# STATEWIDE SHORELINE MONITORING FRAMEWORK

## Shoreline Monitoring – Measuring Success – Phase II



Final Report

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Prepared for

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# Executive Summary

## Project Overview

In 2018, New York State Department of State (NYSDOS), with funding from National Oceanic and Atmospheric Association (NOAA) and New York State Energy Research and Development Authority (NYSERDA), initiated a jointly managed project on the development of a shoreline monitoring framework for New York's coastal areas (Phase I). The goal of the framework is to assess effectiveness and performance of various shoreline treatments, including unaltered shorelines, natural shorelines, nature-based features, and hard structural shorelines. Phase I was a two-year initiative that brought together a literature review, technical expert working groups, regional stakeholder and advisory council input, and experience from pilot field data collection. The Phase I monitoring protocols were piloted in summer 2019 and broad lessons learned were recorded. In 2021, NYSDOS contracted with Gomez and Sullivan Engineers to complete a second phase of the project. Gomez and Sullivan assembled a team of consultants, including Bay Environmental Consulting and Industrial Economics, to address the needs of the first phase of the project. Such challenges included streamlining the protocols to improve efficiency, methods for insuring quality assessment/quality control of the data and providing a meaningful conversion between the data collected and "actionable information" relevant to the overall goal of the project. Phase II evaluated the Phase I protocols and built upon and refined existing efforts to create a statewide shoreline monitoring framework. These changes include updated protocols, development of an ArcGIS Online Solution for improved data management, employment of the updated protocols in the field using the ArcGIS Online Solution, while also incorporating feedback from the Project Advisory Committee (PAC) and the teams who implemented the protocols in the field. The task of revising the protocols was initially started as a desktop exercise, implementing advice from the PAC members and our teams' experience. Field work, completed during the following season, provided an opportunity to build upon the ideas developed in the revisions, and align the database solution and data collection methods. The steps, strategies, and outcomes of these efforts are outlined in this Final Report, as well as recommendations for continued development and implementation of the project.

## Revisions to Shoreline Monitoring Framework

The Phase I protocols and final report served as a foundation for Phase II efforts[1]. Much of the data collected during Phase II closely align with Phase I, but the methodologies have been revised to reorganize and streamline data collection efforts. Universal revision goals were established to guide modifications to the methodology, data collection, and data recording. These goals led to the merging of several Phase I protocols into a single-Phase II protocol, establishment of two new protocols, alterations of the protocols document structure (e.g., worksheets are no longer an appendix, rather they are found throughout the protocol document), revisions to the detailed data collection methodology, and clarifications of data recording methods. Following the implementation of the Phase II protocols, feedback from monitoring teams was incorporated into the protocol document. The updated set includes 13 protocols, associated worksheets and guides, as well as a site feasibility form and annual summary of protocols.

## Improvements to Data Management Capabilities

Phase II included introducing ArcGIS Online as the new technology to collect and manage protocol data. The ArcGIS Online solution provides a centralized, web-accessible platform that allows field crews to query and edit data in real time. The solution incorporates mobile apps like Field Maps and Survey123

[1] Additional Phase I information can be viewed here: https://dos.ny.gov/statewide-shoreline-monitoring-framework

and web browser apps, which provide tools for post-processing data and completing the desktop protocols. The solution also includes a Homepage, which provides quick access to the applications required for each protocol. ArcGIS Online data are backed up daily using Python Notebooks, which are managed and scheduled in ArcGIS Online.

## Implementation of the Phase II Monitoring Protocols

Phase II monitoring data collection was carried out at seven sites in the New York coastal zone with the purpose of testing Phase II data collection protocols, providing data for established sites. Two new sites were also established, and initial data was collected for those sites. Phase II efforts involved two field teams as well as desktop researchers. Implementation of protocols was conducted during June and July 2022. The results reported in this document build upon the results given in the *Measuring Success: Monitoring Natural and Nature-Based Shoreline Features in New York State Final Report* (Science and Resilience Institute at Jamaica Bay, 2020) (Phase I Final Report)[2].

## Recommendations for Continued Development

Generally, the implementation of Phase II of the protocols went smoothly. Nonetheless, there were several suggestions that the team recommends for future applications of the protocols to ensure that information is successfully transferred to future researchers, and that data collection runs efficiently. These include the following:

- **Have a clearly defined goal for monitoring efforts at each site that are reflective of holistic resilience services**. While protocols are intended to be relatively easy to undertake, implementing them requires time and energy by teams completing them. The goals for the Statewide Monitoring Framework are to collect consistent and comparable data on shoreline features and the resilience services they provide to better support shoreline decision makers. While NYSDOS understands that individuals may have other goals for monitoring, this Framework encourages consideration of holistic resilience services (or benefits provided by shoreline features): ecological function, hazard mitigation/structural integrity, and socioeconomic factors. Future data collectors should be sure to have a clearly defined purpose and use for data collection that considers the overall Framework goals but is relevant to their own site objectives. NYSDOS plans to create a document that outlines goals for the overall monitoring effort. Future researchers may also wish to develop a document that lays out the explicit goals of monitoring at each location that can be referenced by all team members. NYSDOS intends to conduct data analysis in the future; therefore, contributors are supporting future data analysis by collecting data at shoreline sites. Having these goals in mind will inform the future selection and delineation of the sites to be monitored and will ensure that teams' efforts will be valuable to future evaluations.
- **Apply site selection criteria to ensure data collection is feasible and will be useful**. In addition to identifying the goals of individual sites, future data collectors should consider whether sites are amenable to data collection. The new "Monitoring Site Feasibility" form should assist researchers in determining whether sites have attributes are feasible to measure. Things to consider when selecting feasible sites include general accessibility (e.g., distance from parking area, boat-only access, terrain, physical obstructions such as fences, etc.) jurisdiction, sensitive habitats with restricted access, as well as various safety concerns. The socioeconomic protocols further identify criteria that make sites suitable for applying those protocols, particularly for the more involved

[2] The Phase I Final Report can be accessed here: https://dos.ny.gov/system/files/documents/2021/06/measuringsuccess_finalreport_minusappendices_050721.pdf

survey efforts, such whether a site has visitor access and use (for the intercept survey) or being located near residential homes (for the household survey).

- **Coordinate with site owners/managers**. Our team found that additional collaboration with site owners/operators would be valuable early in the process. We suggest that Protocol 7 and Protocol 13 should be conducted earlier in the process in order to gather contextual information on the site, to identify any required permits that may be needed, as well as to establish any coordination with other monitoring efforts that should be undertaken.
- **Provide basic user training for ArcGIS online system**. Our Phase II team found that most users would benefit from a short online tutorial to get familiar with the ArcGIS online system.
- **Provide interviewer training and/or passive survey option.** We found that teams would benefit from a short tutorial that provided some best practices for in-person interviewers for Protocol 12. We would suggest ensuring that a central person or central people at NYSDOS be tasked with delivering such basic training to future interviewers on a regular basis. Alternatively, short online tutorials could be recorded and presented to interviewers. A further step could involve identifying a community of practice for the scientific and economic disciplines that could be called on to provide help to future researchers.

  NYSDOS also recommended a potential change or addition to the survey method that would create a passive version of the intercept survey, i.e., a version that does not require an interviewer. This method would involve posting a link or QR code to the survey on signs at each location, as discussed in section 5.2. While this method would require respondents to "opt in" to participate in the survey, it could increase the overall number of respondents. Respondents that utilize a QR code may be more likely to be engaged with or concerned about the monitoring features on the site than a "typical" visitor. Future analysts would need to be mindful of this bias when analyzing data or reporting statistics about it.
- **Establish a mechanism to collect feedback from future researchers**. We recognize that future data collectors may identify additional improvements that can be made to the protocols and the supporting ArcGIS online system.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| FEMA | Federal Emergency Management Agency |
| Gomez and Sullivan | Gomez and Sullivan Engineers, D.P.C. |
| HSF | hard structural features |
| NNBF | Nature-based features |
| IEc | Industrial Economics |
| NOAA | National Oceanic and Atmospheric Association |
| NYSDOS | New York State Department of State |
| PAC | Project Advisory Committee |

# 1 Project Overview

## 1.1 Shoreline Monitoring Framework Synopsis

### *Phase I*

The New York State Department of State (NYSDOS) Shoreline Monitoring Framework is an initiative to develop a coherent shoreline monitoring framework for shoreline features across New York State. The purpose of the framework is to develop methods for consistent data collection and then to collect data that will allow NYSDOS evaluate the services offered by New York's diverse shorelines and to compare shorelines over time. Development of the monitoring framework began with Phase I with funding from National Oceanic and Atmospheric Association (NOAA) and New York State Energy Research and Development Authority (NYSERDA), with lead development by Science and Resilience Institute at Jamacia Bay. Phase I began in 2018 and concluded in 2020. Phase I efforts resulted in the development of an evaluation framework for monitoring resilience services offered by New York State shorelines. Components consisted of (1) shoreline performance parameters, (2) indicators for monitoring performance relative to those parameters, (3) monitoring protocols to collect data to track those indicators, and (4) a database structure. The project process also initiated the development of an informal network of shoreline managers and other stakeholders to adopt and use the monitoring framework in the future. *Measuring Success - Monitoring Natural and Nature-based Shoreline Features in New York State Final Report* (Science and Resilience Institute at Jamaica Bay, 2020) summarizes Phase I development and results.

### *Phase II*

With the Shoreline Monitoring Framework Phase II initiative, NYSDOS procured Gomez and Sullivan, D.P.C. (Gomez and Sullivan), Bay Environmental, and Industrial Economics, Incorporated (IEc) to build upon and refine the framework developed during Phase I. To begin, Gomez and Sullivan ecologists, engineers, and GIS professionals reviewed the Phase I final report and assessed the framework and 17 data collection protocols. The Gomez and Sullivan team worked with NYSDOS and a Project Advisory Committee (PAC) (Appendix A) to revise and progress the framework. Gomez and Sullivan's efforts to revise data collection protocols have focused on streamlining data collection, incorporating quality assurance measures into data collection, and refocusing the data collected on the purpose of the shoreline monitoring framework, which is long-term monitoring of shoreline resilience services. Methods for data evaluation and analysis have not been included in Phase II. Gomez and Sullivan has also reworked the NYSDOS GIS data management for the shoreline monitoring framework, using the latest offerings in ESRI programs. This report summarizes the Phase II effort.

# 2 Revisions to the Shoreline Monitoring Framework

## 2.1 Overview of Monitoring Protocol Revisions

The Phase II revisions focused on the monitoring protocols; the performance parameters and indicators that were established in the Phase I Monitoring Framework remained constant throughout Phase II. Revisions were made within the existing framework using the resilience services (ecological function, hazard mitigation and structural integrity, and socioeconomic outcomes). The Gomez and Sullivan team revised the Phase I Monitoring Protocols with the following goals:

- Address Phase I feedback;
- Establish a logical workflow, accounting for where, when, and how data are to be collected
- Link each worksheet to a single protocol;
- Standardize terminology;
- Focus on data with relationships to Resilience Services. Reconsider data collection that does not provide meaningful understanding of shoreline services;
- Incorporate QA/QC within data collection methods;
- Eliminate repetitive data creation and collection;
- Determine software and equipment requirements for consistent data quality and write protocols to these requirements;
- Address NYSDOS and PAC feedback on draft Phase II protocols; and
- Pilot updated data collection protocols and made recommendations for further revisions, as needed.

An overview of proposed changes to the data collection monitoring protocols was presented to the NYSDOS and PAC in November 2021 and draft protocols were then provided to NYSDOS and the PAC for review and comment. Meetings were held between Gomez and Sullivan and NYSDOS staff to discuss proposed changes to Shoreline Monitoring Framework data collection and data management. Gomez and Sullivan addressed Phase I comments and summarized changes to each Phase I protocol in *Monitoring Framework Assessment and Review, Initial Revisions to Phase I Protocols* report, dated February 2022. As described in that report, the Phase I protocols have been reworked into the following 13 protocols.

**Table 1. Phase II Shoreline Monitoring Protocols**

| Number | Title | Resilience Service Area(s) | Performance Parameters | Indicators |
|---|---|---|---|---|
| 1 | Monitoring Site Establishment | Not applicable | Not applicable | Not Applicable |
| 2 | Monitoring Feature Characteristics and Dimensions | Ecological function; Hazard mitigation & structural integrity | Habitat Connectivity; Hydrology | Connectivity to adjacent land uses and habitats; Visual evidence of hydrologic alteration; Change in shoreline positions; Change in feature position |
| 3 | Establishing a Monitoring Scheme | Not applicable | Not applicable | Not applicable |
| 4 | Monitoring Feature Elevation and Water Characteristics | Hazard mitigation & structural integrity | Shoreline and topographic change; Coastal flooding; Structural integrity | Change in vertical elevation of the feature; Change in Shoreline position/sea level rise adaptability; Loss of gain of sediment updrift/downdrift; Wave runup; Wave height; Wave period |
| 5 | Erosion and Structural Stability | Hazard mitigation | Structural integrity | Visible scour; Escarpments; Erosion; Weathering |
| 6 | Ecological Monitoring (Substrate, Vegetation, and Sessile Organisms) | Ecological function | Biological health and biodiversity | Distribution and abundance of substrates; Plant species cover, richness, and composition; Sessile organism cover, richness, and composition |

| Number | Title | Resilience Service Area(s) | Performance Parameters | Indicators |
|---|---|---|---|---|
| 7 | Monitoring Feature Supporting Information | Ecological function; Hazard mitigation & structural integrity; Socioeconomics | Shoreline and topographic change | Change in shoreline and feature position |
| 8 | Defining the Area of Influence | Socioeconomics | | Area influenced by monitoring site* |
| 9 | Potential Damages to Commercial Properties, Households, and Public Infrastructure | Socioeconomics | Economic development | Number of households and public facilities exposed to or protected from flooding or erosion |
| 10 | Environmental Justice | Socioeconomics | Environmental justice | Presence/absence of disadvantaged community; community vulnerabilities* |
| 11 | Household Survey | Socioeconomics | Quality of life; | Site perceptions*; Property damage from coastal hazards*; cost of recovery, potential adaptations*, visitor demographics* |
| 12 | Shoreline Visitor Counts and Intercept Survey | Socioeconomics | Recreation and cultural use | Observation and telling of recreation and cultural shoreline use; Business activity** |
| 13 | Costs of Repair and Maintenance | Socioeconomics | Economic development | Property damage and cost of recovery** |

*New or revised indicator in Phase II.
**Existing indicator added to a new protocol in Phase II.

## 2.2 Definitions

One of the goals in revising the monitoring protocols was to standardize terminology. In the Phase I monitoring protocols document there were methodologies used that yielded redundant or imprecise data. Standard, concise terminology has enabled us to streamline the data collection process in the field while keeping the data organized in the ArcGIS Online Database. An exhaustive list of definitions for the monitoring protocols can be found in the *Phase II Shoreline Monitoring Framework Instructions and Protocols* listed in *Table 5. Shoreline Monitoring Relevant Terminology*. Table 2 describes key terms used in Phase II and their relationship to terms used in Phase I.

**Table 2: Key Terms**

| Term | Definition | Previously Used Term (Phase I) |
|---|---|---|
| Monitoring Feature | A distinct area at a shoreline site that has been identified for monitoring. | Segments; Shoreline feature. |
| Monitoring Feature Type | Tidally and non-tidally influenced shoreline features grouped into four distinct categories 1) ecological-enhanced hard structural, 2) hard structural, 3) natural, and 4) nature based. | Not Applicable |

| Term | Definition | Previously Used Term (Phase I) |
|---|---|---|
| Monitoring Feature Component | A subset of the monitoring feature type consisting of infrastructure or shoreline feature that was constructed or naturally occurring to protect the shoreline (e.g. breakwater, dune, tidal wetland). | Not Applicable |
| Monitoring Point | Points along the transects that are representative of the surrounding area. Monitoring points will be used repeatedly during subsequent feature monitoring visits. | Assessment point; Control point; Reference Point. |
| Monitoring Site | A general location that has been identified for monitoring, which may have one or more features associated with it. | Site. |

## 2.3 Summary of Protocol Review and Revisions

Since February 2022, the protocols have been further refined and have been tested at established and new field sites along the Great Lakes and Long Island. The following sections summarize the key changes made to the protocols from the Phase I protocols. Final Phase II shoreline monitoring protocols are presented in full in the *Phase II Shoreline Monitoring Framework Instructions and Protocols*.

**Table 3: Summary of Protocol Review and Revisions**

| # | Title | Description | Source Protocols (Phase I) | Key Changes |
|---|---|---|---|---|
| 1 | Monitoring Site Establishment | Desktop effort to collect data on site location and ownership. | 1,2 | • Protocol completed once rather than annually<br>• Additional data collected |
| 2 | Monitoring Feature Characteristics and Dimensions | Field effort to identify and delineate monitoring features. | 1,2,3,4 | • Clarification of methods<br>• Simplification of data collected<br>• Use of GNSS receiver required |
| 3 | Establishing a Monitoring Scheme | Field effort to establish transects and points used for protocols. | 5 | • Elimination of need for measurement of segments, reference points, control points, assessment points, and points of interest<br>• Establishment of monitoring transects and monitoring points with corresponding coordinates to remain consistent through time |
| 4 | Monitoring Feature Elevation and Water Characteristics | Field effort to collect elevation, water, and wave data. | 6,8,9 | • Establishment of elevation and water points with corresponding coordinates to remain consistent through time<br>• Elevation data collection using GNSS receiver<br>• Water and wave data collection at established points |
| 5 | Erosion and Structural Stability | Field effort to identify erosion, material degradation, and structural failures. | 7 | • Methods for erosion delineation and identification clarified<br>• Elimination of feature displacement from Phase I protocol<br>• Addition of identification of structural failures<br>• Addition of guides for identifying erosion, material degradation, and structural failures |
| 6 | Ecological Monitoring (Substrate, Vegetation, and Sessile Organisms) | Field effort to investigate distribution and abundance of substrates, vegetation, and sessile organisms. | 10,11,12 | • Use of established monitoring points<br>• Native plant references provided |
| 7 | Monitoring Feature Supporting Information | Desktop effort to obtain background information of feature(s). | 1, 2, 3, 4 | • Request of surveys or as-built drawings added |

| # | Title | Description | Source Protocols (Phase I) | Key Changes |
|---|---|---|---|---|
| 8 | Defining the Area of Influence | Desktop effort to determine the geographic region affected by the feature(s). | New | • New protocol |
| 9 | Potential Damages to Commercial Properties, Households, and Public Infrastructure | Desktop effort to count and value the residential, commercial, and industrial properties within the feature/site's area of influence. | 13, 14 | • Added a simple evaluation of potentially vulnerable property near the feature(s)<br>• Removed overly time-consuming analysis of the feature's effects on property values (and developed supplemental Appendix B). |
| 10 | Environmental Justice | Desktop effort to characterize the socioeconomic vulnerability of the population near the feature(s). | 15 | • Incorporated NYS's interim definition of DAC<br>• Added EJ metrics to characterize reasons the local population is vulnerable and/or disadvantaged<br>• Added an Excel tool to facilitate data reporting |
| 11 | Household Survey | Desktop/online survey effort to survey the local population's opinion about the effects of the feature(s). | 16 | • Revised survey questions to improve data quality<br>• Developed a method for mailing the survey to increase the response rate |
| 12 | Shoreline Visitor Counts and Intercept Survey | Field effort to survey recreational usage of the feature(s) and local spending. | 17 | • Revised instructions for positioning reviewers, number of shifts to conduct<br>• Revised survey questions to better target information desired |
| 13 | Costs of Repair and Maintenance | Desktop effort to collect information about the feature's restoration/repair costs from the site manager. | New | • New protocol |

## 2.4 Protocol Review and Revisions by Protocol

### *Protocol 1 Monitoring Site Establishment*

The project team recognized a need to group all site-level data collection into one protocol prior to protocols that required field data collection. Site level data includes information on site location, property ownership, and required permissions. Portions of Phase I Protocols 1 (Site and feature characterization) and 2 (Feature definition, location and aerial dimension) served as a foundation for the redesigned Protocol 1. Revisions to this protocol aimed to create a logical workflow and group all site level data into one protocol.

To complete this protocol, a desktop analysis is conducted to record the location, site name, ownership, contact information, required permissions, region, local government, and adjacent landownership to ensure that the monitoring framework can be applied to the site, and users have necessary information to complete the protocols when in the field or on desktop. Site level data collection were found in multiple protocols in Phase I, now they are grouped together, providing the foundation for field data collection and establishing the site within the database.

### *Protocol 2 Monitoring Feature Characteristics and Dimensions*

Protocol 2 combines Phase I Protocols 1, 2, 3 and 4 (Site and feature characterization; Feature definition, location and aerial dimension; Feature aerial dimension; Shoreline location, intertidal zone definition, and shoreline change). By combining these protocols, we have streamlined and organized the field effort. Furthermore, the protocol asks the observer to record direct observations of biological health and biodiversity, habitat connectivity, hydrology/hydraulic alteration, coastal flooding, shoreline and topographic change, structural integrity, and recreation and cultural use – several of the performance parameters established in Phase I. These performance parameters inform the ecological function, hazard mitigation and structural integrity, and socioeconomics resilience service areas.

In the revised protocol, users identify monitoring feature(s) to be included in monitoring and delineate the monitoring features in the field using a high-accuracy GNSS receiver. While delineating the features, users also record direct observations of ecological function, hazard mitigation, structural integrity, and socioeconomic indicators in a tablet, field computer, or smart phone. This protocol is the baseline for annual monitoring of features within the shoreline monitoring program.

### *Protocol 3 Establishing a Monitoring Scheme*

Phase I Protocol 5 (Establishing Monitoring Scheme) served as a foundation for Protocol 3. This revised protocol aims to create the monitoring scheme for the site using fewer datasets. This protocol is only completed once, the first time a site is monitored, unless new monitoring features are added to a site. The Phase I protocol included segments, transects, reference points, control points, assessment points, and points of interest. This did not allow for efficient or consistent data collection and recording.

Instead of monitoring being conducted within defined segments, it is now conducted by feature, therefore segments are no longer included in the monitoring scheme. The Phase II protocol contains monitoring transects and monitoring points that have associated coordinates that are consistent through time. Instruction for the creation of monitoring points and transects have been clarified to improve consistency and repeatability.

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Protocol 4 combines Phase I Protocols 6, 8, and 9 (Feature Elevation; Wave Height and Period Measurement; Water Levels and Coastal Flooding). Data collected as part of this revised protocol include

elevations along a transect, wave height and period, water level, and wave runup. By combining these three protocols the field data collection process has been streamlined, allowing for efficient data collection. It also serves to improve the quality of data collected by grouping associated data and improving replicability of data collection through time.

All data associated with this protocol is collected at each elevation and water point along the established transect. Elevation data collection requires proficiency in use of an RTK system or differential leveling, in the absence of in-house capacity, individuals with knowledge and experience of traditional survey methods or professional surveyors should be used to collect elevation data. Water depth, wave height, wave period, and wave runup require a known substrate elevation to determine the elevation (i.e., water elevation, wave elevation, runup elevation). Reliable elevation data collection is necessary to create the foundation for water and wave characteristic data collection.

### *Protocol 5 Erosion and Structural Stability*

Phase I Protocol 7 (Erosion Measurements and Feature Displacement) served as the foundation for revised Protocol 5. The protocol includes data collection for erosion areas, material degradation, and structural failure. Measurement of feature displacement was eliminated from the protocol because it appeared unlikely to provide useful results given the anticipated frequency of data collection (annual). Recording structural failure(s) was added to provide information on the type of failure (e.g., sliding of a hardened structure due to scour or rotation of sheet wall due to scour), which can be compared across sites. The revisions focused on providing clear methodology for recording erosion areas.

This reworked protocol is intended to provide consistency of identification and recording of feature conditions across users. *Erosion areas* for the purpose of the protocol includes scour, wind erosion, and surface erosion (i.e., sheet, rill, gully, channel erosion). These are identified by monitoring teams and delineated using a GNSS receiver, creating a polygon in the ArcGIS Online solution. *Material degradation* and *structural failure* is associated with hard or ecological-enhanced hard structures, and observations of the degradation and failure is recorded. Each component of the revised protocol has a corresponding visual and/or written guide to assist protocol users to identify erosion type, material degradation, and failure type. This protocol provides standard terminology and resources to help guide users to collection information on the structural stability of a feature and the degree to which a feature abates shoreline erosion.

### *Protocol 6 Ecological Monitoring (Substrate, Vegetation, and Sessile Organisms)*

Phase II Protocol 6 integrates Phase I Protocols 10, 11, and 12 (Distribution and Abundance of Substrates (Including Wrack, Debris, Concrete, etc.); Plant Species Cover, Abundance, Species Richness and Composition (including Native versus Exotic); and Sessile Organisms Presence, Abundance, (Percent) Cover, Species Richness, and Composition). Revised data collection methods are laid out so that observers can collect all data at a particular monitoring point before moving to the next point or needing to refer to a different protocol, which was the case in the Phase I protocols. Combining Phase I protocols 10, 11, and 12 allows for better clarity, organized data collection, and eliminates redundancy in protocols.

As part of Protocol 6, data on substrate, vegetation, and sessile organisms is collected at established monitoring points. A quadrat is placed at the center of each monitoring point and information for the ecological monitoring is collected. This protocol should be completed during the growing season (July – September). Additional guides and resources have been included in the Phase II protocols to aid users in identifying plants found in New York, invasive species found in New York, and Listed US species. This protocol will provide consistent data collection that will enable the tracking of changes in substrate, vegetation, and sessile organisms at a given site.

### *Protocol 7 Monitoring Feature Supporting Information*

Aspects of Phase I Protocols 1 through 4 (Site and Feature Characterization; Feature Definition, Location & Areal Dimension; Feature Areal Dimension (Field); Shoreline Location, Intertidal Definition, and Shoreline Change) were compiled into Phase II Protocol 7. The revised protocol incorporates additional data collection that was recommended after the implementation of Phase I. The protocols were combined to group desktop efforts together into one protocol in order to streamline the process of data collection.

Protocol 7 is a desktop effort that involves requesting data from the site owner/operator and/or others to obtain information regarding the site, including the year it was constructed, any professional land surveys, as-built drawings, and original design plans. The background information collected in this protocol could aid in better understanding the feature.

### *Protocol 8 Defining the Area of Influence*

Monitoring teams during Phase I noted the lack of a clear connection between the sites of interest and the socioeconomic metrics that were being measured. The Phase II team established that, in order to evaluate the socioeconomic impacts of changes in storm or flood frequency at a site, or to compare impacts across sites, it is important to define the physical inland area affected by conditions at the site. This inland area includes the residences, businesses, and infrastructure that could foreseeably be affected by flooding at the site, or by other coastal-related damages, and that would potentially benefit or be harmed if the likelihood of flooding or the extent of flooding changes at the site.

This new protocol relies on existing, publicly available GIS data of flood hazards (and erosion potential, if available) downloaded from the following sources: NYSDOS's Coastal Risk Areas, Hudson River Composite Risk Areas, and Risk Areas Lake Ontario. This protocol uses these data layers to define an approximate geographic area that may be influenced by particular hazards at a site. This area of influence can be used to evaluate likely direct socioeconomic impacts of changes that occur at the site. This area of influence serves as the basis for identifying the area where coastal damages to properties that a site are likely to occur (Protocol 9), as well as defining areas where household surveys should be conducted (Protocol 11). It may be necessary to revise the area of influence after conducting Protocol 13 if site managers provide new information about how a particular coastal feature impacts the surrounding area.

### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

The Phase I Monitoring Report identified analysis of potential damages to property inland of site features as an area of interest that was not able to be addressed in Phase I. Accordingly, Protocol 9 was added during Phase II to address this area of interest. This new protocol uses the area of influence (defined in Protocol 8) to evaluate the number and value of residential, commercial, and industrial properties with potential risk of flooding or other coastal-related damages associated with the shoreline feature. National datasets, such as those used in FEMA HAZUS flood modeling, typically use aggregated data with uniform assumptions for Census tracts or blocks regarding building counts, attributes, and values. By developing data that is specific to the area prone to flooding from features that are evaluated here, analysts can more accurately evaluate resources that are at risk from flood events. This data can be used to understand a potential upper bound of damages that may be relevant to coastal features. Information related to recent damages to adjacent properties from coastal storms is collected in the new protocol 13.

### *Protocol 10 Environmental Justice Index*

This protocol aims to identify relevant environmental justice considerations for sites and to recognize and understand ongoing economic and environmental stressors and vulnerabilities in communities adjacent to project sites that may exacerbate other effects associated with coastal changes that are occurring at or

associated with the sites. The Phase I Environmental Justice protocol (Protocol 15) did not answer questions about the affected area beyond whether or not it met a threshold for low-income and minority populations, and did not speak to what should or would be done with that information.

The revised protocol expands the use of data collected to include metrics that evaluate the reasons for community vulnerabilities using EJScreen. The protocol includes a worksheet to help users interpret the data that they extract. The State of New York is in the process of updating its definition of Disadvantaged Communities, and is poised to include data for a number of demographic metrics. Once finalized, this protocol could be further updated to pull data from the New York State database rather than EJScreen.

### *Protocol 11 Household Survey*

This protocol describes a method for administering a household survey to gather resident perspectives about the study site, risk and damages from coastal hazards, and attitudes towards various potential adaptation measures. The Phase I Household Survey Protocol (Protocol 16) was administered as an in-person survey, and the field team encountered numerous obstacles in data collection, including establishing a proper set of households to survey. Our review of the questions in the Phase I protocol also suggested that some questions in the survey lacked a clear connection to the site being evaluated or the data that was intended to be collected.

The revised protocol makes use of data used for Protocol 9 for residential household addresses that fall within the area of influence (Protocol 8) to identify the relevant population to survey. It includes a sample postcard (which would be mailed out as part of the effort) as well as revised questions that are part of an online survey.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

This protocol updates the Phase I Protocol, Shoreline Social and Site Assessment (Protocol 17) by clarifying the instructions related to planning for the in-person survey effort and implementing the survey at recommended sites. It also expands the questions posed to include data collection related to business spending in the local neighborhood and better targets the questions to the goals of the monitoring effort. The revised survey removed open ended questions within the survey, but included a section at the end of the survey where longer responses can be recorded. The intent of removing the open ended questions inside the survey itself intended to 1) streamline survey implementation and meet the desire to keep the surveys brief and 2) streamline data analytics once data is entered.

The revised protocol includes site observations, systematic counts of site users, and intercept interviews. This data is collected by using three worksheets: Worksheet 12A (Scheduling Survey Shifts and Performing Site Observations), 12B (Visitor Counts and Field Observations), and 12C (Intercept Questionnaire and Notable Conversations).

### *Protocol 13 Costs of Repair and Maintenance*

As noted above, the Phase I Monitoring Report identified analysis of potential damages to property inland of site features as an area of interest for future monitoring protocols. This new protocol involves an interview or small number of interviews with local municipalities/site owners to evaluate recent flood events and to collect data on associated public and private costs of repairs and maintenance for shoreline features at or related to the sites.

### *Annual Summary of Protocols*

In addition to revising the protocols, the project team recognized a need to provide an overview of activities completed at each site during each measurement year both to summarize results and to inform

future monitoring efforts. The annual summary is intended to be completed following the implementation of all the protocols at a given site. It compiles information on who completed the protocols, what equipment was used, and which protocols were completed. Overall, this summary is intended to collect a simplified record of what was completed at the site to aid the future implementation.

# 3 Evaluation of Data Management Capabilities

In addition to revising the protocols, the Gomez and Sullivan team was tasked with evaluating the data management capabilities and products developed during Phase I. These included the database and geodatabase products, the schema used to model shoreline data, and the data resulting from the 2019 Pilot study. The team identified the following goals for this stage of the project:

- Review the data management capabilities developed during Phase I and recommend new technologies and workflows for managing data.
- Review the Phase I data schema and recommend ways to simplify its structure and make it consistent with the Phase II protocols and any new technologies incorporated for the project. Data schema elements include tables, table relationships, and attribute fields.
- Review the pilot data, check them for completeness, summarize deficiencies, and incorporate them into the final data management solution.

The following subsections describe the results of our team's review of these data elements.

## 3.1 Database and Geodatabase Products Review and Revisions

The Gomez and Sullivan team reviewed the Phase I data management capabilities. The capabilities included a Microsoft Access database and Esri file geodatabase. The Access database was the primary storage container and was used to store attribute/tabular data. The file geodatabase provided storage for the related geometry data (points, lines, and polygons).

The Gomez and Sullivan team found that the Phase I capabilities were mismatched with the goals of Phase II. These goals included developing web and mobile field applications, streamlining data collection workflows, and providing better integration between tabular and spatial data. The Phase I capabilities were also inconsistent with the Department's long-term goal of creating a public website for stakeholder engagement.

The Gomez and Sullivan team recommended replacing the database and geodatabase products with an ArcGIS Online solution. ArcGIS Online would not only provide the capabilities necessary for Phase II, but also a modern framework on which NYSDOS could support future phases of the project. NYSDOS agreed that ArcGIS Online should be the new tool for managing protocol data.

The ArcGIS Online solution is a major step forward for the project. It provides dramatic improvements in accessibility and data management workflows. With its centralized database and web-based platform, the solution allows contributors to review data and submit edits in real time from any location. It also provides intuitive data entry forms, which encourage consistency and data integrity, and significantly increase the speed at which contributors can collect data. The following bullets highlight the major components of the solution.

- A homepage that provides quick links to the apps and resources required to complete the protocols.

- Several web browser apps for completing the desktop protocol. The apps include forms for entering and validating data and the contextual data required to complete the protocols. Contextual data include basemaps, aerial imagery, tax map centroids, and costal risk data. The apps also provide tools for querying historical data and photos.
- A Field Maps application for collecting data for Protocols 2 – 7. The app integrates with high-accuracy GNSS receivers, providing the positional accuracy required to collect ecological and structural data. The app allows field workers to edit the ArGIS Online database directly, or to take data offline to accommodate situations where internet access is unavailable. Workers can easily post offline edits once regaining access to the internet. The app also includes structured data entry forms, which include dropdown menus, data validation capabilities, and support for photo attachments.
- Several Survey123 apps. These include browser-based forms for submitting environmental justice data and household surveys. They also include mobile apps, which allow field workers to collect site observations, record visitor counts, and perform intercept surveys. The apps incorporate a broad range of capabilities (dropdown menus, radio buttons, question branching, photo attachments, etc.), creating a straightforward data entry experience for end users.
- Scripts that automate data backups. NYSDOS can use these to address accidental edits or deletions.

## 3.2 Data Schema Review and Revisions

The Gomez and Sullivan team reviewed the Phase I data schema and reworked its design to be compatible with the Phase II protocols and the ArcGIS Online solution. Notable changes include the following:

- **Breaking up the points table into multiple datasets**: The Phase I schema stored every type of data point in a single table. The Phase II design has dedicated datasets for each point type. This creates a more manageable model and is consistent with ArcGIS Online workflows. Creating a separate dataset for each point type also allows for more granular control over security, which is necessary in some cases. For example, the socioeconomic data have different access requirements than the ecological/structural data.
- **Simplifying the structure of structural and hazard data:** The Phase I schema used a chain of related tables to manage structural and hazard data such as erosion, degradation, water, wave, and elevation measurements. The Phase II design simplifies these relationships and provides more straightforward workflows for entering data.
- **Combining the species tables:** The Phase I schema used separate tables to manage mobile, plant, and sessile species. These tables share a similar structure and are therefore combined into a single table in the new schema.
- **Revising the socioeconomic datasets:** The Phase II schema incorporates the new methodologies used to collect environmental justice data, household surveys, intercept surveys, and other socioeconomic/social assessment data.

## 3.3 Review of Phase I Pilot Data

In addition to reviewing and revising the data management capabilities for the project, the Gomez and Sullivan team was tasked with reviewing the Phase I Pilot data and importing them into the ArcGIS Online solution. The Phase I Pilot data were collected in 2019 and pertained to the following locations:

| Region | Location |
|---|---|
| Great Lakes | Port Bay East |
| | Port Bay West |
| | Sodus Point |
| | Sterling Nature Center |
| Hudson Valley | Coxsackie (Boat Launch, Living Shoreline, Wetland) |
| | Foundry Dock Cold Spring |
| | Peekskill Municipal Park |
| Long Island | Shorefront Park Patchogue |
| | Southold CCE Marine Environmental Center (Cedar Beach Creek) |
| | Widows Hole Greenport |
| NYC | Bayswater |
| | Harlem River Park |
| | Randall's Island Bronx Kill |
| | Randall's Island Living Shoreline |

The pilot data were stored in a Microsoft Access database as well as in other miscellaneous files, including csv files, Excel files, KMZ files, shapefiles, and text files. The Gomez and Sullivan team compiled the data and uploaded them to the new data schema in ArcGIS Online. The data were then checked for completeness. Due to unforeseen issues with data transfer and retention, some of the spatial data from Phase I was not uploaded to the ArcGIS Online solution.

# 4 Implementation of the Phase II Monitoring Protocols

Phase II monitoring data collection was carried out at seven sites in the New York coastal zone with the purpose of testing Phase II data collection protocols, providing data for established sites, as well as to establish two new sites within the Shoreline Monitoring Framework and provide initial data for those sites. The results reported in this summary document build upon the results given in the *Measuring Success Monitoring Natural and Nature-Based Shoreline Features in New York State Final Report* (Science and Resilience Institute at Jamaica Bay, 2020) (Phase I Final Report). Figure 1 describes the sites for which monitoring activities were conducted during Phase II. Table 3 summarizes the sites as well as the protocols that were implemented at each site. Appendix C summarizes Phase II data collection.

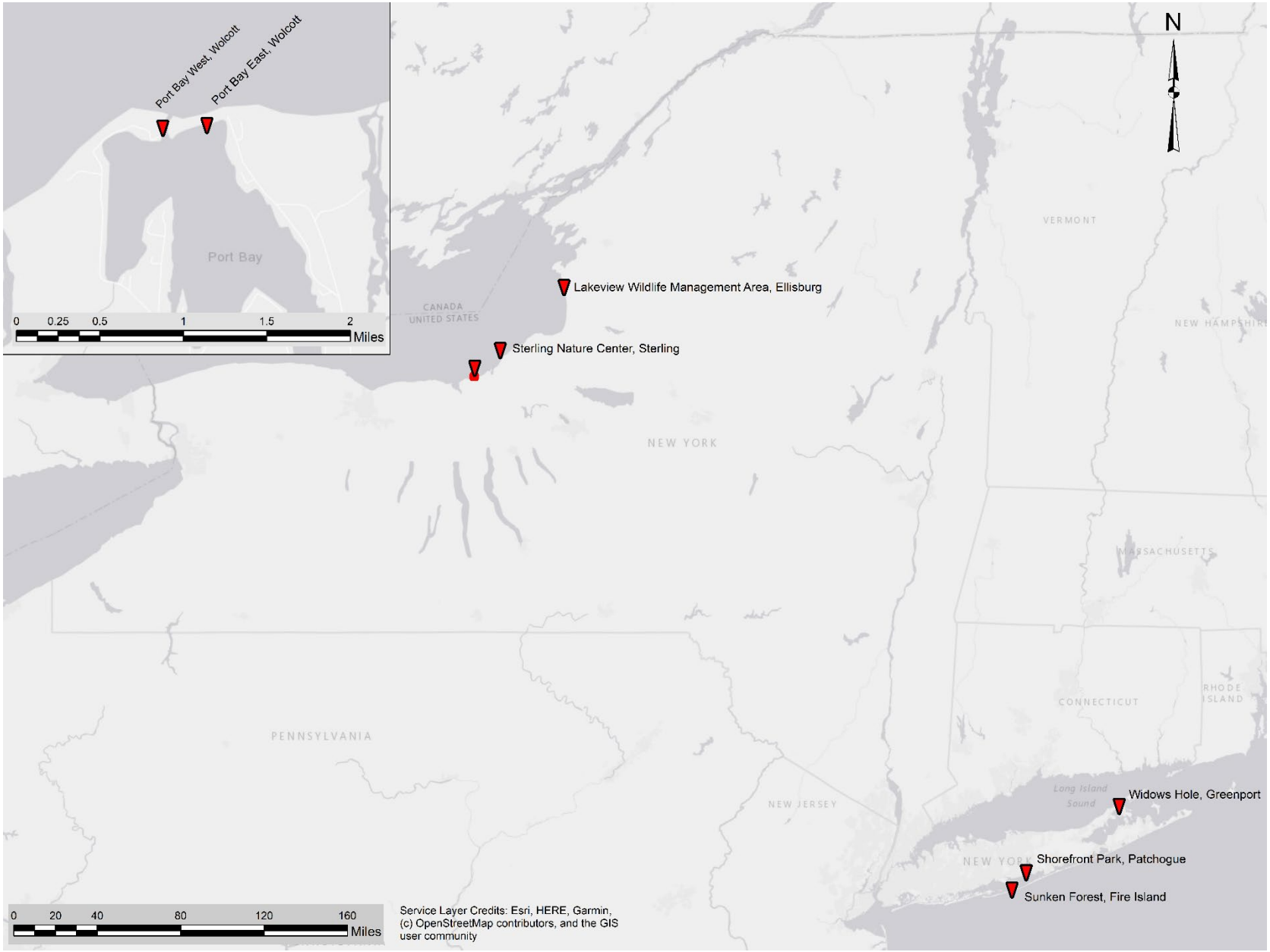



**Figure 1: Phase II Monitoring Site Locations**

**Table 4. Summary of Phase II Monitoring**

| Region | Site | Established | Feature Types | Feature Components | Monitoring Team | Implemented Protocols |
|---|---|---|---|---|---|---|
| Great Lakes | Port Bay West | Phase I | Hard Structural | Bulkhead | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 |
| | | | Hard Structural | Revetment | | |
| | | | Natural | Beach/Beach Berm | | |
| Great Lakes | Port Bay East | Phase I | Natural | Beach/Beach Berm | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 |
| Great Lakes | Sterling Nature Center | Phase I | Natural | Beach/Beach Berm | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13 |
| Great Lakes | Lakeview Wildlife Management Area | Phase II | Natural | Beach/Beach Berm | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| | | | Natural | Dune | | |
| Long Island | Widow's Hole | Phase I | Nature Based | Revetment (rip rap) | Bay Environmental | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
| | | | Nature Based | Tidal Marsh | | |
| | | | Natural | Vegetated Upland | | |
| | | | Natural | Tidal Wetlands/Salt Marsh | | |
| | | | Natural | Bluff | | |
| | | | Natural | Shoals, Mudflats, Nearshore | | |
| Long Island | Shorefront Park | Phase I | Hard Structural | Bulkhead | Bay Environmental | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 |
| | | | Hard Structural | Concrete Outfall | | |
| | | | Natural | Vegetated Upland | | |
| | | | Natural | Tidal Wetlands/Salt Marsh | | |
| | | | Natural | Beach/Beach Berm | | |
| Long Island | Sailors Haven | Phase II | Hard Structural | Bulkhead | Bay Environmental | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13 |
| | | | Natural | Vegetated Upland | | |
| | | | Natural | Shoals | | |
| | | | Natural | Tidal Wetlands/Salt Marsh | | |
| | | | Natural | Bluff | | |
| | | | Natural | Beach/Beach Berm | | |

# 5 Strategies for Future Development and Implementation

## 5.1 Strategies for Continuing to Improve the Protocols

Phase II efforts found that implementation of the revised protocols was largely successful in terms of collecting the data intended. However, our team identified some considerations for future implementation of the protocols, as well as some revisions that could be made. For the *Phase II Shoreline Monitoring Framework Instructions and Protocols* document as a whole, the team recommends the development of more details, definitions, and educational materials for identifying indicators to aid in evaluating progress towards or achievement of a performance goal. Recommendations by protocol include the following:

- **Protocol 1. Monitoring Site Establishment.** During the 2022 monitoring season, the field team found that additional regulatory considerations should be included in the site establishment. It is recommended that data on designated wetlands, historic and cultural resources (per State Historic Preservation Office (SHPO) regulations), threatened and endangered species habitats, and other resources be identified. Furthermore, identification of any required permits should be included in the site establishment protocol as well. Sailors Haven, Fire Island is a National Seashore, and a National Park Service scientific research permit is required to conduct monitoring. Because this site falls on federal lands, all in-person survey questions must be approved by the Office of Management and Budget through a complex process which can take more than a year to be approved. Therefore, the time frame the monitoring team was working with did not allow for the approval of the intercept survey questions at that site. An alternative site at the ferry terminal was identified however, after receiving tentative approval with the ferry company, scheduling the survey date and time was not possible. In the future, the ferry terminal may be a feasible site but effort should be taken to avoid the ferry company's busy season. Regulatory information and required permits could contribute to the understanding of the site and the required preparation to conduct monitoring at the site.
- **Protocol 2. Monitoring Feature Definition, Characteristics, and Dimensions**. It is recommended to separate monitoring feature components for rock beach and sandy beach, since the characteristics of the two sites will be different and may require a different approach to field monitoring efforts.
- **Protocol 4. Monitoring Feature Elevation and Water Characteristics**. It is recommended that methods be developed in the next phase to identify where to place elevation and water points along a given transect to collect data on the waterward and leeward sides of wave action reduction structures (i.e., oyster reef, marsh vegetation, sill, etc.) to quantify wave reduction performance. The change in wave conditions would serve as an indicator for coastal flooding. Additionally, it is recommended to determine how to quantify the impacts of Lake Erie seiches (prolonged standing wave with longer periods of water-level oscillations) because they can be short in duration and have significant impact.
- **Protocol 5. Erosion and Structural Stability**. Erosion data collection posed a challenge in Phase I – users found it difficult to identify and record erosion areas. The Phase II protocol clarified the identification and delineation of erosion areas by providing a guide for identifying erosion types and detailed methodology to delineate an erosion area using a GNSS receiver. It is recommended that additional elevation data, specific to erosion areas, be collected to quantify sediment transport or accretion, and supporting figures or graphics be developed to aid in identifying erosion types.

- **Protocol 8, Area of Influence**. This protocol allowed the Phase II team to define an approximate area that would be influenced by changes at each site. The economic protocols were then implemented in the resulting area, which eliminated spatial ambiguities present in the previous monitoring methods. However, we did find that our revised method involves some user judgment. We further found that the method as described, when applied to a narrow barrier beach (on Fire Island), did not capture communities for which access could be curtailed if the site was damaged. We expect that discussing the defined area with a site manager would help to ensure that the defined area is a logical representation of the site's area of influence. Protocol 13 provides a useful opportunity to ask site managers whether they recommend amending the defined area. If site managers recommend changes, it may be necessary to freehand new boundaries in GIS using satellite images and landmarks as reference points.
- **Protocol 10, Environmental Justice**. The revised protocol provides additional information to help users understand particular community stressors at and around sites. As noted above, the State of New York is in the process of updating its definition of Disadvantaged Communities, and is poised to include data for a number of demographic metrics. Once finalized, this protocol could be further updated to pull data from the New York State database rather than EJScreen.
- **Protocol 11, Household Survey**. Protocol 11 was implemented by mailing postcards to addresses inside the area of influence that encouraged residents to participate in an online survey. Response rates were low, but higher than expected for a single mailing of this type and could be improved with a follow-up postcard. The Phase II survey was implemented at two sites based on the limited number of residential addresses that were located in the study sites' Areas of Influence. This seems appropriate, as we do not expect the survey to be conducted at all sites. During our review of the initial survey results, we identified a couple of minor edits to the questions that we would suggest in order to make the results more consistent. The edits are as follows:
    - In implementing the survey during Phase 2, results suggested that the use of the phrase "the site" in questions 7 and 8 may be vague to respondents, who responded inconsistently between these questions. We would suggest revising Question 7 to include a clarification: In your view, what types of effects does the site, **in its current condition**, have on your neighborhood?"
    - As noted above, in implementing the survey during Phase 2, results suggested that the use of the phrase "the site" in questions 7 and 8 may be vague to respondents, who responded inconsistently between these questions. We would suggest revising Question 8 to include a clarification: "In your view, how important is the site **location** to protecting…"
    - During survey implementation, we noticed that the options provided under Question 19, which focuses on HSFs, and Question 20, which focuses on NNBFs, are inconsistent. This makes comparing the opinions about the effectiveness of these feature types difficult. We would suggest making these two lists consistent in the next implementation phase.
    - As noted above, during survey implementation, we noticed that the options provided under Question 19, which focuses on HSFs, and Question 20, which focuses on NNBFs, are inconsistent. We would suggest making these two lists consistent in the next implementation phase.

- **Protocol 12, Shoreline Visitor Counts and Intercept Survey**. The Phase II protocol provided clarity with respect to setting up interviewers at locations and identifying an appropriate number of shifts for which to conduct surveys. It also revised the questions. The results of survey implementation revealed a need to provide some guidance to interviewers about best practices for conducting in-person surveys and underscored the likely need to separate interview teams from the scientific protocol data collection teams. Teams may benefit from a short tutorial that provides some best practices for in-person interviewers. We would suggest ensuring that a central person or central people at NYSDOS be tasked with delivering such basic training to future interviewers on a regular basis. Alternatively, short online tutorials could be recorded and presented to interviewers. A further step could involve identifying a community of practice for the scientific and economic disciplines that could be called on to provide help to future researchers.

  NYSDOS also recommended a potential change to the survey method that would create a passive version of the intercept survey (i.e., a version that does not require an interviewer). This would involve posting a link or QR code to the survey on signs at each location, as discussed in section 5.2. While this option would require respondents to "opt in" to participate in the survey, it could increase the overall number of respondents. Respondents that utilize a QR code may be more likely to be engaged with or concerned about the monitoring features on the site. Future analysts would need to be mindful of this bias when analyzing data or reporting statistics about it.

  Finally, Phase II research suggested that Question 7, which solicits the respondent's zip code, may be an intrusive way to begin the interview. We recommend moving Question 7 to the demographics section at the end of the survey.

- **Protocol 13. Repair and Maintenance**. We found that speaking to site managers as part of Protocol 13, Repair and Maintenance, revealed important site details that were not identified during other protocols, including information that was not directly part of Protocol 13 itself. For example, one site manager told the Phase II team that another organization was already conducting routine monitoring efforts the site. Another manager pointed out that, while the area that had been selected for site monitoring was not eroding, an area just north of the site was eroding quickly. He further identified a number of expected expenditures that will be undertaken in order to preserve infrastructure in the area just north of the feature. Overall, we found this new protocol to be useful, and recommend that it be conducted early in the site evaluation phase of the monitoring process to assure that monitoring efforts are structured appropriately for the sites.

## 5.2 Strategies for Continuing to Improve the ArcGIS Online Solution

The Phase II implementation of the ArcGIS Online solution focused on developing capabilities that improve the accessibility of data and provide straightforward methods for submitting protocol data. The next phase should focus on expanding the ArcGIS Online solution to include tools that facilitate analysis. The analyses should uncover spatial and temporal trends throughout the state and at local and regional levels. They should also uncover links between the protocols. For example, do the ecological/structural conditions at a site influence the views expressed in the intercept surveys? The following bullets provide examples of capabilities that could be developed to help NYSDOS analyze protocol data.

- Geoprocessing tools to join, overlay, and aggregate data
- Dashboard apps for summarizing and exploring data
- Experience builder apps to provide enhanced querying capabilities

For the next phase, we also recommend enhancements that increase the accessibility of the solution. Currently, contributors must have their own ArcGIS Online account to access the solution. If this is not possible, contributors must use worksheets to collect data and then submit the results using offline methods. As determined during Phase I, this approach can lead to data loss. A better approach would be to have several standby accounts available for users without an account. This could be accomplished by procuring a block of accounts specifically for the project, or by expanding the solution to incorporate ArcGIS Hub.

Finally, we recommend a few usability improvements:

- The ability to add species records that have 0% for absolute percent coverage. This will provide a more definitive way of noting that a monitoring point has no plant and/or animal species.
- A passive version of the intercept survey, i.e., a version that does not require an interviewer. This would involve posting a link or QR code to the survey on signs at each location. As described in section5.1, this option would require respondents to "opt in" to participate in the survey, it could increase the overall number of respondents. Respondents that utilize a QR code may be more likely to be engaged with or concerned about the monitoring features on the site. Future analysts would need to be mindful of this bias when analyzing data or reporting statistics about it.
- An interactive web map for the household survey.
- Additional resources for reviewing and querying historical shoreline data. For example, an app that provides easier methods for accessing and reviewing photos.
- Tools to help NYSDOS automate the administration steps required before, during, and after the field season.

## 5.3 Strategies for Continued Framework Implementation

Phase II efforts found that implementation of the revised protocols was largely successful in terms of collecting the data intended. However, the process can continue to be improved. NYSDOS intends to continue improving the Framework through contributor feedback from Phase II and future phases of the project. This section provides several recommendations from Phase II contributors for the future:

- **Have a clearly defined goal for monitoring efforts at each site**. While protocols are intended to be relatively easy to undertake, implementing them nonetheless requires time and energy by teams carrying them out. The goals for the Statewide Monitoring Framework are to collect consistent and comparable data on shoreline features and the resilience services they provide to better support shoreline decision makers. While NYSDOS understand that individuals may have other goals for monitoring, this Framework encourages consideration of holistic resilience services (or benefits provided by shoreline features): ecological function, hazard mitigation/structural integrity, and socioeconomic factors. Future data collectors should be sure to have a clearly defined purpose and use for data collection that considers the overall Framework goals but is relevant to their own site objectives. NYSDOS intends to conduct data analysis in the future; therefore, contributors are supporting future data analysis by collecting data at shoreline sites. Having these goals in mind will inform the future selection and delineation of the sites to be monitored, and will ensure that teams' efforts will be valuable to future evaluations.
- **Apply site selection criteria to ensure data collection is feasible and will be useful**. In addition to identifying the goals of the efforts at each site, future researchers should consider whether sites are likely to be amenable to data collection. The new "Monitoring Site Feasibility" form should assist researchers in determining whether particular sites have attributes that will make them

feasible to measure, and to help researchers determine if they have the resources required to implement long-term monitoring at sites. The socioeconomic protocols further identify criteria that make sites suitable for applying those protocols (e.g., for Protocol 12, Shoreline Visitor Count and Intercept Survey, whether there is recreational use at the site or residential homes nearby is a criterion).

- **Coordinate with site owners/managers**. Our team found that additional coordination/communication with site owners/operators would be valuable early in the process. We suggest that both Protocols 7 and 13 be conducted early in order to gather contextual information and to identify any required permits or coordination with other monitoring efforts that should be undertaken.
- **Provide basic user training for ArcGIS online system**. Our Phase II team found that most users would benefit from a short online tutorial to get familiar with the ArcGIS online system.
- **Provide interviewer training and/or passive survey option.** We found that teams would benefit from a short tutorial that provided some best practices for in-person interviewers for Protocol 12. We would suggest ensuring that a central person or central people at NYSDOS be tasked with delivering such basic training to future interviewers on a regular basis. Alternatively, short online tutorials could be recorded and presented to interviewers. A further step could involve identifying a community of practice for the scientific and economic disciplines that could be called on to provide help to future researchers.

  NYSDOS also recommended a potential change to the survey method that would create a passive version of the intercept survey, i.e., a version that does not require an interviewer. This would involve posting a link or QR code to the survey on signs at each location, as discussed in section 5.2. While this option would require respondents to "opt in" to participate in the survey, it could increase the overall number of respondents. Respondents that utilize a QR code may be more likely to be engaged with or concerned about the monitoring features on the site. Future analysts would need to be mindful of this bias when analyzing data or reporting statistics about it.
- **Establish a mechanism to collect feedback from future researchers**. We recognize that future researchers may identify additional improvements that can be made to the protocols and the supporting ArcGIS online system. The State should continue to collect feedback and make revisions as needed. The State should also determine whether the PAC will continue to provide support over time.

# Appendix A. Project Team

| Name | Affiliation | Project Role |
|---|---|---|
| Carolyn Fraioli | New York State Department of State (NYSDOS) | NYSDOS Project Manager |
| Jeff Herter | NYSDOS | NYSDOS Project Team |
| Tanna Legere | NYSDOS | NYSDOS Project Team |
| Elizabeth Clohessy | NYSDOS | NYSDOS Project Team |
| Rebecca Newell | NYSDOS | NYSDOS GIS Support |
| Peter Lauridsen | NYSDOS | NYSDOS GIS Support |
| Paul Breier | Gomez and Sullivan Engineers | Consultant Team Geographic Information Systems Professional |
| Molly Mulhare, EIT | Gomez and Sullivan Engineers | Consultant Team Project Engineer |
| Kendra Gorski | Gomez and Sullivan Engineers | Consultant Team Project Ecologist |
| Erin Redding | Gomez and Sullivan Engineers | Consultant Team Project Ecologist |
| Jennifer Wesolowski, PE | Gomez and Sullivan Engineers | Consultant Team Project Manager |
| Andrew Thyberg | Bay Environmental | Consultant Team Project Scientist |
| Krista Thyberg | Bay Environmental | Consultant Team Project Scientist |
| Leslie Genova | Industrial Economics (IEc) | Consultant Team Socioeconomics Coordinator |
| Robert (Chip) Paterson | IEc | Consultant Team Economist |
| Tabeen Hossain | IEc | Consultant Team Economics Analyst |
| Levi McAtee | IEc | Consultant Team Economics Analyst |
| Lynn Bogan | New York State Office of Parks, Recreation, and Historic Preservation (NYOPRHP) | Project Advisory Committee |
| David Spiering | NYOPRHP | Project Advisory Committee |
| Janine Harris | National Oceanographic and Atmospheric Association (NOAA) | Project Advisory Committee |
| Nelle D'Aversa | NOAA | Project Advisory Committee |
| Shannon Dougherty | New York State Department of Environmental Conservation (NYSDEC) | Project Advisory Committee |
| Molly Farrell | NYSDEC | Project Advisory Committee |
| Alexa Fournier | NYSDEC | Project Advisory Committee |
| Brett Branco | Science and Resilience Institute at Jamaica Bay | Project Advisory Committee |
| Katie Graziano | New York Sea Grant/Science and Resilience Institute at Jamaica Bay | Project Advisory Committee |
| Alison Branco | The Nature Conservancy | Project Advisory Committee |
| Darixa Hernandez Abrams | US Army Corps of Engineers Engineer Research and Development Center | Project Advisory Committee |

# Appendix B. Real Estate Values and Coastal Restoration

## Introduction

Phase I of the Monitoring Report included Protocol 14: Assessing Real Estate Value Impacts Associated with Shoreline Conditions, which directed future monitoring teams to conduct a hedonic property value analysis to estimate relationships between identified natural and nature-based and hard structural features and nearby residential property values. In our review, IEc determined that this protocol would be impractical to implement due to its high level of data and analytical requirements, as well as specific site and study area conditions necessary to yield meaningful results.[1]

While outside the scope of the monitoring framework, certain sites/features may support a hedonic property value analysis on a case study basis. As such, this memo: 1) provides background on the hedonic method; 2) identifies a list of criteria that coastal features must meet to be eligible for hedonic analysis as well as steps for conducting one; and 3) reviews existing studies of coastal features on the Atlantic Coast to illustrate a range of applications and resultant values.

## Hedonic property value Analysis

Hedonic models use data on transaction prices, structure and property characteristics, and local amenities and disamenities to estimate the incremental value of particular attributes of interest. Hedonic analysis has been called one of "the most direct illustrations of how private markets can reveal consumers' willingness to pay for measures of environmental quality" (Bishop et al. 2020, p.260). The hedonic framework is based on the notion that as buyers and sellers of homes negotiate transactions, the market equilibrium is only achieved when every buyer can no longer increase their satisfaction by moving. The value of a given property is therefore equal to the sum of a buyer's willingness to pay for the property's bundle of attributes. The goal of hedonic analysis is to isolate how much a particular characteristic, such as a specific coastal feature, contributes to the overall value of a property. When conducted properly, hedonic models are considered the gold standard for determining how much consumers value (or disvalue) proximity to amenities (or disamenities).

Although hedonic analyses require significant data collection, preparation, and analysis, which can be expensive and time consuming, the results are generally straightforward to explain and intuitive, which can be appealing to decision-makers and the general public alike. However, there are also underlying conditions that must be satisfied to ensure that hedonic analyses provide accurate and reliable results.

## Background: how coastal features may affect property values

There are four types of shoreline features addressed in the New York State Shoreline Monitoring Framework, which are referred to as natural features, nature-based features, hard structural features, and ecologically enhanced hard structural features. The hedonics literature tends to group those four categories into two, simpler categories: natural and nature-based features (NNBFs) and hard structural features (HSFs).

NNBFs are either naturally occurring features or features that use the minimum number of structural components necessary to control or direct water or sediment movement, while also realizing habitat and resilience benefits. Common examples of NNBFs include wetlands, floodplains, dunes, and "living shorelines." On the other hand, HSFs are features that are typically constructed of hard human-made materials (e.g., concrete) and designed to control or direct water and/or sediment movement. These features can disrupt natural processes and have limited or no living components. Examples of HSFs include levees, seawalls, revetments, dams, structural stream channels, and stormwater conveyances.

NNBFs and HSFs have the potential to affect property values, most directly by altering the risk of flood and erosion damage. To the extent that these features can shield homeowners from expenditures on repairs and maintenance related to coastal storm damages, shoreline features should provide a commensurate boost to property values. Shoreline features may also influence property values by contributing to an area's desirability in terms of recreational amenities or aesthetic appeal. Features may also affect water quality and habitat for species. Depending on the nature and condition of the feature and the preferences of homeowners and buyers, a given feature may have a positive or negative effect on any or all of these components. A feature's overall impact on property values will be the sum of these effects.

## Application to NYS Monitoring Framework

Although the potential exists for applying hedonic analysis in the context of NNBF and HSF monitoring, IEc determined that, as a monitoring protocol, it would be too time and resource intensive to conduct and could have limited utility, depending on the specific location and feature of interest. Our principal concern for the Phase I Protocol 14 was whether property value effects could be accurately and reliably measured for the types of features these protocols are intended to evaluate. In addition to extensive data and analytic requirements, we noted the following challenges associated with evaluating property value effects at these sites:

- **Spatial issues**. The standard proxy for the influence of a feature in hedonic models, whether expected to be positive (e.g., a park) or negative (e.g., a waste site), is a measure of the distance from the property to that feature. Given that the sites that would be evaluated by the monitoring protocols are all coastal sites, changes in property values will be highly correlated with distance to the shoreline generally. The effect of general proximity to the waterfront on property values could thus be confounded with the effect of specific NNBFs or HSFs that are part of a particular site. To conduct a meaningful evaluation, a material change in the site or site features would be necessary to observe whether there is a corresponding change in the effect of proximity to the site. That is, the protocols may not be meaningful for sites where no significant changes (physical, ecological, or otherwise) have occurred or been planned.

- **Temporal issues**. Even if a substantial change has occurred at a site, the changes in property values may be sensitive to other factors that may be correlated over time. The most compelling evidence would involve comparing the before and after effect of a specific site change to any changes over the same time period in a similar coastal community.

- **Complexity**. The monitoring framework stated that socioeconomic indicators and protocols were selected that "would be relatively easy to implement and produce data that could be directly converted into 'actionable information' relevant to the sustainability and resilience of shoreline communities" (p.34). The Phase I Monitoring Team did not fully implement Protocol 14, finding it to be "prohibitively time-consuming" to obtain the data required. The team also noted likely challenges associated with isolating causal relationships between shoreline features and property values. They requested that future teams evaluate the utility of the data collected through this portion of the protocol. Our review confirms these findings.

Given the level of effort and inherent difficulties involved in conducting hedonic analyses in the current context, we offer criteria to help future analysts understand when undertaking such an effort has the potential to yield meaningful results. This memorandum also provides a brief review of selected studies in order to provide more general reference information on values associated with coastal features.

## Criteria for Conducting Hedonic Analysis

While carrying out the modeling requires some econometric expertise, none is required to conduct a basic evaluation of whether a particular site or feature is potentially amenable to hedonic analysis. Below we identify two fundamental criteria that must be satisfied to support an analysis:

1. **Significant site change.** To distinguish the effect of a specific site/feature from that of general proximity to the shoreline, or other co-located amenities or disamenities, the site must experience some form of change. While "significant" in this context is a matter of judgment, and ultimately an empirical question, these would generally be changes in the physical attributes, appearance, and/or management of a site for which there is a reasonable expectation of local public knowledge and awareness. Of particular interest in the context of the broader monitoring framework may be cases where a HSF is replaced with a NNBF, a new NNBF is created, or an existing NNBF is expanded materially in nature or size. Changes that are not amenable to assigning at least an approximate 'pre' and 'post' period (for example, erosion or vegetation changes that are cumulatively significant but occur gradually over time) also complicate identification of any property value relationships attributable to the site.
2. **Proximate properties and sales.** In addition to a notable change, there must be a sufficient number of property transactions within reasonable proximity to the feature before and after the change in order to be able to statistically identify an effect. This is determined both by the density of nearby development and the frequency of sales, where the latter is influenced by broader housing market and economic conditions. Here again, "reasonable proximity" is a matter of judgment, but may be expected to be proportional to the size and significance of the feature. While it is not possible to identify a generic minimum sample size, it should be straightforward from information contained in other protocols to eliminate sites for which adequate sales data are unlikely to exist.

As noted above, the monitoring sites selected for Phase II of the Monitoring Framework implementation lack a notable change that could be evaluated. As such, an evaluation was not conducted at these sites. We also conducted a review of available information about other potential sites that we could evaluate using a case study approach. This included a review of 31 restoration projects being conducted by the U.S. Army Corps of Engineers New York District (New York District Website > Missions > Environmental > Environmental Restoration (army.mil)), as well as 46 recent projects conducted by the National Fish and Wildlife Foundation in New York State and New Jersey (2014-grants-list-v2.pdf (nfwf.org)). However, we were not able to identify a site for which a notable change occurred and for which sufficient data exist to undertake a study at this time.

## Steps in conducting a hedonic analysis

Bishop et al.'s *Best Practices for Using Hedonic Property Value Models to Measure Willingness to Pay for Environmental Quality* published in the *Review of Environmental Economics and Policy*, describes three basic steps to constructing a hedonic model: 1) define the housing market; 2) collect the property value data; and, 3) choose an econometric specification (modeling strategy). We review these steps below.

### *Step 1. Defining the Housing Market*

For a hedonic analysis to yield accurate results, the housing market should theoretically satisfy the "law of one price function." That is, if homes are identical within the market, they should be priced the same. It is easy to imagine why this condition might not hold if a housing market is defined too broadly. For example, a waterfront house in Manhattan will likely be more expensive than a waterfront house on Lake Ontario, even if the houses are otherwise identical. To avoid violating the "law of one price function," some studies have limited their housing markets to a single township or metropolitan area. Other studies have employed more sophisticated methodologies and allowed price functions to evolve over space and time. Because shoreline features typically only impact households adjacent to them, most hedonic analyses of coastal features are unlikely to violate this assumption. However, the limited influence of these features impedes hedonic modeling in a different way- if a feature does not impact enough households, there will be insufficient variation in property values for researchers to detect any effects the feature may have.

### *Step 2. Data collection*

Best practice in hedonic modeling involves use of individual property transaction data (as opposed to assessed or self-reported values, or data aggregated over census units, for example). These sales data must be matched with property characteristic information, and additional relevant spatial/neighborhood features that require Geographic Information System (GIS) analysis (at a minimum in this case, calculating distances between individual sales and the site/feature of interest). Compiling an adequate dataset may require synthesizing multiple publicly available sources in different formats, or otherwise purchasing data from a commercial vendor.

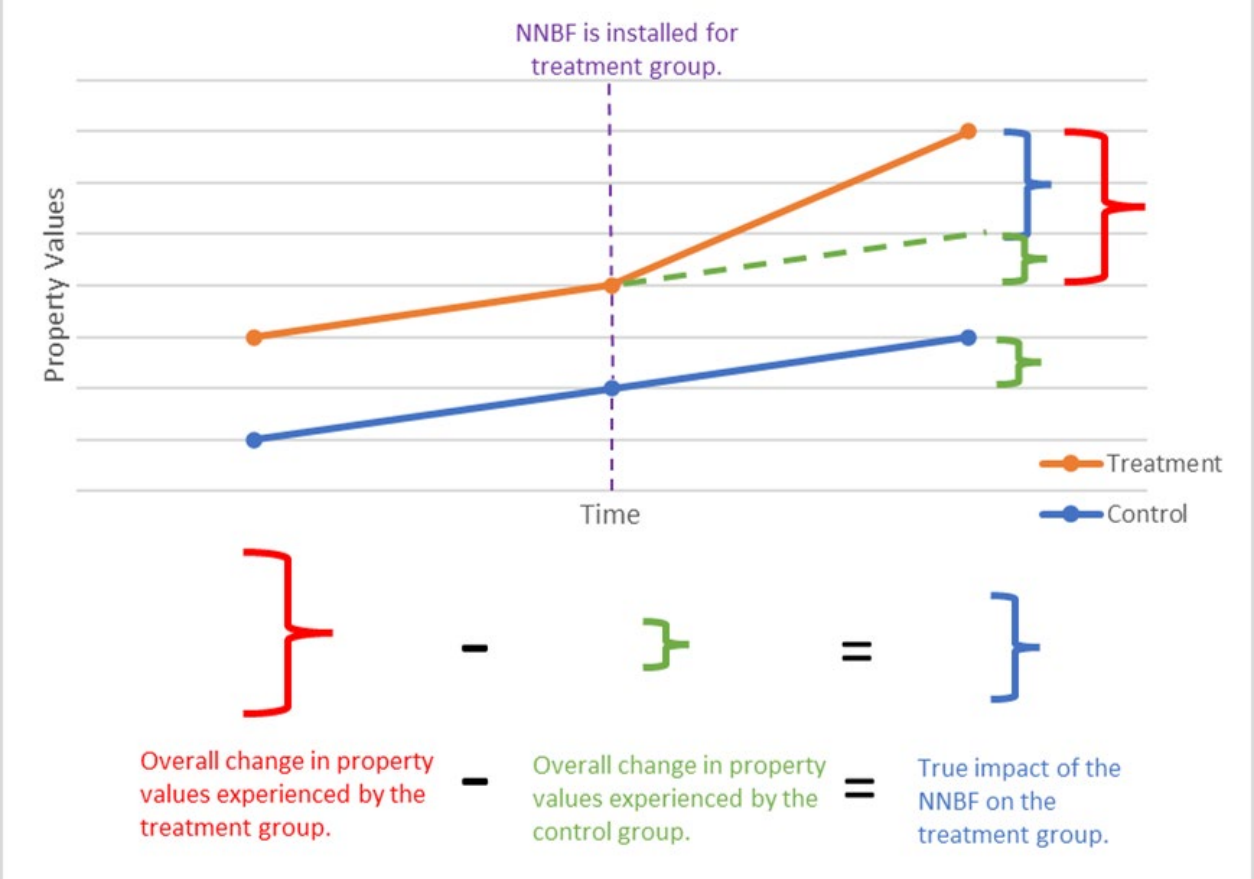
### *Step 3. Econometric specification*

The final step is to choose a modeling strategy; that is, a form for the econometric model. The hedonics literature has established that price functions should be assumed to be nonlinear. Several studies have shown that, compared to linear specifications, nonlinear specifications of price functions are superior predictors of buyers' willingness to pay for amenities and household characteristics. Nonlinear specifications have the added benefit of allowing researchers to explore whether certain household characteristics are valued more (or less) when complemented by other characteristics. Model specifications must also avoid omitted-variable bias, which occurs when a researcher fails to control for a variable that both influences property values and is correlated with the specific property attribute(s) of interest. Perhaps the most intuitive strategy for addressing omitted-variable bias is a difference-in-differences (DID) approach.

A DID framework is a quasi-experimental design that involves comparing changes in outcomes between a treatment and a control group. For example, if researchers wanted to use a DID model to measure the effect of a NNBF on property values, they might compare how property values change in a community that installs a NNBF with how property values change in a similar, nearby community that does not install a NNBF (Figure 1 below provides a simplified graphical representation). This framework reduces bias from omitted variables that vary over time. For example, suppose the entire region experiences an uptick in burglaries around the same time that the NNBF is installed. Because the communities are similar and adjacent, the regional increase in crime should affect prices in both housing markets similarly. Thus, by subtracting the change in property values experienced by the control community from the change in property values experienced by the treatment community, researchers can eliminate the effect of crime (among other regional factors) to isolate the impact the NNBF had on property values. Even if the

researchers in this example are unable to control for the increase in crime directly, they account for it using the DID framework.

**Figure B1. D-I-D model of the Effect of a nnbf on Property Values**




## Existing Studies of Coastal NNBFs and HSFs

Within the environmental and natural resource economics literature, there are an array of hedonic property value applications potentially relevant to aspects of the monitoring protocols. These include coastal flood risk (Bin et al. 2006, Gibson 2017), water quality (Leggett and Bockstael 2000), and beach recreation and nourishment (Landry and Hindsley 2011, Gopalakrishnan et al. 2011, Landry et al. 2016, Catma 2020). However, there are few studies that have examined NNBFs and HSFs directly. This section summarizes these studies (including a summary of estimates in Table 1 at the conclusion) to provide additional context and reference for any future analyses that may be conducted on a case study basis.

Of identified studies, Kim (2020) provides the most comprehensive treatment of both NNBFs and HSFs, examining hundreds of individual projects in both Miami Dade County, FL (MDC) and New York City (NYC) implemented between 2009 and 2018. The author employs a DID approach (described above) that compares property sales within 400 meters of a project one year before completion and one year after to other areas.[2] The hedonic model also includes standard structural characteristics, measures of accessibility to public transportation and schools, timing and characteristics of storms in relation to sale

dates, and additional variables to capture temporal and spatial patterns that may affect prices. The "green infrastructural coastal adaptation projects" included wetlands, lagoons, salt marshes, green space restoration, and beach nourishment projects. Results suggest that these resilience projects increased property values by 11.8 percent in MDC and 4.6 percent in NYC. It is worth noting that this is an average effect across the group of NNBFs and does not distinguish among specific project types, sizes, or locations. Turning to HSFs, Kim (2020) includes levees, storm barriers, and other "hard infrastructure" in this category. Results suggest that these projects increased property values by 2.9 percent in MDC and 2.4 percent in NYC. The premiums associated with NNBFs observed in this study support the notion that they convey additional benefits to nearby homeowners that are capitalized in sale prices.

As described earlier, HSFs are typically intended to prevent erosion, provide flood protection, or both, and therefore may have a positive effect on nearby property values. However, unlike NNBFs, HSFs can also have undesirable environmental impacts, or effects on recreation and aesthetics. Seawalls are a prime example of a HSF that may have mixed impacts depending on location and context. Jin et al. (2015), for example, found that seawalls increased waterfront property values in the towns of Duxbury, Marshfield, and Plymouth, MA by an average of 10 percent. Alternatively, Kriesel et al. (2000) conducted a comparable analysis along the coasts of North Carolina, South Carolina, and Georgia and found that coastal armoring did not have a consistent, statistically significant effect on property values.

Other hedonic analyses have examined specific types of coastal armoring, such as bulkheads and riprap. In a Chesapeake Bay study, Walsh et al. (2019) constructed models with interaction terms between sea level rise (SLR) zones and bulkhead presence to determine whether households in high-risk areas were willing to pay a premium for bulkheads. Using property sales data from Anne Arundel County, MD, the authors estimated that having a bulkhead increased property values by 12-14 percent for households outside of the SLR zone, and an additional 22 and 9 percent for households in the 0-2 and 2-5-foot SLR zones, respectively. Of note, the property value increase experienced by households in the 0-2-foot SLR zone was estimated to be sufficient to "compensate for the negative impact of being located in the 0-2-foot SLR zone" in the first place (p.13). The authors also investigated riprap seawalls or ripraps in the same model. Despite their status as HSFs, riprap can provide some collateral habitat benefits compared to bulkheads. They also tend to absorb wave energy, whereas bulkheads merely reflect it. Results suggested that the presence of ripraps increased property values for households outside the SLR zone by 19-21 percent and an additional 23 percent for households in the 0-2-foot SLR zone. No significant effect was observed for households in the 2-5-foot SLR zone.

As a caveat, Walsh et al. (2019) note that their estimates for the property value effects of bulkheads and ripraps may "reflect unobserved characteristics corresponding to higher quality homes and neighborhoods" (p.11). This is a form of omitted variable bias (described above) attributable to limitations in their data and model specifications and may imply that the estimated values of bulkheads and ripraps are overstated.

**Table B1. SUMMARY OF NNBF AND HSF IMPACTS on housing values**

| Feature Type | Study | Location | Impacts on property value | Notes |
|---|---|---|---|---|
| General NNBF | Kim, 2020 | Miami Dade County, FL | 11.8 % increase in property value associated with location within a 5-minute walk of "green infrastructure." | Includes the effects of beach nourishment projects. |
| General NNBF | Kim, 2020 | Miami Dade County, FL | 4.6 % for being within a 5-minute walk of "green infrastructure." | Includes the effects of beach nourishment projects. |
| General Seawalls | Jin et al., 2015. | Duxbury, Marshfield, and Plymouth, MA. | 10% for seawall presence. | For waterfront residences. |
| General Seawalls | Kriesel et al., 2000. | Coasts of NC, SC, and GA. | No statistically significant effect at the 10%level. | The effect was positive and statistically significant at the 20 percent level. |
| Bulkheads | Walsh et al., 2019. | Chesapeake Bay Watershed. | 12-14% for bulkhead presence. | For waterfront residences. |
| Bulkheads | Walsh et al., 2019. | Chesapeake Bay Watershed. | 34-36% for bulkhead presence. | For waterfront residences in the 0-2-foot SLR zone. |
| Bulkheads | Walsh et al., 2019. | Chesapeake Bay Watershed. | 21-23% for bulkhead presence. | For waterfront residences in the 2-5-foot SLR zone. |
| Ripraps | Walsh et al., 2019. | Chesapeake Bay Watershed. | 19-21% for riprap presence. | For waterfront residences. |
| Ripraps | Walsh et al., 2019. | Chesapeake Bay Watershed. | 42-44% for riprap presence. | For waterfront residences in the 0-2-foot SLR zone. |
| General HSFs | Kim, 2020. | Miami Dade County, FL. | 2.9% for being within a 5-minute walk of a "hard infrastructure." | Includes small-scale projects. |
| General HSFs | Kim, 2020. | Miami Dade County, FL. | 2.4% for being within a 5-minute walk of "hard infrastructure." | Includes small-scale projects. |

## References


Bin, Okmyung, and Jamie Brown Kruse. "Real estate market response to coastal flood hazards." *Natural Hazards Review* 7.4 (2006): 137-144.

Bishop, Kelly C., et al. "Best practices for using hedonic property value models to measure willingness to pay for environmental quality." Review of Environmental Economics and Policy (2020).

Catma, Serkan. "Non-market valuation of beach quality: Using spatial hedonic price modeling in Hilton Head Island, SC." Marine Policy 115 (2020): 103866.

Gibson, Matthew, Jamie T. Mullins, and Alison Hill. "Climate change, flood risk, and property values: Evidence from New York City." *Work. Pap., Dep. Econ., Williams Coll., Williamstown, MA* (2017).

Gopalakrishnan, Sathya, et al. "The value of disappearing beaches: a hedonic pricing model with endogenous beach width." Journal of Environmental Economics and Management 61.3 (2011): 297-310.

Landry, Craig E., and Paul Hindsley. "Valuing beach quality with hedonic property models." Land Economics 87.1 (2011): 92-108.

Landry, Craig E., Dylan Turner, and Tom Allen. "Hedonic property prices and coastal beach width." Applied Economic Perspectives and Policy (2016).

Leggett, Christopher G., and Nancy E. Bockstael. "Evidence of the effects of water quality on residential land prices." Journal of Environmental Economics and Management 39.2 (2000): 121-144

Jin, Di, et al. "Shoreline change, seawalls, and coastal property values." Ocean & coastal management 114 (2015): 185-193.

Kim, Seung Kyum. "The economic effects of climate change adaptation measures: Evidence from Miami-Dade County and New York City." Sustainability 12.3 (2020): 1097.

Kriesel, Warren, Craig E. Landry, and Andrew G. Keeler. *Costs of Coastal Hazards: Evidence from the Property Market*. No. 372-2016-19411. 2000.

Walsh, Patrick, et al. "Adaptation, sea level rise, and property prices in the Chesapeake Bay watershed." Land economics 95.1 (2019): 19-34.


[1] The set of sites and features identified for evaluation to date do not meet these requirements.
[2] The author adopts 400m as the “pedestrian shed” or area covered by a five-minute walk citing Ker et al. (2003).

# Appendix C. Monitoring Framework Data Collection

# MONITORING FRAMEWORK DATA COLLECTION

## Shoreline Monitoring – Measuring Success – Phase II



Summary

September 2022

Prepared for

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Appendix II. Data Management Options for Phase II of Shoreline Monitoring Presentation

# LIST OF ABBREVIATIONS

| | |
|---|---|
| Gomez and Sullivan | Gomez and Sullivan Engineers, D.P.C. |
| NOAA | National Oceanic and Atmospheric Administration |

# PHASE II MONITORING SUMMARY

Phase II monitoring data collection was carried out at seven sites in the New York coastal zone with the purpose of piloting Phase II data collection protocols, updating data for established sites, and establishing additional sites within the Shoreline Monitoring Framework. The results reported in this summary document build upon the results given in the *Measuring Success Monitoring Natural and Nature-Based Shoreline Features in New York State Final Report* (Science and Resilience Institute at Jamaica Bay, 2020) (Phase I Final Report).

**Figure 1. Phase II Monitoring Site Locations**

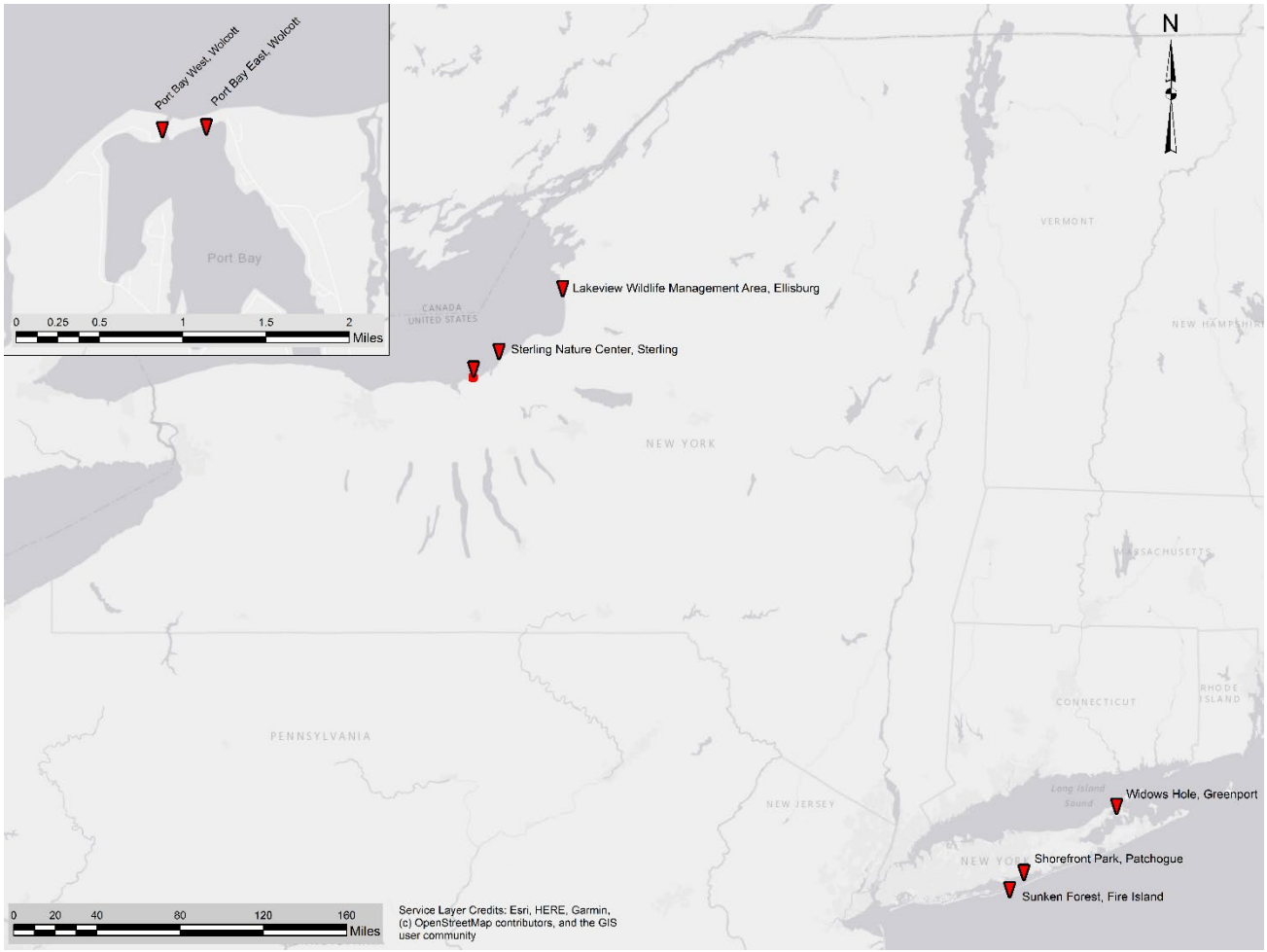


**Table 1. Summary of Phase II Monitoring**

| Region | Site | Established | Feature Types | Feature Components | Monitoring Team | Implemented Protocols |
|---|---|---|---|---|---|---|
| Great Lakes | Port Bay West | Phase I | Hard Structural | Bulkhead | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 |
| | | | Hard Structural | Revetment | | |
| | | | Natural | Beach/Beach Berm | | |
| Great Lakes | Port Bay East | Phase I | Natural | Beach/Beach Berm | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 |
| Great Lakes | Sterling Nature Center | Phase I | Natural | Beach/Beach Berm | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13 |
| Great Lakes | Lakeview Wildlife Management Area | Phase II | Natural | Beach/Beach Berm | Gomez and Sullivan Engineers | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| | | | Natural | Dune | | |
| Long Island | Widow's Hole | Phase I | Nature Based | Revetment (rip rap) | Bay Environmental | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
| | | | Nature Based | Tidal Marsh | | |
| | | | Natural | Vegetated Upland | | |
| | | | Natural | Tidal Wetlands/Salt Marsh | | |
| | | | Natural | Bluff | | |
| | | | Natural | Shoals, Mudflats, Nearshore | | |
| Long Island | Shorefront Park | Phase I | Hard Structural | Bulkhead | Bay Environmental | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 |
| | | | Hard Structural | Concrete Outfall | | |
| | | | Natural | Vegetated Upland | | |
| | | | Natural | Tidal Wetlands/Salt Marsh | | |
| | | | Natural | Beach/Beach Berm | | |
| Long Island | Sailors Haven | Phase II | Hard Structural | Bulkhead | Bay Environmental | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13 |
| | | | Natural | Vegetated Upland | | |
| | | | Natural | Shoals | | |
| | | | Natural | Tidal Wetlands/Salt Marsh | | |
| | | | Natural | Bluff | | |
| | | | Natural | Beach/Beach Berm | | |

## Port Bay West Monitoring Results



*Photo 1: Port Bay West hard structural shoreline feature.*



*Photo 2: Port Bay West shoreline erosion.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

Port Bay West was an established monitoring site; therefore, the feasibility survey form was not completed.

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | PBW |
| **Site Name** | Port Bay West |
| **Site Owner/Operator** | NYSDEC |
| **Ownership Type** | Public |
| **Site Contact** | NYSDEC Regional Wildlife Manager |
| **Site Contact Phone** | Available in GIS data |
| **Site Contact Email** | Available in GIS data |
| **Permission Required for Access?** | No |
| **Access Considerations** | None. |
| **Region** | Great Lakes |
| **NYSDEC Region** | 8 |
| **County** | Wayne |
| **Municipality** | Wolcott (Town) |
| **Directions to Site** | Site is accessed from the end of West Port Bay Road. |
| **Parking Location** | Large parking area, including handicapped parking space, at the east end of the barrier. |
| **Adjacent Landowners** | Private homeowners. |
| **Comments** | |
| **Last Updated** | 5/26/2022 |

## *Protocol 2 Monitoring Feature Characteristics and Dimensions*

The Phase I Final Report identified one monitoring feature at Port Bay West, a hard structural feature. GIS data for this monitoring feature was not available in the Shoreline Monitoring GIS.

Three monitoring features were identified during Phase II monitoring data collection, including the hard structural feature that was identified during Phase I. Across the three monitoring features, indicators of four performance parameters were observed.

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Hard Structural Feature | Bulkhead | 12,661 | Biological Health & Biodiversity<br>Hydraulic Alteration<br>Structural Integrity<br>Recreation and Cultural Use |
| Hard Structural Feature | Revetment | 167 | Hydraulic Alteration<br>Structural Integrity |
| Natural Feature | Beach/Beach Berm | 447 | Habitat Connectivity |

### *Protocol 3 Establishing a Monitoring Scheme*

Three transects and four monitoring points were established during Phase I monitoring. Four additional transects were established during the Phase II monitoring to collect representative data for the newly mapped hard structure and natural monitoring features. These four new transects should also be used for future monitoring. Port Bay West was the first Great Lakes monitoring site in the Phase II field effort. The field crew implemented the revised protocols at this site and established the transects 100 ft apart. Phase I transect 2 was midway between two 100 ft transect and in 2022, data were not collected at Phase I transect 2 and associated points. We recommend collecting data along all seven transects during future monitoring efforts.

| Transects | Monitoring Points |
|---|---|
| 7 | 20 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along six transects. The largest hard structural feature, the bulkhead, was flat with an elevation around 250 feet.

The water was relatively calm during the monitoring visit. Wave period was approximately 5 seconds, with a wave height of less than one inch.

### *Protocol 5 Erosion and Structural Stability*

One erosion area was identified in the natural feature on the south end of the monitoring site. This area has experienced water erosion (i.e., scour).

### *Protocol 6 Ecological Monitoring*

All monitoring points were above the waterline. Substrate and vegetation data were collected for monitoring points along transects 3 through 8. Surface substrates at the site included bedrock/manmade, gravel/cobble, boulders, and upland soil. Vegetation included lawn grasses and common herbaceous lawn weeds. No sessile organisms were observed.

### *Protocol 7 Monitoring Feature Supporting Information*

The property manager, NYSDEC, was not able to provide any surveys or as-built drawings for the bulkhead. Historical information, including photos, is available from the Port Bay Improvement Association (www.portbayny.org/). The Port Bay Improvement Association is working to apply for Resiliency and Economic Development Initiative funding to complete a project near this site.

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 12,661 square feet. The area of influence is presented below.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

Potential coastal-related damages at this site were estimated to be relatively low. One vulnerable property was identified within the site's area of influence: a vacant land property valued at $157,700.

### *Protocol 10 Environmental Justice Index*

The site did not meet NYSERDA's interim criteria for a disadvantaged community. However, the local population exceeded state and national averages across three environmental justice indicators: the low-income rate, the share of the population with less than a high school degree, and the percentage of the population over the age 64.

### *Protocol 11 Household Survey*

Protocol 11 was not implemented at this site because there were no residential properties in the area of influence.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: This site includes a porta-potty, handicapped parking, and a fishing platform. A boat launch is nearby, but outside of the monitoring site.

Visitor's Counts and Intercept Survey: Eight visitors were observed during the June 6 monitoring visit and seven visitors were observed during the June 10 monitoring visit. The field crew asked a number of these visitors to complete the intercept survey; however, no one agreed to complete it.

### *Protocol 13 Costs of Repair and Maintenance*

Protocol 13 was not implemented at this site because the site manager did not respond to the request for interview.

## Port Bay East Monitoring Results



*Photo 3: Port Bay East natural shoreline feature with Port Bay West in the background.*



*Photo 4: Contributor collecting elevation data along a monitoring transect.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

Port Bay East was an established monitoring site; therefore, the feasibility survey form was not completed.

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | PBE |
| **Site Name** | Port Bay East |
| **Site Owner/Operator** | NYSDEC |
| **Ownership Type** | Public |
| **Site Contact** | NYSDEC Regional Wildlife Manager |
| **Site Contact Phone** | Available in GIS data |
| **Site Contact Email** | Available in GIS data |
| **Permission Required for Access?** | No |
| **Access Considerations** | Access is available from the end of East Port Bay Road; however, there is no official parking area or access trail. |
| **Region** | Great Lakes |
| **NYSDEC Region** | 8 |
| **County** | Wayne |
| **Municipality** | Wolcott (Town) |
| **Directions to Site** | Site is accessed from East Port Bay Road |
| **Parking Location** | Grassy area at east end of site. |
| **Adjacent Landowners** | Private homeowners. |
| **Comments** | None |
| **Last Updated** | 5/26/2022 |

## *Protocol 2 Monitoring Feature Characteristics and Dimensions*

The Phase I Final Report identified three monitoring features at Port Bay East, two nature-based features and one natural feature. GIS data for this monitoring feature was not available in the Shoreline Monitoring GIS.

The eastern-most nature-based features identified during Phase I are in an area marked as private property and posted with “No Trespassing” signs; therefore, it was not delineated during Phase II monitoring. This feature is made up of large tires and wood posts. The purpose of the feature appears to prevent shoreline erosion; however, due to the signage, no further investigation was conducted.

The western-most nature-based feature identified during Phase I was not evident during Phase II monitoring. No details regarding this feature were given in the Phase I Final Report, therefore it is unclear what this feature entailed.

The largest Phase I monitoring feature was a natural feature, described as a barrier bar split. In Phase II, this area was defined as a natural feature, beach/beach berm. The feature reached from the Lake Ontario shoreline all the way to the Port Bay side of the peninsula.

Three additional monitoring features were added to the site during Phase I monitoring, extending the monitoring site to the western end of the peninsula. At the western end, the stone beach was tiered, with sharply eroding bluffs. This area appeared to be more dynamic than the eastern end of the monitoring site.

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Natural Feature | Beach/Beach Berm | 42,350 | Biological Health & Biodiversity<br>Habitat Connectivity<br>Hydraulic Alteration<br>Coastal Flooding<br>Recreation and Cultural Use |
| Natural Feature | Beach/Beach Berm | 2,312 | Biological Health & Biodiversity<br>Habitat Connectivity<br>Hydraulic Alteration<br>Coastal Flooding |
| Natural Feature | Beach/Beach Berm | 16,631 | Biological Health & Biodiversity<br>Habitat Connectivity<br>Hydraulic Alteration<br>Coastal Flooding |
| Natural Feature | Beach/Beach Berm | 6,401 | Biological Health & Biodiversity<br>Habitat Connectivity<br>Hydraulic Alteration<br>Coastal Flooding |

The ordinary high water line elevation at this monitoring site was unclear. There were clear indications that the water surface elevation on the Lake Ontario side of the site regularly varied to above the elevation of the water surface during monitoring visits. A line was mapped where a shift in slope, vegetation, and debris was evident. The elevation of this line (approximately 250 ft) is higher than the accepted ordinary high-water line for Lake Ontario (247.3 ft)

### *Protocol 3 Establishing a Monitoring Scheme*

Phase I monitoring focused on the eastern side of this site. Three transects with monitoring points were established. The location of the easternmost transect was with an area marked as private property and posted with “No Trespassing” signs; therefore, this transect was not monitored in 2022.

The location of the remaining two transects and monitoring points did not collect representative data for all the site’s monitoring features; therefore, new transects and monitoring points were added that should be used for future monitoring. These are transects 4 through 10. In 2022, data were not collected at Phase I, transects 2 and 3 and associated monitoring points; however, we recommend collecting data along transects 1 through 11 during future monitoring efforts.

| Transects | Monitoring Points |
|---|---|
| 11 | 25 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along 10 transects. Elevations ranged from 246.7 at the water's edge on June 8, 2022, to 252.8 feet along transect 7 at the top of the bluff on the sites western side.

The water was relatively calm during the first day of monitoring. Wind and waves were greater on the second day of monitoring. Wave period was approximately 5 seconds, with a wave height of less than one inch.

### *Protocol 5 Erosion and Structural Stability*

An erosion polygon was mapped toward the western end of the monitoring site. The shoreline in this area includes a bluff that has been steep eroding in terraces. Erosion is likely caused by wind and waves.

### *Protocol 6 Ecological Monitoring*

Substrate and vegetation data were collected for monitoring points along transects 1, 2, 4, 5, 6, 7, 8, and 9. Surface substrate at the site was gravel/cobble. Most of the monitoring points were at locations without vegetation. No sessile organisms were observed.

### *Protocol 7 Monitoring Feature Supporting Information*

The property manager, NYSDEC, could not offer any surveys at this site. Historical information, including photos, is available from the Port Bay Improvement Association (www.portbayny.org/). The Port Bay Improvement Association is working to apply for Resiliency and Economic Development Initiative funding to complete a project near this site.

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 42,341 square feet. The area of influence is presented below. As noted below under Protocol 13, we learned that this site, a barrier beach, serves to protect the inland coastal communities on the eastern shore. We recommend revising this area of influence in future iterations of this effort to include this community. We have incorporated a note about this issue into the Final Report and suggest that some site-by-site adjustments may need to be made in response to conversations with site managers that relate to peculiarities of individual sites.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

The value of potential site-related damages to residential, commercial, or industrial properties at this site were identified as being low because none of these property types were identified within the site's area of influence.

### *Protocol 10 Environmental Justice Index*

The site did not meet NYSERDA's interim criteria for a disadvantaged community. However, the local population exceeded state and national averages across three environmental justice indicators: the low-income rate, the share of the population with less than a high school degree, and the percentage of the population over the age 64.

### *Protocol 11 Household Survey*

Protocol 11 was not implemented at this site because there were no residential properties in the area of influence.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: There are no amenities at this site. The parking area and common entrance is a grassy spot that is not officially designated for vehicles.

Visitor's Counts and Intercept Survey: Four visitors were observed during the June 8 monitoring visit and zero visitors were observed during the June 10 monitoring visit. One person agreed to complete the intercept survey.

### *Protocol 13 Costs of Repair and Maintenance*

Protocol 13 was not implemented at this site because the site manager did not respond to a request for an interview.

## Sterling Nature Center Monitoring Results



*Photo 5: Sterling Nature Center natural shoreline feature facing northeast.*



*Photo 6: Sterling Nature Center typical fallen tree root ball.*



*Photo 7: Sterling Nature Center natural shoreline feature facing southwest.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

Sterling Nature Center was an established monitoring site; therefore, the feasibility survey form was not completed.

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | SN |
| **Site Name** | Sterling Nature Park |
| **Site Owner/Operator** | Cayuga County |
| **Ownership Type** | Public |
| **Site Contact** | Cayuga County Planning, Sterling Nature Center Site Manager |
| **Site Contact Phone** | Unknown |
| **Site Contact Email** | Available in GIS data |
| **Permission Required for Access?** | Yes |
| **Access Considerations** | None |
| **Region** | Great Lakes |
| **NYSDEC Region** | 7 |
| **County** | Cayuga |
| **Municipality** | Sterling (Town) |
| **Directions to Site** | From parking area, facing kiosk, walk on trail through the woods to the shoreline. |
| **Parking Location** | Sterling Nature Center parking lot |
| **Adjacent Landowners** | None |
| **Comments** | |
| **Last Updated** | 5/26/2022 |

## *Protocol 2 Monitoring Feature Characteristics and Dimensions*

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Natural Feature | Beach/Beach Berm | 13,100 | Habitat Connectivity |

## *Protocol 3 Establishing a Monitoring Scheme*

The monitoring scheme for this monitoring site was established in Phase I. There are four transects at the site. Monitoring in 2022 includes all four transects and 12 monitoring points.

| Transects | Monitoring Points |
|---|---|
| 4 | 12 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along 4 transects. Elevations ranged from 247.3 at the water's edge on June 13, 2022 to 250.9 feet. At elevations greater than 250 ft, tree cover became dense enough to interfere with elevation data collection.

The water was relatively calm during the monitoring visit. Wave period was approximately 3 seconds, with a wave height of less than one inch at the water's edge.



*Photo 8: Contributor collecting elevation data.*

### *Protocol 5 Erosion and Structural Stability*

One erosion area was mapped at the northwest end of the monitoring site. This area happened to overlap with transect 4. Erosion in this area was caused by a tree falling at the edge of the sandy bluff. The tree and root ball were still in place.



*Photo 9: Quadrat used to complete Protocol 6 at a monitoring point.*

### *Protocol 6 Ecological Monitoring*

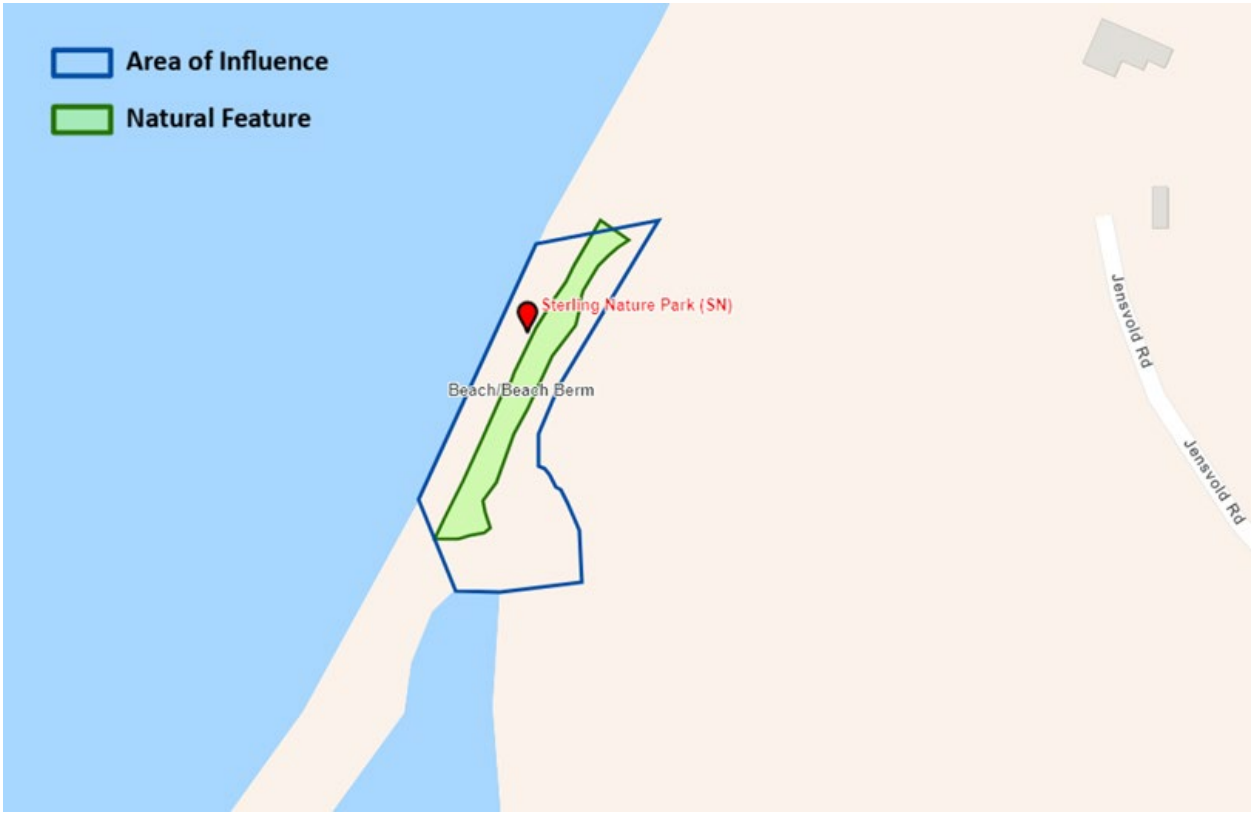
Substrate and vegetation data were collected for monitoring points along transects 1, 2, 4, 5, 6, 7, 8, and 9. Surface substrate at the site was gravel/cobble. Most of the monitoring points were at locations without vegetation. No sessile organisms were observed.

### *Protocol 7 Monitoring Feature Supporting Information*

The site managers were not able to provide any supporting information for this monitoring site. No human-made features are present.

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 13,100 square feet. The area of influence for this site is presented below.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

The value of potential site-related damages to residential, commercial, or industrial properties at this site were identified as being low because none of these property types were identified within the site's area of influence.

### *Protocol 10 Environmental Justice Index*

The site did not meet NYSDOS's interim criteria for a disadvantaged community. However, the local population exceeded state and national averages across two environmental justice indicators: the unemployment rate and the percentage of the population over the age 64.

### *Protocol 11 Household Survey*

Protocol 11 was not implemented at this site because there were no residential properties in the area of influence.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: This site includes a trail to the shore from the Sterling Nature Center parking area. No other amenities are present.

Visitor's Counts and Intercept Survey: Ten visitors were observed during the June 13 monitoring visit. No intercept surveys were completed.

### *Protocol 13 Costs of Repair and Maintenance*

The site manager asserted that this site will not experience any direct repair or restoration for the foreseeable future because it is located on a stretch of beach comprised of clay and other hard materials that fortify it against erosion. He identified a nearby stretch of beach north just North of the area of influence that has been eroding and will require ongoing adaptation and restoration activities. This northern stretch would appear to be a promising area for future monitoring activities, should they continue at this site.

## Lakeview Wildlife Management Area Monitoring Results



*Photo 10: Shoreline at Lakeview Wildlife Management Area.*



*Photo 11: Stairs and boardwalk over dune at Lakeview Wildlife Management Area.*



*Photo 12: Dune, shoreline, and Lake Ontario at Lake View Wildlife Management Area.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

| | |
|---|---|
| **Has the site owner or operator agreed to having the site included in the Shoreline Monitoring Program** | Yes |
| **Is the site located within New York State Coastal Area?** | Yes |
| **Is permission or notification required for each site visit?** | No |
| **Does the site access require specialized equipment?** | No |
| **Is the site within a one-mile walk of a parking area?** | Yes |
| **Does the site access require exceptional safety considerations?** | No |
| **Are there seasonal restrictions to access?** | No |
| **Are resources available for monitoring at this site for at least three years?** | Not yet determined |

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | LVM |
| **Site Name** | Lake View Wildlife Management Area |
| **Site Owner/Operator** | NYSDEC |
| **Ownership Type** | Public |
| **Site Contact** | Regional Wildlife Manager |
| **Site Contact Phone** | Unknown |
| **Site Contact Email** | Unknown |
| **Permission Required for Access?** | No |
| **Access Considerations** | No permission is required for beach access. Yes, permission required to enter dunes. |
| **Region** | Great Lakes |
| **NYSDEC Region** | 6 |
| **County** | Jefferson |
| **Municipality** | Ellisburg (Town) |
| **Directions to Site** | From Southwick St Park parking area, walk to south end of camper loop for access to the shoreline. Walk to beach site from there. Stay off dunes. |
| **Parking Location** | Southwick Beach State Park public parking area |
| **Adjacent Landowners** | NYSOPRHP |
| **Comments** | Permission required for monitoring on dunes. |
| **Last Updated** | 6/13/2022 |

## *Protocol 2 Monitoring Feature Characteristics and Dimensions*

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Natural Feature | Beach/Beach Berm | 21,285 | Biological Health & Biodiversity<br>Habitat Connectivity |
| Natural Feature | Dune | 14,889 | Biological Health & Biodiversity<br>Habitat Connectivity<br>Hydraulic Alteration<br>Shoreline and Topographic Change |

### *Protocol 3 Establishing a Monitoring Scheme*

As a new monitoring site, no transects or monitoring points exist at this location. Six transects and associated monitoring points were established to characterize the monitoring site and monitoring features. Placement of transects following the Protocol 3 guidelines to place a transect every 100 feet. Transects extended from the water line to the edge of the dunes, where dune vegetation began and elevations began to rise. The transects were not extended into the dunes as NYSDEC Regional manager requested that the monitoring crew not walk on the ecologically sensitive dunes. An additional transect was added that aligned with a boardwalk on the site, allowing for monitoring to extend into the Lake View Wildlife Management Area dunes.

| Transects | Monitoring Points |
|---|---|
| 6 | 20 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along all 6 transects. Elevations ranged from 247.3 at the water's edge on June 13, 2022 to 246.2 feet. At elevations greater than 246 ft, along transect 4, tree cover became dense enough to interfere with elevation data collection.

The water was relatively calm during the monitoring visit. Wave period was approximately 3 seconds, with a wave height of up to two inches at the water's edge.

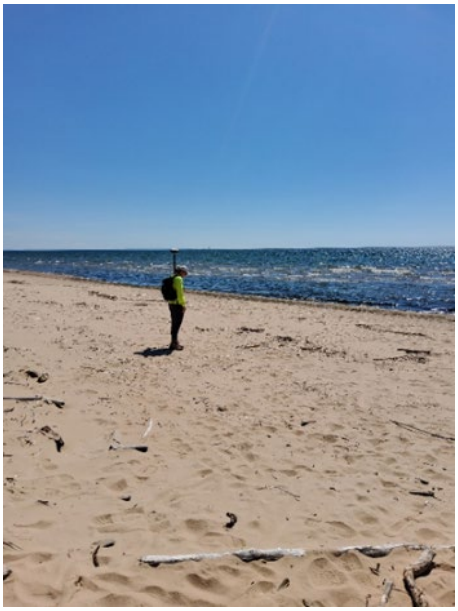


*Photo 13: Contributor collecting elevation data for Protocol 4.*

### *Protocol 5 Erosion and Structural Stability*

No erosion or structural stability issues were observed at this monitoring site.

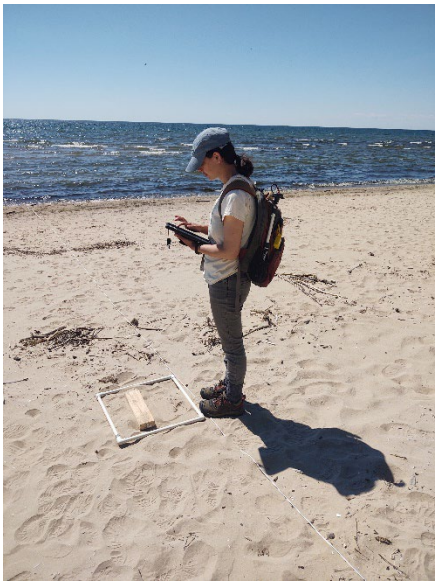


*Photo 14: Contributor using quadrat to complete Protocol 6.*

### *Protocol 6 Ecological Monitoring*

Substrate and vegetation data were collected for monitoring points along all 6 transects. Surface substrate at the site was sand/mud. Slopes ranged from 0 to 17 degrees, with the steepest slope occurring along a thin band of the shore at the water's edge. Most of the monitoring points were at locations without vegetation. No sessile organisms were observed at monitoring points; however, spent bivalve shells were abundant along the shoreline.

### *Protocol 7 Monitoring Feature Supporting Information*

No supporting information was provided by site managers.

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 21,285 square feet. The area of influence for this site is presented below.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

The value of potential site-related damages to residential, commercial, or industrial properties at this site were identified as being low because none of these property types were identified within the site's area of influence.

### *Protocol 10 Environmental Justice Index*

The site did not meet NYSERDA's interim criteria for a disadvantaged community. However, the local population exceeded state and national averages across three environmental justice indicators: the low-income rate, the percentage of the population under the age 5, and the percentage of the population over the age 64.

### *Protocol 11 Household Survey*

Protocol 11 was not implemented at this site because there were no residential properties in the area of influence.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: This site includes a boardwalk trail and interpretive signage.

Visitor's Counts and Intercept Survey: 16 visitors were observed during the June 14 monitoring visit. One person was close enough to speak with, and he declined to complete the intercept survey.

### *Protocol 13 Costs of Repair and Maintenance*

Protocol 13 was not implemented at this site because the site manager contact information was unsuccessful.

# Widow's Hole Monitoring Results



*Photo 16: Widows Hole shoreline.*



*Photo 15: Widows Hole nature-based shoreline feature with residential homes in background.*



*Photo 17: Widows Hole nature-based shoreline feature.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

Widow's Hole was an established monitoring site; therefore, the feasibility survey form was not completed.

| | |
|---|---|
| **Has the site owner or operator agreed to having the site included in the Shoreline Monitoring Program** | Yes |
| **Is the site located within New York State Coastal Area?** | Yes |
| **Is permission or notification required for each site visit?** | Yes |
| **Does the site access require specialized equipment?** | No |
| **Is the site within a one mile walk of a parking area?** | Yes |
| **Does the site access require exceptional safety considerations?** | No |
| **Are there seasonal restrictions to access?** | No |
| **Are resources available for monitoring at this site for at least three years?** | Not yet determined |

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | WHG |
| **Site Name** | Widow's Hole |
| **Site Owner/Operator** | Peconic Land Trust |
| **Ownership Type** | Private |
| **Site Contact** | Director of Stewardship and GIS |
| **Site Contact Phone** | Available in GIS data |
| **Site Contact Email** | Available in GIS data |
| **Permission Required for Access?** | Yes |
| **Access Considerations** | None |
| **Region** | Long Island |
| **NYSDEC Region** | 1 |
| **County** | Suffolk |
| **Municipality** | Greenport |
| **Directions to Site** | Site is accessed from the end of Fourth St. |
| **Parking Location** | Street Parking available |
| **Adjacent Landowners** | Private homeowners; Greenport Oyster Co. |
| **Comments** | |
| **Last Updated** | 7/20/2022 |

## *Protocol 2 Monitoring Feature Characteristics and Dimensions*

The Phase II monitoring data collection identified six features. Feature types monitored included nature-based features, natural features and hard structural features. Feature components monitored included beach/beach berm, vegetated uplands, tidal wetlands/salt marsh, shoals, bluff, and revetment (rip rap). Across the six monitoring features, indicators of four performance parameters were observed. It is important to note that the site owner implemented a living shoreline restoration project at this site. It

was unclear what were natural existing wetlands and planted wetlands. Therefore, the marsh was mapped as one component and classified as a natural feature.

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Hard Structural | Revetment (Rip Rap) | 698 | Structural Integrity<br>Habitat Connectivity<br>Biological Health & Biodiversity |
| Natural Feature | Bluff[1] | 1,225 | Habitat Connectivity<br>Shoreline & Topographic Change |
| Natural Feature | Vegetated Upland | 17,204 | Habitat Connectivity<br>Biological Health & Biodiversity |
| Natural Feature/Nature -Based Feature | Tidal Wetlands/Salt Marsh with Stone Toe | 5,984 | Habitat Connectivity<br>Biological Health & Biodiversity |
| Natural Feature | Beach/Beach Berm | 16,104 | Habitat Connectivity<br>Biological Health & Biodiversity |
| Natural Feature | Shoals | 18,672 | Habitat Connectivity<br>Biological Health & Biodiversity |

### *Protocol 3 Establishing a Monitoring Scheme*

Five transects with four assessment points per transect were established during the Phase I monitoring. The location of these transects and points were sufficient to collect representative data for all of the site's monitoring features; therefore, the same transects and points that were used in the Phase I monitoring were used in the Phase II monitoring.

| Transects | Monitoring Points |
|---|---|
| 5 | 20 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along five transects.

The water was relatively calm during the monitoring visit. Wave period was approximately 2 seconds, with a wave height of less than one inch.

### *Protocol 5 Erosion and Structural Stability*

One erosion area was identified in the bluff feature component on the north end of the monitoring site. The bluff component is eroding due to wind and waves.

### *Protocol 6 Ecological Monitoring*

Substrate, vegetation, and sessile organism data were collected for monitoring points along all transects.

[1] The bluff consisted of a small but steep sloped area of erosion.

### *Protocol 7 Monitoring Feature Supporting Information*

The living shoreline project plan for Widow's Hole and the associated NYSDEC permit was provided by the site owner. This information is useful in understanding what changes have been implemented at the site. Based on information from the site owner, additional maintenance to the existing living shoreline work (phase I) as well as new work (phase II) have been funded and are awaiting permits. Future monitoring at this site should include obtaining the latest update on site changes from the site owner.

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 16,104 square feet. The area of influence for this site is presented below.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

Potential coastal-related damages at this site were moderate. The area of influence contained 53 residential properties with a total value of $31.2 million, four vacant land properties with a total value of $330,000, three commercial properties with a total value of $960,000, and one land trust valued at $1.8 million. The total value of the vulnerable infrastructure was $34.3 million.

### *Protocol 10 Environmental Justice Index*

The site did not meet NYSERDA's interim criteria for a disadvantaged community. However, the local population exceeded state and national averages across six environmental justice indicators: the concentration of ozone, the percentage of households potentially exposed to lead paint, the low-income rate, the unemployment rate, the share of the population with less than a high school degree, and the percentage of the population over the age 64.

### *Protocol 11 Household Survey*

Invitations to participate in the online household survey were mailed to each of the 53 residential properties in the site's area of influence. Over the course of a few weeks, ten responses were submitted, bringing the response rate to 18.9%. Individuals tended to believe their site had beneficial socioeconomic and environmental effects on their neighborhood. A longer response period would have allowed for more responses to be received; a follow up postcard would further encourage responses.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: This site contains a restored shoreline (restored in 2019). The private site is technically closed to the public and no facilities (e.g., restrooms) are available. The site access is not physically restricted, and a few users were observed walking along the shoreline. There is no signage stating the site is closed or restricted.

Visitor Counts and Intercept Survey: Five visitors were observed during the 4-hour observation period on the June 23 monitoring visit, including two dog walkers, one swimmer, and two walkers. The field crew conducted two intercept surveys during that period.

### *Protocol 13 Costs of Repair and Maintenance*

The site manager provided interesting details about the industrial history of this site, as well as a link to a story map his team created about it, which includes a description of planned restoration activities (The Tale of Widow's Hole Preserve (arcgis.com)). He then identified costs pertaining to repair and restoration at the site over the last year. He noted that labor costs associated with gathering the permits necessary for upcoming restoration initiatives amounted to approximately $6,300. He also described $3,300 in labor and capital costs associated with using heavy machinery to clear debris from the site. He added that his organization, Peconic Land Trust, just received a $250,000 grant, so he anticipates more restoration in the future. He clarified that the Trust manages the site as a whole, and that future monitoring efforts would ideally consider the whole shoreline within their property area (the area of influence currently only captures part of it). He also said that there are ongoing regular monitoring activities being conducted by Cornell University at this site, which could be coordinated with additional monitoring efforts.

## Patchogue Shorefront Park Monitoring Results



*Photo 18: Patchogue Shorefront Park hard structural shoreline feature and parking area.*



*Photo 19: Patchogue Shorefront Park hard structural shoreline feature along the park shoreline.*



*Photo 20: Patchogue Shorefront Park outfall feature component.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

Patchogue Shorefront Park was an established monitoring site; therefore, the feasibility survey form was not completed.

| | |
|---|---|
| **Has the site owner or operator agreed to having the site included in the Shoreline Monitoring Program** | Yes |
| **Is the site located within New York State Coastal Area?** | Yes |
| **Is permission or notification required for each site visit?** | No |
| **Does the site access require specialized equipment?** | No |
| **Is the site within a one-mile walk of a parking area?** | Yes |
| **Does the site access require exceptional safety considerations?** | No |
| **Are there seasonal restrictions to access?** | No |
| **Are resources available for monitoring at this site for at least three years?** | Not yet determined |

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | PCSF |
| **Site Name** | Patchogue Shorefront Park |
| **Site Owner/Operator** | Village of Patchogue, NY |
| **Ownership Type** | Public |
| **Site Contact** | Executive Director, Village of Patchogue CDA |
| **Site Contact Phone** | Available in GIS data |
| **Site Contact Email** | Available in GIS data |
| **Permission Required for Access?** | No |
| **Access Considerations** | None |
| **Region** | Long Island |
| **NYSDEC Region** | 1 |
| **County** | Suffolk |
| **Municipality** | Patchogue |
| **Directions to Site** | Site is accessed from the end of Rider Ave. |
| **Parking Location** | There is park parking on the corner of Rider Ave. and Smith St. |
| **Adjacent Landowners** | Private homeowners; restaurant; Rider Avenue Park |
| **Comments** | |
| **Last Updated** | 7/20/2022 |

## *Protocol 2 Monitoring Feature Characteristics and Dimensions*

The Phase II monitoring data collection identified five features. These were the same as those identified in the Phase I Final Report. GIS data for these Phase I features were available in the Shoreline Monitoring GIS. Feature types monitored included natural features and hard structural features. Feature components monitored included beach/beach berm, vegetated uplands, tidal wetlands/salt marsh, bulkhead, and

hardened structure (concrete outfall). Across the five monitoring features, indicators of four performance parameters were observed.

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Hard Structural | Bulkhead | 1,576 | Hydraulic Alteration<br>Structural Integrity<br>Recreation and Cultural Use |
| Hard Structural | Concrete Outfall | 250 | |
| Natural Feature | Vegetated Upland | 79,090 | Recreation and Cultural Use |
| Natural Feature | Tidal Wetlands/Salt Marsh | 5,365 | Biological Health & Biodiversity |
| Natural Feature | Beach/Beach Berm | 3,349 | Biological Health & Biodiversity |

### *Protocol 3 Establishing a Monitoring Scheme*

Seven transects with three assessment points per transect were established during the Phase I monitoring. The location of these transects and points were sufficient to collect representative data for all of the site's monitoring features; therefore, the same transects and points that were used in the Phase I monitoring were used in the Phase II monitoring.

| Transects | Monitoring Points |
|---|---|
| 7 | 21 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along seven transects.

The water was relatively calm during the monitoring visit. Wave period was approximately 2 seconds, with a wave height of less than one inch.

### *Protocol 5 Erosion and Structural Stability*

Six structural issue points along the hardened structural feature (bulkhead) were identified during monitoring. Some sections of the bulkhead were in worse condition; however, the entire bulkhead is failing.

### *Protocol 6 Ecological Monitoring*

Substrate, vegetation, and sessile organism data were collected for monitoring points along all transects.

### *Protocol 7 Monitoring Feature Supporting Information*

No data was requested from the site owner/operator or others; existing site.

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 79,010 square feet. The area of influence for this site is presented below.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

Potential coastal-related damages at this site were high. The area of influence contained 1,139 residential properties with a total value of $340.9 million, 123 vacant land properties with a total value of $5.9 million, 102 commercial properties with a total value of $34 million, 15 recreational properties with a total value of $11.7 million, 21 community service properties with a total value of $157,000, one industrial property valued at $1.6 million, and one public service property valued at $3.2 million. The total value of the vulnerable infrastructure was $553.9 million.

### *Protocol 10 Environmental Justice Index*

The site did not meet NYSERDA's interim criteria for a disadvantaged community. However, the local population exceeded state and national averages across three environmental justice indicators: the concentration of ozone, the percentage of households potentially exposed to lead paint, and the unemployment rate.

### *Protocol 11 Household Survey*

Invitations to participate in the online household survey were mailed to each of the 1,139 residential properties in the site's area of influence. Over the course of a few weeks, 75 responses were submitted, bringing the response rate to 6.6%. In addition to the electronic responses, 3 individuals requested paper copies of the surveys. Our team created a version of the survey that could be sent via U.S. mail, and sent these out to anyone that requested them. Three surveys were mailed out and two of the surveys were returned completed. To include the paper surveys in the data, this response could be manually entered into the database. We recommend that a pdf of the hard copy be uploaded to the system. Manually adding the paper surveys to the ArcGIS Online solution is currently a NYSDOS task. Steps 2 and 3 in Section 1.13 in the ArcGIS Online User Guide provide instructions on accessing the data entry form for each site.

Results indicated that individuals tended to believe their site had beneficial socioeconomic and environmental effects on their neighborhood. A longer response period would have allowed for more responses to be received; a follow up postcard would further encourage responses.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: The park is approximately a quarter mile long and contains baseball fields, a playground, an outdoor stage, a walking trail, and open green space. The southern border of the park along the Great South Bay contains a bulkhead.

Site Observations: The park is approximately a quarter mile long and contains baseball fields, a playground, an outdoor stage, a walking trail, and open green space. The southern border of the park along the Great South Bay contains a bulkhead.

Visitor Counts and Intercept Survey: Sixty-nine visitors were observed during the 4-hour observation period on the July 6 monitoring visit, including walkers and numerous people on the playground. The field crew conducted three intercept surveys.

### *Protocol 13 Costs of Repair and Maintenance*

Protocol 13 was not implemented at this site because the site manager contact information was lacking (email returned). An appropriate point of contact has since been identified and has been updated in the monitoring site attributes. It is important to note that a living shoreline project is in the planning stages for this site.

## Sailors Haven, Fire Island Monitoring Results



*Photo 21: Sailors Haven natural shoreline feature.*



*Photo 23: Sailors Haven hard structural shoreline feature.*



*Photo 22: Sailors Haven natural shoreline feature.*

## *Protocol 1 Monitoring Site Establishment*

*Monitoring Site Feasibility*

Sailors Haven, Fire Island was monitored for the first time during the Phase II monitoring effort. The site was selected for monitoring based on several factors, including accessibility, shoreline characteristics, and the significance of the shoreline. The monitoring area is located just west of the Sailors Haven Marina and continues west along the bay side shoreline of Sunken Forest. The area immediately adjacent to the marina has been renourished in the past, but experiences considerable erosion caused, in part, by the hardened shoreline of the marina. The shoreline further west along Sunken Forest represents a more natural shoreline with less impact from the marina. This shoreline area is bordered on the north by a boardwalk that traverses through Sunken Forest.

| | |
|---|---|
| **Has the site owner or operator agreed to having the site included in the Shoreline Monitoring Program** | Yes |
| **Is the site located within New York State Coastal Area?** | Yes |
| **Is permission or notification required for each site visit?** | Yes |
| **Does the site access require specialized equipment?** | No |
| **Is the site within a one-mile walk of a parking area?** | No |
| **Does the site access require exceptional safety considerations?** | No |
| **Are there seasonal restrictions to access?** | Yes |
| **Are resources available for monitoring at this site for at least three years?** | Not yet determined |

*Monitoring Site Attributes*

| | |
|---|---|
| **Site ID** | FISF |
| **Site Name** | Sailors Haven, Fire Island |
| **Site Owner/Operator** | Fire Island National Seashore |
| **Ownership Type** | Public |
| **Site Contact** | Natural Resources Chief |
| **Site Contact Phone** | Available in GIS data |
| **Site Contact Email** | Available in GIS data |
| **Permission Required for Access?** | No permission is needed for access, however, a NPS Research Permit is needed to conduct field work. |
| **Access Considerations** | Site is only accessible by seasonal ferry or private boat |
| **Region** | Long Island |
| **NYSDEC Region** | 1 |
| **County** | Suffolk |
| **Municipality** | Fire Island |
| **Directions to Site** | Site is accessed from Sayville Ferries (Sayville, NY) or private boat |
| **Parking Location** | There is parking at the Sayville Ferry Terminal |
| **Adjacent Landowners** | National Seashore undeveloped preserve |
| **Comments** | |
| **Last Updated** | 7/12/2022 |

### *Protocol 2 Monitoring Feature Characteristics and Dimensions*

The Phase II monitoring data collection identified six features. Feature types monitored included natural features and hard structural features. Feature components monitored included beach/beach berm, vegetated uplands, tidal wetlands/salt marsh, bulkhead, bluff, and shoals. Across the six monitoring features, indicators of five performance parameters were observed.

| Monitoring Feature Type | Monitoring Feature Component | Square Feet | Performance Parameters |
|---|---|---|---|
| Hard Structural | Bulkhead | 106 | Hydraulic Alteration<br>Structural Integrity<br>Biological Health & Biodiversity |
| Natural Feature | Shoals | 11,313 | Habitat Connectivity<br>Biological Health & Biodiversity<br>Recreation & Cultural Use |
| Natural Feature | Vegetated Upland | 5,914 | Habitat Connectivity<br>Biological Health & Biodiversity<br>Recreation & Cultural Use |
| Natural Feature | Tidal Wetlands/Salt Marsh | 986 | Habitat Connectivity<br>Biological Health & Biodiversity |
| Natural Feature | Bluff | 1,498 | Habitat Connectivity<br>Shoreline & Topographic Change |
| Natural Feature | Beach/Beach Berm | 6,279 | Habitat Connectivity<br>Biological Health & Biodiversity |

### *Protocol 3 Establishing a Monitoring Scheme*

Seven transects with three assessment points per transect were established during the Phase II monitoring. This site was not monitored during the Phase I effort, so the transects and monitoring points were developed during Phase II.

| Transects | Monitoring Points |
|---|---|
| 7 | 21 |

### *Protocol 4 Monitoring Feature Elevation and Water Characteristics*

Elevation and water characteristics were collected approximately every five feet along seven transects.

The water was relatively calm during the monitoring visit. Wave period was approximately 1 second, with a wave height of less than one inch.

### *Protocol 5 Erosion and Structural Stability*

Two erosion points within the Natural Feature Beach/Beach Berm were identified during monitoring. The bluff is eroding due to wind and waves. The area behind the bulkhead is eroding mainly due to focused

wave energy caused by the bulkhead. At the terminus of the bulkhead, there is a distinct scour point that is approximately 1 foot in depth.

### *Protocol 6 Ecological Monitoring*

Substrate, vegetation, and sessile organism data were collected for monitoring points along all transects.

### *Protocol 7 Monitoring Feature Supporting Information*

No data was requested from the site owner/operator or others.



*Photo 24: Contributor completing Protocol 6 Ecological Monitoring.*

### *Protocol 8 Defining the Area of Influence*

The area of influence for this site spanned 11,313 square feet. The area of influence for this site is presented below. We note that because this site is on a narrow barrier island, the directions for defining this site was not able to capture the communities that would likely be affected by erosion at this site, which are located east and west of it along the island. We have incorporated a note about this issue into the *Phase II Shoreline Monitoring Framework Instructions and Protocols*, and suggest that some site-by-site adjustments may need to be made in response to conversations with site managers that relate to peculiarities of individual sites.

The shape of an existing area of influence for a site can be adjusted so long as Protocols 9 and 11 have yet to be completed. If these protocols have already been completed for a site, then the existing area of influence should be marked as historical, and a new area of influence should be defined for the site. The ArcGIS Online solution was built with the assumption that areas of influence would be reassessed annually. Therefore, a site should not have more than one area of influence per year. In most cases, the first area of influence defined for a site will be the one used year after year. Defining a new area of influence for a site should be considered a rare requirement.




### *Protocol 9 Potential Damages to Commercial Properties, Households, and Public Infrastructure*

The value of potential site-related damages to residential, commercial, or industrial properties at this site were identified as being low because none of these property types were identified within the site's area of influence.

### *Protocol 10 Environmental Justice Index*

The site did meet NYSERDA's interim criteria for a disadvantaged community. The local population exceeded state and national averages across six environmental justice indicators: the concentration of ozone, the demographic index, the share of the population identifying as people of color, the unemployment rate, the share of the population with less than a high school degree, and the percentage of the population over the age 64.

### *Protocol 11 Household Survey*

Protocol 11 was not implemented at this site because there were no residential properties in the area of influence.

### *Protocol 12 Shoreline Visitor Counts and Intercept Survey*

Site Observations: The park includes natural shorelines (bayside and oceanside), a 45-slip public marina, boardwalk to the Atlantic Ocean, a 1.5 mile boardwalk trail through the Sunken Forest preserve, public restrooms, a snack bar, picnic tables, grills, gift shop, maintenance facilities, and National Park Service Visitor Center.

Visitor Counts and Intercept Survey: Forty-two visitors were observed during the 4-hour observation period on the June 13 monitoring visit. One hundred and fourteen visitors were observed during the 4-hour observation period on the June 17 monitoring visit. The visitor count survey was conducted in the area where transects were located, and not for the park as a whole. Visitors included hikers/walkers, joggers, bicyclists, and school groups.

BEC was unable to complete the intercept survey (Protocol 12) at Sailors Haven because it was prohibited by Fire Island National Seashore without approval from the National Park Service, which could take up to a year to obtain. Instead, BEC's team intended to conduct the intercept surveys in Sayville, NY at the Sayville Ferry Terminal. The Sayville Ferry Service was contacted and was willing to allow the surveys to take place but had some reservations. BEC was required to notify them in advance of the survey but was not able to get in contact with them at that time.

### *Protocol 13 Costs of Repair and Maintenance*

The site manager for this site described ongoing shoreline erosion that is occurring within the Sailor's Haven Tract at the Sunken Forest location within Fire Island National Seashore. He also described ongoing issues with tidal flooding that results in ponding on the sandy roads that pass by the site. He stated that the Park is in the process of applying for funds for nature-based solutions that could assist the NPS in slowing erosion at the site and estimated that funding could range from $300,000 to $1 million depending on the type of restoration selected. He expressed a need for data to be collected for this area that would support understanding the baseline sediment conditions, particularly bayside sediment transport.