RETREAT. ADAPT. DEFEND.

Designing Community Response to Sea Level Rise in Five Coastal Georgia Communities

A BLUEPRINTS FOR SUCCESSFUL COMMUNITIES PROJECT OF THE GEORGIA CONSERVANCY
WITH THE SCHOOL OF ARCHITECTURE, GEORGIA INSTITUTE OF TECHNOLOGY
FALL 2013

The Georgia Conservancy Blueprints Program

Blueprints for Successful Communities (*Blueprints*) is an 18-year-old sustainable community design program of the Georgia Conservancy. In its 18 years, the Sustainable Growth program has conducted over 30 community-based *Blueprints* planning projects in neighborhoods, communities, cities and counties focusing on issues surrounding natural resource protection, green space accessibility, sustainable land use, and live-work connectivity. Typically, this process is done in coordination with an academic partner; in this case, Georgia Institute of Technology's School of City and Regional Planning and the School of Architecture were engaged in the planning process. In this document, the term "*Blueprints* Team" will mean the Georgia Conservancy, the Georgia Tech studio team and participants listed in the back of the report. The *Blueprints* process is one of the most highly respected planning processes in our state because of its inclusiveness, transparency and technical quality.

We are Grateful to the Generous Donors who Supported the RETREAT. ADAPT. DEFEND. Blueprints:

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Altamaha Riverkeeper

Pinpoint Heritage Museum

Savannah Housing Authority

Georgia
CONSERVANCY

Our mission is to protect Georgia's natural resources for present and future generations by advocating sound environmental policies, advancing sustainable growth practices and facilitating common-ground solutions to environmental challenges.

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INTRODUCTION

Small Marina at Darien

Bungalow in St. Marys

Water – quality, quantity and accessibility – is a central issue in the State of Georgia and across the world. The Georgia Conservancy works to address water challenges through statewide advocacy, education and research, advancing awareness through stewardship trips and land conservation. Sea level rise is an emerging issue of concern to coastal communities in Georgia and will have future consequences for the entire state.

This Design + Research *Blueprints* project concentrates on sea level rise challenges and adaptation opportunities for five communities along the Georgia coast: City of Savannah, Tybee Island, City of Darien, City of Brunswick, and City of St. Marys. These locations were selected because of their various geographic positions along the coast, as well as their different challenges and opportunities.

Georgia's coastal population, economic activity and cultural opportunities will continue to be drawn to, and benefit from, a relationship with the water but what shape will the built environment of communities take on in the future? Cities across the globe are beginning to understand the implications of climate change and coastal communities are exploring options to defend, retreat or adapt to changing conditions.

A *Blueprints* team, composed of *Blueprints* staff, Professor Richard Dagenhart, Dr. Tom Debo and graduate students in a Georgia Tech College of Architecture Design + Research Studio spent almost six months preparing this report. The team made site visits, interviewed

government officials, residents and business owners, collected data and reviewed other communities' planning and design strategies for sea level rise. The studio was multidisciplinary, including students in the Master of Science in Urban Design, Master of Architecture and Master of City and Regional Planning. The Studio developed alternative planning and design approaches for the five coastal communities and developed a set of draft recommendations for stakeholder consideration. These recommendations are supported by *Blueprints* advisors and form the basis of this report.

The final output of the process is this *Blueprints* report, which aims to educate communities across the state and to begin considering responses to climate change and sea level rise. Although these recommendations are not aimed at immediate implementation, we hope the design and planning proposal will draw attention the issues of sea level rise, stimulate conversations, and help begin the process of making appropriate decisions today that will guide future decision over the coming decades.

EXECUTIVE SUMMARY

Based on measurements indicating a significant rise in Earth's sea levels since 1935, scientists have projected that by the year 2110, the surface of the oceans on the Georgia coast will be approximately one meter above today's levels. While this prognosis is significant and potentially devastating, the change will be incremental. We are fortunate to have the opportunity to take advantage of the early warnings and to investigate the effects that a sea level rise of this extent would have on our population, our natural and built environments, and our economy.

In 2012, the Georgia Conservancy sponsored a studio of graduate students studying city and regional planning at Georgia Tech to investigate the impacts of sea level rise in three coastal counties (Chatham, Liberty and McIntosh) and to detail policy- and planning-related adaptation opportunities (Georgia Conservancy 2012). The studio found that one meter of sea level rise would inundate nearly one third of the three-county study area, with a disproportionate impact on parks and conservation land, particularly wetlands areas. The team also found significant inundation of residential and waterfront commercial properties, inundation of 13 miles of state and national highways, and the flooding of railroads.

This RETREAT. ADAPT. DEFEND Design + Research report is based on, but also expands on the past studio's work on the Georgia coast, particularly addressing sea level rise's impact on the five selected sites and what this means to the future of the built environment and how to incrementally plan for changes. The studio was divided into teams of at least three students to address the sites and develop adaptation scenarios. A brief description of each site's challenges and opportunities is presented below.

BLUEPRINTS
for successful communities

PRINCIPLES

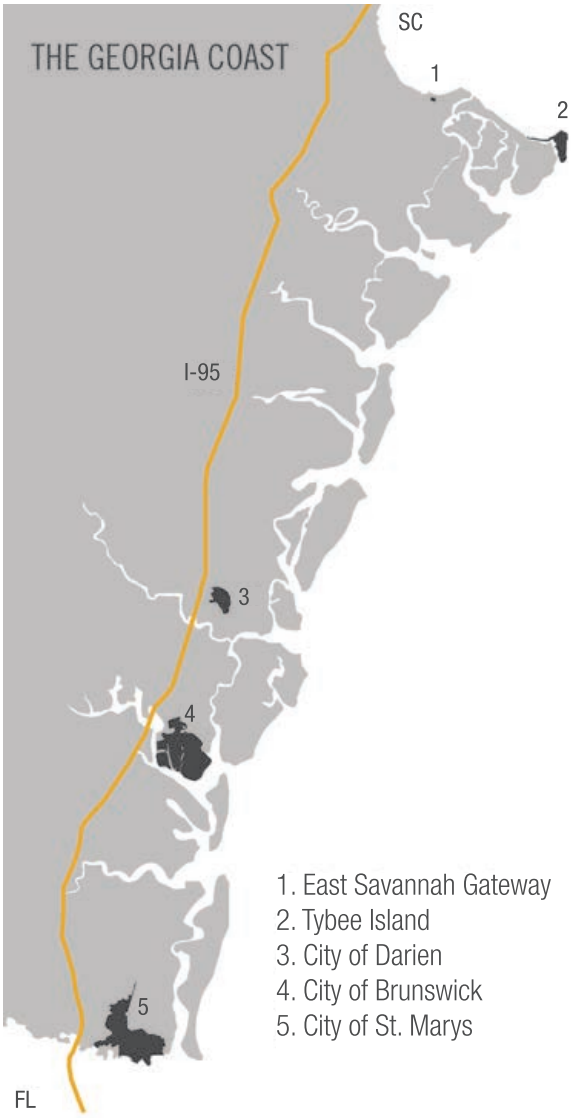
MAINTAIN AND ENHANCE QUALITY OF LIFE FOR RESIDENTS OF THE COMMUNITY

EMPLOY REGIONAL STRATEGIES FOR TRANSPORTATION, LAND USE, AND ECONOMIC GROWTH

CONSIDER THE EFFECT OF THE BUILT ENVIRONMENT ON THE NATURAL ENVIRONMENT AS WELL AS HISTORY AND CULTURE

EMPLOY EFFICIENT LAND USES

The Blueprints for Successful Communities program adheres to values that protect communities and the environment, and it respects the link between the health of our environment, our economic stability and the way we use land. The Blueprints for Successful Communities principles are shown above. By following these principles, we raise public awareness in Georgia about alternative land use and transportation strategies that are good for the environment and good for the economy.



1. East Savannah Gateway

The City of Savannah site is focused within the city limits, just east of the Historic District in the "East Savannah Gateway" neighborhood. Much of the property is owned by the Savannah Housing Authority, who has been tasked with redeveloping demolished housing projects. The site is located very near the Savannah River and within a historic rice plantation, which makes the site especially susceptible to flooding. Previous mitigation ideas have included raising President Street, which forms the northern boundary of the site and is a major east/west corridor in the city.

Tybee Island is the eastern-most point on the Georgia coast, and a popular spot for beach tourists. Previous studies show that one meter of sea level rise will not only cover about half of the island, but also US-80, the only vehicular access on and off of the island. US-80 already faces severe flooding issues during storms, leaving citizens stranded until the water recedes. The island also faces flooding issues, particularly on the west side where marshes have been damaged by a long process of converting wetlands into residential areas.

The City of Darien is a small town of about 2,000 residents, and is the second oldest planned community in the state of Georgia. The oldest English colonial fort on Georgia's coast, Fort King George, was built in 1721 and its reconstruction draws tourists to Darien. The town sits on a bluff on the Altamaha River with an economy based on fishing and shrimping. Recreational tourism and attractive retirement and second-home settings are creating a growing opportunity for Darien.

The City of Brunswick is the second-largest urban area on the coast and is the major urban and economic center in this southeastern part of Georgia. The Port at Brunswick served historically as a strategic military location in WWII, and currently handles 10% of all U.S. ro-ro (roll-on/roll-off wheeled cargo) trade.

The City of St. Marys dates back to the mid-16th century as part of the Spanish settlement in St. Augustine, Florida. The center of the town has been designated as a Historic District by the National Register of Historic Places. Notable features include the waterfront area, historic cemetery, and a memorial oak tree. St. Marys is also home to the Naval Submarine Base Kings Bay, which covers about 16,000 acres of land, of which 4,000 acres are protected wetlands. Additionally, St. Marys is the gateway to the Cumberland Island National Seashore, Georgia's largest and one of the most undeveloped barrier islands on the Atlantic coast.

CONCLUSIONS

THINK IN FEET, NOT YEARS

Several decades of empirical evidence demonstrate that sea levels are rising. The scientific community projects possible sea level increases over a certain number of years – two to three feet in 80 years. But time is elastic – sea levels will rise, but we do not know how much in what period of time. Urban design, planning and civil engineering must anticipate and design for sea level rise foot by foot, not feet in time.

PRIORITIZE ECOLOGY

Ecological conditions of coastal areas, not protection of property values, should guide all decisions on the Georgia Coast. Different decisions may be made in other coastal situations – South Florida or Manhattan, for example. The Georgia Coast is ideally suited for ecology to come first because of its ability to mitigate and adapt to sea level rise. In all coastal areas, urban design, planning and civil engineering design strategies should be based on long term retreat, to allow the ecology to mitigate rising seas, tidal events, and storm surge.

MAKE INCREMENTAL MOVES

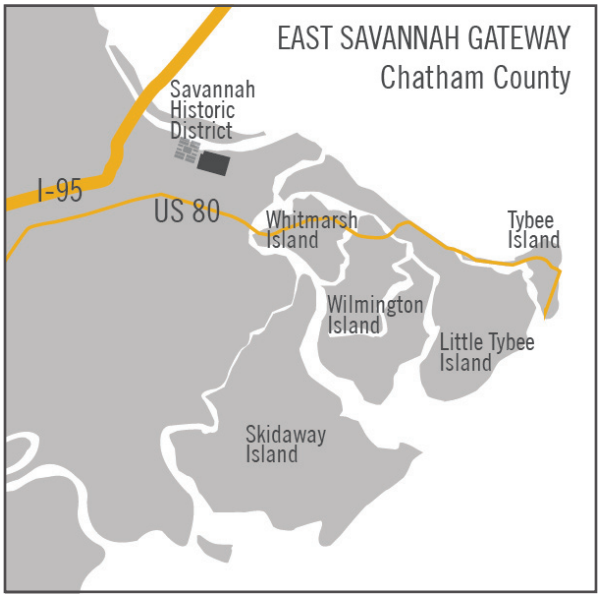
Given that time is elastic and ecological protection is paramount on the Georgia Coast, design strategies should be incremental. One foot. Two feet. Three feet. And so on. This can anticipate both gradual and catastrophic rise. As property values and real estate taxes decline in coastal areas, investments need an incremental approach to defend, to adapt, and to retreat. Major defensive infrastructure investments are unwise. Similarly, major investments to retreat are unwise. Incremental adaptation along the Georgia Coast should be the first aim.

2. Tybee Island

3. City of Darien

4. City of Brunswick

5. City of St. Marys



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E.SAVANNAH GATEWAY

County: Chatham
Area: Approximately 560 acres
Location Type: Neighborhood

HISTORY AND LOCATION

The City of Savannah is located along the Savannah River and houses the largest port on the east coast of the United States. Savannah is the oldest city in the State of Georgia, founded in 1733 by General James Oglethorpe. It is Georgia's fifth-largest city and third-largest metropolitan area.

The East Savannah neighborhood is a primarily industrial area just east of the historic district. It is bounded by President Street to the north, Pennsylvania Avenue to the east, Henry Street to the south, and Price Street, Liberty Street, and Broad Street to the west. Located within the site are the Savannah Golf Club, Hillcrest Cemetery and the historic neighborhoods of Hitch Village, Fred Wessels, Twickenham, and Gordonston.

The area consists of degraded wetlands sitting on the site of an historic 18th century rice field with at least one canal running through it toward the Savannah River. Additionally there is a large swath of low lying property predominately owned by the Housing Authority of Savannah, as well as two major regional roads, the President Street hurricane evacuation route, and the last leg of Truman Parkway as it slices through the wetlands to connect with President Street.

Hitch Village and Fred Wessels homes were two of the first projects by the Savannah Housing Authority (SHA), founded in 1938. The housing development was torn down in 2010 to prepare for a new future for the sites, primarily funded through a Choice Neighborhoods Planning Grant from the U.S. Department of Housing and Urban Development.

In 2006, the City of Savannah, the Savannah Development and Renewal Authority and others identified this large tract of land near its historic core for eastward expansion and developed a master plan for the area. The goal was to grow Savannah while providing a physical framework that would allow the new district to evolve into a thriving and authentic urban extension of the historic district. However, the low-lying topography makes this area susceptible to sea level rise impacts and development should be very thoughtfully pursued to mitigate future problems.

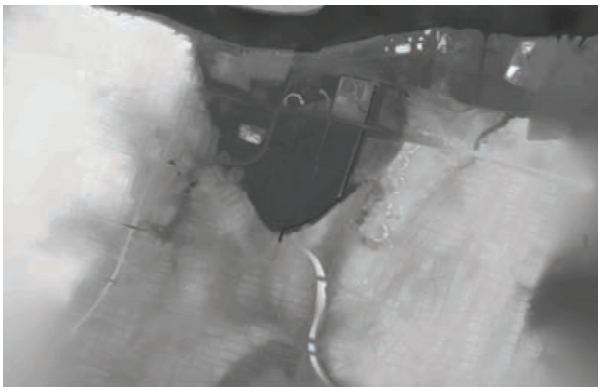
PLANNING FOR SEA LEVEL RISE: POTENTIAL IMPACTS

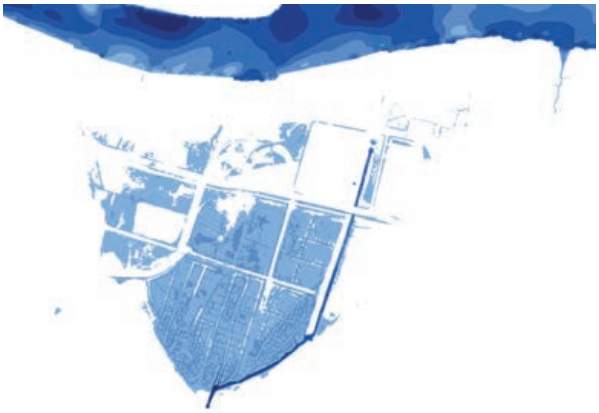
The low lying properties of the housing authority (Hitch Village) have been removed and the Housing Authority is currently in the process of reevaluating the site and redesigning the previous housing infrastructure. President Street forms the northern border of the study area with close proximity to the Savannah River. This heavily traveled route often floods, as it cuts across wetlands and is not built high enough to withstand larger storm events. The low elevation of much of the site puts it at risk for flooding from increased storm surge and sea level rise, making the situation more problematic for redevelopment opportunities.

To establish an urban design framework that considers sea level rise, both East Savannah's landscape and urban features were carefully considered. Landscape layers include the sites' relationship to the two watersheds in which it sits (the Savannah and Ogeechee), the water quality running off of nearby urban districts and the golf course (polluting the wetlands), as well as the coastal context of sea level rise and storm surge and their likely impacts on this area based on the Skidaway Institute of Oceanography's sea level rise assessment. Important structural layers include the sewer and water infrastructure, street network, building locations and parcel data, and the green space network in relation to the historic Savannah core. Key findings include the threat of storm surge on most of the site because of its proximity to the Savannah River. Most of the projected sea level rise will be absorbed within the current wetland area, which will eventually created an open water cove because marshes will be blocked from extending to the west by the existing upland topography. See topographic analysis for the diagrams illustrating this process.

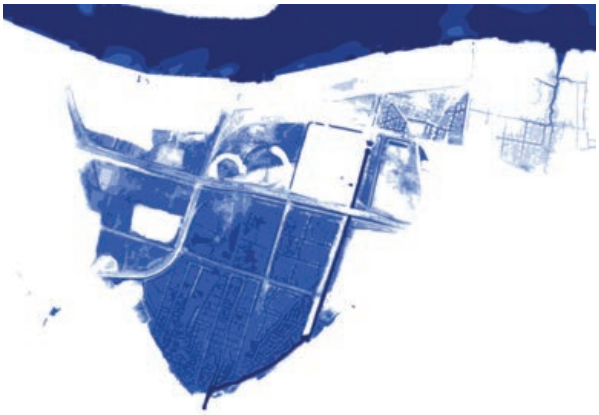

Archived image of original Hitch Village


Aerial image of site location (outlined in white)

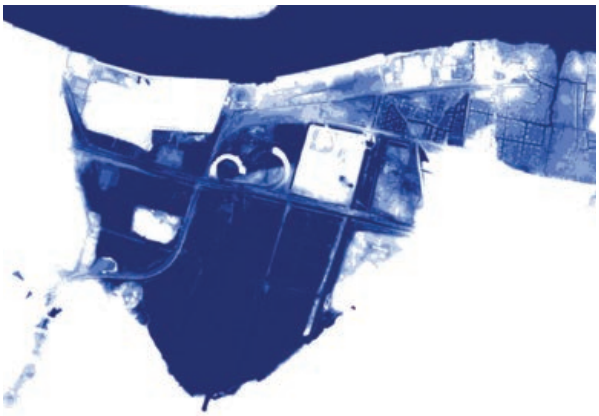

Area topography (lighter = higher ground)



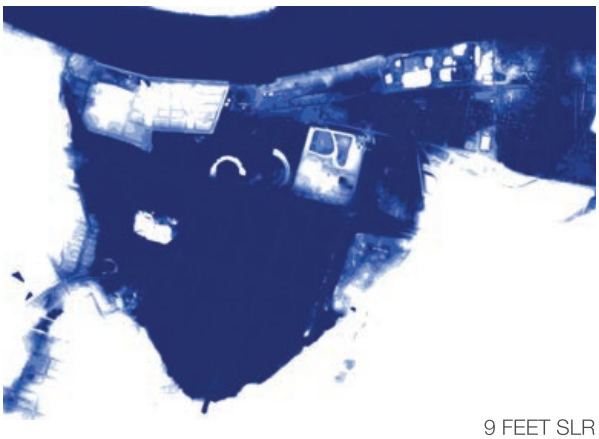
0 FEET SLR



3 FEET SLR



6 FEET SLR



9 FEET SLR

RETREAT

A full retreat approach assumes that as sea levels rise and increased storm surge increase, that natural processes provide protection as urban development moves inland. A full retreat would mean abandoning much of the East Savannah Gateway neighborhood, allowing marches to creep progressively replacing buildings and infrastructure. It would be necessary to abandon President Street or converting it into an elevated causeway protecting the health of future marshes. However, this would only be effective to about a one meter sea level rise before the topography would defeat marsh movement.

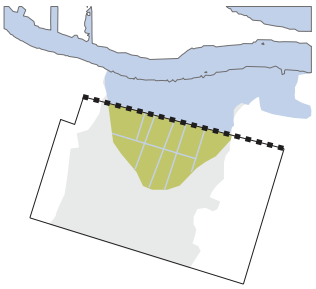
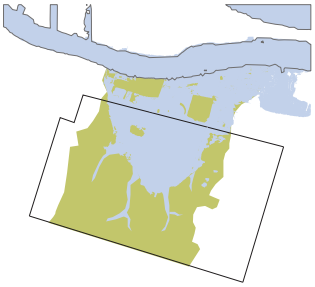
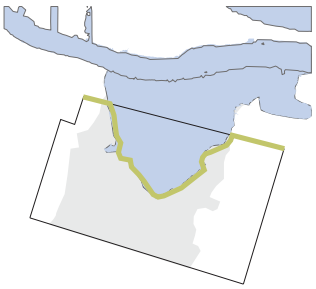
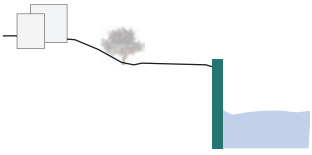
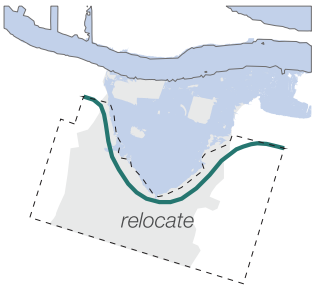
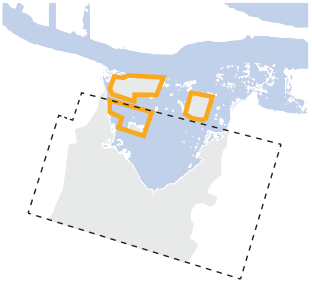
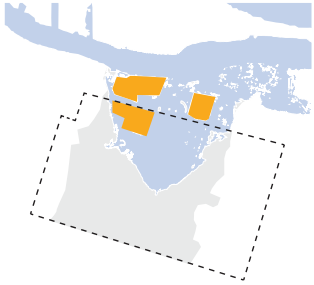
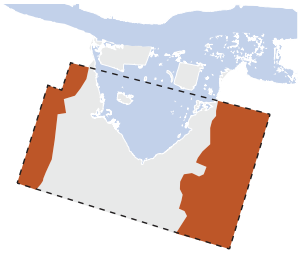
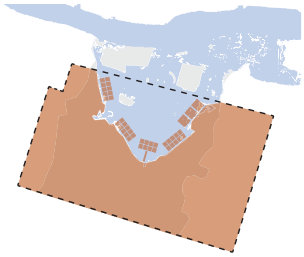
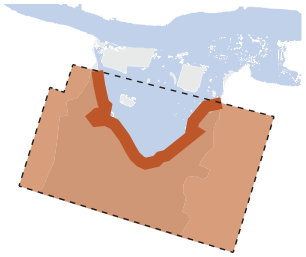
ADAPT

Adaptation assumes that the study area is still viable for development, provided that mitigation efforts are effectively combined with natural environmental processes to allow sustainable urban development. Given the specific environmental and topographic condition of this area of Savannah, continued urban development, properly designed, seem to be the most plausible strategy.

In analyzing the five components (shown at right), the studio team proposes retreating to the cove line (which would fully form with 10 feet of sea level rise) and dredge the cove in the short term to produce a high density waterfront and yacht basin next to the Historic District.

DEFEND

A full defend approach at this site considers existing conditions and assumes that the study area should be entirely protected. Full defense alternatives would include raising the height of President Street, accommodating for some levels of sea level rise. This alternative would need constant maintenance as sea level rise continues.

	FULL DEFEND	FULL RETREAT	ADAPTATION
LOWLAND The lowland areas of the East Savannah Gateway are those areas within the floodplain.	 *levee*	 *marsh creep*	 *dredge cove*
PRESIDENT STREET	 *levee*	 *bridge*	 *relocate*
ISLANDS	 *armor with levees*	 *natural restoration*	
DEVELOPMENT TYPES	 *high density development*	 *floating development*	 *waterfront development*

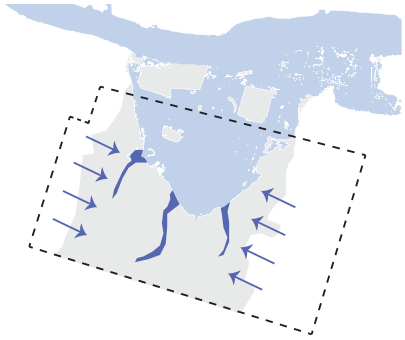
Regional Marinas And Their Potential Relocation

0 feet sea level rise (existing)

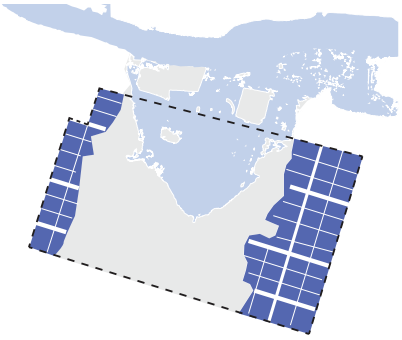
If the lowland area is dredged at 1 foot of SLR, there is a new, protected place for water to flood. This also allows for President Street to be moved to higher ground.

URBAN DESIGN FRAMEWORK

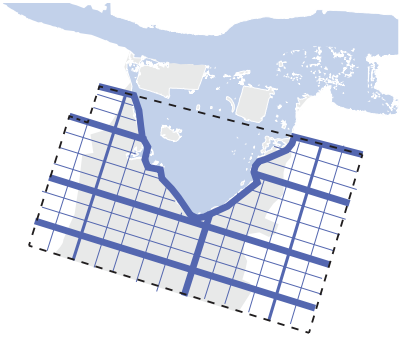
Stormwater



Parcels



Streets



3 feet sea level rise

By incorporating various waterfront edges, multiple uses for recreation, access, and filtration become new opportunities. Using different, yet durable materials and surfaces can help stabilize the bank and encourage marine habitat.

SAVANNAH GATEWAY COVE

The natural cove that is formed by the effects of rising seas provides the opportunity to extend the historic district and form significant new land value and tax revenue in the East Savannah Gateway neighborhood. By consolidating other regional marinas (and letting marsh creep happen in those locations) a new, larger marina and yacht basis can be placed in the new cove. This place becomes a draw for new residents and regional visitors while planning for and allowing the effects of sea level rise.

1 foot sea level rise

At this level, armoring the islands would need to begin, in addition transforming the eastern most island into a wetland cell to combat toxins and may later have the potential to become a wildlife refuge. Truman Parkway can convert in its last leg to a boulevard, meeting President Street at grade.

2 feet sea level rise

Integrating stormwater facilities into new or revised streets, open space, blocks, and parcels, can lead to the formation of a network that efficiently directs and filters water from the bluff, through the lowlands and out to the river.

6 feet sea level rise

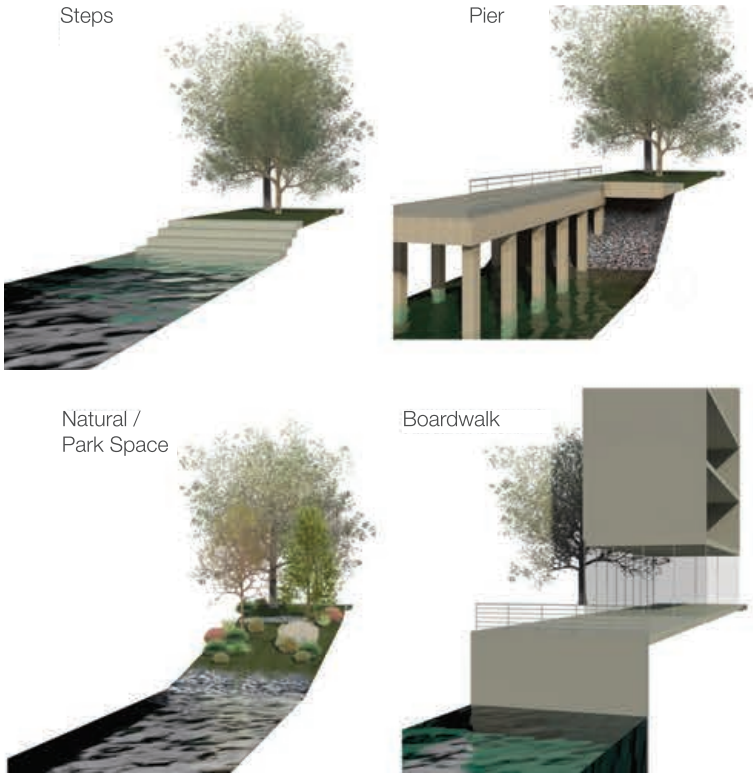
Ideally, development would begin inland on the western edge of the site, moving towards the water as the waterfront continues to add amenities. One can expect the waterfront to increase property values of the surrounding areas as well as provide recreation to the community.

9 feet sea level rise

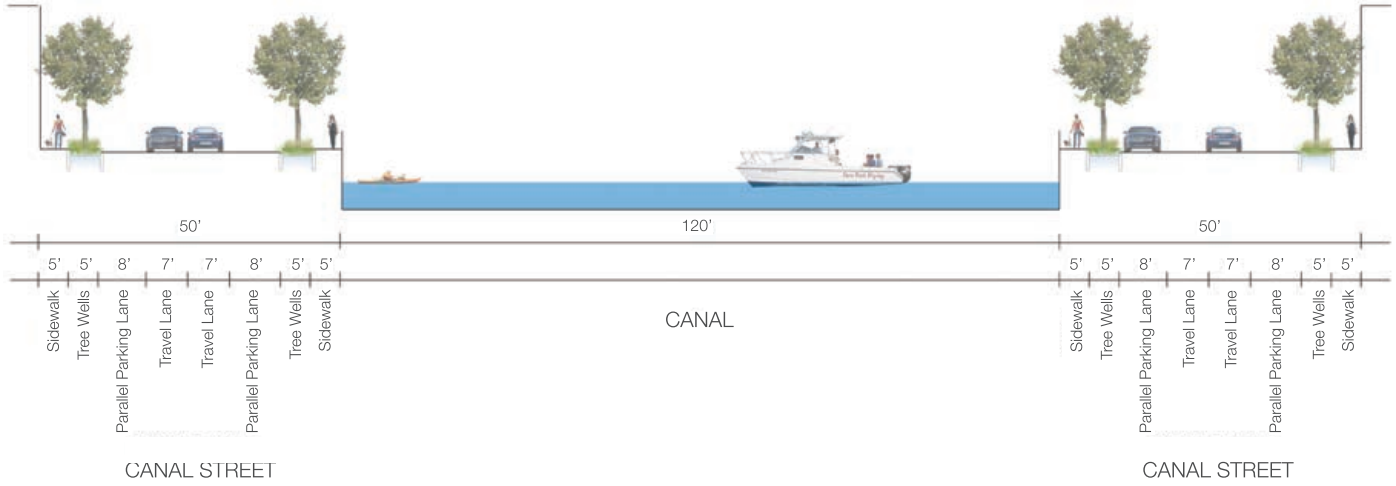
Ultimately, the islands will be at risk and any continued development should be on the mainland. The island at the greatest risk will have already been transformed into natural landscape.

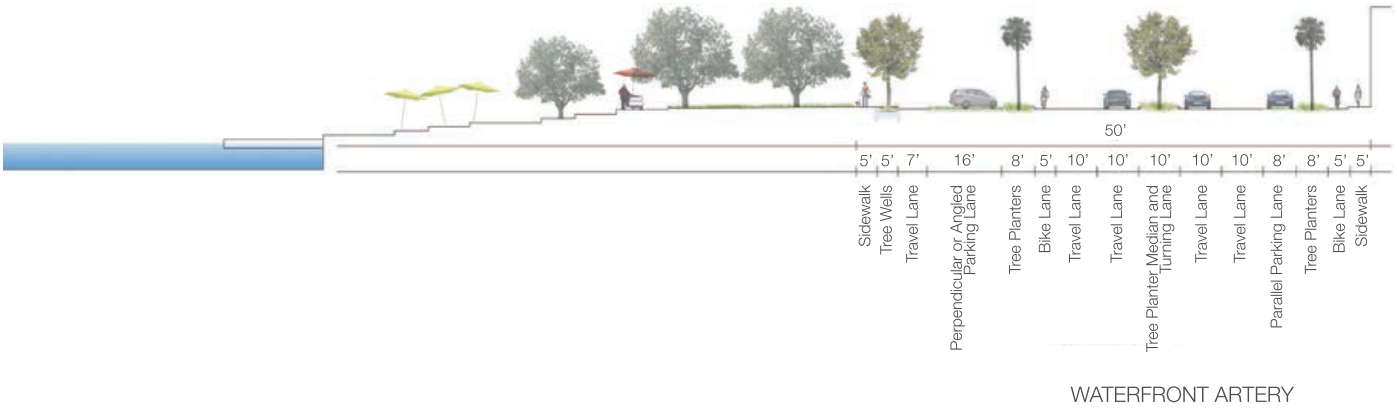
Savannah Gateway Cove and Marina Aerial Rendering

Typical Block Design



Waterfront Edge Condition Alternatives





Waterfront Edge Condition: Steps

GEORGIA TECH DESIGN + RESEARCH STUDIO
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Tybee Island flood conditions

TYBEE ISLAND

County: Chatham
Area: Approximately 3.2 square miles
Location Type: City and Barrier Island

HISTORY AND LOCATION

Tybee Island is both a barrier island and a city, and is the easternmost point on the Georgia Coast. The island is a popular vacation spot for visitors from the Savannah metropolitan area (it was originally known as Savannah Beach and is only eighteen miles east of the city and from across the State). Tybee Island is home to a beach community of about 3,000 year round residents. Tybee sits on the mouth of the Savannah River and is approximately 2.7 square miles, and about 2.5 miles long (north to south).

In the late 19th century during the height of the Industrial Revolution, residents from larger cities would seek out locations like Tybee Island because the saltwater breezes were believed to help remedy ailments like asthma and some allergies. Steamships carried patients and tourists to Tybee Island after the Civil War, and in 1887, the Central of Georgia Railway completed a line to Tybee, opening the island to greater tourism opportunities. In 1923, US-80 was built parallel to the railroad to allow for vehicular travel between the island and Savannah. The rail was converted to a walking, hiking and biking trail (McQueen's Island Trail, completed in 1999).

Of the thirteen barrier islands along Georgia's coast, Tybee Island is the most significantly developed due to its proximity to Savannah

and natural beach formations. The majority of development centered along the highest ridge line, about 12 feet above sea level at its highest point, but less than 9 feet on average. Over time, portions of the island where marshes previously existed have been infilled to allow for more development. The areas infilled (particularly on the southwest portion of the island) already experience more significant flooding and the remaining marshes will provide little protection for storm surge. Tybee Island has only one access road on and off the island, US-80, which floods during storms events and spring seasonal high tides. Flooding of this highway leaves residents stranded, sometimes for hours, waiting for the water level to decrease. During a major storm, the only evacuation route would be eliminated.

PLANNING FOR SEA LEVEL RISE: POTENTIAL IMPACTS

There are three critical concerns for Tybee, even without sea level rise. The US-80 causeway is the only evacuation route from the island, therefore addressing this concern must be a top priority. The second priority is protecting and renourishing the beach front because it is the primary, and really the only economic generator for the town. The third priority involves protecting the marsh buffers on the back of the island. The areas most susceptible to changes are those already experiencing flooding issues, thus pressing the need for immediate action.

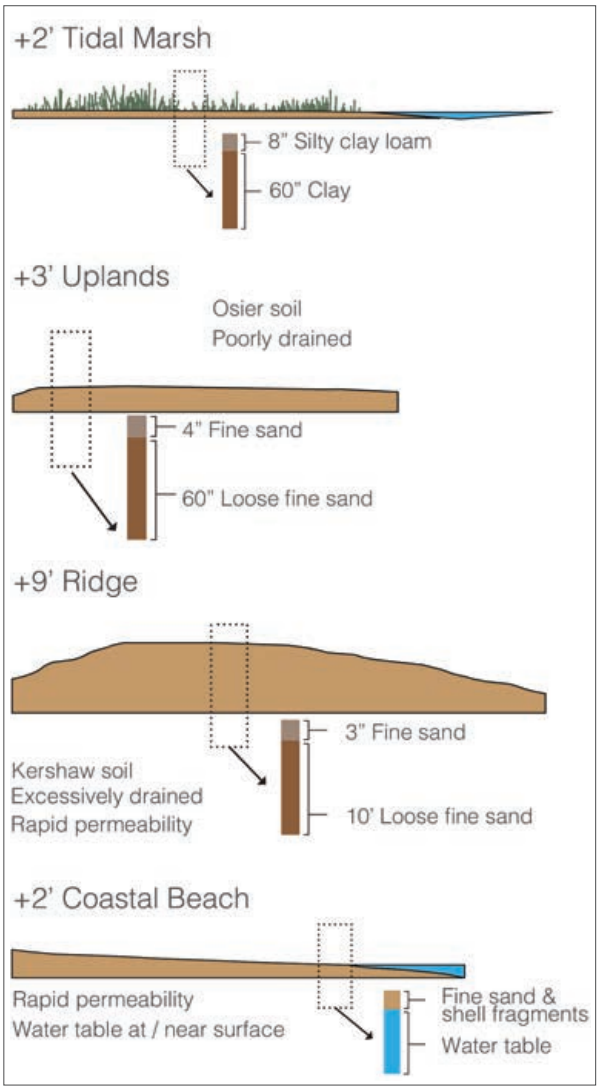
Tybee Island has employed the techniques of jetties, bulkheads, tidal gates, and beach renourishment in order to protect itself from some of the effects of ocean erosion, seasonal high tides and potential storm events. While these tactics are effective in the short term, future sea level rise will make these efforts, if continued, temporary and unsustainable fixes. The report "Tracking the Effects of Sea Level Rise on Georgia's Coastal Counties" (Georgia Conservancy 2012) looks at recommended various types of hard- and soft-scaping mitigation techniques and their corresponding benefits and potential consequences. This is also illustrated in the figures demonstrating marshland deterioration processes from bulkheads on the next page. Tybee Island leaders and citizens should consider alternatives to these hard-scape methods, including ways low-impact development/green infrastructure can immediately help alleviate flooding and water drainage issues. These methods mimic natural hydrology to manage stormwater runoff, and are often cheaper and more effective than traditional methods.

RETREAT

A full retreat approach recognizes that sea level rise and increased storm surge will happen and that the island's natural processes should take over. In this case, no additional urban development should occur on the island and public investment should decline as property values and tax revenues decline. A phased retreat over a long period of time would be a viable approach, allowing the beach

Tybee Island aerial with transects labeled

Tybee Island Section / Natural Processes Transect



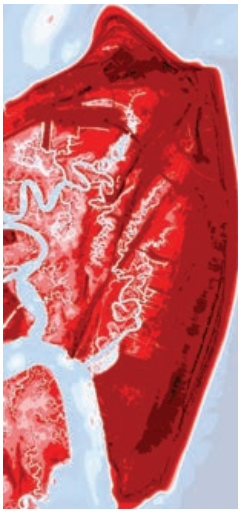
Existing Conditions

1 foot SLR

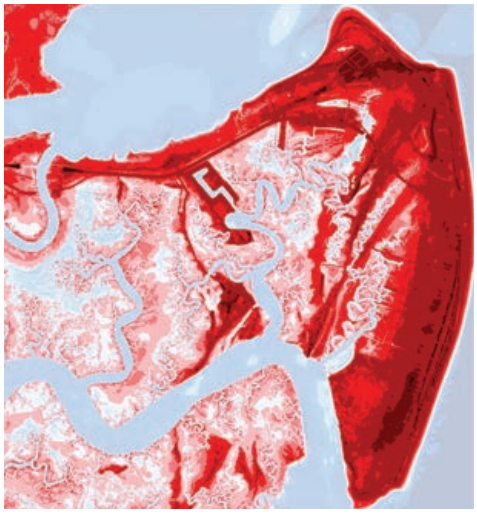
3 feet SLR

Areas Susceptible to Storm Surge (combined with Sea Level Rise)

- water level (at and below sea level)
- 0-1 ft storm surge
- 1-2 ft storm surge
- 2-5 ft storm surge
- 5-10 ft storm surge
- 10-15 ft storm surge
- 15+ ft storm surge



Existing Conditions



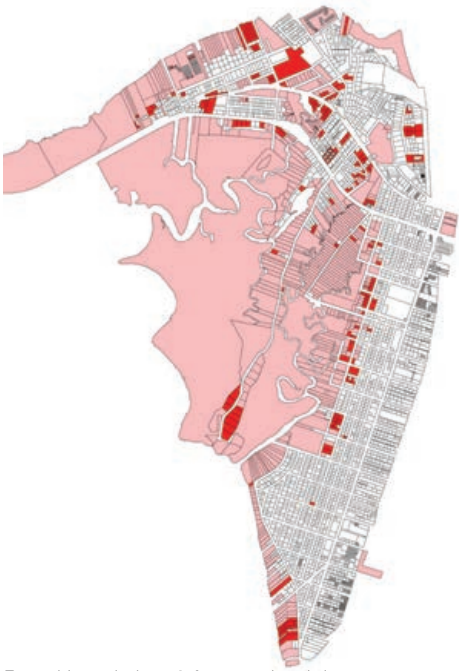
Susceptibility to Storm Surge with 1 foot SLR

Susceptibility to Storm Surge with 3 feet SLR

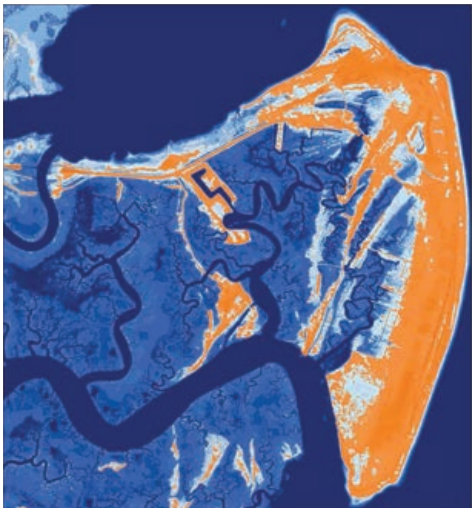
to be re-nourished until it finally disappears and allowing the marshes to creep upland by sequentially removing residences as the seas rise.

ADAPT

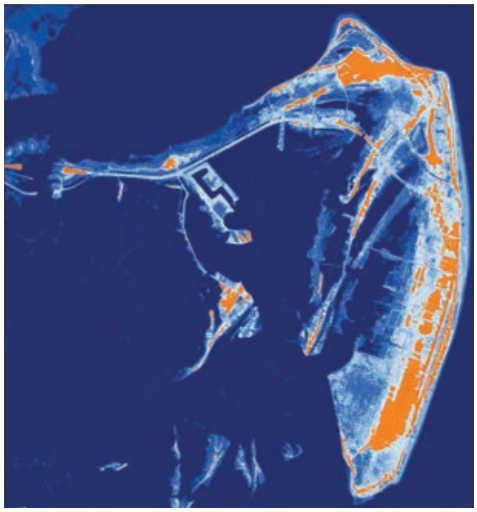
In the long term – understanding that sea level rise is not predictable and will continue in perpetuity, Tybee Island will inundated and either defending or retreating strategies can be effective. The strategy for Tybee is adaptive, but realizing that eventually, the barrier island will again be part of the sea floor. This leads to a situation where public investments must be carefully managed with tax revenues to allow transfers of development from lower densities to higher densities. This could include parallel efforts to allow floating houses in open water beyond the marshes, transfers of development rights from lowlands to the ridgeline.



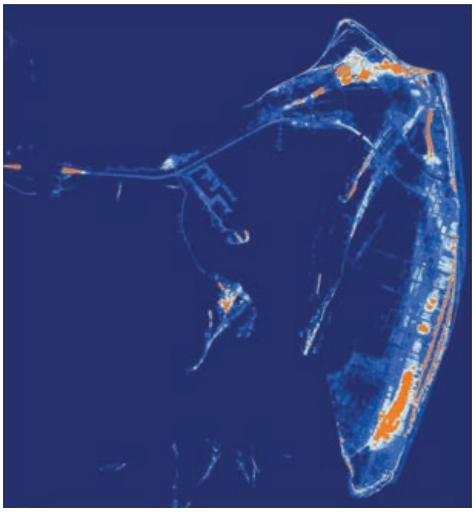
Parcel Inundation: 3 feet sea level rise



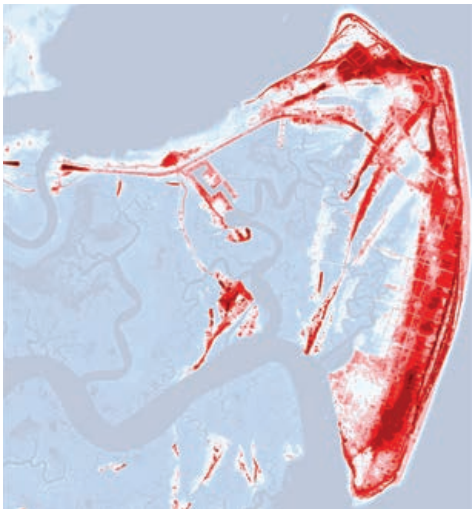
6 feet SLR



9 feet SLR

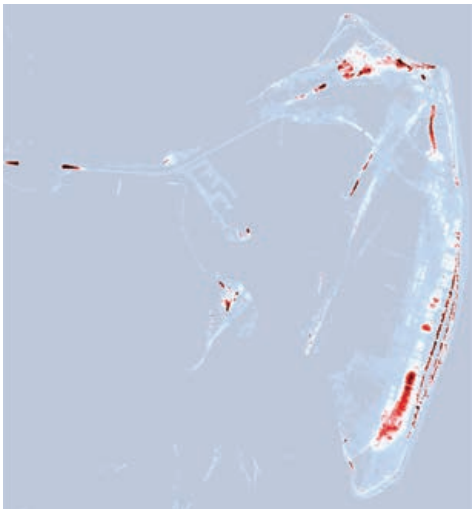


12 feet SLR

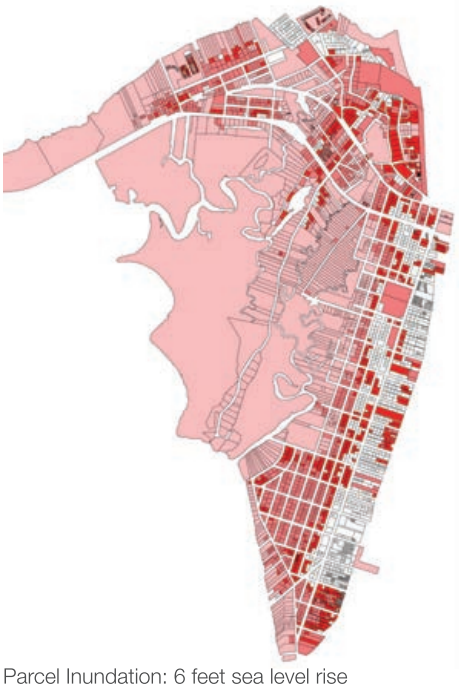


Susceptibility to Storm Surge with 6 feet SLR

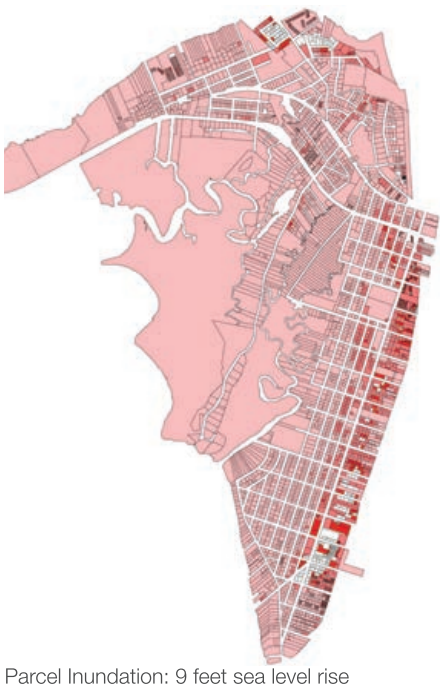
Susceptibility to Storm Surge with 9 feet SLR



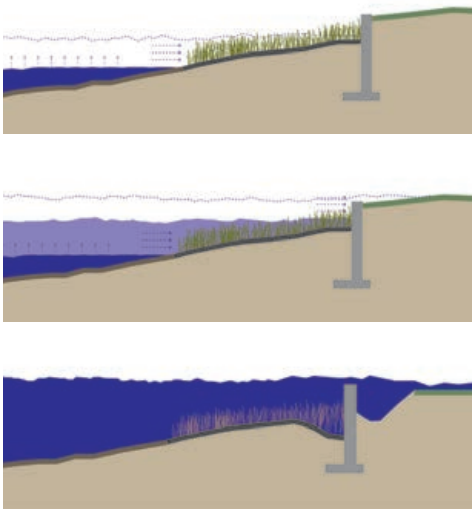
Susceptibility to Storm Surge with 12 feet SLR



Parcel Inundation: 6 feet sea level rise



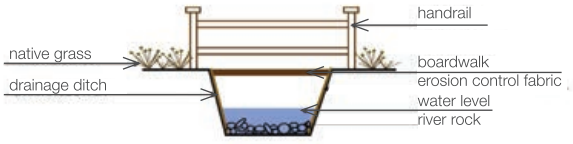
Parcel Inundation: 9 feet sea level rise



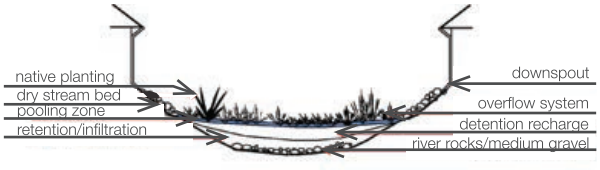
Typical bulkhead effects and marsh deterioration

Existing zoning conditions. Increased density along the ridgeline of the island (primarily R-2) will allow for populations to remain safely on the island, with a lessened risk of flooding.

Storm Sewer Analysis for Low-Impact Development Opportunities



Utilizing drainage ditches to hold water during storms



Utilizing rain gardens to filter and hold water

DEFEND

A full defend approach for Tybee Island would consider existing conditions and assume the town should be entirely protected. Full defense alternatives would provision for a large barrier wall surrounding the island. However, the diagram at the left shows how such a barrier could only protect the island for a certain period of time. Sea levels will not stop rising in 50 or 100 or 200 years. Eventually, Tybee will be inundated. A defense strategy for Tybee is clearly a temporary one and should be recognized as such.

US-80 CAUSEWAY

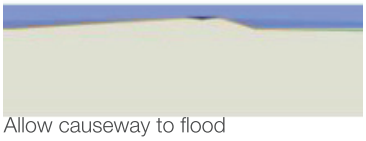
Mitigating the current flooding of the causeway should be a priority as this will only worsen with increased sea level rise and storm occurrence. Retreat is not an option, as that would leave the island only accessible by water transportation, impacting the quality of life of residents and economic potential of visitors. To defend the causeway might include a wall barrier on either side, to hold back the water. This would only work to a certain height, and would isolate natural habitats and crossing for native specials, as well as inhibit marsh migration and ecology.

In order to adapt the causeway, three options may exist. The causeway could be built up to levels higher than what exists currently. This would be effective with certain levels of flooding, but useless in higher floods and rising seas. The second option would be to reconstruct the causeway on ‘buoyant foundations’, essentially a floating road. This would ensure the road remains above sea level regardless of water levels. Another alternative is to construct an overpass at a high enough level to ensure no flood waters would effect the bridge.

The following pages show renderings of the impact of sea level rise on Tybee Island and proposed incremental adaptations to learn to live with the water.

US-80 Causeway: Retreat. Adapt. Defend. Alternatives for addressing sea level rise.

RETREAT



Allow causeway to flood

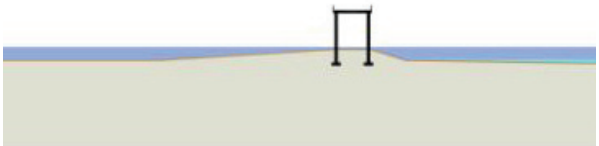
DEFEND

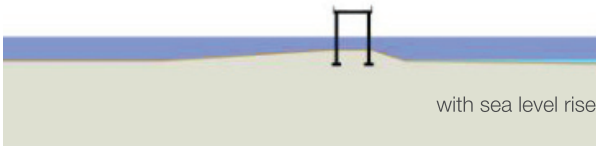
Build walls on sides of causeway to prevent water infiltration

ADAPT

Fill and increase causeway height

Floating causeway

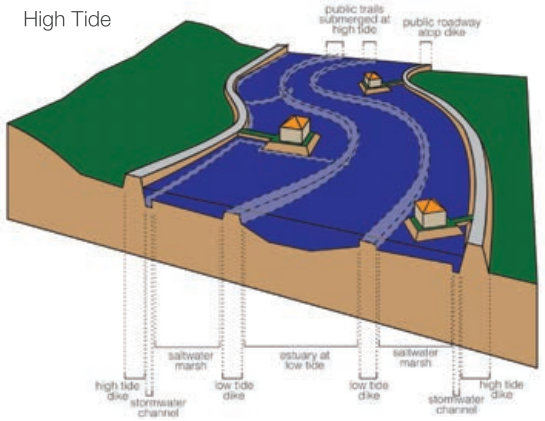




Build overpass

Low Tide

High Tide



Proposed Marsh Alternatives with Development at Low and High Tides

Lacey V. Murrow Memorial Floating Bridge, Washington

Bridge in Brunswick, Georgia

Rendering of increased density on ridgeline and proposed marsh development

Rising Waters (3 feet)

Rising Waters (6 feet)

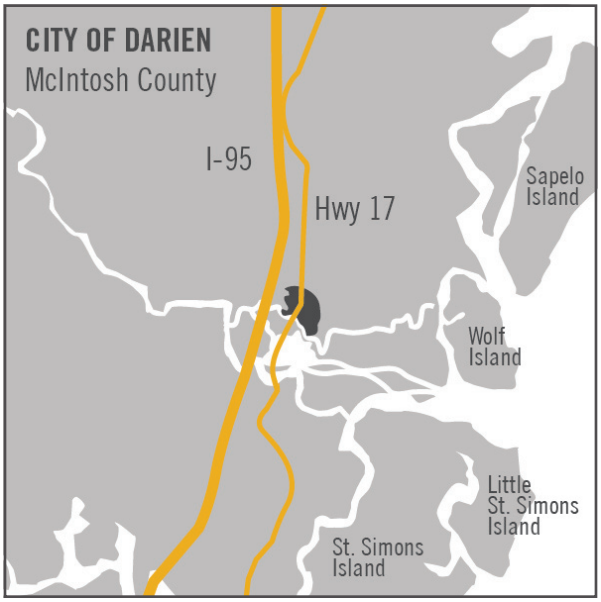
Rising Waters (9 feet)

Existing Condition (0 feet)

Rising Waters (3 feet)

Migrate towards ridge + marsh creep (6 feet)

Near Abandonment (9 feet)



GEORGIA TECH DESIGN + RESEARCH STUDIO
Audrey Plummer, M.Arch/MCRP, R. Dawn Riley, M.Arch/MCRP, Yigong Zhang, MSUD

Watersheds on the coast (Darien in orange)

CITY OF DARIEN

County: McIntosh
Area: Approximately 2 square miles
Location Type: City

HISTORY AND LOCATION

Darien is a city in McIntosh County at the mouth of the Altamaha River leading to the Atlantic Ocean. It is about 50 miles south of Savannah. Darien is the second oldest planned city in Georgia, laid out by James Oglethorpe and originally known as New Inverness (original Oglethorpe plan shown on page 30).

Historically, Darien's location along the Altamaha River (11 miles from the sea and on a high bluff) has worked to its advantage. After the American Revolution, cotton and other agricultural exports from inland farms were shipped through Darien, down the Altamaha, and up to the northeastern states. After the Civil War, Darien relied primarily on the timber trade; for forty years, virgin pine harvested inland and along the stretch of the Altamaha River was sent by raft to Darien where it was processed into lumber and other timber products. Nonetheless, overcutting upriver led to a dramatic decline in timber production and by 1925, Darien's timber trade had come to a grinding halt. Even with the extension of the railroad in 1914 from Darien to Brunswick, a larger metropolitan area further south, the timber trade could not be saved.

The population declined steadily after the failure of the timber industry, but fortunately, Darien found prosperity in a new industry: commercial

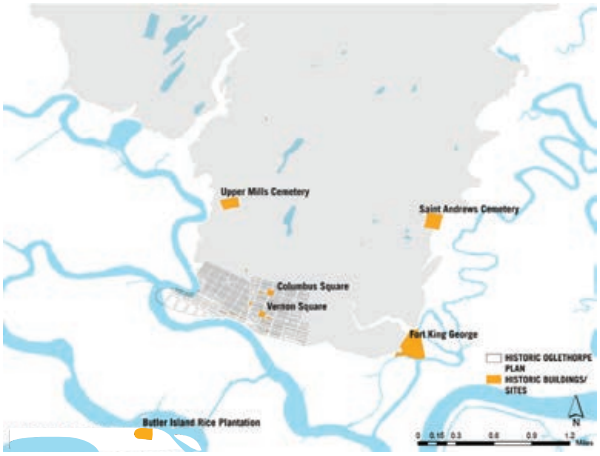
fishing. Large bounties of oysters, shrimp and crabs quickly made the town an important center for the processing and shipment of seafood. At the peak of its fishing industry, Darien had one of the largest shrimp-boat fleets on the South Atlantic coast. Unfortunately, the shrimping industry, upon which the town has come to rely, has been in decline since the 1980s due to rising fuel costs, lower yields compared to previous years, and competition from foreign markets. With the majority of residents tied to the now-failing commercial fishing industry, officials and planners in Darien and McIntosh County are desperate to find ways to diversify the local economy.

Despite these struggles, Darien is making efforts to achieve greater economic diversity. These efforts range from promoting light industry (through the addition of the new Tidewater Industrial Park off Interstate 95) to pursuing eco-tourism, as the town's location on the Altamaha River makes it a destination for water sports enthusiasts, and lastly, marketing itself to retiring populations that enjoy the character and small town feel. A more unique and currently very successful endeavor is the fishing and processing of canonball jellyfish. Colloquially known as 'jellyballs', these are in greater demand in many Asian countries and has become Georgia's third-largest commercial fishery (by weight). Even more surprising is that the only known processing factory in the U.S. is locally owned and located just off the Darien waterfront. Even though jellyballs are sold at much lower prices than shrimp, the work is less labor intensive and the yields are higher.

Currently, Darien's aquatic economy exists because of the marshes at the mouth of the Altamaha. Surrounding Darien at the base of the 30-foot-high bluff, the brackish marsh is home to the breeding grounds of white shrimp, prized for their sweet, tender flesh. The marsh also attracts eco-tourists who kayak on the Altamaha river. These stretches of water are some of the most pristine on the East Coast.

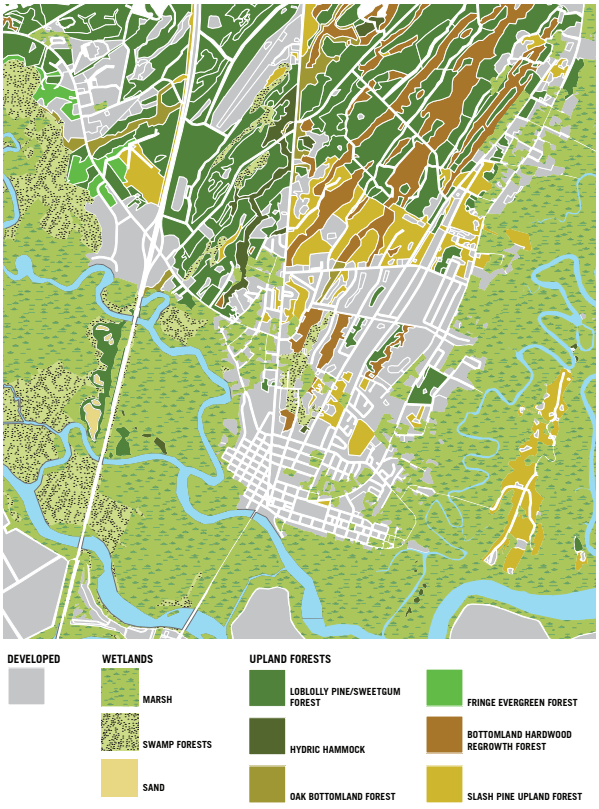
PLANNING FOR SEA LEVEL RISE: POTENTIAL IMPACTS

While Darien's fortunate positioning on a 30-foot-high bluff helps protect the City from more of the immediate impacts of sea level rise, it is still susceptible to intensified storm surge that will result from rising and warming seas. While the coast of Georgia has not in recent past been affected by a larger category hurricane, this is still an area of concern because of the historic patterns of severe hurricanes, which Darien is in the path of. In total, 14 hurricanes made landfall on the Georgia coast in the 19th century, six of which were major hurricanes (Category 3 or greater). In fact, the most recent major hurricane to hit Georgia (1898) caused an 18-foot storm surge in Darien, resulting in devastating flooding and 32 deaths. Thus, while these major incidents are outside of recent personal experience and history, the coast of Georgia is susceptible to future incidences and leaders and decision-makers should be proactive preparing for such events (see hurricane diagram on page 28).



Darien Historic Fabric

Darien Elevations (10 foot contours)



Darien Elevations (10 foot contours)

Sea Level Rise 1 foot

2 feet

Sea Level Rise + FEMA 100 Year Flood 1 foot

2 feet

Sea Level Rise + Category 1 Hurricane 1 foot

Sea Level Rise + Category 2 Hurricane 2 feet

Sea Level Rise + Category 3 Hurricane

SEA LEVEL RISE + 100 YEAR FLOOD + HURRICANES

The studio measured the impact of sea level rise on Darien, shown at top. As depicted on previous pages, Darien is positioned on a bluff and not as immediately susceptible to rising seas. Because of this, it is also important to illustrate the combined effects of sea level rise with storm surge (FEMA 100 year flood) as well as with Category level hurricanes. Storms will increase in both frequency and intensity, which will have significant impacts to coastal communities, particularly when combined with rising seas.

3 feet

6 feet

9 feet

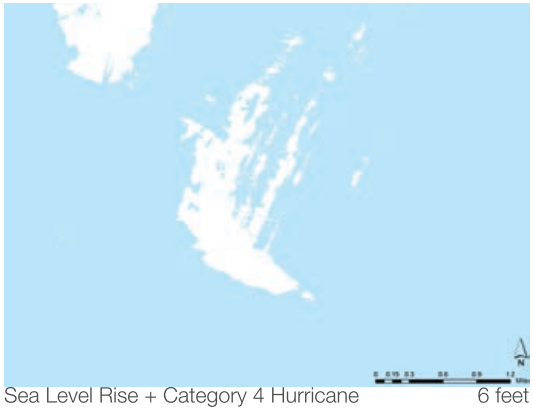
3 feet

6 feet

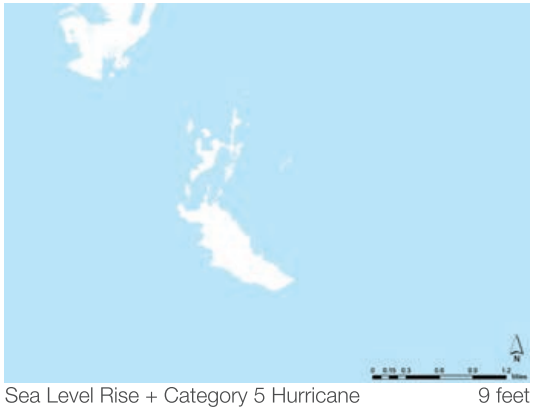
9 feet

3 feet

Sea Level Rise + Category 4 Hurricane

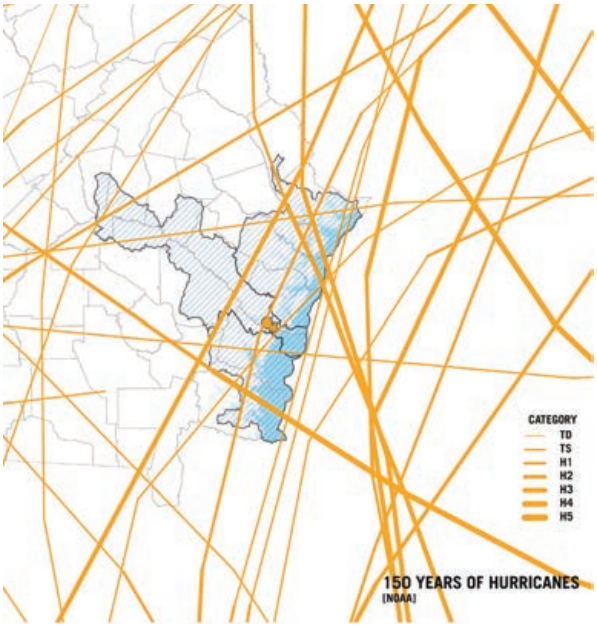


6 feet



Sea Level Rise + Category 5 Hurricane

9 feet



150 Years of Hurricane Paths on the Georgia Coast


Marsh around Darien

Preparation includes emergency and evacuation programs which will help for a specific disaster event. However, there are also actions that can be taken within the built environment to better handle an excess of water and ways to quickly move that water from vulnerable places. This *Blueprints* studio group looked at the potential ways Darien will be affected and several strategies to help mitigate the negative effects of sea level rise and storm surge.

As previously discussed, the coastal ecology of the entire Georgia coast, including marshland surrounding Darien, is incredibly important for local habitats and the local economy. Sea level rise could harm the marshland if an excess of water means the wetlands cannot migrate and then become a part of open water. As mentioned, sea level rise does not immediately affect the City of Darien because of its high elevation, but the storm surge diagrams signify a clear threat.

RETREAT

Full retreat assumes the hydrological problems are far too advanced to solve with no viable alternatives present. A full retreat approach assumes that sea level rise and increased storm surges will happen and natural conditions should take over and no more development within the area should occur. A retreat approach would maintain the marsh habitat, but the fishing industry, property and the historic town would be lost. Darien does not face the imminent need to adopt a full retreat approach because of its higher elevation. However, the city does need to consider how it protects low lying lands during major storm events.

ADAPT

Adaptation assumes that the study area is still viable for development, provided the proper mitigation efforts and environmental analysis to occur to understand how the site may be used in the future. The options to wholly defend and/or abandon the site are extreme and not needed in entirety to accommodate rising seas.

The *Blueprints* studio team created six strategies to protect valuable infrastructure and help the city move water quickly off the land in the event of flooding during a storm event. These strategies are illustrated on page 31.

The first strategy is to use the Oglethorpe grid to capture stormwater for well recharge. Rising seas will put pressure on groundwater by threatening the drinking supply with salt water intrusion. Darien currently pulls its water from one well that will likely be at risk in light. The studio team encourages water infiltration for groundwater recharge through the Oglethorpe squares. As shown, the original Oglethorpe plan for Darien includes a large middle square, designed to house livestock and over time was modified to allow for public

spaces like parks and green space. The *Blueprints* studio team envisions this middle area as a place that can channel excess water to the marshes and allow for better soil infiltration. By reconstituting the historic Oglethorpe grid and adding in additional squares, the original plan and historic sense of place remains and the additional squares allow for a greater network of water recapture areas, water cleansing and public space.

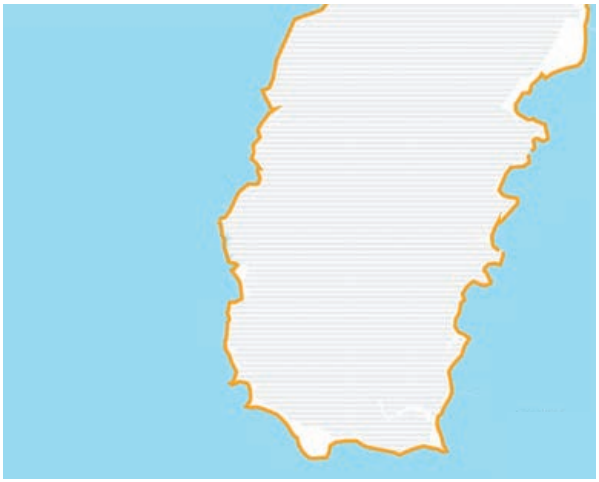
The second strategy involves cleaning excess rainwater and channeling it into the marsh. While it is important to move water quickly, it is important to consider the quality of the water being returned to the sea. This strategy suggests for Darien to implement gutters to carry water towards underground tanks that clean the water before it naturally flows (because of the topography) into the river and sea.

The third strategy designed for adapting Darien to the effects of rising seas is to begin removing all buildings and infrastructure from the foot of the bluff, as these are more immediately threatened by sea level rise. While much of Darien does sit on the bluff, these several buildings rest on infill and are thus susceptible to flooding. The studio team suggests these be relocated in order to create better protection for where the wetlands meet the bluff.

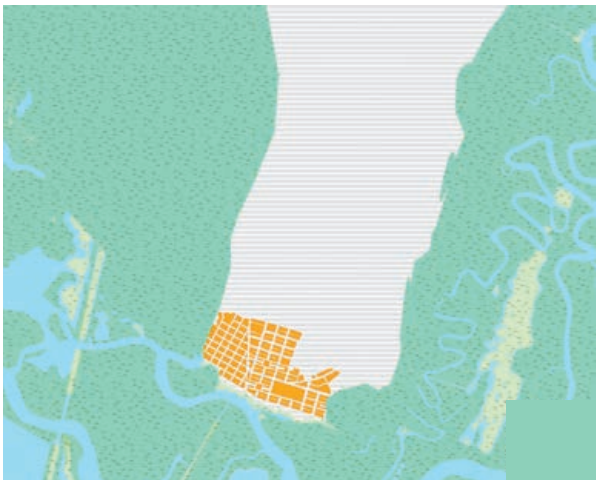
The fourth strategy directly addresses and impacts the fishing industry. Darien should begin to build a new fishing port and related infrastructure in open water. Many of the buildings that reside on the lowest parts of Darien along the waterfront (as mentioned in the third strategy) are related to the local fishing industry. The studio team suggests these, as well as all port infrastructures, are relocated to the middle of the river, away from the land and in an area undisruptive to the marsh. This allows the marshland greater area to migrate as seas rise and also allows the potential for new marsh to grow. This also protects the structures from significant property flooding on land.

In moving the port infrastructure and fishing industry to open water, the lowest points of Darien no longer have hard infrastructure on them and can be naturally restored. The *Blueprints* team suggests creating man-made marshes to grow around the edge of the bluff and protect it. This allows for an additional system to cleanse water from on top of the bluff before it enters the ocean, as marshlands are natural filters.

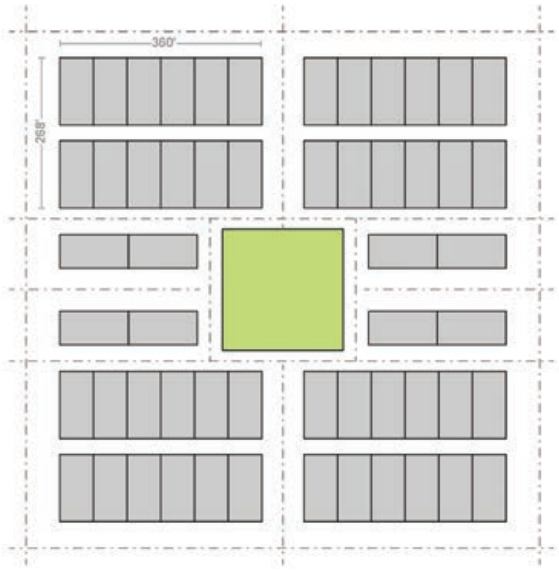
Although sea level rise alone does not threaten most of the developed area on the bluff, the combination of flooding, storm surge and increased sea levels do raise concerns for a significant portion of developed area. In these identified areas, we suggest avoiding further development and encourage increasing density in areas located out of the flood plain. The transect shows a gradient of densities applied to the areas considered safe for development. This transect offers higher density in Darien with a range of dwelling options, house



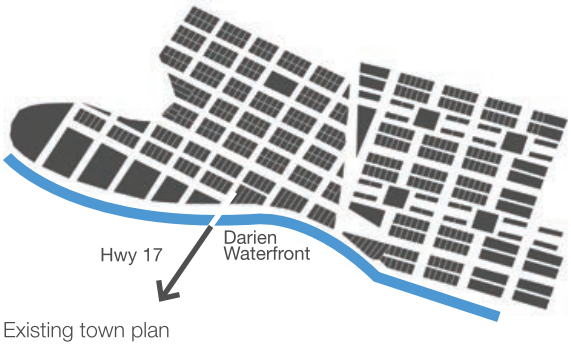
Defend Alternative
Loss of Fishing Industry, Marsh, Public Space
Maintain Existing Property and Some Waterfront Development



Retreat Alternative
Loss of Existing Land, Public Space and Fishing Industry
Maintain Marsh



Traditional Oglethorpe plan



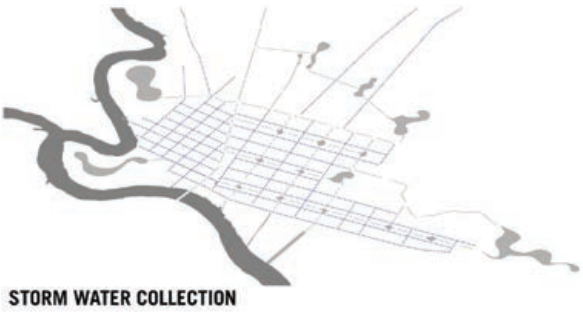
Existing town plan


Port of Darien on the Altamaha River


Port infrastructure relationship with the river

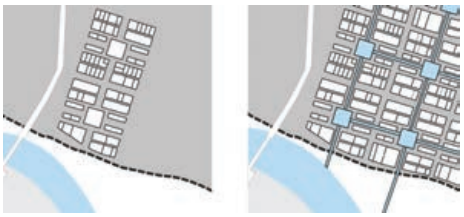
sizes and lot sizes to suit most residents with the highest density only reaching 4 to 5 stories in the central business core along State Highway 17.

Lastly, as many historic elements of the City of Darien have been addressed, it is also important to consider the impacts of sea level rise at the historic Fort King George site. Fort King George is on very low lying land near Darien and will begin to be inundated with just two feet of sea level rise. Though the Fort is a replica, it is important to preserve the memory and keep the site viable for tourism. The team suggests building a simple wall out of tabby construction around the



BEFORE AFTER BEFORE AFTER

STRATEGY 1
Use Oglethorpe grid to capture stormwater for well recharge.



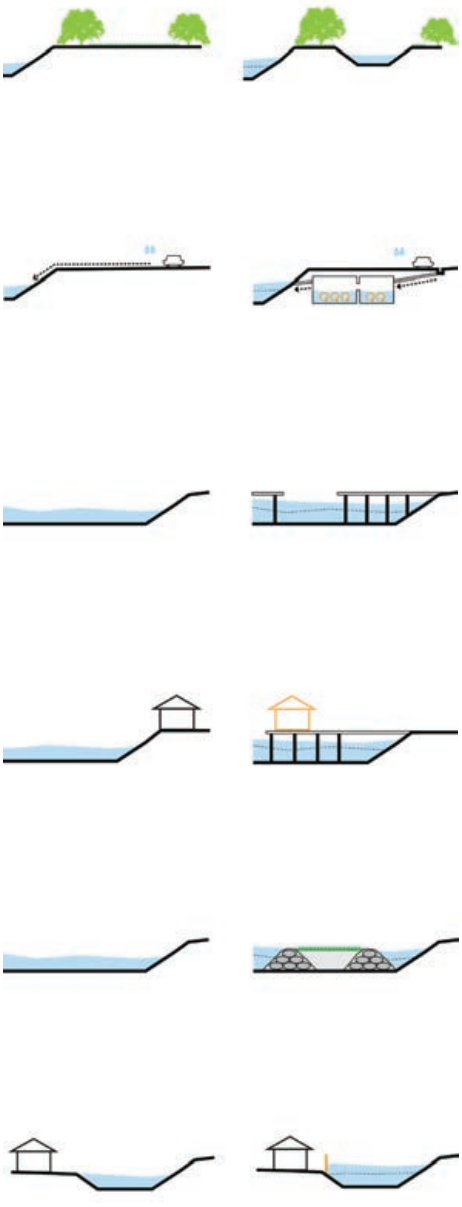
STRATEGY 2
Clean excess rainwater and channel it into the marsh

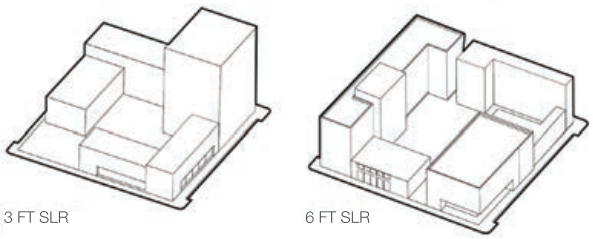
STRATEGY 3
Begin removing all buildings and infrastructure from the foot of the bluff

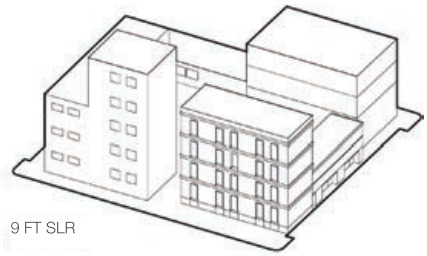
STRATEGY 4
Begin building new fishing port infrastructure out in open water

STRATEGY 5
Create man-made marshes to grow around the edge of the bluff and protect it

STRATEGY 6
Mark and commemorate site of historic Fort King George







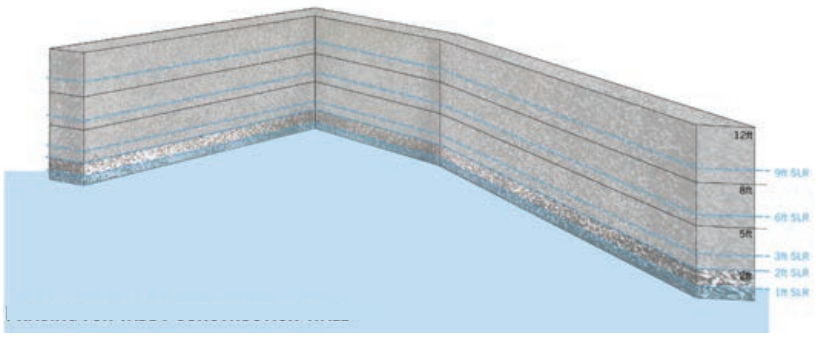
Phasing for Intensity of Land Use

boundary of the fort, approximately a foot above the high tide level. As the sea level rises, the city along with Georgia State Parks can make incremental additions to the wall to keep it at a visible height. The *Blueprints* team suggests to slowly build-up the wall surrounding the fort so it becomes a unique historical feature in the water, particularly attractive for paddlers and other eco-tourists. The site remains in its significant original location but is adapted to changing environments, perhaps bringing a new draw for some tourists.

DEFEND

A full defend approach for the City of Darien considers existing conditions and assumes that the study area should be entirely protected. Full defense alternatives would build up the areas surrounding the bluff further and reinforcing areas of lowlying land. The diagram on page 29 illustrates a complete hardscaped wall around the higher land elevations of Darien, causing significant marsh loss and open water to take over, leaving Darien as a new peninsula. While this maintains some existing property and waterfront development, the marsh fishing industry is lost, along with marsh ecologies and the waterfront greenspace. The cost to employ this technique would be significant and would require regular and upgrades and maintenance.

Transects



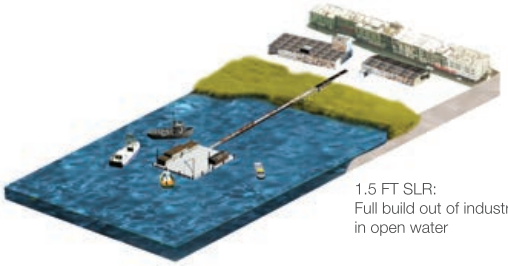
Phasing for Tabby Wall Construction

Rendering of Fort King George with Raised Wall

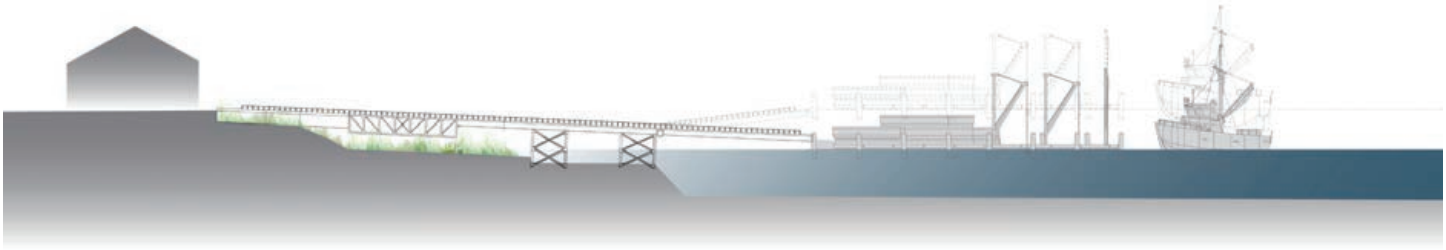
TODAY:
Start moving buildings away from foot of bluff to allow marsh regeneration

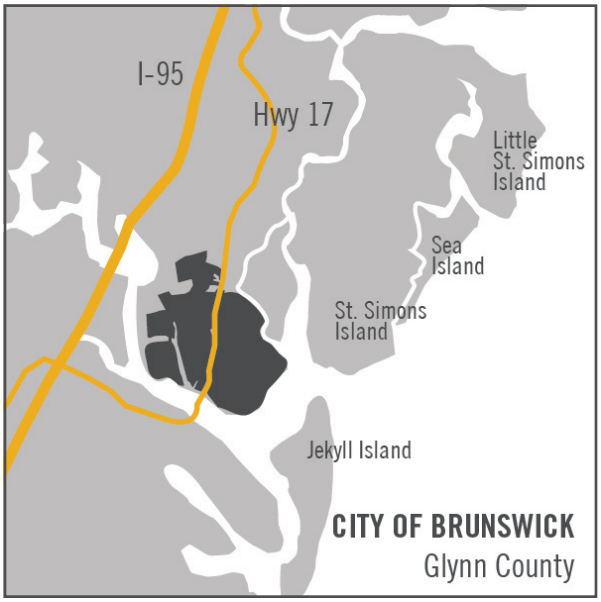
TOMORROW:
Lay groundwork for infrastructure in open water

1 FT SLR:
Have full infrastructure in place for industry



1.5 FT SLR:
Full build out of industry in open water





GEORGIA TECH DESIGN + RESEARCH STUDIO
Alyssa Hutchison, M.Arch/MCRP, Jiawen Wang, MSUD

CITY OF BRUNSWICK

County: Glynn
Area: Approximately 25.2 square miles
Location Type: City

HISTORY AND LOCATION

The City of Brunswick is located in Glynn County, about 80 miles south of Savannah. The city itself is set on a peninsula buffered from the sea by barrier islands. Brunswick is historically a port town, founded in 1771. The city's geography consists of a deep water port (Marine Port) on the west side, marshlands and barrier islands to the east (St. Simons Island, Jekyll Island, Sea Island, and Little St. Simons Island), and an extremely low topography, the lowest city in the state of Georgia with an average elevation of just 10 feet above mean sea level. Highway 17 (Ocean Highway) runs through Brunswick and serves as an evacuation route also from Jekyll Island. There is also a rail line on the port side of the peninsula.

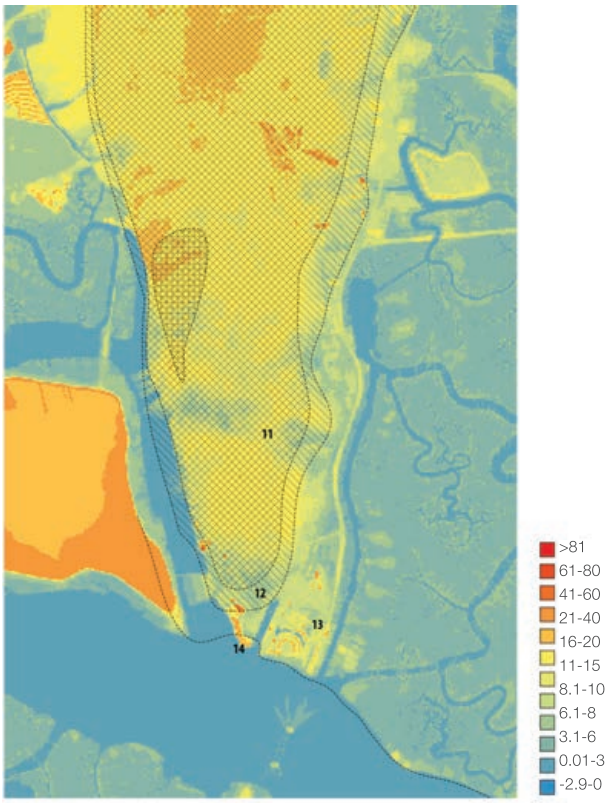
Brunswick's four ports account for about 10% of the roll-on roll-off (ro-ro) cargo in the United States, third behind Los Angeles, CA and Newark, NJ. While Marine Port is located on the peninsula and adjacent to the historical old town, most of the ports are located southwest of Brunswick. Due in part to the port activity, the peninsula of Brunswick is mostly developed, though not at a high density.

PLANNING FOR SEA LEVEL RISE: POTENTIAL IMPACTS

Brunswick currently experiences flooding issues due to its low

elevation and outdated infrastructure. Almost the entire city is within the designated FEMA Flood Plain, meaning that the whole peninsula would be flooded in a 100-year-flood, which has a 1% chance of occurring in a given year. During a 100-year-flood, parts of Brunswick would be inundated with 10 or more feet of water. Because of the FEMA map and coastal hazard assessment, the Flood Insurance Reform Act will significantly affect homes in the area. Current seasonal high tides in Brunswick can be upwards of nine feet above sea level, and storm surge threatens the low elevation areas. Sea level rise will exacerbate both of these existing issues, with the added threat of permanent inundation.

With one to two feet of sea level rise, Brunswick will be relatively untouched by water. However, rising seas will affect the marshes to the east, inundating a precious resource that helps counteract storm surges. Because of this, flooding instances are predicted to be worse because of the low elevation of the city and lack of protective buffers. At three feet of sea level rise, the southern tip of the peninsula is expected to be inundated by water. Four to six feet of sea level rise will significantly impact the city, showing a series of islands forming as water covers the peninsula. This level of sea level rise will hinder the marshes ability to creep, likely causing permanent damage. The long term future of Brunswick without mitigation efforts is illustrated on page 37, with six feet of sea level rise. The proposal developed by this *Blueprints* studio team seeks to creative innovative opportunities from potentially damaging effects, invoking both retreat and defense strategies to help Brunswick adapt to a future of living with water.



Brunswick is the lowest lying city in Georgia with an average elevation of 10ft.

RETREAT

Full retreat assumes the hydrological problems are far too advanced to solve with no viable alternatives present. A full retreat approach assumes that sea level rise and increased storm surges will happen and natural conditions should take over and no more development within the area should occur. As pictured in the sea level rise scenarios above, Brunswick forms into a series of islands based on topography. Populations would need to shift to high ground, with the possibility of connecting the highways through bridges and linking them to existing evacuation routes. The historic old town would need to be abandoned as it is low lying, and retreating the Marine Port could mean a huge economic loss for the city. While the incremental approach of rising seas would allow for these steps to happen incrementally, building new bridges, both traditional and floating would be very costly.

Defense visualization at Brunswick peninsula

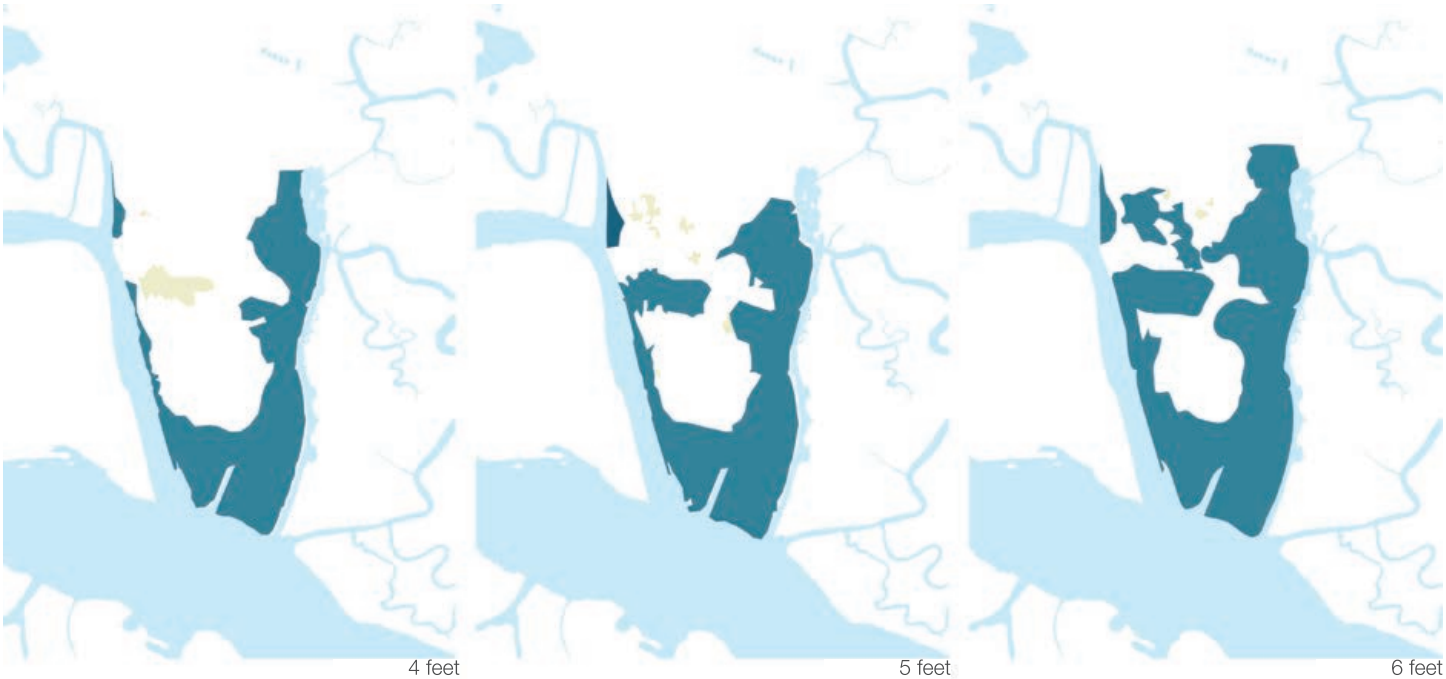
ADAPT

Adaptation assumes that the study area is still viable for some development, provided the proper mitigation efforts and environmental analysis to occur to understand how the site may be used in the future. The options to wholly defend and/or abandon the city are extreme and costly, and possibilities exist to accommodate rising seas.

The City of Brunswick should be prepared to make difficult decisions regarding what is possible and what should be preserved, keeping in mind that the general topography of the area that will dictate many of these decisions. Areas of higher elevation should be evaluated for increasing densities as populations shift and migrate. Once some of these decisions are made, a building moratorium for development in low lying areas should be enacted to protect existing land and buildings. Exclusions to this may include structures on stilts, out of the risk of flooding and inundation, or structures with the ability to float during a storm event or flooding.

The *Blueprints* studio team developed an approach that allows for both defense and retreat options, where the peninsula can accommodate flooding over time and prevent regular flooding events.

Brunswick can adapt to rising sea levels through water canals within existing city blocks. A system of canals allows for a network of water flow to mitigate some of the effects of sea level rise. Subsequently, the dirt taken out of the block structure may then be reused to build up land, helping fortify other blocks from flooding and sea level rise. The use of an entire city block space is necessary because of the extreme range in tidal heights on the Georgia coast. From season



to season, daily tides can have a six foot difference. A narrower canal would not be able to accommodate this large flux of water; a wider canal would better handle a range of inflow. Through the loss of the blocks, connectivity would be necessary by lining the canals with sidewalks and providing bridge access over them. At times of high tide, boats can come into the city through the flooded canal waterways. At lower tides, the canals may become public spaces or gardens. Floating houses can be attached to the “main” islands, connected by floating walkways.

Planning ahead for the locations of designated canals and high spaces will allow Brunswick to begin to strengthen itself today and plan for a future with an uncertain time frame.

DEFEND

A full defend approach for the City of Brunswick considers existing conditions and assumes that the study area should be entirely protected. Full defense alternatives would protect the entire peninsula, essentially creating a hardscaped wall surrounding the city. Since the port side is already a retaining wall, this west side would mostly need reinforcement to accommodate higher waters, and so the port could maintain functionality. The marsh side on the east has some natural protection from the highway, but portions of this highway may need to be temporarily elevated for flooding situations before a more permanent alternative is developed. Armoring around the peninsula would protect the historic town and downtown properties, but the marsh surrounding it may die from higher elevations of water. This would be an extremely costly expenditure for the city because of the cost of the wall as well as needed infill on the land.

Retreat visualization at Brunswick peninsula

Incremental Adaptation 1 foot SLR

2 feet SLR

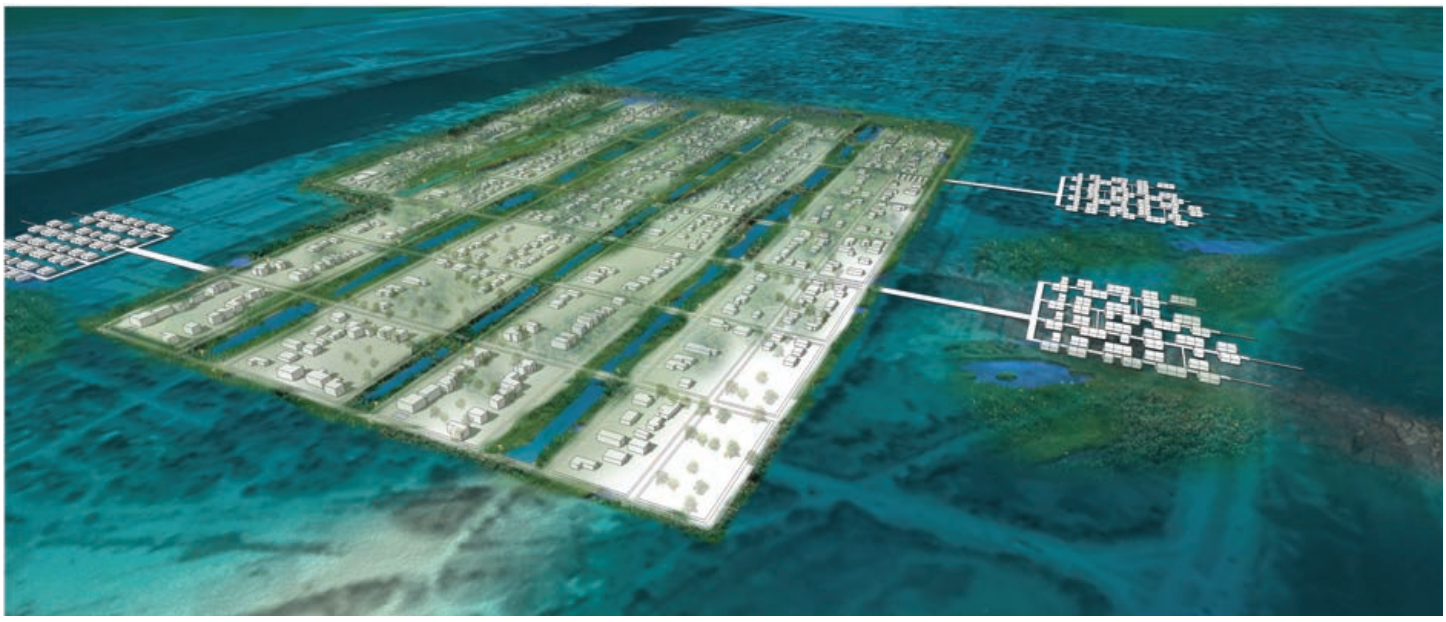
3 feet SLR

Canal and park space on Brunswick peninsula

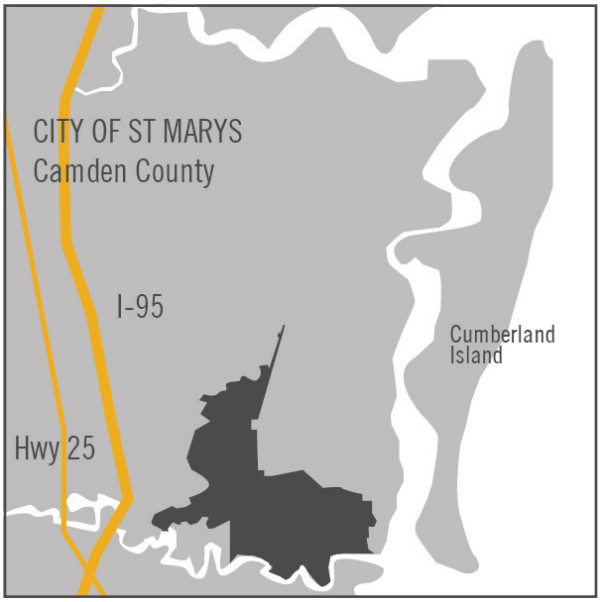
4 feet SLR

5 feet SLR

6 feet SLR



Brunswick Historic District



GEORGIA TECH DESIGN + RESEARCH STUDIO
Johnny Aguilar, M.Arch/MCRP, Daniel Alhadeff, M.Arch/MCRP, Justin Wallace, M.Arch

CITY OF ST. MARYS

County: Camden
Area: Approximately 24.9 square miles
Location Type: City

HISTORY AND LOCATION

The City of St. Marys is along the southern border of Camden County and the State of Georgia, just across the St. Marys River from Florida. The city was founded by Camden County inhabitants who gathered together on Cumberland Island in 1787 and signed a charter to establish the city. Since then, St. Marys has been the gateway to the Cumberland Island National Seashore, the largest of Georgia's coastal barrier islands. The National Seashore's visitor center and boat access are both located on the St. Marys waterfront. The city is also home to the Rock Shrimp Festival, an annual tourist and resident attraction celebrating 45 years in 2015.

The city has grown and expanded upland towards Kingsland, near to the Kings Bay Naval Submarine Base. The historic area of St. Marys along the riverfront is only at a ten foot elevation, susceptible to flooding events and storm surges.

PLANNING FOR SEA LEVEL RISE: POTENTIAL IMPACTS

The most important hydrological issues facing St. Marys are storm surge (both in frequency and intensity), sea level rise (through more water and warmer waters), water quality (due to population and development) and salt water intrusion (into the deep aquifer -

illustrated on page 42). These issues will effect the ecology in St. Marys, but also have economic and built environment impacts. The low elevation of the city will make existing building foundations vulnerable to destabilization, potentially requiring raising, relocating, or demolishing of structures.

The incremental, foot-by-foot visualization of sea level rise (pages 42-43) shows that the impacts of water will affect the entire region. From one to six feet of anticipated sea level rise almost all residential development in Camden County will be either inundated by water, subject to substantial marsh creep or within the ebb and flow of high tide. Within the first four feet of sea level rise, water will submerge the majority of downtown St. Marys and will significantly impact the historic district. Further, Category 1 to 5 storms will potentially inundate the region, exclusive of sea level rise.

The impacts on the city are significant, but it is also important to consider the effects on Cumberland Island, as the barrier island protects and bulwarks the city from significant storms events. Portions of the island are within the 100- and 500-year flood plain, putting it at risk of shrinking in land area at the very least, which could have impacts on the islands capacity for protecting St. Marys may be compromised. There are two historical barrier islands in the landscape - one beneath the base of the city, which is more low lying, and the other lies where St. Marys and Kingsland meet, on higher ground (shown at right).

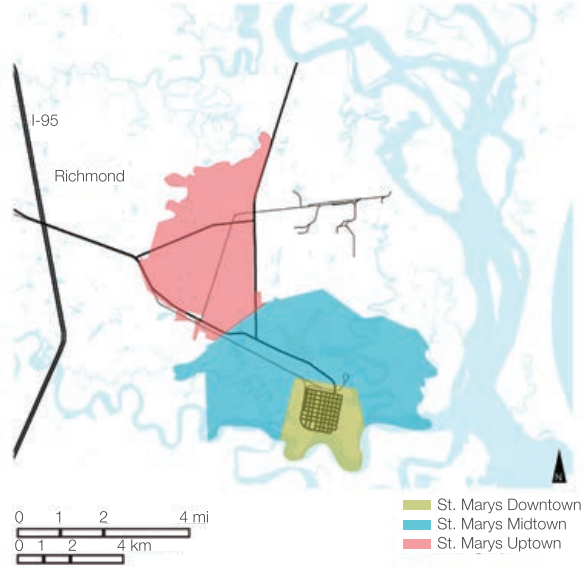
Presently, St. Marys has employed a variety of techniques to address flooding occurrences and evacuation routes, but these alternatives will not protect the city indefinitely.

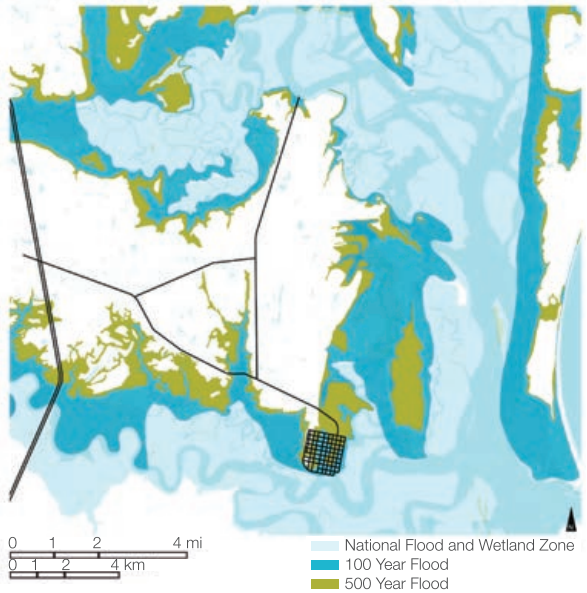
RETREAT

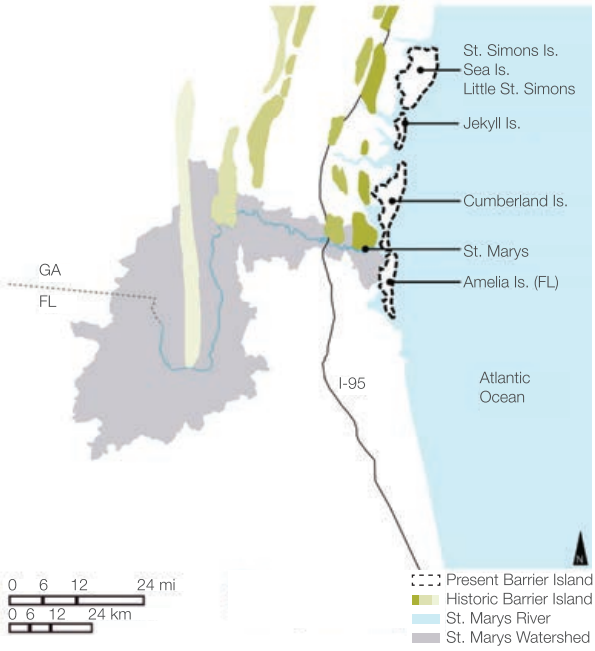
Full retreat assumes the hydrological problems are far too advanced to solve with no viable alternatives present. A full retreat approach assumes that sea level rise and increased storm surges will happen and natural conditions should take over and no more development within the area should occur. In order to fully retreat, the city would be moved to higher ground to protect the buildings and population from potential hazards in the present context. This approach is primarily oriented in the realm of a planning department; incentives would be made to incrementally direct development to higher areas, selectively urbanizing a new area and re-establishing critical infrastructure and civic areas and creating new value for the area. This, in turn, reduces the value of the original sites where development is not appropriate.

ADAPT

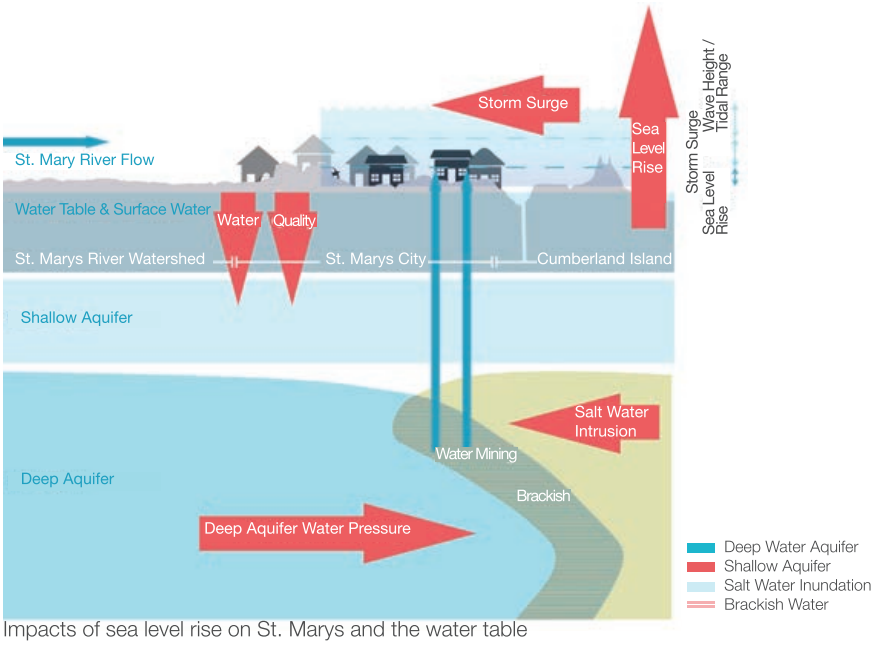
Adaptation assumes that the study area is still viable for some development, provided the proper mitigation efforts and environmental analysis to occur to understand how the site may be



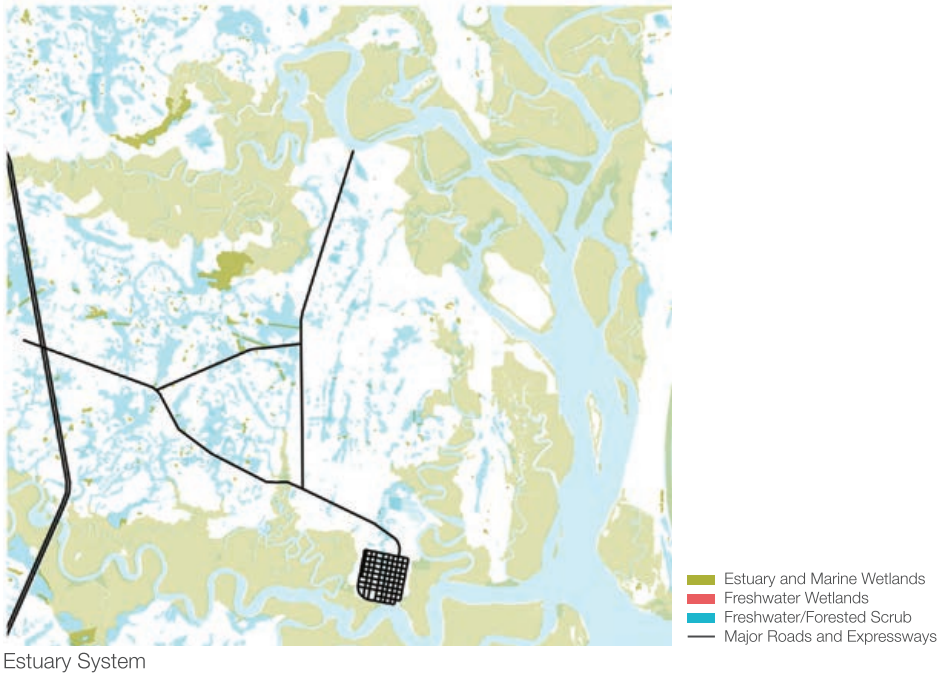




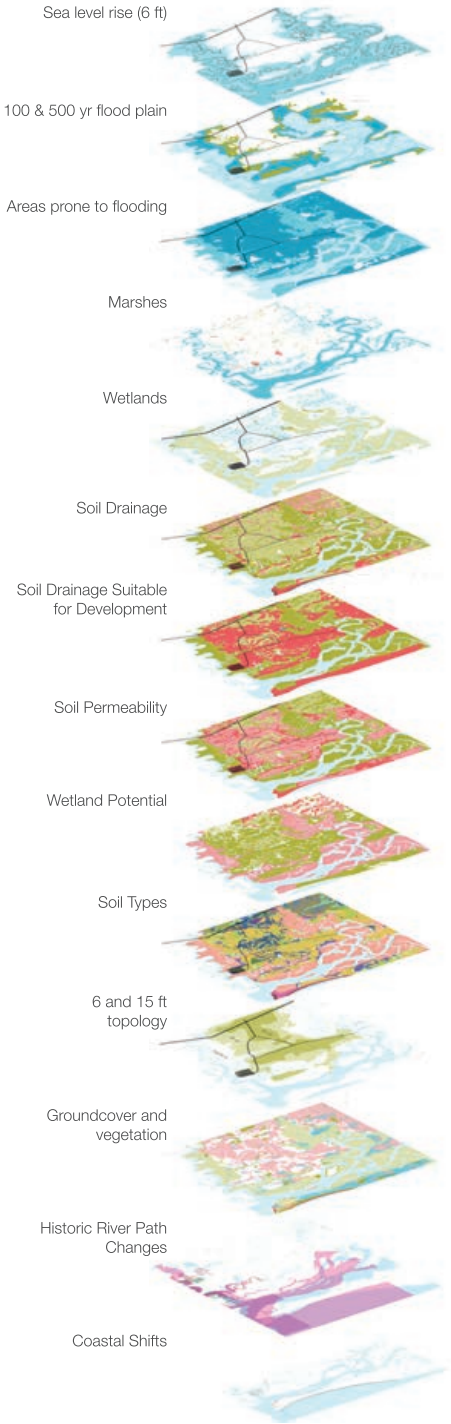
Sea level rise impacts on St. Marys historic structures



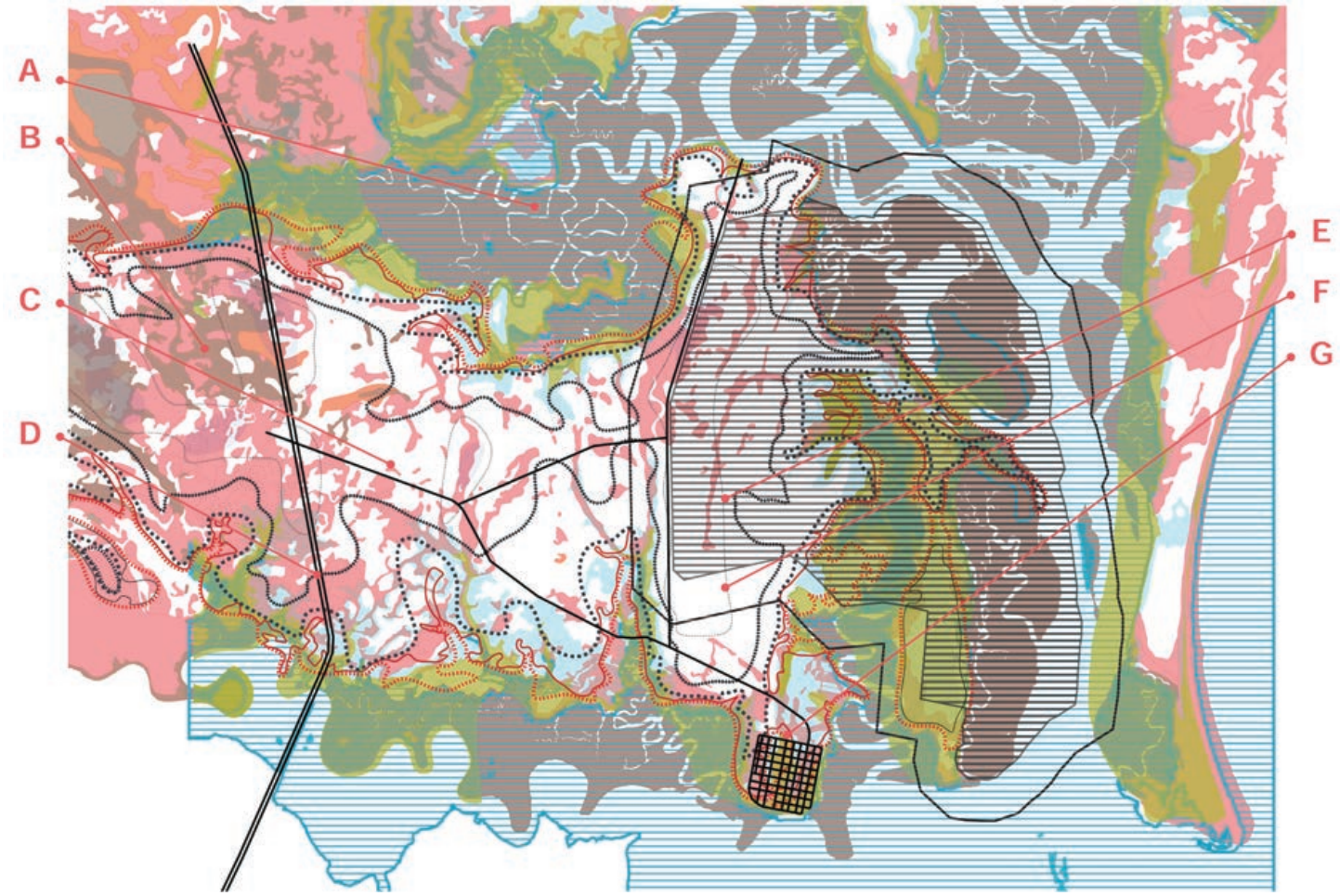
Impacts of sea level rise on St. Marys and the water table



Estuary System



Development Appropriateness and Layer Categories (at right)



A. Marshy/Clayey areas unsuitable for development. These areas have the most chance to convert to open water.
B. Clayey areas of built up sediment that are development poor.
C. Best areas for development. These areas have the fewest or least negative characteristics that would inhibit good development.
D. This is the I-95 North/South Corridor.
E. These areas are good for development but they are part of naval property and cannot be used by St. Marys for redevelopment or retreat.
F. This area is good for development but within the 3,000 naval base buffer zone.
G. This is the present location of St. Marys and has many negatives for continued development.

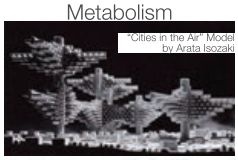
Strategies for Addressing Sea Level Rise

ADAPT — RETREAT — DEFEND

Float and Rise

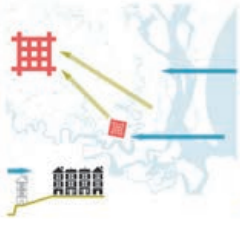
Political Costs: High, Monetary
Initial Costs: High
Maintenance Costs: Moderate
Pros: Anticipate further change
Cons: Politically difficult to do with no visible crisis forcing changes

Metabolism



Political Costs: Cultural, Social
Initial Costs: Moderate
Maintenance Costs: Moderate
Pros: Adapts to future needs
Cons: Culturally and socially hard for citizens to accept

Planned Retreat



Political Costs: High if no impending crisis
Initial Costs: Moderate to High
Maintenance Costs: Low
Pros: Move to area of lowest maintenance/costs
Cons: High initial costs given these usually occur because of a crisis

Urbanize

Political Costs: Cultural, Social
Initial Costs: Moderate to High
Maintenance Costs: Low
Pros: Adapts by creating density in safe areas
Cons: Politically difficult; private ownership issues

Polder Strategy

Political Costs: High, Cultural
Initial Costs: High
Maintenance Costs: Moderate to High
Pros: Can adapt unsafe areas to become safer
Cons: Very expensive; dependent on area being of significant economic or political value

Mound Building

Political Costs: Moderate to High
Initial Costs: Moderate to High
Maintenance Costs: Moderate to High
Pros: Creates area of low maintenance
Cons: Depending on extent, initial costs can be extremely high; high political

Sea Wall

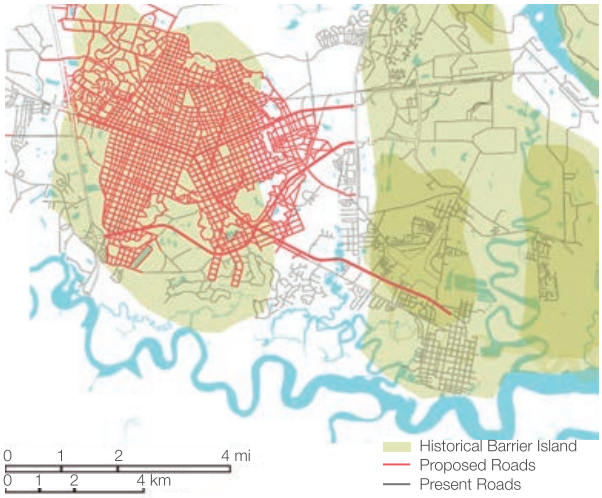
Political Costs: Limited
Initial Costs: Low to High
Maintenance Costs: Low to High
Pros: Lower defense costs than most options
Cons: Can destroy ecosystems/natural processes; area must be economically or politically important

Stanley sea wall, Vancouver, B.C.

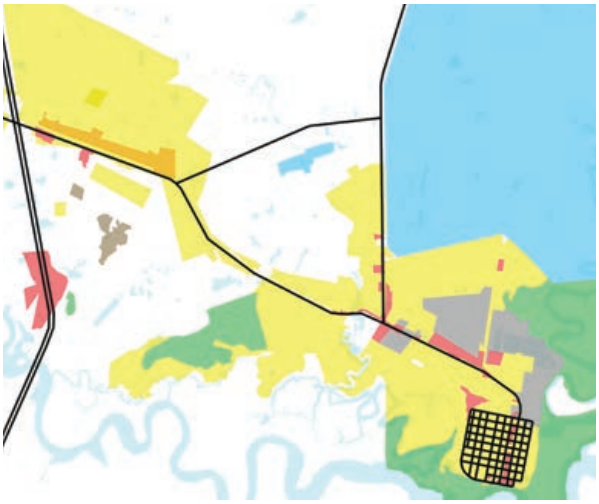
used in the future. The options to wholly defend and/or abandon the city are extreme and costly, and possibilities exist to accommodate rising seas.

In considering the particular approach most appropriate for St. Marys, this *Blueprints* studio team took into consideration the various public, natural, and historic/commemorative factors that need to be addressed, and how prioritizing these may reveal the best approach. The St. Marys historic district will be inundated with four feet of sea level rise. Considering this, it is important for the city to determine what structures should be memorialized, which should be moved, and where and how this should be executed.

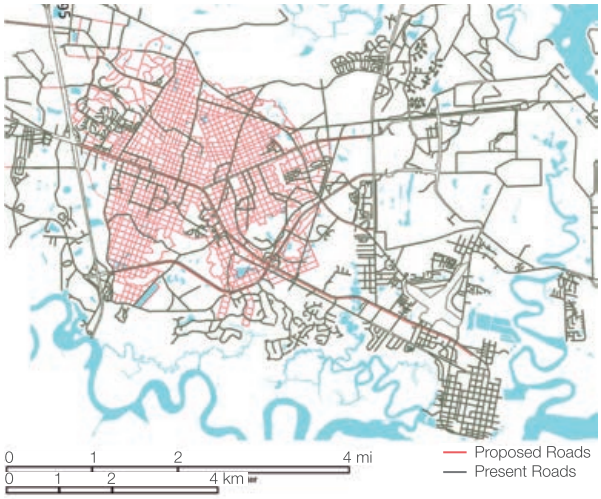
This *Blueprints* studio team created a proposal that is based on foot-by-foot incremental development that considers actually occurring environmental changes. These 'urban moves' address many of the problems that presently exist as well as those problems that may become exacerbated as options are more limited due to increases in sea level, marsh creep, increased storm surges and higher wave action during storm events. These moves are outlined page 45 and address adaptation for the city in several ways including more near-term proposals as well as an assumption of significant rise in sea level, requiring the need for St. Marys to reconsider its historic position on the water and possibly retreat to higher ground. Fortunately, these options can be used in tandem or individually - however we perceive adaptation should utilize all of the proposed methods to be most successful.



Urban Move 1: Build upon previous barrier island.
This area was once a barrier island and contains a soil composition that will be better for drainage and urban development than other areas in the vicinity.

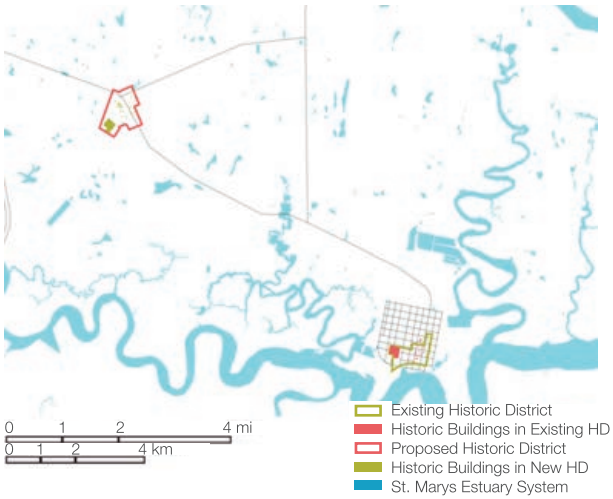


Urban Move 2: Change Land Use priorities to make St. Marys more liveable, walkable and workable. (Present LU shown)
The proposed action also sets in place a flexible land use pattern that will facilitate flexible use, keep maintenance costs down and provide for future expansion.

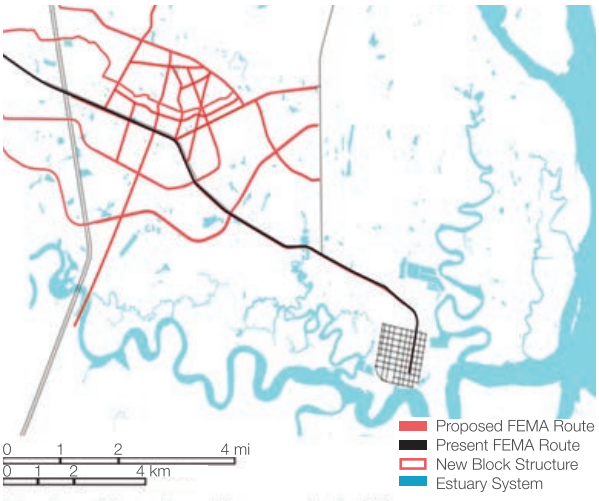


Urban Move 3: Integrate Present and Proposed Streets
Future streets and expressways will take present parcel lines and streets into consideration. The new streets will integrate older streets, open cul-de-sacs, and create more effective circulation.

Urban Move 4: Coordinate block structure around existing estuary system and utilize this system for carrying water.



Urban Move 5: Relocate historical buildings to new center.
As the historical downtown area is threatened by inundation, moving historic structures to higher land in the middle of the proposed development will help maintain St. Marys' connection to its history and civic spaces.



Urban Move 6: Expand FEMA Emergency options.
By further expanding and integrating circulation and transport system, more east/west corridors are creating allowing people multiple routes of emergency above the 16 foot storm line.

Relocated St. Marys Phases of Development

Phase One

Phase Two

Phase Three

Phase Four

Phase Fix

Phase Six

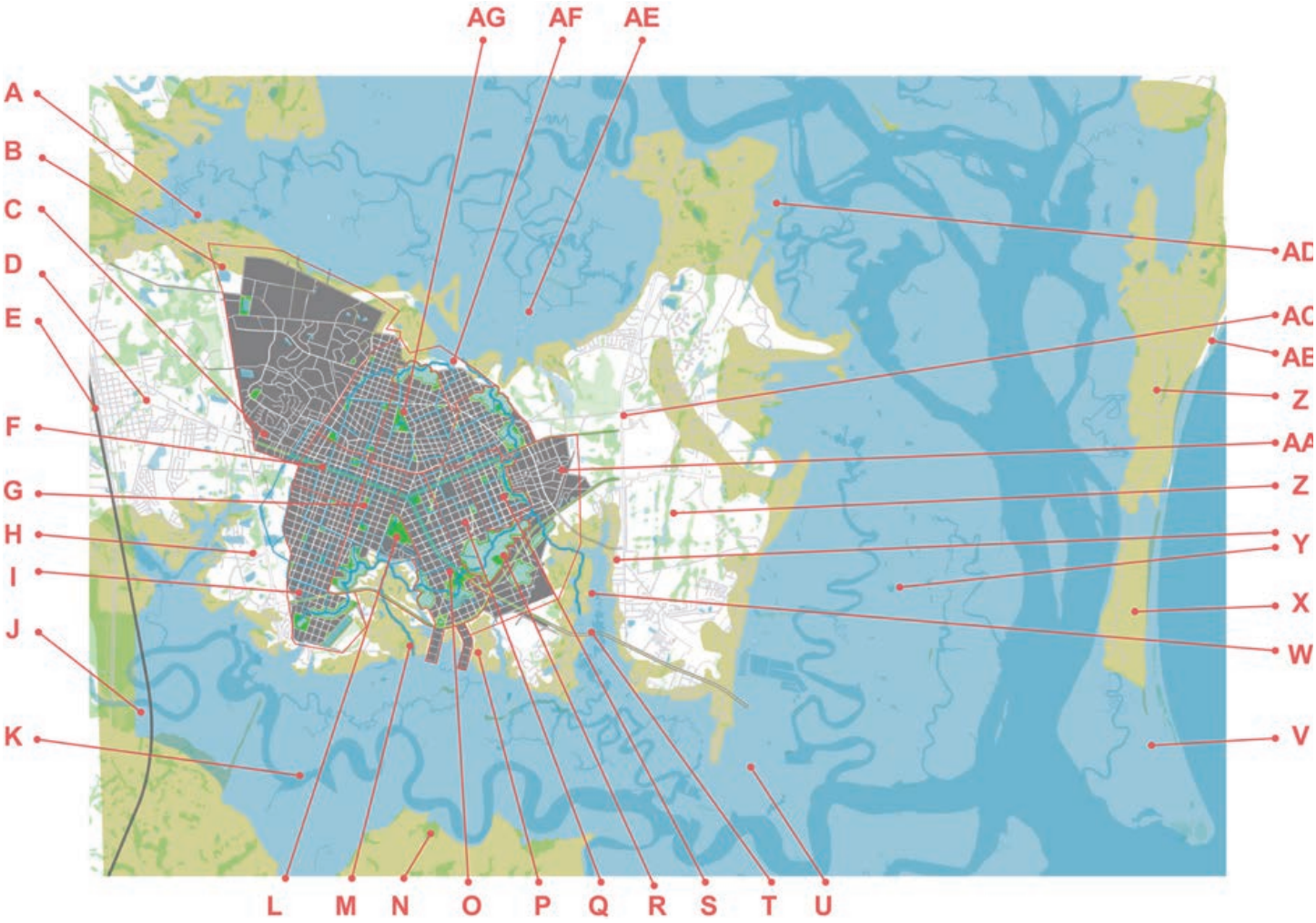
In order to phase these approaches, civic buildings and public spaces should be the first integrated into the newly planned area for St. Marys. Because the present historic district is on the lowest lying property in St. Marys, those buildings with historic significance should be relocated to the new land. These buildings should be place in a pattern that carefully considers historical context and of memorializing of the existing layout.

The team proposal recognizes that environmental changes will happen incrementally, so major changes should occur as needs arise, while taking into consideration the next phase of development. The first phase of development is in the creation of a new city center, establishing mixed-use commercial streets, a compact urban framework integrating streets and block, sets the first phase for a new wharf, creates the initial phases of a water delivery and water quality system and sets historic buildings in the new center. In short, this phase is creating a new urban core that will function on its own but be able to integrate future phases of development. Further, each phase of development has to set up the infrastructure changes and needs of the next stage so that as the following phase occurs, the infrastructure changes have already taken place to make the next 'development ready'.

The realized plan occurs when the remaining neighborhoods become developed and integrated within the larger city, and as previously developed areas are inundated with water on a foot-by-foot basis. The result is a fully developed and centralized city that can accommodate present residential and commercial populations while anticipating future changes.

DEFEND

A full defend approach for the City of St. Marys considers existing conditions and assumes that the study area should be entirely protected. Full defense alternatives would protect the entire peninsula, essentially creating a hardscaped wall surrounding the city and blocking off the surrounding marshland. However, as discussed in previous site areas, sea level rise is an ongoing situation, and walls can only be built so high to stave off water. Some strategies include combining large dikes with water removal, mound building and raising land in large areas, sea walls that protect land behind the wall but destroy beaches and marshes, and a delta, which protects against surges and high tides while also allowing for modulation between the environment and protected areas. As can be imagined, these options are generally the most expensive in proportion to the area being protected and require constant and costly maintenance.



Realized Development Plan for the Relocated St. Marys

A. Water inundates the North/South I-95 Corridor

B. Development option 7e

C. Center park area, functions as main transit, city park, water delivery system, and trolly corridor

D. Parts of Kingsland inundated while it survives

E. Georgia Highway 17 still viable North/South Corridor

F. Development section 7a

G. Development section 4

H. Water delivery system canal

I. Development section 7c

J. Section of Georgia Highway 17 inundated

K. Original course of river, now the water inundates the original marshes and creates a larger bay

L. City cemetery graves moved from St. Marys

M. Canal serves as a recreation, water delivery and retaining area within estuary system

N. High areas on Florida become inundated by define south of St. Marys River

O. Development section 1

P. Dock area functions as a wharf for new ferry transport

Q. Development section 2

R. Main system of lakes which function as water retention, detention and delivery system

S. Development section 3

T. Main corridor of present St. Marys inundated with water

U. St. Marys Historic downtown inundated with water

V. Original barrier island inundated; area vulnerable to sea storms and wave action

W. Park system part of water retention and delivery system

X. Marshes occupying most of remaining Cumberland Island land

Y. Areas with high development in St. Marys now inundated

Z. Developable land within the Naval base and in the buffer zone

AA. Development section 7d

AB. Limited protection from sea because most of Cumberland Island is now underwater

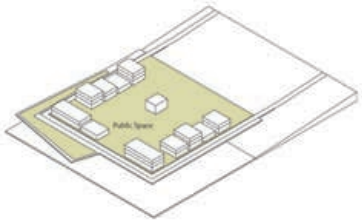
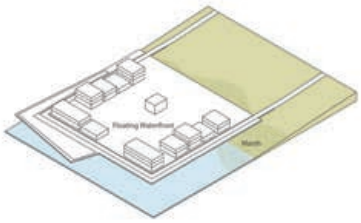
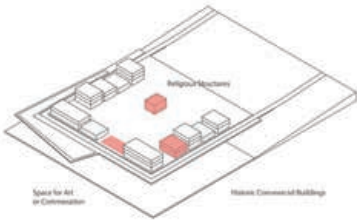
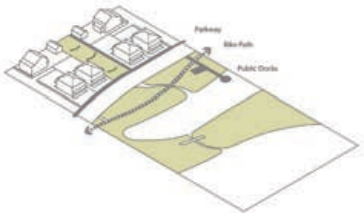
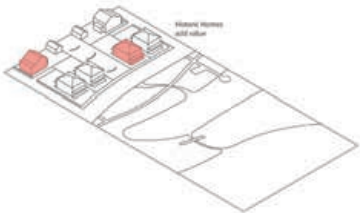
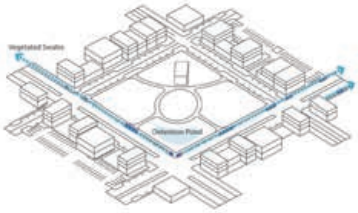
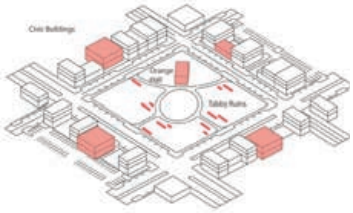
AC. Original streets integrated into framework

AD. Portion of Kingsland Naval Base inundated

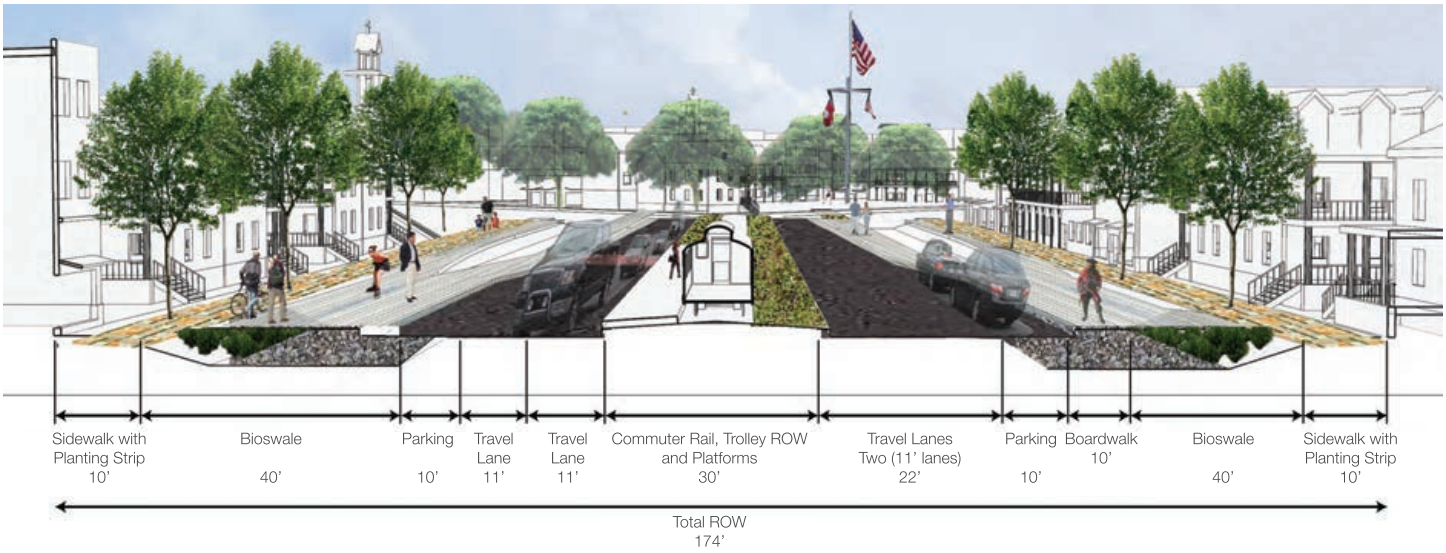
AE. Large development area inundated by water as marshes creep

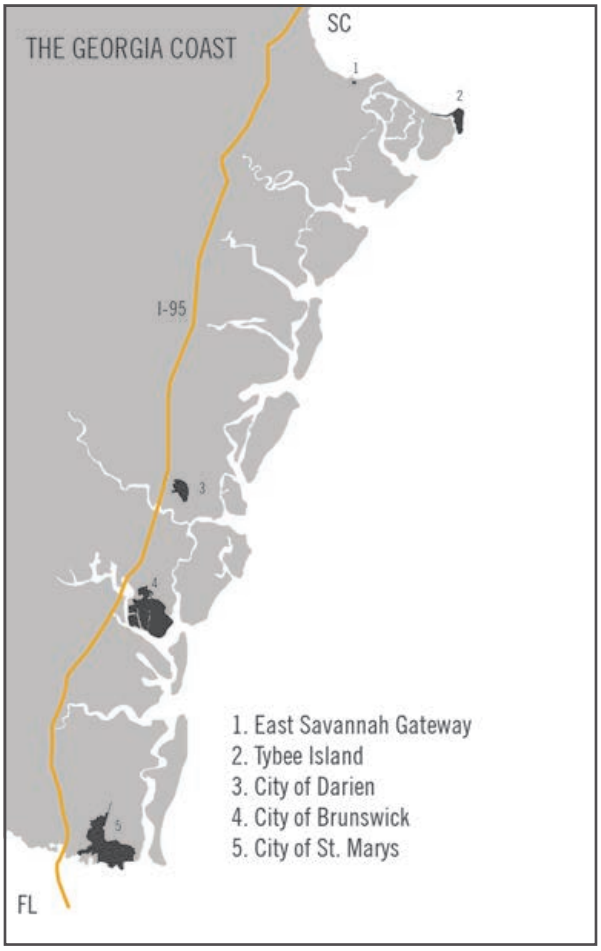
AF. Estuary inlet which connects various created lakes into the larger estuary system

AG. Large development area inundated with water becoming a possible area for docks and water recreation.

	PUBLIC SYSTEMS	NATURAL SYSTEMS	HISTORICAL/ COMMEMORATIVE SYSTEMS
WATERFRONT CONDITION			
	fill or defend	*adapt to location*	*raise and protect*
EDGE CONDITION			
	parks or civic needs	*water quality, retention, detention*	*value add of historic homes*
TOWN SQUARE CONDITION			
	center square as greenspace/park	*direct and hold water*	*face historic buildings inward*

Proposed Boulevard Section





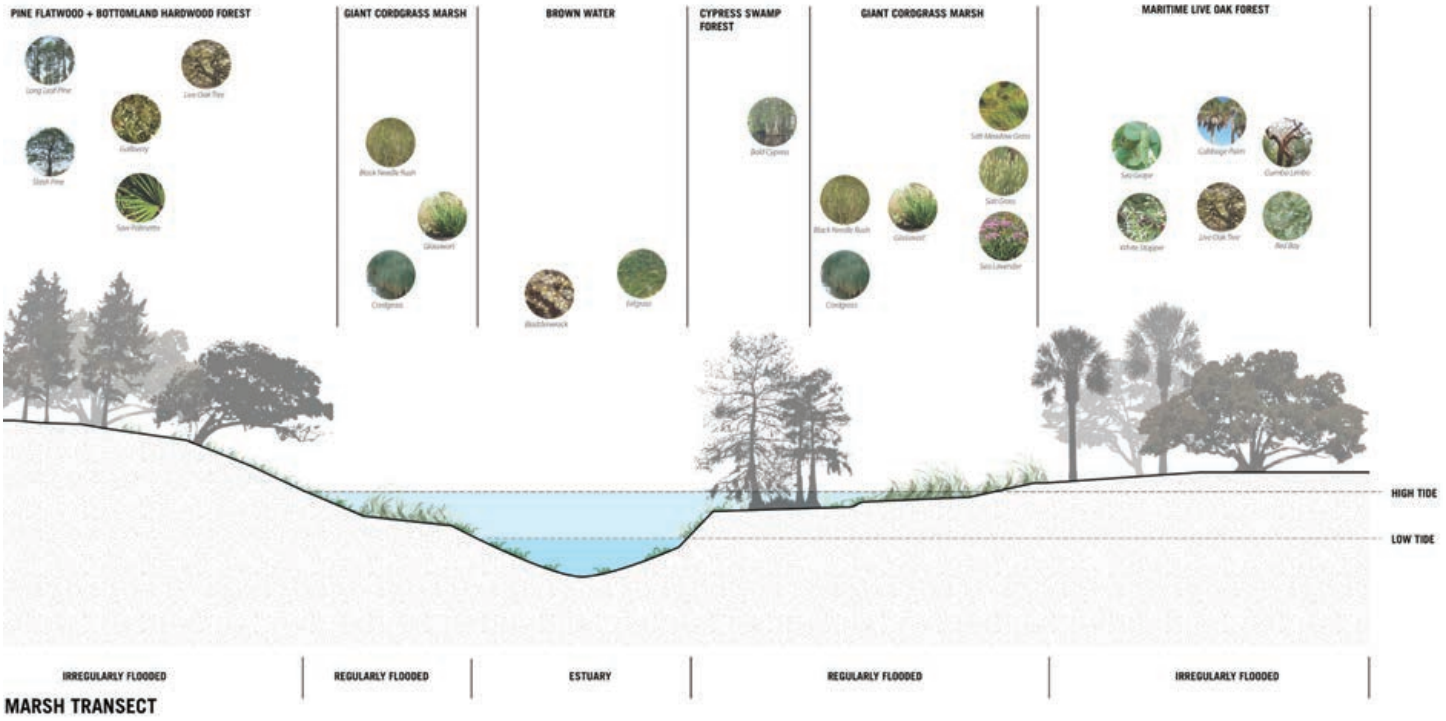
CONCLUSIONS

THINK IN FEET, NOT YEARS

Several decades of empirical evidence demonstrate that sea levels are rising. The scientific community projects possible sea level increases over a certain number of years – two to three feet in 80 years. But time is elastic – sea levels will rise, but we do not know how much in what period of time. Urban design, planning and civil engineering must anticipate and design for sea level rise foot by foot, not feet in time.

PRIORITIZE ECOLOGY

Ecological conditions of coastal areas, not protection of property values, should guide all decisions on the Georgia Coast. Different decisions may be made in other coastal situations – South Florida or Manhattan, for example. The Georgia Coast is ideally suited for ecology to come first because of its ability to mitigate and adapt to sea level rise. In all coastal areas, urban design, planning and civil engineering design strategies should be based on long term retreat, to allow the ecology to mitigate rising seas, tidal events, and storm surge.



MARSH TRANSECT

MAKE INCREMENTAL MOVES

Given that time is elastic and ecological protection is paramount on the Georgia Coast, design strategies should be incremental. One foot. Two feet. Three feet. And so on. This can anticipate both gradual and catastrophic rise. As property values and real estate taxes decline in coastal areas, investments need an incremental approach to defend, to adapt, and to retreat. Major defensive infrastructure investments are unwise. Similarly, major investments to retreat are unwise. Incremental adaptation along the Georgia Coast should be the first aim.

BLUEPRINTS PRINCIPLES

Maintain and enhance quality of life for residents of the community

Employ regional strategies for transportation, land use, and economic growth

Consider the effect of the built environment on the natural environment as well as history and culture

Employ efficient land uses

Blueprints for Successful Communities is an education and technical assistance program of the Georgia Conservancy designed to facilitate community-based planning across the state. The program is committed to achieving successful communities by creating sound conservation and growth strategies, and building consensus for action.

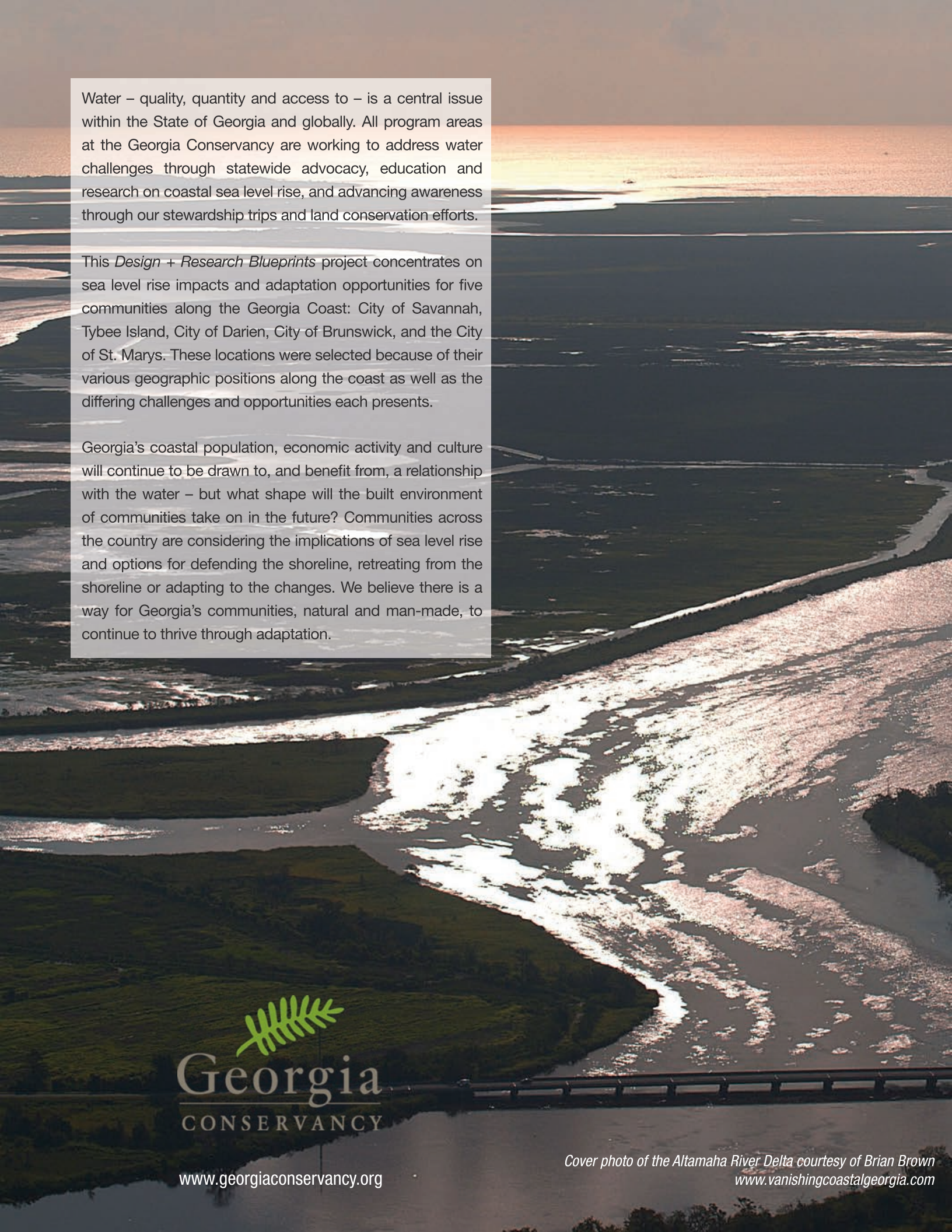
Georgia is home to an abundance of natural and cultural resources. Our development patterns over the last 50 years present a very real threat to these resources and to quality of life as a whole. Sprawling, decentralized development, where people must depend on automobiles, is expensive for local governments to serve and has a staggering effect on the environment. Vehicle emissions create toxic air pollution. Stormwater runoff from asphalt poisons rivers and streams. Thousands of acres of farms, woodlands, and open space are lost to wasteful, non-sustainable forms of development.

The Georgia Conservancy in partnership with the Urban Land Institute and the Greater Atlanta Homebuilders hosted its first Blueprints for Successful Communities symposium in 1995. Currently the Conservancy maintains an active partnership with thirteen organizations. These diverse organizations and their members provide a great deal of understanding and expertise in the relationships that exist between land use, public infrastructure, economic growth, and environmental quality.

Prior to this *Design + Research* effort, *Blueprints* has addressed multi-jurisdictional watershed planning, heritage corridor preservation, location of commuter rail stations, inner city neighborhood issues, coastal sea level rise research and other planning opportunities all through a collaborative planning process.

Georgia Conservancy Blueprints Partners

American Council of Engineering Companies of Georgia
American Institute of Architects - Atlanta Chapter
American Society of Landscape Architects - GA Chapter
Association County Commissioners of Georgia
Atlanta Neighborhood Development Partnership
Atlanta Regional Commission
Georgia Institute of Technology - College of Architecture
Georgia Municipal Association
Georgia Planning Association
Institute of Transportation Engineers
Southface Energy Institute
Urban Land Institute - Atlanta District Council
U.S. Green Building Council - Georgia Chapter



Water – quality, quantity and access to – is a central issue within the State of Georgia and globally. All program areas at the Georgia Conservancy are working to address water challenges through statewide advocacy, education and research on coastal sea level rise, and advancing awareness through our stewardship trips and land conservation efforts.

This *Design + Research Blueprints* project concentrates on sea level rise impacts and adaptation opportunities for five communities along the Georgia Coast: City of Savannah, Tybee Island, City of Darien, City of Brunswick, and the City of St. Marys. These locations were selected because of their various geographic positions along the coast as well as the differing challenges and opportunities each presents.

Georgia's coastal population, economic activity and culture will continue to be drawn to, and benefit from, a relationship with the water – but what shape will the built environment of communities take on in the future? Communities across the country are considering the implications of sea level rise and options for defending the shoreline, retreating from the shoreline or adapting to the changes. We believe there is a way for Georgia's communities, natural and man-made, to continue to thrive through adaptation.

Georgia
CONSERVANCY

www.georgiaconservancy.org

Cover photo of the Altamaha River Delta courtesy of Brian Brown
www.vanishingcoastalgeorgia.com