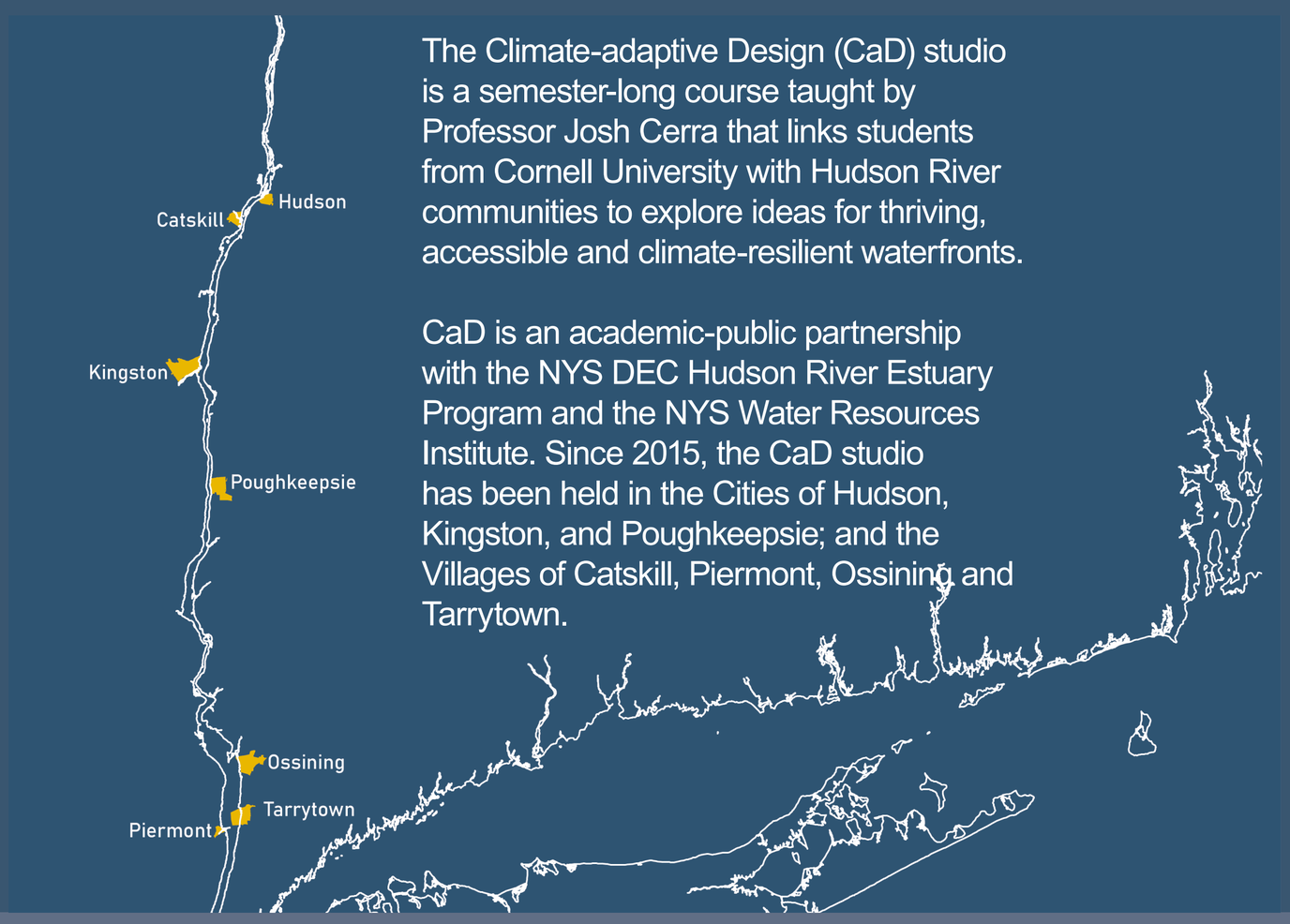
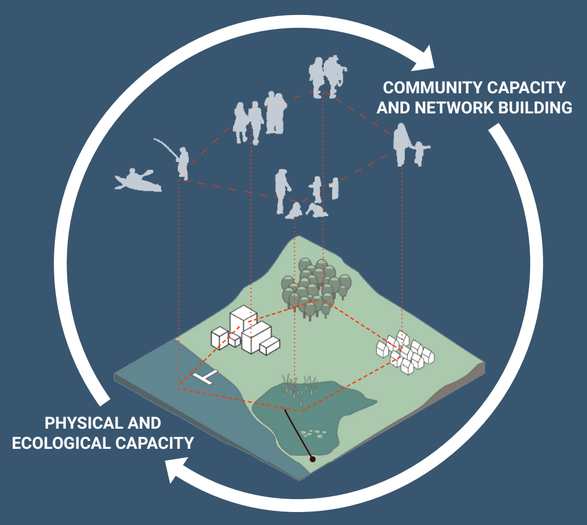
WHAT IS THE CLIMATE-ADAPTIVE DESIGN STUDIO?

Inspiring change for waterfront communities



The Climate-adaptive Design (CaD) studio is a semester-long course taught by Professor Josh Cerra that links students from Cornell University with Hudson River communities to explore ideas for thriving, accessible and climate-resilient waterfronts.

CaD is an academic-public partnership with the NYS DEC Hudson River Estuary Program and the NYS Water Resources Institute. Since 2015, the CaD studio has been held in the Cities of Hudson, Kingston, and Poughkeepsie; and the Villages of Catskill, Piermont, Ossining and Tarrytown.



CaD is grounded in the idea that by working with both people and place, we can build physical, ecological and community capacity to adapt to change. CaD helps to start conversations about adapting to climate change now, so that long-term planning can begin.

CaD studio process

Pre-semester meeting
CaD team meets with community core team

Early in the semester
Students collect and review site information

Back on campus
Student teams begin design concept development

Design feedback
Key stakeholders participate in on-campus studio reviews

Post-semester meeting
The CaD team reviews designs with stakeholders

August | September | October | November | December | January

First site visit
The class tours the host community and meets with stakeholders

Design concept workshop
Students meet with stakeholders to discuss early design ideas

Open house
Students share their final designs with stakeholders

CaD studio principles

Design A Waterfront

Maximize the value of what a waterfront can be by encouraging water-dependent and water-enhanced uses, like marinas, beaches, and parks

Design For Flooding

Work with water instead of against it by pursuing strategies such as flood adaptation, reinforcement, and strategic relocation

Design With Nature

Preserve and enhance natural areas and use nature-based techniques for erosion control and stormwater management

Design With Community

Waterfronts that are universally accessible can contribute to the prosperity and well-being of the entire community

Design For Change

Create places that continually provide value under changing conditions.
Phase projects over time in ways that are both practical and visionary

Partners

NEW YORK STATE | Department of Environmental Conservation | Hudson River Estuary Program

CornellCALS
College of Agriculture and Life Sciences

NEW YORK STATE WATER RESOURCES INSTITUTE
Cornell University

VILLAGE OF TARRYTOWN · INCORPORATED DEC 5TH 1870 ·

For More Information

For a brief video about CaD:

https:trophic.design/cad/
tinyurl.com/CornellCaD

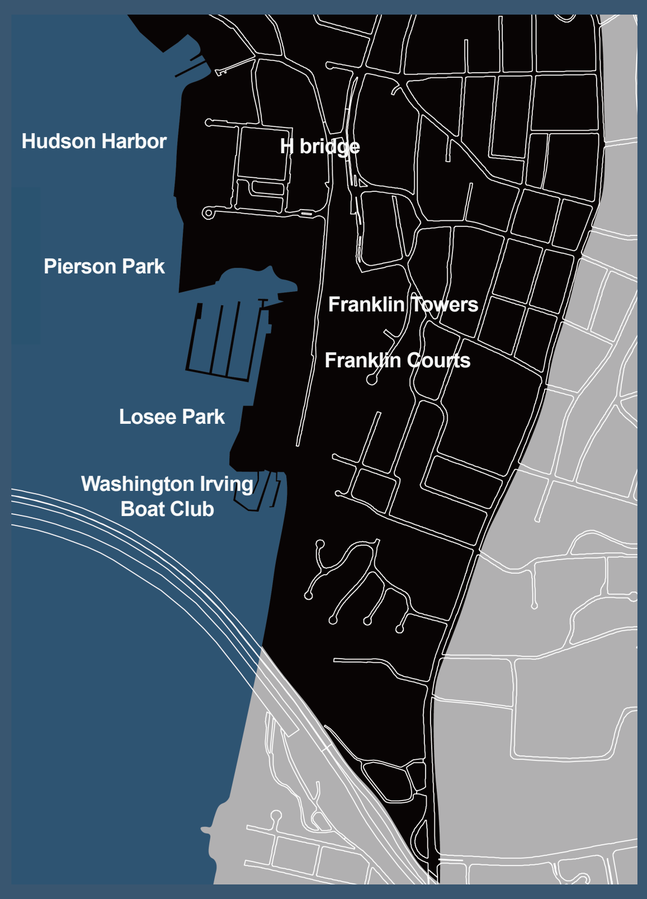
This exhibit was made possible through a partnership between Cornell University Landscape Architecture Department, Resilience Communications & Consulting, LLC, and the NYS Water Resources Institute, with funding from the Environmental Protection Fund through the NYS Department of Environmental Conservation Hudson River Estuary Program. These student projects are concepts that have not been assessed for regulatory implications, and will require further refinement before being considered for implementation.

Versión en Español

CAD STUDIO IN TARRYTOWN
Exploring climate change impacts

The CaD studio study area stretched from **Hudson Harbor** in the north to the **Washington Irving Boat Club** to the south.

The study area included **Pierson Park** and **Losee Park**, as well as the **rail line, H bridge,** and areas east of the tracks, including **Franklin Courts** and **Franklin Towers.**



2020s: 100-year flood

This map shows flood extent and depths in the “100-year” flood zone. Dark green indicates depths of up to 2 feet, light green indicates depths of up to 4 feet.

2080s: 100-year flood

This map shows the shoreline with 60 inches of sea level rise during the 100-year-flood. Areas in green indicate water up to 4 feet and orange up to 8 feet.

Data source: Columbia University Hudson River Flood Impact Decision Support System

Flooding & Sea Level Rise

The Hudson River experiences ocean tides for approximately half of its length, from New York Harbor to the Federal Dam at Troy. Due to this marine influence, the Tarrytown waterfront is affected by rising sea levels resulting from climate change. Since 1900, sea level has risen more than 12” along the New York coast.

New York State officially adopted projections of how much sea level may rise by the 2100s. Students used the NYS projections to envision how the future Tarrytown waterfront could look and perform in different design scenarios. Digital tools, such as Columbia University’s Hudson River Flood Impact Decision Support Tool, were used to envision where the shoreline might be in the 2080s under a high sea level rise scenario of 60 inches.

The so-called “100-year” storm can occur more often than once a century. It has a 1% chance of happening every year. Climate change is making heavy rainstorms happen more often, and the 100-year storm is becoming more frequent. Even without a storm, some areas may be under permanently underwater.

60” of Sea Level Rise

This map shows the waterfront with 60 inches of sea level rise under sunny day conditions with no stormy weather. Areas in green are permanently underwater.

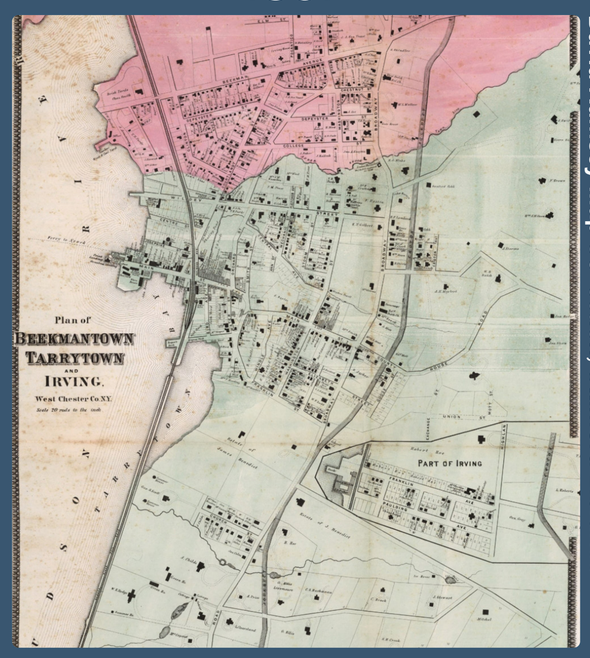
The Village of Tarrytown hosted the CaD studio in the fall of 2022 to consider future climate change impacts - like rising sea levels - on the waterfront. Stakeholders who met with the students included municipal officials, non-profit organization representatives, business owners, and residents. Stakeholders identified several key themes:

- The waterfront is transitioning from industrial to residential and recreational uses.
- Much of downtown, including Village Hall, Franklin Courts, and Franklin Towers, are at flood risk.
- Traffic circulation and bicycle/pedestrian access needs improvement.
- Current development projects are changing circulation patterns in Tarrytown and Sleepy Hollow.
- Decisions about appropriate waterfront development should include consideration of sea level rise.
- Some factors, including the future of the rail line and Army Corps of Engineers flood control projects, are out of local jurisdiction, but will affect the community.

MAPPING OUT THE FUTURE
How do we respond to sea level rise?

According to NYS Department of Environmental Conservation, it's possible that sea level will rise as much as 60 inches as soon as the 2080s. That amount of water will permanently flood parts of Tarrytown's waterfront. Much the area that will be underwater in the future was historically part of the river.

1867



David Rumsey Map Collection, Stanford Libraries

An 1867 map of Tarrytown & Sleepy Hollow shows the Hudson River extending east of the train tracks.

1926

This aerial photo taken in 1926 shows how parts of the shoreline were filled to create land.

1940

Aerial photos courtesy of Westchester County, NY

This aerial photo taken in 1940 shows further filling of the shoreline.

1960

In this photo, taken in 1960, note how the shoreline has been extended towards the lighthouse.

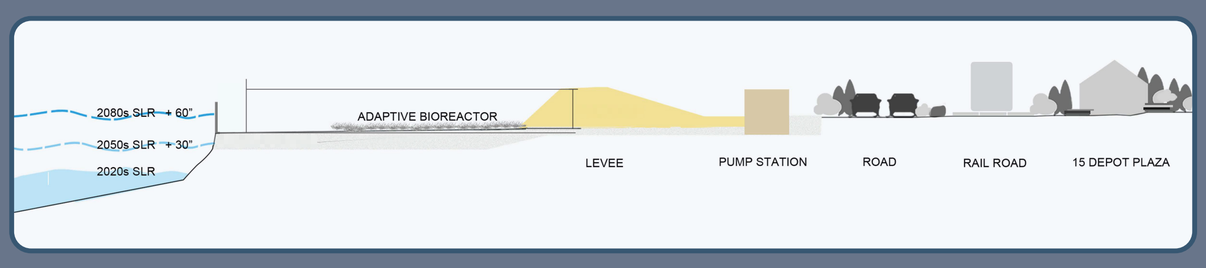
The CaD studio explores three possible responses to sea level rise:
- build barriers to try to stop the water;
- adapt to new water levels;
- and/or relocate away from the water.

Students often incorporate all three of these responses into their designs.

Do we build barriers to try to keep the water out?

Keiki Hu

This student design combines a levee with deployable flood gates to protect the train station and areas east of the tracks from flooding and inundation.



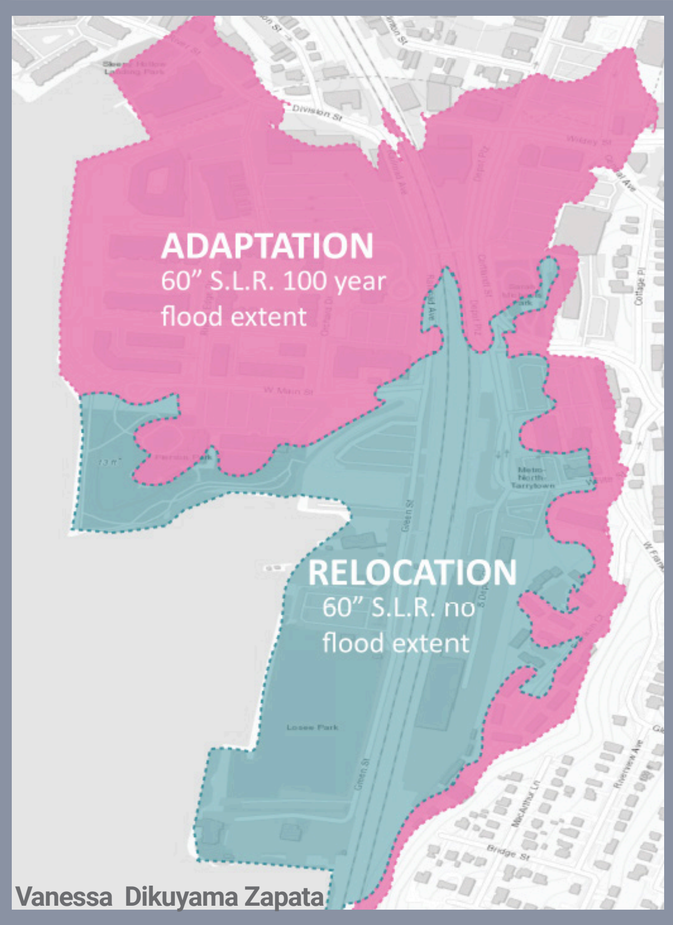
A levee to defend against water includes a pump station to move water back into the river if the levee is overtopped, or if rising ground water levels cause flooding in locations east of the barrier. Note that the dimensions in this image may not be to scale. Any consideration of barriers requires thorough engineering and review by NYS DEC permitting authorities.

Do we change land use to let the water in?

Xiaoyun Ren

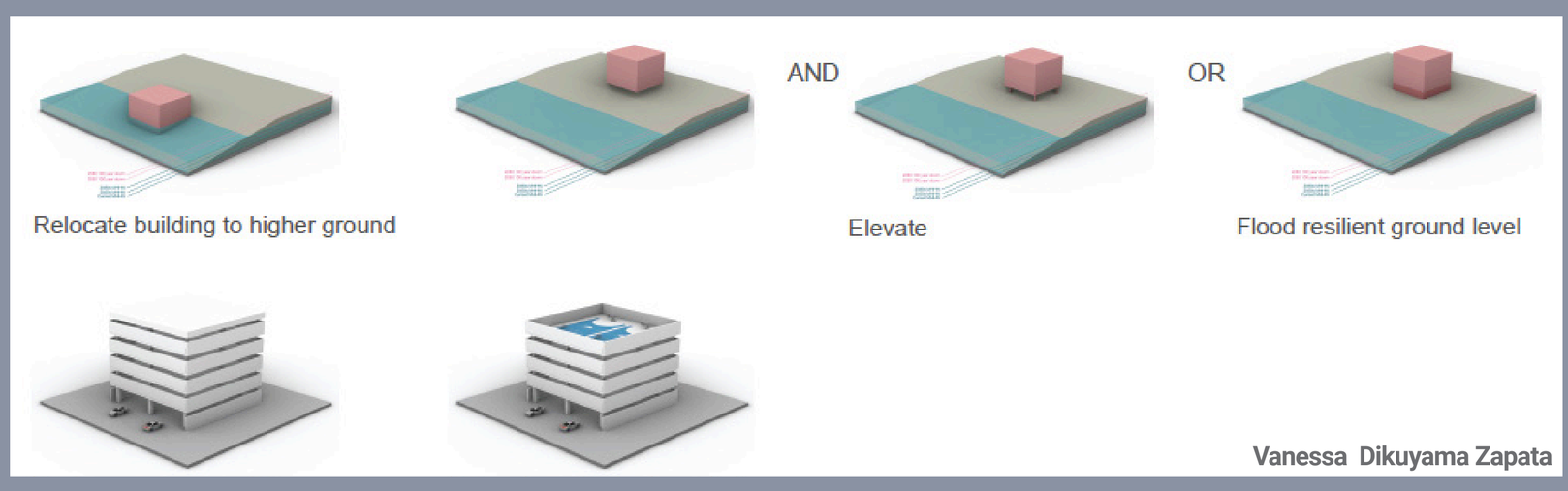
This design proposed the construction of a natural shoreline at Pierson Park, with a building elevated above the water for use by the marina and a commuter ferry.

Do we relocate away from flood risk?



Vanessa Dikuyama Zapata

A map identifies parts of the waterfront that will require adaptation strategies to maintain use. It also shows areas that are projected to be underwater with 60 inches of sea level rise, requiring relocation of current uses.



Vanessa Dikuyama Zapata

This graphic illustrates a proposal to move some buildings to higher ground, and to elevate and floodproof other buildings. The student also proposes replacing surface parking with an elevated parking garage with tennis and basketball courts on the roof.

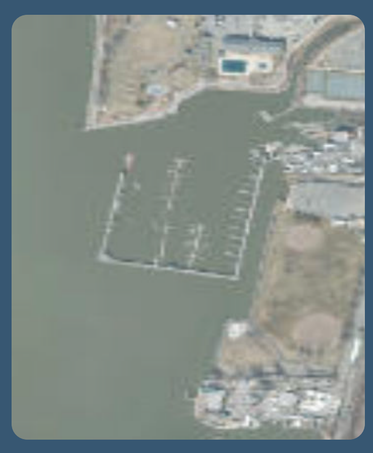
PIERSON & LOSEE PARKS
CaD Student Design Ideas

Pierson and Losee parks are currently at high risk of flooding and shoreline erosion, and the problem is expected to increase as water-levels rise in the tidal Hudson and heavier storms affect the region.

By the 2080s much of Losee Park and portions of Pierson Park may be permanently underwater due to sea-level rise. The accessibility and usability of these public recreation areas will be impacted, so we must plan now to maintain future use of the parks.

Students envisioned a variety of approaches to this problem, including allowing the water to flood low-lying areas while elevating some uses above the flood zone. Many students suggested consolidating and/or relocating the boat clubs, and building walkways that maintain shoreline access, even as water levels rise.

Which ideas do you like?



2020s

This map shows Pierson & Losee parks under sunny day conditions with no stormy weather in the 2020s.

2080s

Pierson & Losee parks under sunny day conditions with no stormy weather and 60 inches of sea-level rise, which could occur as soon as the 2080s. Areas in green are submerged up to 4 feet.

Elevate parts of the parks to maintain access

A proposal to use a cut & fill strategy to elevate part of Losee Park without a net-fill of the flood plain. This strategy would be implemented in the 2050s.

An elevated walkway maintains access to Losee Park, which may be underwater by the 2080s.

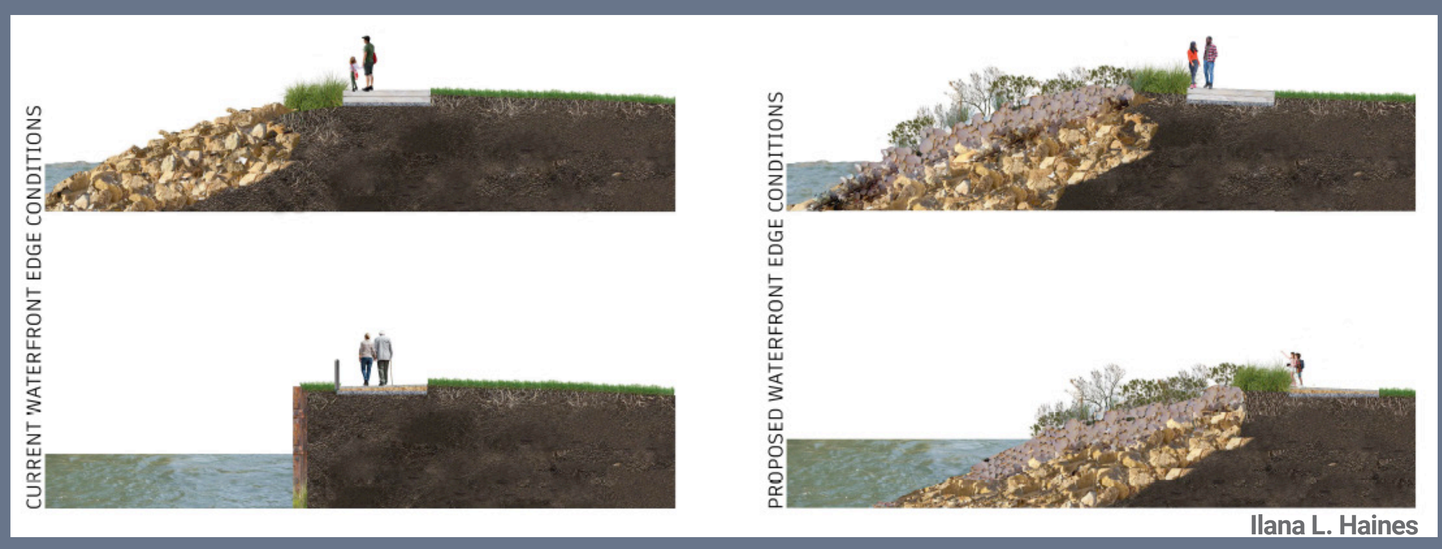
A viewing platform in Pierson Park overlooks the Hudson.

Allow low-lying areas to flood to promote natural shorelines

Tidal marshes offer carbon sequestration, water filtration, and rich habitat that supports biodiversity.

Restore tidal marsh habitats

This image of the waterfront with 60 inches of sea level rise in the 2080s shows portions of Pierson and Losee parks, as well as some areas east of the tracks, converted to natural land cover to accommodate rising water.



The images on the left illustrate current conditions in Pierson Park, with bulkheads and rock revetments along the shoreline. The images on the right depict the proposed changes. Plantings are added to rock revetments to enhance habitat and erosion control. Bulkheads are replaced with a graded slope of rock and plants.

Hang Wang & Xue Xia

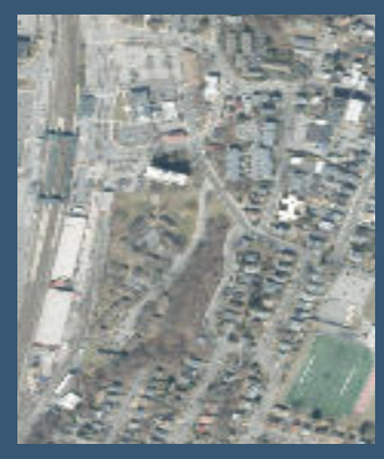
EAST OF THE TRACKS

CaD Student Design Ideas

Much of Tarrytown east of the waterfront faces significant and growing flood risk. The rail line, Metro North train station, business, and residential buildings are all located in the 100-year flood zone. Sea level rise of 60 inches would cause much of this area to be permanently underwater.

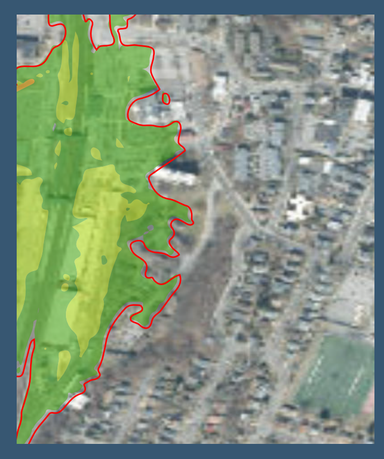
Students proposed a variety of approaches for adapting to rising waters. Ideas for the future of the railroad ranged from elevating the rail line and train station to moving the train tracks inland, to removing the rail entirely and introducing water-based transportation for commuters. Students considered improving circulation patterns between the waterfront and downtown as part of their proposed designs.

Students also addressed flood risk at the Franklin Courts affordable housing, which is located in the current 100-year flood zone. They suggested a range of potential approaches, including relocating Franklin Courts uphill of its current location.



2020s

This map shows areas east of the tracks in Tarrytown under sunny day conditions with no stormy weather in the 2020s.



2080s

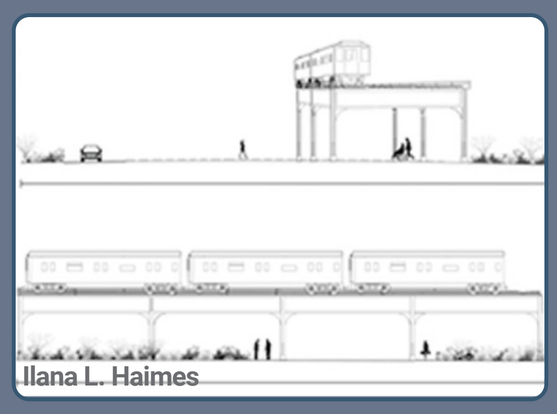
This map shows areas east of the tracks in Tarrytown with 60 inches of sea-level rise, under sunny day conditions with no stormy weather. Areas in green are submerged up to 4 feet.

Elevate key infrastructure to maintain use

This design included a proposal to use the space beneath the elevated H bridge for recreational activities in the short-term.

The elevated rail allows roadway and recreational uses below.

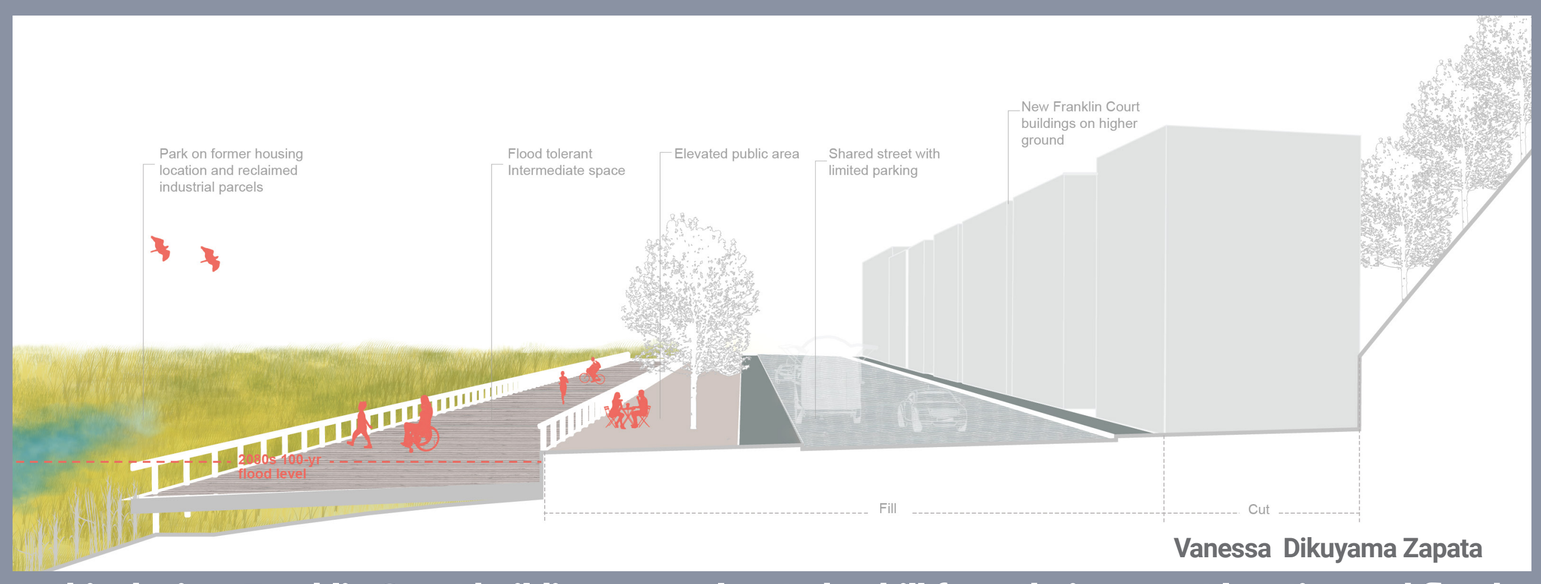
Several students examined the idea of elevating the rail line and using the area beneath to improve transportation circulation and green corridors.



This concept proposed elevating the rail line, removing the H bridge, and replacing it with a traffic underpass and greenway in the 2040s. The train station would move north to a higher elevation area, near the current H bridge.

Relocate community assets to reduce flood risk

This graphic illustrates suggestions to relocate the Senior Center to higher ground, re-grade the location of Franklin Court to reduce flood risk, and expand green space in the floodplain.



In this design, Franklin Court buildings are relocated uphill from their current location and flood-adapted uses that enhance quality of life are proposed in the flood zone.

Franklin Court buildings are consolidated and moved away from the flood zone.