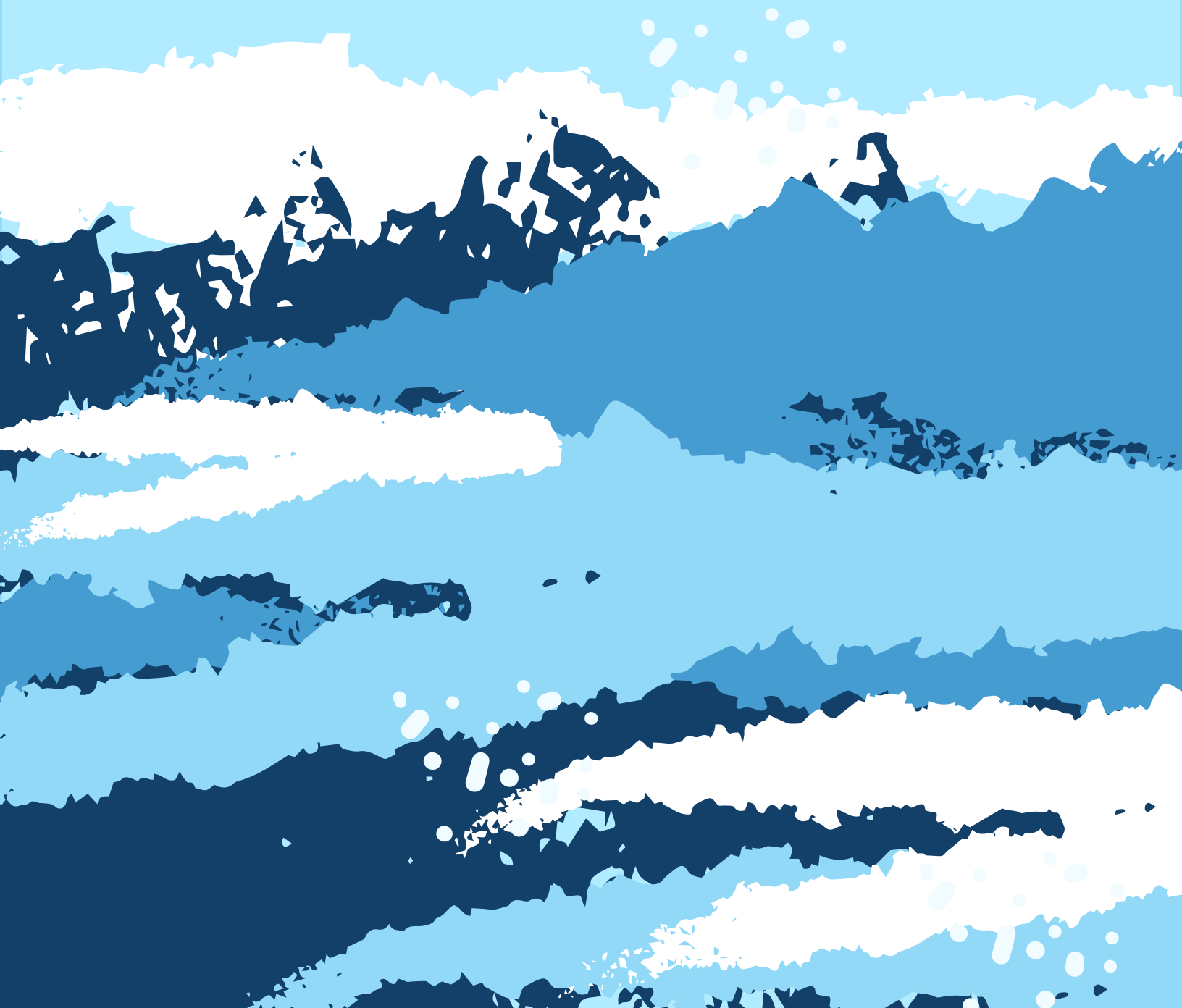
Weston & Sampson
transform your environment

COASTAL SCIENCE & ENGINEERING

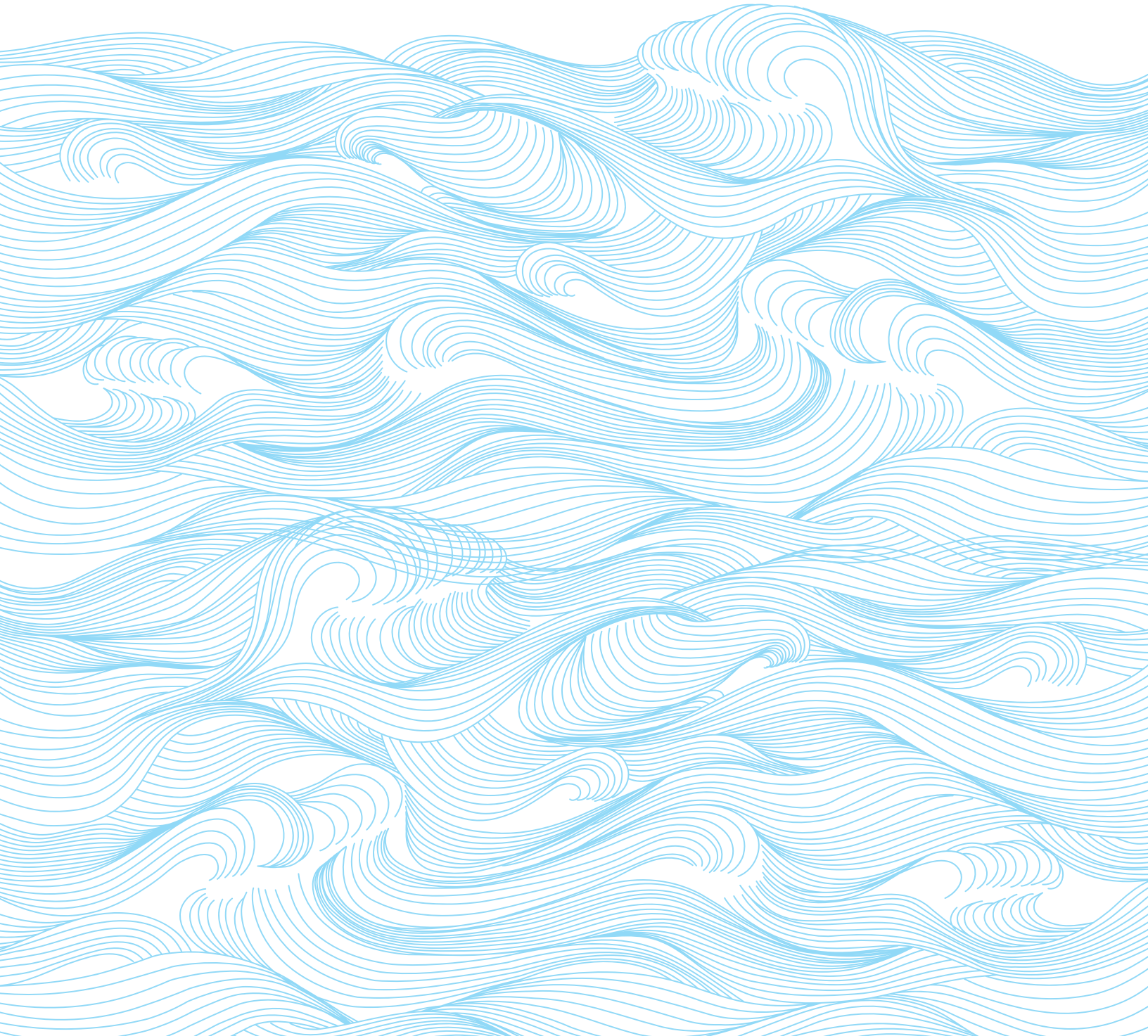
April 2023
RFP 2023-01

SEA LEVEL ADAPTATION PLAN

CITY OF ISLE OF PALMS, SOUTH CAROLINA



Transmittal Letter



TRANSMITTAL LETTER

City of Isle of Palms
Attn: Mr. Douglas Kerr
1207 Palm Boulevard
Isle of Palms, SC 29451

Re: Request for Proposals 2023-01, Sea Level Rise Adaptation Plan

Dear Mr. Kerr and Members of the Selection Committee,

Weston & Sampson and Coastal Science & Engineering (CSE) are pleased to present our proposal for the City of Isle of Palms Sea Level Rise Adaptation Plan. Our team provides **knowledge of localized impacts from climate change** as well as **nationally recognized climate resilience expertise**. We are passionate about this work and recognize the importance of preparing for sea-level rise in a community like Isle of Palms.

The partnership between Weston & Sampson and CSE yields a team of **engineers, coastal geologists, hydrologists, beach management experts, and environmental scientists** with unparalleled expertise in **modeling, planning, stakeholder engagement, and implementation**. Our team will deliver an actionable adaptation plan that assesses the vulnerability of the community, models potential scenarios at high resolution, identifies strategies to mitigate risk, and increases community resilience. Our team has the breadth of knowledge and expertise needed to craft a strategy that is **robust, usable, and meaningful** to Isle of Palm's residents and stakeholders.

Our team understands the needs of the City in regard to Plan development. We recognize that due to low elevation and aged infrastructure, the City is vulnerable to the impacts of sea level rise. Our team will inventory existing conditions and identify specific vulnerabilities of the City. Our team will then be able to combine the existing inventory of stormwater infrastructure with advanced flood modeling techniques to yield a range of scenarios for future conditions. This effort will inform mitigation strategies the City can enact to combat the long-range effects of sea level rise.

Both Weston & Sampson and CSE pride themselves on **innovation, creativity, and collaboration**. Working together with the City of Isle of Palms, our team will deliver a product of the highest caliber. We have the team and qualifications necessary to provide the professional services requested by the City. We are confident that our practical approach, technical capabilities, and experience in flood modeling and coastal resiliency will result in the identification of significant opportunities for mitigation throughout the City. Your consideration of our credentials is greatly appreciated and we look forward to the opportunity to discuss this project in greater detail. Please contact Jeannie Lewis, Senior Project Manager, at 843-790-0580 or Lewis.Jeannie@wseinc.com if you need any additional information.

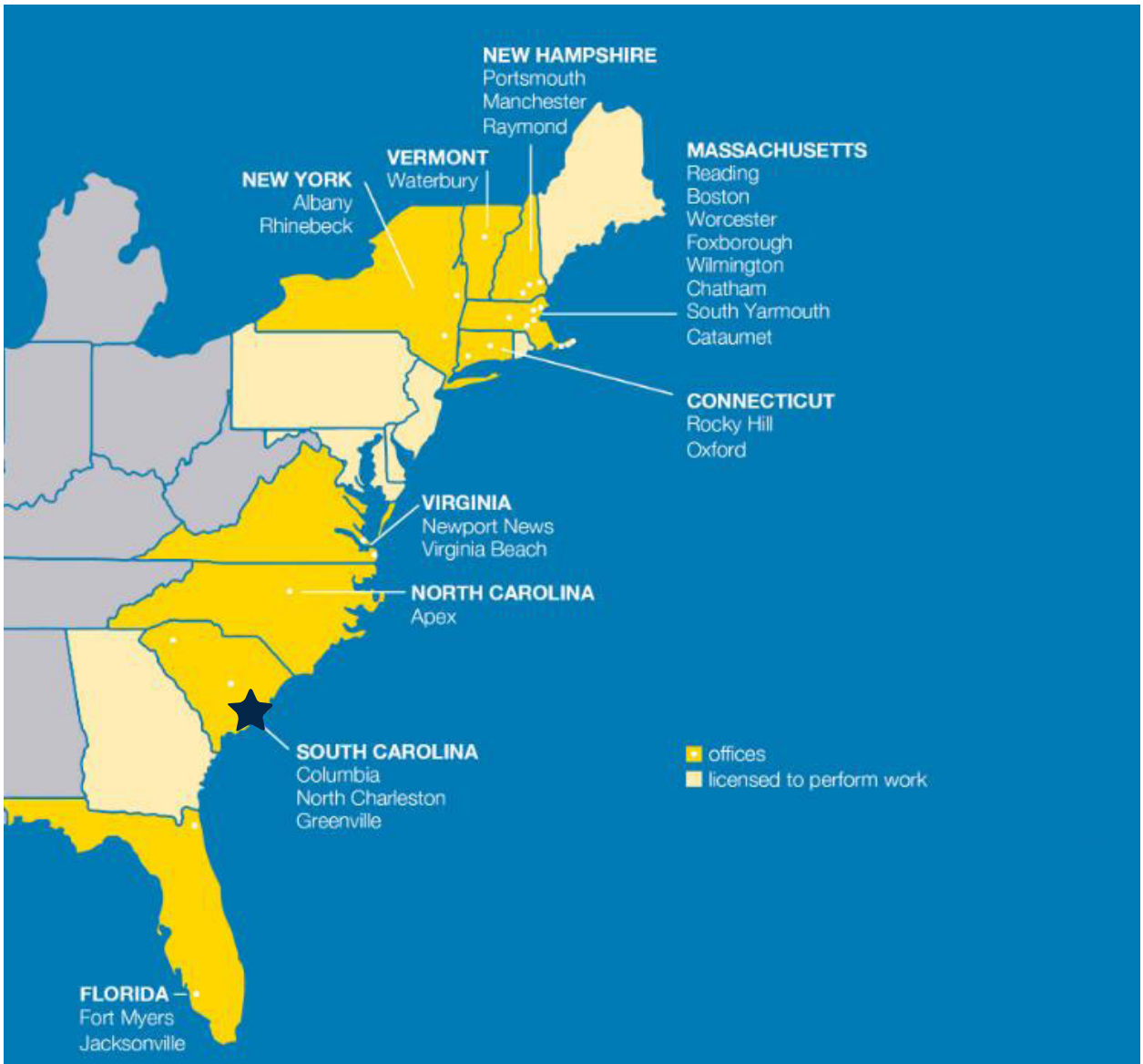
Sincerely,

Kipling R. Gearhart

WESTON & SAMPSON ENGINEERS, INC.
Kip Gearhart, Regional Manager
3955 Faber Place Suite 300, N Charleston SC 29405

Scope of Work

WHERE WE WORK



124
years in operation

800
current employees

24
office locations

22
employees in the Charleston office

VISION STATEMENT

Resilient

We envision an Isle of Palms where residents and property are safe from coastal climate impacts and the nature of the city is preserved in the face of rising challenges.

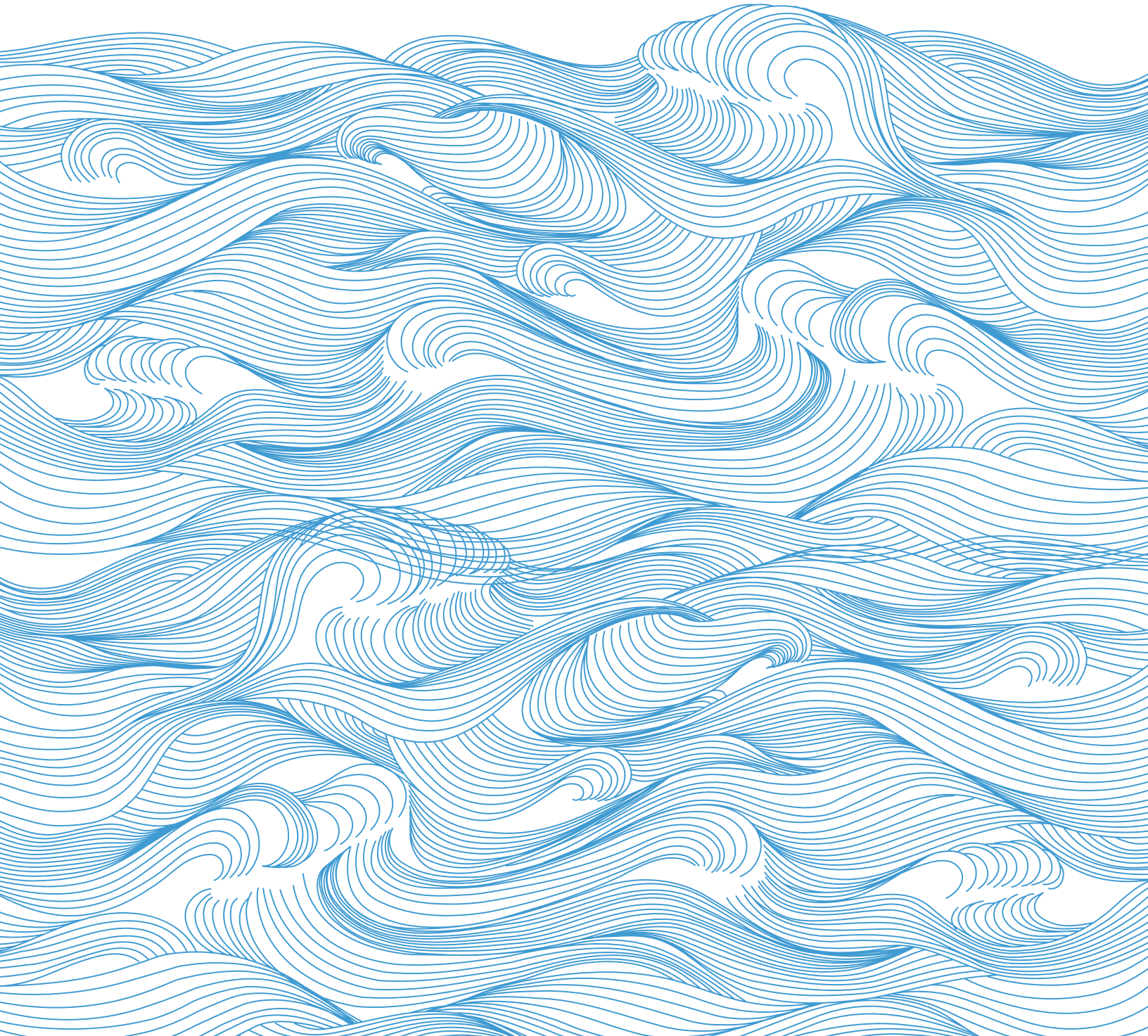
Way of Life

We envision an Isle of Palms where daily life is uninterrupted by rising sea levels and residents learn to live with water.

For all

The key to success is rooted in the engagement of Isle of Palm's stakeholders, residents, and climate champions who will work to encourage adaptation and mitigation as the City faces the challenges associated with sea level rise.

Work History & References



KIAWAH ISLAND FLOOD MITIGATION & SEA LEVEL RISE ADAPTATION PLAN

town of kiawah, south carolina

In 2017, the Town of Kiawah began researching the impacts of climate change, sea level rise, and flooding on the island. After 18 months, the subcommittee tasked with the research determined that over the next 30 years Kiawah Island will face significant flooding challenges. In order to combat these upcoming challenges, over 100 recommendations were made, including the creation of an Adaptive Management Plan to provide long-term planning for the community.

As part of the Flood Mitigation and Sea Level Rise Adaptation Plan, Lucas Hernandez, then a graduate research assistant at the College of Charleston Lowcountry Hazards Center and now staff with Weston & Sampson, created high-resolution 2-D flood maps of the island using NOAA's Relative Sea Level Change Projections (2017) and the most recent LiDAR digital elevation model. The models developed as part of this study included inundation from storm surges from 1 foot to 8 feet above Mean Higher High Water (MHHW) in half-foot increments and inundation from NOAA sea level rise predictions for the years 2030, 2050, 2075, and 2100.

All these models were validated using personal accounts from the subcommittee and provided a basis of understanding for vulnerable stormwater infrastructure, roads, and structures on the island. These models were later updated to include rainfall and drainage infrastructure to help the Community Association prioritize six major infrastructure projects that are currently being constructed.

- climate & coastal resiliency
- sea level rise
- flood impact assessment
- mapping
- stakeholder engagement

client contact

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843-768-9166

NORTH CAROLINA RESILIENT COASTAL COMMUNITIES

elizabeth city and pasquotank county, north carolina

North Carolina
RESILIENT COASTAL COMMUNITIES PROGRAM

Weston & Sampson will start working in May of 2023 with two communities in coastal North Carolina to promote sustainability and improve resilience in the face of climate change and other hazards. Our approach will follow a framework to identify and prioritize projects that will mitigate risks and enhance community resilience. We are producing a Resilience Strategy, which will consist of a Risk & Vulnerability Assessment Report, evaluating the vulnerability of critical assets, natural infrastructure, and vulnerable populations to a range of hazards, including flooding (rainfall, tidal and riverine), storm surge, sea level rise, and other locally-relevant hazards. We will build upon existing work with involvement from a Community Action Team, North Carolina Coastal Zone Management agencies, and the public. A Project Portfolio will also be developed as part of the Resilience Strategy, which will outline a series of options aimed at reducing exposure, reducing sensitivity, and increasing adaptive capacity to flooding and other hazards. This portfolio will consider a combination of policy, nonstructural, hybrid, and structural approaches.

Our team recognizes the importance of identifying a diverse range of strategies that can be implemented to enhance community resilience. We will work closely with local leaders and stakeholders to identify specific projects that will advance the resilience of the community and to take the next steps towards shovel-readiness. Additionally, we will link these communities to funding streams to support the implementation of these projects. Through these deliverables, we will help these communities identify and prioritize the most effective approaches to address their unique challenges and promote a resilient and sustainable future.

- sustainability
- sea level rise
- green and gray solutions
- community resilience
- risk & vulnerability assessment
- prioritized project identification
- stakeholder engagement

client contact

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IMPROVEMENTS TO LOPRESTI PARK

boston, massachusetts | boston parks and recreation department





LoPresti Park is a four-acre park located on the waterfront of Boston's inner harbor in the southwest end of East Boston. In 2012, Boston Parks and Recreation Department selected Weston & Sampson to design a modern-day park that links the Maverick Gardens neighborhood back to the water and strengthens pedestrian connections to the surrounding housing development and, since that time, we have worked together to achieve that vision. This premiere location affords some of the most dramatic and sweeping views of the Boston skyline, July 4th fireworks, and sunsets all year long. With Piers Park as a nearby attraction, LoPresti Park is reportedly one of the best kept secrets of the city and often overlooked as a destination for anyone other than the locals. LoPresti functions as a well-used neighborhood park and playground and is frequented by residents who arrive mostly on foot or by bike.

The most recent improvements at LoPresti Park provide a number of active recreational amenities, including two basketball courts, a children's playground, splash pad, fitness equipment, an open lawn, and a state-of-the-art synthetic turf playing field that is the centerpiece of the park. Passive activities are organized in a way to complement the amazing vistas that exist throughout the park. A renovated harborwalk promenade serves as the spine of the park and provides for pedestrian circulation. Additional programming includes benches, ping-pong, and lounge chairs organized around the scenic promontory, as well as a kayak launch that provides direct access to the harbor waters. The park's new main entry plaza is centered on the Maverick Gardens housing development and provides sweeping views of the park and the city. These improvements to LoPresti Park are sure to become part of East Boston's legacy for years to come.

Our team researched and considered sea level rise and site resiliency throughout the design process. We explored iterations of seawall protection to find balance between defense against the rising sea and day-to-day access. Ultimately, we installed granite seawall blocks in a staggered pattern to diffuse wave action during extreme high tide conditions.

- active and passive recreational designs
- waterfront amenities
- sea level rise and site resiliency considerations
- harborwalk promenade and improved pedestrian connections
- synthetic turf fields, basketball courts, playground/splash pad facilities
- environmental evaluations/ assessments

client contact

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EAST BOSTON CLIMATE RESILIENT COASTAL WATERFRONT DESIGN

boston planning and development agency

The East Boston waterfront has experienced rapid transformation due to recent development as well as an increase in flooding. In particular, the areas around Carlton Wharf and Lewis Mall were identified as near-term flood pathways through the City of Boston's Climate Ready Boston initiative in 2017. Weston & Sampson was selected to develop design options that advance flood protection along parts of the East Boston waterfront while at the same time ensuring waterfront access and enhancing nearby coastal habitat.

While close in proximity, Carlton Wharf and Lewis Mall present different challenges and serve as examples of different coastal conditions throughout the City of Boston. Both sites are near-term flood pathways that routinely flood during storm events since they are part of the waterfront's low-lying historic fill area. We developed several schematic design scenarios through review of existing conditions, engagement with neighborhood residents and other stakeholders, and resilience technical analysis. Each design scenario considered a design flood elevation of 22.5 ft. that was based on:

- the most up-to-date coastal model for Massachusetts
- evaluation criteria developed through Climate Ready East Boston
- technical feasibility
- public access and open space along the waterfront

The project demonstrates practicable and replicable solutions that meet resiliency goals despite site constraints and create more equitable access to the waterfront. The designs advanced through this project provide a basis to be continued through design, permitting, and construction. Our team's efforts are critical to ensuring the East Boston waterfront will continue to serve as an inviting and accessible part of the neighborhood and also provide a buffer to the long-term effects of climate change.

- climate resilience
- schematic design
- waterfront access
- stakeholder engagement

client contact

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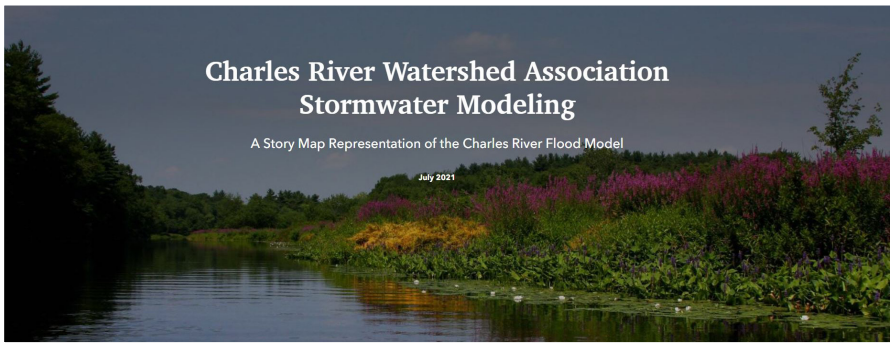
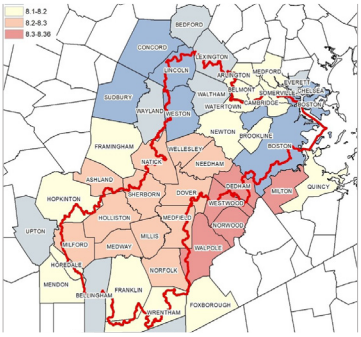
CHARLES RIVER FLOOD MODEL

charles river watershed, massachusetts





The Charles River Watershed is experiencing climate change impacts, such as heavy precipitation and flooding, which can create significant damage. Weston & Sampson, along with the Charles River Watershed Association, was selected to develop the Charles River Flood Model (CRFM) to forecast expected flooding scenarios and test watershed scale adaptation strategies for 20 communities in the 270-square-mile portion of the Charles River watershed that drains to the Watertown Dam. The CRFM was developed using the PCSWMM 2D modeling platform. First the 1D model was developed in PCSWMM, which included over 700 subcatchments, over 1550 conduits, and more than 440 field verified structures, such as dams, culvert crossings, junctions. Next, the 2D flood model was developed to include areas within the existing 500-year floodplain to capture instream and near stream storage, as well as to reflect the capacity of those floodplains to convey flows downstream. Weston & Sampson modeled 10 different 24-hour duration rainstorms in the watershed:

- 3 present day storms: 2-year or 50% chance of occurring annually, 10-year or 10% chance of occurring annually, and 100-year or 1% chance of occurring annually
- 6 corresponding future storm scenarios: 2-, 10-, and 100-year design storm events projected for mid-century (2030/2050), and 2-, 10-, and 100-year design storm events projected by late in the century (2070/2090)
- 1 extreme rain event of 11.7 inches in 24 hours, which was used in a similar modeling effort in the neighboring Mystic River Watershed

The team assessed the impact of six different flood mitigation strategies employing green, nature-based solutions using the CRFM. These include adaptation measures such as onsite storage, raingardens, bioretention basins, reduction in impervious surfaces, and others that focus on the protection, restoration, and/or management of ecological systems to safeguard public health, provide clean air and water, increase natural hazard resilience, and sequester carbon. Weston & Sampson, in association with Communities Responding to Extreme Weather (CREW), also sought extensive public input to inform the modeling scenarios and develop solutions that would work best for each community. This stakeholder engagement and coordination of input led to an informed public and acceptance of the results.

The CRFM represents the impacts of flooding across the watershed from various types and sizes of rainstorms under both present and future climate scenarios and can be used to test the efficacy of various flood mitigation measures. It is augmented by the online Flood Model Results Viewer, an interactive web-based GIS application to view present and future flood risks in the watershed that allows the user to see the flood mitigation benefits from an array of green infrastructure strategies.

- urban and suburban watershed
- stakeholder engagement and coordination
- watershed model development
- flood impact assessment

client contact

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MOAKLEY PARK VISION PLAN & IMPLEMENTATION

boston parks and recreation department | stoss landscape urbanism

The Boston Parks and Recreation Department (BPRD), as part of their plans to increase city-wide climate resilience, targeted the rehabilitation of Moakley Park as an opportunity to address climate vulnerabilities and advance climate resilience along the South Boston waterfront while re-programming opportunities for recreation and community gathering. Moakley Park, a 60-acre public open space, is located across from Carson Beach, and is increasingly vulnerable to flooding due to climate change and identified as one of the major flood pathways in Climate Ready Boston. The 2018 Moakley Park Vision Plan, by Stoss Landscape Urbanism (Stoss), presented concepts for a resilient Moakley Park. The plan called for the creation of an approximately 2,600-foot vegetated berm (levee) to provide flood protection.

Weston & Sampson supported BPRD in their successful application for a Massachusetts Municipal Vulnerability Program (MVP) Action Grant for the preliminary resilient design of Moakley Park; the state awarded BPRD the grant in July 2019. Subcontracted to Stoss, Weston & Sampson advanced the Vision Plan by analyzing current and future climate risks and analyzing challenging onsite conditions. We developed future design storm projections and recommended scenarios at the park to evaluate flooding impacts by combining extreme rainfall and sea level rise/storm surge under existing and proposed design conditions at the park. Weston & Sampson collaborated with Nitsch Engineering to develop a stormwater flood model fin PCSWMM 2-D by building upon the stormwater flood model for the surrounding areas provided by Boston Water & Sewer Commission (BWSC) using BWSC's stormwater inundation model. We collaborated with BWSC and Massachusetts Water Resources Authority (MWRA) to understand operational needs and identify how park redevelopment might affect their respective area infrastructure. The resulting schematic design reflects strategies to manage changes in our climate over time, including sea level rise and storm surge with a flood barrier integrated into the park and floodable landscape/vegetation on the coastal side of the barrier; more frequent and intense rainfall events and changing groundwater conditions with green infrastructure and integrated stormwater management; and extreme heat conditions with increased tree canopies, light/reflective material selection, shade and cooling structure.

Weston & Sampson is leading design, bidding, and construction of the first phase implementation and is responsible for establishing the basis-of-design with respect to climate change projections, including design standards for sea level rise/storm surge, extreme precipitation, and extreme heat, and corresponding impacts to design. The performance of the park under current and future climate conditions is being modeled, including urban heat island modeling and peer review of coastal and stormwater modeling. This has involved continued close coordination with BWSC and integration of their stormwater model. Our team will help the city realize a new park that is more resilient to climate events and provides a range of active and passive recreational opportunities for a diverse, multi-generational population.

- waterfront park improvements
- climate & coastal resiliency
- geotechnical & environmental engineering
- flood barrier design
- stormwater management & green infrastructure strategies
- utility coordination
- successful MVP action grant application

client contact

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Amy Whitesides
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WASTEWATER TREATMENT FACILITY CLIMATE RESILIENCE ASSESSMENT

town of seabrook, new hampshire

The Town of Seabrook identified several critical wastewater treatment components vulnerable to the anticipated changes in sea level rise under projected future climate scenarios in the Town Master Plan Chapter on Coastal Hazards and Adaptation. The focus of this project was the town's critically important wastewater treatment infrastructure, which collects and treats domestic, commercial, and industrial wastewater from most of the town.

The wastewater treatment facility (WWTF) and other system treatment components are all located on Wright's Island, a small upland area within the salt marsh that straddles the New Hampshire/ Massachusetts border south of Route 286. Vehicular access to Wright's Island is via a single-lane causeway from Route 286. The isolated nature of the WWTF makes it particularly susceptible to sea level rise (SLR) and coastal surge, and any disruptions to WWTF operation quickly becomes a public health risk. The project involves assessing the specific vulnerabilities at the site and identifying/assessing up to four options for improving resiliency.

The project also involves identifying effective communication and outreach methods, building upon successful efforts of regional organizations to continue the conversation about climate change in Seabrook and engage the public in the results of the WWTF assessment. It is expected that our outreach process will be easily replicated by other New Hampshire coastal communities.

Key objectives of this project included:

- Identify current/projected flooding from SLR/storm surge and impacts
- Include new site-specific SLR and storm surge evaluations
- Incorporate new science on groundwater rise projections
- Identify and create design concepts, permit strategy, and costing for four options for improving the climate resiliency of the WWTF
- Engage over 50 residents though the development of public engagement strategy on climate threats and emergency procedures

client contact

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Superintendent
Sewer Department
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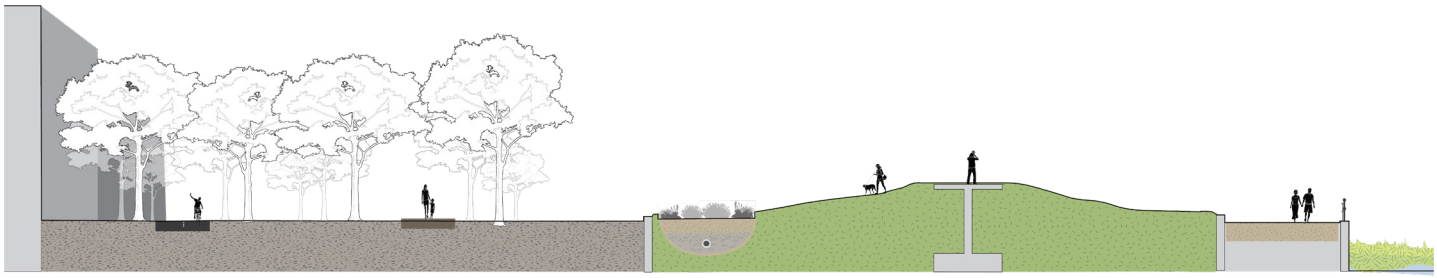
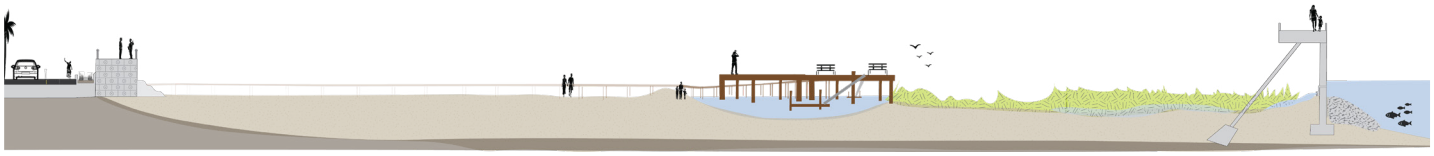
cslayton@seabrooknh.org

U.S. ARMY CORPS OF ENGINEERS CHARLESTON SC 3x3x3 PERIMETER PROTECTION PLAN

Clemson University Master of Resilient Urban Design-Design Alternatives





The historic City of Charleston, South Carolina faces diverse flood threats including tidal flooding, storm surge, sea level rise, and stormwater runoff from intensified rainfall. In response to storm surge concerns, the US Army Corps of Engineers (USACE) conducted a federal planning process referred to as 3x3x3 with a price tag of $3 million to complete a study in three years with three concurrent levels of review. The result is a USACE proposed perimeter protection plan that includes a nearly eight-mile long seawall at 12' elevation which would wrap around Charleston's historic and beloved peninsula. In 2021, the Clemson University Master of Resilient Urban Design program completed a design alternative study to the Corps' Charleston perimeter protection plan. Kim Morganello, now staff with Weston & Sampson, had the opportunity to work on the project as part of her graduate studies, focusing on the iconic areas of Union Pier, Joe Riley Waterfront Park, and the High Battery. Alternatives sought to:

- Enhance public space and access to the water's edge for resident livability and visitor experience
- Provide edge repair to restore ecosystem services
- Design site specific perimeter protection based on existing physical, cultural, and natural resource conditions,
- Create a resiliency laboratory for research and education on a world stage

A Master Plan was created for Union Pier which includes approximately 30 acres of mixed-use development and 40 acres of open space. Portions of the existing pier deck are removed, daylighting open water and restoring a degraded tidal marsh ecosystem. The Joe Riley Waterfront Park provides 10 acres of public green space in Charleston's urban core. Special design considerations are essential to preserve the vision of Mayor Joe Riley. A Mounded T-Wall (above section) is proposed as part of the alternative design that largely hides the perimeter protection from view and protects a majority of existing live oaks and site line to the water. Since the first hurricane the High Battery withstood in 1797, the High Battery has been battered by storm events resulting in the need for near constant repair. The design calls for an offshore combo wall that protects the High Battery and the City within. The combo wall creates a polder system (above section), designed to allow water to enter with the ebb and flow of the daily tides.

Design alternatives were communicated to the City's Civic Design Center through plan view drawings, sections, renderings, a physical model, diagrams, and hand sketches. The design process included regular meetings with the client, presentations, poster sessions, and community engagement.

- **resilient urban design**
- **historic areas & districts**
- **site analysis & research**
- **diverse visualization techniques**
- **community engagement**
- **design standards & guidelines**

client contact

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Charleston Civic Design Center
City of Charleston, SC
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KIAWAH ISLAND 2015 CHANNEL REALIGNMENT & LONG-TERM SAND MANAGEMENT

kiawah island, south carolina

CSE staff have assisted Kiawah Island for over 40 years, including assisting in the initial development plan for the community to ensure development was sufficiently set back from the ocean. In 2004, the encroachment of a flushing channel from Stono Inlet caused severe erosion on the northeastern end of Kiawah Island. CSE designed and implemented two channel realignment projects (2006 and 2015) to mitigate erosion threatening the 16th and 18th holes of the famed Kiawah Ocean Course and restore the sand flow to downcoast beaches. Each of these projects occurred in designated critical habitat for the piping plover and incorporated methods to reduce impacts and prolong habitat formation suitable for these birds. This required close consultation with state and federal resource agencies and detailed post-project monitoring.The 2006 and 2015 Kiawah Island channel realignment projects illustrate how engineering solutions can be used to balance the protection of property and the development of wildlife habitat. In addition to restoring the flow of sand to downcoast areas of Kiawah Island, these projects were also designed to prolong washover habitat crucial for the piping plover.

client contact

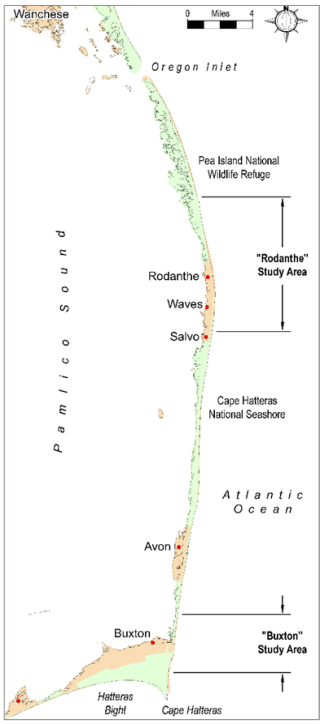
Jim Jordan, Wildlife Director
21 Beachwalker Drive, Kiawah Island, SC 29455
843-768-9166 | jjordan@kiawahisland.org

- Total Volume: 650,000 cy
- Project Length: 6,000 lf

DARE COUNTY BEACH EROSION ASSESSMENTS & NOURISHMENT

dare county, north carolina

CSE was retained in 2013 to evaluate shoreline erosion along the critically eroding "S-curve" sections of Highway NC 12 and adjacent beaches in the areas of Rodanthe and Buxton on Hatteras Island (NC) and develop alternate plans for beach restoration. The study's primary goal was to determine the feasibility and probable costs of beach restoration and maintenance to protect community infrastructure (particularly along sections of Highway NC 12) from chronic erosion and flooding. Based on the profile volume analyses of the project area and the adjacent healthy beach, CSE developed 5-year and 10-year beach restoration plans. As the project area was located on a National Seashore, the effort required extensive coordination with federal agencies, local municipalities, property owners, and the County. This study has culminated in an ongoing coastal engineering consulting relationship with Dare County. Over the past 10 years, CSE has designed and managed two beach nourishment projects along 15,500 ft of coastline at Buxton (Jun 2017-Feb 2018 – 2.6 million cy; Jun-Aug 2022 – 1.2 million cy), a feasibility study and nourishment project for Avon (Jun-Aug 2022 – 1.0 million cy placed along 13,200 lf of beach), and a feasibility study for Rodanthe anticipated in 2023.



client contact

Robert Outten, County Manager / Attorney
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252-475-5811 | outten@darenc.com

- Total Project Volume: 4,008,000 cy
- Project Length: ~8.5 Miles

CSE
COASTAL SCIENCE & ENGINEERING

DEBORDIEU COLONY BEACH NOURISHMENT & GROIN CONSTRUCTION

DeBordieu colony, south carolina

CSE has provided coastal engineering services to DeBordieu Colony Community Association since 1984. Early work included the first shoreline erosion assessment and a comprehensive tidal wetlands management plan. This led to two nourishment projects by truck using inland sand resources (1990 and 1998). CSE also developed plans between 1989 and 1996 for beach stabilization via terminal groins at the south end of the 1.5-mile beach. Legal challenges related to groins delayed implementation of the project. After re-engaging CSE in 2015, the project was permitted successfully, including a rigorous monitoring and mitigation plan to compensate for future downcoast impacts. CSE's modeling and empirical measurements predict the project will double or triple the renourishment interval (from 5 years to 10-15 years) and save the community over $30 million in renourishment costs over the next 30 years.

- 2022 Total Project Volume: 718,346 cy
- 2022 Groin Numbers: 3 Built

client contact

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843-527-4436
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LITCHFIELD BEACH SHORELINE ASSESSMENT & BEACH RESTORATION

litchfield beach, south carolina

Property owners' groups retained CSE within the Inlet Point community to provide a feasibility assessment and restoration plan for ~1 mile of shoreline. This involved a substantial community outreach effort to build support for the privately funded project. Based on the plan, CSE designed and administered the first large-scale restoration project along Litchfield Beach, adding 450,000 cy of sand to ~3,500 lf of shoreline. CSE leveraged its relationship with the contractor to coordinate the Litchfield project with a nearby effort and provide the community with a more economical alternative. As a result, the contractor completed both projects on a single deployment and provided both communities with cost savings of $1,000,000 each.

- 2022 Total Project Volume: 450,000 cy
- Project Length: ~3,500 lf

client contact

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CSE
COASTAL SCIENCE & ENGINEERING

SEABROOK ISLAND INLET RELOCATION & LONG-TERM SAND MANAGEMENT

seabrook island, south carolina

Seabrook's shoreline is bounded by an unstable migratory inlet (Captain Sams Inlet) to the north and a large, stable inlet (North Edisto River Inlet) to the south. CSE has served as the project engineer for Seabrook Island sand management projects since 1984. Our company has prepared dozens of beach monitoring, shoreline feasibility studies, and environmental reports tracking long-term changes along the beach. This has led to beach preservation designs that work with the inlets' natural dynamics and complex sediment pathways. CSE projects have helped sustain the sand supply along the island, buried most of the seawalls, and maintained the dry sand beach without groins. CSE projects have added ~2 million cubic yards alongshore using highly cost-effective inlet relocations (three at <$950,000 each ($2015) and one channel realignment by dredge (1990). CSE has also assisted in preparing Seabrook's two LCBMPs (1991 and 2014).

client contact

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- 2015 Total Volume: 165,000 cy
- Project Type: Inlet Relocation

TOWN OF EDISTO BEACH, BEACH NOURISHMENT & GROIN LENGTHENING

town of edisto beach, south carolina

- 2017 Total Volume: 1,006,000 cy
- Project Length: ~19,000 lf
- Groin Extensions: 26

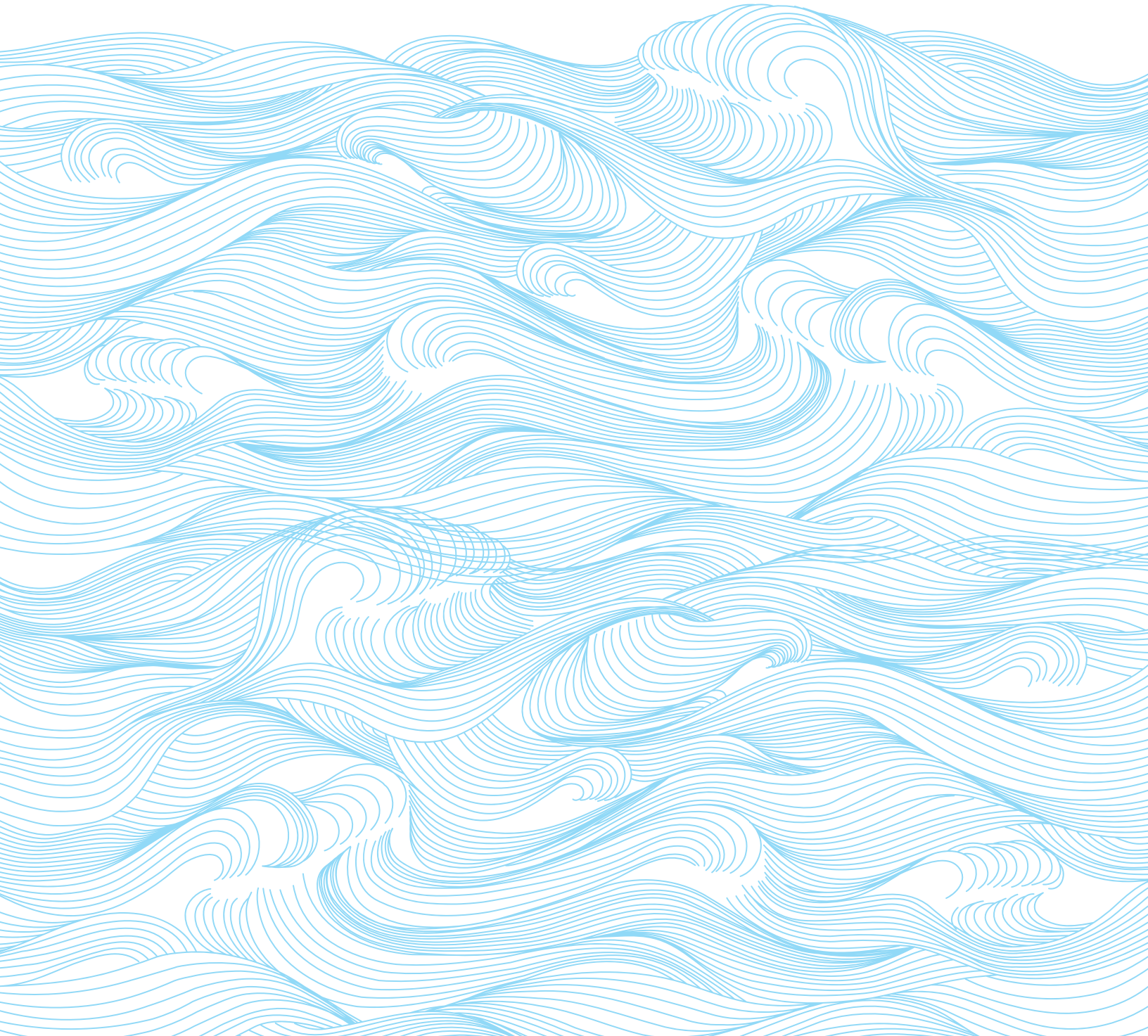
Following a 922,000 cubic yard nourishment project managed by CSE in 2006, the Town of Edisto Beach anticipated the need for a renourishment project around 2016. Planning for the project began in 2012 with the initiation of a groin-lengthening study. CSE determined that most of the groins were too short to hold a beach that could withstand seasonal fluctuations in the shoreline position without damage to developed property. The renourishment project included lengthening 26 groins to maintain an adequate berm width and protective dune for storm damage reduction. The project was completed between January and June 2017 and placed 1,006,000 cy along 3.6 miles, including Edisto Beach State Park. FEMA Category G disaster assistance funds were approved after Hurricane Matthew (2016) and paid for a portion of the project. CSE presently provides annual post-project monitoring for the Town.

client contact

Mark Aakhus
Town Manager
2414 Murray Street
Edisto Island, SC 29438
843-869-2505
maakhus@townofedistobeach.com

CSE
COASTAL SCIENCE & ENGINEERING

Project Team



WHY OUR TEAM

Our team takes a "local knowledge first" approach.

We believe our team, comprised of Weston & Sampson and CSE, provides the essential balance between proven resilience expertise and an understanding of local stakeholder engagement. The proposed mitigation strategies developed by Weston & Sampson and CSE will be the most effective with extensive local stakeholder buy-in. Local knowledge of and experience with the impacts of sea level rise will be invaluable to the development of mitigation strategies. Our team consists of engagement experts who are skilled at soliciting this local knowledge from stakeholders and citizens.

- **Nationally recognized** climate resilience team
- Nimble team of **local champions and specialists**
- **Graphic forward** approach to document development
- **Technical excellence**
- **Dynamic** engagement methodologies

WHO WE ARE

Resilience Specialists

Coastal Resources Experts

Community Planners

Beach Management Specialists

Visualization Specialists

Enagement Innovators

Certified Floodplain Managers

Modeling Experts

MEET OUR TEAM

Weston & Sampson SM
transform your environment

CSE
COASTAL SCIENCE & ENGINEERING

Management

Jeannie Lewis
Project Manager

Steven Traynum
Assistant Project Manager & Engagement Lead

Technical Review

Indrani Ghosh, Ph.D.
Senior Technical Leader

Climate

Rupsa Roy, Ph.D.
SLR Analysis

Bella Purdy
Urban Planner

Adria Boynton, AICP
Graphic Designer

Community

Anna Kimelblatt, CFM
Certified Floodplain Manager & Community Resilience Planner

Tim Kana, Ph.D. PG
Senior Coastal Scientist

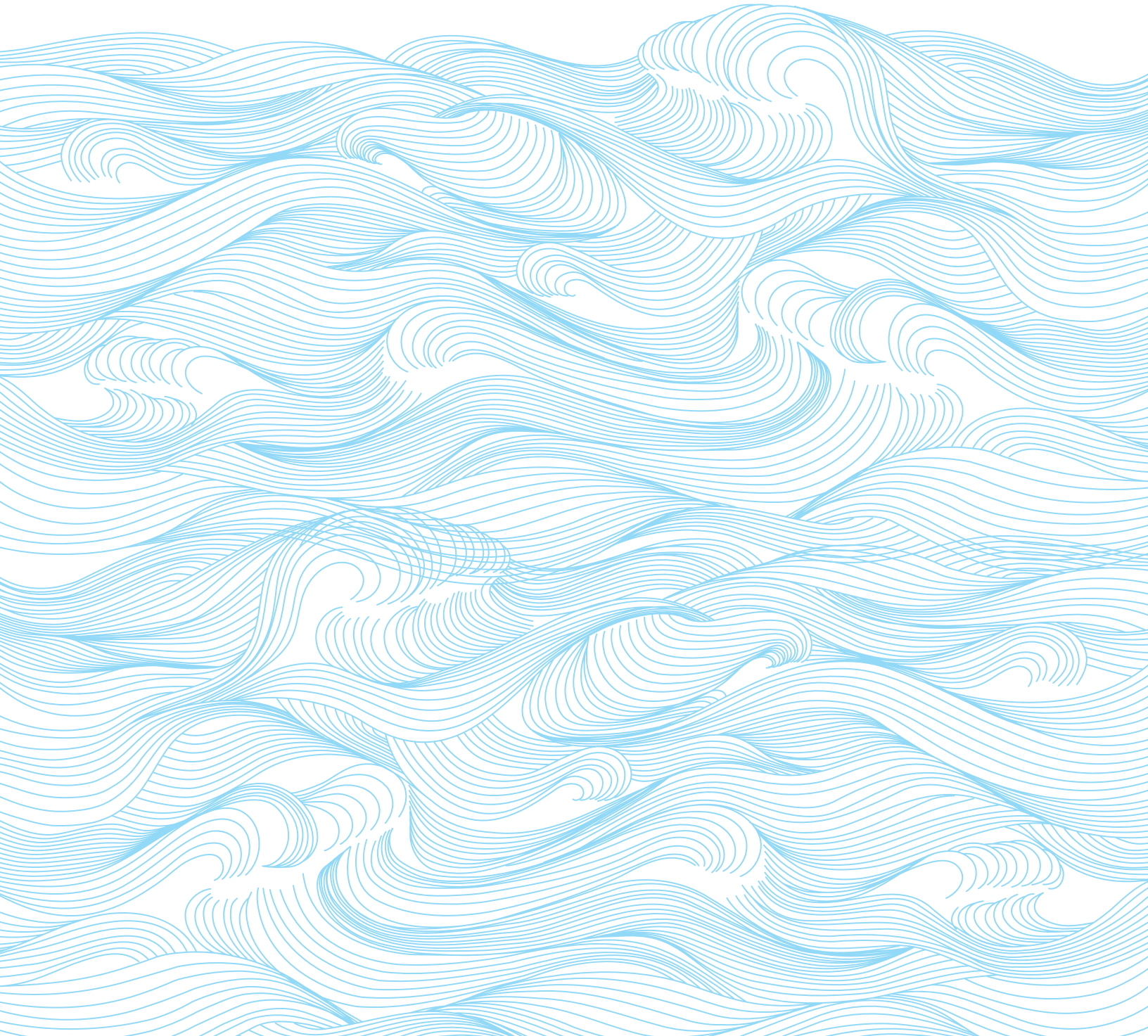
Kim Morganello
Resilient Urban Designer & Engagement Specialist

Technical

Lucas Hernandez
Modeling Lead

Patrick Barrineau, Ph.D. PG
Coastal Scientist

Sub-Consultants/ Contractors



SUB-CONSULTANTS/ CONTRACTORS

CSE specializes in engineering, planning, and scientific studies in the coastal zone.

Coastal Science & Engineering Inc. operates in the State of South Carolina as a registered Engineering firm with LLR South Carolina State Board of Registration for Professional Engineers and Surveyors with current registration from 2021 to 2023 (COA #1950). CSE's founder, Dr. Tim Kana (Lic #564) and Dr. Patrick Barrineau (Lic #2773), are also actively registered professional geologists with the LLR South Carolina Board of Registration for Geologists.

Since 1984, our experts in coastal and environmental engineering, geology, oceanography, and surveying have developed innovative engineering solutions to problems related to changing coastlines. CSE has in-house capabilities and experience to provide turn-key beach management services in conducting the following engineering work:

- Shoreline erosion assessment and feasibility studies
- Developing local and/or regional short-term and/or long-term beach management plans
- Community outreach and education
- Coastal shoreline numerical modeling and alternatives analysis
- Topographic mapping and bathymetric surveys from the beach zone to deep water
- Inland and offshore sand searches and geotechnical studies
- Project cost analysis to assist the client with public financing and planning

- State and federal permitting, environmental compliance, and documentation
- FEMA coordination and cost estimation for public assistance funds
- Development of plans and specifications for construction
- Bidding and negotiating with contractors
- Construction Administration
- Post-project monitoring to evaluate project performance

Among CSE's Milestone Are:

55

A total of 55 large-scale nourishment projects (~42 million cubic yards) via hydraulic dredge, hopper dredge, truck hauling from inland and offshore sources, sand transfers from accreting zones, and inlet relocation/realignment. These projects have helped protect property worth over $15 billion.

5

Five projects have been recognized as Best Restored Beaches by the American Shore & Beach Preservation Association (ASBPA), including Sagaponack–Bridgehampton, NY (awarded 2018), Seabrook Island, SC (2016), Folly Beach County Park, SC (2015), Nags Head, NC (2013), and Isle of Palms, SC (2011).

The 2011 Nags Head (NC) project was the largest locally funded nourishment project ever constructed in the US at 4.6 million cubic yards and received an ACEC National Engineering Excellence Award in 2013.

CSE's innovative relocation of Captain Sams Inlet (SC) (1983, 1996, and 2015) was recognized by the National Academy of Sciences as "both environmentally sensitive and cost-effective, indicating the benefits of combining fundamental research on coastal processes with coastal engineering practices."

Developed methodology for establishing objective setback lines for development in South Carolina (enacted as part of the State's Beach Management Act in 1988)

Consultant to the federal government (eg – US Army Corps of Engineers, US Environmental Protection Agency), state government (South Carolina, North Carolina, Georgia, and New York), and numerous municipal governments throughout the Carolinas.

EXTENSIVE SOUTH CAROLINA BEACH MANAGEMENT EXPERIENCE

CSE is the most experienced beach nourishment design firm in South Carolina, with more project experience than the USACE-Charleston District. Since 1984, CSE has provided engineering or consulting services for every developed beach in South Carolina.

CSE maintains the largest database of volumetric and linear erosion measurements in South Carolina, developed over 35 years of hands-on field data collection and aerial photo analysis. Our team has conducted over 40 engineering projects along South Carolina's highly irregular coastline and is intimately familiar with the erosion challenges, regulatory obstacles, and funding hurdles that local coastal communities face.

ISLE OF PALMS EXPERIENCE

CSE has been involved with shoreline management at the Isle of Palms for over 35 years. Over the past decade, CSE has worked for the City in all aspects of beach management, including surveys, permitting and execution of beach restoration projects, hurricane response, coastal policy, education, and outreach.

Beyond our consulting role for the City, CSE has invested in the Isle of Palms and the beach processes affecting the island by supporting studies, preparing conference presentations and scientific papers, and sponsoring graduate-level student research of the island. These efforts increase our professional understanding of the area while providing the City with a work product that exceeds simple beach volume calculations, which improves future beach management decisions.

PUBLIC OUTREACH AND ENGAGEMENT

Education and outreach are vital to improving the public's understanding of coastal resiliency. This includes increasing general awareness that beach erosion and sea level rise are happening and explaining the steps that coastal communities are taking to combat these problems.

CSE's goal is to help our clients communicate the challenges our coastline faces, the strategies adopted to mitigate them, and explain science and engineering evidence supporting these strategies. We provide various outreach and engagement tools to assist local communities in sharing relevant information regarding coastal resiliency planning and projects. These collaborative tools promote the benefits of beach nourishment and help broaden community participation and support.

CSE's communication tools assist project planners in the following ways:

- Promote the economic benefits of beach nourishment to local businesses and property owners
- Communicate potential benefits to coastal habitats and local wildlife
- Increase outreach to property owners impacted by beach nourishment activities
- Provide opportunities to increase community awareness and participation in resilience planning
- Communicate information about beach management planning and processes
- Highlight progress on planning and execution of beach nourishment projects

CSE understands that our clients have a vital role to play in educating the public about beach management initiatives. At the beginning of each project, CSE works with our clients to define a communication strategy and a suite of materials that will be used to provide consistent and regular messaging. Through close coordination with our clients, we keep all stakeholders updated with timely information throughout the life of the project.

The following tools and techniques are used to provide user-friendly information to educate stakeholders on specific issues related to beach nourishment activities. These materials are customized to match our clients' branding styles to help ensure that messaging is consistent with all other types of public communications.

- Town meetings
- GIS maps
- Education materials
- Newsletter/project updates
- Public notices
- FAQ sheets
- Workshops, roundtables, and public meetings

Sea Level Rise Impacts to the Beach & Dune System

CSE has been projecting SLR and monitoring associated environmental changes for decades, with some of our earliest reports occurring in the Charleston region under contract for the EPA in the 1980s. That work forecasted future sea level rises and provided estimates for changes in water levels and marsh habitats over 50- and 100-year periods. We have updated those findings with each successive round of the Intergovernmental Panel on Climate Change (IPCC) report issued in recent years. Our findings have been included as a cost-free add-on in our annual monitoring reports for clients from Long Island (NY) to Sea Island (GA), including the Isle of Palms.

Beaches and dunes can more easily adjust to SLR because waves simply build (and erode) these features at the ambient water level – whatever that level may be. As sea levels rise, the beach profile will be displaced proportionately upward and landward. The amount of displacement is related to many factors, but for much of Isle of Palms, a one-foot rise in sea level equates to 15–30 ft of landward shoreline movement. The change depends on the natural slope of the beach, such that the relatively steep Dewees and Breach Inlet shorelines will experience less displacement than the relatively shallow beaches along the center of the island.

Assuming this average rate of displacement, every mile of developed beach will need 100,000 to 300,000 cubic yards (cy) of sand to hold the shoreline position constant through one foot of SLR. This volume will be gained naturally along shorelines experiencing natural accretion – as often happens along portions of the Isle of Palms when shoals from Dewees Inlet attach. But along eroding shorelines, more than this volume will be needed to offset erosion. Isle of Palms should expect 1 ft of SLR by 2050, with an additional foot likely by 2080.

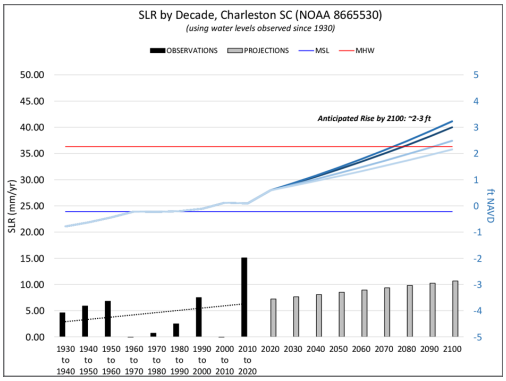
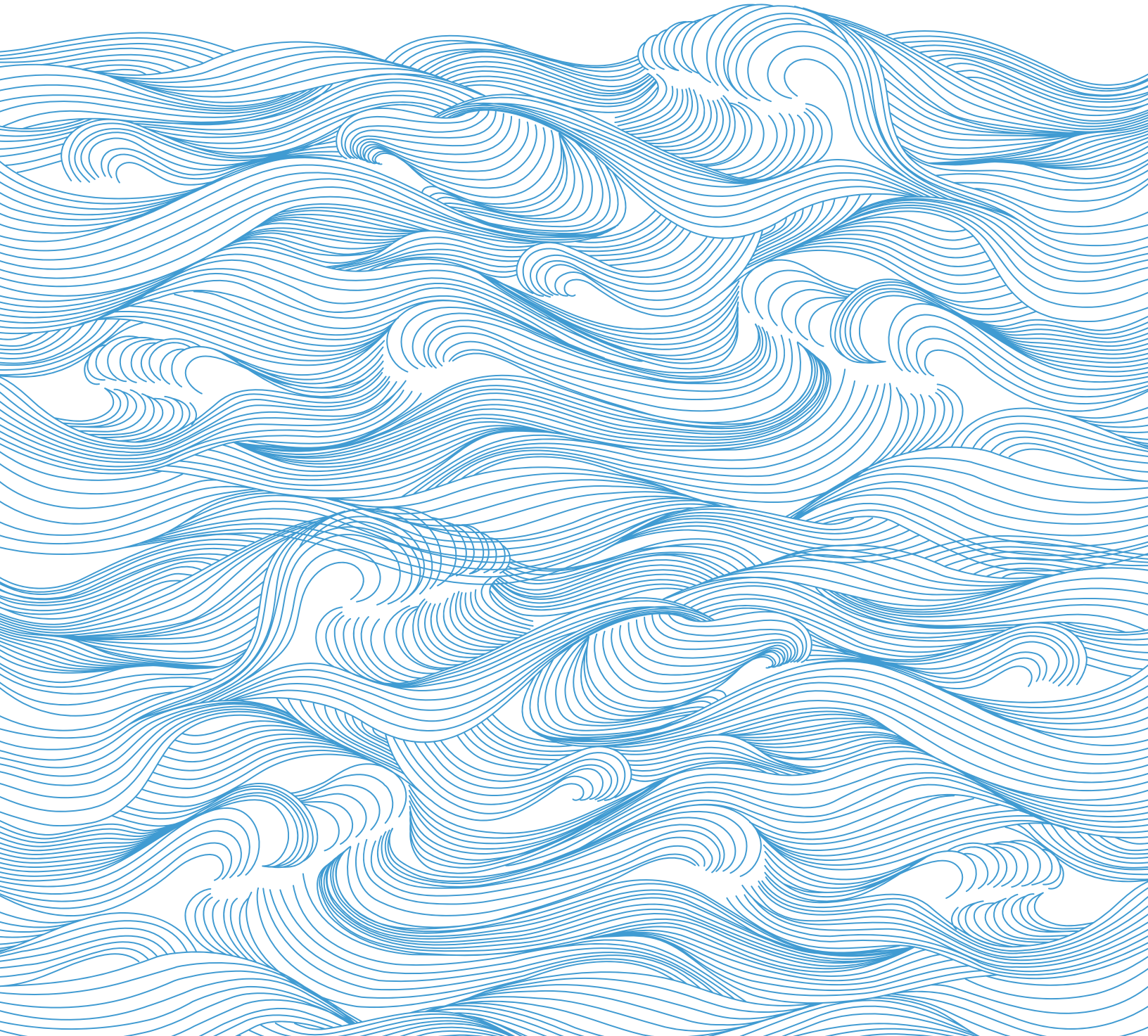


FIGURE A. CSE actively tracks up-to-date water level observations at Charleston to provide our clients with the latest information on their vulnerability to enhanced beach erosion as well as nuisance flooding. Observed sea level rise rates from 1930 to 2020 (black bars), with the average decade-to-decade increase (dotted black trend line) used to predict future sea level rise rates through 2100 (gray bars). If the average increase in sea level rise rates from 1930 to 2020 holds steady, 2 to 3 feet of sea level rise are possible by 2100. Current Mean High Water (MHW – red line) would be Mean Sea Level by ~2070.

Considering accelerated SLR rates are highly likely for the next several decades, CSE is already assisting clients to quantify sand deficits under a range of SLR conditions and erosion rates. Using this information, we identify eligible sand resources for placement via truck or dredge, and assist clients by effectively managing environmental restoration projects with a hands-on approach.

CSE's extensive knowledge of implementing renourishment projects on Isle of Palms and our decades of experience working with state and federal partners to obtain permits place us at the forefront of oceanfront environmental restoration projects in South Carolina.

Scope of Work



SCOPE OF WORK

Isle of Palms needs a comprehensive approach to sea level rise mitigation and adaptation.

Our team is confident that the Sea Level Rise Adaptation Plan will result in tangible, accessible, and equitable actions that will help protect Isle of Palms from future impacts of sea level rise and preserve its island way of life.

This process also provides the opportunity to drive regulatory discussions around climate adaptation and resilience. Through the development of the Plan, stakeholders will come together to define their goals and vision in regard to climate resilience. These conversations will contribute to a more comprehensive project review and implementation process.

Our approach will exceed standard modeling practices and provide better insight into the impacts of sea level rise on Isle of Palms. Our team has the capacity to build in-depth hydrologic models that consider a wide variety of variables, such as varying levels of sea level rise, storm surge, and precipitation. Our team has the ability to develop 2D model outputs at the parcel level to help the Isle of Palms Community confirm known locations vulnerable to sea level rise and storm surge and identify new areas that may not be immediately recognized by the community or island staff. Additionally, we can use the stormwater model currently being developed by Davis & Floyd to provide an analysis for how storm surge and future sea level rise scenarios will impact the island's drainage network through the manipulation of tidal boundary conditions. This type of analysis would provide enough information to develop potential solutions and test proposed solutions against the capabilities of the existing stormwater infrastructure. We are committed to providing Isle of Palms with the most detailed possible output with the intent that these models will be used to drive mitigation and adaptation strategies.

Determine vulnerabilities and model future scenarios

Use stakeholder input and model output to develop mitigation strategies

Make a document that is robust but accessible and usable

Our team is confident that the Plan we produce will align well with the priorities and goals of the IOP Strategic Plan for 2022-2027. The Plan will not only engage citizens on environmental issues but will also put IOP at the forefront of resilience and sustainability in South Carolina. We are confident that we will produce a Plan that will help IOP be the most sustainable and family-friendly beach community in the area, both presently and for many years to come.

1. Information Gathering

Deliverables: background report with current slr and groundwater data, and findings from stakeholder interviews.

1.1 Internal Meetings and Interviews

The project team will hold a series of internal meetings and interviews with the City staff, the Planning Commission, the Environmental Advisory Committee, utility providers, and other relevant staff to establish expectations, finalize timelines, assess existing capabilities, and determine which critical assets are considered vulnerable to sea level rise.

Document Review:

- Isle of Palms Comprehensive Plan
- Local Comprehensive Beach Management Plan for Isle of Palms
- City of Isle of Palms Strategic Plan 2022-2027 State of South Carolina Statewide Resilience and Risk Reduction Plan
- Charleston County Regional Hazard Mitigation Plan
- 2023 Drainage Master Plan (upcoming)
- Flood Mitigation and Sea Level Rise Adaptation for Kiawah Island, SC
- 2023 Flooding and Sea Level Rise Strategy Update for the City of Charleston

1.2 Personal and Small Group Interviews with Stakeholders

The project team will develop a comprehensive and diverse contact list of potential participants for personal and small group interviews that includes public officials, representatives from special districts and regional agencies, local community groups, service organizations, businesses, neighborhood groups, developers, local colleges, and other interest groups.

Stakeholders:

- IOP Neighborhood Association
- IOP Environmental Advisory Committee
- IOP City Council
- IOP Building, Planning & Zoning Depts
- Isle of Palms Business Council
- Isle of Palms Exchange Club
- Wild Dunes Resort
- IOP Police Department
- IOP Fire Department
- Shipwatch Homeowners Association
- Wild Dunes Community Association
- Sea Cabins on the Ocean HOA
- College of Charleston Lowcountry Hazards Lab
- Coastal Conservation League
- Charleston Resilience Network
- South Carolina Department of Natural Resources
- South Carolina Department of Health & Environmental Control
- US Army Corps of Engineers
- South Carolina Department of Transportation
- Charleston County Public Works
- Charleston County Floodplain Management

1.3 Compile SLR Data

The project team will compile the best available sea level rise data at the local, regional, and national levels. The project team will also review and incorporate all data within the City of Isle of Palms Drainage Master Plan, such as groundwater level data.

1.4 Public Outreach Workshops

In conjunction with City staff, the project team will host a series of public outreach workshops. These workshops will introduce the project to the public, define project parameters, inform the community of project opportunities and constraints, and solicit opinions from the community to shape the Plan. Feedback from these workshops will be incorporated into the Plan.

Photos from recent engagement events

2. Draft Plan Development

Deliverables: draft plan and presentations.

2.1 Develop Goals and Visions

The project team will use feedback from stakeholder and staff interviews to develop goals and priorities for the Plan.

2.2 Draft Illustrative Map of Vulnerabilities

The project team will create a map to geographically illustrate the vulnerabilities of the City. Such vulnerabilities may include commonly flooded areas, common road closures, areas of particularly low elevation, critical facilities, or areas experiencing severe erosion.

2.3 Draft Adaptation Strategies

Using the information and data collected from Task 1, the project team will devise a set of draft adaptation strategies. Strategies may include structural projects, green infrastructure projects, enhancements to emergency services, public outreach projects, amendments to ordinances, property protections, retrofits, or other regulatory tools.

2.4 Draft Cost Estimates of Potential Projects

The project team will develop cost estimates for each of the strategies proposed in section 2.3.

2.5 Potential Funding Sources

The project team will identify potential funding sources for the strategies developed in section 2.3. Staff will provide a review of grant opportunities that are available to local municipalities for hazard and flood mitigation.

2.6 Presentation of Draft Findings

The draft of the Plan will be presented at a public meeting. Staff will review the proposed goals, visions, strategies, and funding sources and will solicit feedback from City staff and stakeholders.

Public meeting presentations

3. Final Plan Development

Deliverables: final plan including inventory of existing conditions, projections, vulnerabilities, visions, goals, strategies, potential projects, maps, cost estimates, potential funding sources, and any other documentation necessary to meet the stated goals of the request.

3.1 Refine the Draft Plan

The Plan will be revised based on stakeholder and staff feedback received at the public meeting in task 2.6. Stakeholder and staff feedback will be recorded at the public meeting and incorporated into the revised Plan.

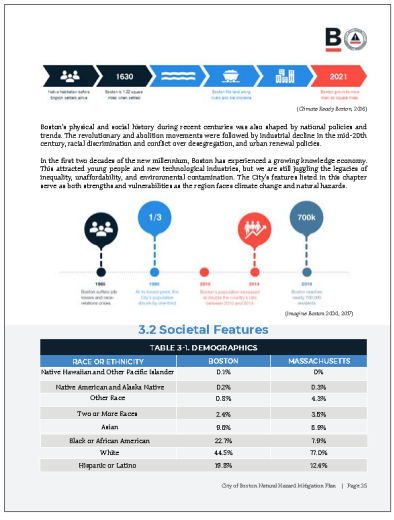
Photos from a stakeholder meeting

3.2 Present the Final Plan to Interested/Affected Parties

The project team will first present the final plan to smaller groups of stakeholders and other relevant affected parties. This will allow staff an additional opportunity to obtain feedback and gauge any concerns that stakeholders may have.

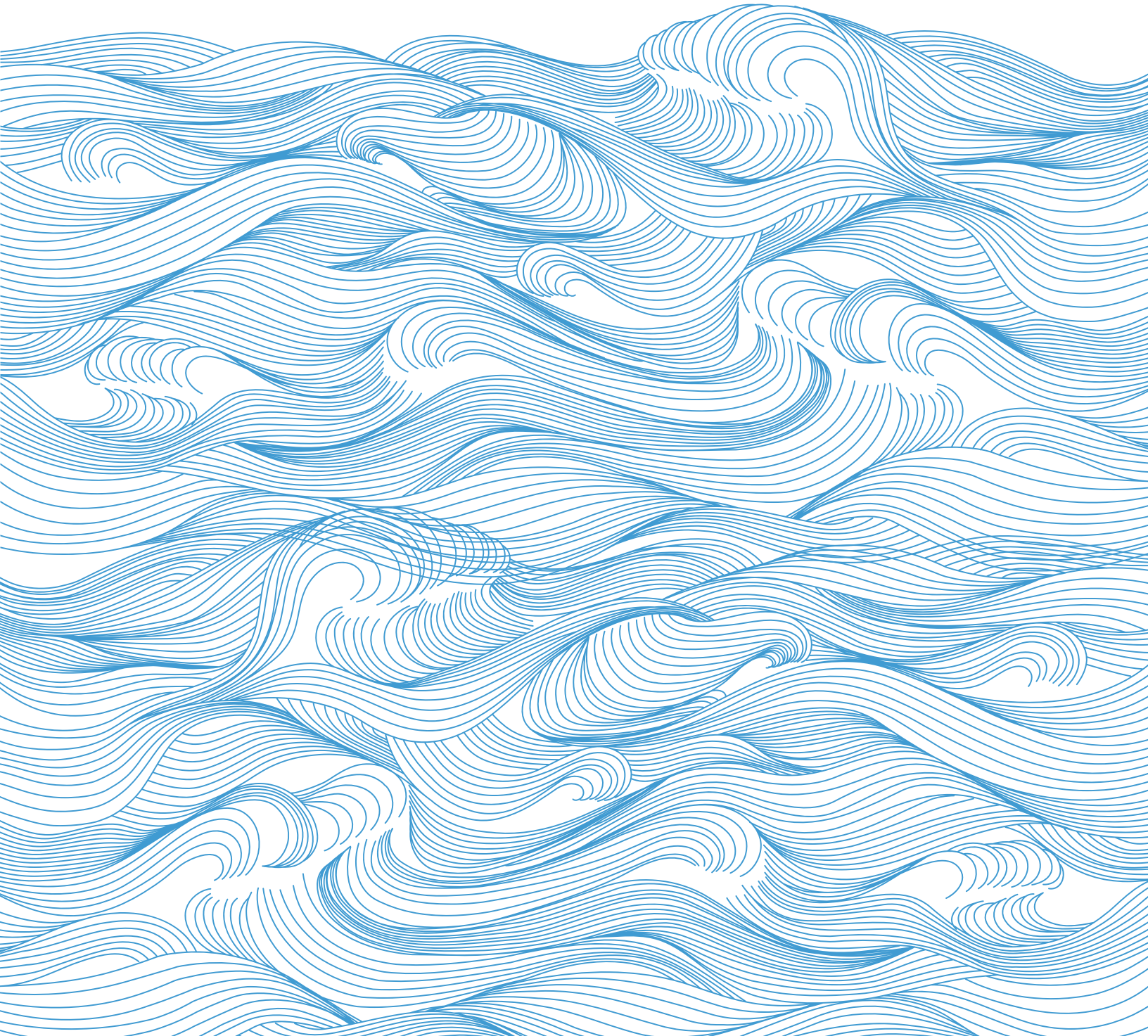
3.3 Present the Final Plan to IOP Council

A presentation on the final plan will be provided for the City of Isle of Palms Council. The project team will discuss the process through which the plan was developed and review the proposed strategies and funding sources. The goal of this presentation will be to have Council officially adopt the Plan.



An example of a formatted report

Our Experience



OUR EXPERIENCE

Weston & Sampson has robust technical knowledge in **actionable climate resilience, municipal vulnerability assessments, equitable engagement practices, infrastructure adaptation, and climate resilient design and engineering for coastal communities.** Our team has worked with many communities along the east coast to develop their plans which often address historical assets, districts, and flood risks. On the following pages, there are descriptions of our team's experience with these plans and links to prior projects that our team has completed.

Local Resilience Plans

Our team regularly supports communities across the East Coast in creating their resilience plans.

- Weston & Sampson is currently working on the Central Virginia Planning District Commission's Resilience Plan through Virginia Department of Conservation and Recreation's Community Flood Preparedness Program.
- Weston & Sampson is devloping **resilience plans for two coastal North Carolina communities,** Elizabeth City and Pasquotank County through the Resilient Coastal Communities Program.
- Weston & Sampson has provided support to Massachusetts communities as they complete their Municipal Vulnerability Preparedness (MVP) Plans through the Massachusetts Executive Office of Energy and Environmental Affairs. Our team has supported over **30 resilience plans or projects** through this program.
- Weston & Sampson supported resilience planning in Lynn, Chelsea, Everett, Boston, and Hingham - historic New England towns - through the **MA Coastal Zone Management Program.**
- Weston & Sampson is currently working on a vulnerability assessment and **resilience plan for Lee County, Florida** through the Resilient Florida Program.
- Weston & Sampson was the technical advisor for the **City of Cambridge's Resilience Plan.** This plan included a vulnerability assessment and focus on equity and community connection, as well as a section on Resilient Buildings with an emphasis on Cambridge's historic nature.

Historic buildings in Chelsea

Chelsea City Hall

We've worked with more than **47** communities on flood resilience projects

We've worked on resiliency grant projects totaling nearly **$9M** in grant funding

Completed over **$6.2M** worth of climate resiliency work

$6.5M resilience grant funding secured for clients since 2018

HISTORY OF GRANT SUCCESS

Completed over **100** climate resiliency projects

Over **20** staff members dedicated to flood resilience projects

Completed **15** Hazard Mitigation Plans

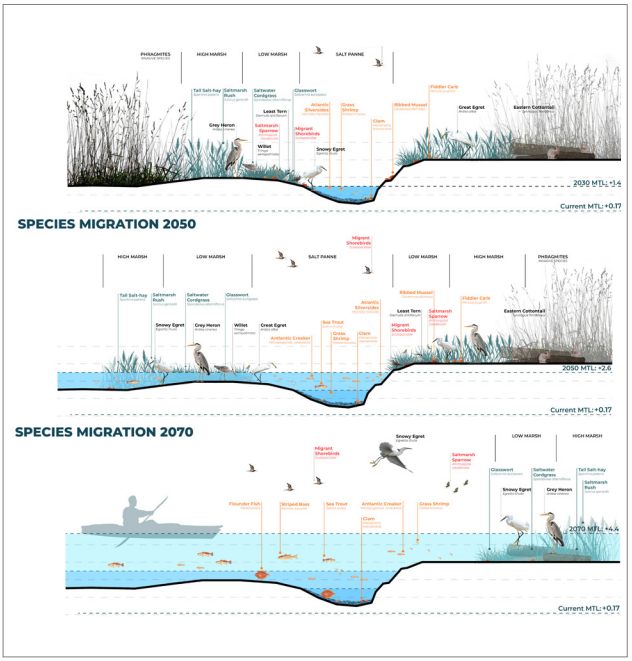
21 municipal climate resilience grant applications completed

BOSTON COMMON MASTER PLAN
Boston, MA

The Boston Parks and Recreation Department (BPRD) commissioned Weston & Sampson Design Studio to develop a creative, historically compatible, and flexible master plan for the revitalization of Boston Common, America's first public park. A robust public outreach process captured diverse voices across the city and beyond. Nearly 6,000 individuals took our online survey or engaged with us at an in-person event and these interactions provided valuable data about how people use the Common now and how it can better serve them in the future.

MASSACHUSETTS DEPARTMENT OF CONSERVATION AND RECREATION CLIMATE VULNERABILITY ASSESSMENT
Massachusetts, Statewide

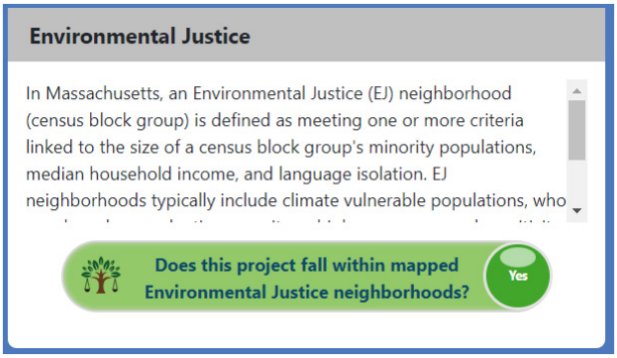
Weston & Sampson led the second phase of DCR's climate change vulnerability assessment which involved developing interactive engagement tools, adaptive nature-based design solutions, and integration with the state's ongoing initiatives. Weston & Sampson refined the methodology for assessing the exposure, sensitivity, and adaptive capacity of DCR's properties. The map above shows exposure to sea level rise/ storm surge. The map below is an output from an online ArcGIS portal that shows automated maps and evaluations. Nearly 500 DCR facilities exist in both coastal and non-coastal environments.



CLIMATE RESILIENCE DESIGN STANDARDS TOOL

Massachusetts, Statewide

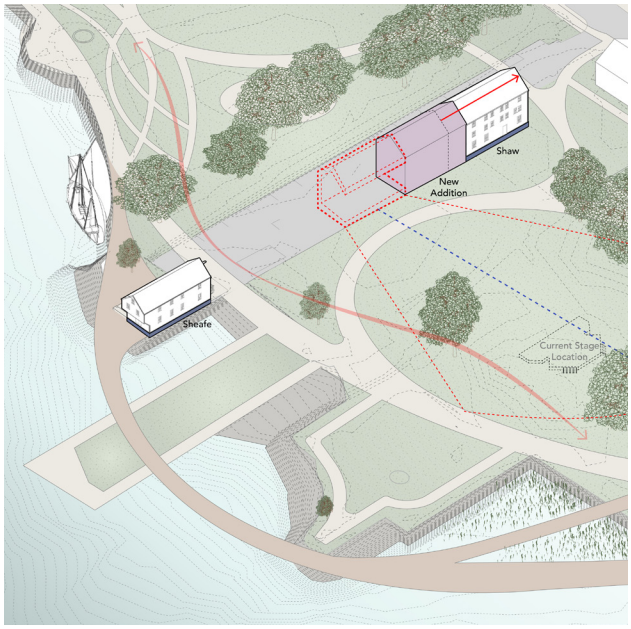
Weston & Sampson led this project for the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) and the Massachusetts Emergency Management Agency (MEMA). The first of its kind, this project developed statewide climate resilience standards and guidelines that integrate specific climate resilience actions into state and municipal capital planning efforts through a web-based tool. This free, interactive GIS-based application enables users to create a project online and receive data-driven output within 15 minutes, including a preliminary climate exposure and ecosystem services benefits score, climate risk ratings, and recommended design standards.



PRESCOTT PARK MASTER PLAN & IMPLEMENTATION

Portsmouth, NH

Prescott Park hosts hundreds of thousands of visitors annually for passive daily use and special events. The goal of the master plan is to revitalize this high-profile and high-visibility waterfront space, provide active and passive recreation opportunities, create essential pedestrian connections, and sustain the lasting legacy of park benefactors Josie and Mary Prescott for generations to come. Weston & Sampson performed a thorough site analysis, conducted extensive public engagement, and developed a comprehensive master plan that identifies inspired, yet achievable, renovation and restoration strategies for this signature property.



ISLE OF PALMS (SC) BEACH RESTORATION & SHORELINE MANAGEMENT

2018 Total Volume: 1,700,000 cy
Project Length: ~2.1 miles

The northeast end of Isle of Palms (SC) is periodically subject to significant and rapid shoreline fluctuations in response to "shoal-bypass" events, during which sand bars in Dewees Inlet detach from the delta and migrate onshore. These shoal-bypass events act as breakwaters and create areas of rapid accretion on the beach, flanked by areas of rapid erosion. A large event occurring from 2004 to 2008 caused severe erosion of the beach and necessitated the use of emergency sandbags in front of several large condominiums.

CSE was retained in 2007 to develop and implement a plan to restore the recreational beach, to provide dune protection, and to restore beach habitat along an ~11,000 ft stretch encompassing the northeast end of the island. CSE developed a plan consisting of periodic nourishment of the beach using offshore sand deposits coupled with land-based sand transfers as needed in response to attaching shoals.

For the initial project, CSE fast-tracked permitting for a ~850,000 cy dredging project, which was completed in July 2008, just 13 months after CSE's initial involvement. The project also involved documenting the removal of 13,000 emergency sandbags that were placed to protect structures.

Following the successful completion of the first project, CSE provided annual monitoring services for the City to document project performance and anticipate future beach changes do to shoal movements.

COASTAL SCIENCE & ENGINEERING

KIAWAH ISLAND ADAPTIVE MANAGEMENT PLAN

In 2018, The Town of Kiawah Island completed their Flood Mitigation and Sea Level Rise Adaptation Report. This report included over 100 recommendations, one of which was to develop an Adaptive Management Plan to better cope with the impacts of sea level rise and climate change.

An Adaptive Management Task Force was formed to initiate **development of an actionable plan to address sea level rise, climate change, and flooding on the island.** Weston & Sampson's Lucas Hernandez, lead the plan development and Task force, then as the Resilience Specialist for Kiawah Island.

The Sea Lever Rise Adaptive Management Plan would include a structured process to identify goals and objectives, implement management decisions, and carefully monitor the island's key systems (green and gray infrastructure):

- Roads/Access
- Salt Marsh
- Public/Common Property
- Beaches and Dunes
- Utilities
- Maritime Forest

The Task Force, at Lucas' direction, organized focus groups, community surveys, commercial entity studies, and stakeholder interviews to reach community consensus for intolerable conditions for community's key systems. **Over 1,500 people** responded to the Task Force's survey. **The unique community outreach identified thresholds for which mitigation or adaptation actions should be implemented by community decision makers.**

As part of developing thresholds for this study, both frequency and duration of a system disruption were considered. Additionally, the proposed plan outlined what parameters should be monitored and what timeframes should be considered. Once a threshold is reached, a management strategy can be implemented. Management strategies can be revised or improved depending on the severity of the disruption to provide an immediate resolution or to establish a more in-depth monitoring program to better inform decision making. This helps to account for the high level of uncertainty surrounding both local and national sea level rise projections, the challenges associated with cross-organizational collaboration, and funding community resilience.

This work was an exceptionally important step to sea level rise and climate change adaptation on Kiawah Island.

EXPERIENCE IN DEVELOPMENT OF GRAPHICS

Project Spotlight

BROOKLINE CLIMATE RESILIENCE DESIGN CHECKLIST & REGULATIONS

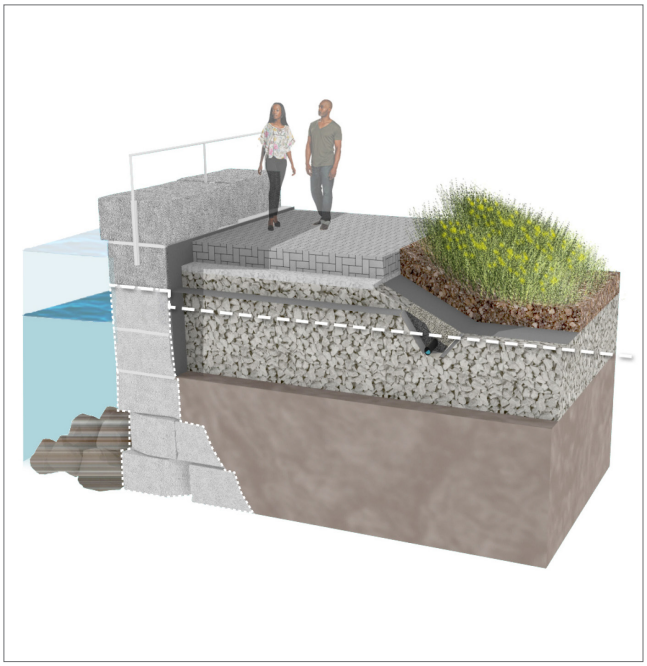
Brookline, MA

The Town of Brookline wanted to pursue climate adaptation and resiliency proactively by updating their local bylaws and regulations. Weston & Sampson assisted the town by conducting an extensive literature review of regional and national examples and then reviewed 23 of the town's bylaws, regulations, and guidelines to identify gaps and opportunities to incorporate climate resiliency language. Weston & Sampson also provided an in-depth analysis and recommendations on how to promote nature-based solutions and strategies such as green infrastructure (GI), low impact development (LID), open space protection, and floodplain protection.

CLIMATE-RESILIENT DESIGN STANDARDS & GUIDELINES

Boston, Massachusetts

Weston & Sampson assisted the Boston Public Works Department in establishing climate-resilient design standards/guidelines for managing adaptation projects to achieve four feet of flood protection by 2070, with the option to add an additional 2 feet in the future. Our team developed sample specifications, drawings, design, operations, maintenance, and cost considerations for 4 barrier options: harborwalk, raised roadway, deployable flood barriers, and vegetated berms. Our design considerations include adjacent development, accessibility, structural, geotechnical, transportation, utilities, stormwater, groundwater, vegetation, site boundary constraints, off-site impacts, and incremental adaptation.



EXPERIENCE WITH STAKEHOLDER ENGAGEMENT

Weston & Sampson believes in meeting people where they are and reducing barriers to participating in community engagement. We are life-long learners and explore innovative methods for engagement in our monthly public engagement collaborative. Our team frequently supports projects that serve climate vulnerable populations and environmental justice communities. We are committed to providing translation services as needed, accessible language, and multiple-touch points for engagement. We have trained facilitators on our team, and frequently lead workshops and working groups on sensitive topics related to climate resilience trade-offs. Our North Carolina staff regularly support engagement work to identify key input from residents.

Our team provides **"high-tech"** as well as **"high-touch"** engagement methods, and have used the following methods to help reach underrepresented populations:

- Educational **videos** posted and shared on social media
- Youth and family-oriented engagement **events** that use demonstrations and hands-on projects
- Have **translators** on-site at events
- Create online **surveys** or ArcGIS **Storymaps** so that residents can access information on their own time
- Created **multi-lingual** materials
- **Partnered** with community organizations to help build trust with residents
- Identified **"neighborhood captains"** so that residents can interact directly with other residents
- Provide **childcare, food, or compensation** for participating in a workshop

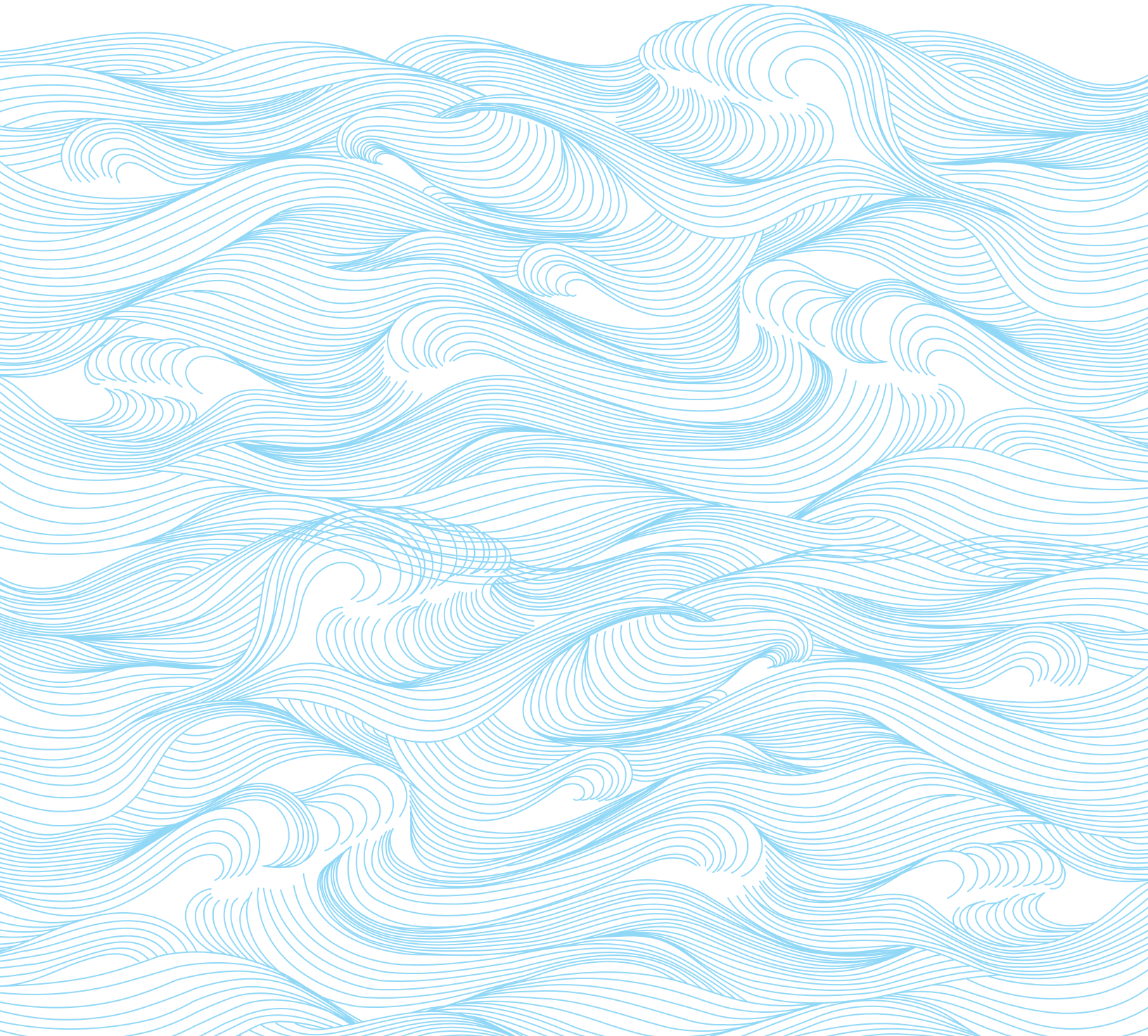
Project Spotlight

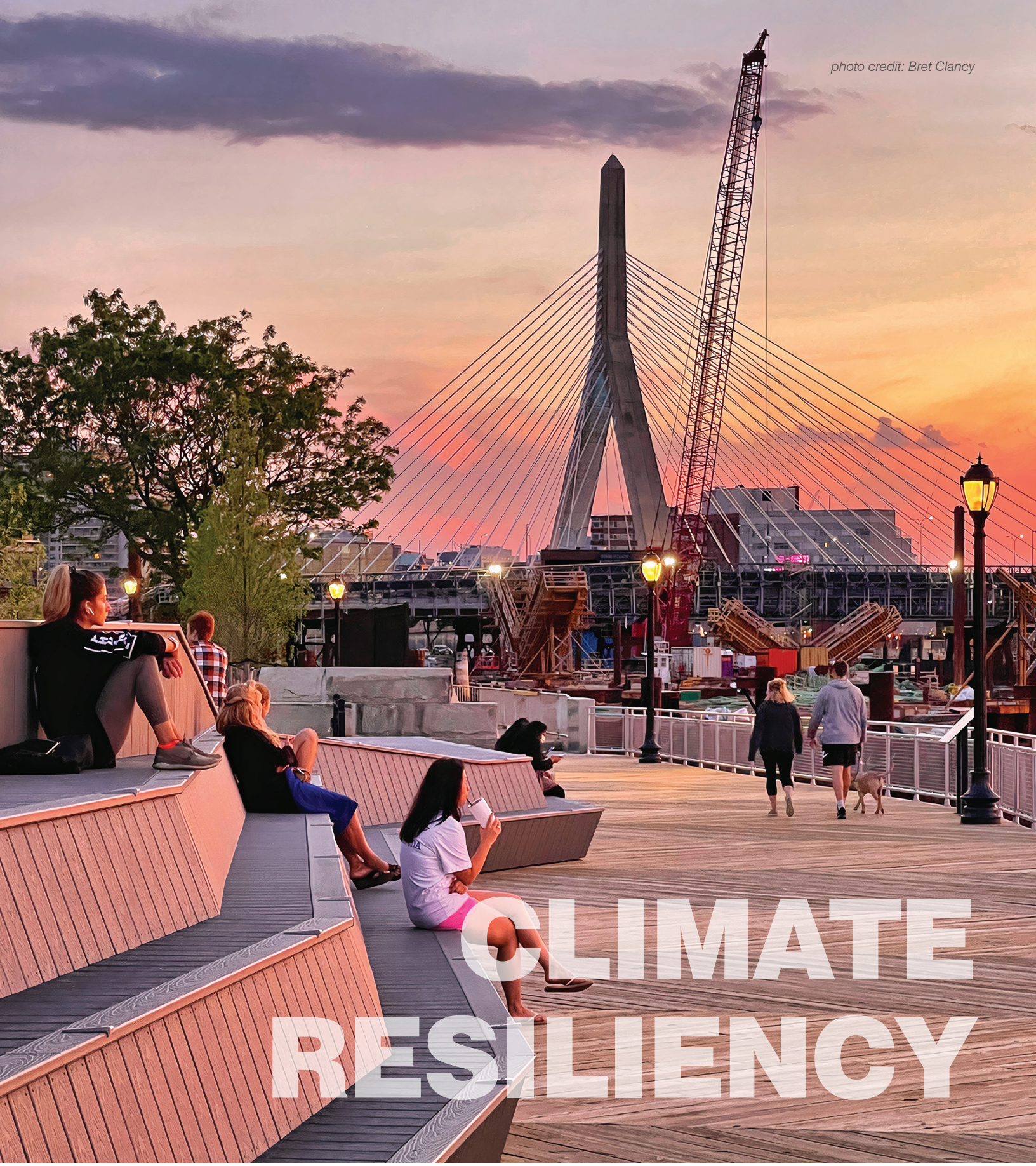
WALTHAM RESILIENT STORMWATER PLAN

Waltham, MA

Weston & Sampson conducted youth-focused STEM engagement for Waltham. Our team developed an educational video on climate change and climate-related careers, developed a web-page with youth-focused resources, and a informative fact sheet.

About Our Firm





CLIMATE RESILIENCY

transform your environment

Weston & Sampson℠

ADAPT. SURVIVE. THRIVE.

Weston & Sampson's climate resiliency services support creating designs that adapt, survive, and thrive both chronic and catastrophic changes in the natural environment. Since 1899, Weston & Sampson has been providing municipalities, public agencies, and private sector clients along the East Coast with cost-effective and innovative solutions to their infrastructure and environmental challenges.

Our climate resilience practice provides several interdependent services, including: Climate Modeling, Risk and Vulnerability Assessments, Planning, Design Guidelines, Public Engagement, Design and Adaptation, and Mitigation and Sustainability.

Weston & Sampson's interdisciplinary team of engineers, scientists, climate specialists, architects, landscape architects, designers, and planners incorporate relevant climate models and data into the design of our infrastructure and facility projects. We work with our governmental (municipal and state) clients to study, plan, and implement resilient and cost-effective strategies for their infrastructure, buildings, and natural resources.

What is climate resiliency in practice

- Model climate scenarios, assess risk, and develop plans and strategies
- Design projects to adapt to new design criteria and manage uncertainty
- Emphasize natural systems to mitigate climate impacts and create value

Our design approach

- Evaluate current and future climate risk
- Conduct a regulatory review
- Establish basis of design for climate resilience
- Propose actionable design recommendations

climate modeling

- Climate projections using global climate models (GCMs)
- Coastal modeling using sea level rise (SLR) projections
- Cumulative probability/risk analyses with climate projections
- Estimating climate impacts to water quality
- Estimating impacts of extreme precipitation and/or SLR on groundwater
- Extreme precipitation analyses (H&H modeling)
- Future & extreme wind analyses
- Future drought analyses & impacts to water supply
- Heat analyses (UHI modeling)
- Visualization and analysis of climate projections

A field team member measuring the diameter of a culvert

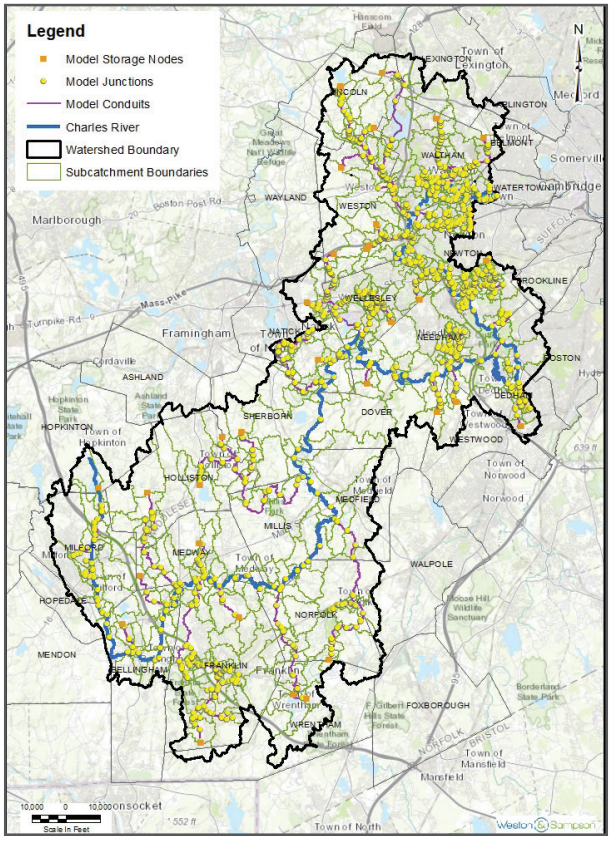
Urban Heat Island Mitigation | City of Chelsea, MA

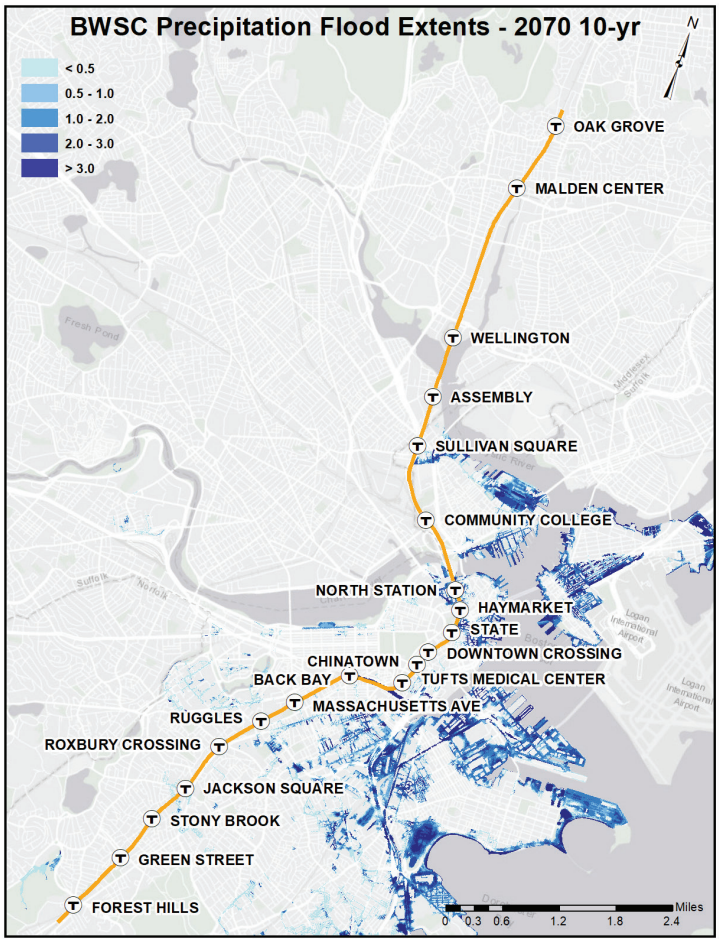
Transportation . Resiliency . Planning . Architecture

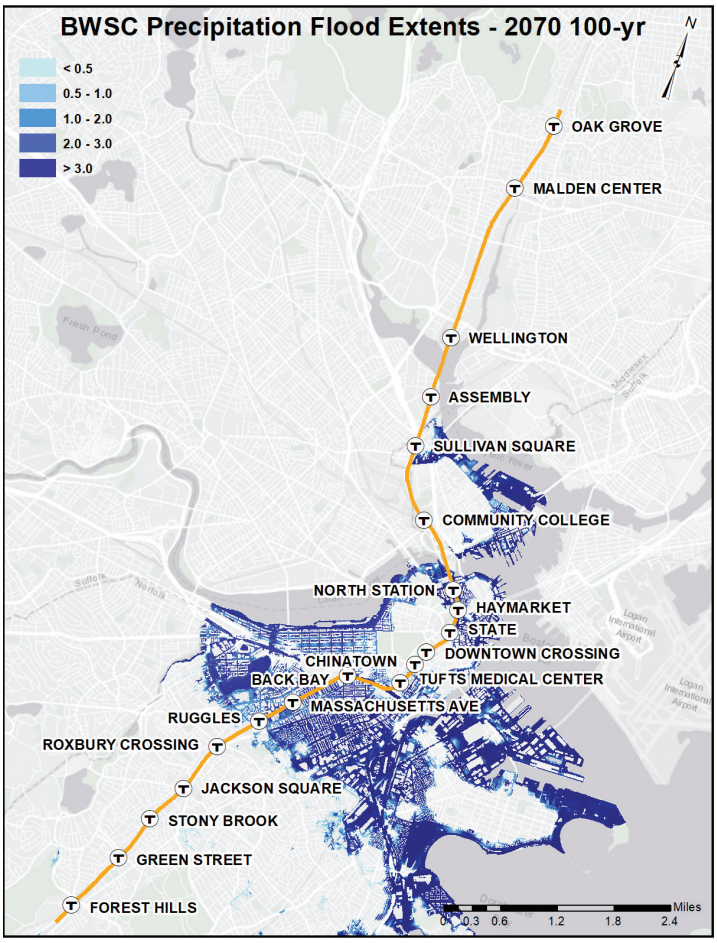
Charles River Watershed Flood Model | MA

Water . Resiliency . Planning

View the ArcGIS StoryMap here,
Green Infrastructure StoryMap here,
and the Charles River Flood Model Viewer here.







Flood data layers provided by the Boston Water and Sewer Commission Stormwater Model

MBTA Orange Line Vulnerability Assessment I City of Boston, MA

Planning . Resiliency

risk & vulnerability assessments

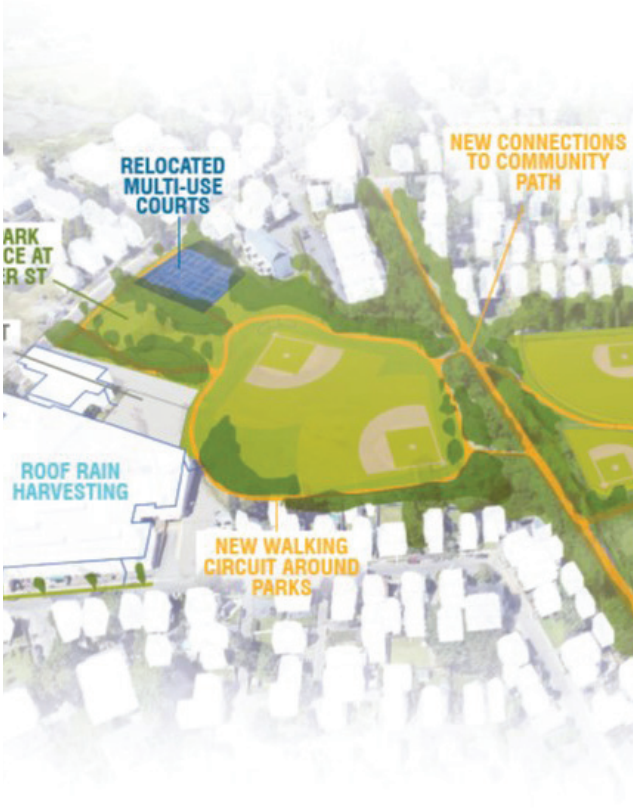
- Adaptive capacity and sensitivity assessments - buildings, natural resources, infrastructure, or community
- Applying ICLEI framework
- Applying ISO 31000 framework
- Applying transportation vulnerability assessment tool (VAST) framework
- Applying water and wastewater risk assessment tool (VSAT) framework
- AWIA risk and resilience assessments
- Consequence evaluation criteria
- Criticality analyses
- Installation Energy and Water Plans (IEWP) - military installation assessments
- Risk assessment (probability/consequence - different levels)

Church Creek Drainage I Charleston, SC

Water . Planning . Public Engagement . Resiliency

planning

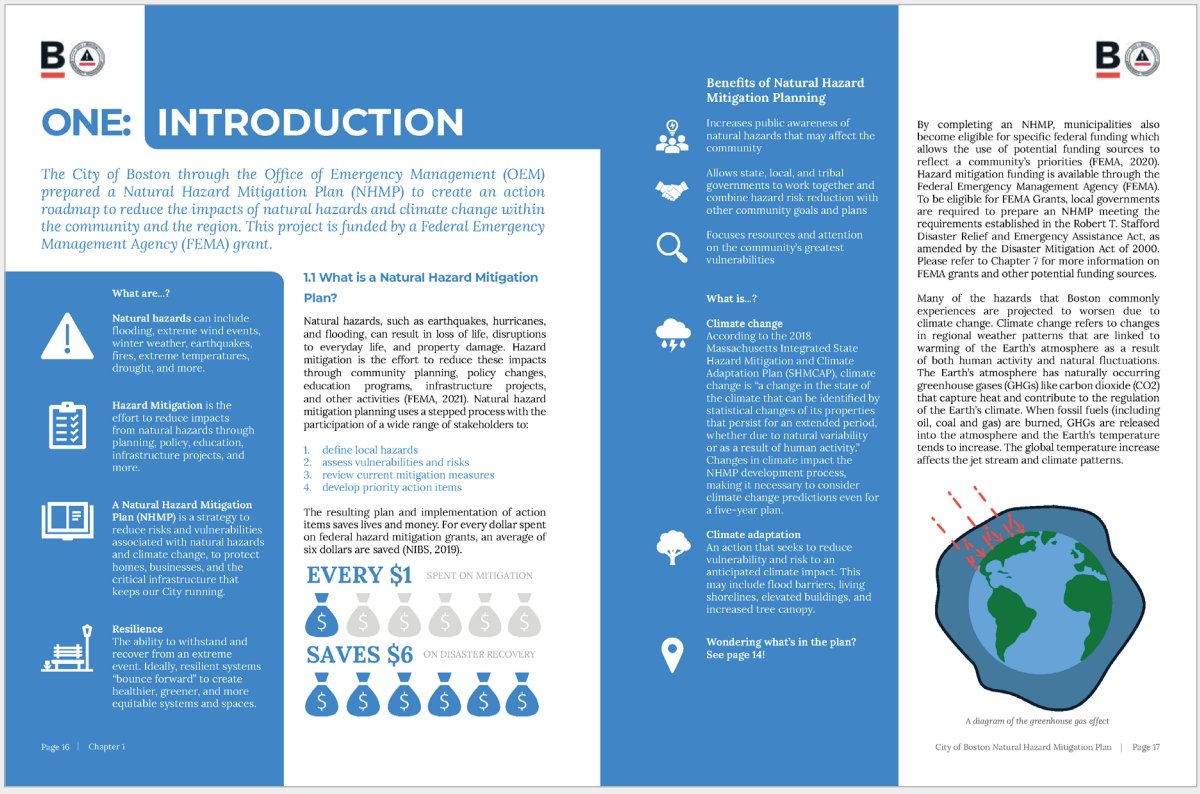
- AWIA emergency response plan updates
- Capital improvement plans/asset management
- Cost-benefit analyses (FEMA or otherwise)
- Economic impact analyses (using economic models, such as IMPLAN)
- Establishing alternative governance structures for implementing resilience
- Financial capability analyses
- Grant applications
- Hazard mitigation planning
- Implementation roadmaps using climate projections/ tipping points
- Integrating resilience and sustainability into master plans
- Local food systems analysis
- Municipal vulnerability preparedness (MVP) planning
- Open space planning
- Resilience funding/financing analyses
- Zoning/by-laws/regulations update recommendations



Strawberry Brook Resilient Stormwater Management & Implementation Plan | City of Lynn, MA

Water . Planning . Resiliency

View the ArcGIS StoryMap here.



ONE: INTRODUCTION

The City of Boston through the Office of Emergency Management (OEM) prepared a Natural Hazard Mitigation Plan (NHMP) to create an action roadmap to reduce the impacts of natural hazards and climate change within the community and the region. This project is funded by a Federal Emergency Management Agency (FEMA) grant.

What are...?

Natural hazards can include flooding, extreme wind events, winter weather, earthquakes, fires, extreme temperatures, drought, and more.

Hazard Mitigation is the effort to reduce impacts from natural hazards through planning, policy, education, infrastructure projects, and more.

A Natural Hazard Mitigation Plan (NHMP) is a strategy to reduce risks and vulnerabilities associated with natural hazards and climate change, to protect homes, businesses, and the critical infrastructure that keeps our City running.

Resilience
The ability to withstand and recover from an extreme event. Ideally, resilient systems "bounce forward" to create healthier, greener, and more equitable systems and spaces.

Page 16 | Chapter 1

1.1 What is a Natural Hazard Mitigation Plan?

Natural hazards, such as earthquakes, hurricanes, and flooding, can result in loss of life, disruptions to everyday life, and property damage. Hazard mitigation is the effort to reduce these impacts through community planning, policy changes, education programs, infrastructure projects, and other activities (FEMA, 2021). Natural hazard mitigation planning uses a stepped process with the participation of a wide range of stakeholders to:

1. define local hazards
2. assess vulnerabilities and risks
3. review current mitigation measures
4. develop priority action items

The resulting plan and implementation of action items saves lives and money. For every dollar spent on federal hazard mitigation grants, an average of six dollars are saved (NIBS, 2019).

EVERY $1 SPENT ON MITIGATION

SAVES $6 ON DISASTER RECOVERY

Benefits of Natural Hazard Mitigation Planning

Increases public awareness of natural hazards that may affect the community

Allows state, local, and tribal governments to work together and combine hazard risk reduction with other community goals and plans

Focuses resources and attention on the community's greatest vulnerabilities

What is...?

Climate change
According to the 2018 Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), climate change is "a change in the state of the climate that can be identified by statistical changes of its properties that persist for an extended period, whether due to natural variability or as a result of human activity." Changes in climate impact the NHMP development process, making it necessary to consider climate change predictions even for a five-year plan.

Climate adaptation
An action that seeks to reduce vulnerability and risk to an anticipated climate impact. This may include flood barriers, living shorelines, elevated buildings, and increased tree canopy.

Wondering what's in the plan? See page 14!

By completing an NHMP, municipalities also become eligible for specific federal funding which allows the use of potential funding sources to reflect a community's priorities (FEMA, 2020). Hazard mitigation funding is available through the Federal Emergency Management Agency (FEMA). To be eligible for FEMA Grants, local governments are required to prepare an NHMP meeting the requirements established in the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000. Please refer to Chapter 7 for more information on FEMA grants and other potential funding sources.

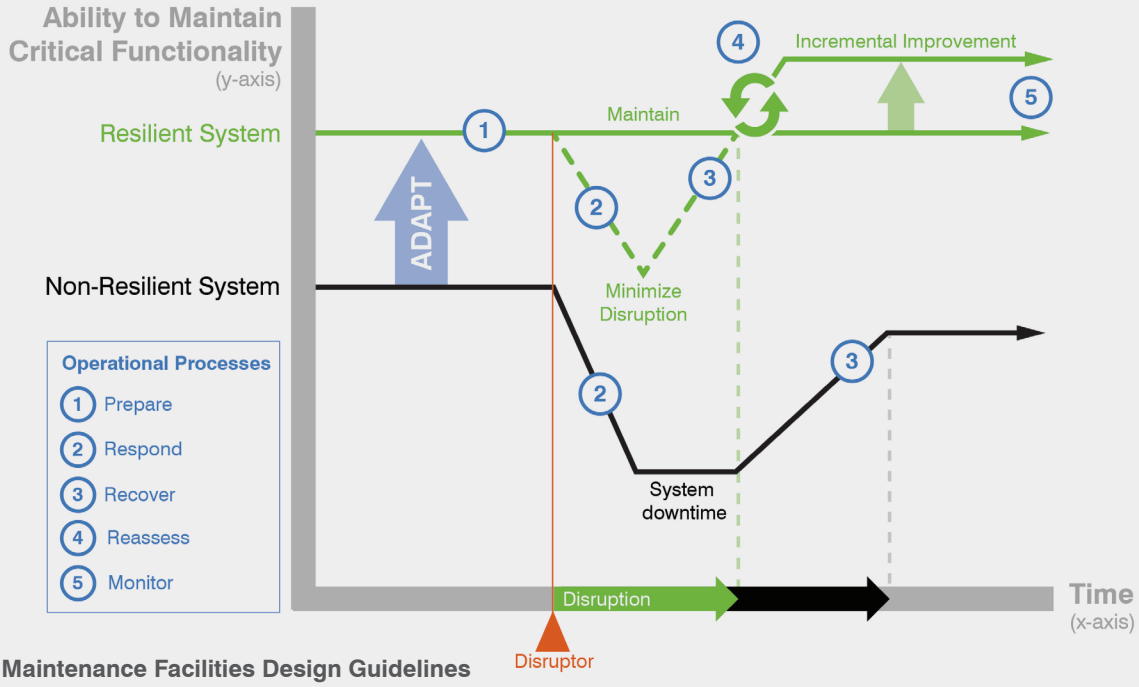
Many of the hazards that Boston commonly experiences are projected to worsen due to climate change. Climate change refers to changes in regional weather patterns that are linked to warming of the Earth's atmosphere as a result of both human activity and natural fluctuations. The Earth's atmosphere has naturally occurring greenhouse gases (GHGs) like carbon dioxide (CO_2) that capture heat and contribute to the regulation of the Earth's climate. When fossil fuels (including oil, coal and gas) are burned, GHGs are released into the atmosphere and the Earth's temperature tends to increase. The global temperature increase affects the jet stream and climate patterns.

A diagram of the greenhouse gas effect

City of Boston Natural Hazard Mitigation Plan | Page 17

Hazard Mitigation Plan | City of Boston, MA

Planning . Resiliency



MBTA Bus Maintenance Facilities Design Guidelines
Resilience Section | Boston, MA
Resiliency . Planning . O&M . Transportation . Facilities . Architectural . Civil . MEP . Structural

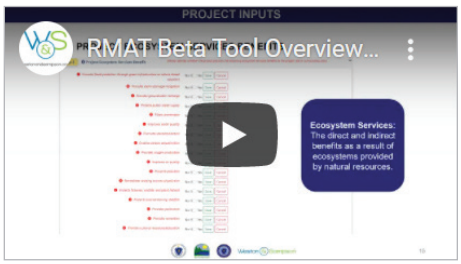
design guidelines

- Applying existing design guidelines credits (WEDG, LEED, ENVISION, STARS, etc.)
- Case study development
- Climate adjustments/design standards recommendations
- Developing evaluation criteria
- Discipline-specific considerations
- Existing best practices/literature review
- Flexible adaptation pathways considerations
- Flowchart or process graphics development
- Forms or templates development
- O&M considerations
- Policy recommendations
- Regional coordination considerations
- Site suitability considerations
- Translating climate projections into design criteria

A berm rendering

Boston Public Works Guidelines
City of Boston, MA
Resiliency . Planning . O&M . Water . Transportation Infrastructure . Geotechnical . Structural . Landscape Architecture

View the guidelines here



Resilient Massachusetts Action Team Technical Support
MA Executive Office of Energy and Environmental Affairs
Resiliency . Applied Technology

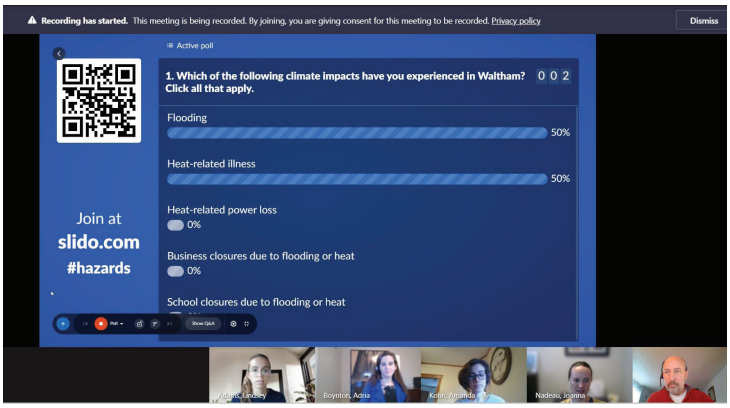
public engagement

- Commitment to inclusion, diversity, equity, and access
- Data visualization and fact sheets
- Dynamic multimedia formats including videos, social media, mapping, and webpage content
- Focus groups and interviews
- Hosting site walks/tours
- Identifying stakeholders and building partnerships
- In-person workshops and open houses
- Interactive engagement games and coloring pages
- Online and in-person polling and surveys
- Print media
- Synthesizing stakeholder feedback
- Translation, interpretation, and captioning support
- Virtual workshops, open houses, webinars, and related technical support

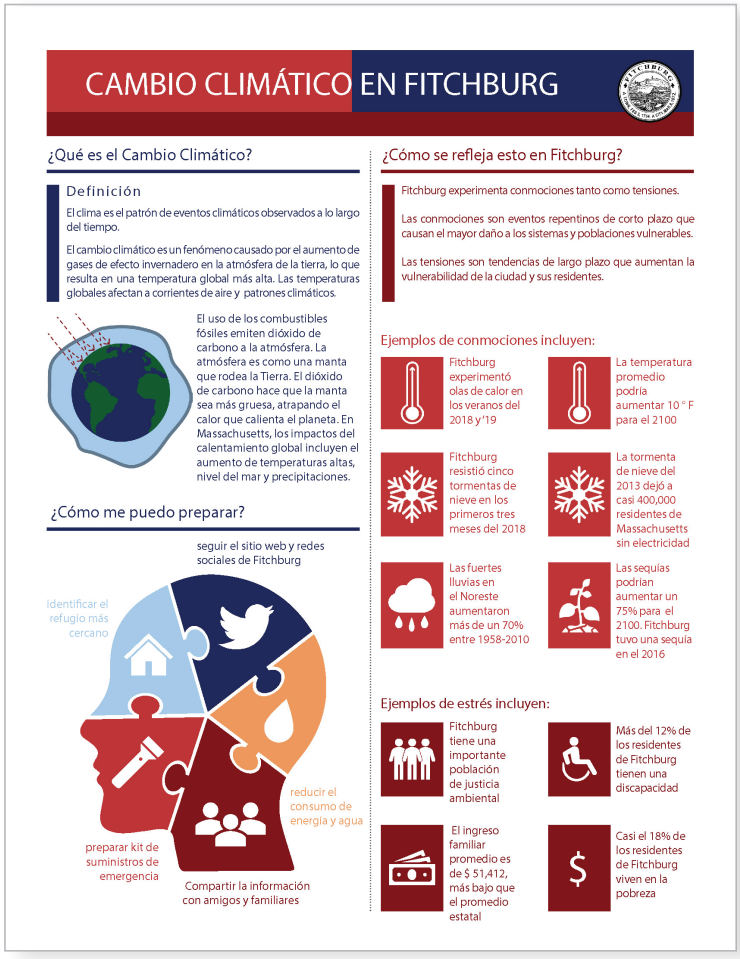
Flood Reduction Program | City of Charleston, SC

Planning . Resiliency . Water

Interactive engagement pinwheels



A virtual workshop



A fact sheet in Spanish visualizing the potential local impacts of climate change

HMP & MVP | City Fitchburg, MA

Planning . Resiliency . Water

design & adaptation

- Stormwater and green infrastructure strategies
- Conceptual adaptation strategies - cost estimation
- Conceptual adaptation strategies - visualization
- Deployable flood barriers evaluation
- Ecological restoration
- FEMA levee certification compliance evaluation
- Flood protection strategies (inland or coastal)
- Invasive species management
- Life cycle/adaptability assessment
- Living shoreline and climate migration design
- Permitting matrix and timelines
- Resilient building strategies
- Resilient infrastructure strategies
- Resilient natural resource strategies
- Resilient parks/open space strategies

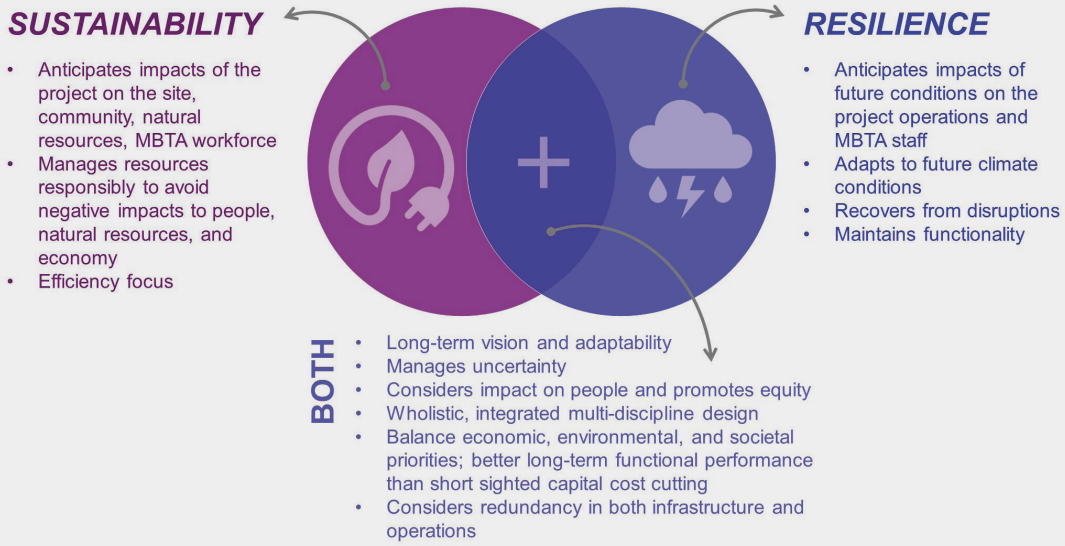
Pump Station Resiliency Implementation
City of New Haven, CT
Wastewater . Resiliency . Construction

raised deck built on top of an existing sea wall

Langone Park & Puopolo Playground | City of Boston, MA
Landscape Architecture . Water . Geotechnical . Environmental . Planning . Permitting . Resiliency

mitigation & sustainability

- Carbon sequestration strategies
- Energy efficiency strategies
- Greenhouse gas/carbon emissions analyses
- Renewable energy projects
- Sustainable materials selection
- Water use reduction strategies
- Climate action planning



MBTA Bus Maintenance Facilities Design Guidelines
Resilience Section | Boston, MA
Resiliency . Planning . O&M . Transportation . Facilities . Architectural . Civil . MEP . Structural

Solar Energy Facility at a Former Coal-Fired Power Plant
City of Orlando, FL
Resiliency . Energy . Environmental . Permitting . Civil/Site

Babson College Electric Vehicle Charging Station
Town of Wellesley, MA
Water . Resiliency . Energy

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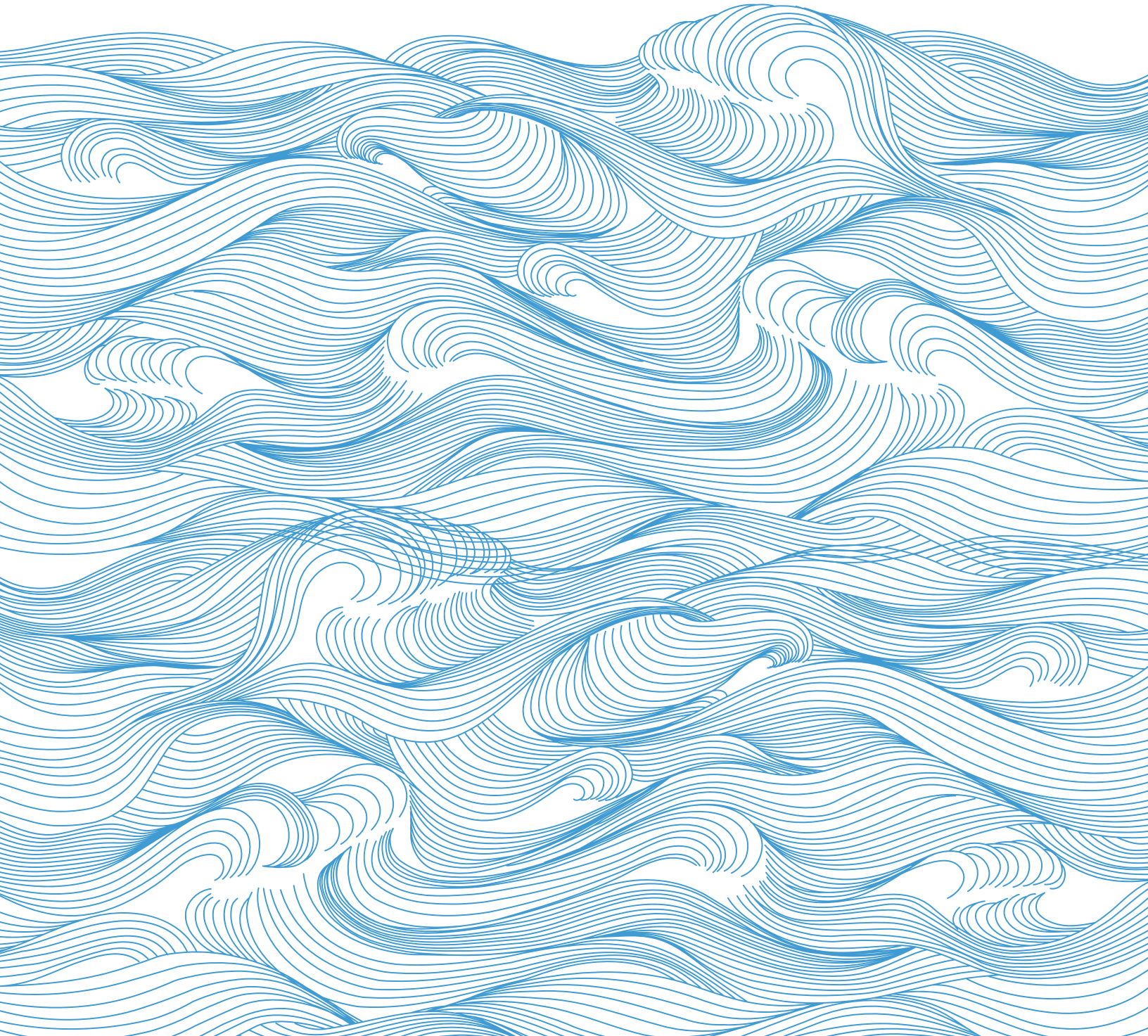

JEANNIE LEWIS

BACKGROUND

2021-Present
Senior Project Manager
Weston & Sampson

2016-2021
Coastal Zone Consistency Project Manager
SC Department of Health and Environmental Control

2013-2016
Natural and Coastal Resources Consultant
Brunswick, GA

2013-2014
Coastal States Organization
Chair/Facilitator, National Nonpoint Source Workgroup

2005-2013
Natural Resources Biologist
GA Department of Natural Resources- Environmental Protection Division

2001-2005
Marsh and Shore Regulatory Program Manager
GA Department of Natural Resources- Coastal Resources Division

1994-2001
Senior Program Coordinator
VA Department of Environmental Quality

1990-1994
Analyst
VA Department of Environmental Quality

1989
Analyst
US Geological Survey/University of Virginia Coastal Research

EDUCATION

1988
Graduate Studies Environmental Science, Coastal Geomorphology

1987
Bachelor of Arts
University of Virginia

Jeannie is a coastal resources expert and innovator with more than 30 years of government experience in the Southeast and Mid-Atlantic. She has in-depth knowledge of and practice in regulatory permitting and compliance, sustainable and resilient design, and community development strategies for protection of wildlife, water quality, wetlands, and preservation of cultural and historic resources in a changing climate. Jeannie is known for her collaborative team-building, multidisciplinary approaches and as a catalyzing problem solver and communicator. She has extensive experience with outreach, community engagement, grant writing and management and working with diverse stakeholders.

SPECIFIC PROJECT EXPERIENCE

- SE Regional Technical Lead for Climate Resilience, Weston & Sampson
- Charleston Region OCRM-SHPO Liaison, SC DHEC
- City of Charleston Stormwater Design Manual, Team Member, SC DHEC
- Sustainable Communities Team, Project Leader, GA DNR
- Model Ordinance Development and Outreach for Coastal Communities, Project Leader, GA DNR
- Green Infrastructure / Better Site Design Coastal Stormwater Manual, Project Leader, GA DNR
- Georgia Green Growth Guidelines, Project Leader, GA DNR
- Riparian Buffer Protection Models, Project Leader, GA DNR
- Priority Species Identification and Scaled Habitat Protection through Permitting, GA DNR
- Nontidal Wetlands Protection Project, Project Leader, GA DNR
- Virginia River Country Sustainable Economic Development Project, VA DEQ

Senior Project Manager, Weston & Sampson Engineers, Charleston. Team Leader SE Resilience and Regulatory Group. Develop and support projects designed to elevate preparedness for a changing climate and in current and upcoming regulatory framework.

Coastal Zone Consistency Project Manager, SC DHEC - Ocean and Coastal Resource Management, Charleston. Evaluated and provided coastal zone consistency determinations (environmental impact review) for all development activities requiring state and federal permits with a focus on the Charleston region.

Chair, Coastal States Organization: National Coastal Nonpoint Source Workgroup, Washington, DC. Lead dynamic workgroup representing all coastal management and water quality programs of the US coastal states and territories. Assisted program/project development, provided leadership to build and foster stronger relationships and regular dialogues between intrastate, regional, and interstate interests.

INDRANI GHOSH, PH.D.

BACKGROUND

2023-Present
Associate/Senior Technical Leader
Weston & Sampson

2022-2023
Senior Technical Leader
Weston & Sampson

2019-2022
Technical Leader
Weston & Sampson

2010-2019
Senior Professional
Kleinfelder

2005-2010
Teaching and Research Assistant
Department of Civil and Environmental Engineering
Northeastern University

2004-2005
Design Engineer
Thermax India Ltd.

2002-2004
Research and Teaching Assistant
Department of Civil Engineering
Indian Institute of Technology

EDUCATION

2010
Doctor of Philosophy (PhD)
Environmental Engineering
Northeastern University

2004
Master of Science
Environmental Engineering
Indian Institute of Technology

2002
Bachelor of Science
Materials & Metallurgical Engineering
Jadavpur University

CERTIFICATION

Municipal Vulnerability Preparedness (MVP) Certified Provider

AWARDS & HONORS

Clean Charles Award
Charles River Watershed Association
2022

Indrani has more than 15 years of experience as a water resources engineer and as technical lead in climate change resiliency projects, specializing in leading interdisciplinary teams and stakeholders through risk-based prioritization of adaptation solutions. She has industry-leading experience in translating climate change projections to engineering design criteria for new and existing infrastructure and modeling climate impacts for the purposes of vulnerability assessment and adaptation planning for many projects. She has worked with numerous municipalities and public agencies to model their exposure to coastal and stormwater flooding using the best available and most appropriate sea level rise, storm surge, and rainfall projections. She has extensive experience integrating climate projections in hydrologic/hydraulic models of urban storm and sanitary sewer systems. Indrani is frequently invited to be part of panel discussions on climate risk and resiliency at New England universities, and has won national awards for her contributions to the engineering profession. In addition, Indrani is fluent in Begali, English, and Hindi.

SPECIFIC PROJECT EXPERIENCE

Coastal Climate Change Vulnerability Assessments and Adaption Plans, Various Locations, Massachusetts and Connecticut. Served as technical lead for projects in Duxbury, Gloucester, Hingham, Hull, Marshfield, Oak Bluffs, Scituate, and Swampscott, Massachusetts, and Waterford, Connecticut. Led coastal flood modeling and mapping tasks, including the development of appropriate sea level rise and storm surge scenarios for present, medium-, and long-term time horizons. The resulting models and maps were used to assess the vulnerability of public infrastructure and natural resources and prioritize adaptation planning efforts.

Climate Ready DC, District Department of Environment, Washington, DC. Served as lead modeler for the climate change adaptation plan for Washington DC to integrate climate change resiliency in the district's capital improvements, planning, policies, and programs. Led the development of sea level rise and storm surge scenarios and downscaled precipitation and temperature projections. Also led the translation of climate change impacts into engineering design criteria for drainage infrastructure.

Moakley Park Master Plan, Boston Parks and Recreation Department (BPRD), Boston, Massachusetts. Providing resiliency support for the advancement of the Moakley Park Vision Plan, for which Weston & Sampson serves as a subconsultant to Stoss. Moakley Park is the largest waterfront park in Boston and is increasingly vulnerable to flooding due to climate change. The project scope includes baseline technical assessments, community engagement, and schematic flood barrier design. Responsibilities include the review of inland stormwater modeling and integrating with coastal flood modeling results, climate resilient engineering, and assessment of green infrastructure strategies.

RUPSA ROY, PH.D.

BACKGROUND

2020-Present
Project Scientist
Weston & Sampson

2017-2019
Research Associate
School for Marine Science and Technology
University of Massachusetts – Dartmouth

2010-2017
Graduate Teaching & Research Assistant
Department of Earth, Ocean, and Atmospheric Sciences
Florida State University

2007-2009
Seismic Data Processing Geoscientist
CGG Veritas India, Ltd.

2005-2007
Research & Teaching Assistant
Department of Earth Sciences
Indian Institute of Technology

EDUCATION

2017
Doctor of Philosophy (PhD)
Environmental Geochemistry
Florida State University

2007
Master of Science
Applied Geology
Indian Institute of Technology

2005
Bachelor of Science
Geological Sciences
Jadavpur University

PROFESSIONAL AFFILIATIONS

President, FSU Regional Student Association

Secretary, Indian Student Association

American Geophysical Union

Association for Women Geoscientists

Geological Society of America

Rupsa is a project scientist with more than 10 years of experience as an environmental geochemist, researching climate change, water contamination, and water chemistry. She is currently working on modeling climate data to predict future climate change and analyzing the projections for vulnerability assessment and adaptation planning for projects in the Northeast. She is working with several municipalities and public agencies to support their HMP and MVP report writing and modeling their exposure to extreme heat, sea level rise/storm surge and extreme precipitation. She has extensive experience with modeling and interpreting large volumes of data using excel, R, and GIS platforms.

SPECIFIC PROJECT EXPERIENCE

Hazard Mitigation & Municipal Vulnerability Preparedness Planning and Action Grant, Lowell, Massachusetts. Supported the preparation of a joint Hazard Mitigation Plan (HMP) and Municipal Vulnerability Preparedness (MVP) plan. Responsible for equitable community engagement through interviews and an online survey, vulnerability assessments of the city, and writing the MVP report. The work led to a successful MVP Action Grant filing. Responsibilities also included analyzing the urban heat island effect under existing and proposed conditions in the Claypit Brook Area of the city as part of the Action Grant.

Implementation of the Master Plan for Prescott Park, Portsmouth, New Hampshire. Provided coastal resiliency support for the implementation of the Prescott Park Master Plan. Identified future extreme rainfall projections using methodologies outlined in NCHRP 15-61, "Applying Climate Change Information to Hydrologic and Coastal Design of Transportation Infrastructure" to be used in inland stormwater modeling and sizing of infrastructure.

Moakley Park Master Plan, Boston Parks and Recreation Department (BPRD), Boston, Massachusetts. Providing resiliency support for the advancement of the Moakley Park Vision Plan, for which Weston & Sampson is a subconsultant to Stoss. Moakley Park is the largest waterfront park in Boston and is increasingly vulnerable to flooding and high heat due to climate change. Responsibilities included the review of existing urban heat island (UHI) effects, analyzing changes in temperature under various projected scenarios, and assessing green infrastructure strategies to reduce UHI.

Revitalization of Draw Seven Park, Massachusetts Department of Conservation & Recreation (DCR), Somerville, Massachusetts. Providing resiliency support for the revitalization of this signature park along the banks of the Mystic River. Work involved developing sustainability/resiliency services related to park redevelopment. Worked closely with Woods Hole Group to develop BH-FRM flood vulnerability design criteria and identifying strategies to mitigate risk, accommodate/embrace future flood waters (living shoreline), and design for incremental flood protection measures.

BELLA PURDY

BACKGROUND

2021-Present
Project Planner
Weston & Sampson

2019-2021
Climate Resource Planner
Water Resource Team
Kleinfelder

2018-2019
Climate and Environmental Planning Fellow
City of Boston Department of Environment, Energy, and Open Space

2014-2017
Designer
KieranTimberlake Associates

EDUCATION

2019
Masters in City Planning
Housing, Community and Economic Development
Massachusetts Institute of Technology

2014
Bachelor of Science in Architecture
University of Virginia

PAPERS & PRESENTATIONS

Spring 2023
"A Practical Guide to Updating Local Regulations for Climate Resilience"
American Planning Association

Bella is a climate resiliency specialist and urban planner with eight years of professional experience. She works with institutions, government agencies, and municipalities to address their environmental and climate concerns through adapted design, land use, and policy. She is skilled in urban design, graphic communication, spatial analysis, research, and innovative outreach. She uses these skills to convey climate change as an opportunity to create more just and equitable urban environments. As a City of Boston Climate and Environmental Planning Fellow, Bella wrote an amendment to the historic preservation regulatory standards to include resiliency standards for Bay Village District and was the author and illustrator of the Boston Resilient Historic Buildings Design Guide. She has three years of experience as an architectural designer, specializing in the design of university buildings and green building techniques.

SPECIFIC PROJECT EXPERIENCE

Hampton Circle Area Adaptation Roadmap and Design Alternatives Analysis, Hull, Massachusetts. Project manager for a coastal design alternatives analysis in the Hampton Circle neighborhood of Hull. This project included an intensive community engagement process, climate vulnerability assessment, and design recommendations for an area exposed to coastal flooding. The adaptation roadmap is the result of the engagement and analysis and includes a phased approach to climate adaptation over several decades. Design alternatives for the area include redesign of critical infrastructure, nature-based solutions for coastlines, home elevations, and potential planned retreat. Bella has provided both timely delivery of complex deliverables as well as relationship building with the community.

North Carolina Resilient Coastal Communities Program, Resilience Plans for Elizabeth City and Pasquotank County, North Carolina. Serving as project manager for two resilience plans to be completed during 2023-2024 through the NC DEQ Resilient Coastal Communities Program (RCCP). These resilience plans will include a vulnerability assessment and identification of critical assets, a comprehensive outreach strategy, and development of prioritized actions. The RCCP provides funding for coastal communities with an emphasis on equitable outcomes, nature-based solutions, and data-driven decision making.

Hazard Mitigation Plan, Boston, Massachusetts. Developed the City of Boston's Natural Hazard Mitigation Plan. Researched and compiled existing citywide mitigation measures, documented progress on the past plan, and identified future priority actions through interviews with critical stakeholders. Conducted inclusive community outreach to receive feedback on the plan recommendations. Wrote the final Plan and ensured compliance with FEMA's HMP guidelines

Climate Resilience Zoning Task Force, Cambridge, Massachusetts. Contributed to the development of the 'Cambridge Cool Factor' - one of the nation's first zoning ordinances that uses development regulations and design guidelines to reduce urban heat island impacts. Conducted extensive research about the relative temperature reduction various landscape and building elements can provide to the urban environment. Developed outreach materials to present to an expert advisory panel on climate resilient zoning.

ADRIA BOYNTON, AICP

BACKGROUND

2023-Present
Project Planner & Visualization Specialist
Weston & Sampson

2022-2023
Senior Environmental Planner & Resiliency Specialist
Metropolitan Area Planning Council

2020-2022
Planner III
Weston & Sampson

2018-2020
Planner II
Weston & Sampson

2018-2020
Resiliency Specialist
Weston & Sampson

2017-2018
Sinclair Kennedy Traveling Fellow
Harvard University, Università degli Studi di Firenze

EDUCATION

2017
Master in Design Studies, Risk and Resilience
Harvard University
Graduate School of Design

2015
Bachelor of Architecture
Bachelor of Fine Arts
Rhode Island School of Design

PROFESSIONAL REGISTRATIONS & CERTIFICATIONS

American Institute of Certified Planners (AICP)
American Planning Association

Municipal Vulnerability Preparedness (MVP) Certified Provider

SELECTED AWARDS

2021, Weston & Sampson Innovation Committee, Shark Tank Competition Winner, collaborative entry

2021, Weston & Sampson Corporate Recognition Award for leading transition to virtual public / stakeholder engagement during COVID-19, collaborative entry

2020, Weston & Sampson Innovation Committee, Shark Tank Competition

Adria is a Project Planner & Visualization Specialist with Weston & Sampson, working on interdisciplinary projects. Adria works collaboratively to advance the use of graphics to accessibly communicate technical information to a range of audiences. A certified Planner and a certified MVP Provider, Adria's experience includes working on Climate Action Plans, FEMA Hazard Mitigation Plans (HMP), Municipal Vulnerability Preparedness (MVP) Planning and Action Grant projects, Risk & Resilience Assessments (RRA), Emergency Response Plans (ERP), resilient design guidelines, master plans, public outreach and engagement, and more.

SPECIFIC PROJECT EXPERIENCE

Moakley Park Master Plan, Boston Parks and Recreation Department (BPRD), Boston, Massachusetts. Assisting with climate resilient design features and project management tasks for the advancement of the Moakley Park Vision Plan. Moakley Park is the largest waterfront park in Boston and is increasingly vulnerable to flooding due to climate change. Work includes baseline technical assessments, community engagement, and schematic flood barrier design.

Climate Resilient Design Standards and Guidelines, Boston Public Works Department, Boston, Massachusetts. Resiliency specialist responsible for assisting the city in its efforts to establish resilient design standards and guidelines. Provided as-needed support for the development of sample specifications for resilience options (e.g., harborwalk barriers, raised roadways, deployable flood barriers, and vegetated berms), sample design drawings, and design considerations.

Charles River Climate Compact Resilience Strategic Plan, Charles River Watershed Association and Medway, Massachusetts. Led the development of a strategic plan for the Charles River Watershed Association's Climate Compact. The Compact is a group of municipalities planning for climate impacts at a regional scale. The project included outreach and engagement to define a vision, values, and goals for the plan (including an Equity Focus Group); the development, refinement, and prioritization of strategies; and the creation of an interactive online dashboard. This project was funded by a Technical Assistance Program (TAP) grant from MAPC.

Flood Protection along Island End River, Chelsea, Massachusetts. Assisted with analysis and design related to a proposed incremental flood barrier in Chelsea and the identification of conceptual flood resilience strategies in Everett as part of a Vision Plan funded by a Coastal Zone Management (CZM) grant. Also assisted with the creation of a Climate Resilience Scope of Services and participated in a site visit to document existing conditions and considerations that may impact future design recommendations. Supported the city in writing a successful grant application to fund the next phase of work through a Municipal Vulnerability Preparedness (MVP) Action Grant. Reviewed engagement materials, which included an Equitable Climate Resilient Engagement Framework, promotional materials to get the word out about events, and plans for community meetings, including a socially distanced outdoor cleanup and open house.

ANNA KIMELBLATT, CFM

BACKGROUND

2023-Present
Resiliency Planner II
Weston & Sampson

2021-2023
Floodplain Management Coordinator
Charleston County Building Inspection Services Department

2019-2021
Administrative Support Coordinator
Charleston County Zoning and Planning Department

2016-2018
Biologist
South Carolina Department of Natural Resources

EDUCATION

2021
Master of Science cum laude
Environmental and Sustainability Studies
College of Charleston

2015
Bachelor of Arts
Biology
The College of the Holy Cross

PROFESSIONAL CERTIFICATION

ASFPM Certified Floodplain Manager

Anna is a Resiliency Planner and Certified Floodplain Manager with over three years of experience in resilience planning and floodplain management. Her expertise includes hazard mitigation planning, Community Rating System administration, National Flood Insurance Program administration, flood mitigation, retrofitting, resilience integration via regulatory tools, sustainable and resilient design, smart growth initiatives, and low impact development. She also has experience with public outreach, community engagement, and grant administration. Anna has worked with diverse stakeholders across numerous projects in the Southeast.

SPECIFIC PROJECT EXPERIENCE

Sea-level Rise Mitigation and Adaptation Planning, Charleston, South Carolina. Graduate Assistant conducting a study on sea-level rise mitigation planning in South Carolina. Compiled and reviewed all available comprehensive plans from the coastal counties of South Carolina. The plans were analyzed quantitatively for the presence of regulatory tools or development standards that would contribute to sea-level rise mitigation or adaptation. Planners and other relevant stakeholders across the coastal counties of South Carolina were interviewed for their experience with sea-level rise planning. The analysis contributed to her master's thesis, Sea-level Rise Mitigation and Adaptation Planning in South Carolina Using Regulatory Tools and Land-use Optimization.

Resilience Planning, Charleston County, South Carolina. Floodplain Management Coordinator participating as a member of the Charleston County Resilience Committee. Attended all monthly Committee meetings. Extensively researched possible strategies and initiatives that would increase the resilience of Charleston County. Worked in conjunction with other committee members to comprehensively review the County's building, floodplain, and development ordinances for opportunities to integrate resilient strategies and initiatives. These opportunities were then presented to Charleston County Council and new ordinance language to include resilience strategies and initiatives was drafted. Met with stakeholders to discuss potential changes to the ordinances. Addressed questions and concerns from both stakeholders and Charleston County Council members.

Hazard Mitigation Plan Update, Charleston County, South Carolina. Floodplain Management Coordinator responsible for leading the annual update to the Charleston Regional Hazard Mitigation Plan. Coordinated and lead all meetings related to the update. Coordinated all stakeholder engagement, which included 33 jurisdictions and utilities. Researched and updated all hazard frequencies. Updated the plan with the latest information concerning outreach projects, public information, mitigation strategies, repetitive loss properties, and drainage projects. Conducted analysis to determine how many structures were at risk in the Special Flood Hazard Area for all 17 jurisdictions included within the Regional Plan. Obtained the most recent data from the National Flood Insurance Program for Charleston County and the participating jurisdictions to conduct a Community Rating System-approved flood insurance assessment.

KIM MORGANELLO

BACKGROUND

May 2023 Start
Senior Project Manager
Weston & Sampson

2020-2023
Water Resources Extension Associate
Clemson University

2017-2023
Assistant Program Team Leader, Water Resources
Clemson University

2011-2020
Water Resources Extension Agent
Clemson University

2007-2011
Stewardship Biologist
South Carolina Department of Natural Resources, ACE Basin National Estuarine Research Reserve

EDUCATION

2022
Master of Resilient Urban Design
Clemson University

2008
Masters of Science Environmental Studies, College of Charleston

2002
Bachelor of Science Elementary Education, Presbyterian College

SELECT PUBLICATIONS

Collins, K. & Jackson, K . Editor K.C. Morganello. (2022). Stream Bank Repair Manual for South Carolina. Cooperative Extension, Clemson University, Clemson, S. C.

Morganello, K.C. (2021). "Life Along the Salt Marsh: Troubleshooting Salt Marsh Decline." HGIC 1891. Cooperative Extension Home & Garden Information Center, Clemson University, Clemson, S.C

Kim specializes in community resiliency and adaptation as it relates to water quantity and quality management concerns. Kim has developed tools, resources, and programming to broaden the application of nature based solutions; practices of focus include bioretention, vegetative buffers, rainwater harvesting, living shorelines, stormwater pond retrofits, and native plant landscaping. Kim has designed in-the-ground projects that serve as community demonstration sites for green infrastructure. She has extensive experience assisting local governments with NPDES permit compliance. Kim enjoys collaborative development of innovative approaches to better steward water resources for current and future generations.

SPECIFIC PROJECT EXPERIENCE

U.S. Army Corps of Engineers Charleston SC 3x3 Project, Clemson University Master of Resilient Urban Design. Created design alternatives to the proposed USACE perimeter protection plan for peninsular Charleston, SC. Performed site analysis which incorporated historical, cultural, ecological, and economic considerations. Area of focus included iconic High Battery, Joe Riley Waterfront Park, and Union Pier. Kim's design alternatives placed emphasis on place-making, ecological restoration, and resilient urban design. Design alternatives are communicated through master planning, sections, renderings, diagrams, and hand sketches.

Features proposed:

- Polder system seaward of High Battery & tidal creek daylight at Market Street.
- Terraced Joe Riley Waterfront Park utilizing a split T-wall approach.
- Edge repair with emphasis on public access and multi-modal transportation.

Folly Beach Resiliency Study, Clemson University Master of Resilient Urban Design & Clemson University Extension. The Folly Beach Resiliency Study is a three-year study in which data was collected during restricted public access, associated with COVID-19, and when access was not restricted. The study objective is to provide insight into how human presence may influence barrier island ecosystems. The information gathered applies more broadly to coastal communities and provides insight on public education strategies, resource management, and urban design. A better understanding of humans in nature lends to a more thoughtful, diversified approach that protects environmental integrity and enhances the user experience.

Features proposed:

- Redevelopment of the island causeway for multi-modal & green infrastructure.
- Emphasis on community art installations as a stewardship communication tool.

LUCAS HERNANDEZ

BACKGROUND

2022-Present
Environmental Scientist III
Weston & Sampson

2019-2022
Resilience Specialist
Kiawah Island Community Association

2017-2019
Graduate Assistant
College of Charleston

2017-2018
Marine Science Educator
Patriots Point Naval & Maritime Museum

EDUCATION

2019
Concurrent Degrees, Master of Environmental and Sustainability Studies and Master of Public Administration
University of Charleston

2016
Bachelor of Science
Environmental Technology & Management
North Carolina State University

PROFESSIONAL AFFILIATIONS

Charleston Resilience Network

South Carolina Beach Advocates

Southeast Sustainability Directors Network

Johns Island Task Force

National Weather Service Weather Ready Nation Ambassador

Lucas is a Climate Adaptation and Resilience Specialist with over five years of experience in resilience planning. His expertise includes raster-based flood modeling, sustainable and resilient design, environmental monitoring, community development, green infrastructure, wildlife and water quality protection strategies, stormwater management, cultural and historic resources, and associated legal and regulatory frameworks. In addition, he has experience with public outreach, community engagement, and grant administration. Lucas has worked with diverse stakeholders across numerous projects throughout the Southeast.

SPECIFIC PROJECT EXPERIENCE

Kiawah Island Flood Mitigation and Sea Level Rise Adaptation Plan Experience, Kiawah island, South Carolina. Graduate research assistant at the College of Charleston Lowcountry Hazards Center in charge of developing storm surge and sea level rise maps for the Town of Kiawah Island in support of the Town's Flood Mitigation and Sea Level Rise Adaptation Plan. As part of this project, the graduate research assistant was provided a grant from the Town of Kiawah Island to develop high-resolution 2-D flood maps of the island using NOAA's Relative Sea Level Change Projections (2017) and the most recent LiDAR digital elevation model. The models developed as part of this study included inundation from storm surges from 1 ft. to 8 ft. above Mean Higher High Water (MHHW) in half-foot increments and inundation from NOAA sea level rise predictions for the years 2030, 2050, 2075, and 2100. All these models were ground-truthed using personal accounts from the subcommittee and provided a basis of understanding for vulnerable stormwater infrastructure, roads, and structures on the island. Later, through work with Stantec Consulting Services Inc. and the Kiawah Island Community Association's Water Management Task Force, these models were updated to include rainfall and drainage infrastructure to help the Community Association prioritize six major infrastructure projects that are currently being constructed.

Community Flood Modeling Exposition, Mt Pleasant, South Carolina. Responsible for developing high-resolution flood models and participating in community outreach and engagement. This effort was funded by a National Oceanic and Atmospheric Administration Regional Coastal Resilience Grant obtained by through the S.C. Sea Grant Consortium on behalf of the Charleston Resilience Network. The original goal of this outreach event was to gather anecdotal flooding data from residents to ground-truth storm surge and rainfall models developed by the Low Country Hazards Center, housed at the College of Charleston. This event involved coordination with local stormwater engineers, emergency managers and public works departments to develop a list of study areas, rainfall/ storm surge scenarios, historic storms, and future scenarios of sea level rise to model for the events. After developing and presenting the models to each municipality, presented the models to the public in two separate outreach events and answered questions about modeling methods. Recorded anecdotal reports from community members.

TIMOTHY W KANA, PHD PG

SENIOR COASTAL SCIENTIST

Email: tkana@coastalscience.com

PROFILE

Founder of Coastal Science & Engineering (CSE) (1984–present) and Adjunct Professor of Geology at the University of South Carolina (1981–2009). Prior to 1984, he was a founder and principal in the firm Research Planning Institute Inc. Kana is an internationally recognized expert in coastal and estuarine processes, and has written over 300 publications and technical reports. Contributions to coastal engineering literature include reports on estuarine sedimentation and harbor shoaling, sediment partitioning among marshes, beaches and tidal channels, potential impacts of sea level rise on beaches and coastal wetlands, preparation of sediment budgets, and beach nourishment design.

BEACH NOURISHMENT EXPERIENCE

Kana has served as project director or technical advisor on more than 40 beach restoration projects totaling over 35 million cubic yards. His work emphasizes soft engineering solutions to erosion along the oceanfront. Among the innovative projects Kana has directed was an inlet relocation at Seabrook Island (SC) which resulted in long-term restoration of two miles of eroded beach. Major nourishment projects Kana directed in North and South Carolina and New York include:

- Myrtle Beach (1.3 million cubic yards)
- Hunting Island (0.75 million cubic yards)
- Bogue Banks (4.5 million cubic yards)
- Seabrook Island (0.6 million cubic yards)
- Bridgehampton–Sagaponack (2.5 million cubic yards)
- Nags Head (4.6 million cubic yards)

INTERNATIONAL EXPERIENCE

Dr. Kana has served on design and environmental impact assessment teams for numerous projects in the Caribbean, West Africa, Kuwait and other Middle East countries. From 1977 to 1989, he served as coastal processes and environmental monitoring consultant on the 20-km Kuwait Waterfront (KWF) project. Work included establishing a beach erosion monitoring program, periodic field measurements over many years, and assistance to the project engineers on Phases I–V. Kana was senior scientist for a Kuwait Foundation for the Advancement of Science (KFAS) study of environmental and water quality impacts of the KWF (1984–1986).

SEA LEVEL RISE STUDIES

Pioneering work by Dr. Kana includes two of the earliest case studies of potential impacts of sea-level rise on coastal wetlands for the U.S. Environmental Protection Agency (1984–1988), which quantified the controlling physical conditions and processes for tidal wetlands evolution.

EDUCATION & ACADEMIC TRAINING

PhD. Geology (Coastal Processes), University of South Carolina (USC)
MS. Geology (Coastal Geology), USC
BA. Natural Sciences (Geological Oceanography), The Johns Hopkins University

PROFESSIONAL AFFILIATIONS & AWARDS

Board of Directors – American Shore & Beach Preservation Association
Associate Editor – Journal of Coastal Research
Affiliate Member – American Society of Civil Engineers
Registered Professional Geologist (NC and SC)
ASBPA Morrough P. O'Brien Award (2015)

EXPERT TESTIMONY

Qualified and admitted in the following areas:

- Marine geology
- Coastal Processes
- Estuarine processes
- Beach erosion

COASTAL EROSION STUDIES

Technical work by Kana includes development of a methodology for objective delineation of present shorelines and setback lines along the South Carolina coast. Prototype application of the methodology was implemented by Myrtle Beach (1984) and incorporated in local zoning ordinances. In 1988, the methodology was incorporated into the state's Beach Management Act and used to establish development setback lines throughout the coast. The methodology was the first in the U.S. to provide for quantitative placement of setback lines based on the volumetric condition of the beach.

Kana has been principal investigator for contracts from the US Army Corps of Engineers for a number of coastal engineering studies, including Buffalo District (inventory and analysis of 200 shore protection structures, Lake Ontario), New York District (sediment budget, Fire Island Inlet to Montauk Point), Charleston District (sand search, Horry County, SC; and ICWW erosion), and CERC (sediment transport at Duck, NC; and performance evaluation of three SC beach nourishment projects).

STEVEN B TRAYNUM

COASTAL PHYSICAL SCIENTIST

Email: straynum@coastalscience.com

PROFILE

Mr. Traynum specializes in coastal hydrodynamics and estuarine processes (2007–present). He also serves as project manager for numerous beach monitoring programs and nourishment projects. Mr. Traynum is experienced in critical area permitting including analysis of environmental impacts and preparing biological assessments and EIS documents. Liaises between resource agencies and clients, and assists in developing appropriate monitoring plans to determine project impacts to endangered and threatened species. His coastal engineering project experience includes design of coastal erosion mitigation projects, monitoring and analysis of erosion and morphological changes of natural and nourished beaches and coastal inlets, measurement and analysis of tidal inlet currents, and on-site land and hydrographic surveys.

TECHNICAL EXPERIENCE

Extensive experience in estuarine and coastal settings including deployment and recovery of hydrographic equipment, such as acoustic Doppler current profilers (SonTek, RDI, Nortek), acoustic Doppler velocimeters, CTDs, and pressure sensors.

Mr. Traynum has collected thousands of beach profiles using the latest surveying techniques (RTKGPS). He is a certified (SSI), open-water diver.

COASTAL EROSION/RENOURISHMENT EXPERIENCE

Managed restoration projects at Nags Head (NC) involving placement of 4.6 million cubic yards (cy) of sand, Isle of Palms (SC) involving placement of 2.5 million cy, Folly Beach (SC) involving placement of 415,000 cy and 745-ft-long terminal groin construction, and Edisto Beach (SC) including placement of one million cy and construction management for 25 groin extensions (~$5 million).

Project manager for beach monitoring programs involving collection and analysis of land-based and hydrographic profile data to determine short- and long-term erosion rates and project performance and impacts. Monitoring sites include: Isle of Palms, SC Hunting Island, SC Edisto Beach, SC Kiawah Island, SC

Critical area permitting for projects in SC and NC, including Biological Assessments, Essential Fish Habitat reports, EIS documents, and monitoring programs coordinated with USFWS, USACE, NMFS, and state agencies.

MatLab® scripts for automatic generation of sediment grain-size distributions, beach profile analysis, and nourishment profile design.

EDUCATION

MS. Marine Science, University of South Carolina
BS. Marine Science, USC Honors College
Coastal Engineering Certificate, Old Dominion University
ME. Coastal Engineering (pending) Old Dominion University

SPECIALTIES

- Beach nourishment design and monitoring
- Design of coastal structures
- Environmental impact assessments
- Coastal and estuarine processes
- Collection and analysis of beach profile data
- Hydrographic instrument deployment
- Collection and analysis of coastal sediments

SOFTWARE PROGRAM CAPABILITIES

- ArcGIS
- Global Mapper
- MatLab
- Microsoft Office

SELECT PUBLICATIONS

Traynum, SB, TW Kana, HL Kaczkowski. 2019. The construction and impacts of a groin-lengthening project at a southeast U.S. beach. In Proc. Coastal Structures 2019 (Hanover Germany) 30 Sep – 20 Oct, 10 pp.

Traynum, SB, TW Kana, and DR Simms. 2010. Construction and performance of six template groins at Hunting Island, South Carolina. Shore & Beach, Vol 78(3), pp 21–32.

Kana, TW, HL Kaczkowski, and SB Traynum. 2015. (BC) An empirical approach to beach nourishment formulation. Chapter 4 in YC Kim (ed), *Design of Coastal Structures and Sea Defenses*, Vol 2, Series on Coastal and Engineering Practice, World Scientific, pp 105–144.

Kaczkowski, HL, SB Traynum, TW Kana, and M Rentz. (2015) Terminal groin and beach restoration at Folly Beach County Park (South Carolina). In D Cox and L Wallendorf (eds), Proc. Coastal Structures and Solutions to Coastal Disasters, ASCE– COPRI (Boston MA, 9–11 September 2015), 12 pp.

Kana, TW, SB Traynum, D Gaudiano, HL Kaczkowski, and T Hair. 2013. The physical condition of South Carolina beaches 1980–2010. Jour Coastal Research, Special Issue 69, pp 61–82.

C PATRICK BARRINEAU, PHD PG

COASTAL SCIENTIST

Email: patrick@coastalscience.com

PROFILE

Dr. Barrineau serves as a coastal scientist and project manager for CSE, performing work in the field, laboratory, and office. He served as project manager at Arcadian Shores and Singleton Swash (2018), Myrtle Beach (2017-present), Pawleys Island (2020), Sea Island (2018-present), and regularly curates coastal data from collection to publication in concert with CSE staff.

While at CSE, Dr. Barrineau has prepared reports and/or permit documents for projects at Nags Head (NC), Buxton (NC), Myrtle Beach (SC), Pawleys Island (SC), Debidue Island (SC), Edisto Beach (SC), and Sea Island (GA). Prior to joining CSE, Dr. Barrineau studied coastal processes and landforms through field-based research on sediment transport and barrier-lagoon evolution. He has organized and led field studies in South Carolina, Texas, New Mexico, California, Brazil, and Israel. In addition to his work at CSE, Dr. Barrineau teaches a graduate-level course in Coastal Zone Management at the University of South Carolina.

REGISTRATION

Professional Geologist (SC #2773, NC #2761)

RESEARCH EXPERIENCE

Conceptual modeling of landscape evolution in coastal systems; modeling fluid dynamics and sediment transport; identifying controls on sediment transport patterns; and monitoring beach and dune response and recovery following storm impact. Field research at Isle of Palms (SC); Padre Island (TX); White Sands (NM); Pismo Beach (CA); Jericoacoara, Brazil; Ashkelon, Israel.

TECHNICAL EXPERIENCE

Dr. Barrineau has extensive experience working in coastal and desert settings, collecting elevation and geophysical data using RTK-GPS, Total Station, ground-penetrating RADAR, and Electromagnetic Induction Profilers.

He has also collected vibracores and analyzed hundreds of sediment samples for grain size, sorting, and X-ray fluorescence analysis.

EDUCATION

PhD. Geography, Texas A&M University
MS. Geography, University of South Carolina
BS. Geography, Auburn University

SPECIALTIES

- Collection and analysis of elevation and geophysical data
- Collection and analysis of coastal sediments
- Beach and Dune processes
- Conceptual models of landscape evolution

SOFTWARE PROGRAM CAPABILITIES

- ArcGIS
- ERDAS Imagine
- QGIS
- ENVI

SELECT PUBLICATIONS

Barrineau, P., Janmaat, R., Kana, T., 2021. Empirical depths of closure along the US East Coast. *Coastal Engineering*, Vol. 170, DOI 10.1016/j.coastaleng.2021.104009.

Barrineau, P., Tchakerian, V., 2021. Geomorphology and dynamics of a coastal transgressive dune system, central California. *Physical Geography*, 43:1, 122-144, DOI: 10.1080/02723646.2021.1944462.

Harris, M., Ellis, J., Barrineau, P., 2020. Evaluating the geomorphic response from sand fences on dunes impacted by hurricanes. *Ocean and Coastal Management* 193 DOI 10.1016/j.ocecoaman.2020.105247.

Barrineau, P., Kana, T., 2019. Unpacking Storm Damages on a Developed Shoreline: Relating Dune Erosion and Urban Runoff. *Shore and Beach* 87(3), 35-45.

Houser, C., Barrineau, P., Hammond, B., Saari, B., Rentschler, E., Trimble, S., Wernette, P., Young, S., 2017. Role of the foredune in controlling barrier island response to sea level rise. In: *Barrier Islands*, ed. Moore and Murray.

Barrineau, P., Wernette, P., Weymer, B., Trimble, S., Hammond, B., Houser, C., 2015. Coastal Landscapes in the Critical Zone. In: *Principles and Dynamics of the Critical Zone*, Vol. 19, pp. 495-420