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Design for Climate-resilient Hudson River Communities

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Image by Thackston Crandall and Veronica Chan, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

Abstract

This project investigated planning and design implications of emerging municipal climate adaptation interests by developing alternative strategies for two project locations, the Kingston Point Park area located in City of Kingston, New York and for the Hudson riverfront of the Village of Piermont, New York. The project was developed in the spring 2017 LA6020 second-year graduate design studio and the fall 2017 LA4010 fourth-year undergraduate studio at Cornell University Department of Landscape Architecture. Each project accessed a climate-adaptive design framework approach to understand projected climate change impacts, risks, and potential climate adaptation opportunities for the waterfront locations. Studio participants reviewed planning and policy documentation, conducted contextual analysis and site reconnaissance, interviewed stakeholders, and shared their initial design concepts with stakeholders for comment and revision. Each design team then developed an alternative design concept that addressed projected climate change risks in combination with urban revitalization goals and other interests. These concepts included provision for flood-adapted landscapes and structures, waterfront park and open space, green infrastructure, contributions to urban ecosystems, phased retreat strategies and/or other features. Final design boards were shared in an open house style format with stakeholders at the end of each studio. The alternative design concepts developed for these locations can serve as case studies for other municipalities seeking to confront climate risks to their water systems, built environment, ecosystems and community as their municipality changes and grows.

Three Summary Points of Interest

- **Many Hudson River waterfront communities are subject to climate change-associated risks, but few climate adaptation precedents are scaled to the size of these municipalities**
- **Two academic design studio project teams each worked either with the Kingston Point Park waterfront or the Piermont waterfront, and their respective community stakeholders, to explore projected climate change impacts and potential climate adaptation options**
- **During this design process, alternative design concepts (ten for Kingston and five for Piermont) were generated to address goals for climate adaptation and urban revitalization in these locations.**

Keywords: climate-adaptive design, urban resilience, community engagement, urban ecological design

Introduction

Climate change and will have far-reaching impacts on urban environments and land uses. Many cities are or will be subject to extremes in temperature and precipitation, sea level rise and/or changing flood elevations, with diverse impacts on human and natural systems. For some cities, there is an emerging understanding that we need to be thinking of multiple adaptation responses, each folded within important municipal objectives for growth, revitalization, and other goals.

This research investigates the potential for incorporating climate adaptation options into revitalization strategies for locations in the City of Kingston, New York and the Village of Piermont, New York. Each project explored a methodology (piloted in 2015 in the Village of Catskill, explored further in subsequent semesters in City of Hudson and City of Kingston) for engaging waterfront community stakeholders around a climate-adaptive urban planning and design process that incorporates aspects of participatory action research (Deming and Swaffield, 2011). The projects accessed academic-public and other partnerships to create an expert-rich, studio-based process for delivering alternative design concepts that engage community members within a single, semester-long timeline for each project. A project description and outcomes for each of the two site locations investigated are described below.

Like many Hudson River waterfront municipalities, the City of Kingston is experiencing growing urban redevelopment interest. Kingston is a city with historically strategic importance, serving as a port in the canal era. Kingston is bordered by both Rondout Creek to the south and the Hudson River to the east. Much of the low elevation area adjacent to the waterfront will be subject to flooding and inundation projected with climate change. Kingston Point, the project study area investigated in spring 2017, encompasses the existing Kingston Point Park, an oil transfer facility, and a large wetland at the confluence of Rondout Creek and the Hudson River (Figure 1). It sits at the confluence of Rondout Creek and the Hudson River itself and is one of the few publicly available waterfront access locations in Kingston. The park offers a variety of programmed and unprogrammed park uses including a beach, nature trail and wetland area, fenced dog exercise area, playfields and a BMX bike course. At the tip of the park is a privately-owned oil transfer facility, which shares vehicular access with the park via a single road. Kingston Point sits roughly one mile from the increasingly active West Strand Historic District along the Rondout. An historic trolley runs from the district along a set of trolley tracks on a levee to the far end of the park on the water. Also nearby is the historic Rondout Lighthouse, a popular landmark that still serves as a navigational light. Portions of the site are currently subject to tidal and storm-associated flooding from the Hudson River.

Figure 1. Kingston Point study area, outlined in red in the aerial photo. (Image adapted from aerial imagery by Google Earth)

Much of the Village of Piermont sits at the base of the Palisades escarpment, with its historic neighborhoods and downtown district only a few feet above sea level. It is also adjacent to Sparkill Creek to the south, which meets the Hudson River at Piermont Marsh, a tidal, brackish wetland. Piermont is a village with historically strategic importance. The Sparkill Gap, the only sea-level gap in the Palisades, historically offered access inland via the creek for maritime trade and, later, waterfront access for railroad from the west. More recently, it has developed a significant arts community and serves as a destination for cyclists, hikers, birders, and other tourists interested in its natural surroundings, casual dining, and local shops.

The Village of Piermont currently experiences strong real estate development interest due to its proximity to New York City, which makes it not only an

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accessible day-trip for tourists but also a convenient and desirable location for commuters and retirees. In recent decades, high-value waterfront condominiums and new shopping and dining locations have expanded the downtown area onto the village's formerly industrial pier.

The project study area investigated in fall 2017 encompasses the entirety of the Village of Piermont (see Figure 2), including the waterfront and pier, marinas, downtown area, historic neighborhoods, newer developments, creek, marsh, and other unique ecological features.

Figure 2. Village of Piermont, outlined in red in the aerial photo. (Image adapted from aerial imagery by Google Earth)

Because of the village's unique geography, flooding from storm surge affects the village's waterfront neighborhoods along Sparkill Creek and a large portion of the downtown district including key municipal and emergency service locations. Some of these areas are also currently impacted by tide-based flooding during "higher high" tides. Additionally, Sparkill Creek which drains to the Hudson River at Village of Piermont has significant water quality issues. Given the scarcity of elevated, developable land within the village, local options for relocation due to flood risk are limited. Over time, Piermont's waterfront is projected to be subject to increased frequency of flooding and precipitation and/or permanent inundation from sea level rise in certain locations along the Hudson and lower Sparkill Creek. Many residents consider the risk of flooding from storm events and sea level rise to be an existential threat to the community.

This project investigation proposed alternative planning and design strategies for Kingston and Piermont that explore new futures for their respective waterfronts to better understand how a design studio process may inspire climate awareness and interest toward action as municipalities grow and change.

Results & Discussion

Cornell Landscape Architecture's LA6020 second year, second semester graduate studio focused on the Kingston Point Park location in spring 2017. Ten teams of graduate students in the studio each developed an alternative design concept for the Kingston Point project area. Each generated options for climate adaptation that included floodable park spaces and programs, while seeking to link interventions to community and ecological benefits for Kingston's waterfront. The ten projects and select highlights are briefly described below.

Figure 3. Deconstructed oil tanks form a sculptural landscape evoking the site's history (top), while other waterfront elements highlight sea level rise through the years in Tracing Time. Images by Tess Ruswick and Daisy Hoyt, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

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1) The "Tracing Time" design alternative (Tess Ruswick MLA'18 and Daisy Hoyt MLA'18) 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 (Figure 3).

2) "Weaving the Waterfront" (Luyao Kong MLA'18, Hong Gao MLA'18, and Qianli Feng MLA'18) focuses on public space, wetland restoration, and developing climate-resilient programs and interventions to build upon both ecological and scenic value in Kingston's future waterfront. Areas projected to be inundated are planted to become wetland, while an innovative design approach maintains the existence of regionally significant public beach as parts of the park are inundated Figure 4). Elevated walkways carry visitors over land and water alike, tying together key site elements such as the new Smorgasburg location and the former oil station. This project was nationally recognized with a Student Honor Award for General Design by the American Society of Landscape Architects in 2018.

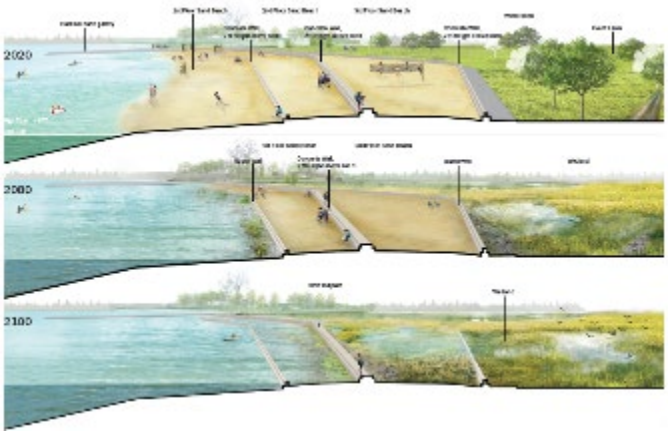

Figure 4. With sea level rise, low retention walls that stabilize a man-made beach become elevated walkways between different stages of marsh migration with sea level rise in Weaving the Waterfront. Images by Luyao Kong, Hong Gao, and Qianli Feng, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

3) Topographic moves link water and terrain, creating novel land and water forms in "Kingston Cove: Rising Together" (Kari Spiegelhalter MLA'18 and Katherine Goodrich MLA'18). The "North Cove" maintains swimming access and nature trails, while the "South Cove" harbors unique installations that allow visitors to participate in transitioning wetland communities as water depths change with sea level rise (Figure. 5).

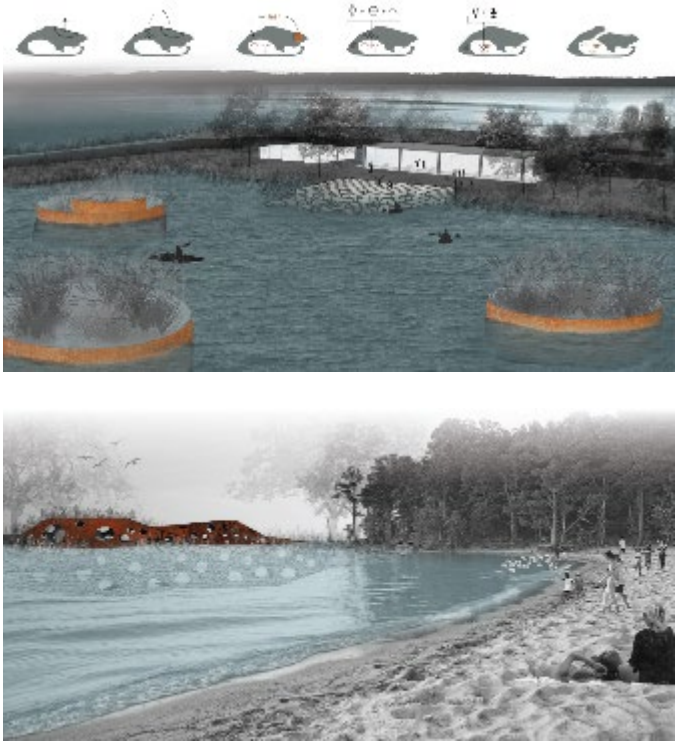

Figure 5. Kingston Cove: Rising Together Sculptural shorelines invite visitor interest and inhabitation by aquatic animals alike. Images by Kari Spiegelhalter and Katherine Goodrich, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

4) "Actipelago" (Yifu Kang MLA'18 and Xuru Yuan MLA'18) pursues the idea of an archipelago or island-complex as a metaphor while assembling places of high recreational and ecological value. Both terrestrial and aquatic interventions create places within the design for recreational activities and flood adaptability as the site changes over time (Figure 6). Actual islands created within the proposal, while inspirational, would likely be difficult to permit in reality.

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Figure 6. Floodable parks and expanded wetlands make the most of sea level rise in "Actipelago." Images by Yifu Kang and Xuru Yuan, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

5) "Blue: Kingston's New Green" (Parth Divekar MLA'18 and Sara Vandenbroek MLA'18) most significant move is to cut a new channel through Kingston Point (Figure 7). The depth of this channel is designed so that with anticipated sea level rise, recreational and ecological benefits are made possible. Sets of designed experiences, including a notable bridge as the primary access to the park across the channel, take advantage of waterfront access to heighten attractive interest in the park from Kingston residents and beyond, possibly with economic benefits.

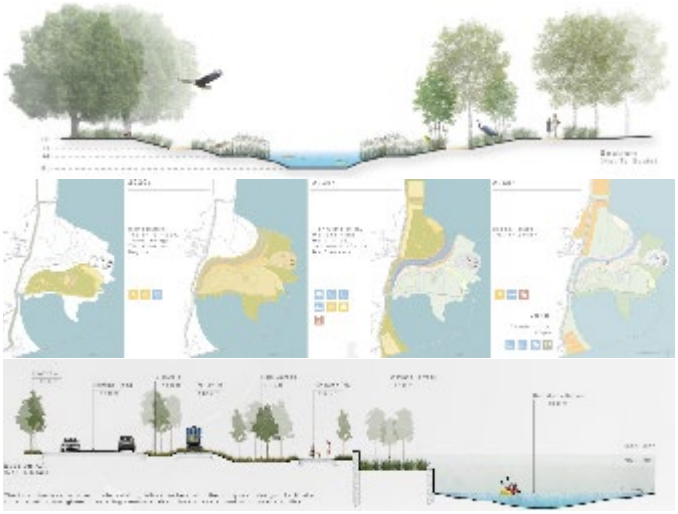

Figure 7. Sections and phasing of remediation, wetland expansion, and pedestrian trail extension in Blue: Kingston's New Green. Images by Parth Divekar and Sara Vandenbroek, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

6) The "Coexist with Time" (Mengtian Song MLA'18 and Zhuo Cheng MLA'18) design alternative also cuts a canal through the site, using the excess material to create other features beneficial to the park. Features include transition to multipurpose park land over specialized uses that don't benefit from a waterfront location, elevation and protection of the trolley line, sculpting of underwater substrate to introduce a variety of wetland types, and repurposing the oil transfer facility elements as focal points for an ecologically-oriented park (Figure. 8).

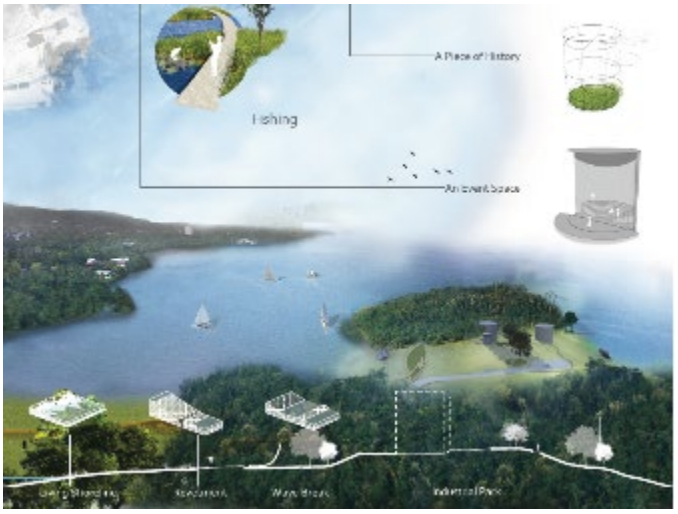

Figure 8. Coexist with Time proposes different

shoreline interventions to maintain the park amidst future flooding and sea level rise. Images by Mengtian Song and Zhuo Cheng, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

7) “Kingston Point Park: Floating with the Tides” (by Kelly Farrell MLA’18 and Yuting Liu MLA’18) maintains access by elevating the main access road as a causeway and widening and elevating the existing trolley alignment to include pedestrian and bike access. Wetland diversity and habitat is supplemented by introducing floating wetland modules throughout the southern portion of the site to create lower intertidal condition that will transition into submerged aquatic vegetation substrate (Figure 9). Docks proposed on the north side of the site would create educational and recreational spaces that float as the river rises. A proposed jetty to protect the beach from continue sand loss would likely be challenging to permit if pursued.

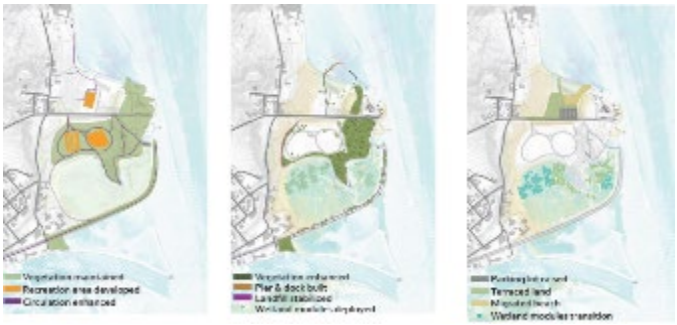

Figure 9. Kingston Point Park: Floating with the Tides phasing of landfill stabilization, circulation and vegetation enhancement, and floating wetland module deployment and transition. Images by Kelly Farrell and Yuting Liu, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

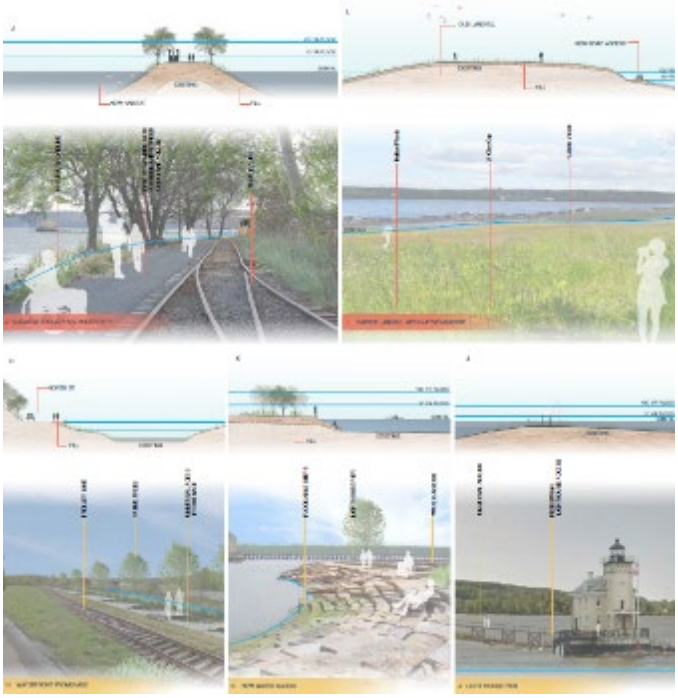

Figure 10. Elevated above sea level projections, trolley and pedestrian paths connect visitors to sites new and old, including the Rondout Light and new meadow, in Investing in Kingston Point Park. Images by David Ffrench and Meagan Rogowski, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

8) Accessibility and history take strong precedence in “Investing in Kingston Point Park” (David Ffrench MLA’18 and Meagan Rogowski MLA’18). An elevated and widened trolley causeway maintains pedestrian access to the Kingston Point and a long pier maintains access to Rondout Lighthouse over time (Figure 10). These features as well as a bridge over areas of future inundation on the west side of site invite users to access recreational assets maintained with sea level rise. These include the beach which is moved to higher ground on the northern point of the property and a hotel proposed on and adjacent to the former oil transfer facility property.

9) Anticipating change over time, “Set into Motion” (Thackston Crandall MLA’18 and Veronica Chan MLA’18) proposes several modular responses inspired by the growth patterns of barnacles. Recycled rubble fills mound-shaped wave breaks to

protect shorelines from debris and ice shear. Modular "marsh ramps" create varied topography underwater to accommodate wetland plant communities with different inundation tolerances. Modular docks and piers create a network of public spaces that invite varied uses. Floodable natural and programmed areas improve adaptive capacity of public uses (Figure 11).

Figure 11. Floodable forest changes over time in Set into Motion. Image by Thackston Crandall and Veronica Chan, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

10) "The Kingston Loop" design (Li Bai MLA'18 and Yuting Liu MLA'18) links proposed park assets through a set of two thematic walkways. The "Cultural Loop" links constructed features in the park, while the "Eco Loop" takes visitors through diverse habitat types and adaptive features including wetlands, living shorelines, and green infrastructure interventions . Water-dependent and water-enhanced recreational uses are featured throughout, encouraging residents to visit and remain invested in the park (Figure 12).

Figure 12. Ecological assets such as living shorelines and crib walls are featured alongside walking trails in The Kingston Loop. Images by Li Bai and Yuting Liu, Cornell Landscape Architecture 2017 LA6020 Integrating Theory and Practice II.

All of the final boards for the project were displayed in an open house for stakeholders and other interested parties on May 15, 2017 at Kingston City Hall. While the academic studio portion of the project is complete, DEC, Columbia-Greene CCE and Ulster CCE partners continue to follow up with municipal and organizational stakeholders in Kingston to offer technical support and provide information about future funding opportunities. A third studio is also scheduled in Spring 2018 with City of Kingston.

Cornell Landscape Architecture's LA4010 senior undergraduate studio focused on the Village of Piermont project location in Fall 2017. Five alternative concepts merged climate-adaptive design strategies with potential for growth of Piermont's waterfront and downtown. The five projects and select highlights are briefly described below.

1) The "Piermont Nexus" alternative design (Woo Young Choi BSLA'18, Yiren Du BSLA'18, and Shaun Wu BS URS'19) proposes three nexus points on the waterfront – a "New Urbanist Hub" with a community park and program space located near present-day Flywheel Park, an elevated promenade on the "Pier," and a protective "Terrace" at Ferry Road and Piermont Avenue (Figure 13). The design concept includes elevated roadways and the construction of a "megaberm" using materials repurposed from the demolition of the old Tappan Zee Bridge, upon which the new town center is

elevated above projected sea level rise and flood elevations.

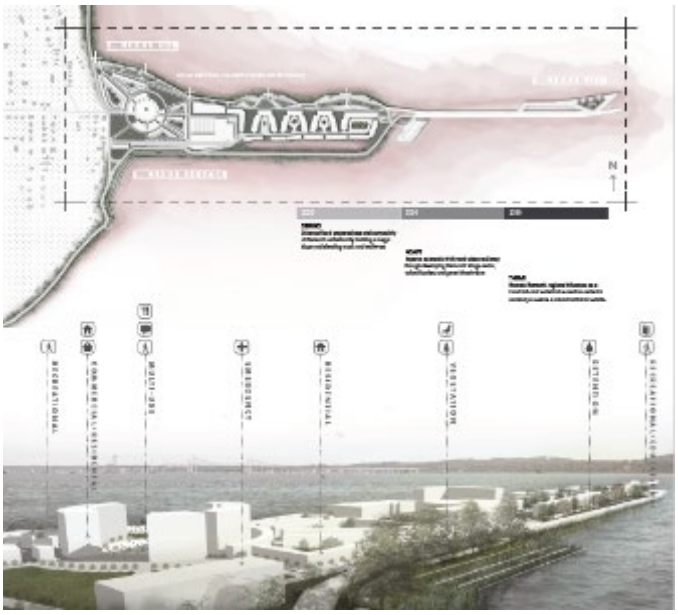

Figure 13. In Piermont Nexus, demolition of the nearby Tappan Zee Bridge provides fill for an elevated "megaberm" where a new residential and commercial town center featuring flexible public spaces for social and cultural community events would be located . Images by Woo Young Choi, Yiren Du, and Shaun Wu, Cornell Landscape Architecture 2017 LA4010 Urban Design Studio.

2) "Evolve // Connect // Redefine" (Trevan Signorelli BSLA'18, Erin Tou BS URS'18, and Cristian Umaña BSLA'18) reimagines Piermont as a waterfront community by applying several major moves. Construction of a channel as part of the Hudson in the lowest elevation areas of downtown would be accompanied by bridge spans over it to connect the existing downtown main street area to the existing condominium complex (Figure 14). Neighborhoods most susceptible to flooding on the southeastern end of the village would be relocated or replaced with amphibious housing, while seawalls and berms that also serve as walking paths and ecological buffers would limit flooding in other neighborhoods along the Hudson and Sparkill. Finally, an elevated pier north of the village would provide a second commercial waterfront location for Piermont.

Figure 14. Evolve // Connect // Redefine proposes a channel through downtown in place of land that would be otherwise lost to projected sea level rise. Image by Trevan Signorelli, Erin Tou, and Cristian Umaña, Cornell Landscape Architecture 2017 LA4010 Urban Design Studio.

3) "[Re]Appearing Piermont" (Blake Enos BSLA'18, Jacob Kuhn BSLA'18, and Sage Magee BS URS'18) proposes strategic relocation and/or amphibious housing in low-lying southeastern neighborhoods of the village to allow for marsh migration, with public access provided to the marsh via a boardwalk. As Piermont Avenue becomes more susceptible to flooding and inundation over time, elevated walkways will provide pedestrian access to the second stories of commercial buildings. Near downtown, a park above a parking garage and a new flood-adapted Flywheel Park provides open space between the marsh to the south and new wetlands on the north side of the pier (Figure 15).

4) In "Culture-Led Adaptation" (Najila Ahsan BS URS'19, Caterina Brescia BSLA'18, Edna Samron BS URS'19, and Yuchen Tong BSLA'18), an upwardly spiraling art museum serves as a flood-adapted attraction nearby art-related galleries in Piermont, creating a new node of activity in Piermont's downtown. Parts of a one-way network of elevated roads are elevated to protect some downtown locations from flooding. Other neighborhoods projected to be inundated would be relocated to a proposed mixed-use development uphill that would allow residents to remain in Piermont while still having visual access to the Hudson River.

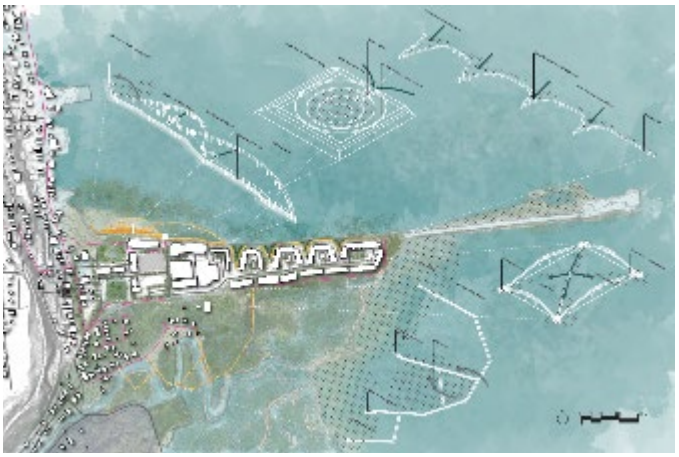

Figure 15. Strategic inundation and marsh migration weave waterfront habitat through the town in [Re]Appearing Piermont. Image by Blake Enos, Jacob Kuhn, and Sage Magee, Cornell Landscape Architecture 2017 LA4010 Urban Design Studio.

5) "Piermont: A New Beginning" (Abdulaziz Alrifaie BSLA'18, Lucas Bulger BS URS'19, and Naixin Ren BSLA'18) positions the entire village as an exhibition space for climate-adaptive interventions. A museum for resilience serves a dual function as a flood wall, while demonstrations of other adaptation techniques are exhibited outdoors by the northern edge of the condominium development. Elevated walkways throughout the village and marsh allow visitors to observe adaptation activities in action in the neighborhoods (Figure 16). A levee around much of the waterfront, which also doubles as a bike path, has a flood gate to the south of Piermont to allows movement of daily tides and Sparkill flows while protecting from certain flood events. The path sits atop breakwaters to the north of Piermont that can intercept debris projectiles during Hudson flood events.

Figure 16. In Piermont: A New Beginning, elevated walkways provide views of natural areas and adaptation activities throughout Piermont. Image by Abdulaziz Alrifaie, Lucas Bulger, and Naixin Ren, Cornell Landscape Architecture 2017 LA4010 Urban Design Studio.

All of the final boards for the project were displayed in an open house held on 12/12/2017 at the Piermont Village Hall, which was attended by approximately 80 stakeholders and interested parties.

Policy Implications

The design concepts for this project explored the potential for incorporating climate adaptation goals into long-term waterfront visioning and planning in ways that are accessible to the public. The studios opened up discussion amongst participating stakeholders about the projected impacts of climate change and possible strategies for climate adaptation amidst interests in waterfront redevelopment, natural resource conservation, and/or enhanced value for the community. While the academic studio portion of the project is complete, an exhibition of the work is planned in both cities, and participating DEC partners continue to follow up with municipal and organizational stakeholders in Piermont and Kingston to offer technical support and provide information about future funding.

Methods

The project began with collaboration with NYSDEC Hudson River Estuary Program staff to determine potential municipal locations for the project based on urban setting, policy, and projected future climate vulnerability. The sites in Kingston and Piermont were ultimately selected. For the Kingston Point project, the project team was composed of Associate Professor Cerra, Libby Zemaitis of the NYSDEC Estuary Program, Liz LoGiudice, Melinda Herzog of Ulster County Cooperative Extension and 21 graduate landscape architecture students. City of Kingston Mayor Steve Noble and Conservation Advisory Council chair Julie Noble were key partners during the project. Focused technical support was provided by multiple collaborators during the design process including members of the Cornell Soil and Water Lab, NYS Department of Environmental Conservation, Scenic Hudson, and others.

The Kingston Point project was developed in the spring 2017 LA6020 Climate-adaptive Design (CAD)

studio led by Cerra. Work began by accessing the *ClimAID Integrated Assessment for Effective Climate Change Adaptation* Technical and Synthesis reports (ClimAID Reports) (Rosenzweig et al. 2011a, Rosenzweig et al 2011b) and their 2014 update (Horton et al. 2014), to understand climate projections for the area. The design team accessed new GIS data developed by Columbia University that provides design flood location estimates based on a continuous flow model for design floods. Sea level rise elevations (SLR) and design flood data are linked in this dataset, so the design team cross-walked NYS Community Risk and Resilience Act (CRRA) high-scenario SLR projection elevations for the 2020's, 2050's and 2080's with the Columbia data to generate a revised GIS dataset to serve as flooding and inundation baselines for design in the studio (Spiegelhalter and Cerra, 2016). Mean Higher High Water (MHHW), Mean Sea Level (MSL), and Mean Lower Low Water (MLLW) elevations were estimated from the Hudson River Estuary Tidal Datums GIS dataset (Georgas, 2013). We accessed the Columbia University dataset to estimate the .1%, .02%, .01% and .002% flood elevations and areal footprints. While the project site would be subject to sea level rise and surge effects on the Hudson, we assumed the site would not be subject to Hudson River wave run-up impacts due to the location of the site relative to likely hurricane fetch vectors.

The project team used a comprehensive climate-adaptive design (CAD) framework (Cerra, 2016), modified for coastal communities, to categorize projected climate change impacts, climate-associated risks and potential adaptation options for addressing these risks. The CAD framework organizes adaptation options based on three general adaptation categories: water systems support (flood preparedness, low impact development), ecosystem support (landscape connectivity, resilient planting design, assisted marsh migration) and built environment support (flood-adapted structures and landscapes, urban heat island mitigation, multimodal mobility). The project team also consulted and added to a set of climate adaptation precedent case studies organized using this framework by previous CAD project studios.

During the analysis and concept development phases, two trips to the City of Kingston were conducted for field visits and interviews with project stakeholders including staff from the city, Scenic Hudson, NYSDEC, organizations and others located either downtown or along the waterfront. The project team broke into ten design teams to develop alternative concepts. During the second visit early design concepts were shared with stakeholders for discussion and feedback. Interviews, desk critiques by technical experts and formal studio reviews of the design concepts were conducted during the design development phase. Review critics included faculty in landscape architecture, practicing professionals, city staff and NYSDEC staff. Design teams incorporated critique to produce a set of final design boards for their design concept that included site plans, sections, perspective drawings, plant lists and/or performance metrics illustrating the project concepts. The final design boards were presented to stakeholders and interested parties during an open house on May 15, 2017, which was attended by about 50 stakeholders and invited guests.

The Village of Piermont project was developed in the fall 2017 LA4010 Climate-adaptive Design (CAD) studio led by Cerra. The project approach for the Village of Piermont site was similar to that of Kingston, with a few key differences. First, the design team for Village of Piermont in fall 2017 was composed of a combination of ten undergraduate landscape architecture students and six undergraduate Urban and Regional Studies students. Building on the Fall 2016 collaboration with Professor Todd Walter's Watershed Engineering course, during the second half of the semester engineering students also worked with the design teams during the design development phase to assist in green infrastructure facility sizing, surface flooding mitigation options, and other water-based technical aspects of the project designs. Despite extending the time for this cross-disciplinary interaction by two to three weeks compared to the fall 2016 course, student surveys from both courses again indicated that they enjoyed the cross-disciplinary activity but felt they would have benefitted from more structured interaction and time to work together. We will take these comments into account for future studio projects.

Outreach Comments

As discussed, the project was developed in collaboration with multiple partners and participants. Multiple individual and group meetings (in-person and via phone call and video conference) were also held with project stakeholders during the course of the project. Staff from the each of the respective cities, Scenic Hudson, NYSDEC, other state agencies, practicing professionals, several businesses and non-governmental organizations were engaged during the project's field visits, interviews, desk critiques and formal reviews.

The results of this project were shared with stakeholders in the final open house event for each of the cities. Approximately 50 people attended the Kingston event, and approximately 80 attended the Piermont event. Since, Estuary Program staff, Ulster CCE staff and other partners have maintained contact with City of Kingston and Village of Piermont to assist with moving adaptation interests forward.

The following governments, organizations, and businesses were engaged during the course of the project:

- City of Kingston
- Village of Piermont
- NYSDEC Hudson River Estuary Program
- Cornell Cooperative Extension
- Scenic Hudson
- Sustainable Shorelines
- Kingston Parks and Recreation
- Kingston Land Trust
- Hudson River Maritime Museum
- Heritage Energy
- Sparkill Watershed Alliance
- Hudson River National Estuarine Research Reserve
- Piermont Condominium Association

Student Training

Twenty-one graduate students and sixteen undergraduate Cornell design and planning students participated in climate-adaptive planning and design, and engagement methods with stakeholders. Approximately 25 engineering students also participated in the fall 2017 studio as described above. One graduate research assistant and one research fellow developed GIS flood layers for the project areas, assisted with project data collection and documentation, and coordinated design studio activities.

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