imagine the wall

Preparing for Change

INVESTING IN OUR CITY

As ecologists, landscape architects, architects, and engineers with applied experience with shoreline protection projects around the world, we offer this document as a response to the US Army Corps of Engineers' recent Charleston Peninsula Coastal Flood Risk Management Study. In considering our comments on the Study, we realized that some of concepts that should be central to the conversation might be unfamiliar to some of our fellow citizens. Therefore, we decided to build on the study's solid technical foundation for protecting Charleston from storm surge by creating a kit-of-parts with visual support to encourage conversation around durable, city-strengthening designs.

Our firms are part of a national movement towards nature-based designs, which combine hard engineering and traditional materials like concrete and steel with ecological forms such as marshes and oyster reefs. The combination offers redundancy of combined approaches, reduced maintenance costs, and living systems that can respond dynamically to future conditions. Nature-based designs can also offer co-benefits that enhance the community and the surrounding environment.

Charleston Peninsula Coastal Flood Risk Management Study

2020 US ARMY CORPS OF ENGINEERS

Two years ago, the US Army Corps of Engineers Charleston District embarked on an effort to better understand Charleston's storm surge risk and how perimeter protection could mitigate it. The draft report and environmental assessment were released in April 2020. The plan includes three features: a perimeter storm surge wall, an off-shore wave attenuator, and nonstructural flood proofing. Designs, exact layouts and other specific plan details are not finalized. It is summarized across multiple platforms. http://www.sac.usace.army.mil/charlestonpeninsulastudy

Height of USACE Proposed Flood Wall
Image Credit: Biohabitats

USACE Proposed Flood Wall alignment
Image Credit: DesignWorks

imagine the wall

DESIGNING A DREAM CITY IS EASY; REBUILDING A LIVING ONE TAKES IMAGINATION.

-JANE JACOBS

Imagine a wall that is more than a wall. Imagine an integrated, interlocking and connected system of nature-based solutions interwoven throughout the urban fabric that is quintessential Charleston. Now imagine that this system has all of the built-in engineering required to protect Charleston from storm surges, adapt to changing sea levels, and reduce flooding from stormwater.

Core Principles

Viewing Water Holistically

Water behaves as water, whether it arrives as standard precipitation, rain bombs, tidal flow, rising seas or storm surge. Protecting what we value requires seeing how each dynamic interacts with our built and natural forms, in tandem or in concert.

Grounded in Charleston

The protection we choose should respond to this place – the Lowcountry - and be woven into the urban fabric that speaks to Charleston's unique character.

Aligned with Dutch Dialogues

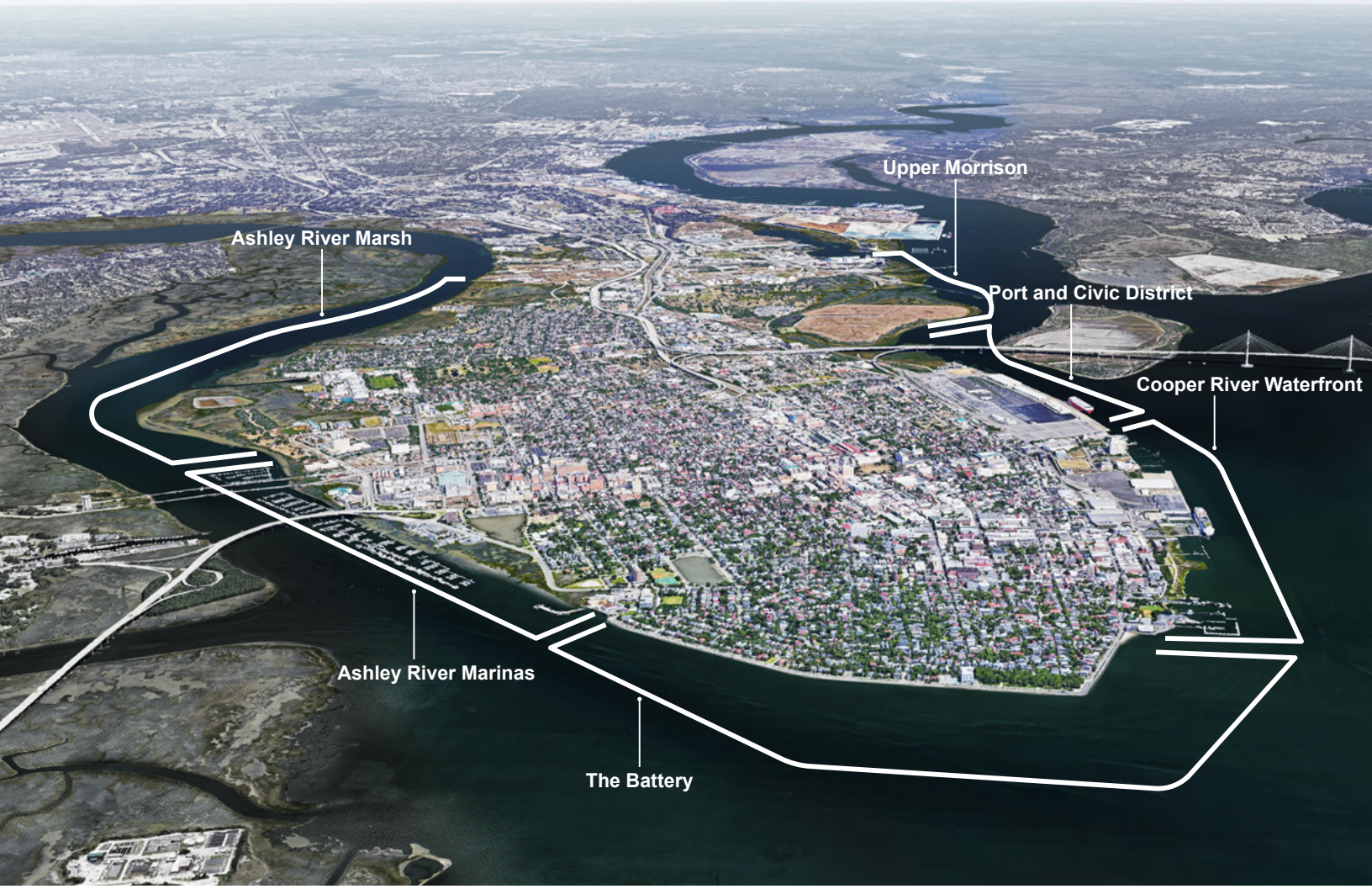
The wisdom shared throughout the Dutch Dialogues process, and the common vocabulary we developed through our participation, should serve as the foundation for major infrastructure decisions moving forward.

Presenting Benefits in Layers

Water is part of the context of this place and what has attracted people here for thousands of years. Our solutions offer benefits beyond storm surge protection, such as increased recreation and fishing opportunities, improved transportation access, improved flood control and water quality, enhanced aesthetics, and even carbon sequestration.

Equitable in Approach

A small group of designers working over a few weeks cannot create an equitable plan, nor do equitable outcomes result from financial cost-benefit analyses based on property values. Recognizing the limits of the thought experiment presented on these pages, we hope to spark conversation that brings us closer to protection outcomes that are a result of genuine community-based design.



Bespoke and Partitioned

Bespoke is a term describing designs that are tailored to their place. Rather than applying cookie-cutter designs that have little relationship to place, our approach responds to the unique ontogeny of Charleston's shoreline and coastal forms as they exist today. Each natural element has been combined with conventional structural approaches to protect Charleston from climate change.

The transitions between our built city and its natural context range throughout the USACE Study Area. Whether acres of marsh or concrete seawalls, these transitions help determine which set of strategies are best suited for different sections of the shoreline. Conceiving of the study area in these typological partitions also underscores its potential for a strategically phased approach over time. Instead of rushing to build a wall, Charleston could implement the strategies recommended in this vision over time, combined with other City projects and funded through a variety of sources.

Access and Use

Unlike walled cities, Charleston has traditionally been a place where water access is part of the daily life of its residents. Whether fishing, biking along the shore, enjoying wildlife in city parks, or launching kayaks, the recreational uses of Charleston's shoreline are part of how our City sees the sea.

Bikes at the Battery
Image Credit: Ivan P. Z. Torres

Dragonboat Fundraiser
Image Credit: Brett Lemmo Post & Courier


COOPER RIVER
ASHLEY RIVER
FOUR MILE / HIBERNIAN
LAUREL ISLAND
SILVER HILL / MAGNOLIA
MONT
MAGNOLIA
EAST CENTRAL
EAST SIDE
NORTH CENTRAL
WESTSIDE
WAGENER TERRACE
HAMPTON PARK TERRACE
HAMPTON PARK
THE CITADEL
BRITTLEBA PARK
KEY
PUMP STATION
WATER CONTROL STRUCTURE
PORT CANAL GREENWAY
BATTERY WALL
ELEVATED ROAD
RAISED PARK PROMENADE
HORIZONTAL LEVEE
LIVING SHORELINE
LIVING BREAKWATER ARCHIPELAGO
STORMWATER CORRIDORS
MARSH - Existing
PARK SPACE - Existing and Planned
GREEN ROOFS - Potential

Perimeter Strategies

This plan identifies an array of nature-based strategies embedded within engineered structures to provide perimeter storm surge protection and sea level rise adaptation, along with interior flood control management. A description of each strategy is found on proceeding pages.

Image credit: DesignWorks

Perimeter Strategies

Horizontal Levee

A hardened structure (levee) with an elongated (or 'horizontal') slope toward the water. The horizontal levee both absorbs wave energy and provides room for tidal wetlands to migrate upslope as seas rise. The top would be set at elevation 12' NAVD88. Roadways, greenways, parks, nature reserves, and stormwater management can be integrated into its design.

Water Control Structures

Features that regulate the storage and discharge of stormwater from behind the perimeter protection. These structures may consist of pumps, overflow berms, and tide gates to prohibit storm surge from entering at locations such as railroad crossings and navigable channels.

Elevating Lockwood and Morrison Drives

Both Lockwood Drive and Morrison Drive are vital transportation links to the Medical District, the port, and downtown. Raising these roads to serve both as a perimeter storm surge barrier and reliable links to vital services will enhance the resiliency of the peninsula.

Living Shorelines

A range of shoreline stabilization techniques including tidal wetlands, oyster reefs, and living seawalls engineered to reduce erosion, dampen wave energy, and provide additional resiliency to the coastline. In many areas around the peninsula, they can supplement existing structures to enhance aquatic habitat.

Battery Wall

The Low Battery Wall can be raised to 12' while keeping with the historical context of the neighborhood. In accordance with the USACE Study, the High Battery Wall may have to be completely refurbished and reinforced 12' to withstand the surge/wave forces.

Living Breakwater Archipelago

Provides a multi-faceted nature-based approach to wave energy protection by incorporating habitat and recreational features into the engineered structure.

Raised Park Promenade

Charleston Waterfront Park, its proposed extension to the new cruise terminal, and the shoreline extending to the Aquarium can be artfully redesigned as perimeter protection. Features such as raised walkways, seating walls, planter boxes and public gathering spaces can achieve the 12'NAVD88 height needed for protection from storm surge and sea level rise.

Port Canal Greenway

Along E. Bay Street behind the port's Columbus Street Terminal, a wall cleverly combined with a canal and greenway provides pedestrian connection from downtown to the Cooper River bridge. The canal collects, filters and stores stormwater from the surrounding neighborhoods.

Water in the City

Stormwater Corridors

An array of 'green infrastructure' strategies can be applied throughout the City to collect, treat and manage stormwater. Daylighting and restoring historic creek beds and marshes, rain gardens, bio-swales, green roofs and urban canals are just some of the techniques that can be used to reduce flooding while living with water.

All forms of perimeter protection and the steep rise in nuisance flooding over recent years require Charleston to rethink how we manage water. Three of the Overall Recommendations from the Dutch Dialogues Charleston™ complement these strategies.

Developing a City-wide Water Plan should be a priority that advances alongside perimeter protection, so that walls or levees interact successfully with stormwater and natural creek systems.

Managing Water on Public Properties is an opportunity that must be folded into the planning for the placement of pumps.

Reducing Fill is a tactic that Charleston has thus far been unable to put into effect, largely because today's projects were approved before we felt today's urgency to reduce flood risk.

"Developing projects that combine natural and engineered systems to produce more value and a broader array of benefits is gaining increasing attention worldwide."

- USACE in Engineering with Nature: An Atlas

Gadsen Creek
Image Credit: CHS Waterkeeper


Horizontal Levee
Ashley River
Raised Lockwood Drive
with Living Shoreline
Enhanced Battery Wall


Horizontal Levee
Cooper River
Wando River
Drum Island
aised Morrison Drive
Port Canal Greenway
Raised Park and Promenade with Living Shoreline
Castle Pinckney
Living Breakwater Archipelago
Image credit: ONE

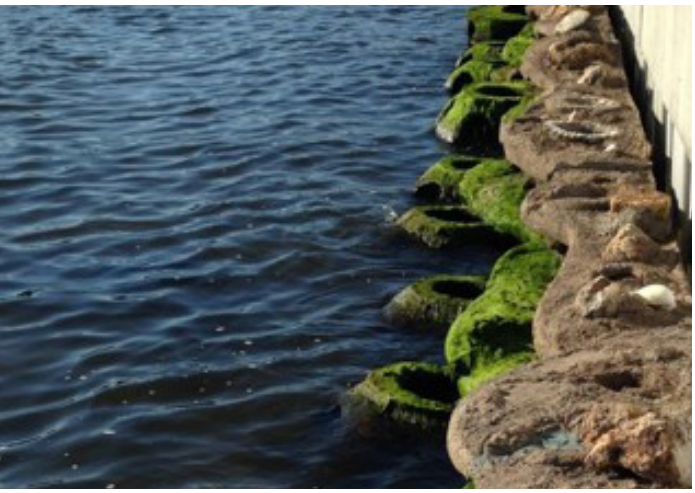


Image Credits: Top, Oyster Restoration Workgroup; Bottom left Reef Ball Foundation; Bottom right Biohabitats

Oyster reefs dampen wave energy while improving water quality; living bulkheads deliver storm surge protection while offering habitat for fish and other marine animals; tidal marshes buffer storm surges while providing refuge for crabs and shorebirds.

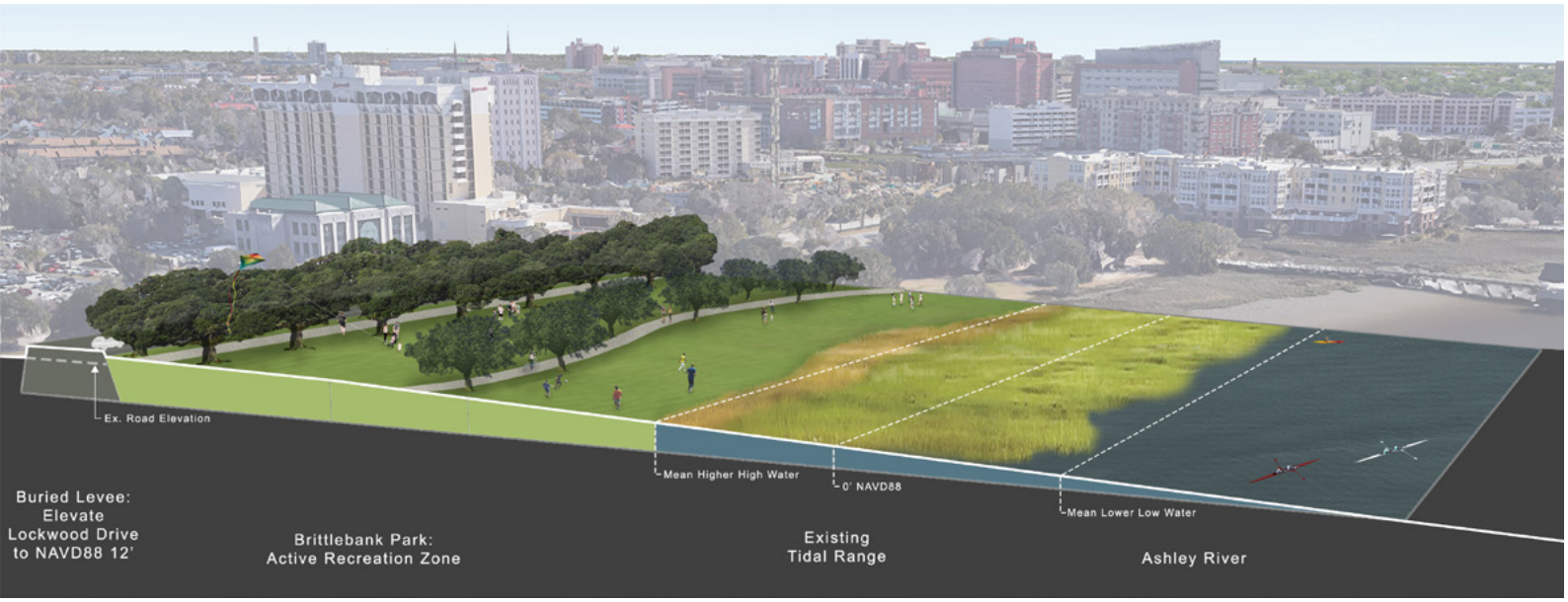
Living Shorelines

Where a traditional wall or bulkhead is chosen, it is possible to soften the interface between engineered and natural systems with a living shoreline.

For example, the promenade at Waterfront Park offers perimeter protection to an elevation almost matching the USACE recommendations. The saltwater marsh buttressing the southern end of the park is an existing living systems approach that could be bolstered to add protection from wave energy and enhance habitat.

Along the battery and where perimeter protection is created by elevating roadbeds, such as along Lockwood Drive, a living shoreline approach on the seaward side of the hard wall allows Charleston to retain its characteristic connectivity to the water.

Living shorelines are a suite of practices that can be arranged along a continuum from grey to green, and their efficacy cannot be accurately characterized by one simple statement. Neither living shorelines nor horizontal levees allow nature to take its course: they are engineered structures designed by humans to meet stated goals. What distinguishes both from conventionally engineered solutions is that they are multi-functional.



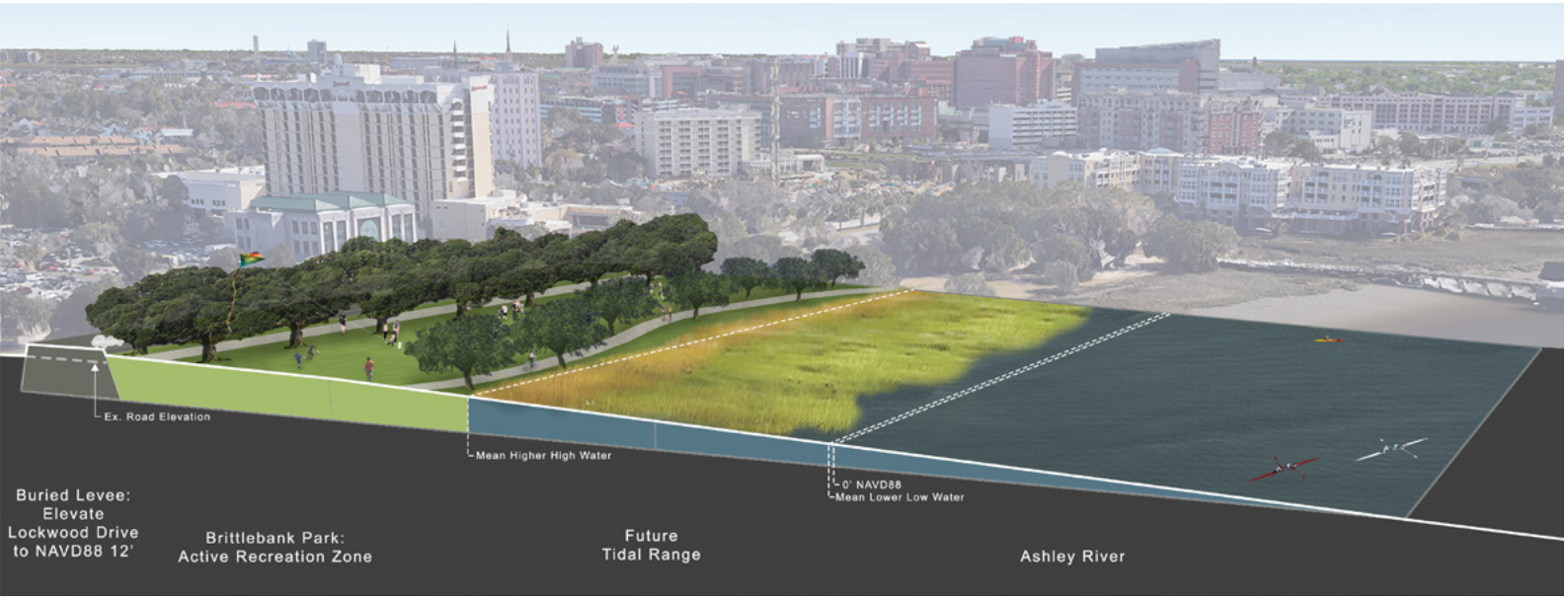


Image credit: DesignWorks

The Horizontal Levee

In contrast to living shorelines created in front of a hardened perimeter structure, the horizonal levee is itself the primary line of defense: a re-imagining of the typical vertical construction. The hardened structure is set back from the Mean High Water by a wide expanse of natural habitat. In contrast to an upright wall that severs the connection between land and water, a horizontal levee for Charleston uses tidal marsh along its sloped shore to absorb wave energy and reduce the impacts of coastal flooding, storm surge and wave action. As a result, the hardened features may be reduced in size when compared to levees without a buffer from the shoreline. This reduces the overall cost of constructing the levee and maintains the natural shoreline, allowing for the marsh over time to migrate upslope in response to sea level rise.

Coastal communities everywhere are grappling with the cost of protecting themselves from climate change. How we consider the cost/benefit or return on investment is a central question as we move forward from the USACE Study. The formula for determining the federal investment relies on saving money on a wall to find the most economical path to meeting the solitary goal of storm surge protection without condiseration of sea level rise and stormwater.

In contrast to static structures such as walls that will be maintained and replaced at enormous cost, horizontal levees and living shorelines can be engineered to trap sediment and accrete vertical elevation. They can also readily accept thin-layer deposition of dredge spoils, as can the living breakwater. None is free of maintenance cost, but the investment is as multifaceted as the potential use, whereas a wall has a singular function.

Image credit: ONE

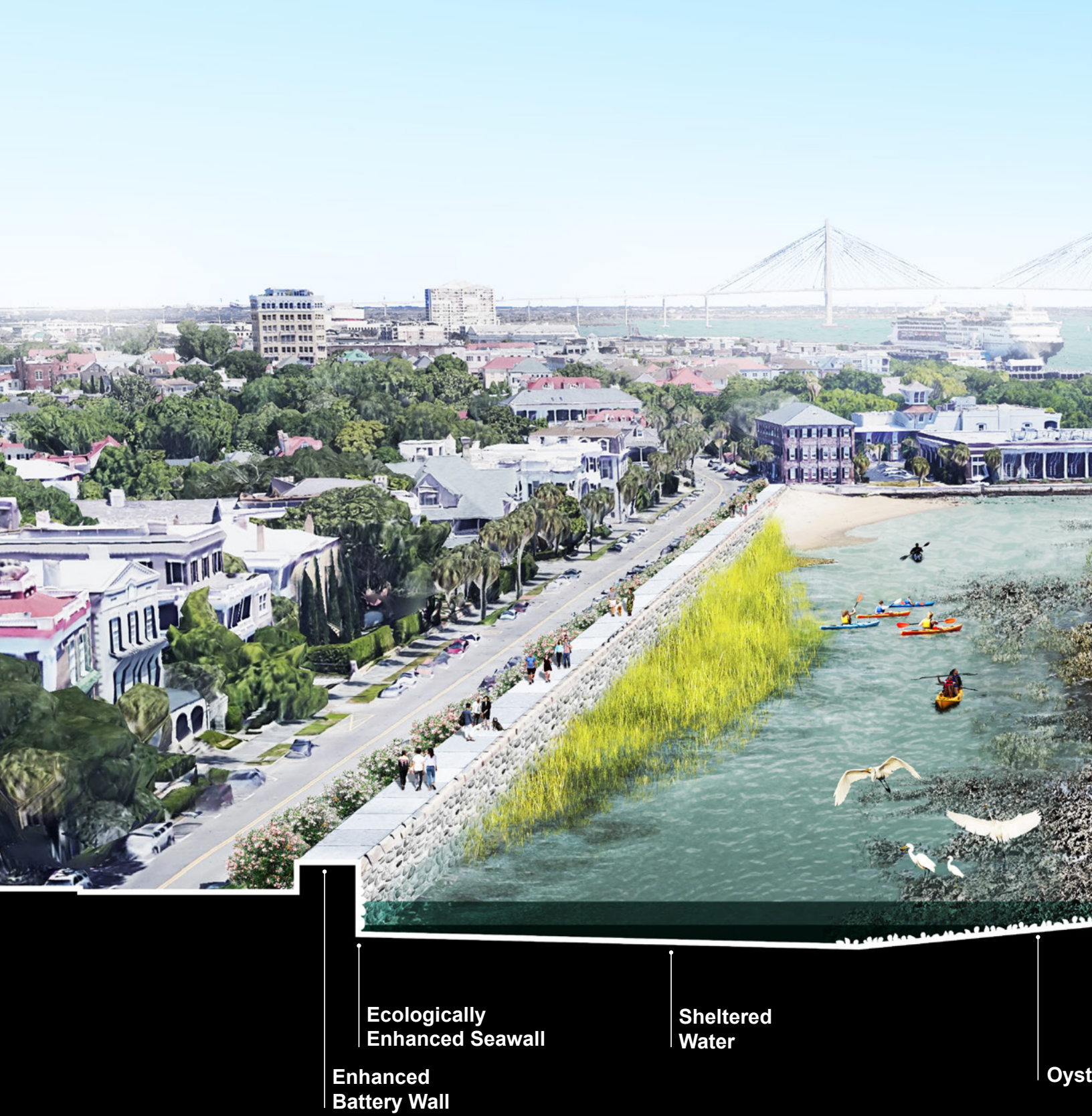
Living Breakwater Archipelago

A RETURN TO OYSTER POINT

To early English settlers, the peninsula created by the confluence of the Ashley and Cooper Rivers was known as Oyster Point. Their first efforts there were to build fortifications. Can we reimagine the breakwater as a multifaceted structure that reduces wave heights, offers recreational and scenic enhancement, and provides shallow coastal habitat?

The Living Breakwater will provide a multi-faceted, nature-based approach for the City of Charleston. It is important to note that a living breakwater would provide the same wave protection at a lower elevation than a traditionally engineered breakwater, with less interruption of harbor views. Along with providing the necessary protection from wave energy, the Living Breakwater provides ecological, recreational, and economic benefits, including:

- Engineered rock formations provide escape and refuge for fish
- Concrete-coated material encourages colonization by marine organisms
- Oyster reefs dampen wave energy, filter water, and provide food
- Dredge material can be beneficially used to construct and enhance protection and habitat
- Tidal wetlands provide shelter for crabs, shrimp larvae and marsh birds
- Shell mounds and mudflats encourage shorebird habitat
- Birding, nature education, kayaking & canoeing, stewardship



Living Breakwater Archipelago

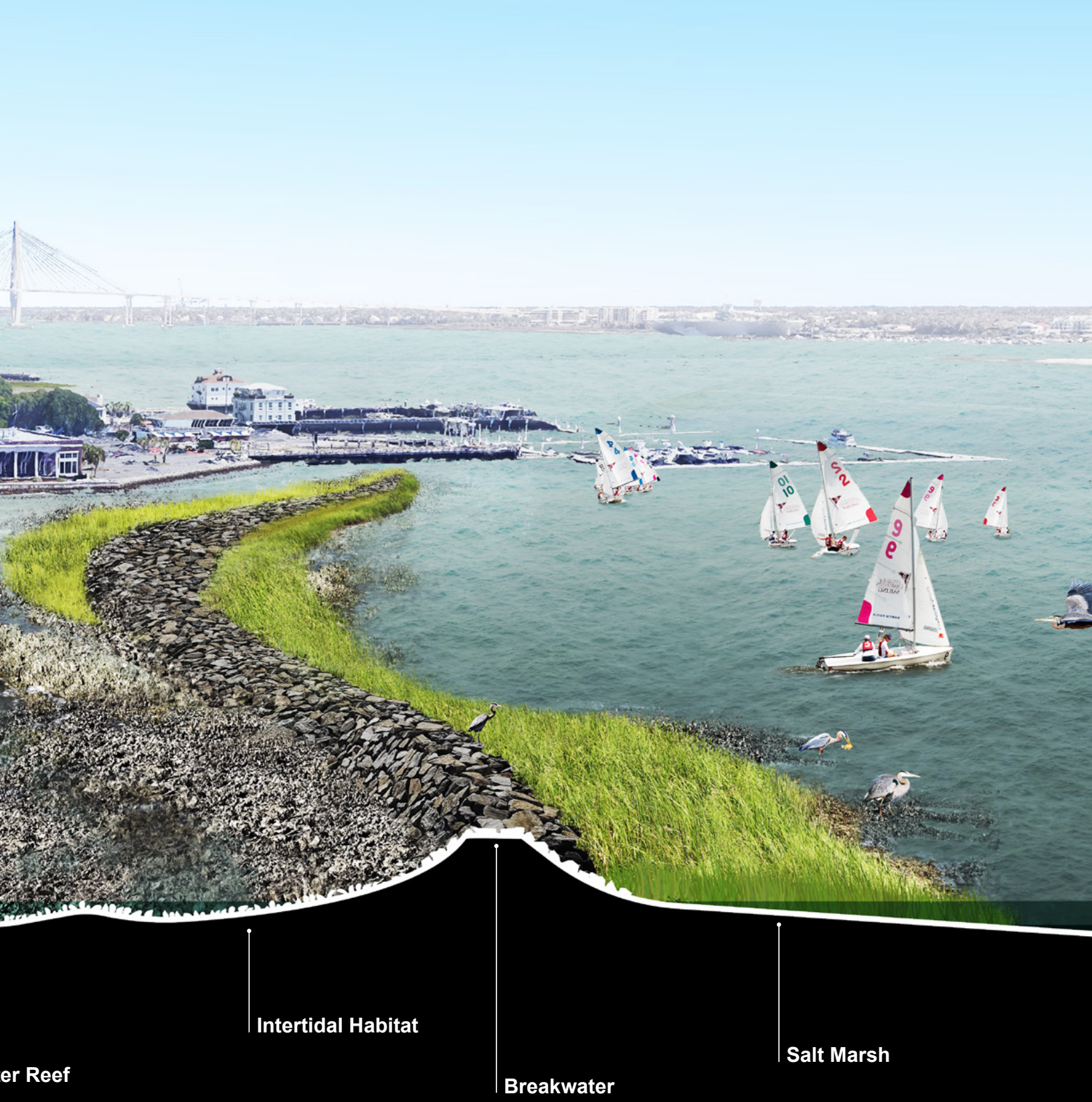
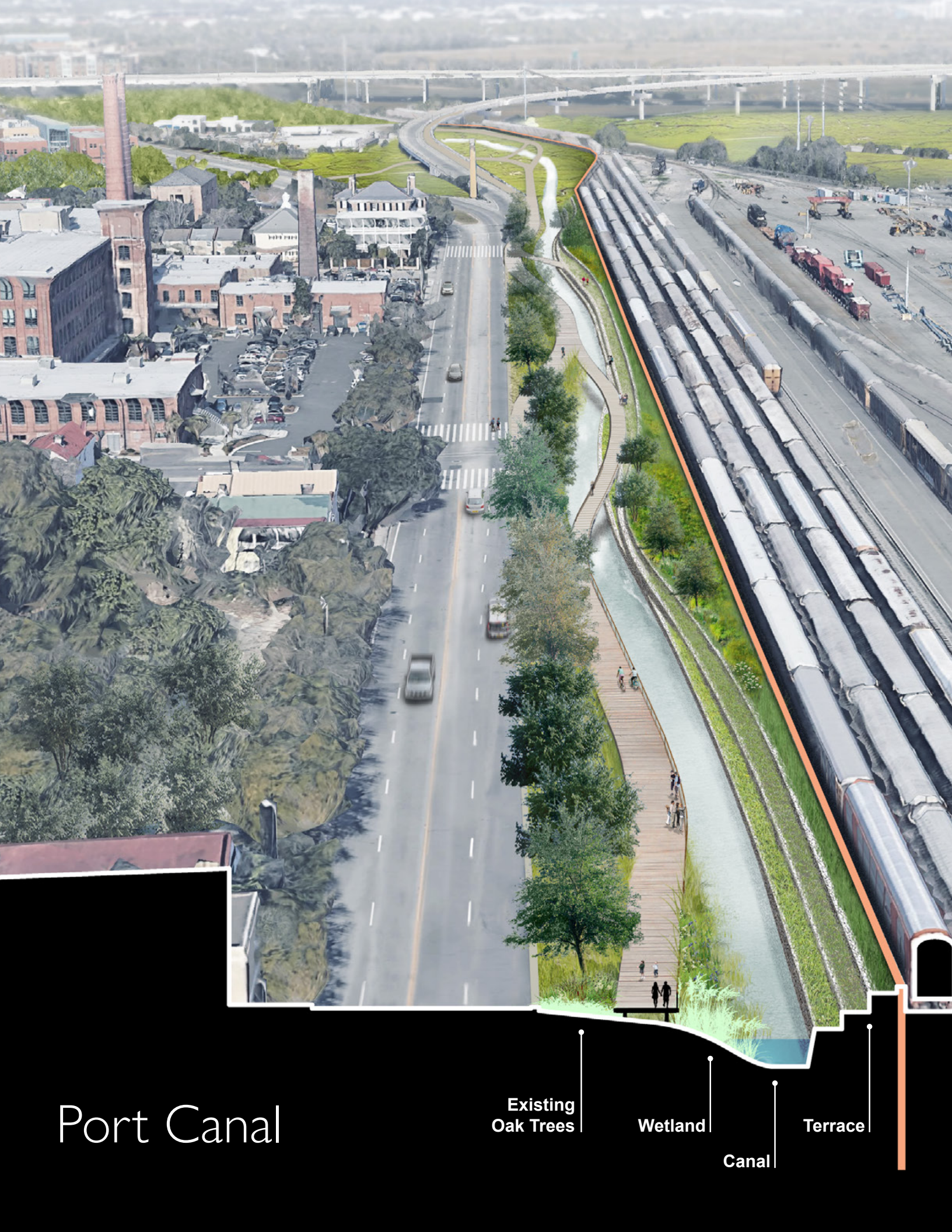
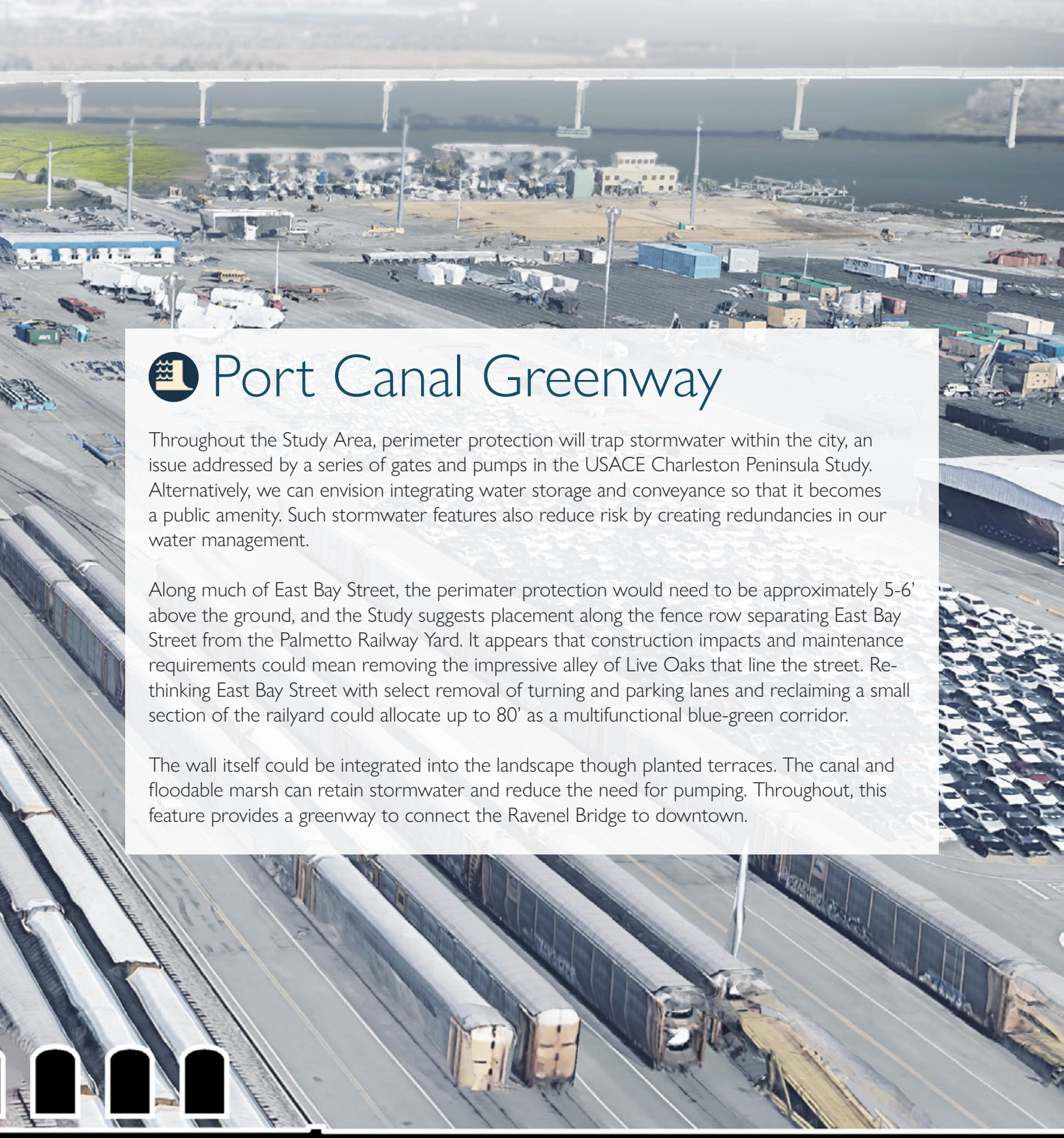


Image credit: ONE



Port Canal



Port Canal Greenway

Throughout the Study Area, perimeter protection will trap stormwater within the city, an issue addressed by a series of gates and pumps in the USACE Charleston Peninsula Study. Alternatively, we can envision integrating water storage and conveyance so that it becomes a public amenity. Such stormwater features also reduce risk by creating redundancies in our water management.

Along much of East Bay Street, the perimater protection would need to be approximately 5-6' above the ground, and the Study suggests placement along the fence row separating East Bay Street from the Palmetto Railway Yard. It appears that construction impacts and maintenance requirements could mean removing the impressive alley of Live Oaks that line the street. Re-thinking East Bay Street with select removal of turning and parking lanes and reclaiming a small section of the railyard could allocate up to 80' as a multifunctional blue-green corridor.

The wall itself could be integrated into the landscape though planted terraces. The canal and floodable marsh can retain stormwater and reduce the need for pumping. Throughout, this feature provides a greenway to connect the Ravenel Bridge to downtown.

Image credit: ONE

Next Steps

Our intention in creating this document is to broaden the conversation about Charleston's "Sea Wall" and perimeter protection.

Our Teams' work on other projects has taught us that USACE studies can be the first step in a vibrant conversation, laying a sound technical foundation upon which a community can build a vision of the future based on their own natural, social, and economic context.

The key to an integrated approach is to have a shared vision and then a consensus plan in place, one that can guide zoning, project review, and capital improvement decisions through the midterm. Dutch Dialogues Charleston™ provides a foundation for the shared vision, and our decision-makers can move towards a plan to provide consistency.

We look forward to working with the many smart, engaged stakeholders in the project to find the solution that works best for our City.

Key References

Bridges, T. S., E. M. Bourne, J. K. King, H. K. Kuzmitski, E. B. Moynihan, and B. C. Suedel. 2018. Engineering With Nature: an atlas. ERDC/EL SR-18-8. Vicksburg, MS: U.S. Army Engineer Research and Development Center. http://dx.doi.org/10.21079/11681/27929.

De Vriend, HJ and M. Van Koningsveld, 2012. Building with Nature: Thinking, Acting and Interacting Differently. Ecoshape, Dordrecht, The Netherlands. https://www.ecoshape.org/en/

PIANC: Permanent International Association of Navigation Congresses. 2014. Working with Nature. Collection of Waterborne Infrastructure Projects (2012-2014). https://www.pianc.org/uploads/files/EnviCom/WwN/WwN-Booklet.pdf

USACE. 2020. A Coastal Flood Risk Management Study Draft Feasibility Report / Environmental Assessment.

Waggoner & Ball, The Water Institute of the Gulf, and Kingdom of the Netherlands. 2019. Dutch Dialogues Charleston. https://www.charleston-sc.gov/DocumentCenter/View/25055/Dutch-Dialogues-Charleston_Final-Report-September-2019

imagine the wall

Contact

Keith Bowers, FASLA, PWS
Biohabitats, President & Founder
kbowers@biohabitats.com
854.999.4053

www.imaginethewall.com
Version 1.0 June 19, 2020

As ecologists, landscape architects, architects, and engineers with applied experience with shoreline protection projects around the world, we are part of the movement towards nature-based designs that blend grey and green infrastructure to harness the resilience of natural systems in adapting to climate change. We believe that traditional hard-engineering approaches of the past are giving way to a design standard that embraces living systems.

Biohabitats
SOUTHEAST ATLANTIC BIOREGION

DesignWorks

one architecture
new york city amsterdam

ATM DESIGN ENGINEERING CONSULTING
APPLIED TECHNOLOGY & MANAGEMENT, INC.

Resiliency Consultation
Curtis Cravens

Logos & Illustration
John Nettles, Jr.