RESILIENT STAFFORD

FORSYTHE MARSH RESTORATION CONCEPTUAL DESIGN

JANUARY 2026

STAFFORD TOWNSHIP ESTABLISHED 1749

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

RAMBOLL

KLEINFELDER
Bright People. Right Solutions.

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1 | Introduction

Project Background

The Resilient NJ program has supported Stafford Township (Stafford) through the Municipal Assistance Program in developing an action plan for climate resilience. As a coastal municipality, Stafford is intimately familiar with the past damages from hurricanes and nor'easters and continues to prepare for anticipated climate impacts. The Resilient Stafford Action Plan (2022) evaluated current and future risks in Stafford and provided recommended actions to mitigate those risks in the form of projects, studies, and regulatory actions that can be implemented as they are funded.

In 2025, Stafford received funding from the New Jersey Department of Environmental Protection (NJDEP) to further develop a selected set of projects identified in the Resilient Stafford Action Plan, with the goal of advancing projects toward implementation.

Process

The Project Team (Kleinfelder and Ramboll) engaged with Stafford early to review projects identified in the Action Plan and discuss the criteria for advancing the projects towards implementation. For this effort, eligible activities included collecting data, conducting additional studies or plans, drafting ordinances or regulations for adoption, developing conceptual designs, conducting feasibility and cost-benefit analyses, and preparing grant applications. Funding did not allow for field work, on-site baseline monitoring, or construction. The Project Team also conducted community engagement as it related to the selected project(s).

Project Selection

In collaboration with Stafford, the Project Team reviewed the proposed resilience projects and presented a preliminary list of projects that were eligible to move forward under this stage of work. Stafford provided updates on projects that were already in various stages of completion and narrowed down the list to prioritize projects that would better align with the timeframe and available funding for this stage of implementation.

Stafford has ongoing projects to dredge the navigable waters in the Township, conduct beneficial reuse of the dredged material, and restore the marsh along Popular Point. To complement this effort, the Project Team and Stafford decided to proceed with completing a conceptual design for thin layer placement and restoration of a portion of the Edwin B. Forsythe National Wildlife Refuge that sits to the southwest of Popular Point, including Oyster Point, Drum Point, and Mud Cove.

Additionally, Stafford requested the Project Team to help develop a roadmap for conducting ongoing community outreach around resilience. Noting the various projects that have been completed and identified, Stafford identified the need to have a framework for disseminating information, engaging community members in ongoing efforts, and generally informing the public about what Stafford is doing to increase resilience.

Purpose

This document provides context for the project area selected (in the Forsythe National Wildlife Refuge) for conceptual design of marsh restoration and construction of a marsh sill. The following sections describe the existing conditions of the marsh, discuss restoration techniques and tools, detail a conceptual design, and frame a plan for implementation following the completion of this work. Additionally, summaries of stakeholder engagement from this effort provide context for discussion and development of the project. The roadmap for ongoing resilience outreach is also included.

2 | Existing Conditions Analysis

Overview

The Edwin B. Forsythe National Wildlife Refuge (Forsythe) contains 47,000 acres, extending over 50 miles of the New Jersey coast.[1] This assessment focuses on the portion of Forsythe in Stafford Township, New Jersey along Manahawkin Bay, which comprises over 1,700 acres (**Figure 1**).

Figure 1. Thin Layer Placement Project Area

1 About the Refuge - Friends of Forsythe National Wildlife Refuge

Site Ownership and Stakeholders

The U.S. Fish and Wildlife Service (USFWS) owns and manages the Forsythe Refuge. USFWS ensures conservation and management to protect and enhance habitats, enforces federal laws and regulations related to wildlife, provides opportunities for public access and education, and conducts scientific research to inform management practices, among other things.[2] Partnerships with a range of local organizations allow for funding contributions and other projects that benefit visitors and improve wildlife habitat.

Partner organizations include:

- Alliance for a Living Ocean
- Atlantic Audobon Society - South Jersey
- Barnegat Bay Partnership
- Boys & Girls Club of Atlantic City
- Clean Ocean Action
- Conserve Wildlife Foundation of New Jersey
- Ducks Unlimited
- Holgate Taxpayers Association
- Jacques Cousteau National Estuarine Research Reserve
- New Jersey Audubon
- New Jersey Beach Buggy Association
- New Jersey Department of Environmental Protection
- New Jersey Department of Transportation
- New Jersey Division of Fish and Wildlife
- Rutgers University
- Saltmarsh Habitat & Avian Research Program
- Save Barnegat Bay
- Stockton University Coastal Research Center

Site History

Originally established as two distinct refuges - Brigantine (1939) and Barnegat (1967) - the wildlife refuge was combined in 1984 under the name Edwin B. Forsythe to honor the late conservationist Congressman from New Jersey.[3] Forsythe was an important advocate for the National Wildlife Refuge System, significantly involved in establishing the Marine Mammal Protection Action of 1972, sponsored the Fishery Conservation and Management Act, and was a key advocate for helping to acquire 4,000 acres of marsh habitat near the Mullica River.[3]

2 Mission and Vision - US Fish and Wildlife Servicew

3 About the Refuge - Friends of Forsythe National Wildlife Refuge

The refuge lies within the indigenous lands of the Lenni Lenape, who enjoyed the wealth of seafood available in New Jersey, and inhabited New Jersey, Delaware, southern New York, and eastern Pennsylvania when European settlers arrived. The marshes of the refuge contained railroad tracks from the Brigantine Beach Railroad, which was constructed as a branch of the Camden and Atlantic Railroad. When the refuge was established, the railbeds originally constructed in the marsh were elevated, creating the impoundments that support the management of migratory birds year-round.

Current Marsh Conditions

The Coastal Resilience Evaluation and Siting Tool (CREST) was developed by the National Fish and Wildlife Foundation (NFWF) as part of the Regional Coastal Resilience Assessments program. CREST is intended to be used as a screening-level tool to help identify areas that may be well-suited for nature-based solutions (NBS).[4]

Figure 2 displays the project area and buffer used for the CREST evaluation. The NFWF National Coastal Resilience Fund (NCRF) is a funding mechanism that has supported other nature-based projects in the New Jersey back bays. NFWF recommends applicants use the CREST tool to evaluate potential grant-funded projects. This analysis of existing conditions is largely based on analysis using CREST to assist Stafford Township in submitting future NFWF NCRF grant applications. Analysis using CREST is also applicable to other grant funding sources at the state level.

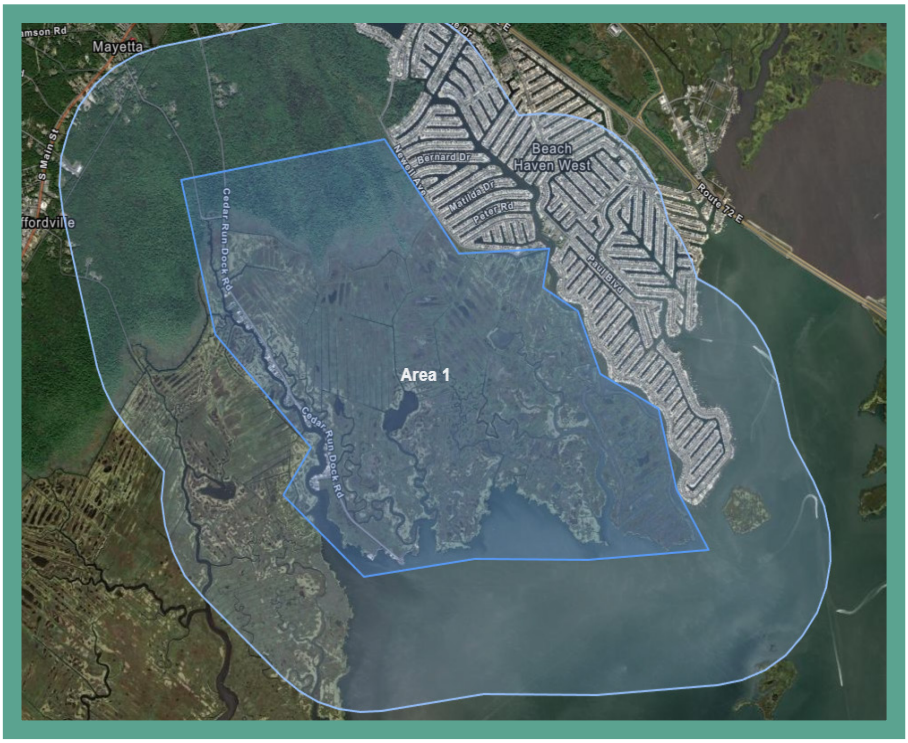

Figure 2. Project Area - CREST Evaluation (Project Area with Buffer)
(Source: NFWF CREST Tool)

4 About CREST - National Fish and Wildlife Foundation

The CREST scores for the Forsythe marsh in Stafford Township are:

- Medium (4.45) for Resilience Hub
  - Hubs are ranked by priority, given the level of exposure that nearby assets have to flood-related threats and the presence and abundance of fish and wildlife species within and surrounding the Hub.
  - Results suggest this Project Area is a lower priority for resilience hubs.
- Medium-high (7.47) for Community Exposure
  - Score indicates areas in the landscape where community assets are potentially exposed to flood-related threats.
- Low (1.15) for Community Asset
  - High values suggest areas with a higher, cumulative prevalence of community assets on the landscape.
- Medium-high (8.27) for Threat
  - Index of flood-related datasets, including storm surge scenarios and landscape characteristics that exacerbate flood potential. High values in the Index represent those areas on the landscape where there are multiple high values of individual inputs.
  - For this area, *high threat inputs include areas of low slope, impermeable soil, sea level rise, and storm surge.*
- Medium-high (5.00) for Fish and Wildlife
  - Identifies valuable habitat for species of concern in both the terrestrial and marine environments.
  - *Higher values indicate more valuable habitat areas for both.*
- High (5.0) for Aquatic
  - An index of priority aquatic species and their habitats, ranked by HUC-10 watershed.
  - *A high value represents watersheds where the most priority species and their habitat are present.*
- Medium-Low (2.0) for Terrestrial
  - An index of priority terrestrial species and their habitats, ranked by HUC-10 watershed. Also includes Important Bird Areas, which transcend watershed boundaries.
  - *A high value represents areas where the most priority species, their habitats, and important bird areas are present.*

The marsh conditions of the Forsythe project area are described as highly valuable habitat for fish, wildlife, and aquatic species, likely to experience threats from low beach slope, impermeable soil, sea level rise, and storm surge, and likely to have community assets that are potentially exposed to flood-related threats.

Sediment Condition

Stafford Township has conducted sediment sampling activities within the navigable waters (lagoons) of the Township to improve navigability. For dredging operations, a critical component is the cost-efficient disposal or beneficial reuse of the excavated material. Sediment sampling and analysis are necessary to characterize the material before a determination of placement can be made. In September 2020, NJDEP approved a sampling plan to collect 50 sediment samples from Stafford's navigable waters for physical/geotechnical analysis. In October 2020, ACT Engineers collected 50 grab samples and analyzed them for Total Organic Carbon, Grain Size, Size Distribution, and Percent Moisture. Sediment sampling and subsequent analysis characterize the material physically and chemically.

This information is necessary for determining cost-efficient disposal methods or potential beneficial reuse of the dredged material. The site characteristics and the characteristics of the dredged material must be compatible so as not to impact ecosystem health and water quality. Dredging is also important for preserving recreational and commercial boating and water access, ultimately improving navigation and maintaining property values of waterfront lots. The dredged material must be placed somewhere once removed, and increasingly, it has been used for other co-beneficial objectives, such as restoring marshlands and providing greater wave attenuation - rather than being disposed in open water or confined disposal facilities.

Marsh restoration and thin layer placement projects, such as potential restoration efforts in the Forsythe refuge project area, require collaboration across entities responsible for managing the sediment, entities accepting the sediment, and associated permitting and funding agencies. Stafford Township is seeking to align the ongoing lagoon dredging project with marsh restoration and flood mitigation projects in the Forsyth refuge. This co-beneficial approach would achieve improvement to navigable waters within the Township, while also increasing efficiency of sediment disposal and improving conditions of the marsh.

Future modeling will verify the stability of the dredged material under a reasonable wave return period. The focus of thin layer placement design should be access and logistics of sediment deployment for efficient spread. The Popular Point design (by ACT Engineers) may also provide precedent for filling old ditches that are a degrading factor for coastal salt marshes.

Land Coverage

The marsh surface of the Forsythe refuge varies between 0' and 2' NAVD88. The Forsythe refuge landscape has been altered by mosquito ditches and canals, which can be at lower elevations to serve as drainage features. The refuge has small ponds that serve as tributaries to the back bay. According to the Restoration Explorer by The Nature Conservancy, Rutgers, and Partnership for the Delaware Estuary, Forsythe refuge is assigned a "major" alteration status, indicating that over 66% of the marsh has been impacted by human activity.[5] According to The Nature Conservancy's Resilient Land Mapping Tool, Forsythe refuge is an ecoregion and state-based area of "recognized biodiversity value," meaning there are high quality species and protected land managed for biodiversity and natural processes.[6]

Tidelands

According to The Nature Conservancy's Resilient Land Mapping tool, Forsythe refuge is categorized as a "Resilient Tidal Habitat." This means that this area has an above average capability of adapting to rising sea levels.

The map in **Figure 3** shows the 1971-1978 shoreline in green and the 2012 wetlands limit in pink. The shoreline along Forsythe has eroded in areas around Oyster Point and Drum Point, as well as Popular Point which is being remedied by an ongoing project.

Figure 3. Forsythe refuge near Stafford Township; 1971-1978 shoreline (green) compared to 2012 wetland limit (pink)
(Source: Ramboll)

5 Restoration Explorer

6 Resilient Lands Mapping Tool

Threatened & Endangered Species

According to The Nature Conservancy's Resilient Land Mapping tool, the northern part of Forsythe refuge is designated as "migration space for tidal habitat," allowing coastal species in the refuge to migrate inland. However, the majority of Forsythe refuge is classified as a "low or blocked flow" area, indicating that species face challenges migrating to this region due to human modifications. Approximately 78% of Forsythe consists of tidal salt marsh, complemented by patches of Laurentian-Acadian freshwater marsh.

Forsythe refuge hosts over 1,000 plant and animal species.[7] Piping plover birds find refuge in Forsythe marshland, seeking undeveloped coastal land for settling. Human activities along the coastline have led to a decline in the piping plover population. USFWS undertakes long-term research and monitoring in Forsythe refuge to manage this species, with around 40% of New Jersey's piping plover population nesting in Forsythe.[8]

A banded piping plover on Holgate unit at Edwin B. Forsythe National Wildlife Refuge
(Source: Conserve Wildlife Foundation of New Jersey)

The elusive black rail bird also nests in Forsythe marshland. Due to its secretive nature, it remains relatively unstudied. USFWS is developing methods to survey this species in Forsythe refuge to gain better insights into its behavior.[8] The red knot bird, which nests in the Arctic, utilizes Forsythe's tidal marshes to replenish before embarking on a southbound migration, reaching destinations as far south as the southern tip of South America.[8]

Salt marsh sparrows are notably abundant in New Jersey, with Forsythe's tidal marsh serving as a critical habitat. Partners of Forsythe are documenting the sparrows on the refuge and working on strategies to enhance their habitat, particularly as high-quality high marsh habitats are diminishing.[8]

7 Edwin B. Forsythe National Wildlife Refuge | Species | U.S. Fish & Wildlife Service

8 Endangered Species Monitoring | U.S. Fish & Wildlife Services

3 | Marsh Restoration Precedents

Purpose

Salt marsh restoration projects attempt to address issues of subsidence and erosion through efforts like beneficially reusing dredged material to fill interior areas of marsh, resulting in an increased elevation. The National Fish and Wildlife Foundation has supported restoration efforts through grants that fund projects demonstrating effective restoration techniques. Precedents provide a foundation for conceptual design, detailing the site specifications, logistics, and outcomes that can be useful to inform the design. The following section describes salt marsh restoration and thin layer placement projects that have been implemented in New Jersey and other Atlantic coastal locations.

Examples

Avalon Salt Marsh Restoration

Figure 4. Avalon - Cape May Wetlands Wildlife Management Area *(Source: GreenVest)*

In the Cape May Wetlands Wildlife Management Area, a section of marsh in Avalon, NJ was chosen as a pilot demonstration site for thin layer placement for salt marsh restoration (**Figure 4**). With a Hurricane Sandy grant from NFWF, dredged material was reused to enhance the marsh and ecosystem services, and stabilize the shoreline.[9] During the winter of 2015, fine-grained sediments from the New Jersey Intercoastal waterway were pumped hydraulically onto the marsh at an average depth of 30 cm on plots that started as marsh platforms. The mean elevations at Avalon were comparable to the Mean Higher High Water line.[10]

9 *Avalon Salt Marsh Resiliency Project - GreenVest*

10 *The Status and Future of Tidal Marshes in New Jersey Faced with Sea Level Rise - NJDEP*

Ring Island Salt Marsh Restoration

The Ring Island salt marsh restoration project, located in Middle Township, NJ, was also chosen as a pilot demonstration site and grant funded by NFWF (**Figure 5**). The effort was completed in 2014 and included placing sand dredged from the New Jersey Intercoastal waterway on Spartina alterniflora salt marsh to create a thin layer placement (TLP) pilot project.[11] Sand was placed at an average depth of 15 cm, hydraulically dredged, and sprayed onto the marsh.

Figure 5. Ring Island - Cape May Wetlands Wildlife Management Area *(Source: GreenVest)*

Fortescue Salt Marsh Restoration

Fortescue was the third pilot restoration site (along with Avalon and Ring Island) chosen for evaluating thin layer placement in New Jersey (**Figure 6**). The marsh was experiencing subsidence and erosion, causing diminished ecosystem services, and received a mix of sandy and fine-grained sediment from the Fortescue Creek navigation channel, spread across six acres of vegetated salt marsh.[11] Average depth of material placement was 17 cm and mean elevation was comparable to the Mean High Water line.

Figure 6. Fortescue Wildlife Management Area *(Source: GreenVest)*

11 *The Status and Future of Tidal Marshes in New Jersey Faced with Sea Level Rise - NJDEP*

Shooting Island Shoreline Restoration

In Ocean City, NJ, the Shooting Island Shoreline Restoration project utilized living shoreline with a rock sill breakwater and invertebrate habitat block clusters to reconstruct the island edge to the historic 1978 footprint.[12] The project was partially funded through a NFWF grant and. At completion, the project provided erosional protection and flood resiliency along 3,300 linear feet of shoreline and will ultimately result in approximately nine acres of tidal wetland restoration (**Figure 7**).

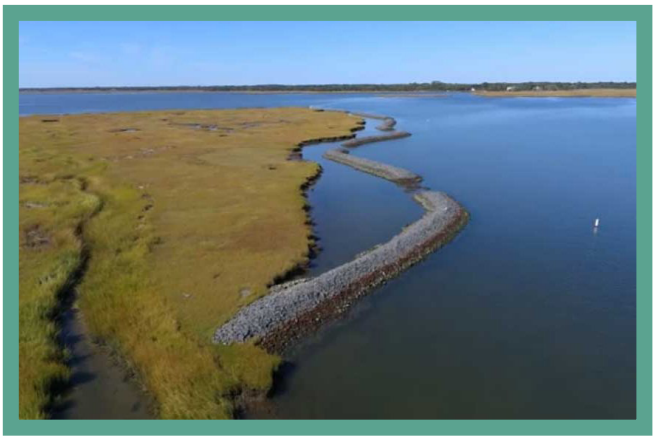

Figure 7. Shooting Island - Ocean City, NJ
(Source: ACT Engineers)

Prime Hook Restoration

The Prime Hook National Wildlife Refuge was established in 1963 and remained healthy until the 1980s, when managers converted some of the area into a freshwater marsh with open water to attract migratory waterfowl.[13] A series of strong storms from 2006 to 2012 (including Hurricane Sandy) necessitated an effort by the USFWS to restore over 4,000 acres of salt marsh. More than 1 million cubic yards of sand were dredged from Delaware Bay to create two miles of beach and barrier dune, planted with beachgrass plugs, to stabilize the shore. Throughout the refuge, 25 miles of channels have been dredged to attempt to restore the natural flow of salty and brackish water - 600,000 cubic yards of sediment from those channels was placed to create sand flats colonized by *Spartina alterniflora* (**Figure 8**).

Figure 8. Prime Hook National Wildlife Refuge - Delaware Bay *(Source: USFWS)*

12 Shooting Island Shoreline Restoration - ACT Engineers

13 Prime Hook National Wildlife Refuge - Global Center on Adaptation

Poplar Island Restoration

The Poplar Island Ecosystem Restoration Project began in 1994 and is a collaborative effort across the U.S. Army Corps of Engineers, Baltimore District and the Maryland Department of Transportation Port Administration, to restore habitat and optimize the placement capacity of dredge material.[14] Sediment that accumulates in the navigation channels leading to the Port of Baltimore is collected and pumped into sections of the island to incrementally fill to the appropriate elevation and then planted with marsh grasses (**Figure 9**). After more than 20 years, the U.S. Geological Survey found that the most successful Common Tern colony in Maryland was on Poplar Island.[14]

Figure 9. Poplar Island - Chesapeake Bay *(Source: USACE)*

Historic Forsythe

Historic aerial imagery is useful to compare to present-day conditions (**Figure 10**). The top black and white image of Forsythe National Wildlife Refuge is from 1930, and the bottom color image is from 2020. For the purposes of concept design, the imagery can provide a target for restoration.

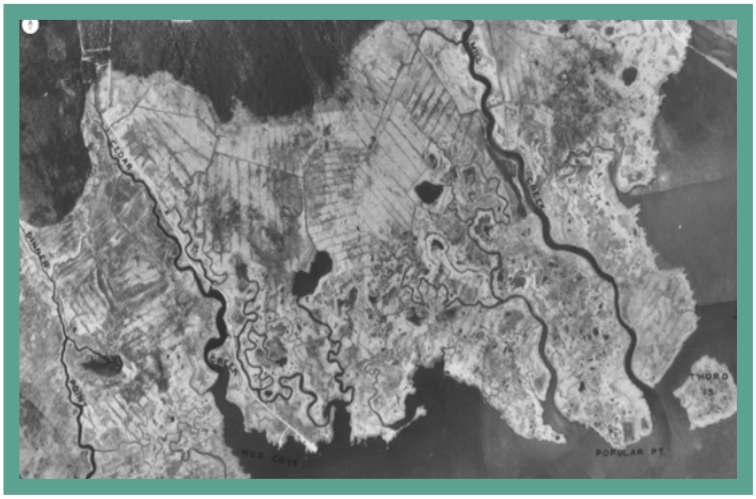

Figure 10. Forsythe Project Area - 1930 (top), 2020 (bottom) *(Source: NJOIT)*

14 Poplar Island: A Story of Successful Restoration - UCMES

Techniques

Ditch Remediation/Restoration

Historically, drainage ditches were dug in salt marshes across New England during the 17th and 18th centuries to increase production of salt marsh hay.[15] In the 1900s, ditches were dug to drain the marsh to prevent mosquitoes from breeding; yet by the early 2000s, a lack of maintenance has caused the ditches to clog and form large pools of water throughout the marsh.

Addressing historic ditching can be beneficial to restoring the hydrology of salt marshes. Options that have been piloted include digging shallow channels (runnels) to help drain pools of standing water; adding bundles of native salt marsh hay to encourage peat soil development and vegetation growth; and removing ditch plugs (small dams of soil) that increase drainage.[15]

Precedents of ditch remediation and restoration for salt marsh include the Parks River National Wildlife Refuge[15] in Massachusetts, the Rachel Carson National Wildlife Refuge[16] in Maine, the Great Marsh[17] in Newbury, Massachusetts, and Pucha Pond at Martha's Vineyard, Massachusetts.[18]

Ditch filled with salt-marsh grass, held in place with twine and wood stakes to collect sediment over time *(Source: Wendall Waters / Wicked Local)*

15 Nature-Based Solutions: Salt Marsh Habitat Restoration

16 Initial Ecosystem Response to Ditch Plugging and Pool Creation: Experiments at Rachel Carson National Wildlife Refuge - Adamowicz and Roman

17 First Runnel Completed at Newly Permitted Site in Ipswich - On the Coast

18 Building Strong Salt Marshes: Using Nature-Based Techniques to Enable Marshes to Keep Pace with Sea-Level Rise - The Trustees

Shoreline Erosion Control

Erosion control along the shoreline can be accomplished through a variety of methods, including proprietary products. Shoreline stabilization options like QuickReef[19] (**Figure 11**) and Shoreline Erosion Control Solutions[20] (**Figure 12**) can provide varying levels of wave attenuation, potentially create aquatic habitat within the structure, and encourage marsh accretion behind the structure.

Figure 11. QuickReef (Native Shorelines) Product

Figure 12. Shoreline Erosion Control Solutions Product

19 QuickReef - Native Shorelines

20 Shoreline Erosion Control Solutions

4 | Forsythe Marsh Restoration Conceptual Design

Design Objectives

The purpose of this section is to advance a feasible conceptual restoration strategy for a degraded portion of the Edwin B. Forsythe Marsh west of Beach Haven West in Stafford Township, with the specific goal of positioning the Township to successfully pursue future state and federal resilience and restoration grant funding in coordination with the New Jersey Department of Environmental Protection (NJDEP). This phase of work is intentionally conceptual in nature and is intended to establish a technically defensible and environmentally meaningful restoration approach that can be refined and advanced through future design stages. Subsequent phases will require additional site characterization–including topographic and bathymetric survey, geotechnical investigation, targeted soil and sediment sampling, and possibly detailed hydrodynamic and morphologic modeling–to support final design and permitting. As such, the proposed concepts and layouts presented herein are expected to evolve as new data become available, and future analysis may result in modifications to align designs with site conditions, engineering constraints, and regulatory feedback.

The overarching project goal is to improve long-term coastal storm resilience by enhancing the marsh platform's ability to keep pace with sea level rise and continue to provide natural storm surge attenuation. Key objectives include stabilizing the eroding marsh edge to reduce wave-driven shoreline retreat, strengthening the system's physical resilience to future climate conditions, and restoring natural hydrologic function where practicable to improve overall marsh health and sustainability.

Figure 13. Conceptualized Thin Layer Placement (TLP) Cellular Sequence *(Ramboll/Kleinfelder)*

The design approach integrates historical shoreline alignment and targeted hydrologic improvements to support ecological enhancement and geomorphic stability. This includes restoring the approximate 1932 shoreline position and selectively mitigating legacy mosquito ditch networks to reestablish more natural tidal exchange patterns (**Figure 13**). By improving hydrologic connectivity and reducing anthropogenic drainage impacts, the project seeks to expand and reinforce high and low marsh habitat.

Conceptual Design

The marsh restoration design will incorporate several different elements and techniques based on location, accessibility, and target habitat. Along the marsh shoreline, the design will consist of an engineered marsh and marsh sill. For the interior portions of the marsh, the design will consist of a combination of mosquito ditch filling and thin-layer placement of dredged material. Each of these methods is discussed below. **Figure 14** provides a conceptual plan-view illustration of the marsh restoration design.

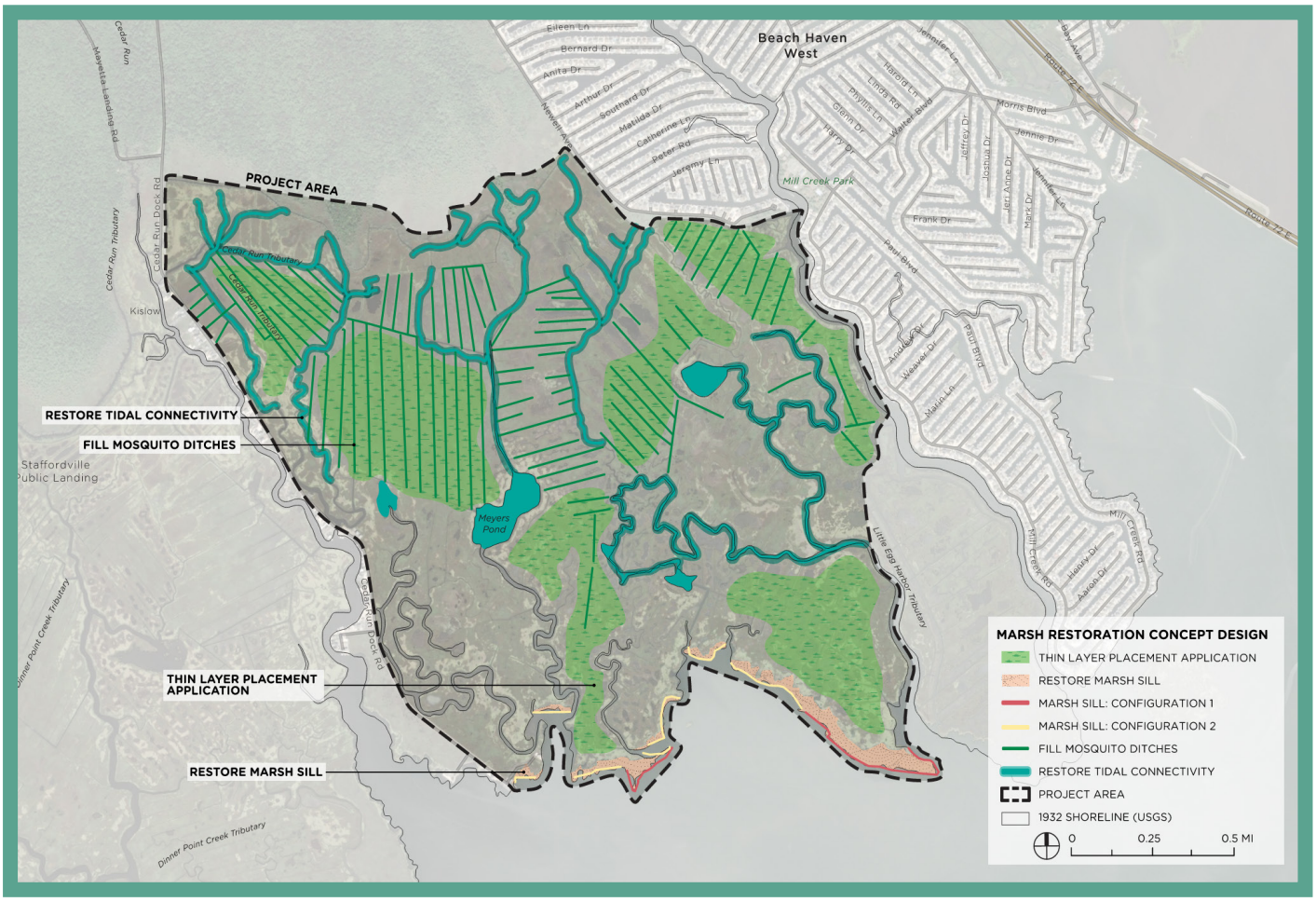

Figure 14. Marsh Restoration Concept Design *(Ramboll/Kleinfelder)*

Most of the restoration activities will involve placement of hydraulically dredged sediment. Because hydraulically placed fine-grained sediments experience significant dewatering and consolidation following placement, the construction (placement) elevation must exceed the final ecological elevation. The design will therefore establish placement elevations that account for anticipated post-placement settlement to ensure the restored marsh platform ultimately achieves the desired habitat elevation range.

The pumped volume of fine-grained sediment can initially be two to four times its in-situ volume due to bulking and entrained water, whereas sand exhibits minimal bulking or post-placement settlement (Piercy et al., 2023). Dewatering, settling, and consolidation occur over days to months after placement and are strongly influenced by grain size. Sandy material undergoes relatively limited volume reduction compared to silt-clay mixtures; therefore, storage capacity requirements vary by sediment type.

Table 1 provides a rule-of-thumb relationship—developed by USACE Baltimore District—linking in-situ dredged volumes with the corresponding volumes observed after upland placement.

Sediment Type	Footprint Volume (cy/ac-ft)
Silt	800
Mixed	1,000
Sand	1,200

Table 1. Baltimore District "Blama" Rule of Thumb for Estimating Site Sediment Capacity

Note: Bob Blama, former member of the USACE Baltimore staff, suggested these rules based on his extensive ecosystem restoration work in Chesapeake Bay.

Dredged material will be pumped behind the sill to create a marsh surface for future planting. After the placed material is allowed to consolidate, the marsh surface will be planted with Spartina alterniflora to create low marsh habitat (**Figure 15**). The final marsh surface, after settlement, will be between mean high water (MHW) and mean sea level (MSL).

The resulting configuration is intended to dissipate wave energy, limit further marsh edge erosion, and create a sustainable sediment buffer that enhances long-term shoreline stability, while also providing a defined area for future placement of fine-grained dredged material as part of ongoing beneficial use efforts.

Figure 16 details a marsh sill designed for locations with lower wave energy.

Engineered Marsh and Marsh Sill

The shoreline stabilization strategy incorporates the construction of an engineered marsh sill to reduce wave energy and protect the marsh edge. In shoreline segments with greater exposure to wind-driven waves and vessel wakes, a more robust sill design (Configuration 1, **Figure 15**) will be implemented, consisting of a trapezoidal rock section or pre-cast concrete units (e.g., QuickReef or equivalent). In more sheltered, lower-energy areas where the marsh edge experiences limited direct wave attack, a less structurally intensive approach (Configuration 2, **Figure 16**) will be used, consisting of staked coir logs.

For Configuration 1, it is anticipated that oyster recruitment and colonization of the hard substrate will enhance structural stability, provide water quality benefits, and contribute to vertical accretion of the sill over time, helping the structure maintain functional elevation in pace with relative sea level rise. The sill alignment will generally follow the approximate 1932 historic shoreline position to re-establish a more stable and resilient marsh-water interface (**Figure 14**). The crest of the sill will be constructed at approximately mean sea level (MSL). The crest width will be greater than the mean local wavelength to promote attenuation of wave energy.

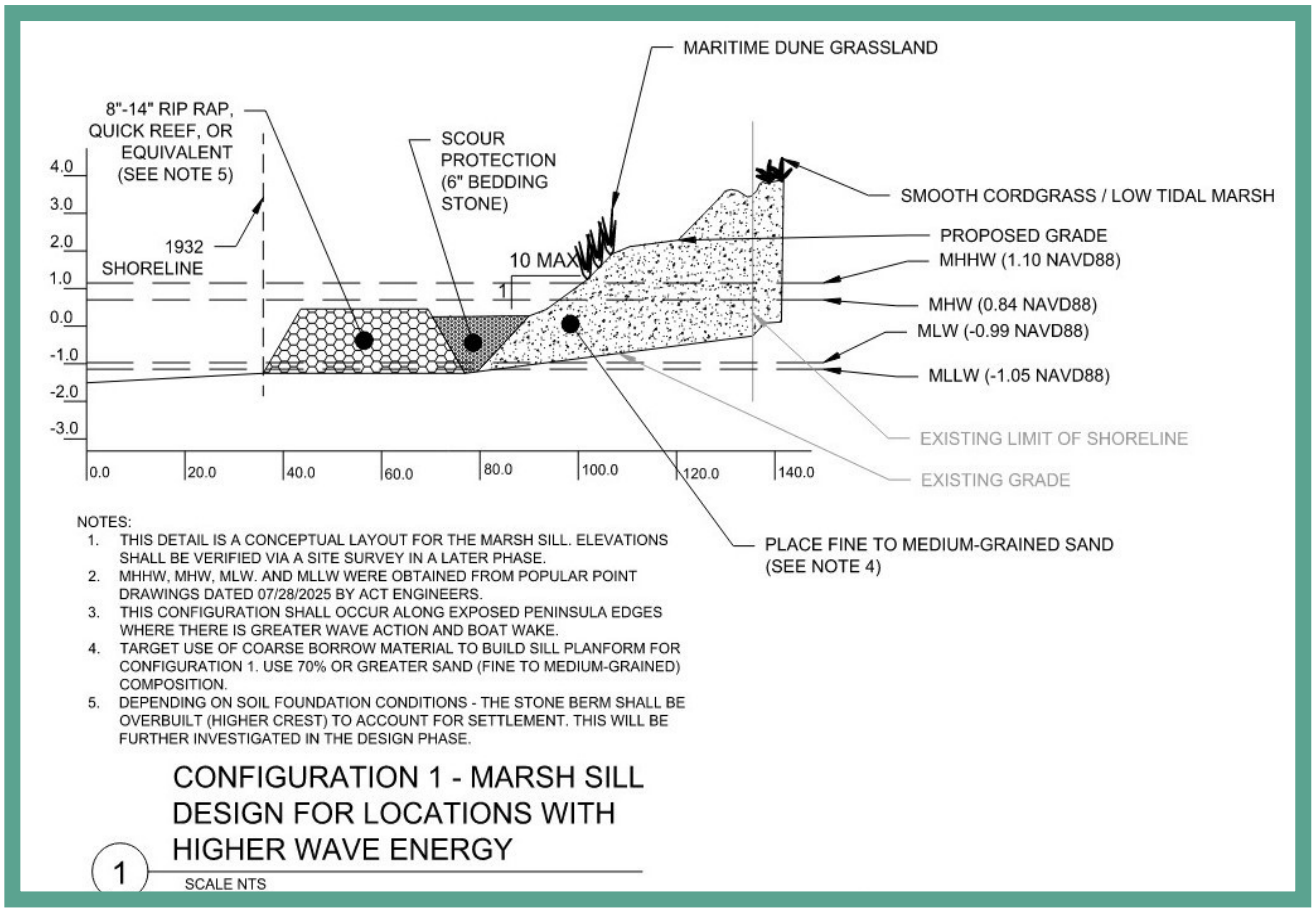

Figure 15. Configuration 1 - Marsh Sill Design for Locations with Higher Wave Energy (Ramboll/Kleinfelder)

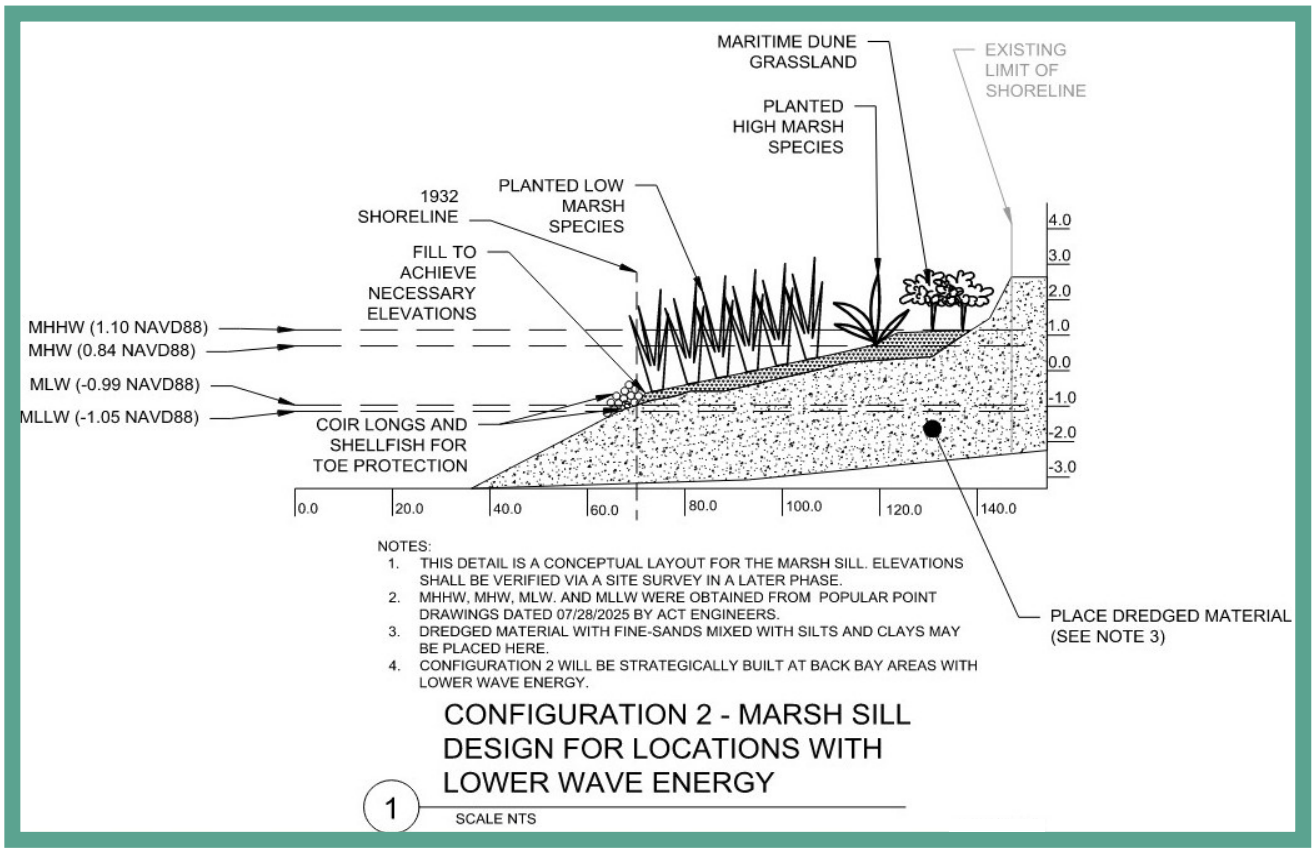

Figure 16. Configuration 2 - Marsh Sill Design for Locations with Lower Wave Energy (Ramboll/Kleinfelder)

Interior Marsh Restoration

Restoration of the marsh interior will be completed using a combination of mosquito ditch infilling, selective restoration of natural tidal creek networks, and thin-layer placement of fine-grained dredged material.

Mosquito Ditch Filling

Filling legacy mosquito ditches offers an opportunity to restore tidal hydrology, improve sediment retention, and enhance marsh platform resiliency. By reducing drainage efficiency and reconnecting fragmented marsh plains, ditch filling can increase water residence times, support natural sedimentation processes, and promote the recovery of native vegetation communities.

Ditch filling will be accomplished by first prioritizing mosquito ditches based on size and hydrologic connection to Barnegat Bay, with initial focus placed on secondary and tertiary channels where tidal exchange remains active but manageable for treatment. Prior to placement, hay will be mechanically mowed, harvested, and subsequently staked within target ditches. Due to limited precedent for large-scale hay amendments in tidal channels, implementation will follow an adaptive management framework, enabling real-time adjustments informed by field performance and monitoring results.

The capacity of hay to promote hydraulic slurry sedimentation remains uncertain under variable field conditions and may differ by ditch geometry and flow regime. Where necessary, biodegradable baffles (e.g., staked hay bales) may be incorporated within larger channels to reduce velocities and enhance sediment capture. Design considerations must also account for post-placement consolidation and dewatering dynamics. Because filling is not expected to adversely impact existing marsh vegetation, initial placement lifts exceeding 12 inches may be appropriate; however, early installations will be evaluated to confirm stability, consolidation behavior, and ecological response prior to scaling across the project area.

Tidal Creek Restoration

In combination with mosquito ditch filling, natural tidal flooding and drainage will be restored by creating a naturalistic tidal creek network in the upper portion of the tidal marsh. The tidal creek design will generally recreate tidal creeks evident in the 1932 aerial imagery and supplemented by design guidance from Chirol et al. (2018). Restored creeks will consist of constructed runnels, or micro-ditches.

Runnels are shallow channel excavations used to allow impounded water on the marsh platform to drain and improve natural marsh processes (e.g., increase primary productivity). Construction methods may also involve compaction of material to create the drainage feature instead of excavation (Mass DEP 2024).

Creating tidal creeks will cause disturbance to the marsh, however this work will help to restore the hydrologic functioning of the marsh, which has been shown to reduce coverage of common reed, improve high marsh habitat, and increase rates of natural marsh accretion. Material cut by creating the tidal creeks can be considered for use in plugging mosquito ditches, or side cast to avoid marsh impacts from transporting cut material. To the extent possible, anticipated tidal creek alignments would be used for transportation pathways to reduce the overall footprint of impact (with contractors "working backwards" to dig and transport sediment along the creek alignment. It is anticipated that characterization of sediment exposed in tidal creeks will be required by NJDEP, consistent with typical requirements for dredging programs.

Tidal creek restoration using runnels *(Source: Suffolk County DPW)*

Thin-layer Placement

TLP will be accomplished through the use of slurry discharge lines connected directly to hydraulic dredging operations. Dredged sediment will be distributed to the surface of the existing marsh through high-pressure discharge outlets. Placement areas (cells) will be selected to restore degraded zones to target ecological elevations consistent with high and low marsh habitat requirements.

Construction Logistics

Construction activities for marsh platform restoration will be sequenced to maximize efficiency while minimizing disturbance to existing marsh conditions. Slurry pipeline corridors will be strategically identified to limit impacts to the existing marsh. Hydraulic dredging will occur within Township-owned slips and channels, with dredged material routed based on grain size characteristics. Finer-grained sediments will be directed to thin-layer placement (TLP) and ditch-filling areas to support marsh platform restoration, while sandy material will be pumped toward engineered marsh and marsh sill.

Coordination with state and local managers will be needed to develop the schedule and logistical needs of using coarse sediment dredged from navigational features servicing Beach Haven West. Current understanding is that sediment characterization and dredging/beneficial use permitting have been completed by others.

Engineered Marsh and Marsh Sill Construction

Construction of the marsh sill will be completed prior to marsh construction, following the established alignment along the approximate 1932 shoreline. Sill layout will be controlled using existing ground elevations and the specified crest elevation to ensure consistent overtopping performance and integration with adjacent marsh elevations. Installation of the sill is expected to be performed from a shallow-draft barge or similar marine plant to minimize impacts to the marsh surface.

Following sill installation, fine-grained dredged material will be hydraulically pumped landward of the sill through a low-pressure discharge. The material will be spread and graded using low ground-pressure earthmoving equipment to establish the target construction, pre-settlement, elevation while limiting rutting or disturbance to marsh substrate.

As shown in the example in **Figure 17**, dredged material is pumped into the placement area and graded concurrently to achieve uniform distribution.

Figure 17. Direct Placement of Fine-grained Dredged Material for an Engineered Marsh
(Source: USACE Dredging Operations and Environmental Research Program (DOER))

Marsh Planting

After the dredged material has consolidated to the design elevation, the marsh surface will be planted with Spartina alterniflora (aka smooth cord grass) between the MHW and MSL elevations. For planting purposes, two forms of vegetative plant materials are recommended: containerized and bare-root plugs. Both plant forms have shown to be equally successful in establishing plant stands when planted properly and on applicable site (USDA 2018).

Containerized plants have a higher per unit cost compared to bare-root plugs but provide the most reliable means of establishment. Containerized plants have proven to be a highly successful transplant, especially along shorelines and other areas of high wave energy. Bare-root plugs are the most economical of the commercially available plant sizes. Per unit production costs are low and transportation costs are very low compared to container plants.

Bare-root plugs are generally limited to planting sites with little or no energy exposure. In high-energy environments, because of their limited surface area, bare-root plugs tend to dislodge prior to establishing. Bare-root plugs have significantly less root mass than container plants, will suffer a higher level of transplant shock, and are slower to spread than container plants (USDA 2018).

Generally, smooth cord grass should be planted between April 1 and September 30. Shoreline plantings are typically planted as a single or double row parallel to the shoreline. Containerized plants should be planted on 5-to-8foot centers and plugs on 2-to-3 foot centers. Under applicable site conditions, smooth cordgrass will spread laterally filling spaces between plants and will grow to its highest elevation and down to its lowest elevation. It is not uncommon for smooth cordgrass to produce 8 to 10 feet of lateral spread in one growing season (USDA 2018).

Mosquito Ditch Filling

Ditch filling will be performed using hydraulically dredged material. Ditches will be lined with hay and staked at intervals of approximately 100 feet to contain the material and promote sedimentation. Material will be discharged at the head of each ditch through a low-pressure outlet to allow gradual filling along the ditch alignment. Alternatively, select ditches may be filled concurrently during high-pressure TLP operations.

Tidal Creek Restoration

The tidal creek restoration approach aims to initiate natural tidal marsh hydrodynamics and then allow natural processes to establish the dynamic equilibrium of tidal creek structure and function. Tidal creek restoration is envisioned to follow mosquito ditch alignments where appropriate to minimize disturbance to the marsh. Marsh sediment excavated to create the creeks may either be side cast to initiate tidal creek levy development or be used to help with mosquito ditch plugging. Tidal creek restoration means & methods that are anticipated include low ground pressure and amphibious equipment working in a strategic matter to minimize run lengths and disturbance. To the extent possible, creek restoration work would be sequenced such that on site access and logistics needed to complete the creek restoration could be leveraged to support TLP and mosquito ditch filling.

Thin Layer Placement

TLP operations will restore marsh cells to target ecological elevations while allowing for post-placement consolidation. The slurry discharge will be positioned to access multiple placement cells, transitioning to new cells as construction elevations are reached. A conceptual cell layout and construction sequence is shown in **Figure 18.** Placement areas will be located away from major wetland channels and edges to provide sufficient transport distance for sediment deposition prior to entering open water.

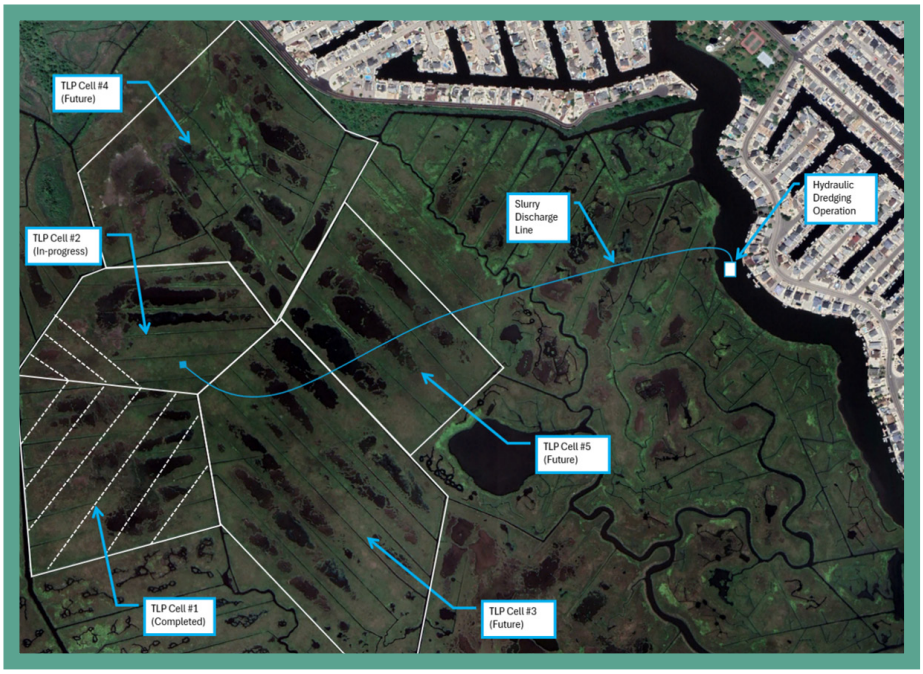

Figure 18. Conceptualized Thin Layer Placement (TLP) Cellular Sequence

Figure 19. Blackwater NWR TLP Project Witness Board *(Source: Middleton Evans, USFWS)*

Individual lifts will not exceed approximately 12 inches. Settling and volume reduction of fine-grained dredged material is expected to result in 10–40% elevation loss over the first 10 days following placement. Elevation monitoring will be conducted using witness boards or similar grade-control systems. Witness boards consist of paired vertical stakes with surveyed horizontal reference boards indicating maximum placement height and predicted consolidated elevation (Whitbeck et al., 2019) (**Figure 19**).

Because consolidation rates may vary between placement area and dredged material characteristics, multiple placement events may be required to achieve final ecological elevation across a cell.

Placement Methods and Sediment Behavior

Hydraulically dredged sediment will be pumped as a slurry through either low-pressure or high-pressure discharge outlets:

- Low-pressure discharge involves an open-ended pipe without any attachment, or a pipe equipped with a spreader plate to slow the discharged slurry so it can be directed with better control over the placement point and reduce impacts to the wetland surfaces or the water column (Cahoon and Cowan 1987).
- High-pressure discharge uses a nozzle to increase exit velocity, generating jetting action that distributes slurry in an arc-shaped pattern (**Figure 20**; Cahoon and Cowan 1987). Local scour will be monitored and controlled where this method is used.

Figure 20. TLP by Conventional Cutterhead with a Crib-Mounted High-Pressure Nozzle at Avalon, New Jersey
(Source: New Jersey Department of Transportation [NJDOT], Office of Maritime Resources [OMR])

Data Needs

Successful design of the marsh platform restoration requires refinement of existing elevation, sediment, and geomorphic datasets. During future phases of work, the following information should be collected and used to support detailed design:

- High-resolution topographic survey of the marsh surface, including characterization of mosquito ditch depth, spacing, and network density.
- Nearshore bathymetric survey along the marsh shoreline to establish current hydrodynamic and geomorphic conditions at the marsh-water interface.
- Sediment core data on marsh platform and along proposed sill alignment to evaluate in-situ material properties relevant to consolidation and settlement behavior, including moisture content, grain-size distribution, bulk density, and organic content.

These data will be used to calibrate settlement assumptions, refine proposed construction elevations, and determine optimal placement strategies for dredged material.

5 | Implementation Plan

Future Project Overview

The project site in Forsythe National Wildlife Refuge is approximately 1,700 acres of marsh southwest/west of Beach Haven West and northwest/west of Popular Point. Marsh restoration and sill conceptual design, as described in Section 4, will aim to restore tidal connectivity, fill mosquito ditches, and place dredge material in thin layer application to raise the elevation. A restored marsh sill will provide wave attenuation and limit further erosion along the edge of the marsh.

This section considers steps that Stafford Township can take to further project implementation, including site investigation, design milestones, permitting considerations, timeline for implementation, estimated costs, partner organizations, and public outreach considerations.

Site Investigation

The Township will oversee and coordinate site investigations, surveys, and resource delineation to support the Refuge enhancement and nature-based resilience design components. This project builds on previous work done by Stafford Township, including the lagoon dredging program and the Popular Point restoration projects. Popular Point is also part of the Forsythe Refuge, located directly to the north of the project described in this report.

Further site investigation is required to characterize the marsh refuge, which is larger and has a slightly different topology than the Popular Point location. Different nature-based solutions are proposed and must be adjusted to the place-specific features within the refuge.

Major tasks are expected to include the following:

- Visual assessments of the marsh tidelines, low marsh, salt pannes, tidal creek, and high marsh areas. The extent of these respective marsh features will be mapped.
- Flora and Fauna assessments. The composition of species, type and extent of marsh plant communities, both native and invasive, will be characterized.

Evidence of fauna (bird, mammal, aquatic, fish) species will be identified, including the presence of threatened or endangered species. NJDEP's Natural Heritage Database and the USFWS database will be reviewed for the presence of State or federal threatened and endangered species.

- Site surveying. Drone mapping will be conducted to achieve high resolution topographic survey (+5 cm vertical resolution) needed to delineate marsh features. A bathymetric survey of the waters of Manahawkin Bay to depths of approximately-8.0 NAVD88, or approximately 300 ft from the shoreline will be conducted. Supplemental surveys using ground crews may be conducted to further delineate inaccessible areas or critical features.
- Beneficial reuse of sediment characterization. The Township will utilize the previous 2021 sediment characterization completed by the Township for its lagoon dredging and Popular Point marsh restoration. The report describes the quantity, environmental quality, and grain size distribution.
- Delineation of coastal wetlands and NJ state open waters. Field delineation of these regulated areas will be conducted to assess jurisdictional and permitting requirements. The results of this analysis will be later used for a permitting task.

The project team will perform quality review of data collected from site surveys and environmental assessments. This information will be shared with the project team as directed by the Township.

Deliverables:

- Topographic and limited bathymetric surveys will be completed to inform the physical condition of the site. The survey will include property boundaries, tideland claims, velocity profiles at low and high tides, location of sediment probes and dredging, and visual assessments of mean high, mean higher high, mean low, mean lower low tide elevations in the NAVD88 vertical datum. Environmentally regulated areas like tidal wetlands and state open waters will also be delineated.
- Wetlands and state open water delineation will be performed to accurately identify wetlands and other aquatic resources. Final deliverables include a wetlands delineation report.
- Flora and Fauna assessment will combine desktop analysis and field data collection to identify the composition of existing native and invasive plant species, and threatened and endangered species. The information will be provided in a summary report.

Design Scope of Work

The current phase of work has established a conceptual design at approximately 10% completion. Advancing the design will require progressively detailed engineering, regulatory coordination, and stakeholder engagement. The following scope of work has been developed to see this project to its design and permitting completion, at which point the Township will have bid-ready documents to advance to another phase of construction.

Major tasks in the design scope of work are expected to include the following:

- **Design refinement and preliminary engineering:** The conceptual layouts that have been shared with the public and stakeholders will be developed into 30% design drawings, including preliminary marsh sill alignments, thin-layer placement cells, and mosquito ditch restoration concepts. Initial design assumptions will be validated using available desktop data and prior sediment characterization reports.
- **Modeling and regulatory coordination:** At the 60% stage, hydrodynamic modeling will be completed to confirm design feasibility and performance. Draft permit application materials will be prepared as described in Section 5.4, and regulatory feedback will be incorporated into the design.
- **Development of an Adaptive Management Plan:** The 60% design phase will include a project-wide adaptive management plan with clear performance metrics, monitoring parameters, and decision triggers tied to contingency actions. Monitoring will address vegetation success, marsh elevation, hydrologic function, shoreline stability, species use, invasive species, and water quality during placement. Sea level rise will be incorporated through adaptive elevation targets and benchmarks, with triggers for maintenance if water levels exceed design assumptions. The plan will also define agency coordination and reporting commitments to ensure compliance and guide long-term resilience.
- **Final engineering and Issue for Bid (IFB) documents:** Advancing to 90% design will involve completing detailed engineering specifications for marsh sill structures, thin-layer placement logistics, and planting plans. A comprehensive cost estimate, construction sequencing plan, and sediment management strategy will be developed to position the project for final permitting and funding applications.

Deliverables:

- 30% design package including preliminary drawings, design assumptions, and updated cost estimates.
- 60% design package incorporating modeling results, refined drawings, adaptive management plan, and draft permit application materials.
- 90% design package with final engineering specifications, comprehensive cost estimate, implementation plans, and supporting documentation for permitting and grant applications.
- IFB construction documents and project manual to allow the Township to go out for public bids.

Permitting

Stafford has already secured federal and state permits for the Popular Point project, including dredging permits. The dredging permit allows for the beneficial reuse of sediments at sufficient volumes to proceed with the restoration design of practices in the Forsyth Refuge, such as thin layer lift placement and shoreline restoration.

Stafford will apply for additional state and federal permits to advance the Forsythe project. Based on the conceptual design project and its planned components, as well as permitting requirements in tidal settings in New Jersey, the project will require approvals and coordination by the United States Army Corps of Engineers (USACE) and the State of New Jersey. This project anticipates preparing the following permit applications:

New Jersey State Permits	Federal Permits
Flood Hazard Area Control Act rules under N.J.A.C. 7:13	Section 404 Clean Water Act
Coastal Zone Management Rules under N.J.A.C. 7:7 (including CAFRA, Waterfront Development, and Coastal Wetlands)	408 Review
Freshwater Wetlands Protection Act Rules under N.J.A.C 7:7A	Section 7 Endangered Species Act

<u>Section 106 National Historic Preservation Act</u>
Due to the historic presence of indigenous tribes, coordination with State Historic Preservation Office (SHPO) and Tribal Nations will be included in the next phase of design, including but not limited to, development of procedures for unanticipated discoveries.

Deliverables:

- Facilitation and preparation of pre-application meetings with state and federal regulatory agencies.
- Preparation and submission of permitting applications.

Implementation Timeline

Months 1-4: Advance to 30% Design
During the first four months, the project team will refine the conceptual design based on stakeholder feedback and site constraints. Additional desktop studies, such as sediment characteristics and marsh elevation data, will be conducted to inform the design. Coordination meetings with Stafford Township and NJDEP will confirm the design approach, while preliminary regulatory discussions with agencies such as USFWS and USACE will begin. Outreach materials will also be drafted to support early community engagement. By the end of this phase, the team will deliver a 30% design package that includes preliminary drawings, design assumptions, and an updated cost estimate.

Months 5-9: Advance to 60% Design
The next phase will focus on incorporating feedback from regulators and stakeholders into the design. Hydrodynamic modeling will be completed to validate design assumptions, and draft permit application materials will be prepared. Community engagement will continue through a public meeting or virtual update, and the project webpage will be updated with progress and FAQs. At the conclusion of this phase, the team will provide a 60% design package that includes refined drawings, modeling results, and draft permit application documents.

Months 10-14: Advance to 90% Design
In the final phase, the team will address regulatory comments from the permit pre-application review and finalize design details, including marsh sill specifications and the thin-layer placement plan. A final cost estimate and implementation roadmap will be prepared, and the team will host a concluding community outreach meeting to present the 90% design. Updates will also be summarized for press releases and the project website. The deliverable for this phase will be a comprehensive 90% design package ready for final permitting and funding applications.

Estimated Costs

Stafford has estimated the direct labor costs and expenses to implement the site investigation, design work, permitting, and public outreach as described in this section for the proposed next phase of work.

An estimated cost to hire consultants to perform these services would be in the range of $450,000- $500,000, exclusive of permitting fees. Note that this is not a construction cost estimate but rather is an estimate of the professional services needed to complete the design task.

Project Partners

A diverse coalition of federal, state, and local partner organizations will be engaged during the duration of the project. Many of these organizations are historically and currently involved in efforts in the bay and Forsythe National Wildlife Refuge.

Stafford Township will lead project implementation, with support from municipal engineer Owen, Little & Associates (OLA) and ACT Engineers. The US Fish and Wildlife Service supports habitat restoration, sediment deposition, tidal reconnection, and revegetation activities and will coordinate regulatory review for the project. The US Army Corps of Engineers reviews and administers permits necessary to dredge and place material.

The New Jersey Department of Environmental Protection provides state-level permitting coordination. The New Jersey Coastal Resilience Collaborative (NJCRC) and broader network of partners are committed to developing and implementing coastal resilience solutions, like the Forsythe marsh restoration project, and can provide support throughout implementation.

Other project partners like Stevens Institute, Stockton University, Save Barnegat Bay, Ducks Unlimited, and NJ Sea Grant can also support this project with local resources and long-term monitoring.

Public Outreach

Stafford should plan public outreach consistently throughout the marsh restoration project to keep community members updated and discuss the progression through design and into implementation. As described in the framework for ongoing outreach (Section 6), Stafford should develop appropriate informative materials about the project and can provide project updates during council meetings and other scheduled events. Project partners can support outreach to foster support for the project and help community members understand the benefits of marsh restoration through beneficial use of dredge materials.

6 | Stakeholder Engagement Summary

The Project Team engaged consistently with stakeholders throughout the project. Eight meetings were held with Stafford Township, one stakeholder meeting was held with ACT Engineers, and one Public Meeting was held where the Project Team presented findings on the Phase II Forsythe National Wildlife Refuge Thin Layer Placement and Marsh Restoration project. The following sub-sections highlight key takeaways from each meeting.

Project Team Meetings with Stafford Township

Meeting #1: June 4th, 2025

This meeting served as the Project Kick-off Meeting with Stafford Township. The following topics were covered: introduction and roles of the project consultants, Stafford Township staff, NJDEP staff and other project members; a review of the Municipal Assistance Program (MAP) objectives and criteria; a review of the Stafford Resilience Action Plan and current priorities; and a preliminary discussion of the proposed scope of work and a preliminary project timeline. During this first meeting, the consultant team heard about the Township's current priorities from Township Administrator Matt von der Hayden. The preliminary list included the following projects:

- Consolidation of Township's Water Towers to a higher elevation
- Manahawkin Bay Bridge (Route 72) Storm Event Preparedness
- Township Bulkhead Elevation
- Manahawkin Wildlife Management Area Restoration
- Mud City Sewer Upgrade Plan
- Regional Back Bay Sediment Management Plan (NFWF grant support with Save Barnegat Bay)
- Popular Point Sill Restoration and Thin Layer Placement (NFWF grant support)
- Water Quality Improvements Community Outreach with Save Barnegat Bay
- Dredging at William Cook Boulevard
- Cedar Bonnet Islands Sewer System Upgrades and Redevelopment Study

Meeting #2: June 25th, 2025

The second meeting with Stafford Township involved reviewing the preliminary short list of implementation projects (previously mentioned above) and agreeing upon the final list of projects for the Implementation Memo and discussing the Stakeholder Engagement Plan. This meeting covered general project logistics like the overall timeline and recurring meetings. The agreed upon projects for the implementation memo included: Thin Layer Placement and Marsh Restoration behind Popular Point and the Outreach Campaign and Communication Materials for the Township. Stafford Township staff were also interested in having the consultant team investigate the feasibility of a living breakwater concept and approach off of Beach Haven West.

Meeting #3: July 21st, 2025

The purpose of the meeting was to gain insight into the ongoing Popular Point restoration work from ACT Engineers. The meeting focused on updates and discussions regarding the experience of ACT Engineers with dredging permits in Stafford Township, prior work with NJDEP and Forsythe NWF. Eric Rosina from ACT Engineers highlighted his experience with the Popular Point/Forsythe Salt Marsh Sill, insight into thin layer placement strategies, how living shorelines create habitat, and the feasibility of living breakwater concepts off the shore of Beach Haven West. There were discussions about community concerns with these types of projects, material dredging challenges, and long-term project timelines. The group also discussed multiple grant funding opportunities.

Meeting #4: August 18th, 2025

The consultant team shared updates on the Forsythe Marsh Sill and Thin Layer Placement desktop analysis and provided an update on the outreach campaign. At this stage of the project, the consultant team shared ideas about outreach strategies for the Township, which included updating the Township website, creating outreach materials for Stafford to use, or a roadmap outline for the Township to use for future engagement. The Township representatives preferred the third option, which the consultant team has included in Section 7 Roadmap for Ongoing Resilience Outreach.

Meeting #5: September 15th, 2025

This meeting was a joint call with Stafford Township and served as the stakeholder meeting with ACT Engineers. For more information about this project meeting, see the section below, titled Stakeholder Meeting with ACT Engineers.

Meeting #6: October 20th, 2025
During this October meeting, the consultant team shared the high level workplan for the Forsythe Marsh Sill/Restoration Project and the final draft of the Outreach Campaign with the Township. The consultant team discussed precedent projects for marsh restoration on the East Coast, which were applicable for the ongoing work concept design. Precedents included restoration at Shooting Island, NJ and Poplar Island in the Chesapeake Bay. Stafford shared information about their experience with the State and federal permitting process for dredging and placement of dredged materials. The group also discussed logistics for the Public Meeting.

Meeting #7: November 17th, 2025
This meeting focused on the upcoming Public Meeting on December 9th, 2025. During the call, the consultant team shared a final draft of the Forsythe Marsh Sill/Restoration Project Report and the content outline for the upcoming Public Meeting. The consultant team shared a list of academic and environmental groups or partners that the Township could consider inviting to the meeting.

Meeting #8: December 15th, 2025
This meeting served as debrief on December 9th Public Meeting and to talk through the upcoming final report.

Stakeholder Meeting with ACT Engineers

Consultants from Ramboll and Kleinfelder met with Eric Rosina of ACT Engineers virtually on September 15th, 2025. Matt von der Hayden, the Stafford Township Administrator, Montana Knutsen of NJDEP, Stafford Township consultants from Owen, Little, & Associates and Remington & Vernick Engineers were also in attendance.

The purpose of the meeting was to understand the work done to date by ACT Engineers for Popular Point marsh restoration using dredged material from navigable channels in Stafford Township. Discussion focused on the process of acquiring permits from USACE and US Fish and Wildlife, dredging navigable channels around Stafford, the site conditions of Popular Point marsh, and administration and logistics related to the project. ACT Engineers provided detail that the Ramboll/Kleinfelder consultant team incorporated into the approach for marsh restoration and marsh sill concept design for the Forsythe project area.

Public Meeting

The Public Meeting was held as a hybrid event on December 9th, 2025, at the Stafford Township Administration Building in Stafford, New Jersey, and simultaneously on Zoom. Participants included multiple community members, a representative of Forsythe National Wildlife Refuge, a representative from Stevens Institute and NJ Sea Grant, the project manager from NJDEP, and a naturalist from the Barnegat Bay Partnership.

The meeting lasted approximately 90 minutes and included a presentation and a question-and-answer session. Staff from Kleinfelder and Ramboll presented materials along with Matt von der Hayden, the Stafford Township Administrator.

The objective of the meeting was to raise awareness about the Resilient NJ project, Resilient Stafford, and similar projects, to discuss conceptual designs for the Forsythe project area, and to answer questions from the public about the Forsythe Marsh Restoration concept design project.

The meeting discussed the existing conditions at Forsythe Wildlife Refuge and the project area, successful marsh restoration precedents like Shooting Island, NJ, and Ring Island, NJ, overall conceptual design of various marsh restoration techniques, logistical information for the mentioned marsh restoration techniques, and next steps for the project. The conceptual design included information about the four key elements of marsh restoration: restoring marsh sills, restoring tidal connectivity, filling mosquito ditches, and the application of dredge material for thin layer placement. Additionally, the consultant team provided benefits for all the design elements. The team also described the logistical aspects of hydraulic dredging, marsh planting, mosquito ditch filling, tidal creek restoration, and thin layer placement.

The next steps presented at the Public Meeting identified the need for Stafford Township to seek additional funding through State and Federal grants for the full design development and permitting of the project. It was also noted that the presented conceptual design will eventually evolve during the next full design and permitting phase.

7 | Roadmap for Ongoing Resilience Outreach

The purpose of this framework is to act as a roadmap for ongoing community engagement in Stafford Township, particularly with respect to climate resilience, water quality, and habitat restoration efforts. A community engagement plan is vital for guiding meaningful interactions and fostering a sense of belonging, trust, and active participation. Building strong relationships with residents is crucial for a thriving community. By implementing this plan, the Township will provide continuous opportunities for community stakeholders to stay informed and engaged in efforts to make Stafford more resilient.

The Consultant Team has provided this framework as a guide for Stafford Township to build upon and modify to meet their specific goals and needs.

Getting Started

Stafford will define engagement goals. Goals should be SMART - **S**pecific, **M**easurable, **A**chievable, **R**elevant, **T**ime-bound. All identified goals should be tangible metrics with attainable timeframes to help the Township track progress.

The Consultant Team has provided examples below of different types of metrics that the Township could use to track the impact and evaluate the success of the community engagement framework. The Township may use these goals and metrics and/or develop new ones that are tailored toward the local community.

- Raise awareness about resilience projects among 80% of Stafford Township residents by December 2025 through flyer postings, social media postings, and newspaper postings.
- Engage 25 local businesses and organizations in water quality initiatives (e.g., water quality monitoring, community water stewardship, training of best practices) by June 2026.
- Recruit 100 volunteers for habitat restoration projects and conservation projects (i.e. Spartina grass plantings, park or beach clean ups, community sand/dredged material bucket brigades) by August 2026.

- Partner with Marine Academy of Technology and Environmental Science (MATES) to develop and deliver environmental protection curriculum to elementary students within the Township by September 2026.
- Facilitate involvement of 500 residents in resilience planning workshops and feedback sessions by March 2026.
- Increase representation of underrepresented groups in environmental action teams by 30% by December 2026.Track progress through initial survey and follow up survey.

Evaluate Internal Capacity & Existing Efforts

Existing Methods of Public Communication and Feedback:

- Township Facebook (https://www.facebook.com/StaffordTownshipNJ/)
- Township website (https://www.staffordnj.gov/)
- Public Access Cable, Channel 22
- Route 72 Billboard

Existing Staff Capacity for Engagement

- The Mayor/Township Council/Administrator are all responsible for engagement.
- The Town Administrator is the point of contact for public and community engagement.
- Stafford Township may consider establishing a new role (e.g., Chief Resilience Officer) to help deliver engagement. This new role would require additional funding (e.g. grants from the state or the Township annual budget).

Map Community Stakeholders

Stafford should identify community stakeholders, including local government agencies, educational institutions, local businesses, non-profits, neighborhood associations, and other groups that are important to the participatory process.

Consider the following groups:

Local and Government Agencies
- Stafford Township Municipal Offices, Planning and Zoning Board, Environmental Commission
- Ocean County Agencies
- Long Beach Island Municipalities
- New Jersey Department of Environmental Protection (NJDEP)
- US Fish and Wildlife Service

Neighborhood Associations
- Homeowner associations
- Neighborhood watch groups
- Civic organizations

Recreational and Sports Organizations
- Local sports leagues
- Clubs
- Recreational centers

Health & Safety Services
- Stafford Township Police Department
- Local fire department & EMS

Faith-Based Organizations
- Houses of worship
- St. Francis Community Center

Media Outlets
- Local newspapers (The SandPaper)
- Radio stations
- Local TV channels
- Year-round residents (homeowners and renters) and seasonal residents (homeowners and visitors)

Local Businesses & Developers
- Chamber of Commerce
- Real estate developers
- Small business owners
- Major employers

Educational Institutions
- MATES
- Southern Regional
- Stafford Township School District
- Ocean County College's satellite campuses
- Stockton University
- Drexel University
- Rutgers University
- Stevens Institute

Non-profit Organizations
- Save Barnegat Bay
- Environmental groups
- Community service rrganizations
- Conservation groups

Implement Engagement Strategies

The engagement strategies presented below are intended to be a comprehensive framework for Stafford to implement as needed. The framework includes both strategies that the Township is already doing and new strategies that can be added to the engagement toolkit. Levels of engagement – inform, consult, involve, or empower – are noted in bold.

Inform: Educate the public about the Township's work to increase community resilience and provide information to residents and businesses about available resources to increase their resilience (e.g., funding for home elevation)

Tools for engagement:

Flyers

- Distribute printed handouts/ informational packets/brochures about coastal resilience efforts
- Create digital flyers for social media/ website with information about coastal resilience efforts
- Timeline: Quarterly or Annually

Newsletter Email

- Evaluate current newsletter email methods and identify areas of improvement (i.e. why do the newsletters not work?)
- Improve email distribution mechanism and continue to share Township updates on initiatives, meetings, and progress routinely via email (quarterly/monthly)
- Post a copy of the newsletter on the Township website
- Timeline: Quarterly

Presentations

- Present information at Township Council meetings or open houses
- Timeline: Project-specific, as-necessary

Website

- Create dedicated sections for coastal resilience updates, resources, and feedback forms
- Post presentations (PDF) and recordings (video) to website
- Evaluate view to ensure it is mobile-friendly
- Update Township website to include similar elements to the Charleston example site (see below)
- Hire assistance in building the new website
- Timeline: Ongoing

Consult: Engage stakeholders in discussions to gather their opinions and insights.

Tools for engagement:

Focus Group Meetings

- In-depth discussion with small groups of interested parties or key community groups.
- Timeline: Annually, Project-specific

Social Media

- Provide project updates
- Post engagement polls
- Engage in discussion
- Timeline: Monthly, Ongoing

Involve: Allow the stakeholders to participate in decision-making processes

Tools for engagement:

Community Rating System

- Continue to develop and implement public information campaigns to inform residents about flood hazards
- Timeline: Ongoing

Public Meetings/Events

- Continue to host project-specific Town Hall meetings, open houses, and workshops
- Timeline: Project-specific

Special Initiatives

- Continue to involve community members for events surrounding sustainable practices, emergency preparedness, and environmental conservation.
- Continue to invite town members to participate in planning meetings, surveys for areas of interest for the township.
- Timeline: Project-specific

Citizen Science

- Work with Beach Haven West Civic Association to create or identify opportunities for citizen science that contribute to resilience projects (monitoring, photo data collection, planting, etc.)
- Work with academic partners (including MATES, Stockton University, Drexel University, Rutgers University, Stevens Institute, Save Barnegat Bay) to support citizen science activities
- Timeline: Annually, Project-specific

Empower: Support stakeholders in their efforts to influence outcomes.

Tools for engagement:

Community Liaison

- Identify a community liaison that can support Township engagement efforts - (e.g. The Township Administrator). This could be in the form of a Chief Resilience Officer (once position is established and funded), a representative from the Resilience Advisory Committee, or other
- Timeline: Monthly or Quarterly

Determine Schedule / Timeline

To compliment engagement strategies, Stafford should determine the frequency of engagement that fits their needs. To do so, Stafford should:

- Create a draft schedule for each engagement topic or strategy
- Review schedule annually
- Define roles and responsibilities and assign tasks

Move Towards Implementation

START with pilot programs

To test strategies, start with small-scale pilot engagements and evaluate outcomes

ENSURE transparency

Regularly update the community on progress and adjustments

ACTIVELY engage

Maintain consistent and continuous interaction with community members during events and online discussions

Evaluate Community Engagement

To understand the impact of engagement strategies and refine systems, Stafford should implement methods of evaluation.

- **Collect feedback**
  Use surveys, participation data, and feedback forms to gather insights on what's working

- **Measure success**
  Compare outcomes with original objectives

- **Adapt strategies**
  Modify approach based on lessons learned and feedback

- **Share findings**
  Communicate results and improvements to residents, reinforcing transparency and trust

Continuous Improvement

Based on evaluating feedback, Stafford can understand where improvements or changes are needed.

- **Steadily maintain ongoing engagement**
  Regularly update and refine the engagement framework/plan to reflect what has been successful

- **Enhance digital platforms**
  Use a robust online platform to support continuous engagement

Examples of Engagement Strategies

Stafford can review a variety of engagement strategies for inspiration and examples to follow.

- Village of Key Biscayne, FL
- Jacksonville, FL | Transparency Dashboards
- Resilient NJ | Long Beach Island, NJ
- Cape Cod Regional Government | Barnstable County, MA
- Coastal Resilience | Hampton, NH
- Community Resilience Planning | Nantucket, MA
- Climate Resilience | Boston, MA
- Resilience | Charleston, SC
- St. Francis Community Center | Long Beach Island, NJ
- Outreach Material | Nantucket, MA
- Resilient Newburyport Newsletter | Newburyport, MA
- Energize Framingham Newsletter | Framingham, MA
- Brochures & Handouts | UCONN CIRCA
- Bridgeport Climate Action Case Study | UCONN CIRCA
- Social Media Toolkit | MAPC
- Citizen Stream Brochure Mailer | Superior, WI
- Social Media Post Image | MAPC
- Resiliency Planning | Jersey City, NJ

8 | References

Cahoon, D. R., and J. H. Cowan Jr. 1987. Spray Disposal of Dredged Material in Coastal Louisiana: Habitat Impacts and Regulatory Policy Implications. Baton Rouge, LA: Louisiana Sea Grant College Program, Center for Wetland Resources, Louisiana State University. https://nsgl.gso.uri.edu/lsu/lsut87006.pdf.

Chirol, C., I. D. Haigh, N. Pontee, C. E. Thompson, and S. L. Gallop. 2021. Parametrizing Tidal Creek Morphology in Mature Saltmarshes Using Semi-Automated Extraction from LiDAR. Geomorphology 375: 107551. https://doi.org/10.1016/j.geomorph.2020.107551.

Eagle, Meagan J., Kevin D. Kroeger, Amanda C. Spivak, Faming Wang, Jianwu Tang, Omar I. Abdul-Aziz, Khandker S. Ishtiaq, Jennifer O'Keefe Suttles, and Adrian G. Mann. 2023. Soil Carbon Consequences of Historic Hydrologic Impairment and Recent Restoration in Coastal Wetlands. Global Change Biology 29 (12): 3527-3543. https://doi.org/10.1111/gcb.16732.

Massachusetts Department of Environmental Protection, 2024. Guidance for Salt Marsh Restoration Techniques, Including Ditch Remediation, Runnels, and Marsh Habitat Mounds, Massachusetts Dep. of Env. Protection, Boston, MA.

Piercy, C., T. Welp, and R. Mohan. 2023. Guidelines for How to Approach Thin-Layer Placement Projects. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Department of Agriculture, Natural Resources Conservation Service. (2018). Smooth cordgrass (Spartina alterniflora Loisel.) - Plant guide (PM PG 13-933). https://www.nrcs.usda.gov/plantmaterials/njpmcpg13933.pdf

Whitbeck, M., A. MuCullough, E. Meyers, and D. Curson. 2019. Shorters Wharf Tidal Marsh Resilience Project: Implementation Report. Arlington, VA: The Conservation Fund. https://ecos.fws.gov/ServCat/DownloadFile/165618.