



# Mussels, Marshes and Submerged Grasses: Hybrid Living Shoreline Concepts to Remediate Urban Tidal Freshwater Waterfronts

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## Abstract

In recent years there has been upswing of interest and activity to restore urban waterfronts in Philadelphia, Wilmington, Chester and Camden, which are situated within the nation's largest freshwater tidal estuary. The objective of this project was to prepare preliminary conceptual designs for urban waterfront living shorelines at the Harrison Avenue Landfill site in North Camden and the Phoenix Park remediation site in South Camden, New Jersey. The restoration projects were designed mainly to maximize ecosystem services along the littoral zone, such as water quality enhancement.

A new "hybrid mosaic" living shoreline approach is proposed for these freshwater tidal sites, which would seek to restore three synergistic habitats: tidal freshwater marsh, submerged aquatic vegetation, and freshwater mussel beds. All three habitats help stabilize substrates, sustain water quality, and enhance fish and wildlife, while also buffering against waves.

Preliminary site reconnaissance suggests that key biota needed for these habitats exist within the urban corridor, and that the bathymetry and substrates at the two potential project sites may be amendable for living shoreline construction and success. More studies will be needed to confirm these observations and to render final project designs. If successfully implemented, these redevelopment projects are expected to impart water quality benefits to the urbanized system while also improving coastal resilience, aesthetics, and quality of life for urban communities.

## Introduction

Living shorelines consist of an array of new restoration tactics designed to stabilize coastal erosion and help adapt to sea level rise while also enhancing ecology, such as fish and wildlife habitat and water quality. Beginning in 2007, the Partnership for the Delaware Estuary and the Haskins Shellfish Research Laboratory of Rutgers University crafted and implemented the Delaware Estuary Living Shoreline Initiative (DELSI), consisting of planning, design, implementation and scientific monitoring of new types of living shoreline projects that are suitable for our region. Until recently, DELSI efforts have been focused in tidal salt marsh habitats surrounding Delaware Bay.

A core principle of DELSI is that the ecological structure and functions at a site need to be sustained or enhanced, while addressing other goals such as erosion control, flood mitigation, contaminant stabilization, etc. A first step in studying the feasibility of a living shoreline approach at a new site is to determine the baseline ecological conditions and assess whether suitable biotic "raw material" exists in the target area. Living shorelines should be designed to take advantage of the natural resilience properties of dominant fauna and flora and their interactions.

This project examined which flora, fauna and habitat types exist within the urbanized Delaware River waterfront that might be targeted for use in living shoreline projects. Initial concepts have been suggested for two potential sites in Camden, New Jersey: Harrison Avenue Landfill and Phoenix Park.

**Figure 2.** RTK-GPS surveys of intertidal and shallow subtidal elevations.



Photo Credit: Danielle Kreeger

**Figure 3.** PDE staff record the locations and sizes of native species of freshwater mussels in 2013.



Photo Credit: Roger Thomas

**Figure 4.** Frank McLaughlin holds examples of mussels found at the Harrison site, including scarce species, in April 2013.



Photo Credit: Danielle Kreeger

## Harrison Landfill Site



Photo Credit: Frank McLaughlin

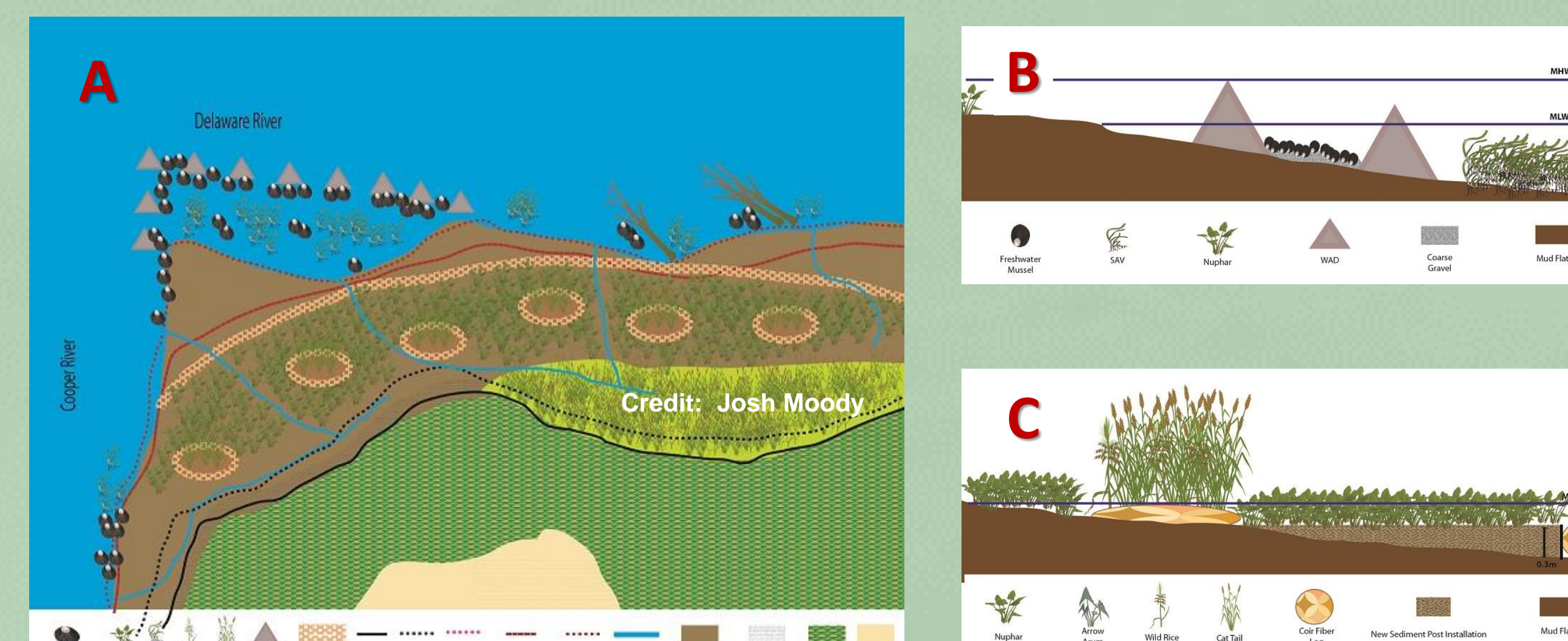
**Figure 5.** The upland shoreline edge is high gradient with exposed landfill materials including large woody debris, concrete slabs, bricks, and stones.



Photo Credit: Frank McLaughlin

**Figure 6.** The intertidal mud flat is dominated by one species of low marsh succulents, *Nuphar sp.*

## Hybrid Mosaic Concept



**Figure 7.** Conceptual diagrams for hybrid living shoreline at Harrison Landfill site in North Camden, New Jersey. Fig. 7A depicts top view of a mixture of upland slope regrading, high marsh creation, low marsh expansion/stabilization, and subaqueous bottom stabilization for mussels and SAV. Figs. 7B and C depict side view of subtidal and intertidal amendments, respectively. Several different concepts have been proposed as options for this site.

## Phoenix Park Site



**Figure 8.** Conceptual diagram for a hybrid living shoreline at the Phoenix Park site in South Camden, New Jersey. The project would expand intertidal high and low marsh and encourage subtidal communities of SAV and freshwater mussels.

## Methods

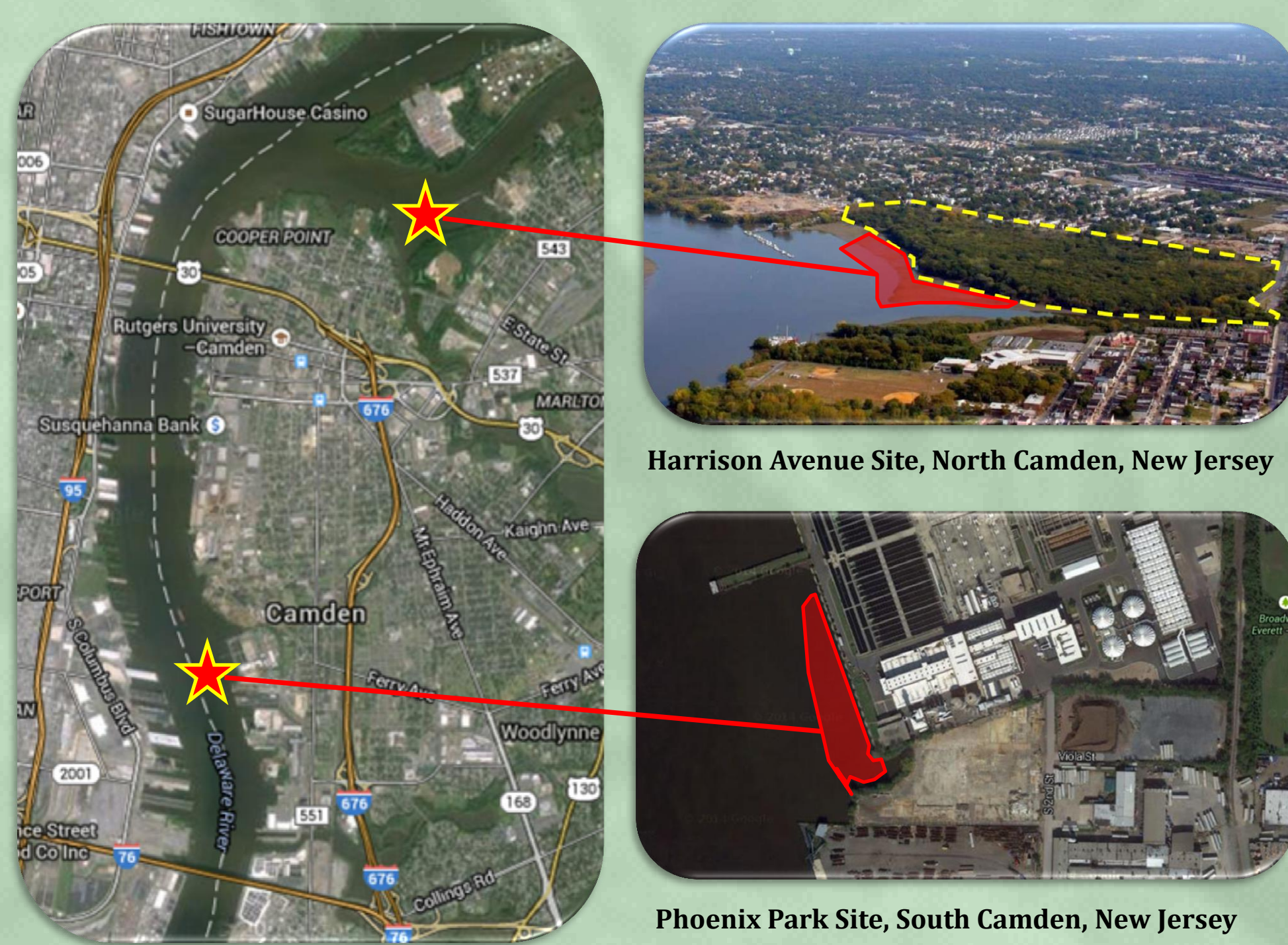
Field reconnaissance at the Harrison Landfill site during 2012-2013 consisted of surveys using a RTK-GPS for mapping of intertidal elevation contours, intertidal vascular plants, and substrate types. Shallow subtidal communities of freshwater mussels and submerged aquatic vegetation were surveyed at the Harrison site using semi-quantitative snorkeling methods in 2013 (Figures 2-4), building on earlier qualitative surveys in the vicinity. Field surveys at the Phoenix Park site were limited to visual observations of elevation gradients, substrates and dominant biota at mean low water.

Elevation data from RTK surveyed areas were used to generate topographic maps. Substrate and biotic data were interpreted using best scientific judgment to devise project concepts designed to diversify, expand and stabilize targeted habitat types. For more details, please see Partnership for the Delaware Estuary Report Number 14-05, available at: <http://delawareestuary.org/science/reports>.

## Conclusions and Next Steps

- Preliminary results suggest that a "hybrid mosaic" living shoreline design is possible for both Camden project sites.
- A mix of SAV, low marsh and high marsh would add complexity for fish and wildlife, augment rare wetland types, and strengthen coastal resilience.
- Beds of freshwater mussels would likely boost particle filtration services by millions of gallons per day, and help protect and restore rare species.
- When paired with adjacent restoration of the upland, these projects would enhance the quality of life for urban communities.
- Additional studies are planned to improve living shoreline project designs and to estimate net benefits for water quality of urban waterfront projects.

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**Figure 1.** Google map of the tidal Delaware River showing the locations for two prospective living shoreline sites.