**PROJECT BACKGROUND**

Hunts Point Landing in the Bronx is one of six locations included in a study called *What Made Shorelines Resilient: A Forensic Analysis of Shoreline Structures on the Hudson River Following Three Historic Storms*. The sites had either traditional or non-traditional nature-based shoreline stabilization techniques and were impacted by Tropical Storms Irene and Lee in 2011 and Post-Tropical Storm Sandy in 2012. Separate case studies describing each site and the impact of the three storms have been prepared. Two additional reports describe the methodology used and the common project performance factors. All eight documents can be found at [http://www.hrnerr.org/shorelinesforensicanalysis](http://www.hrnerr.org/shorelinesforensicanalysis). Each Forensic Analysis included the review of historic photographs and design drawings, interviews with project managers and designers, field data collection, and modeling of the hydrodynamic conditions during each of the three storms. Collectively, this information was used to create a holistic picture of each site, from which the critical project performance factors could be determined. Impacts from debris, undersized stones, improper slopes, as well as monitoring and maintenance protocols, adaptive management, and maturity of vegetation were all considered. The Hunts Landing Point project was only in place for one of the three historic storms and experienced a moderate amount of damage. Much of the immature vegetation and some of the upland ornamental features were damaged during the storm, but most of the structural features made it through with little to no damage.

**SITE BACKGROUND**

The Hunts Point Landing site’s industrial past can be traced to the mid-20th century when there was a mass migration of power plants, wastewater treatment plants, and food storage buildings to the outer boroughs of New York City. By the 21st century, the entire Hunts Point waterfront was industrialized, and very little green, open space was left available for recreational use. The Hunts Point Landing site is located along the shoreline of the East River at the dead end of Farragut Street (Figure 1). Prior to its restoration, the street end, consisting of degraded pavement and discarded industrial waste, served as one of the only access points to the water and

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**Figure 1 – Historic photograph of Hunts Point (1952).**
was a popular fishing location. The South Bronx Greenway championed the revitalization to create a park space that would allow community members to access the water and experience a natural East River shoreline. Construction of the Hunts Point Landing project was completed in August 2012, and the park was opened to the public with an official ribbon-cutting ceremony on September 24, 2012, just one month prior to Superstorm Sandy. The project contains a variety of elements designed to restore habitat, including an intertidal marsh, a brackish tidal pool, and oyster balls that both dissipate wave energy and reclaim shellfish habitat. A recreational pier and kayak launch were also included in the project. Due to the variety of ecological enhancements incorporated into the project, Hunts Point Landing was selected to be a part of the Hudson River Sustainable Shorelines Project demonstration project network (https://www.hrnerr.org/hudson-river-sustainable-shorelines/demonstration-site-network/).

SHORELINE STABILIZATION HISTORY

To create a history of the shoreline evolution at Hunts Point Landing, we used Google Earth for aerial photographs and www.historicaerials.com for both aerial photographs and topographic maps. A time-lapse video of the changes was created and is archived at https://www.hrnerr.org/hudson-river-sustainable-shorelines/shorelines-engineering/. The Hunts Point Landing site lies between two industrial shorelines that have been stabilized with traditional engineering structures. Immediately to the west of the project site, the shoreline is stabilized with a bulkhead, and to the east by a combination of rock revetment and bulkhead. Prior to the completion of the restoration work, the Hunts Point Landing site was stabilized by a rock/rubble revetment. Figure 2 shows the site prior to restoration (left), one month prior to its opening to the public (center), and immediately after Superstorm Sandy (right). In order to create the salt marsh and pond along the river, the original rock revetment and an extensive amount of material from the base of the street were removed.

![Figure 2 - From left to right: before construction (2010), at completion (August 2012), and after Sandy (November 2012).](https://www.hrnerr.org/hudson-river-sustainable-shorelines/shorelines-engineering/)

DESIGN AND ECOLOGICAL ALTERATIONS

The goals of the design were to increase habitat and recreational access. The shoreline was designed at a 7% slope to allow for tidal salt marsh species to migrate in the event of a variety of sea level rise scenarios. The gentle slope and native vegetation included in the design allowed for recreational water access at any tidal stage. The plantings included saltmarsh cordgrass (Spartina alterniflora) in the low marsh; saltmeadow cordgrass (Spartina patens) and seaside saltgrass (Distichlis spicata) in the high marsh; and saltwater bulrush (Schoenoplectus robustus) in the brackish pond (Figure 3). The selected plants helped recreate the habitat of the native Hunts Point shoreline. Figure 4 shows a plan view of the structural and ecological components of the intertidal portion of the constructed park. Reef balls were placed in front of the stone wall to reclaim shellfish habitat and protect the marsh.
plantings. Additional boulders were placed higher in the marsh area to provide protection during extreme weather events when elevated water levels and waves might impact the vegetation growing at higher elevations. The restored ponds also serve a secondary purpose as stormwater management controls to limit stormwater discharge into the river. Long-term maintenance at the site is provided by the NYC Economic Development Corporation and includes debris removal from the natural areas as well as routine maintenance of the kayak launch and fishing pier. The images in Figure 5 show the revetment and reef ball toe (left), the high marsh plantings tucked behind the stone wall and revetment (center), and the salt pond (right).

Figure 3 – Cross-section presenting engineering design (HDR, Inc.).

Figure 4 – Overview of Hunts Point Landing’s intertidal design (HDR, Inc.).
COLLECTION OF ENGINEERING DATA

Multiple sources of data were collected and analyzed to understand the behavior of the shoreline at Hunts Point Landing. The conclusions of the Forensic Analysis were based on the following sources/types of information:

- Historic Aerial Photographs
- Topographic Maps
- Photographs (construction, pre- and post-storm photographs of the site)
- Initial Site Visit
- Discussions with Property Owner/Design Engineer
- Engineering Plans
- Final Site Visit (including topographic/bathymetric survey)
- Hindcast of Storm Conditions (Wave and Water Level Climatology)

CHARACTERIZATION OF SITE CONDITIONS

Hunts Point Landing is located in a special flood hazard area, as defined by FEMA. The shoreline is located in a VE Zone with a base flood elevation (BFE) of 16 ft NAVD 88, while the upland portion of the site lies within an AE zone with a BFE of 15 ft NAVD88 (panel 3604970111G, effective December 5, 2013). The VE zone designation signifies the expectation that the shoreline area surrounding Hunts Point Landing will be impacted by waves greater than 3 ft during the 1% annual chance of occurrence storm, while the BFE represents the water elevation expected during that storm. The BFE and 3 ft wave threshold represent useful baselines with which to compare both the typical and storm conditions at the site.

The Sustainable Shorelines physical forces climatology dataset was used to characterize the conditions during a typical year. The climatology is based on a one-year numerical simulation of conditions within the Hudson and was generated using an ultra-high resolution version of the NYHOPS numerical model. The climatology was developed based on the conditions in 2010 and included one significant Nor’easter. Based on the modeling results, the water level, which was exceeded only 5% of the time (WL95%) in 2010, was 4.76 ft NAVD88, while the wave height exceeded only 5% of the time (H95%) was 0.75 ft. The median wave height (Hmed) for the 2010 hindcast was only 0.22 ft. No ice or wake data were available for the Hunts Point Landing site. However, significant wakes are expected due to the proximity of the navigation

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channel and the number and size of the vessels transiting this section of the East River. An analysis of the fetches at the site confirms that the site can be considered a moderate-energy site with respect to wind waves. The relevant fetches are shown in Figure 6, where the average and maximum fetches were found to be 7,814 ft (1.48 mi) and 12,443 ft (2.32 mi), respectively. The 2.32-mile fetch to the east of the site is an indication that the V-zone designation is likely appropriate for the site.

Topographic and bathymetric surveys of the site were conducted to obtain detailed information about upland elevations, nearshore slopes, and offshore depths. The survey (Figure 7) shows that the elevation offshore of the project site drops immediately to -25 ft (NAVD 88). Once offshore, the elevation remains fairly flat, gradually reaching a maximum depth of approximately -35 ft (NAVD88) in the channel. Further offshore the elevation increases to -20 ft. The elevation of the intertidal zone created within the park ranges from 0 to -5 ft.

![Figure 6 – Fetch analysis at Hunts Point Landing.](image1)

![Figure 6 – Topographic and bathymetric survey results.](image2)

**HINDCAST STORM CONDITIONS**

Conditions during the three historic storms were hindcast using the NYHOPS numerical model. The hindcast water levels (Figure 9) during both Irene and Sandy significantly exceeded the 95th percentile based on the 2010 climatology. The hindcast water level during Sandy matches a nearby high-water mark observation collected by the USGS, which registered 10.3 ft NAVD88. The storm surge extent mapped by FEMA (Figure 8) confirms that the majority of the site was submerged during Superstorm Sandy. The wave heights hindcast (Figure 10) during both Irene and Sandy significantly exceeded both the 95th percentile and maximum wave heights from the 2010 climatology. While these results indicate the relative significance of these storms, in an absolute sense the wave heights are not indicative of high-
energy conditions, which typically range from 4 to 6 ft in height. The designed structural reinforcement protected the site from having severe erosion and damages.

**Figure 9** – Water levels (ft NAVD 88) at Hunts Point Landing during Irene and Sandy.

**Figure 10** – Wave heights at Hunts Point Landing during Irene and Sandy.

**DOCUMENTED PERFORMANCE**

The Hunts Point Landing project was officially opened to the public only one month prior to Superstorm Sandy. Although the site was designed with measures to protect against extreme events, significant damage was experienced to parts of the project during the storm. A significant portion of the marsh was damaged due to floating debris (Figure 11), and the fencing along the fishing pier was torn. A large amount of debris filled the kayak launch (Figure 12), and a water fountain was ripped from its fittings. Many of the larger structural elements remained in place, which limited the amount of shoreline erosion. More recent site surveys indicate that the marsh is recovering, although it is unclear whether this is due to natural processes or human interventions.
Hindcasting of the storm conditions during Sandy revealed that the entire intertidal zone was submerged and that the Hunts Point Landing shoreline was exposed to waves as high as 3 ft. While the majority of the structural elements of the project survived with little to no damage, much of the vegetation and some of the decorative/ancillary project elements were destroyed. While the extreme wave heights are suspected as one of the causes, the primary damage mechanism is believed to be debris impact. The amount and type of debris (trash, large pieces of wood, wrack, and smaller stones) found at the site after the storm indicates that the storm waves carried a large amount of debris capable of ripping out vegetation and scouring unprotected slopes. While many of the structural features appear adequately sized and the slopes are reasonable for wetland establishment, the characteristics of the debris documented in post-storm photographs and the damage sustained by ancillary structures suggest that it is unlikely that even mature vegetation would have survived. Currently, debris impact is not something that is typically accounted for in project design.