WHAT'S WITH THE WEATHER? Kingston copes with climate change



Experiencing climate-associated impacts in Kingston

- The Kingston waterfront experienced widespread flooding from extreme precipitation during Hurricane Irene and Tropical Storm Lee in 2011, and from storm surge during Superstorm Sandy in 2012.
- Portions of the Kingston waterfront, including the East Strand, are experiencing flooding during very high tides and heavy rain events.
- The Kingston Point Park parking lot is flooding under high tide conditions.
- The beach at Kingston Point is eroding from high water and strong velocities in the Hudson River.
- Stormwater flowing off of paved surfaces adds to flooding problems in Kingston.

Signs of Climate Change in the Hudson River Valley



+ Changing



Precipitation

- As the surface of the planet warms, more water evaporates into the atmosphere and turns into clouds.
- More water in the atmosphere means more frequent and intense rain storms.
- Our current infrastructure cannot handle the volume of rain water, leading to flooding in places that normally stay dry.

Flooding

- Projected extreme rainfall means that more and more areas that normally stay dry will begin to experience flooding during storms events.
- According to the National Climate Assessment, there was a 71% increase in very heavy precipitation from 1958-2011.

U Temperature

- Summers may be hotter and winters colder because climate change increases air temperature and shifts in air currents.
- Urban areas covered with pavement and concrete contribute to even higher temperatures in the urban environments.

Rise

- Ocean tides push into the Hudson River all the way to Troy, so if the ocean level rises, so does the river level.
- There are two causes of sea level rise: first, as the water gets warmer it expands. Second, landbased ice is melting due to rising temperatures.
- So, a melting ice shelf in Greenland can change the water level in Kingston.

Climate Change: A Global Phenomena

Causes

- Recent rapid climate change is caused by human emissions that stay in the atmosphere.
- These emissions greenhouse gases – come from burning fossil fuels for energy, transportation, industry, and other human activities.

Effects

- On a global scale, warming temperatures are melting ice shelves, raising sea level and adding more moisture into the air.
- Global changes in the air lead to more frequent and intense natural disasters on the ground, like hurricanes, heat waves and droughts.
 Effects can vary widely from

place to place.

Evidence

- Our atmosphere is warming faster than it has in thousands of years.
- According to NOAA, ten of the warmest years on record have occured since 1998.
- We know this from measuring ice core samples, tree rings, satellite images and more.

Responses

- Reducing greenhouse gas emissions can lessen the impact of climate change in the future.
- Adapting to changes happening now include taking action to reduce vulnerability to flooding, heat waves and other threats.
- Designing our waterfronts to recover from flooding is an

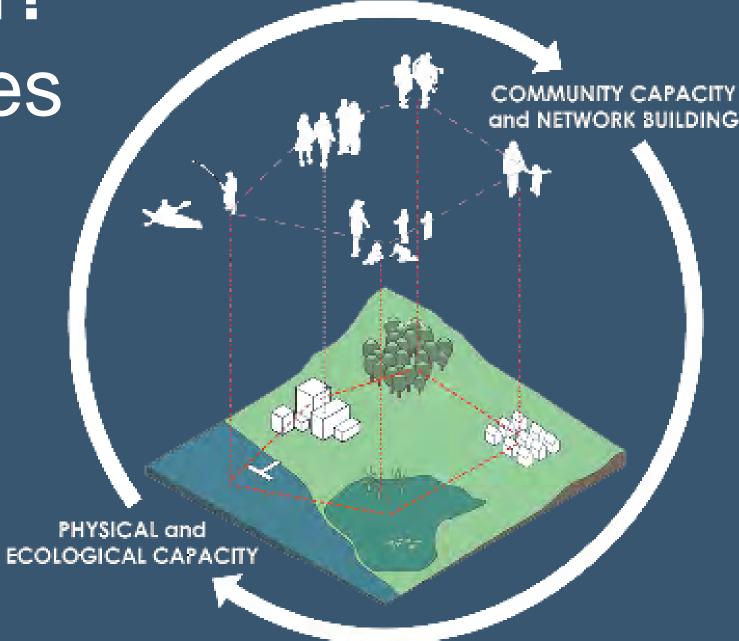
important step we can take today.

For more information, contact: Associate Professor Joshua F. Cerra, JFC299@cornell.edu Website: http://tinyurl.com/CornellCAD

WHAT IS CLIMATE-ADAPTIVE DESIGN? Envisioning vibrant waterfront communities

Creating designs for a more resilient future

The Cornell Climate-adaptive Design (CAD) studio is a design research program that links Cornell students in landscape architecture with Hudson Valley communities to explore design alternatives that envision more climate resilient waterfront communities. By working with both the studio process and the design products it creates, we seek to inspire climate awareness and action within the communities with whom we work.



The design process begins with an initial analysis of the site including **site visits** to better understand the place that we are working in, and meeting with the community to understand their vision for a future waterfront. This analysis allows us to identify current and future challenges and opportunities.



During the design process we continually meet with **stakeholders and community members** to share our initial ideas and design concepts, including an onsite stakeholder workshop. We are committed to finding design strategies that work for many, and seek ongoing participation from the community.



On our campus in Ithaca, NY we refine the **design concepts** based on the information and feedback gathered during our community and stakeholder meetings.



At the end of the semester we present our **final designs** to the community to inspire further

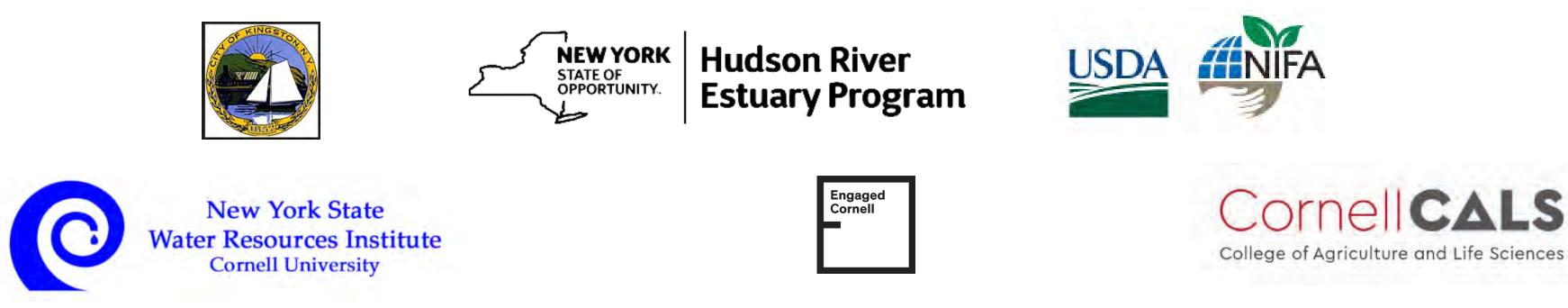


discussion about the value of vibrant and resilient waterfront communities.

Partners

Associate Professor Joshua F. Cerra directs the Climate-adaptive Design studio at the Cornell Department of Landscape Architecture. We work closely with our partners including Hudson River Estuary Program as part of the New York State Department of Environmental Conservation, Cornell Soil and Water Lab, Cornell Cooperative Extension, Scenic Hudson, and critically, our key community partners which have included Kingston, Piermont, Catskill and Hudson since 2014. The CAD Studio also wants to thank the many

students and research assistants that have worked on this project over time.



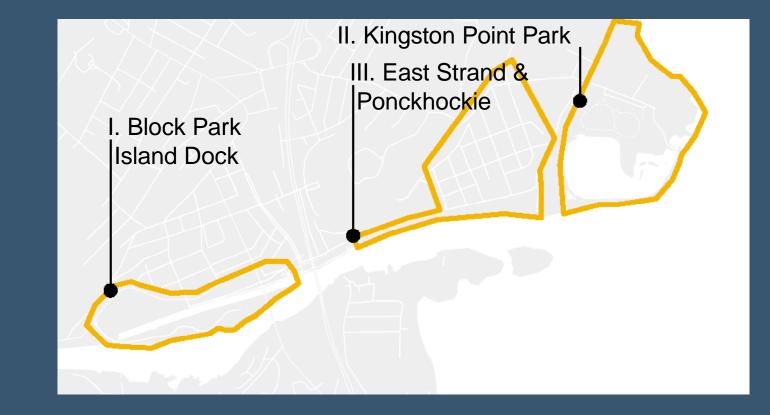
This material is based upon the work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Smith Lever project number 2015-16-210. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do notnecessarily reflect the view of the U.S. Department of Agriculture. This report was prepared for the New York State Water Resources Institute and the Hudson River Estuary Program of the New York State Department of Environmental Protection Fund.

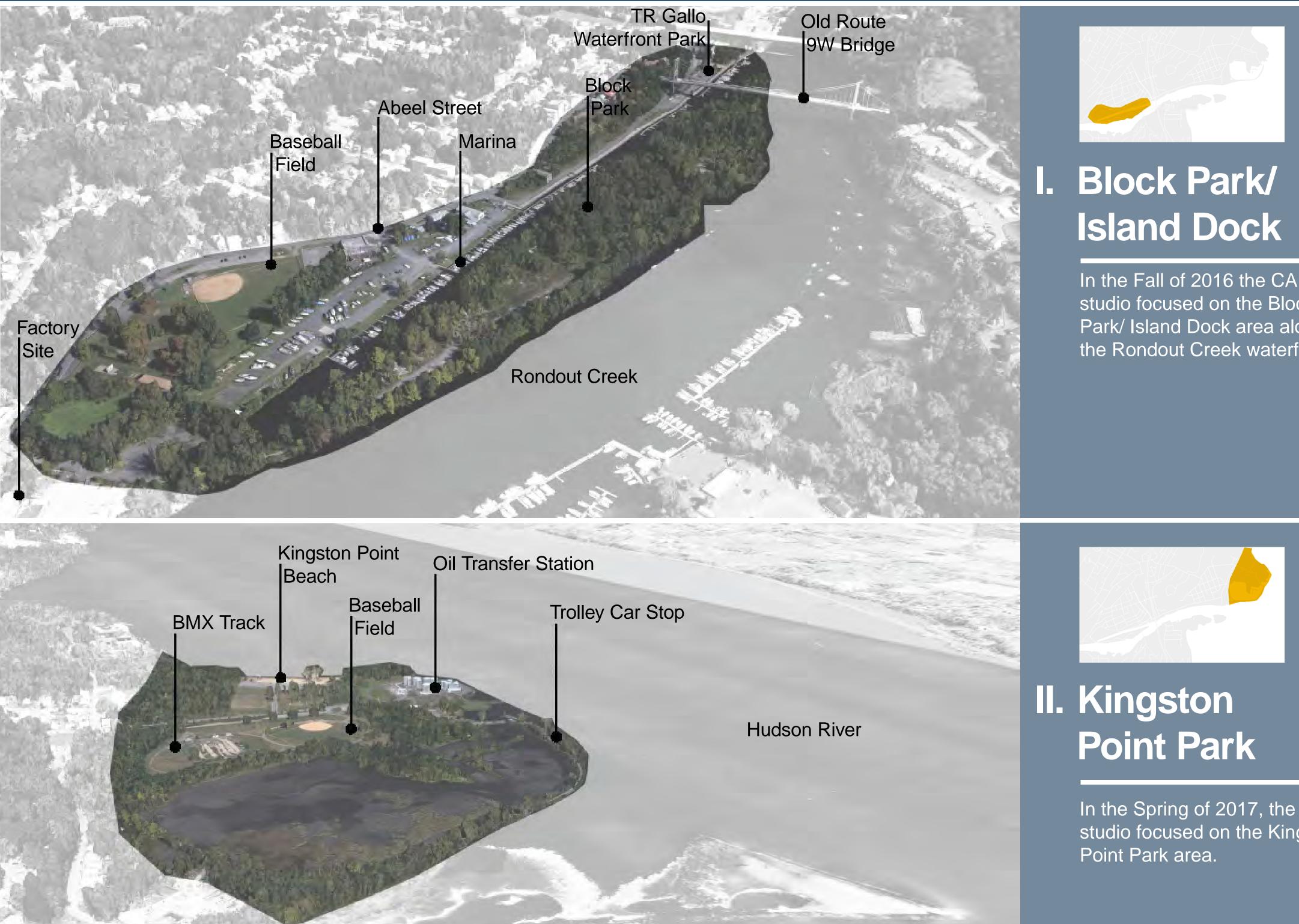
CAD STUDIO IN KINGSTON Building on strong foundations to inspire change

The CAD Studio along Kingston's Waterfront

The CAD Studio has taken place along Kingston's Waterfront a total of three times. The first studio was in Fall 2016. A class of senior level undergraduate students from Cornell University worked on the Block Park/ Island Dock site. The following year second-year graduate students

continued the work along the waterfront with their studio focusing on Kingston Point Park. The third and last studio took place in the Spring of 2018 with another group of secondyear graduate students focusing on the East Strand near Ponckhockie neighborhood.

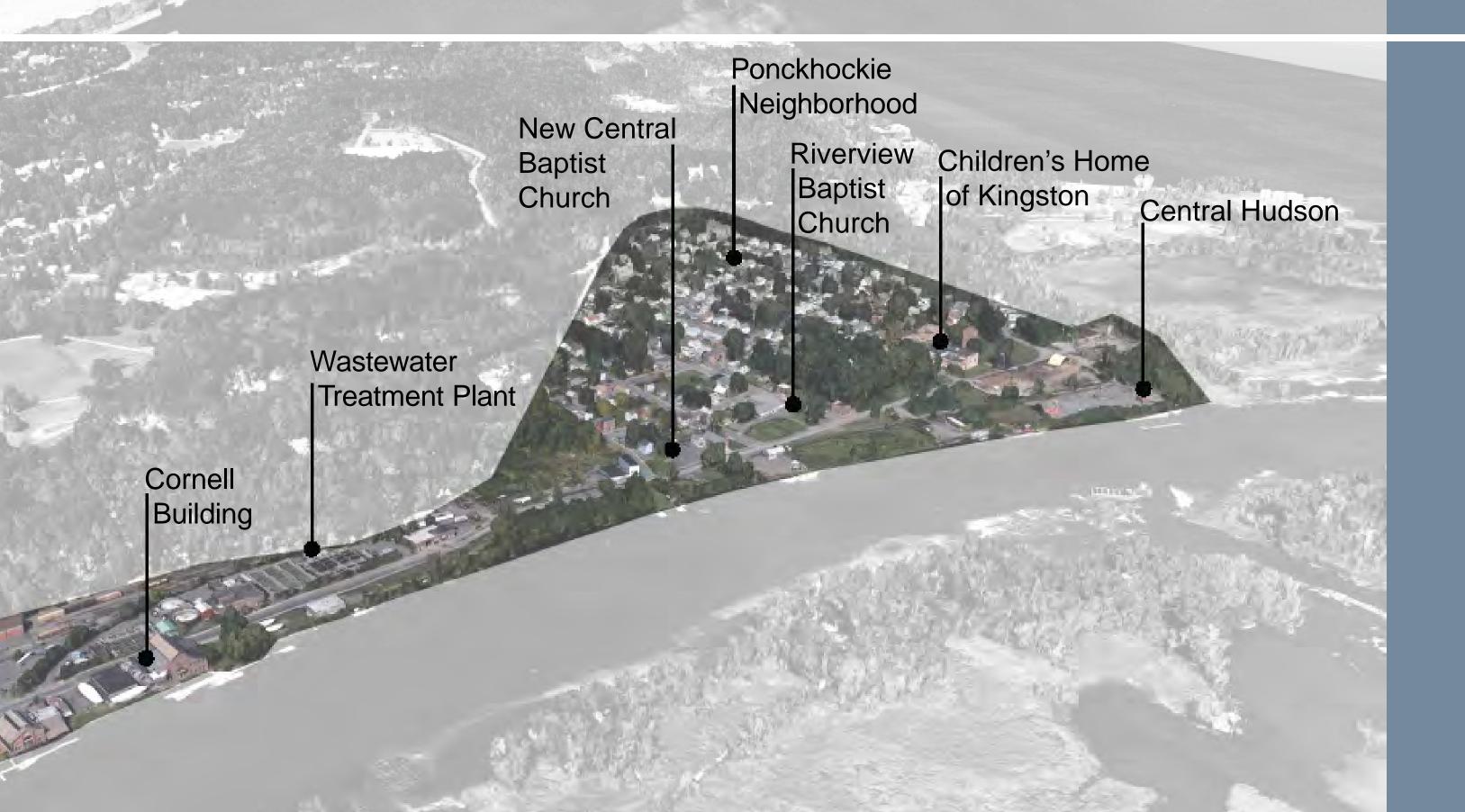




In the Fall of 2016 the CAD studio focused on the Block Park/ Island Dock area along the Rondout Creek waterfront.

In the Spring of 2017, the CAD studio focused on the Kingston

Rondout Creek





East Strand & Ponckhockie

In the Spring of 2018, the CAD studio focused on the East Strand area near the Ponckhockie neighborhood.

DESIGN PRINCIPLES Five Key Principles That Guide The Design Process



DESIGN A WATERFRONT

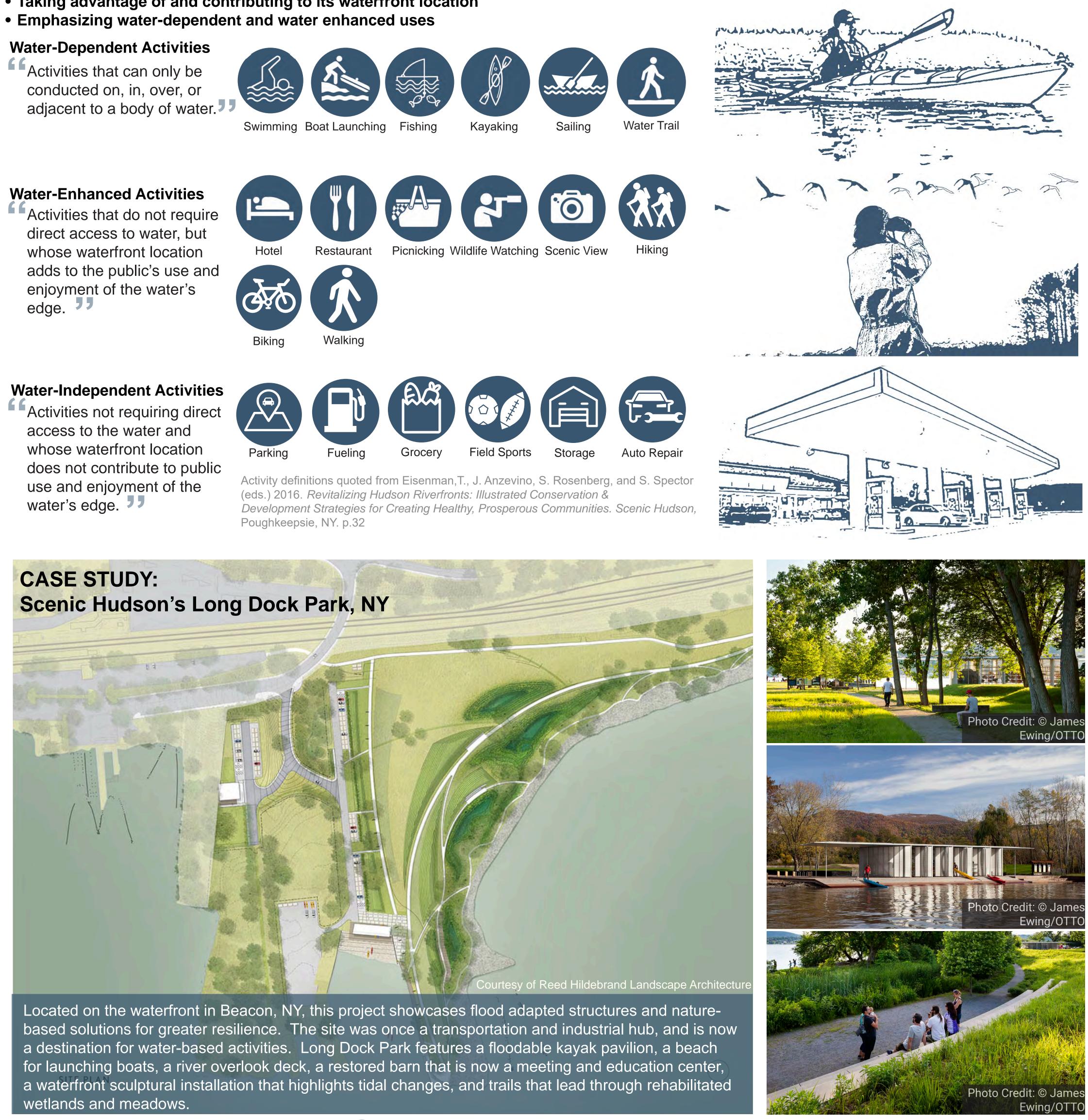
Maximize the value of what a waterfront can be

Designing a waterfront means:

- Taking advantage of and contributing to its waterfront location

conducted on, in, over, or







Long Dock Park Masterplan from Reed Hilderbrand LLC Source: https://www.asla.org/2015awards/96213.html



DESIGN FOR FLOODING

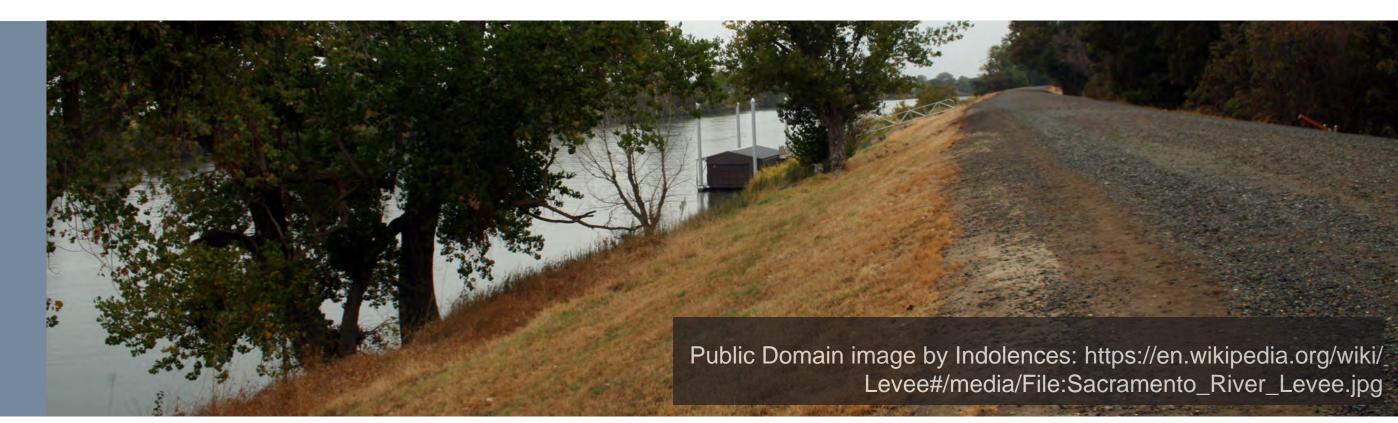
Working with water may be better than working against it

Design for flooding means:

- Understanding strategies for reinforcement, adaptation, and strategic relocation
- Making choices that minimize flood risk

einforcement

Techniques that exclude or limit water from entering locations, like levees, sea walls, and hardened shorelines. While sometimes used to protect important infrastructure or development at risk of flooding, these solutions also carry "residual risks" if reinforced infrastructure fails, for example by over-topping by water.



daptation

Design techniques that incorporate uses and structures that can accomodate flooding, such as floodable landcapes and wet flood-proofed buildings.





floodplain to places where they will not be impacted by water.





DESIGN FOR COMMUNITY

Waterfronts should be universally accessible and decidedly memorable

Designing for community means:

• Providing equitable access to waterfronts for the public benefit







Mark J Hirshbeck, Ilia Savin, Kingston CAD Studio I



Rachel Yunyann Liu, Susan Rhodes, Samuel Packer Catskill CAD Studio

Riverway Promenade

A Trolley Extension Community Dock Space Formal Bike Lanes Green Infrastructure

> Mark J Hirshbeck, Ilia Savin, Kingston CAD Studio I

Contributing to the prosperity and vision for the community

Kingston CAD Studio arrell, Yuting L

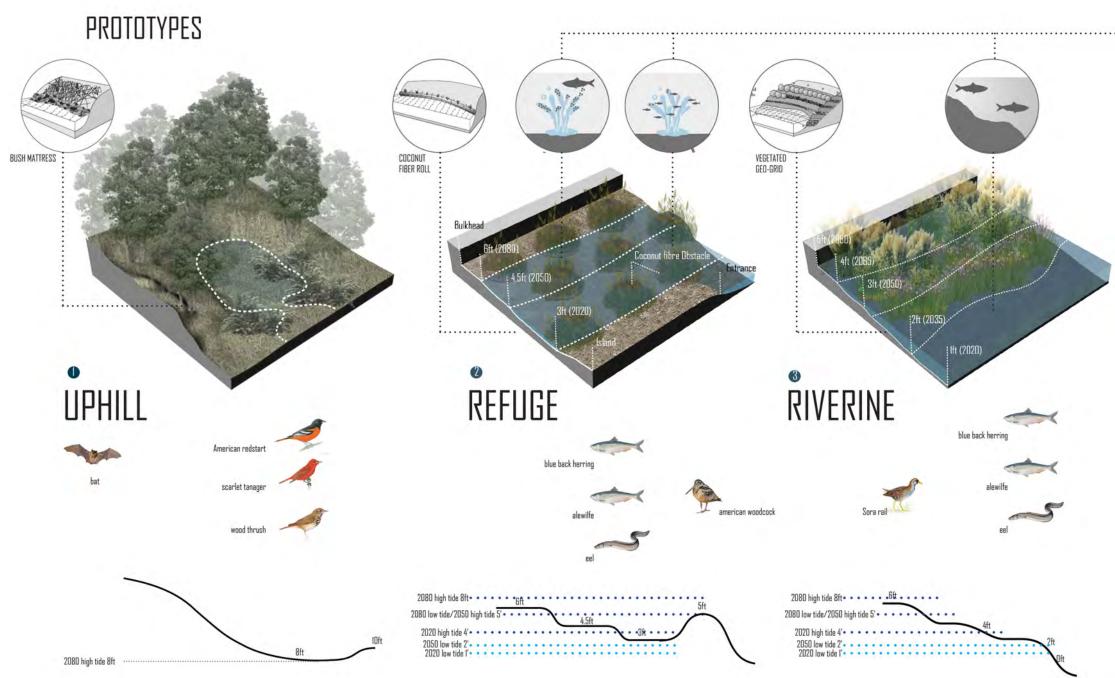


DESIGN WITH NATURE

A healthy Hudson is good for us and the greater ecology

Designing with nature means:

• Building a healthy Hudson by creating and maintaining healthy terrestrial and aquatic ecosystems



• Helping habitat work for us- through ecosystem services

Interventions include: Green Infrastructure Living Shorelines Assisted Marsh Migration Canopy Connectivity

Benefits include: Water Quality Enhancement **Shoreline Stabilization** Stormwater Management Recreation Shading and Temperature Regulation



Shan Lin, Lijin Liu, Kingston CAD Studio III

Kimberly Blacutt, Ivy Wong, Kingston CAD Studio I

This constructed wetland concept captures runoff from storms to improve water quality while contributing to the character and aesthetic of its park setting.

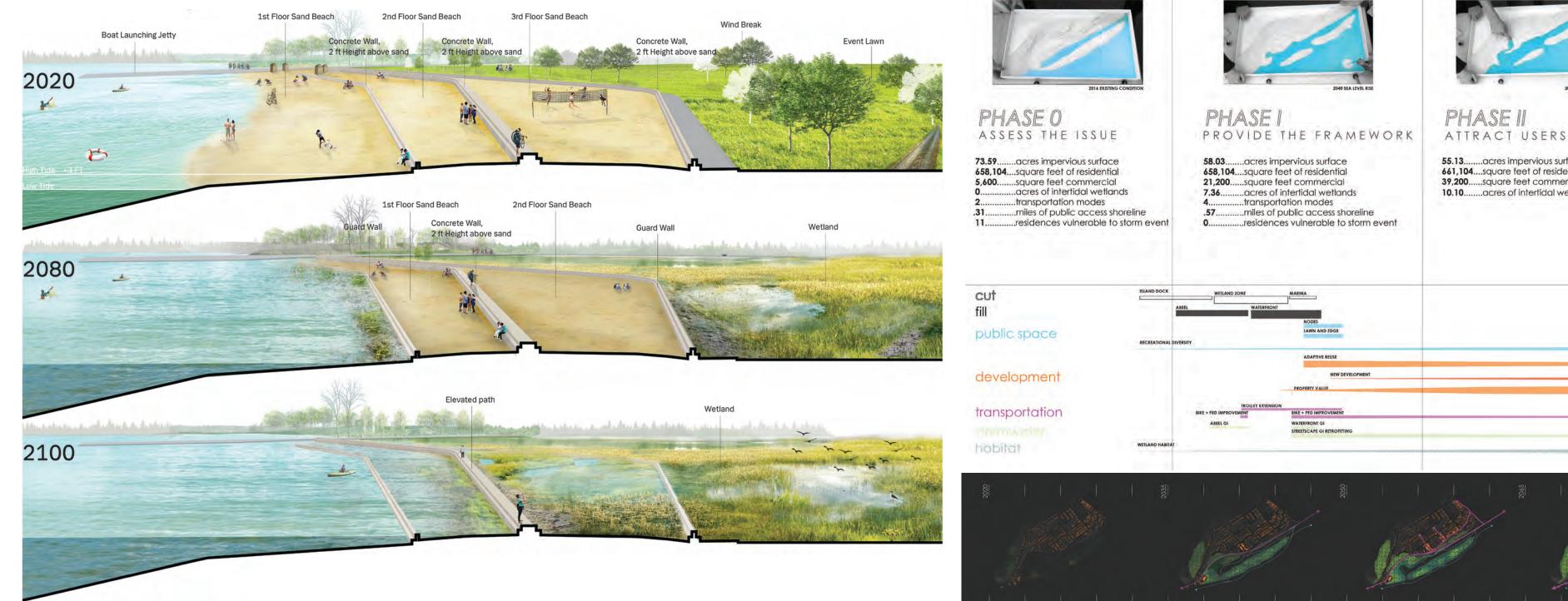


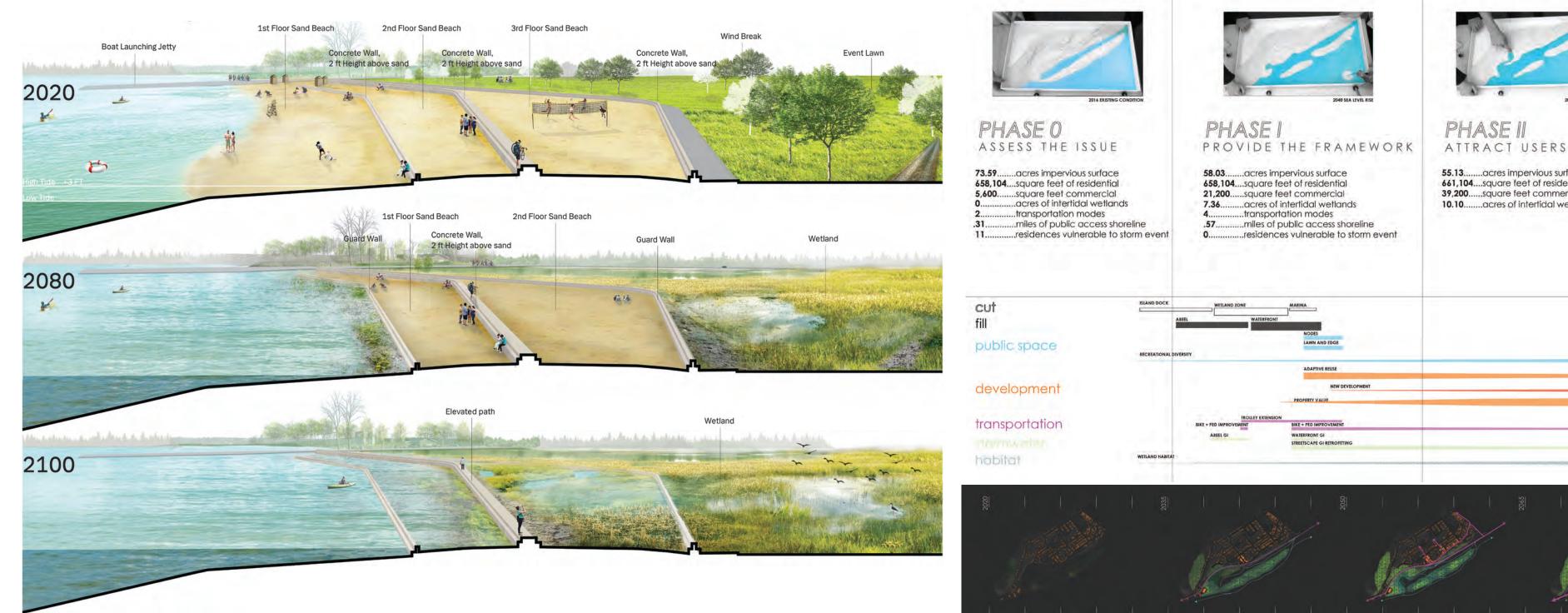
DESIGN FOR CHANGE

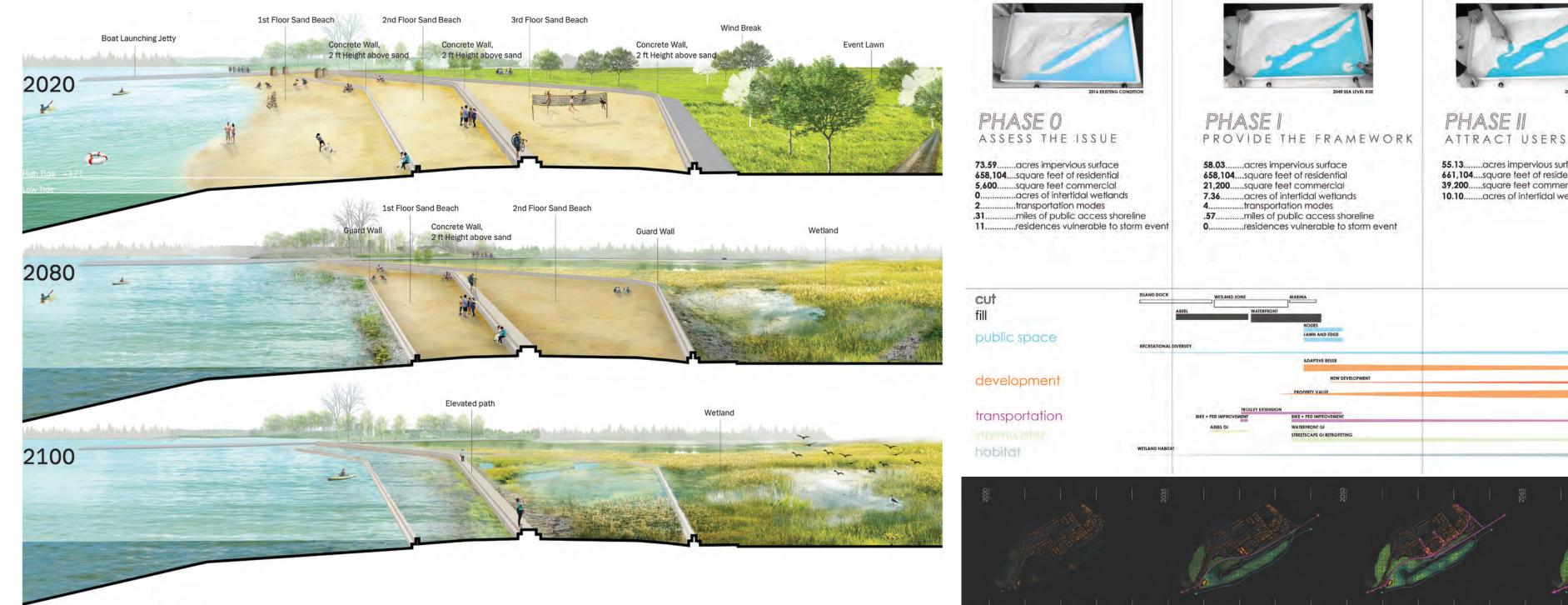
Build value into waterfronts as they change over time

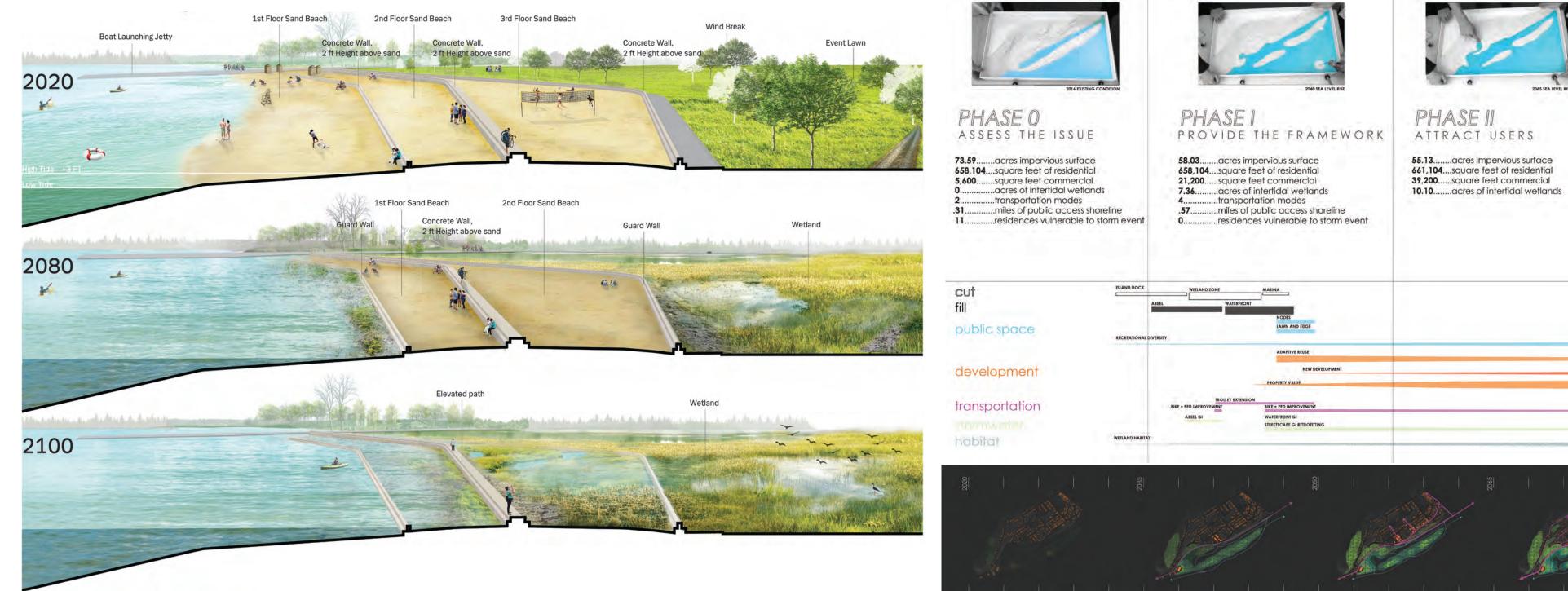
Designing for change means:

- Creating adaptable places that consistently provide value with changing conditions
- Phasing in projects over time in ways that are both practical and visionary











PHASE III

FILL IN THE GAPS

54.03.....acres impervious surface 661,104....square feet of residential

61,200.....square feet commercial

13.40.....acres of intertidal wetlands

Hong Gao, Luyao Kong, Qianli Feng, Kingston CAD Studio II

Mark J Hirshbeck, Ilia Savin, Kingston CAD Studio I

Block Park/Island Dock

GENERATION RONDOUT

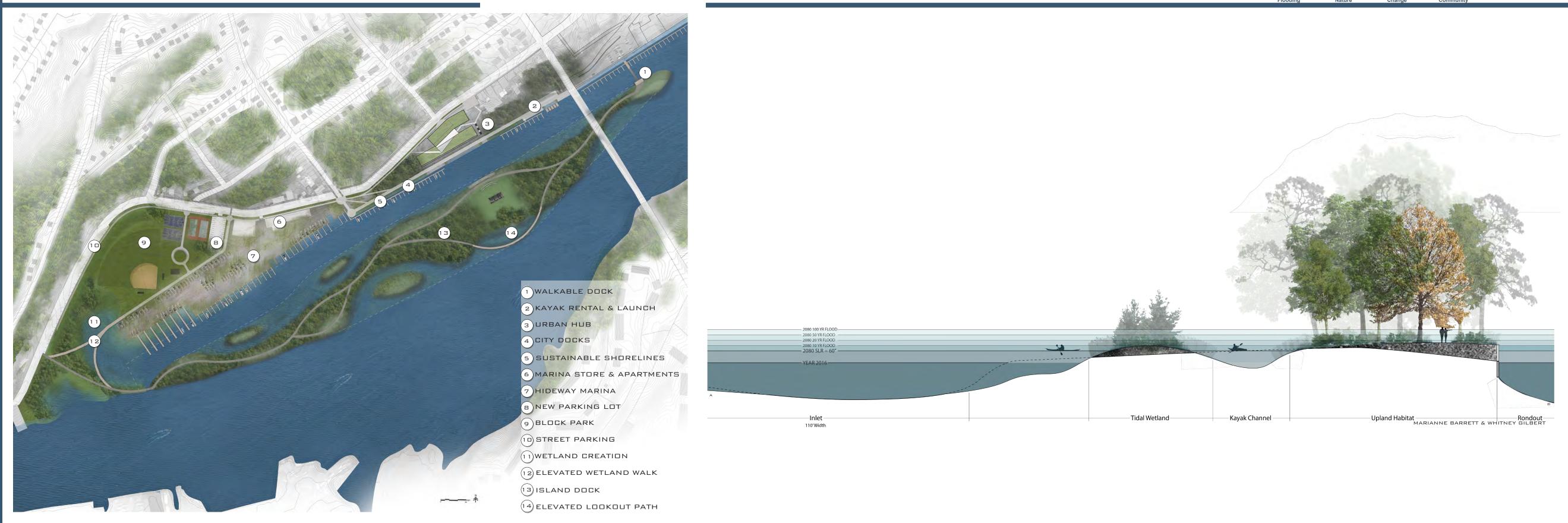
Student Design Team: Marianne Barrett (BSLA '17) and Whitney Gilbert (BSLA '17)

What is this project about:

"Generation Rondout proposes revitalizing public and commercial areas along the waterfront, including athletic facilities, jogging paths, and kayaking to encourage climate-ready economic growth and community reinvestment along the river. Infiltration planters and green roofs act as green infrastructure on new development of proposed hotel and office properties. Protected natural areas, expanded wetlands, and an adaptable event space turn Island Dock into an area for passive recreation while also retaining a varied ecosystem."

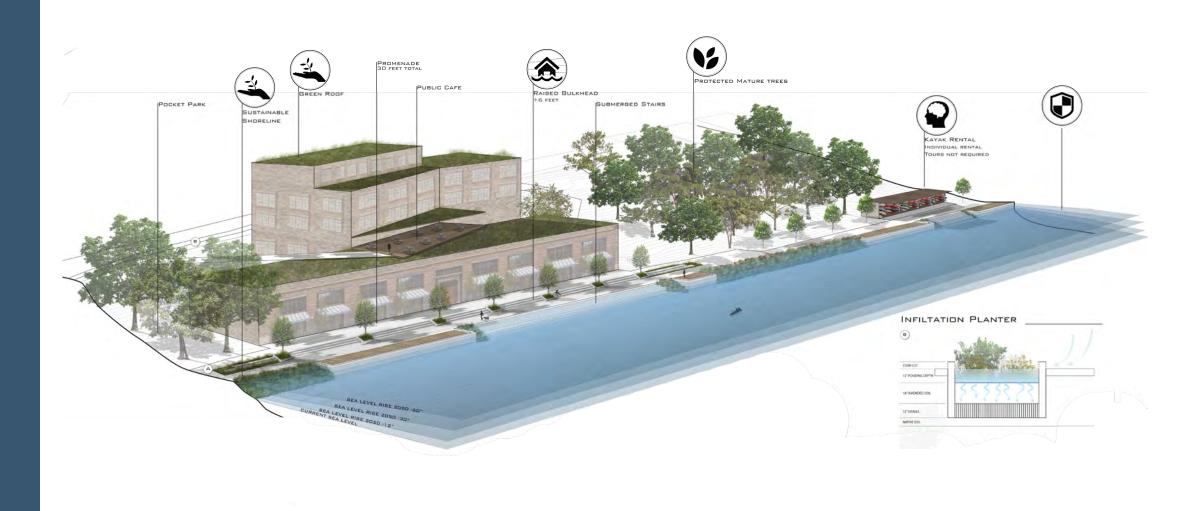
- Marianne Barrett and Whitney Gilbert

2080 Masterplan



Network. Invest. Adapt. Reconnect. Perform. These are the key themes addressed in this design strategy. Four specific areas were considered in this project: the KOSCO sites, Block Park, Hideaway Marina, and Island Dock.

II. Revitalizing the Economy



An urban hub would be sited above the current 100 year floodplain and the projected 2080 sea level rise level, and the first floor is wet-floodproofed. Green infrastructure, like infiltration planters and greenroofs that capture and infiltrate stormwater runoff before it enters the Rondout Creek, are incorporated into this design. The site development program includes storefronts, housing, a cafe, and kayak rental facilities along a revitalized waterfront promenade.



Island Dock could be acquired for a park adapted to flooding that with time will become increasingly frequent. Trails, which can be periodically underwater, occupy the higher areas of the park. The different future wetland types resulting from variable topography attract pedestrian and kayak users alike.



In this scheme, the marina storefront could be strategically located upland abutting Abeel St. To maintain marina uses, a small levee would be set back from the existing shoreline which eventually ties into native grade uphill. Floodable uses maintain familiar recreational themes in upland portions of Block Park, while areas anticipated to be permanently flooded are planned for eventual transition to wetland.



Block Park/Island Dock

KINGSTON ON THE RISE

Student Design Team: Nathan Gowen (BSLA '17), George Anderson (BSLA '17), and Nathaniel Welsh (BSLA '17)

What is this project about:

"The Kingston on the Rise design concept seeks to create a climate-responsive space of ecological quality, economic revitalization, and community engagement. Featuring an openair performance space at the eastern tip of the island, multifunction ferries, and significant expansion and accommodation of freshwater wetlands, the project symbolically blurs the boundary between water and land, encouraging visitors to consider the relationship between the City and its waters." - Nathan Gowen, George

Anderson, and Nathaniel Welsh

2080 Masterplan

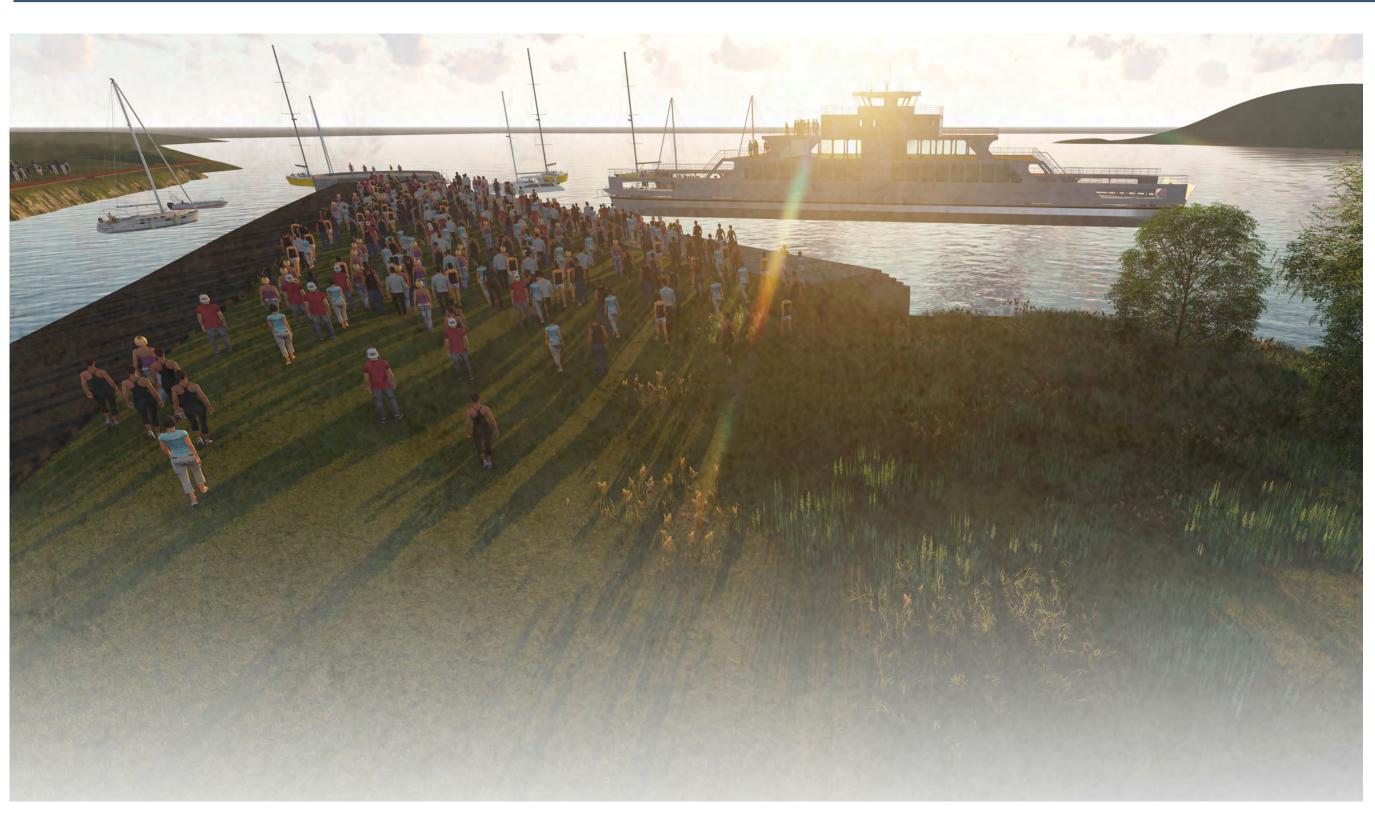


This alternative strategy capitalizes on multiple opportunities found within and around Block Park and Island Dock. A mixture of new habitats, economic assets, floodable open space and community connections could provide new opportunities for growth while adjusting to shoreline changes over time.

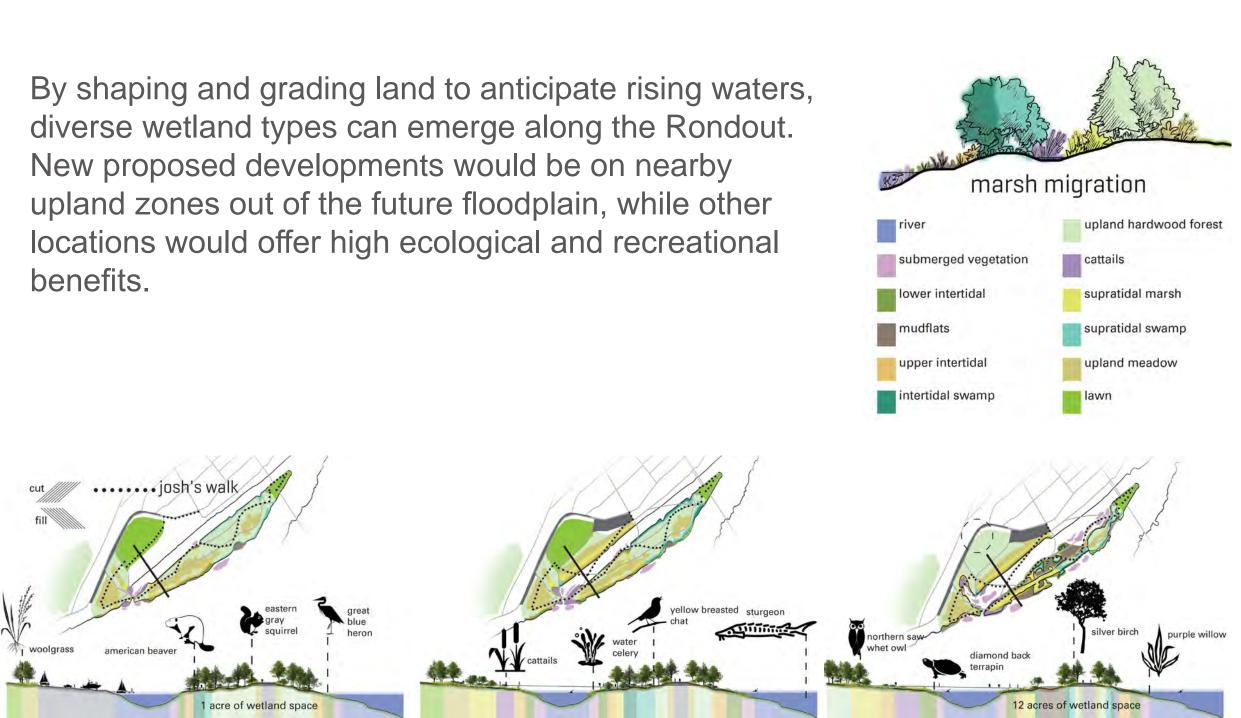
II. Anticipating Marsh Migration *



I. Recreation and Community Event Space



The easternmost point of Island Dock would serve as a park space for both active and passive recreation. The venue, a floodable community space, would serve as a multi-use activity center and recreation destination when the water is low. Visitors can watch a concert, spend the rest of their time interacting with Kingston's new wetland park, or socialize on The Strand.







Block Park/Island Dock

REVELATORY KINGSTON

Student Design Team: Rachel Liu (BSLA '17), Samuel Packer (BSLA '17) and Susan Rhodes (BSLA '17)

What is this project about:

"Disused industrial buildings are reclaimed as cultural and commercial spaces in Revelatory Kingston. New parks and playgrounds feature bioswales for stormwater retention and filtration. New construction follows amphibious and wet floodproofing practices, including a lookout structure offering overviews of the changing hydrology of Island Dock."

- Rachel Liu, Samuel Packer, and Susan Rhodes

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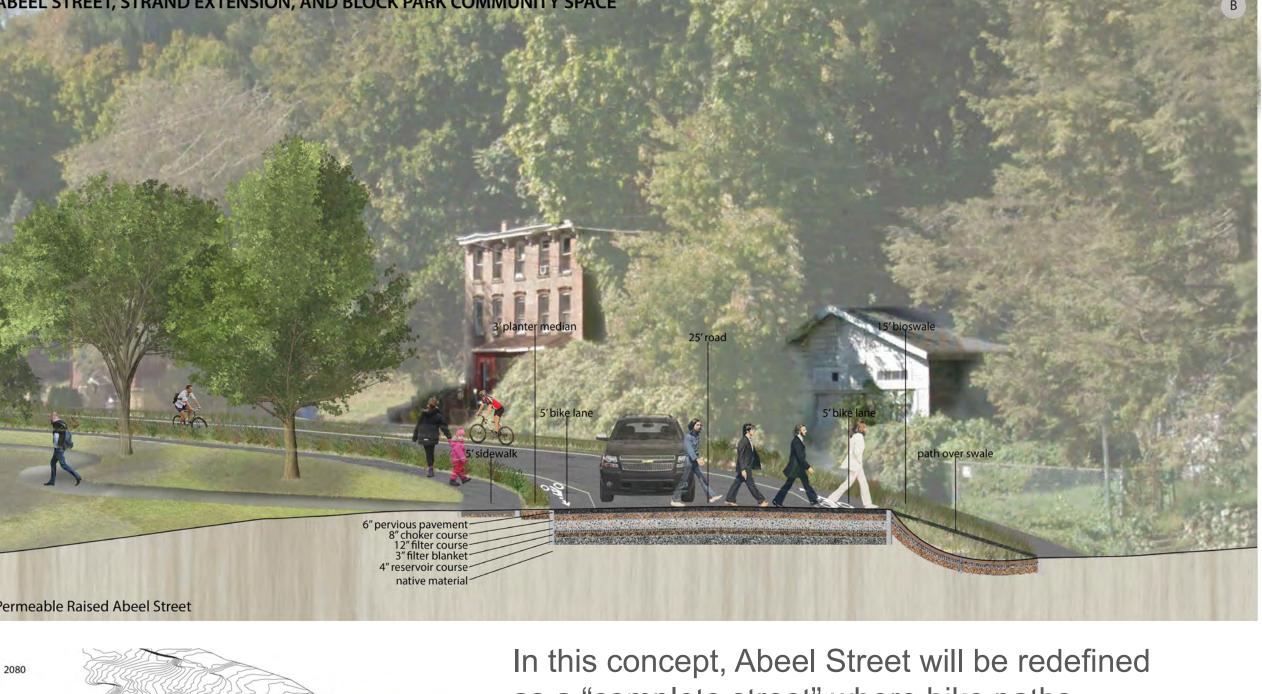


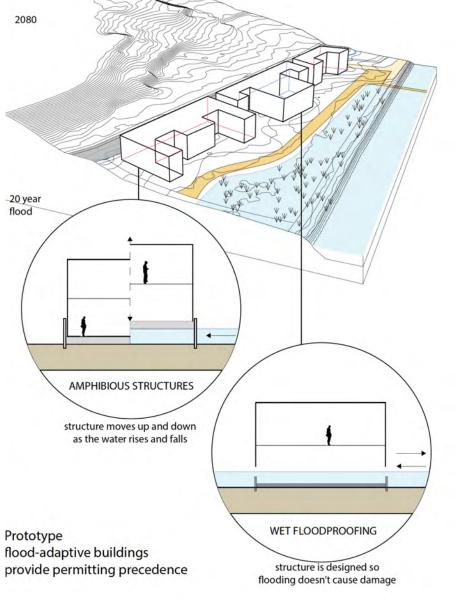
The proposed bioswale park serves as a dual-purpose intervention between the site's functional uses and human uses. While greatly assisting in stormwater management, the space will also provide a fun, educational natural play space for children of all ages. As sea level rise progresses, these features will become habitats for fish and small amphibians.

III. Reusing Buildings for Recreation



I. Flood-adapted Infrastructure







AND EXTENSION, AND BLOCK PARK COMMUNITY SPAC

as a "complete street" where bike paths, sidewalks, and crosswalks will promote shared mobility and activate the street and adjacent park. Raising Abeel Street with permeable paving will alleviate flooding due to surface stormwater runoff. A bioswale will improve drainage, mitigate the new raised grade of the street, and provide added privacy to residents along the road. New buildings along Abeel would be either out of protected future floodplains or have "wet floodproofed" features that allow structures to recover quickly should there be future flood events.

> waterfront access and stunning views for visitors. Future iterations of this concept could add nature-based approaches that still protect shorelines while providing ecological benefits.



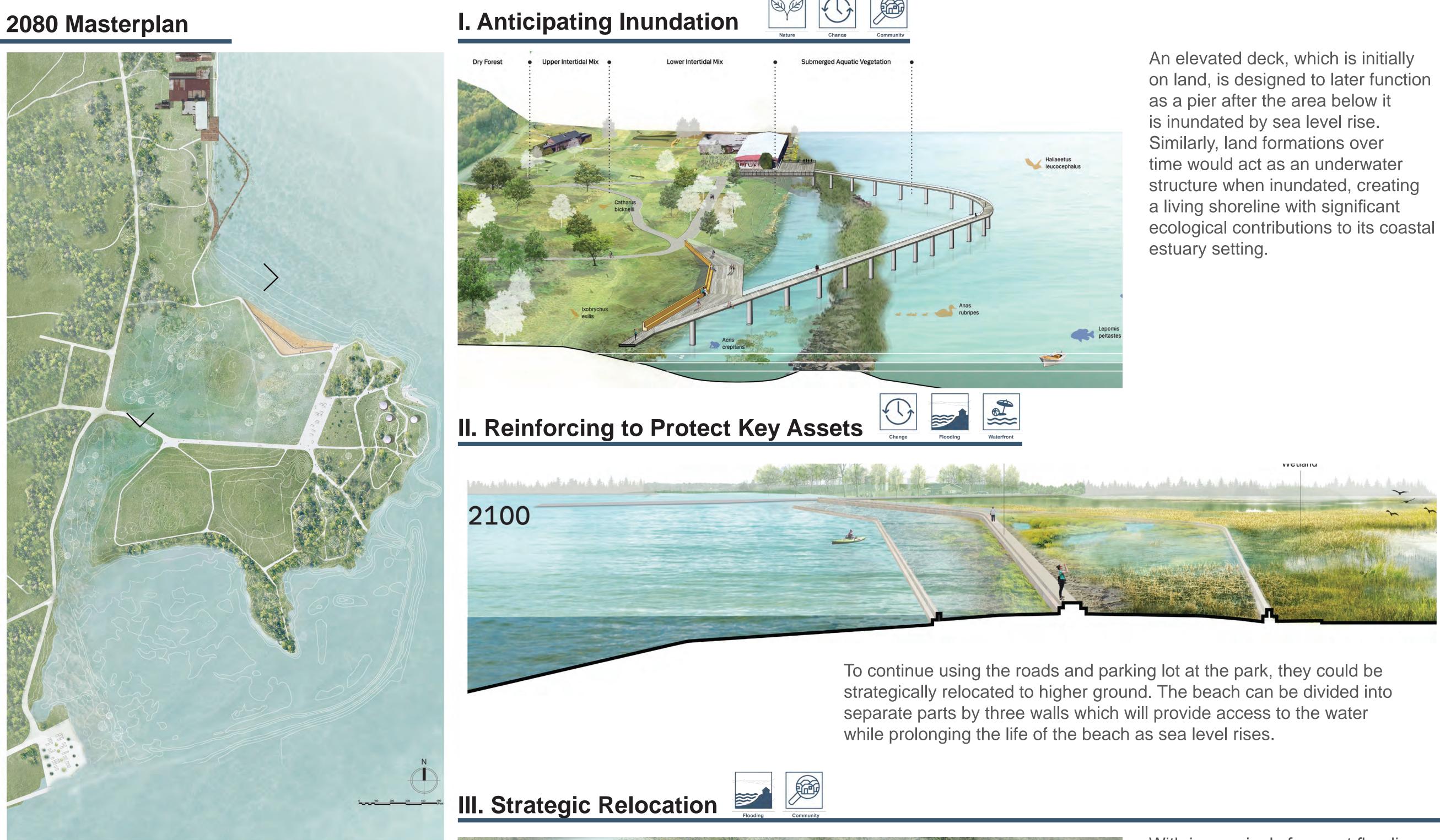
Kingston Point Park

WEAVING THE WATERFRONT

Student Design Team: Hong Gao (MLA '19), Luyao Kong (MLA '18), Qianli Feng (MLA '18)

What is this project about:

"Weaving the Waterfront" focuses on public space and wetland restoration, developing climate resilient programs and interventions, to build upon both ecological and scenic value in Kingston's new waterfront. Areas that are projected to be inundated are planted to become wetlands. Elevated walkways carry visitors over land and water alike, tying together key site elements, such as the new Hutton Brickyard location and the former oil transfer station." - Hong Gao, Luyao Kong, and Qianli Feng



This alternative strategy focuses on how sea level rise will affect Kingston Point Park, and how the usability of the park can be prolonged by using the adaption, reinforcement, and strategic relocation methods.





With increasingly frequent flooding over time, the oil transfer facility could relocate to higher ground with the site itself transitioning into part of Kingston Point Park. Remnants of the oil tanks could serve as a reminder of uses past.



Kingston Point Park

KINGSTON COVE

Student Design Team: Kari Spiegelhalter (MLA '18) and Katherine Goodrich (MLA '18)

What is this project about:

"Topographic moves link water and terrain, creating novel land and water forms in Kingston Cove: Rising Together. The "North Cove" maintains swimming access and nature trails, while the "South Cove" contains unique installations that allow visitors to participate in transitioning wetland communities as water depths change with sea level rise." - Kari Spiegelhalter and

Katherine Goodrich

2080 Masterplan



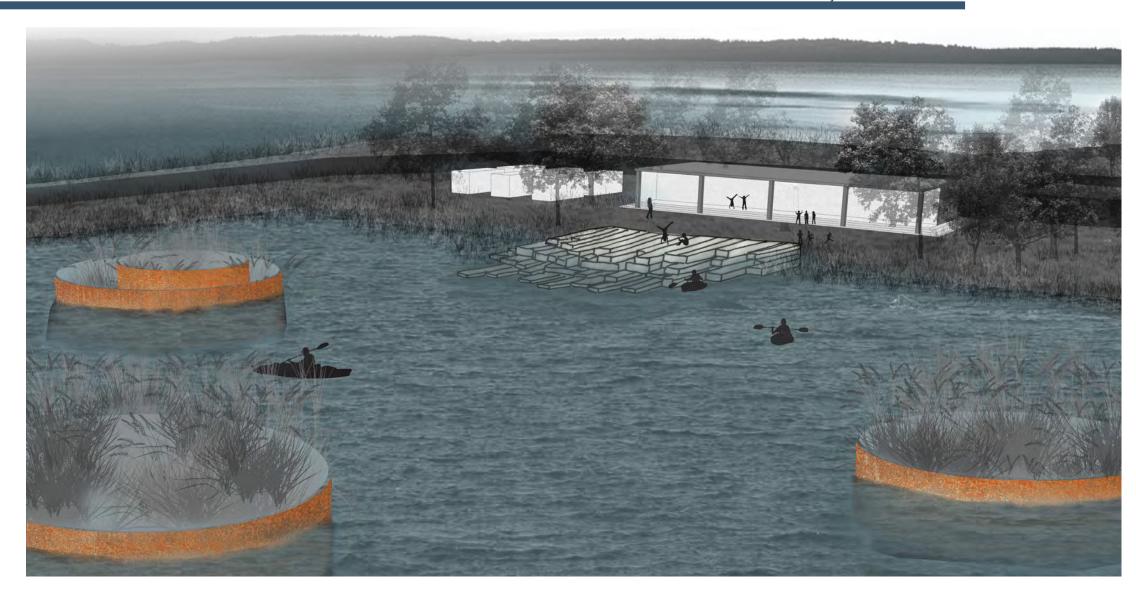
The 2080 Masterplan of Kingston Point Park proposes dynamic spaces that respond and change with sea level rise. The areas created between these spaces would become innovative interpretative experiences, making the transition between the aquatic and terrestrial environments an experiential connection to the Hudson.

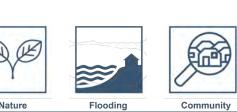
II. Sculpting a New Shoreline

North Cove, located at the northern portion of Kingston Point Park, would utilize a sculptured living shoreline as a sustainable shoreline type that provides structure for aquatic habitat, interpretive/ spacemaking benefits, and protection against environmental factors such as erosion. By working with both human and ecological interests, it would provide an interesting and beneficial transition from water to land.

I. Environmental Education Marsh Migration Machine

South Cove, located in the southern point of Kingston Point Park, would maintain wetland habitats during marsh migration while serving as an interactive educational tool for the community through "migration stations" that teach about wetland plantings and communities.





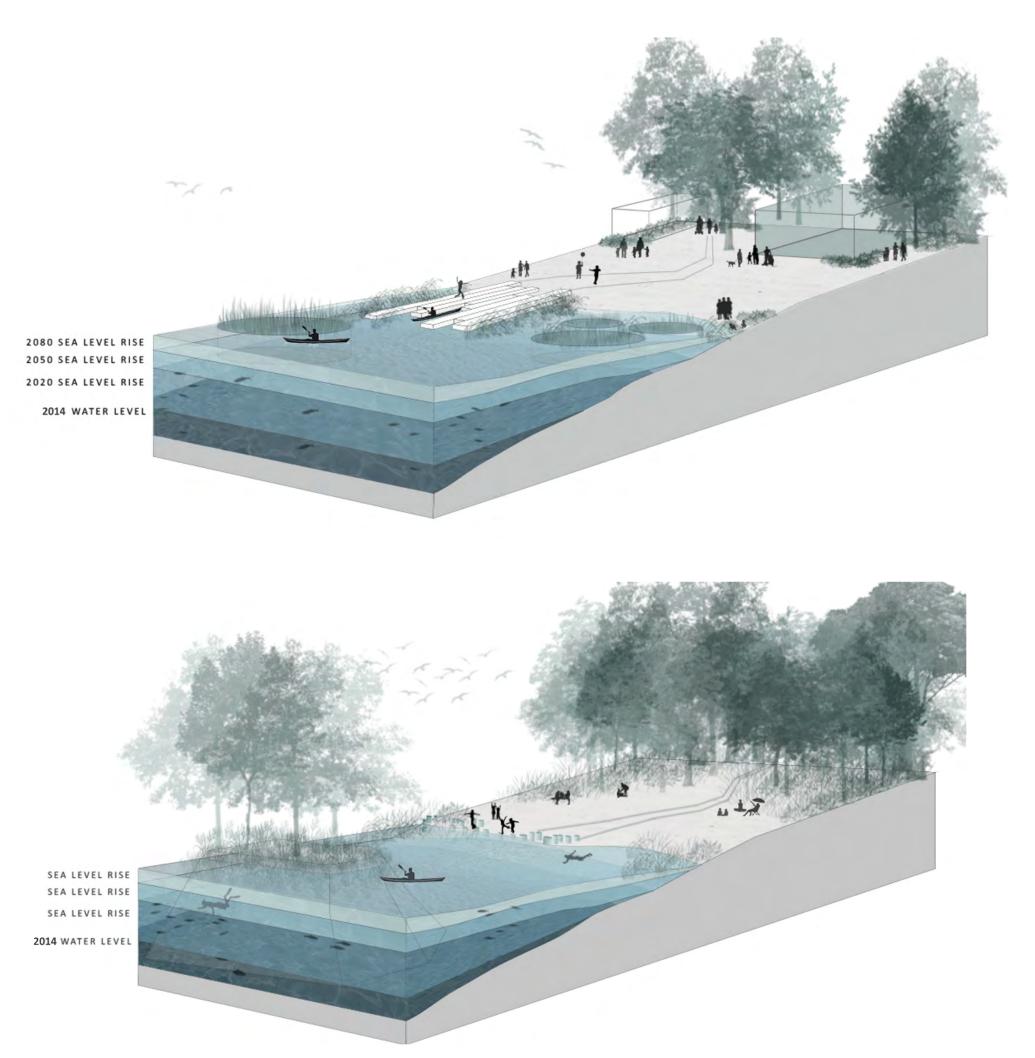


By planning and designing thoughtfully for sea level rise and periodic flood events, the Kingston Point Park waterfront can continue to provide recreational and ecological benefits over time to the city.



III. Designing Waterfronts for Change Over Time







Kingston Point Park

TRACING TIME

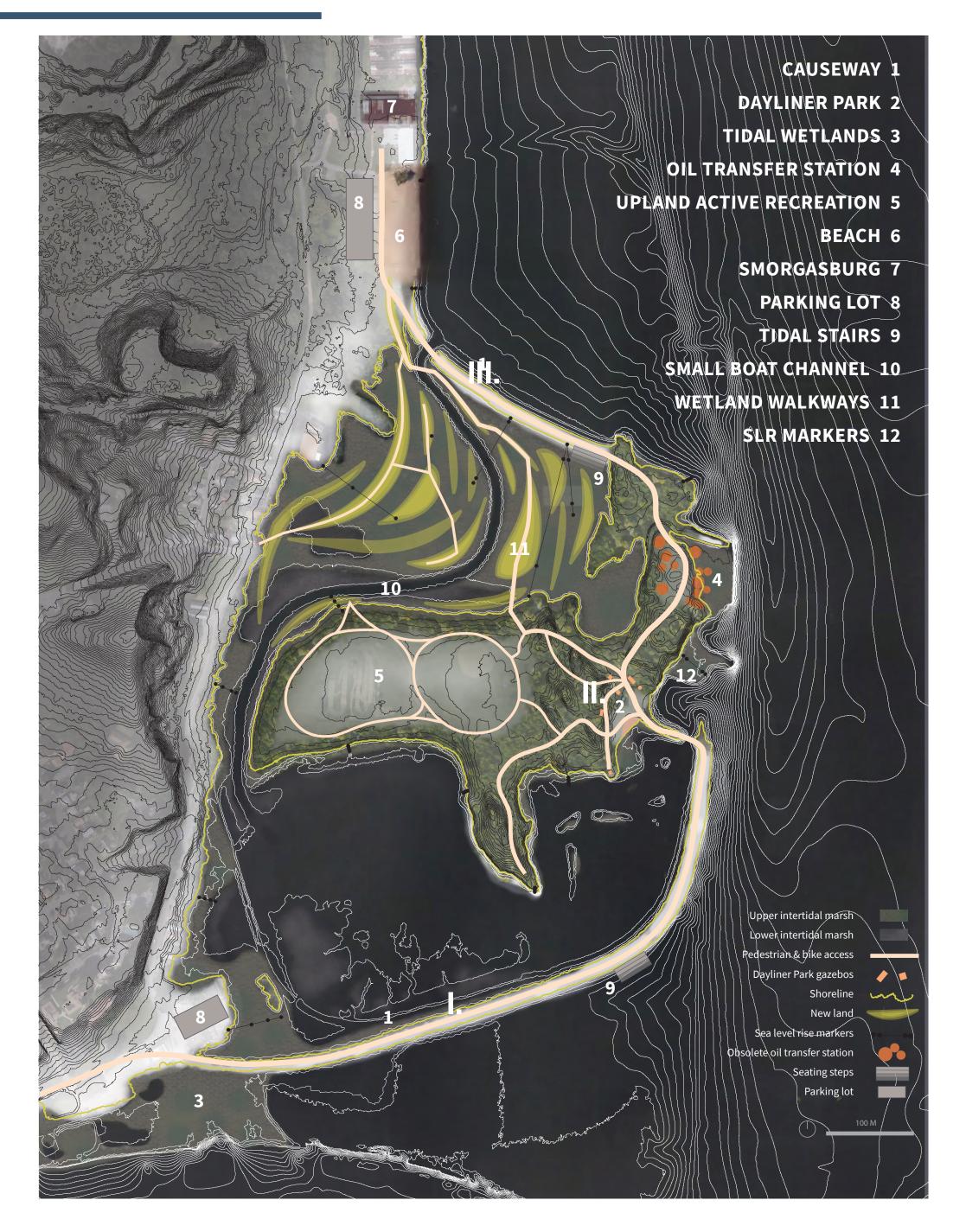
Student Design Team: Daisy Hoyt (MLA '18) and Theresa Russwick (MLA '18)

What is this project about:

"The Tracing Time design alternative features a series of interventions focused on documenting and memorializing landscape change over the years, referencing past, present, and future uses. Pedestrian and cycling paths atop berms of different elevations disappear and must reroute with sea level rise, reminding future visitors of the site's prior uses." - Daisy Hoyt and Theresa

Russwick

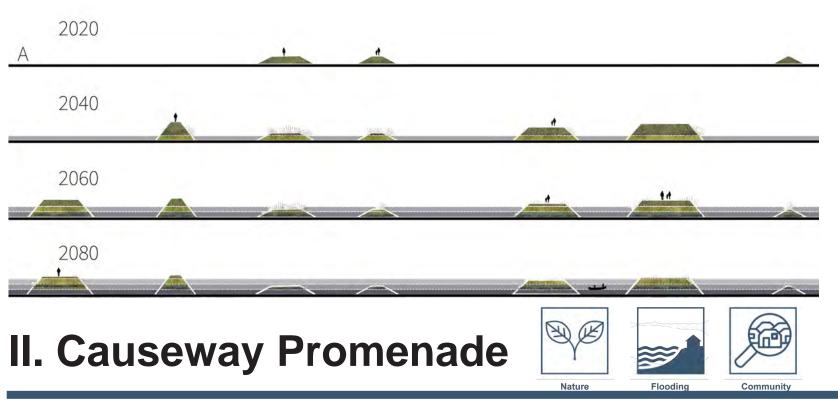
2080 Masterplan



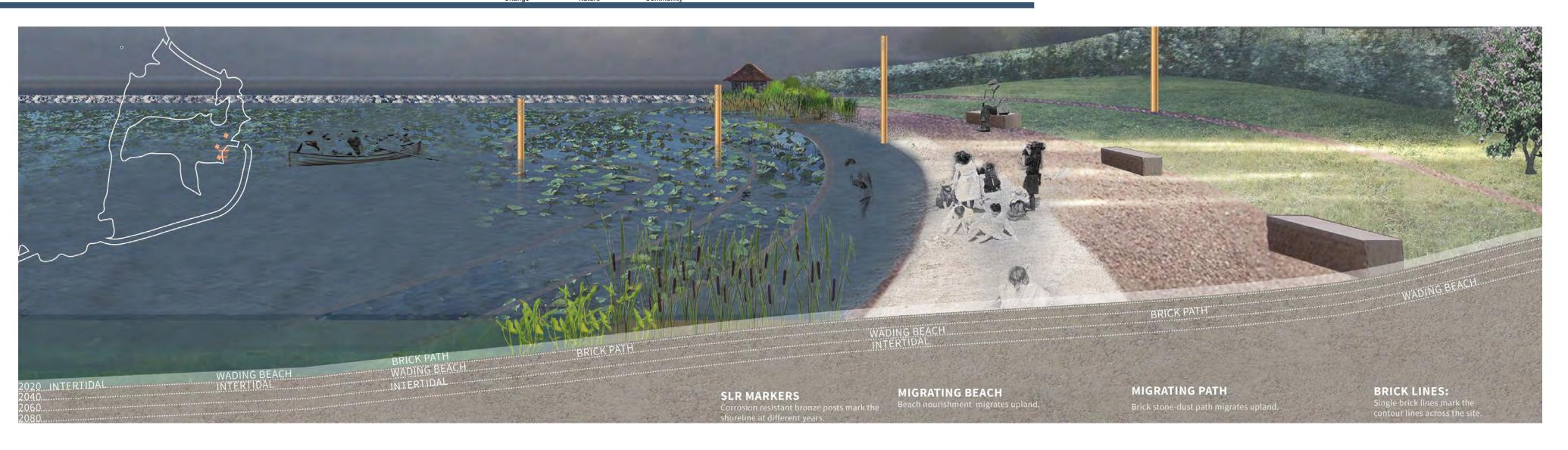
III. Revealing the Future Through Interpretive Shorelines

The beach and walkways of Dayliner Park would slowly migrate upland with sea level rise, a process delineated with markers and brick lines that register both past locations where the path had once been and future locations where it must move as water levels change.









I. Creating Recreational Spaces Adapted to Future Flooding



Dayliner Park would invite visitors into staggered wetland waterways that adjust over time with the rising water levels. The berms were inspired by other historical causeways along the Hudson River which unintentionally created wetland habitat behind them.

The limestone causeway promenade would open up a new route for the people of Kingston to enjoy the waterfront while protecting the wetlands that form behind it.



East Strand/Ponckhockie

TUNING UP

Student Design Team: Shealyn Wan (MLA '19) and Yixuan Li (MLA '19)

What is this project about:

"Tuning Up proposes to adjust the Kingston Waterfront area along Rondout Creek in terms of six major aspects to achieve a more resilient Kingston in the future. These aspects are categorized as opportunities and restraints which we found through our site analysis, including habitat conditions, access and open space, tourism resource, flood and tidal risks, brownfield risk, and sea level rise risk. To approach such goals, all of our actions form from points of site-specific strategies, to lines of protection, and eventually to an overall sustainable surface."

- Shealyn Wan and Yixuan Li

2080 Masterplan



0	Ecological Shift
J	New Floodable Developments
K	Connections
	Wetland Park
M	Removed Modular Units

II. Creating Access to a New Shoreline

At the easternmost edge of East Strand, adaptation to the new water level requires two different treatments of the edge created by the raised access routes. The landward edge creates calmer waters behind it as sea levels rise while the riverside edge give visitors a vast view of the Rondout in the near-term.

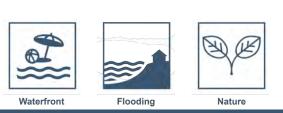


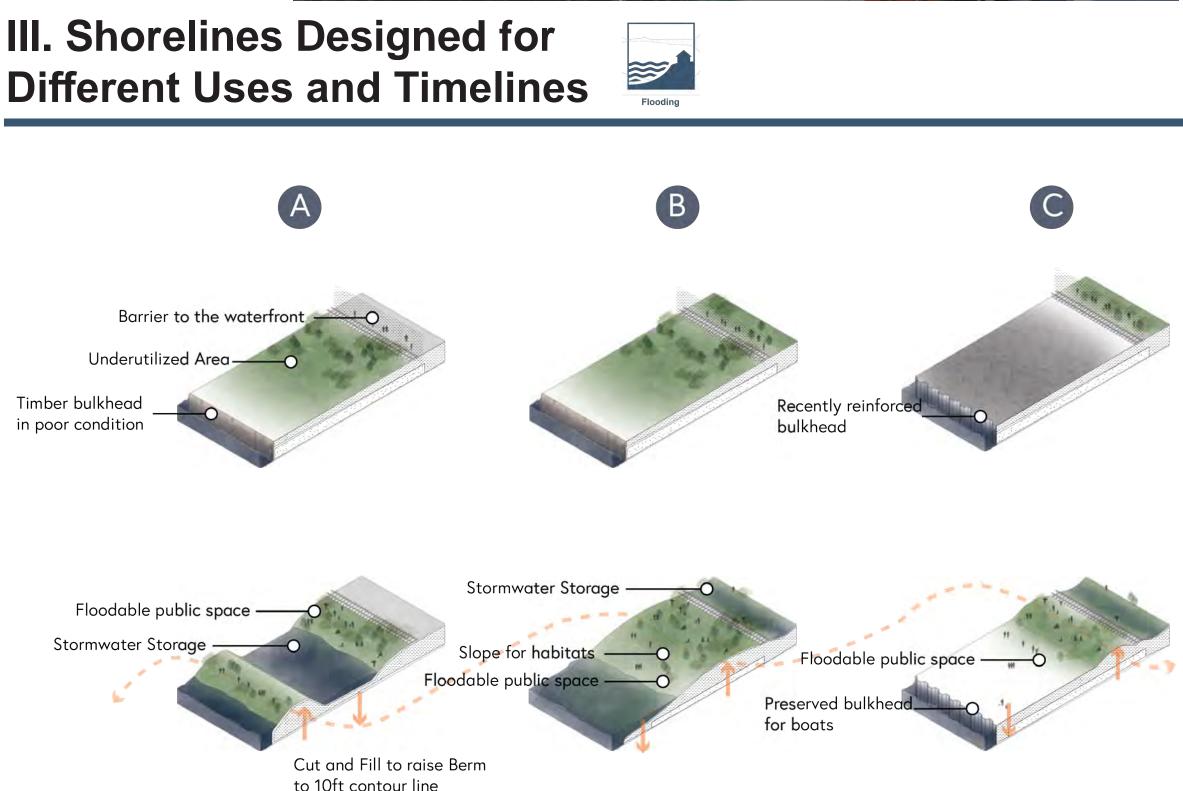
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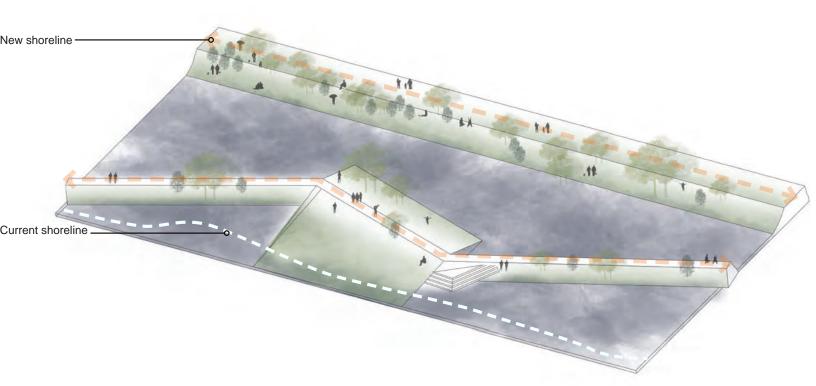
I. Imagining a Floodable Event Space



New open spaces on the Rondout Riverfront along the East Strand would provide attractive waterfront features, yet are designed to be floodable during tidal cycles, and extreme rain and flood events. The open spaces support various community activies such as concert staging, farmers markets and other public or private events.



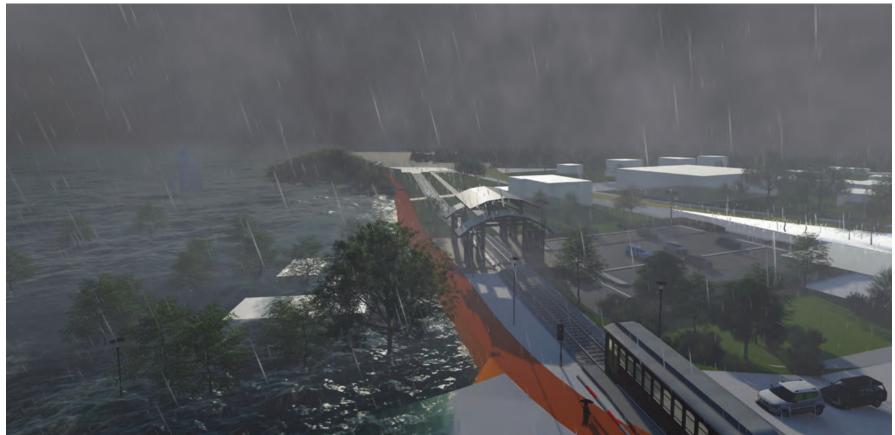






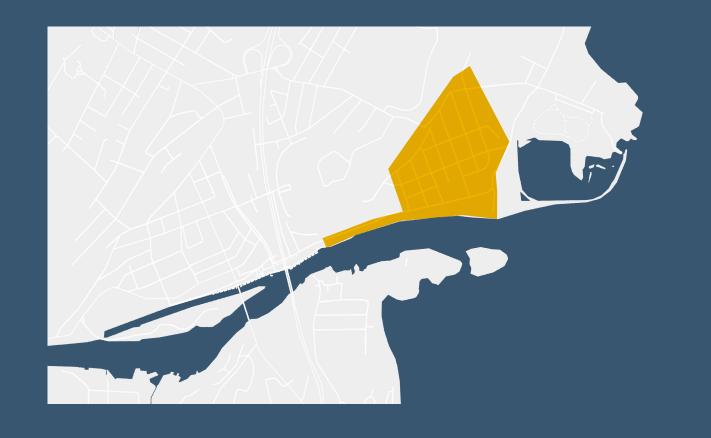






When reinforcement is necessary to protect infrastructure, these solutions can be combined with nature-based strategies to limit ecological impacts and provide additional benefits.

2080 Masterplan



East Strand/Ponckhockie

PONCKHOCKIE'S WORKING WATERFRONT

Student Design Team: Liz Fabis (MLA '19) and **Eve Anderson (MLA '19)**

What is this project about:

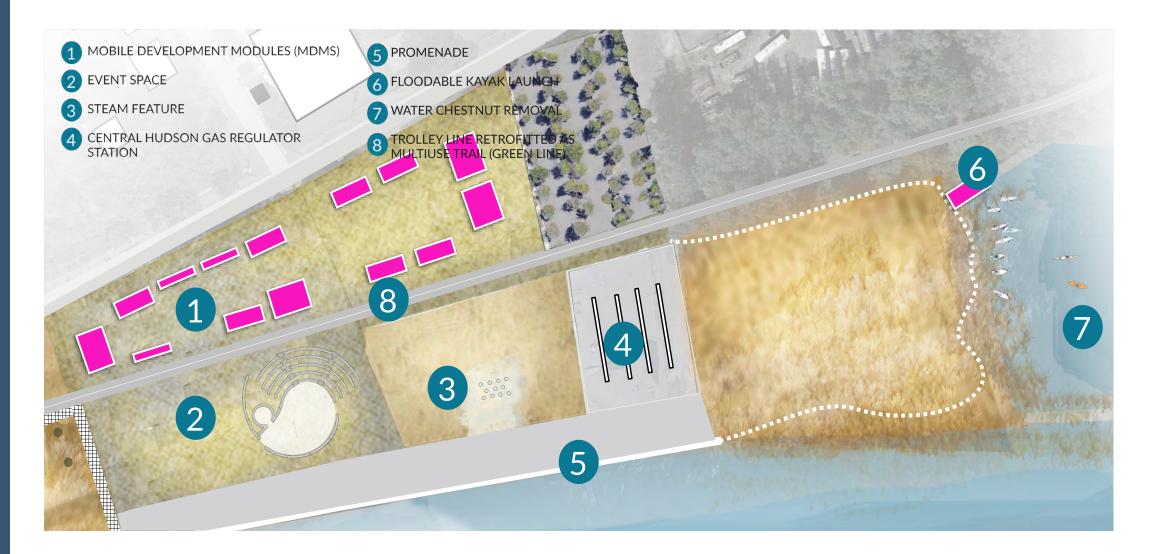
"Ponckhockie's Working Waterfront repurposes past and current industrial waterfront infrastructure to create a more climate adaptive community. In this project, Ponckhockie's cement legacy becomes a bridge between the neighborhood's material history and a future where industrial, recreational, and ecological functions of the waterfront coexist."

- Liz Fabis and Eve Anderson

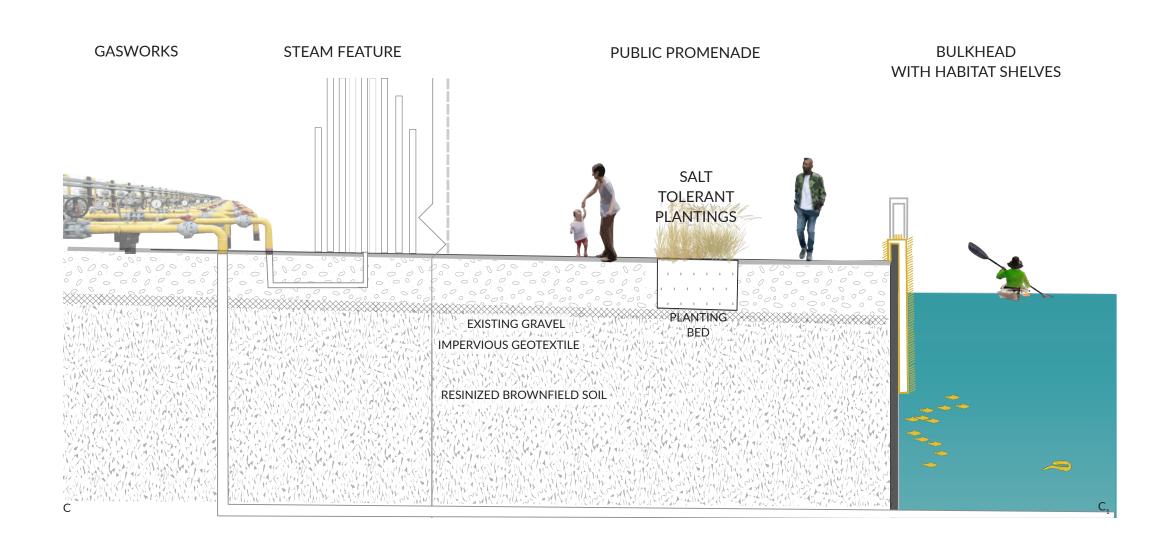


II. Adding Ecological Elements into Existing Infrastructure

Existing bulkheads can stabilize shorelines, yet their simple, contiguous forms have limited ecological value. Adding texture and structure to the smooth surfaces, in this case in the form of 'habitat shelves,' enhances habitat quality for species, contributing to local ecosystems.







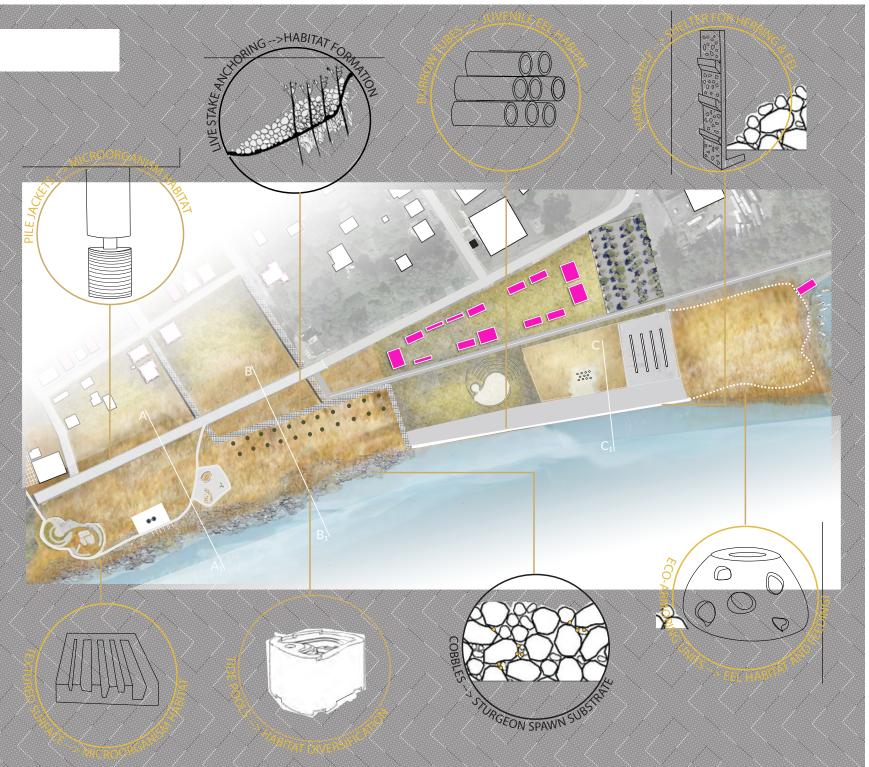
III. Adapting Site Uses to Change



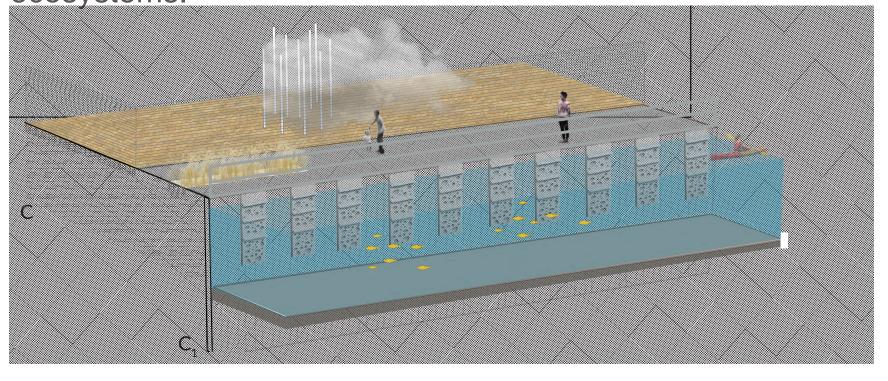


I. Incorporating Habitat Complexity into **New Shoreline Construction**



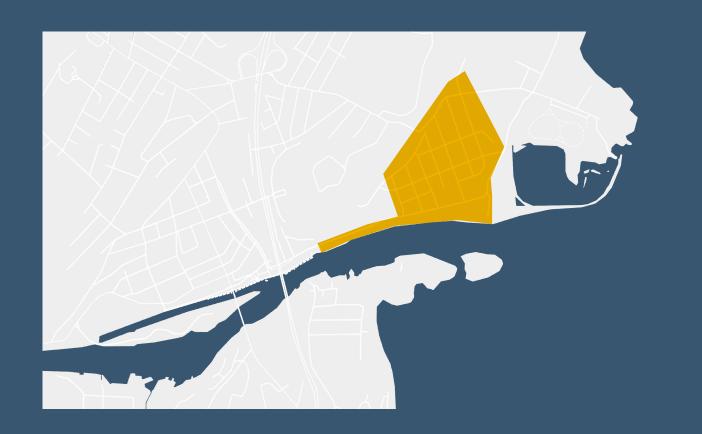


These diagrams show a set of possible waterfront interventions that can stabilize shorelines while enhancing habitat quality. Many are structural features that can create refuge for aquatic species of various sizes, adding diversity to nearby ecosystems.



This project proposes deployment of "Mobile Development Modules" (MDM's) as sustainable economic development that can be moved upland as sea level rise continues. Uses of these structures can vary based on needs and interests in Ponckhockie and the city at-large, including possible

partnerships with nonprofit organizations and creation of food markets.



East Strand/Ponckhockie

REVEALING **KINGSTON'S** WATERFRONT

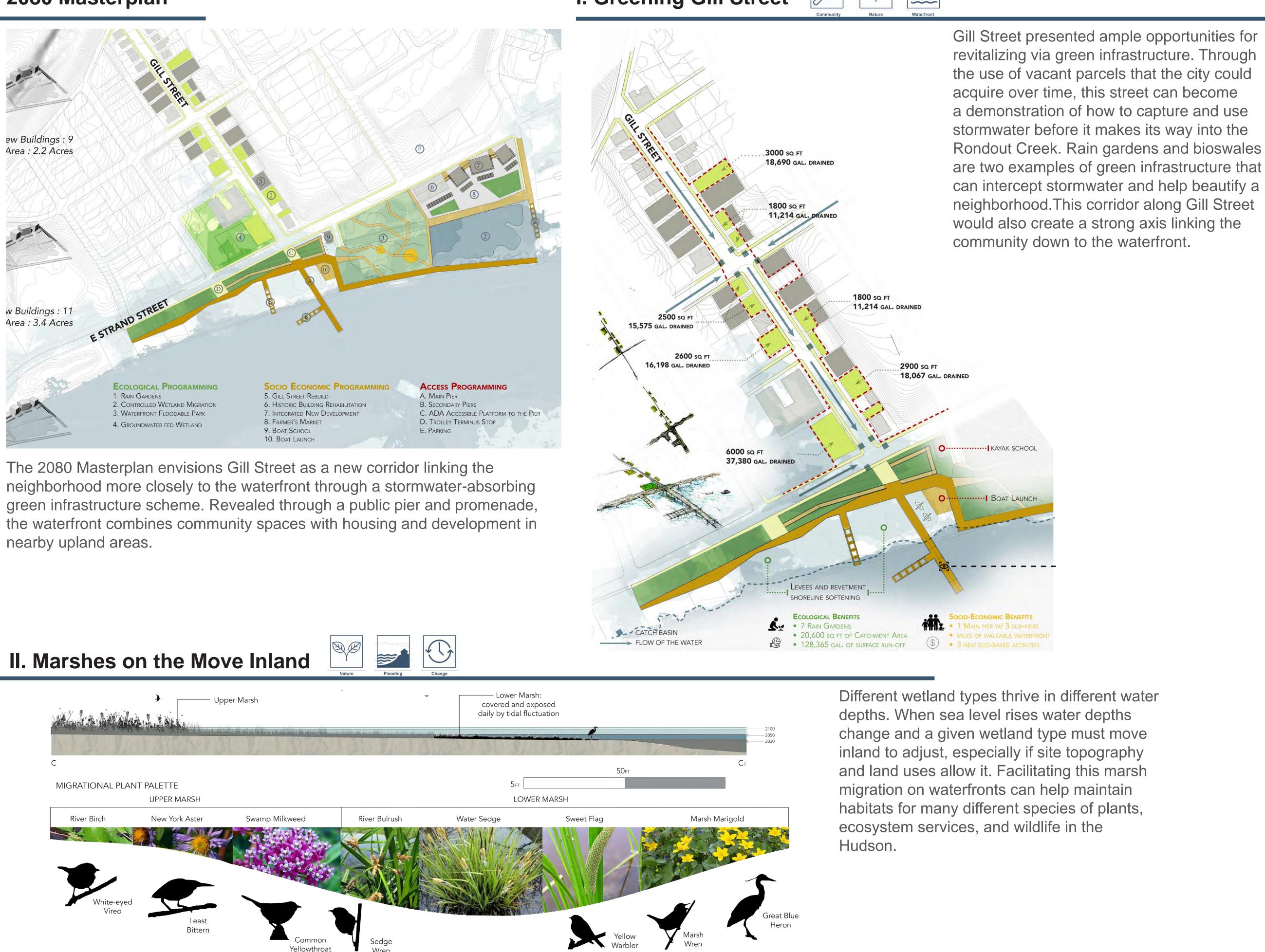
Student Design Team: Sarah Boutata (MLA '19) and Kayla Mosebrook (MLA '19)

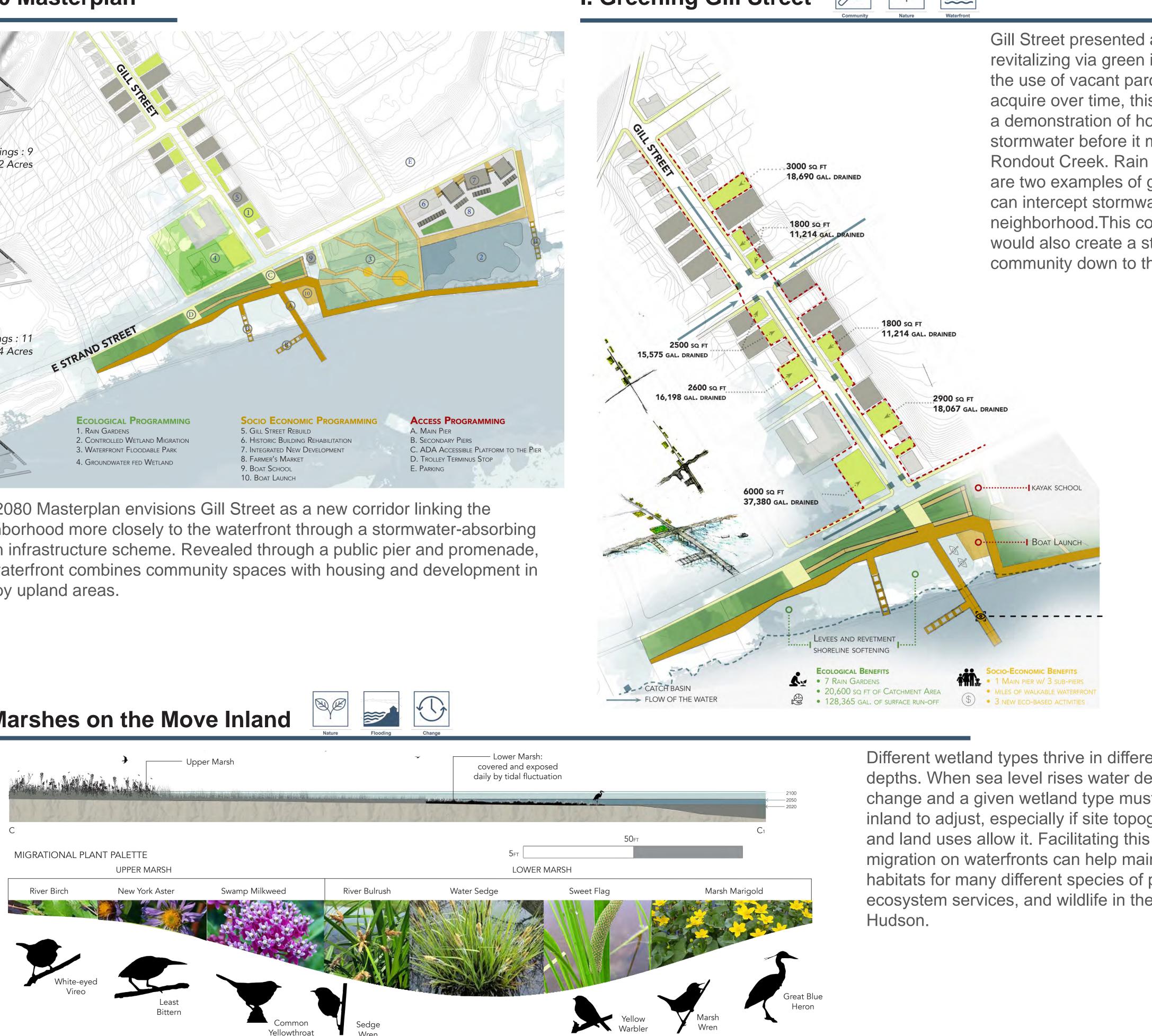
What is this project about:

"This project is about revealing processes at work such as stormwater management, tidal fluctuations, and marsh migration. The concept begins on Gill Street, using vacant parcels to create a green infrastructure corridor that leads the community down to the waterfront where a perpendicular axis provides community space and facilitated marsh migration."

- Sarah Boutata and Kayla Mosebrook

2080 Masterplan





I. Greening Gill Street



Different wetland types thrive in different water depths. When sea level rises water depths change and a given wetland type must move inland to adjust, especially if site topography and land uses allow it. Facilitating this marsh migration on waterfronts can help maintain habitats for many different species of plants, ecosystem services, and wildlife in the