Program Summary:

Implementation of resilient infrastructure, including a custom-designed pump station, bolster a coastal neighborhood against flooding and improve quality of life for this historic community.

Program Statement:

Funded as part of the HUD-initiated National Disaster Resilience Competition (NDRC), the City of Norfolk's Ohio Creek Watershed Resilience project aims to reduce risk from nuisance flooding and coastal inundation for two neighborhoods along the Elizabeth River. Our firm was the lead designer on the NDRC application and served as the architect and urban designer for the implementation. A coastal protection alignment, designed as a continuous berm or floodwall, encircles the edge of the waterfront neighborhoods to reduce risks posed by storm surge and sea level rise, limit coastal erosion, and expand tidal ecosystems through the integration of a living shoreline.

Finding or creating space for water is a guiding principle of the project. The protection and expansion of Haynes Creek, a historic inlet, provides opportunities for increased water storage, habitat regeneration, and recreation. Green infrastructure along key streets filters runoff and reduces street flooding and urban heat.

Resilience strategies aim to create smart investments by providing solutions with multiple benefits. A grassy area near the neighborhood's elementary school was redesigned to hold water during storm events while also improving playing fields, upgrading playgrounds and adding a walking path. Streetscape improvements consider stormwater management as well as access, with increased connectivity for pedestrians and cyclists. A pump station required to drain water over the coastal defense was designed with windows and covered outdoor spaces to make its machinery visible, providing opportunities for education and serving as a portal for riverfront access.

SP190.01

Building Area: (sf)
3000 sf (1050 sf above grade, 1950 sf below)

Total planning area is about 1/3 square mile

Cost per Square Foot:
$5300 (including pumps, electrical, machinery, etc)

Construction Cost
$16 million (pump station)
$112 million (full project)

Date of Completion:
2023

SP190.02

A City of Tidal Creeks

Sitting at the mouth of the Chesapeake Bay, the Tidewater region of Virginia has long been defined by water, playing a key role in the early colonial settlement of the U.S. and remaining today an important strategic maritime region as NATO's home in North America.

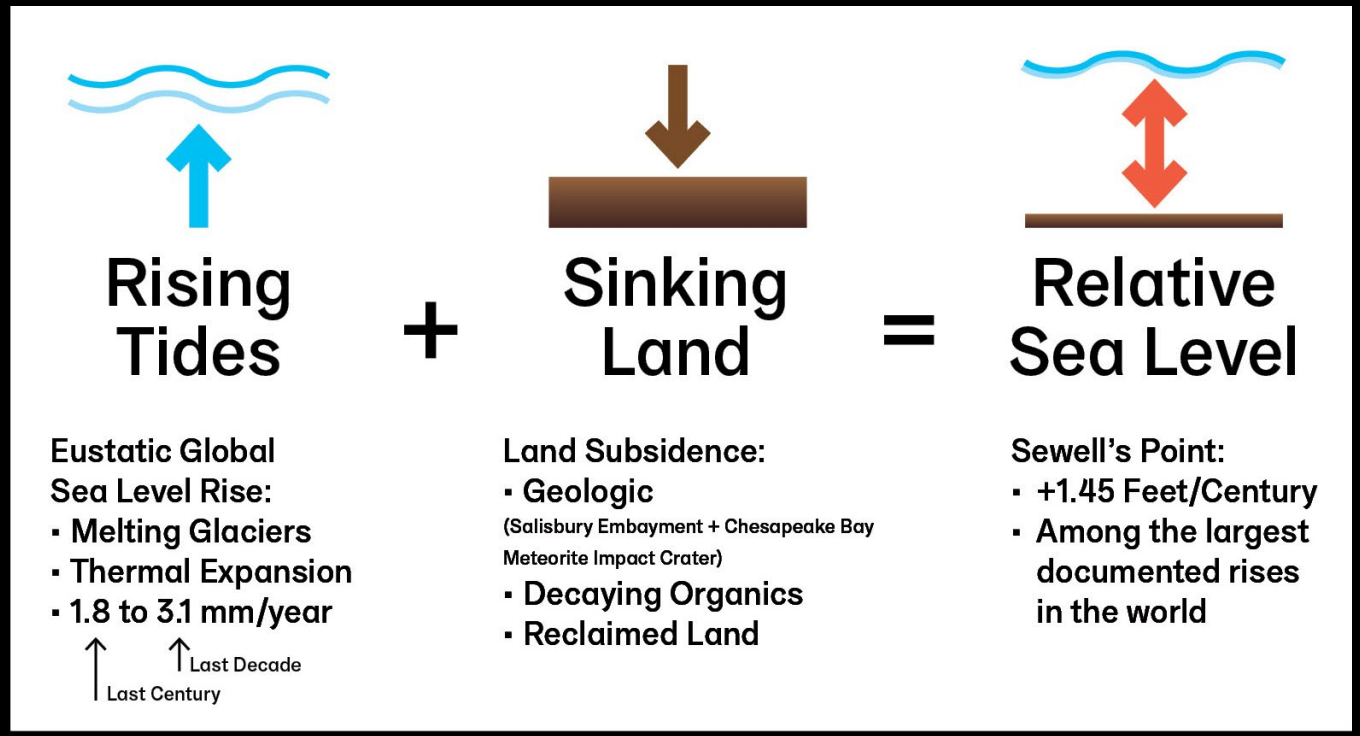
This recolored map from 1892, looking north, illustrates Norfolk's relationship to its tidal creeks and rivers. Historically, the City has sought to reclaim land by filling in these tidal creeks, and this disregard for water has led to increased flood risk where the city urbanized over the footprint of former creeks. On the right, the Chesterfield Heights and Grandy Village neighborhoods were the focus of this project.

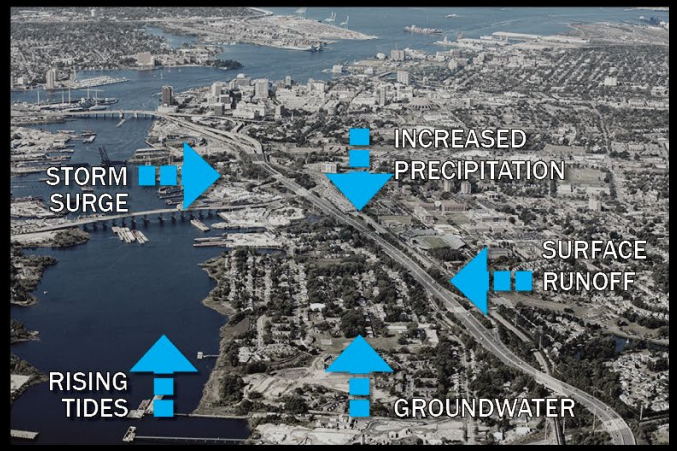
SP190.03

The Forces of Water

Norfolk faces threats from water on all sides. As a coastal city, its waterfronts are subject to sea level rise and to storm surge. Heavier rain events driven by climate change mean flooding isn't limited to neighborhoods along the coast and rivers. And rising groundwater tables leave less space to infiltrate runoff beneath the surface. All of these challenges necessitate a deliberate and thoughtful approach to the way the city lives with water.

The neighborhoods of Chesterfield Heights and Grady Village sit on the Elizabeth River, with many houses just a few feet above sea level. With rising sea levels comes increasing nuisance flooding and growing risk from major storm events. The key challenge of this project was to defend these neighborhoods from coastal flooding while preserving their character and connection to the waterfront.

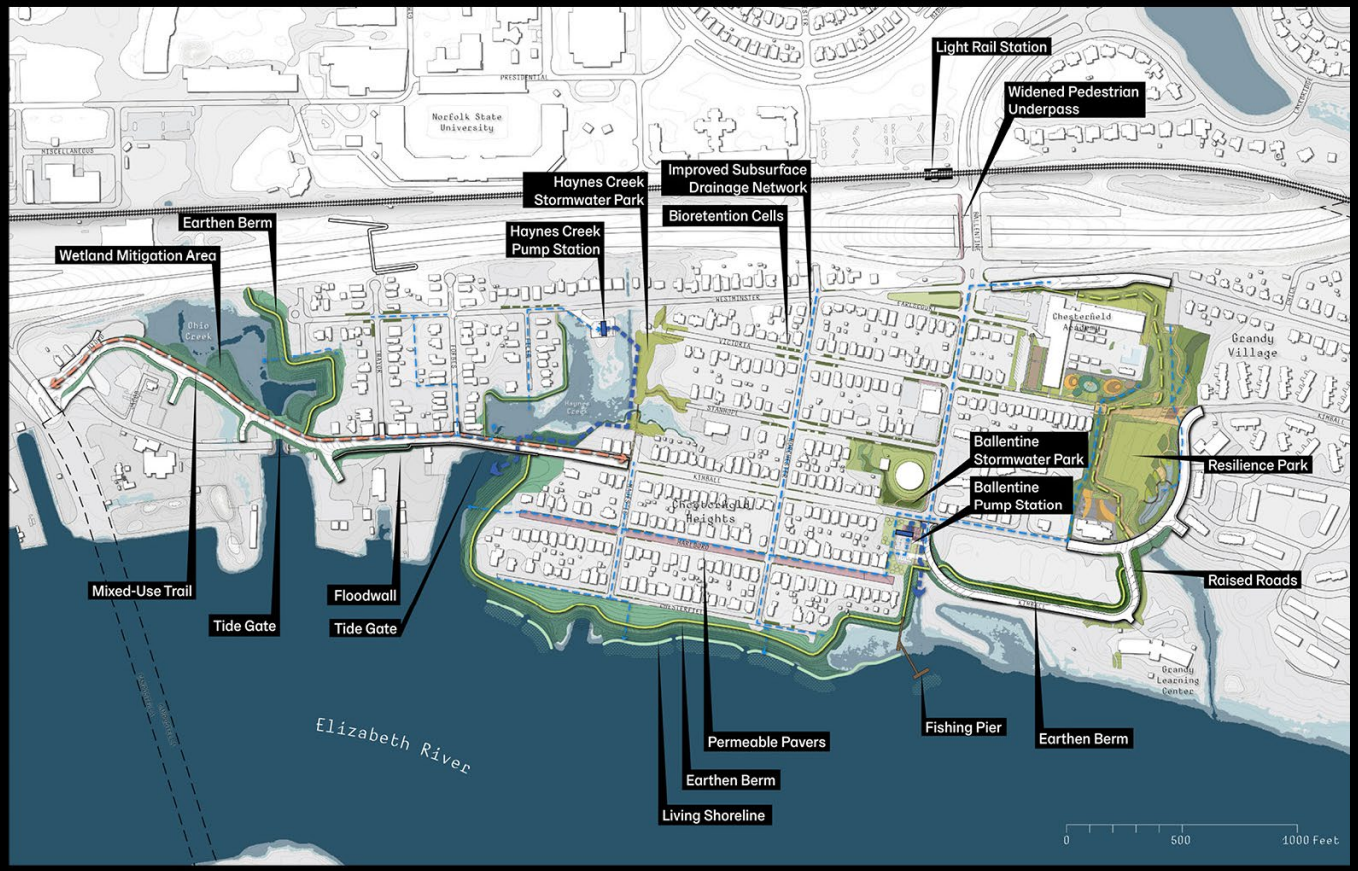


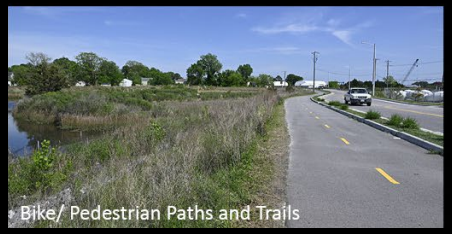


SP190.04

Community-Driven Design

Addressing these challenges in the project area required sustained coordination between the planning team and residents over the four-year course of the project's planning, design, and implementation. The team conducted numerous rounds of community stakeholder events to learn about the needs of the residents, internal workshops with high-level stakeholders to establish project priorities, and design workshops with city and state officials and community leaders. Through collaboration with the local Housing Authority, the team shared regular project updates with both public housing residents and single-family homeowners. A series of community meetings at the neighborhood Community Center, including workshops with children from the school, helped to refine the landscape design of the Resilience Park and surrounding landscape features.

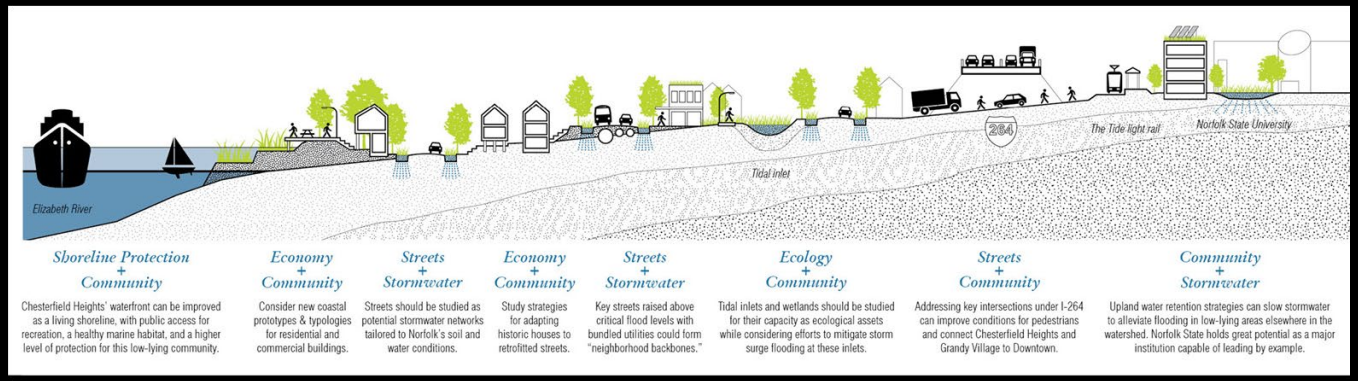




SP190.05

Strategies and Interventions

Beyond just levees and floodwalls, the project includes a holistic suite of adaptation measures to bolster community resilience. On the river, living shorelines and constructed breakwaters buffer wave action, filter urban runoff, and provide habitat. Behind the earthen berm, large-scale detention ponds and stormwater parks hold rainwater impounded within the line of protection, while neighborhood pump stations turn on in storm events to drain the excess runoff. Throughout the neighborhood, small scale interventions like permeable pavers, streetside bioswales, and green infrastructure further slow, store, and filter runoff. Multimodal mobility improvements bolster connectivity and reduce the burden of car-dependency, while new plantings reduce the impacts of urban heat islands.



SP190.06

Elevation as Adaptation

Central to the Watershed Resilience Project was an elevation-based adaptation strategy. While the largest part of the project, the riverfront levee, protects the lowest-lying houses in the neighborhood, it creates new challenges for managing rainwater that falls inside the levee. Thus, a suite of green infrastructure projects, streetside bioswales, and internal retention ponds slow and store runoff before it reaches the bottom of the watershed. Two neighborhood pump stations round out the project's stormwater resilience components. At the same time, mobility and streetscape improvements support a holistic strategy for sustainable urbanism, with protected bike lanes and widened sidewalks on the route to a nearby light rail stop.

SP190.07

A Public Waterfront

On the ground, the centerpiece of the resilience project is the riverfront levee that wraps the neighborhood and protects its communities from sea level rise, nuisance flooding, and moderate storm surge events. But more than that, the project conceived of resilience holistically, looking beyond the infrastructure of flood prevention to encompass walkability, public space, and waterfront access.

A waterfront pier sought to connect the neighborhood to the river, spanning the riparian zone of aquatic plantings and overlooking the outflow of the pump station and the deep water channel of the river. As an extension of the riverfront trail along the levees, it offers the best viewpoint for the restored ecology of the living shoreline.

SP190.08

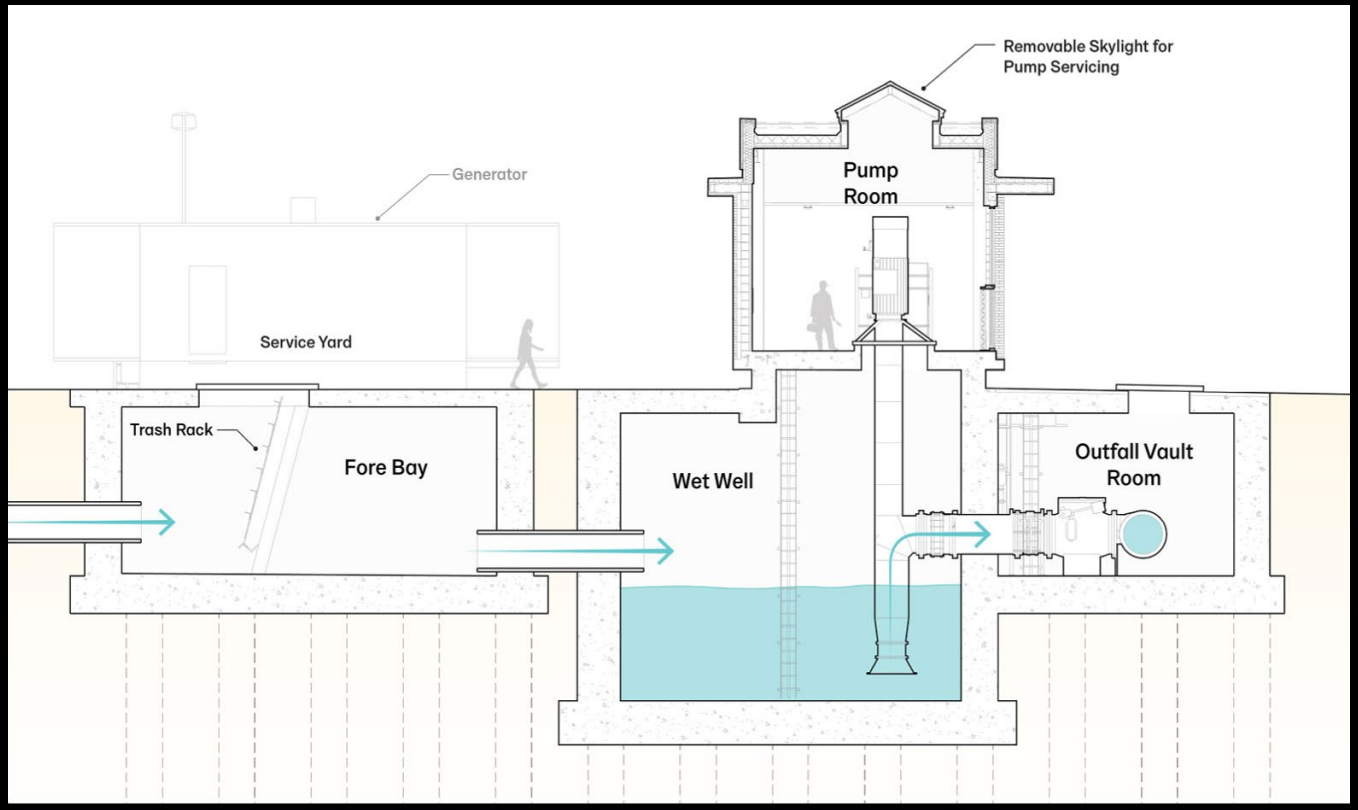
The Pump House

With the project's levees creating a barrier for overland drainage of rainwater, two new pump stations were needed to remove water during storm events. The most prominent of these sits at a key intersection, wrapped by a small plaza and with a connection to the trail along the levee. Neighborhood runoff collects first in the rain gardens and stormwater parklets like the one across the street, before flowing into the drainage system and being lifted by the pumps and drained over the levee, finally outfalling within an area protected by living shoreline.

SP190.09

A Public-Facing Pump House

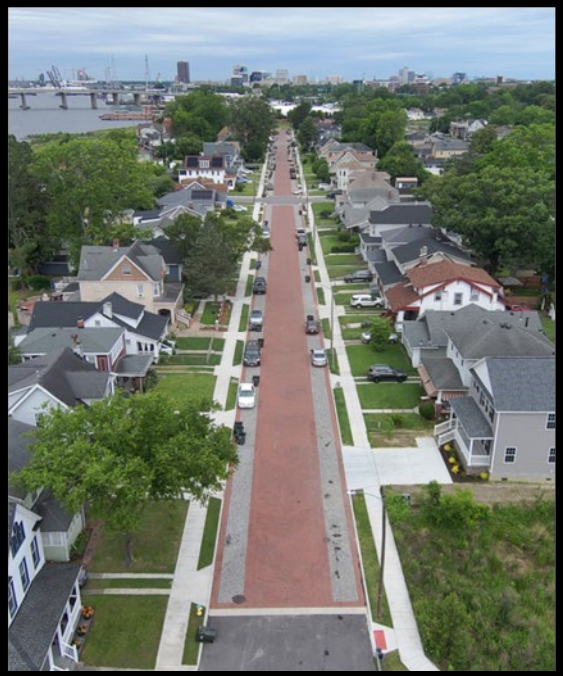
Designed to be more than just a service building, the pump station was conceived as a piece of civic architecture that celebrates its key role in protecting the communities it serves. Throughout the planning process, our team advocated for investment in the pump station architecture to be more-than-standard, with skeek brick detailing, clean shadow lines, and ample windows for the public to see the machinery of its interior. The “front porch” provides a covered outdoor space on the pump station, offering a view to the working pumps that’s sheltered from the rain.



SP190.10

Infrastructure on Display

While purely functional and off-limits to the public on the inside, the pump station is designed to make its operations legible to the public, with each of the three pumps aligned to a window and visible from the adjacent plaze. Just as the levee trail makes green infrastructure visible and accessible, the pump station and its plaza bring the neighborhood's gray infrastructure into the public realm. The pump station is also an iceberg: most of its key spaces lay hidden underground. Service vaults provide access for maintenance workers to upkeep these key spaces for managing stormwater.



SP190.11

Streets and Schools

Inside the levees, a suite of green infrastructure projects slow and store runoff during rainstorms, intercepting it before it flows towards the low ground. A key residential street, Marlboro Ave, runs parallel to the riverfront and was identified as a key corridor for green infrastructure. The street was completely rebuilt with permeable pavers that allow for infiltration into the groundwater table. Along with reconstructed sidewalks to meet ADA slopes, bioswales were designed into the street edge to further capture runoff before it reaches the bottom of the watershed. At the neighborhood's Elementary School, the Chesterfield Academy, rain gardens were installed in the strip of land between the building and the playground, and a stone runnel was added to highlight the flow of water as a teachable moment for young students.

SP190.12

Connecting Communities

The final element of the resilience project, a neighborhood park with recreation fields, walking trails, and stormwater swales, ties into the historic watershed of a tidal creek. Its landscaped swales follow the footprint of the creek and hold water inside the neighborhood's levees. A goal of the park was to bridge the historic division between the historically low-income Grandy Village (comprising mostly public housing) on one side of the park, and the upper and middle class Chesterfield Heights (with mostly single-family homes) on the other. The redesigned park not only offers pedestrian and cycling connections between these two neighborhoods, but also provides an improved gathering space at the heart of the two communities, all while improving recreational opportunities for the adjacent Elementary School.

SP190.13

A Living Edge

As a design firm with roots in New Orleans, we know firsthand the detrimental effects of a concrete floodwall on neighborhood life and connection to water. When we practice elsewhere, we advocate nature-based solutions that work in tandem with local ecology and foster great public spaces at the water's edge.

Here, the design carefully integrates public space and ecology with the infrastructure of flood protection, improving waterfront access with a trail along the levee, and building living shorelines that filter urban runoff and provide riparian habitat for native wetland species. Through the careful integration of pump stations, nature-based infrastructure, and community amenities, the project serves as a model for civic resilience in coastal neighborhoods across the country.