2 or greater should not be interpreted. When simultaneous plotting (biplots) of NMDS and clustering results yield similar patterns, it is assumed that the patterns are robust. NMDS results will also be analyzed by ANOSIM (Analysis of Similarity), a nonparametric test analogous to Analysis of Variance, to determine if patterns detected were statistically significant. ANOSIM is a nonparametric test and only main effects can be tested (year and month or season).

8.4 Endangered Species Monitoring

This sub-section describes the monitoring efforts to be conducted for seabeach amaranth (Federally-listed threatened species), piping plover (Federally-listed threatened species-Atlantic coast population), and rufa red knot (Federally-listed threatened species). The monitoring will be conducted within suitable habitats (see the FIMP Biological Opinion for definitions of suitable habitat) along the entire project length of the barrier island. Monitoring will be conducted consistent with the FIMP Biological Opinion additional detail on the monitoring protocols and requirements can be found in this documents.

Monitoring will be conducted during the spring and summer prior to construction activities, post construction and annually thereafter throughout the project life (50 years). Monitoring efforts for each species are described in the following paragraphs. Post-construction, the results of the terrestrial vegetation monitoring will be factored into the annual monitoring plan for the species below to better focus the monitoring efforts within suitable habitats.

8.4.1 Seabeach Amaranth

Field surveys will be conducted by biologists/botanists or designated representatives and will consist of baseline monitoring conducted one year prior to construction of a given reach, as well as immediately prior to construction, and post construction. Pre-construction monitoring shall be initiated immediately prior to the start of any construction to determine the presence or absence of this species. Surveys will be conducted beginning at least one week before planned construction and will be conducted twice weekly within the planned construction area. Following construction, the project area will be monitored annually in June 1 to October 1, for the life of the project (50 years).

In advance of initial monitoring, a project database and project specific data sheets will be prepared to ensure consistent documentation and comprehensive data compilation. Data will be either entered directly into the database using a portable tablet, or will be entered on paper datasheets for later digital entry. Monitoring will be conducted by biologists/botanists knowledgeable of the plant characteristics and habitat requirements and will consist of a pedestrian meander survey through suitable habitats.

Monitoring will document either presence or absence of seabeach amaranth within the area surveyed, as well as a measurement of the abundance, location, and size of plants. Upon observation, locations of plant clusters or individuals will be recorded using a GPS unit. Locations will be flagged and fenced for protection in accordance with the Conservation Measures outlined in the BO. During each monitoring event, care will be taken to prevent individuals from being counted more than once. The following information will be recorded:

- Date/Time (observations) or duration of survey (absence verification)
- Name and affiliation of field team
- Monitoring location (reach/orientation)
- GPS Coordinates for observed plants/clusters
- Number of individual plants within the cluster
- Plant condition (flowering, not flowering, size (height/width) root condition (intact, exposed)
- Photographs
- Habitat characteristic (e.g., bayside, Oceanside, landscape position [back dune, fore dune, beach/dune crest, etc.])
- Other relevant information

8.4.2 Piping Plover

For detailed information about Piping Plovers and the CPFs see the Biological Opinion. See Table 4 for design criteria for piping plover CPFs Appendix C for preliminary designs of CPFs, and Appendix D for CPF monitoring, success, trigger and thresholds.

All surveys will be conducted from April 1 to September 1. As noted in the BO:

> *Surveying and monitoring of the project area will occur for piping plover during the spring and summer nesting seasons. The monitoring will be completed in coordination with the land manager(s) and the Service. Monitoring will include identification of suitable habitats, nesting areas, establishment of symbolic fencing, and signage… Surveys will be recorded and summarized, piping plover locations will be recorded on maps, indicating areas surveyed and habitat types. Information collected will include the following:*
>
> *i. Date*
> *ii. time begin/end*
> *iii. weather conditions*
> *iv. tidal stage*
> *v. site name (location)*
> *vi. number of adults observed*
> *vii. number of pairs observed*
> *viii. courtship locations*
> *ix. brood locations*
> *x. nest locations*
> *xi. number of chicks fledged/adult pair*
> *xii. habitat type*

xiii. banded plovers
xiv. predator trail indices

Surveys shall be conducted three times weekly with observations evenly distributed over a minimum time period (to be determined based on discussion with the State Heritage Program). Survey time periods shall be conducted during daylight hours from 30 minutes after sunrise to 30 minutes before sunset and should include a full range of tidal conditions and habitat types. Areas should be surveyed slowly and thoroughly and should not be conducted during poor weather (e.g., heavy winds greater than 20 miles per hour (mph), heavy rains, and severe cold), since birds may seek protected areas during these times.

Monitoring will be coordinated between the land manager and appropriate members of the Adaptive Management Team. A summary of the monitoring approach is presented herein. Additional detail can be found in the Biological Opinion and FWCAR. All observations of piping plovers (e.g., resting or foraging) as well as evidence of courtship displays (e.g., evidence of nest building such as scrapes), suitable habitats, courtship locations, nest locations, brood locations, and predator trail indice locations (see above), will be recorded. Nest sites will be identified, marked and fenced as detailed in the Conservation Measures appendix of the BO. Location of each will be recorded with a GPS unit.

After nests are established, they will be monitored every other day until the birds start to incubate. Once the clutch is complete (4 eggs) the nests will be monitored every morning until the chicks fledge.

Nesting sites will be recorded on a GPS unit every year, and plotted on a GIS map. LIDAR or aerial photography images with the GPS locations of each nest location will be provided each year of the monitoring program (50 years).

8.4.3 Rufa Red Knot

Field surveys to document presence of the rufa red knot during migration will be conducted from mid-May to mid-June at suitable habitats (i.e., oceanfront and bayside beaches) prior to the start of construction. Locations of foraging areas will be recorded using a GPS unit. Following construction, the project area will be monitored annually for the life of the project (50 years). During each monitoring event, care will be taken to prevent individuals from being counted more than once. Field data will be recorded on datasheets and/or in the project specific database. The following information will be recorded: date, time, duration, observer, daily species count for the rufa red knot, location of all monitoring events, as well as any incidental information about the monitoring event.

8.4.4 Bio-Analysis and Reports

Annual reports will be prepared to document all biological monitoring events. Reports will include details on methods, locations, maps, results and summary of findings for the monitoring conducted. Findings will include population summaries and calculation of annual and cumulative productivity for piping plover. Photographs and detailed datasheets will be included as appendices. In addition, data will be incorporated into the project specific database.

9.0 References

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ATTACHMENT A
EXAMPLE SOW FOR LIDAR

ATTACHMENT B

SAMPLE SOW FOR AERIAL PHOTOGRAPH FOR VEGETATION MAPPING

ATTACHMENT C

Adaptive Management Team Members

Updated April 2, 2020

Executive Steering Committee

USACE New York District

- District Commander (COL Thomas Asbery)
- Deputy District Engineer (Joseph Seebode)

NYSDEC

- Deputy Commissioner, Office of Water Resources (James Tierney)
- Bureau of Flood Protection & Dam Safety (Al Fuchs)
- Region 1 (Carrie Meek Gallagher)

NYSDOS

- Deputy Secretary of State (Keisha Santiago)

DOI OPEC

- Region 1 (Andrew Raddant)

NPS

- Superintendent FIIS (Alex Romero)
- Associate Regional Director, Resource Stewardship and Science – Region 1 (John Meade)

USFWS

- Assistant Regional Director, Northeast Region (TBD)
- Northeast Regional Director – External Affairs, Northeast Region (Kyla Hastie)
- Deputy Assistant Regional Director, Northeast Region (Spencer Simon)
- NY Field Office Supervisor (David Stilwell)

USGS

- North Atlantic-Appalachian (NAAR) Regional Director (Mike Tupper)

Local Partners

- TBD Senior leader(s)

Adaptive Management and Monitoring Program Oversight Committee

USACE New York District

- Planning Division, Deputy Chief (Steve Couch)
- Planning Division, Chief, Environmental Analysis Branch (Peter Weppler)
- Engineering Division, Deputy Chief (Lynn Bocamazo)

NYSDEC

- Coastal Erosion and Floodplain Section, Chief (Arvind Goswami)
- Coastal Erosion and Floodplain Section, Project Management (Matt Chlebus)
- Regional Coastal Management Supervisor (Eric Star)

NYSDOS

- Office of Planning, Development, and Community Infrastructure – Coastal Resources Specialist (Jennifer Street)
- Office of Planning, Development, and Community Infrastructure – Coastal Resources Specialist (Matt Maraglio)

NPS

- Park Planner FIIS (Kaetlyn Jackson)
- Regional Scientists, Emerita (Mary Foley)

USFWS

- Long Island Field Office (Region 5), Senior Fish and Wildlife Biologist (Steve Sinkevich)
- Long Island Field Office (Region 5), Senior Fish and Wildlife Biologist (Steve Papa)

USGS

- Coastal and Marine Hazards and Resources Program (CMHRP) and/or Ecosystems Mission Area Science Center manager, or delegated staff

Local Partners

- TBD

Technical Advisory Group

USACE New York District

- Planning Division, Environmental Analysis Branch, Chief, Coastal Ecosystem Section (Catherine Alcoba)
- Planning Division, Environmental Analysis Branch, Senior Biologist (Robert Smith)
- Planning Division, Plan Formulation Branch, Planner (Brendan Newell)
- Planning Division, Plan Formulation Branch, Senior Planner (Danielle Tommaso)
- Engineering Division, Senior Coastal Engineer (Suzana Rice)

NYSDEC

- Coastal Erosion and Floodplain Section, Project Manager (Matt Chlebus)
- Regional Coastal Management Supervisor (Eric Star)
- Regional Deputy Permit Administrator (Kevin Kispert)

NYSDOS

- Office of Planning, Development, and Community Infrastructure – Coastal Resources Specialist (Jennifer Street)
- Office of Planning, Development, and Community Infrastructure – Coastal Resources Specialist (Matt Maraglio)

NPS

- Park Planner FIIS (Kaetlyn Jackson)
- Regional Scientists, Emerita (Mary Foley)

USFWS

- Long Island Field Office (Region 5), Senior Fish and Wildlife Biologist (Steve Sinkevich)
- Long Island Field Office (Region 5), Senior Fish and Wildlife Biologist (Steve Papa)

USGS

- CMHRP and/or Ecosystems Mission Area Science Center staff as assigned based on availability and expertise

Local Partners

- TBD

Data Management Team

USACE New York District

- Planning Division, Senior Geotechnical Specialist (Jeffrey Cusano)
- Planning Division, Senior Geotechnical Specialist (Matthew Davis)

NPS

- Region 1, Chief of Natural Resources (Carmen Chapin)

USGS

- CMHRP data management expert, as needed

ATTACHMENT D

Communication Plan for Implementation of Conservation Measures and Adaptive management From USFWS Programmatic Biological Opinion (March 2019)

Timing of actions associated with the Conservation Measures, Reasonable and Prudent Measures, and Terms and Conditions are provided in table 1 below.

1. Project points of contact (POC) from USACE and the Service should be specified. These individuals will be the POCs for all communication associated with the Project. A representative from the local sponsor (including all local cost-sharing partners and each landowner or land manager) should also be identified. Agency and landowner representatives should be updated annually.
2. A Project meeting will be held twice a year to discuss:
    a. any issues associated with implementation of conservation measures;
    b. how CPFs related to early successional, piping plover habitat are functioning;
    c. any adaptive management actions recommended for the upcoming year;
    d. any piping plover management plans that are required (e.g., predator management, symbolic fencing).
    e. This meeting should occur at least 60 days prior to the piping plover breeding season (April 1) and should be attended at a minimum by the POCs identified above. A second meeting will be held within 60 days after the end of the breeding season (September 1) to discuss lessons learned.
3. The Service contact shall be notified via e-mail at least two weeks before work is starting and ending, location and types of anticipated activity. The Service should be contacted via a formal letter if demobilization needs to continue into the breeding season (April), and advance notice given to allow for a qualified monitor(s) to be hired by USACE (if demobilization is taking place after April 1) or its designated construction representative and approved by USACE (see qualified monitor requirements-Appendix E.1) and shared with the Service.
4. If for any reason demobilization is scheduled to continue into the early breeding season outside of the communities,[1] a pre-construction meeting

[1] The FIMI BO (USFWS 2014, p. 20) states, “The Corps has proposed that construction activities would not

should be held and include USACE construction staff member and project biologist, a representative from the Service, the qualified plover/amaranth monitor, and the construction crew to provide all information on conservation measures that must be implemented. A checklist and training materials will be provided by the Service to ensure that all conservation measures are followed.

5. USACE will work with the Service annually to identify where symbolic fencing will be placed in the Project area (on GIS maps). This should be done well in advance of the breeding season when possible, ideally at the pre-season Project meeting. If the landowner develops the plan, they should submit it to USACE who will then share it with the Service within two weeks.
6. Any issues that come up regarding implementation of conservation measures or adaptive management should be communicated between the agencies and landowner representative immediately (via e-mail or phone and then followed up with a formal letter). Representatives from each agency and landowner will be identified for this purpose).
7. A standardized data sheet will be obtained from the state for population surveys (see Population survey data should be given to USACE representative no later than two months after surveys have ended. Information should be populated by the biologist in Microsoft Excel and sent to USACE electronically.

occur during the piping plover breeding season April 1 to September 1, except within the boundaries of the FIIS communities."

Attachment E: Monitoring and Adaptive Management Tables