

ABSTRACT

Title of Thesis: THE EFFECTS OF SEA LEVEL RISE
ON HISTORIC DISTRICTS AND THE
NEED FOR ADAPTATION

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Shoreline communities are unprepared for the increasing effects of sea level rise hazards on the built environment. As a result, Atlantic Coast historic properties reflecting cultural heritage face degradation or destruction. Numerous scientific studies project that sea level rise will likely inundate shorelines, increase the frequency of flood events, and augment wave damage from severe storms. These natural occurrences worsened by sea level rise could diminish a community's identity and quality of life, often represented by National Register historic districts. To minimize the threat, strategies to adapt to sea level rise can offer protection for communities and their irreplaceable historic resources.

To determine a course of action, my thesis question is: How can hard, soft, and non-structural adaptation methods be applied to protect the cultural heritage of National Register historic districts from the impacts of sea level rise? English Heritage, the

Mississippi Development Authority, and the 1000 Friends of Florida provide helpful insights into methods used to protect historic resources from flooding, storm surge, and erosion—the effects of sea level rise. Additionally, the case study cities of St. Augustine, Florida; Elizabeth City, North Carolina; and Alexandria, Virginia, furnish examples of National Register historic district vulnerability to sea level rise and of adaptation methods addressing current natural hazards. My research findings indicate that adaptation methods can protect historic properties, but may also impact their historic integrity. I discover that the historic preservation community is largely uninvolved in the adaptation planning process. Without an advocate, historic properties on low-lying shorelines face an uncertain future by the year 2100 and beyond.

My findings and recommendations include the importance of adaptation planning at the local level and the urgent need for preemptive adaptation implementation. To ease the political, social and economic obstacles associated with adaptation planning, local decision-makers and stakeholders must be educated on sea level rise science. State legislative endorsements are also necessary for municipalities to successfully implement a broad range of adaption strategies. It is essential that state and the federal governments offer technical and financial support to localities as sea level rise intensifies. Most critically, the historic preservation community must campaign for historic property protection that will also preserve historic integrity. The country's coastal heritage and identity are at stake.

Subject Headings: Atlantic Coast historic districts; sea level rise effects on historic properties; flooding in historic districts; climate change adaptation in historic districts; historic districts and quality of life; St. Augustine, Florida, historic districts; Elizabeth City, North Carolina, historic districts; Alexandria Historic District.

THE EFFECTS OF SEA LEVEL RISE ON HISTORIC DISTRICTS
AND THE NEED FOR ADAPTATION

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Thesis submitted to the Faculty of Goucher College in partial
fulfillment of the requirements for the degree of

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CHAPTER IV ATLANTIC COAST CASE STUDIES

Introduction to the Case Studies

To varying degrees, each of the case study cities—St. Augustine, Florida; Elizabeth City, North Carolina; and, Alexandria, Virginia—currently apply adaptations to mitigate flooding, erosion, and storm surges. Due to low-lying locations along Atlantic Coast estuaries, they are vulnerable to the projected effects of sea level rise. The natural hazards these cities face today will worsen as sea level rise incrementally reaches one meter (3.3 feet) by 2100.

As some of the earliest settlements along the Atlantic Coast, the case study sites include historically and culturally significant properties representing early development in the United States. Historic districts have been documented in each city and are listed in the National Register of Historic Places. All representative historic districts prominently define the areas' characters, contributing to quality of life.

I document the development history of each case study city and describe the character of the historic districts. The chapter continues with an analysis of current risks that impact the historic districts. Projected, future risks to the historic districts are mapped for 2050 at approximately 42 centimeters (1.4 feet) and for 2100 at one meter (3.3 meters). Each case study evaluation concludes with an examination of implemented and proposed adaptations and the decision-makers and stakeholders involved.

St. Augustine, Florida

St. Augustine, Florida is the oldest, continuously occupied European settlement in the country. The city is located on a peninsula on the northeast shore of Florida in St. Johns County, between Jacksonville and Daytona Beach. The Spanish settled on the western shore of the tidal Matanzas River in 1565, partially sheltered from the open ocean by the Anastasia Island barrier beach. (Fig. 17) The tidal San Sebastian River



Fig. 17: Looking westward at St. Augustine, Florida. The star-shaped structure on right is the Castillo de San Marcos. The historic Bridge of Lions in the center crosses the Matanzas River, connecting to St. Augustine to Anastasia Island. Maria Sanchez Lake is on the right in the middle of the peninsula. [Google Earth; St. Augustine aerial photograph, December 17, 2011]

borders the city to the west. The city is exposed to frequent flooding, storm surges, and coastal erosion due to its low-lying elevation and proximity to tidal rivers. Sea level rise will intensify these tidal effects. Seven historic districts are located within the city limits, all potentially susceptible to sea level rise.

The history of St. Augustine is divided into four eras, referring to the countries

that governed the city through the years. These periods are the Spanish Colonial, the English, the second Spanish, and the American. The people of each country, joined by immigrants from Europe and Africa, left their cultural marks on the community, creating a cosmopolitan city by the end of the second Spanish era in 1821.¹¹⁸

The Spanish Colonial period begins with Pedro Menendez de Aviles leading a Spanish fleet to the New World and establishing St. Augustine as a military base in 1565. The city was strategically placed to defend Spain's southern territories from the British who had settled to the north.¹¹⁹ In addition to being a strategic military location, the city was founded as a trading center and a mission.

Free blacks settled at Fort Mose, northwest of St. Augustine's colonial city, during the sixteenth, seventeenth, and eighteenth centuries. Spain acknowledged their freedom as long as they joined the Catholic Church.¹²⁰ Fort Mose was the first legal African American settlement in the United States.¹²¹ (Fig. 18)

Between 1573 and 1586, St. Augustine's colonial city was designed according to guidelines established by the Laws of the Indies, a Spanish planning code derived from Roman principles. A centrally located rectangular plaza emanated from four major, corner streets. The plaza was the center of all community activities. Civic and religious institutions bordered the plaza enclosed by King and Cathedral streets. The plan was flexible for growth, allowing for expansion from the central plaza.

Because of its geographic location, St. Augustine did not measurably expand and prosper. Development was confined to the narrow parameters of the peninsula and to the town plan. The placement of the Castillo de San Marcos to the north and the monastery

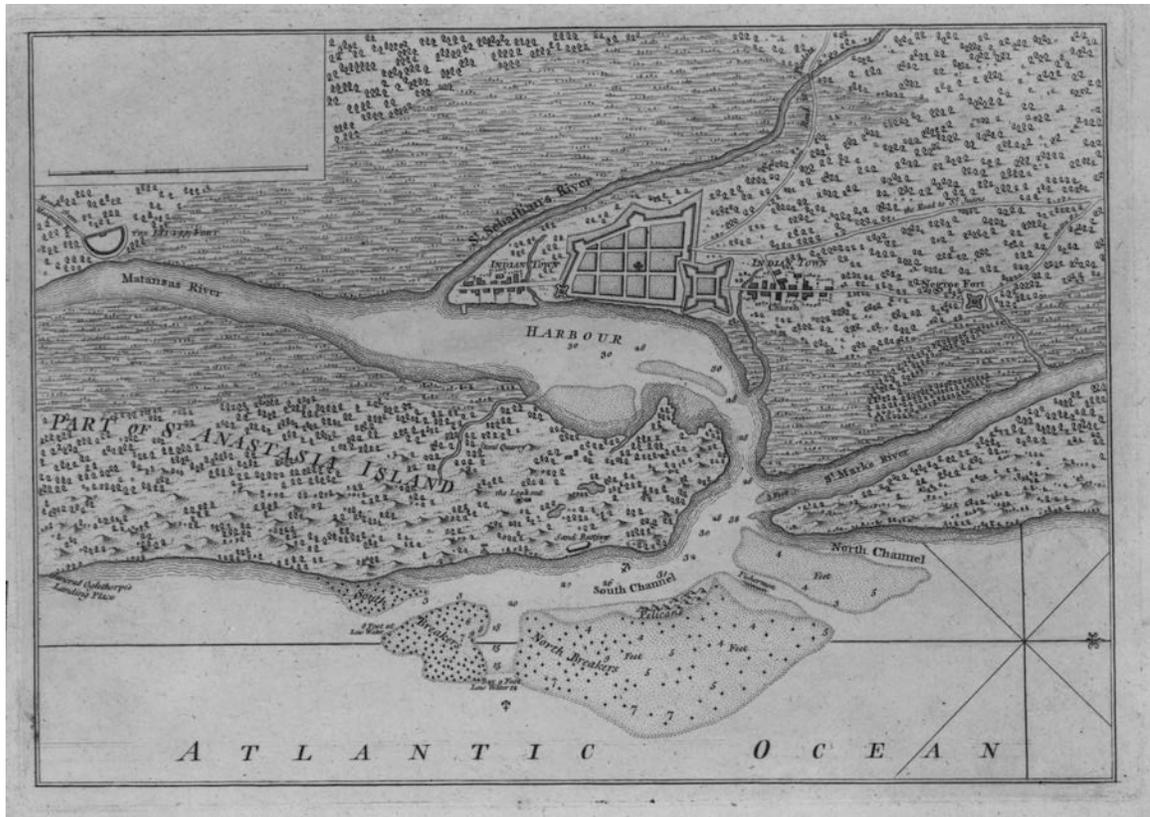


Fig. 18: The walled St. Augustine Town Plan District, a National Historic Landmark, represents the city's colonial heritage. The monastery, now St. Francis Barracks, is located at the southeast corner with the star-shaped Castillo de San Marcos at the northeast corner. The African American settlement, Fort Mose, is labeled as "Negro Fort" to the city's north. [Thomas Jeffery, Library of Congress Geography and Map Division; plan of the town and harbor of St. Augustine, circa 1762]

to the south created obstacles to development. (Figs. 19, 20) The shallow harbor and shifting barrier beaches made the harbor difficult to navigate for trading ships.

Consequently, the success of a port economy eluded the city, forcing the Spanish to subsidize the settlement.¹²²

The colonial years were marked by frequent conflicts between warring colonizers wishing to expand territorial command in the New World. The British and Native Americans fought with the Spanish settlers, periodically attacking the town. As the Carolina colonies strengthened under British rule, the Spanish fortified St. Augustine's



Fig. 19: The Castillo de San Marcos, a NPS site, is located at the northern border of the St. Augustine Town Plan Historic District, overlooking Matanzas Bay. [Ann Horowitz; photograph, January 2013]



Fig. 20: A monastery and missionary first occupied this site in 1577. St. Francis Barracks was constructed between 1724-1755. It faces the Matanzas River at the southern end of the St. Augustine Town Plan Historic District. Since the British period, the building has been used for military purposes. The Florida National Guard is stationed here today. [Google Earth; street view photograph, 2013]

military strength by building a massive coquina stone fort, the Castillo de San Marcos, beginning in 1672. After the British destroyed the city in 1702, the settlement was walled to the north, west, and south.¹²³

The Spanish recognized the need for protection from the sea as early as 1599 when a severe storm damaged the early settlement. The first seawall was constructed between 1596 and 1602 of wooden trees that were three-inches (7.6 centimeters) in diameter.¹²⁴ After that deteriorated, Florida governor Don Diego de Quiroga y Losada wrote to the King of Spain in 1690 requesting funding for a new seawall. He proposed “building a wall the whole length of the City along the sea, seeing the danger in which it now is of being ruined by floods from the sea (which already comes up to the houses) when we have the slightest storm.”¹²⁵ Spain financed the second seawall, constructed of coquina stone between 1694 and 1705. As this seawall decayed, the United States government funded a replacement built from 1836 to 1842.¹²⁶ (Fig. 21) Currently, the rehabilitation of the nineteenth century seawall is under construction.

After the Seven Years’ War in 1763, the Spanish traded Florida for Cuba with the British.¹²⁷ The British period in St. Augustine lasted until 1784 when the British traded the city again with Spain for the Bahamas. The second Spanish period lasted until 1821 when Spain ceded Florida to the United States in 1821. Florida became a state in 1845.¹²⁸

As part of the United States, St. Augustine gradually attracted tourists from the north due to its mild weather and unique European character. The Union Army enlisted the Castillo as a military base during the Civil War, renaming it Fort Marion. After the war, land was slowly developed outside the city’s colonial boundaries. African

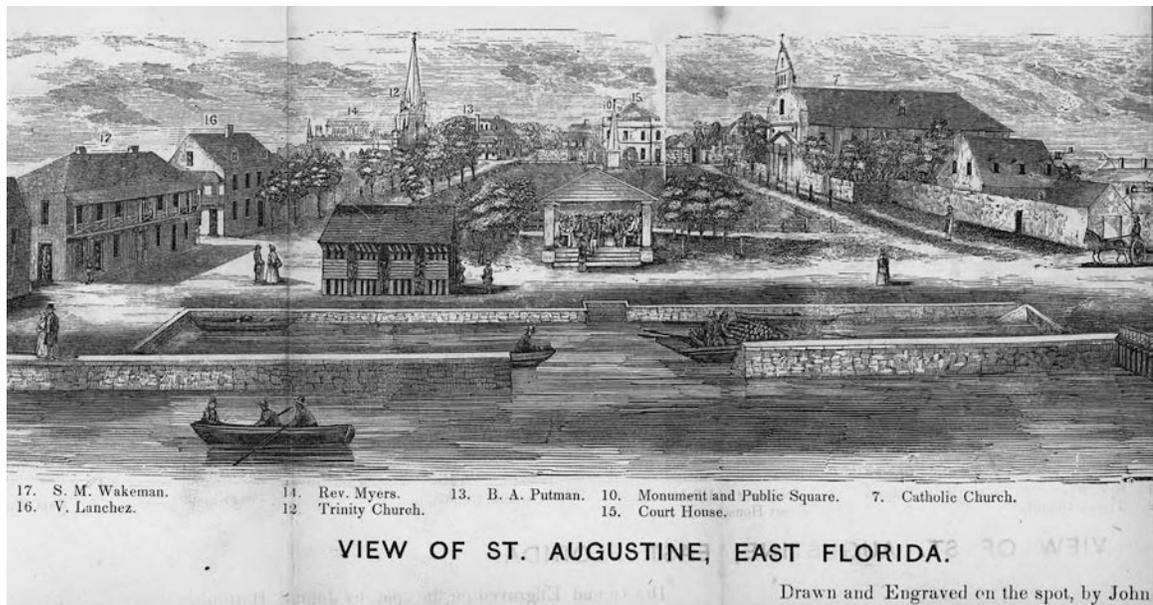


Fig. 21: The plaza was the center of the original town plan, protected from storms by the city's third reconstructed seawall. King Street is to the left of the square; Cathedral Street is on the right. [John S. Horton, Library of Congress Geography and Map Division; View of St. Augustine, East Florida, 1855]

Americans settled southwest of the historic city in Lincolnville; the Abbott Tract neighborhood grew to the north.

In 1883, Henry Flagler, John D. Rockefeller's co-partner in Standard Oil, believed the city could rival Newport, Rhode Island as a tourist destination.¹²⁹ He purchased the railroad and land west of the city wall to build the Ponce de Leon and the Alcazar Hotels. With partner Heth Canfield, Flagler filled part of the Maria Sanchez Creek, a saltwater tributary of the Matanzas River, to create additional land for his tourist hotels.¹³⁰ The creek became Maria Sanchez Lake, south of the city plaza and east of Lincolnville.

Henry Flagler continued to build within the community. West of his hotels, he developed the Model Land Corporation neighborhood near his railroad station. The

Flagler era in St. Augustine, however, quickly came to an end in the late 1890s when Flagler decided to develop in southern Florida's warmer climates.¹³¹

Since the early twentieth century, tourism in St. Augustine has remained one of its primary industries. The National Park Service took over the Castillo de San Marcos in 1924, opening it to the public for tours. Inspired by Colonial Williamsburg, the St. Augustine Historical Society in conjunction with the Carnegie Institute began preservation efforts in 1937. Their goal was to preserve, restore, and reconstruct the city's architectural past to reflect the first Spanish era. The group created a "living museum," along St. George Street, highlighting the area's unique Spanish heritage.¹³² (Fig. 22) The



Fig. 22: St. George Street has evolved from a "living museum" into an area of tourists' shops. The street features many building reconstructions. [Ann Horowitz; photograph, January 2013]

University of Florida Historic St. Augustine, Inc. (UFHSA) currently owns, leases, preserves, and interprets sixteen buildings on St. George Street in addition to 45 others within the original colonial city.¹³³

The Flagler Hotels were adapted to contemporary uses. City government offices and the Lightner Museum moved into the rehabilitated Alcazar Hotel in the 1960s. In 1968, Flagler College purchased the Ponce de Leon Hotel for its campus.¹³⁴

Government, religious, and educational institutions own 51% of the city's property, limiting the amount of property taxes St. Augustine can collect from its property owners. For this reason, the city relies on sales and room taxes generated by tourism to fund the city budget. The economic base has diversified in recent years with the addition of light industries and service businesses in the area.¹³⁵

The population in 2011 was estimated at 13,336. Median household income for city residents is \$38,325, \$9,502 less than the state average. Twenty-two percent live below the poverty line, compared to 14.7% for the state. The land area measures 9.43 square miles with 1,376.2 persons per square mile.¹³⁶

National Register Historic Districts

St. Augustine has emphasized its architectural and cultural past through its commitment to historic preservation. In addition, support of historic preservation is indicated in the city's Comprehensive Plan, recommending the nomination of neighborhoods to the National Register. Seven National Register historic districts have been listed. These illustrate the historical periods of St. Augustine. They are: the City of St. Augustine Town Plan, Abbott Tract, Model Land Company, Lincolnville, North City,

Fullerwood Park, and Nelmar Terrace. (Fig. 23) Historic districts encompass 159 blocks with 1,711 buildings.

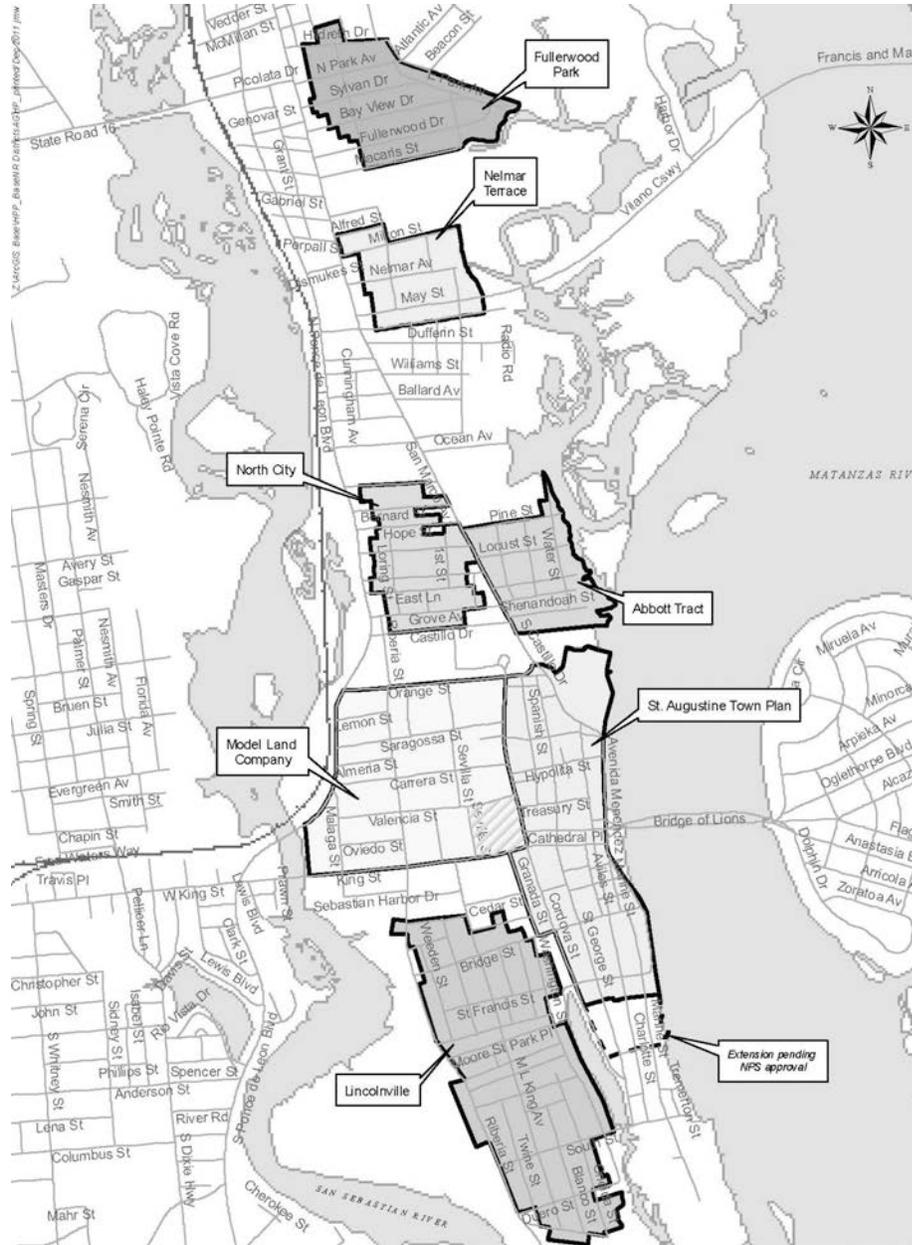


Fig. 23: The seven historic districts of St. Augustine are sited at low-lying elevations near rivers and wetlands. [City of St. Augustine “Architectural Guidelines for Historic Preservation, p. 22; Historic districts of St. Augustine, October 2011]

The Historic Architectural Review Board reviews proposals for alterations and new construction according to guidelines specified for five historic preservation zones. The St. Augustine Town Plan and Abbott Tracts areas are the only districts comprehensively regulated by historic preservation zones. Limited sections of the North City, Model Land Corporation, and Lincolnville districts are subject to design review. Alteration and new construction reviews are not required in the Fullerwood Park and Nelmar Terrace districts.¹³⁷

The St. Augustine Town Plan Historic District is a 22-block area characterized by Colonial era development from 1565–1821. The 394 contributing buildings are located within the “Old Walled City.”¹³⁸ In addition to Spanish and British Colonial architecture, styles from the American period—Gothic Revival, Queen Anne, and Colonial Revival—add character to the district. Vernacular bungalows were constructed during the early twentieth century. (Fig. 24) Spanish and British reconstructions were created on St. George Street to form the “living museum.”¹³⁹



Fig. 24: The Joaneda House was erected during the British period, circa 1806. [Google Earth; street view photograph, 2013]

The district is also listed as a National Historic Landmark for its extraordinary example of early town planning and its collection of colonial architecture. Spain's Laws of the Indies were the basis for the development of St. Augustine. In 1573, King Phillip II compiled the urban planning guidelines for the country's colonies. Settlements were to be placed in areas with good sea and land access for commercial prosperity and for defense. Towns were to be sited on a northern or eastern shore. The plaza was the social, political, and economic center of the town, where eight roads extended from it to the settlement's borders. If a town was walled, it was densely built.¹⁴⁰

Four other buildings inside the district are also National Historic Landmarks. These are: the Cathedral of St. Augustine, the Gonzalez-Alvarez House, the Hotel Ponce De Leon, the Ximenez-Fatio House, and the Llambias House.¹⁴¹ (Figs. 25, 26)



Figs. 25 and 26: The Ximenez-Fatio House (left), constructed in 1807 exemplifies the second Spanish period. The Llambias House (right) represents the first Spanish period and was built around 1763. [Frances Benjamin Johnston, Library of Congress Prints and Photographs Division; photographs, circa 1936]

The Castillo de San Marcos is included in the St. Augustine historic district. The fort was constructed between 1672 and 1695 as a military warehouse and a fortress to house residents when the town was under attack. The Castillo is the last remaining seventeenth century fort in the United States and one of two military installations constructed of coquina.¹⁴² The porous and lightweight stone is a natural composite of quartz, sand, and fragmented shells found in most of Florida and in North Carolina.¹⁴³ Coquina was quarried on Anastasia Island and cut into blocks for construction use. The porosity of coquina is vulnerable to deterioration when exposed to the elements. The native stone, however, proved to be well suited for military defense since cannonballs compressed the building material rather than cracking it. The thick, porous walls absorbed the projectile force or deflected it.¹⁴⁴

The Abbott Tract Historic District is composed of 124 contributing buildings on 17 blocks located north of the St. Augustine Town Plan Historic District.¹⁴⁵ The Matanzas River borders the district on the east. A pond and an inlet form the northern border. As the first area constructed outside of the original city limits, the district represents the highest concentration of nineteenth century buildings in St. Augustine. Queen Anne, Colonial Revival, Mediterranean styles of frame and masonry construction are featured in the district.¹⁴⁶

The Model Land Company Historic District is a 245 building, 19-block residential and commercial area developed during the late nineteenth and twentieth centuries under the guidance of Henry Flagler.¹⁴⁷ The St. Augustine Town Plan Historic District is to the west of the district; the San Sebastian River borders the area on the west.

The Ponce de Leon (1888) and Alcazar Hotels (1889) are included in the district.

Both were designed by architects John Carrere and Thomas Hastings to harmonize with the city's Spanish Colonial architecture.¹⁴⁸ The Ponce de Leon Hotel was the more luxurious and elaborate of the two. (Fig. 27) Louis Comfort Tiffany designed stain



Fig. 27: Henry Flagler built the exclusive Ponce de Leon Hotel in 1888. Flagler College now uses the former hotel as its campus. [Ann Horowitz; photograph, January 2013]

glass, murals, and mosaics decorating the Gilded Age interior. Indoor plumbing and electricity, rarities for hotels at the time, accommodated wealthy tourists.¹⁴⁹ The Alcazar Hotel held claim to the first indoor swimming pool in Florida and to a casino on the premises. (Fig. 28) Italianate, Queen Anne, Romanesque Revival, and Colonial Revival, and Mediterranean architectural styles are incorporated in the neighborhood. Bungalow and vernacular residences from the twentieth century add to the district's character. Frame and masonry building materials were used in construction. Architects Carrere and



Fig. 28: The Alcazar Hotel pool was drained and is now a restaurant. [Detroit Photographic Co., State Archives of Florida; Alcazar hotel casino pool in Saint Augustine, Florida, circa 1905]

Hastings designed additional buildings in the district.¹⁵⁰

The Lincolnville Historic District of 45 blocks and 548 contributing buildings, constructed from 1870 to 1930, represents the history of an African American settlement developed after the Civil War.¹⁵¹ The district is southwest of the colonial city, located to the east of Maria Sanchez Lake. During the civil rights era, the neighborhood hosted Martin Luther King and the Southern Christian Leadership Conference. African American builders and craftsmen constructed many of the residential and commercial buildings in the district. Frame buildings, some with coquina foundations, characterize the area, featuring Mediterranean Revival architectural styles, bungalows, and vernacular buildings.¹⁵² The neighborhood, however, is currently at risk due to deteriorating and abandoned buildings. To improve conditions, the city is considering a Community Redevelopment Area designation for the neighborhood.¹⁵³

The North City Historic District is a collection of subdivisions developed between 1879 and 1935. Twenty-four blocks with 235 contributing buildings are located northwest of the St. Augustine Historic District.¹⁵⁴ Residential buildings are commonly frame construction. Commercial buildings display the early use of concrete block and poured concrete.¹⁵⁵

The Fullerwood Park Historic district is the northernmost historic district that was originally developed as a streetcar suburb beginning in 1914. Construction in the neighborhood continued until 1964. The district is laid out on 13 blocks and portrays 65 contributing examples of frame styles popular during the early to mid-twentieth century in St. Augustine.¹⁵⁶

The nine-block Nelmar Terrace Historic District, featuring 100 contributing buildings, is located in the area north of the original platted city.¹⁵⁷ Construction of the subdivision began in 1913, accelerating during the 1920s Florida Land Boom and after World War II. The result is a residential neighborhood of varied architectural styles such as Colonial Revival, Mediterranean, and Tudor. Bungalows are scattered throughout as in many sections of St. Augustine. The majority of homes are frame construction.¹⁵⁸

Social, Economic, and Environmental Benefits of the Historic Districts

Social, economic, and environmental factors inherent in the historic districts benefit the area's quality of life. As sea level rise increases, flooding, storm surge, and erosion may diminish the value of the historic resources over time unless adaptations are applied. The city and its residents recognize the positive impact of their historic environment. Nancy Sikes-Kline, a city commissioner and member of the Citizens for the

Preservation of St. Augustine, stated, "Our historic buildings are a core value to our city. It's why a lot of people move here. I think that gives people security in knowing that their neighborhood is going to increase in value and remain stable. It's also a quality of life issue. Everything will be well maintained."¹⁵⁹

The popular press has acknowledged the city's characteristic sense of place with recent accolades. Most recently, Forbes Magazine named St. Augustine to its ten top prettiest cities in the United States. The ranking took into account natural beauty and a unique identity. In early 2012, TripAdvisor listed it as one of the top 15 tourist locations. Glen Hastings, Executive Director of the St. Johns County Tourist Development Council, noted, "In past years, St. Augustine was named among the most walkable cities and the best place to feel like you're in Europe even though you're stateside."¹⁶⁰ Each honor was bestowed due to the city's unique qualities, all resulting from its preserved and maintained historic districts.

Of the seven districts, the St. Augustine Town Plan Historic District most clearly demonstrates the benefits of historic settlements and their contribution to creating quality of life. The densely developed area fosters social interaction since walking is the most efficient way to navigate the narrow streets. The densely developed residential and commercial district make destinations easily accessed on foot. The central plaza promotes social interaction through farmers' markets and civic events.

A distinct sense of place is evident in the St. Augustine district, strengthening the social and cultural ties to the area. The blend of colonial Spanish and British architecture, uncommon in the United States, and the use of native coquina and tabby create an image unique only to St. Augustine.¹⁶¹ Pride of place, generated by these architectural

characteristics, has drawn residents and politicians together to preserve the cultural legacy.

The six other historic districts convey unique historical legacies of their own. Lincolnville portrays the post-Civil War African American experience in St. Augustine as it developed around a former plantation. Flagler's enthusiasm for St. Augustine is displayed in The Model Land Corporation. The suburban Abbott Tract, North City, Nelmar Terrace, and Fullerwood Park reflect a diversity of aesthetic tastes, representative of national architectural styles popular during the period.

Economically, local property tax abatements for certified rehabilitation work benefit residents who own historic property in the historic preservation zones. Additionally, this incentive supports local construction jobs that require expertise in repairing buildings unique to St. Augustine. Increased employment and wages not only add to personal and business income, but also to city tax revenues.

Heritage tourism contributes substantially to the economic well-being of St. Augustine. The industry attracts 6.2 million visitors a year.¹⁶² The National Trust for Historic Preservation conducted a survey in 2002, assessing the impacts of heritage tourism on St. Augustine. The study found that 80 percent of tourists came to the city to visit historic sites.¹⁶³ At the Castillo de San Marcos, 750,000 people visit every year.¹⁶⁴ St. Johns County reported that \$712 million tourist dollars were spent in 2012. The sales tax revenue from tourism in 2008 registered at \$42 million. Tourism-related jobs employ 12,000 in the county.¹⁶⁵

Town planning guidelines from the Laws of the Indies adapted to environmental conditions. These considerations have contributed to the long-term sustainability of St.

Augustine. In St. Augustine, the town is sited on the eastern shore of the peninsula. The city receives morning sun and opens up to the river, naturally cooling the area with ocean breezes. This setting contributes to a reduced need for air conditioning. Additionally, the density of the walled city created an urban plan that was not car-dependent, reducing carbon emissions and improving energy efficiency and air quality.¹⁶⁶

The first Spanish period features building design and materials that have proven to be environmentally advantageous. After the British destroyed the city by fire in 1702, residents rebuilt their homes from fire-resistant coquina and tabby. Their homes were based on designs from Santanderina in Northern Spain, a place similar in climate to St. Augustine.¹⁶⁷ A sheltered porch or loggia was placed in the rear of the residence, opening to a yard. (Fig. 29) The loggia shielded wind in the cold winter months, but let in the



Fig. 29: The first floor loggia at the Gonzalez-Alvarez House, built circa 1720, on St. Francis Street represents a common St. Augustine building feature that began with the first Spanish period. The open, yet shielded, porch is designed to be warm in the winter and cool in the summer. [Historic American Building Survey, Library of Congress Prints and Photographs Division; photograph, February 1965]

warm sun. In the summer the loggia allowed for the free flow of summer breezes, while shielding the porch from the hot sun.¹⁶⁸ Second floor street balconies circulated air, cooling the upper floors in warm weather. The thick masonry walls cooled the buildings. Early Spanish building techniques reduce the reliance on energy consumptive air conditioning.

Natural materials also protected building longevity. The addition of tabby to a coquina exterior made the building watertight. Coats of lime plaster were also painted on the tabby and coquina exterior walls to prevent mold growth, a product of flooding and high humidity.¹⁶⁹

Natural Hazard Risks

Close to tidal waters at a low-lying elevation, St. Augustine is currently susceptible to flooding, storm surge, and erosion. Elevations throughout St. Augustine range between one to two meters.¹⁷⁰ After rainstorms, nuisance flooding over one inch (2.5 centimeters) occurs on a regular basis in the St. Augustine Town Plan and Lincolnville historic districts. Martha Graham, St. Augustine's Public Works Director stated on February 1, 2013 that nuisance flooding will regularly close streets.¹⁷¹ The parking lot at the Castillo de San Marcos floods several times a year in an area that was landfilled by the NPS to create the parking lot.¹⁷² (Fig. 30)

Barrier beaches and wetlands near the St. Augustine peninsula absorb some of the wave action during storms. The St. Augustine historic district, however, is sited due west of an inlet that opens directly to the Atlantic Ocean. Due to this vulnerability, tropical storms, hurricanes, and nor'easters can generate storm surges and waves that overtop the



Fig. 30: The parking lot at the Castillo de San Marcos floods several times a year. [National Park Service; photograph, November 17, 2012]

current seawall. During the 2004 hurricane season, forecasters predicted the possibility of 10-foot (three meter) storm surges. In addition, heavy wave action has eroded the shoreline and the seawall.¹⁷³

Tropical storms and hurricanes are the most damaging and costly of all natural disasters to strike in Florida. Eighteen hurricanes have passed within range of St. Augustine since 1886. Hurricane Dora was the last hurricane to directly hit St. Augustine. In 1964, it came ashore with winds of 115 miles (185 kilometers) per hour, causing widespread damage.¹⁷⁴ More recently, storm surges from Tropical Storm Gabrielle in 2001 and Tropical Storm Faye in 2008 overtopped the floodwall, significantly damaging historic properties along the Avenida Menendez, the shoreline street.¹⁷⁵ Rainfall from Gabrielle measured 6.51 inches (16.6 centimeters).¹⁷⁶ During Tropical Storm Debby in 2012, the Abbott Tract Historic District flooded from 7.7 inches (19.6 centimeters) of

rain.¹⁷⁷ With climate change, projections for higher intensity hurricanes and rain events will impact Florida. Storm surge and flooding will be exacerbated.¹⁷⁸

Past hurricanes have damaged historic resources in the St. Augustine Historic district. The Ximenez-Fatio House, a National Historic Landmark in the St. Augustine district, three blocks inland, was affected by numerous storms. A Save America's Treasures grant of \$200,000 was awarded in 2004 to repair the storm damage and problems from previous repair work.¹⁷⁹ Additionally, the historic coquina seawall, a contributing element in the St. Augustine district, has eroded and collapsed in places after recent tropical storms and hurricanes.¹⁸⁰

Projected risks: 2050 and 2100

The sea level rise projections for Northeast Florida are nearly consistent with global projections. The global average for sea level rise is 2 millimeters (0.08 inches) per year; the closest tide gage at Mayport, Florida registers 2.2 mm (0.09 inches) per year.¹⁸¹ For the year 2050, this study maps sea level rise as 42 centimeters (one foot) and nearly one meter (three feet) in 2100 for all case study cities. As the sea level rise incrementally increases, St. Augustine's historic districts will be placed at greater risk. Historic buildings that are flooded will lead to irreparable damage. Significant buildings close to the inundation areas will also become more vulnerable to flooding, storm surge, and land erosion risks. In addition, nearby wetlands are likely to gradually migrate inland, compromising the land where historic districts are located.¹⁸²

In 2050, sea level rise of 42 centimeters (one foot) will impact the historic districts, although few historic properties will be permanently inundated. (Fig. 31) The

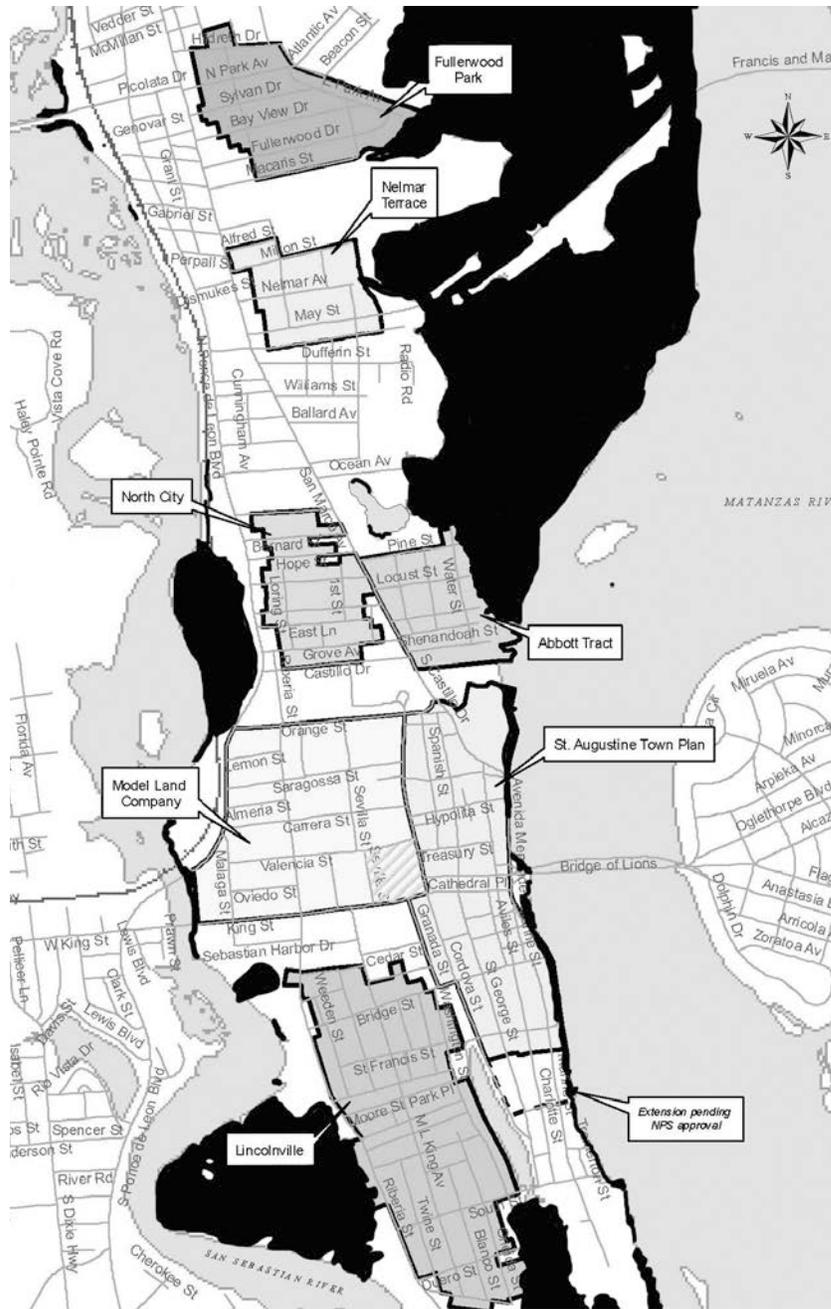


Fig. 31: In 2050, 42 centimeters (one foot) of sea level rise is projected. Flooded areas are illustrated in black. The wetlands, north and south of the colonial city, and a sliver of the Matanzas River shoreline will be flooded. Shorelines will encroach on historic districts borders, although few properties will be flooded. [City of St. Augustine; historic district base map, October 2011. National Oceanic and Atmospheric Administration; sea level rise and coastal flooding impacts one foot overlay, n.d.]

encroachment of shorelines near all districts, except for the North City Historic District, will heighten the areas' vulnerabilities to sea level rise impacts. As sea level rises to 0.5 meters, floods are projected to last 37 days a year, straining historic properties beyond present day conditions.¹⁸³ Additionally, the wetland areas north and south of the St. Augustine district and around Maria Sanchez Lake will be permanently flooded in 2050. This will raise the possibility of marsh-like conditions moving into the Lincolnville, Abbott, Nelmar Terrace, and Fullerwood Park districts. Since wetlands cannot support buildings, the historic properties in these areas will eventually collapse.

By 2100, a one meter (three feet) of sea level rise is likely to affect a large number of properties in the historic districts. (Fig. 32) The shoreline will move farther inland, permanently inundating historic properties in all of the districts except for the North City area. Storm surge and land erosion will have a greater effect on more buildings. Further, more land area could convert to wetlands. At one meter of sea level rise, the duration of floods is projected to last 149 days a year.¹⁸⁴

The integrity of the historic districts will be dramatically altered by 2100. In the St. Augustine Historic District, the areas most affected are along the Matanzas River shoreline and the former Maria Sanchez Creek. The colonial town, representing some of the oldest and most unique buildings on the Atlantic Coast, will be greatly impacted. Examples of a distinct history and identity may be damaged or greatly altered unless carefully planned methods to adapt to sea level rise are applied.

Properties constructed of lime-based materials—coquina and tabby—face an additional threat due to climate change. The rising acidity of ocean and rainwaters from carbonic acid, a result of carbon dioxide in the atmosphere, will hasten the dissolution



Fig. 32: With a one meter (three feet) of sea level rise by 2100, a substantial portion of the city is likely to be affected. Inundated areas are illustrated in black. All historic districts will be impacted by sea level rise to some degree. [City of St. Augustine; historic district base map, October 2011. National Oceanic and Atmospheric Administration; sea level rise and coastal flooding impacts three feet rise overlay, n.d.]

of lime based stone like coquina and tabby.¹⁸⁵ If submerged in highly acidic water, the earliest buildings, portraying the city's Spanish roots will eventually decompose and cease to exist.

Sea level rise will not only impact the St. Augustine district's characteristic streetscapes, but also highly significant individual historic properties. (Fig. 33) Buildings



Fig. 33: Marine Street portrays a characteristic St. Augustine streetscape. Second period Spanish buildings of coquina and tabby are interspersed with American era Victorian styles and bungalow frame architecture. The street will be inundated by sea level rise by 2100 unless adaptation measures are taken. [Google Earth; street view photograph, 2013]

along the Avenida Menendez, the street parallel to the Matanzas River, will be flooded.

This includes the historic Castillo and the St. Francis Barracks. Six original colonial buildings are located between these distinctive landmarks on the Avenida Menendez.¹⁸⁶

The Castillo de San Marcos will suffer structural damage if the dry moat is permanently inundated. In the 1930's, the NPS permanently flooded the dry moat. This caused the walls and foundation to crack and erode. Numerous repairs were

required through the years to restore the coquina and mortar. By 1996, the NPS restored the dry moat and constructed a French Drain to maintain the dry conditions.¹⁸⁷ Permanent inundation from sea level rise could further compromise the foundation of the Castillo, threatening its future. The Gonzalez-Alvarez House on St. Francis Street, a National Historic Landmark, will also be flooded. (Fig. 34)



Fig. 34: The Gonzalez-Alvarez or Oldest House is the earliest residential building in the city. It was constructed in the early 1700s of coquina and tabby. The building will be flooded by 2100. [Daniel Horowitz; photograph, January 2013]

The land where Maria Sanchez creek once flowed, along Cordova and Granada Streets, will be inundated. In this area, the former Alcazar Hotel, constructed by Henry Flagler of rusticated stone, and its landscaped grounds will be flooded. South of the hotel, a neighborhood of frame Queen Anne and Victorian residences will also be permanently flooded. The Dow museum, a collection of nine coquina, tabby, and frame

buildings constructed between 1790 and 1910, is located on one city block in this area of projected inundation.

The Lincolnville Historic District, portraying the history of African Americans in St. Augustine, will be inundated on its south, east and west. (Fig. 35) The majority of



Fig. 35: Vernacular frame houses in the Lincolnville district were originally constructed on block piers, some coquina. The added height currently protects from repetitive flooding in the area. This area on Duero Street, the district's western border, is likely to be flooded by 2100. [Google Earth; street view photograph, 2013]

residences in the district are frame homes that were elevated on blocks, some coquina, when constructed. The elevation may protect some properties from periodic floods.

Coquina blocks, however, will deteriorate if submerged in seawater acidified by carbonic acid, a result of the increased carbon dioxide in the atmosphere.

Permanent flooding will occur in the Model Land Corporation Historic District, eliminating the visible history associated with the Flagler era. Portions of Flagler College, a building of rusticated stone, will be partially inundated. Three office buildings on Riberia Street, erected between 1922 and 1926, housed the offices for Flagler's Florida

East Coast Railway until 2006.¹⁸⁸ (Fig. 36) Flagler College now uses the buildings for dormitories and administrative offices. Residential properties, primarily of frame construction, along Valencia, Oviedo, and King Streets will also be flooded.



Fig. 36: Formerly the headquarters for Florida East Coast Railway, the Flagler College building is part of the Model Land Company Historic District. The masonry buildings will be permanently flooded by 2100. [Google Earth; street view photograph, 2013]

The integrity of the three remaining districts is also at risk by 2100. The Abbott Tract Historic District and its collection of nineteenth century architecture, mainly frame buildings, will be threatened by 2100. Areas near the Matanzas River will be affected as well as properties near the inland pond on the district's northern border. (Fig. 37) Additionally, permanent inundation will affect the twentieth century residences in the Nelmar Terrace and Fullerwood Park districts. (Figs. 38, 39) The longevity of these mostly frame properties will be in question as one meter of sea level rise affects St. Augustine by 2100.



Fig. 37: Frame residences in the Abbott Street Historic District along Pine Street are projected to be flooded by nearly one meter of sea level rise by 2100. Pine Street houses facing an inland pond are currently elevated approximately two feet from the ground. [Google Earth; street view photograph, 2013]



Fig. 38: Early twentieth century frame residences on Nelmar Avenue in the Nelmar Terrace Historic District are located on low-lying elevations susceptible to flooding from sea level rise by 2100. [Google Earth; street view photograph, 2013]



Fig. 39: Vernacular frame homes from the twentieth century on East Park Avenue in the Fullerwood Park Historic District are projected to be flooded by sea level rise of approximately one meter by 2100. [Google Earth; street view photograph, 2013]

Implemented Adaptations

Adaptation methods to minimize flooding have been implemented in the St. Augustine environs due to the area's proximity to the Atlantic Ocean and its low elevation. These adaptations may prove to mitigate the impacts for future sea level rise, although planning efforts considered only current flooding conditions and did not incorporate projections for sea level rise. In addition, adaptations have not yet been proposed that include data for projected sea level rise.

The earliest of these implemented adaptations is the St. Augustine seawall, a prominent historic feature in the colonial district. The coquina seawall, constructed between 1836 and 1842, originally extended from the Castillo southward along the Matanzas River. In the 1950s, this seawall was buried with the widening of the Avenida Menendez between the Bridge of Lions (the bridge intersects with the Plaza) and the Castillo. The historic seawall, integral to the city's identity, remains at the Castillo and

south of the Bridge of Lions. Due to tropical storm and hurricane impacts, the seawall's condition has severely deteriorated. At the Castillo, the seawall shows signs of erosion.

(Fig. 40) The 6.5 foot (two meter) structure no longer protects the city from Category 1



Fig. 40: Part of the nineteenth century seawall borders the Castillo. At low tide, the deterioration from wave action and dissolution is evident on the coquina wall. [Ann Horowitz; photograph, January 2013]

storm surges of 7.4 feet (2.3 meters) south of the Bridge of Lions. Even high tides have the potential to overtop the wall at this location, flooding the historic properties sited inland.¹⁸⁹

The National Park Service (NPS) constructed a “living” seawall of rip-rap design in 2011 to minimize erosion of the historic seawall and provide some environmental

benefit. (Fig. 41) The hard adaptation, composed of loosely piled stones is designed to protect the coquina seawall and to provide a habitat for river species.¹⁹⁰ The water level at



Fig. 41: The rip-rap seawall, as seen at low tide, was constructed by the NPS to reduce erosion on the historic seawall and to create a natural habitat. [Ann Horowitz; photograph, January 2013]

high tide nearly reaches the top of the rip-rap wall. The protective benefits of this adaptation have not been yet evaluated, although the rip-rap wall does not negatively impact integrity. Jon Burpee, Chief of Interpretation and Education at the Castillo stated that the local NPS staff at the Castillo site has not considered future implications of sea level rise in park plans as of March 2013.¹⁹¹

During Hurricane Floyd in 1999, a 7.7 foot (2.3 meter) crest overtopped the seawall south of the Bridge of Lions, transforming the Avenida Menendez into a river.¹⁹² The next year, the city commissioned an engineering report to assess the seawall

condition. The report found that the granite blocks on top of the wall were falling toward the river at a rate of 1/8 inch (0.32 centimeters) per month. Furthermore, soil behind the wall was filtering through cracks in the wall into the Matanzas River. The engineer informed the city's Port Board in 2000 that, "The [wall's] blocks are deteriorating. That's going to continue. Digging out the fill, repairing the wall and putting in new fill may extend its life, but won't reverse the process."¹⁹³

The city considered repairing the wall or replacing it in 2000 after receiving the engineer's evaluation. Repairing the wall would provide a temporary solution. Replacement of the damaged section was the most desirable but costly option. The project's estimate was \$700,000–\$900,000 with the Federal Emergency Management Agency (FEMA) contributing \$180,000. Because of the funding shortfall, the project was not initiated.¹⁹⁴

Storms continued to damage the seawall, diminishing all aspects of its integrity. Tropical Storm Gabrielle caused a 100-foot (30.5 meters) section of the wall to collapse in 2001. Hurricanes Frances and Jeanne inflicted \$60,000 of damage in 2004.¹⁹⁵ The city decided to move forward to rehabilitate the entire length of seawall south of the Bridge of Lions to the St. Francis Barracks. From 2002 to 2003, the city conducted five public sessions to distribute information on the seawall resolution and to collect resident feedback. A cost-benefit analysis indicated 428 properties would be protected and \$15.6 million in property damages would be saved with a new seawall.¹⁹⁶ In 2004, the city received a \$750,000 CDBG grant to replace the seawall south of the Bridge of Lions.

Between 2004 and 2005, the city archaeologist and the SHPO worked with the city to develop an option that would preserve an aspect of the historic seawall behind a

new higher seawall. A Section 106 Report was required because federal funds would partially finance the new seawall. The report was completed on January 10, 2005. The SHPO approved the option to build a new, higher, 8.7-foot (2.7-meter) seawall into the river, leaving a portion of the lower, 6.5-foot (two-meter) historic seawall visible behind it. A 12-foot (3.7-meter) wide pedestrian path would be placed between the two seawalls. (Fig. 42) The St. Augustine Historic Architectural Review Board (HARB) authorized the project, issuing a Certificate of Appropriateness in 2006.

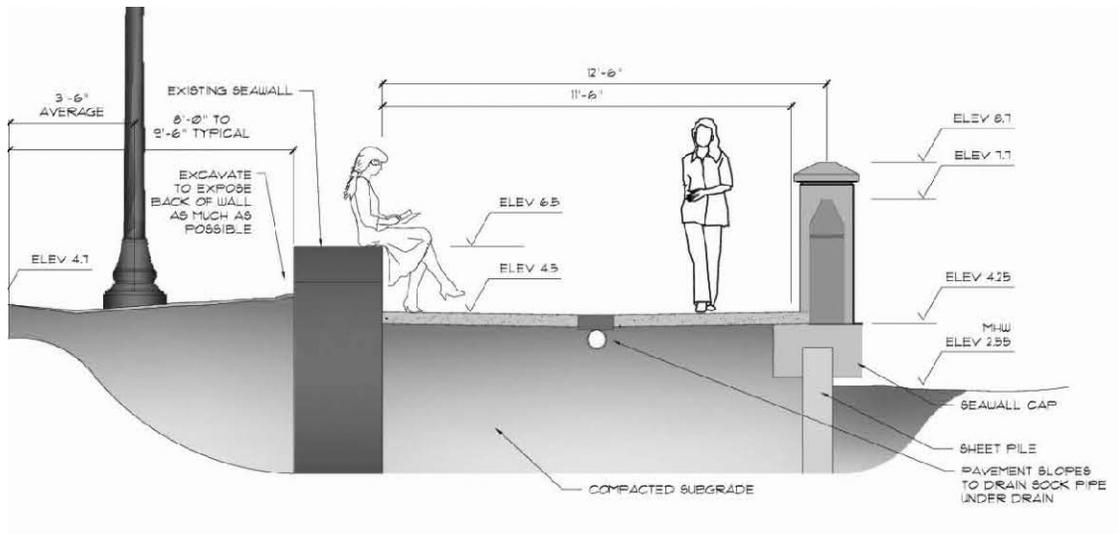


Fig. 42: The section of the current St. Augustine Seawall project illustrates the historic seawall on the left with the new, higher seawall on the right. Approximately two feet (61 centimeters) of the coquina seawall will be visible. This illustration does not depict the six-inch (15-centimeters) height increase for the new seawall and pedestrian path applied after severe flooding in November 2012. [City of St. Augustine; St. Augustine Seawall Flood Mitigation Project, August 22, 2011]

When Tropical Storm Faye caused a 150-foot (45.7 meters) breach in the seawall in August 2008, the city then qualified for a FEMA grant to assist in replacing the entire seawall south of the Bridge of Lions to the St. Francis Barracks.¹⁹⁷ The \$4.7 million grant was awarded in August 2011 to contribute to the \$6.35 million project. The FEMA

Regional Administrator, Phil May explained the reasons for funding the seawall rehabilitation: “The goals are to protect lives, prevent property damage and save money for all in the long run. In the future, there likely will be less damage, due to storm surge and associated flooding, to our historic treasures in the nation's oldest city.” The city funded the remaining portion through the city’s general fund and by increasing the parking fees at the city parking garage.¹⁹⁸

In April 2012, construction began on the new Avenida Menendez seawall. Expected completion is in April 2013. Mayor Joe Boles referred to the seawall rehabilitation as a “legacy project,” stating, “If we don’t leave some infrastructure here for the 450th [anniversary in 2015], then the celebrations won’t have meant a lot.”¹⁹⁹

The planned height of the new seawall and the pedestrian path were raised six inches after a severe November 2012 rainstorm, occurring at high tide, caused flooding in the colonial city district. The finished height of the seawall will be 9.1 feet (2.8 meters)

The higher seawall is projected to hold back Category 1 storm surges and high tides in the short term. By 2050, however, a storm surge during a spring tide could flood the seawall. By 2100, with a sea level rise of one meter (three feet), the sea wall will no longer be high enough to protect the city from storm surges.²⁰⁰

The city of St. Augustine has implemented two non-structural adaptations to improve chronic flooding in historic districts. The Maria Sanchez Lake Weir Gate Installation Project has been completed and the installation of the upgraded Riberia Street stormwater management system is underway. The weir gate project was undertaken to minimize flooding along Cordova and Granada Streets on the western border of the St. Augustine district. Due to inoperable valves, excess rainwater would overtop the weir and

flood. By replacing the valves and the installing of a new weir gate system, the level of the water in the weir can be controlled. If the level gets too high, the weir is drained to marshy sections of the nearby creek. Historic integrity was not affected by the weir gate project.

The Lincolnville Historic District has benefitted from the first phase of the new Riberia Street stormwater management system, part of the larger Riberia Street Redevelopment project. Larger storm drain pipes and check valves have been installed while more are currently being added. Integrity within the Lincolnville Historic District was not impacted by the stormwater system upgrades. After a nor'easter affected the area during high tide in November 2012, the Lincolnville area did not flood.²⁰¹

The local adaptations—the seawall, weir gate, and stormwater improvements—are expected to mitigate flood conditions in the Lincolnville and St. Augustine historic districts. These adaptations may reduce the number of areas projected to be inundated on this study's maps. Other areas, however, remain vulnerable to flooding. Public Works Director Martha Graham reported in 2012 that pumping facilities were the only other option to address chronic nuisance flooding. The city has not committed to installing the costly pumping stations at this time.²⁰²

A non-structural adaptation, St. Augustine's zoning ordinance, Article V-Floodplain Management, Sections 8-422-424, mandate the elevation of new construction or buildings undergoing a major reconstruction. The lowest floors, including basements, are to be elevated above the base flood elevation as determined by FEMA. If elevations are solid foundations, openings on either side must be included in the design to promote the equalization of hydrostatic forces caused by flooding. Floors may be constructed

below the base flood elevation if designated for parking, storage, or access. Historic properties are exempt from these regulations unless historic character has been previously altered. This leaves historic properties with intact integrity vulnerable to flooding and storm surge.²⁰³ New infill in the districts, subject to the elevation ordinance, could alter the integrity of the historic neighborhoods unless design guidelines are developed similar to the Mississippi Development Authority's *Elevation Design Guidelines*.

At the county level, the Land Development Code Article IV, Sec. 4.01.06 requires the maintenance of a 25-foot (7.6 meter) vegetative buffer between new development and wetlands. A 50-foot (15 meter) buffer must be set aside along riverbanks. This non-structural adaptive regulation minimizes flood conditions in adjacent areas, does not affect historic integrity, and improves environmental quality.

The "St. Johns County Flood Facts" brochure informs property owners of hard, soft, and non-structural adaptations they can apply on an individual basis to avoid flood damage. The county recommends: floodwalls, berms, building elevation, flood proofing, sandbag barriers, elevating furniture, sewer line backup valves, and floodwater openings in floors below base flood levels.²⁰⁴ In *Flooding and Historic Buildings*, English Heritage recommends many of these adaptations that maintain integrity.

Regionally, two organizations are providing studies that will be useful for future adaptation planning. The Northeast Florida Regional Council (NEFRC) is a consortium of six counties, including St. Johns, that plans and advocates for the social, economic, and environmental issues that make up the region's quality of life. The organization recently received a grant from the Environmental Protection Agency (EPA) to study the vulnerability and adaptations to sea level rise for natural resource management and to

address inundation and erosion impacts on the built environment. NEFRC plans to develop sea level rise vulnerability maps for local governments.²⁰⁵

In addition, the University of Florida and the Guana Tolomato Matanzas National Estuarine Research Reserve provide sea level rise data analyses to communities in the St. Augustine area. The National Estuarine Research Reserve System Science Collaborative, a partnership of NOAA and coastal states, funds the group's collaboration on "Planning for Sea Level Rise in the Matanzas Bay." In December 2012, this planning group presented Resident Workshops in St. Augustine informing citizens of projected sea level rise. In Spring 2013, they will hold additional workshop sessions for St. Augustine public officials on the development of adaptation policies.

At the state level, Florida is fully engaged in supporting adaptation planning for its communities. Climate change induced sea level rise and increased hurricane intensity will significantly impact the low-lying state. At his 2007 State of the State address, Governor Charlie Crist announced, "Florida is more vulnerable to rising ocean levels and violent weather than any other state."²⁰⁶ The governor moved the climate discussion forward by creating the Governor's Action Team on Energy and Climate Change. A Technical Work Group for Adaptation was one of the teams formed to address climate change impacts on Florida. To prepare for statewide adaptation, the work group outlined initiatives to begin planning adaptations. These are to support: scientific research and analysis; local and state government planning; development of policies balancing private property rights with municipality protection; safeguarding environmental health; beach retention; revising the state building code; and, public education.²⁰⁷

Consequently, Florida is at the forefront of adaptation planning. The Technical

Work Group's recommendations have led to legislative support for adaptive solutions. In 2011 two additional programs, backed by the legislature, encouraged adaptation planning at the state and local levels. One is the Community Planning Act enabling and encouraging local communities to include adaptation planning, termed as Adaptation Action Areas, in their comprehensive plans. The second initiative, *Community Resiliency: Planning for Sea Level Rise*, is a five-year project of the Florida Department of Economic Opportunity (DEO). This will also determine ways to coordinate local adaptation activities. Fort Lauderdale will serve as a pilot program to test adaptation responses. Findings are intended to stimulate additional legislative action.²⁰⁸

The state has almost finished a \$24.5 million LiDAR elevation study of its coastline.²⁰⁹ Light detection and range (LiDAR) mapping offers the most accurate and precise method to measure elevation on the Earth's surface. LiDAR data is combined with sea level rise projections to determine future potential inundation of the land. With precise LiDAR information, Florida will be able to identify coastline areas, as well as specific historic districts, that are vulnerable to sea level rise.²¹⁰

Prior to considering the impacts of sea level rise, Florida had implemented soft adaptation programs to protect its beaches and dunes. The state recognized the importance of these sand features in maintaining the quality of natural and built environments. Beach nourishment does not impact historic integrity, however, the creation of dunes have the potential to block a historic district's waterfront view. This does not apply to the St. Augustine case study because dunes are located on the outlying barrier islands.

Beaches and dunes are critical as buffers, protecting inland areas from flooding,

storm surge, and erosion aggravated by sea level rise. The Beach Erosion Control Program (BECP), authorized through the Florida Beach and Shore Preservation Act, provides federal, state, and local financial assistance to communities for the protection and preservation of its shoreline resources. Beach restoration and nourishment are eligible expenditures. Also under the act, the Strategic Beach Management Plan (SBMP) applies to the restoration of beaches. The St. Augustine Beach, Anastasia Recreation area, and Matanzas Inlet, barrier beaches that may minimize ocean impacts on St. Augustine, are regularly restored with this program. Other state beach nourishment and protection initiatives are the Coastal Construction Control Line Program and the Coastal Building Zone Program.²¹¹

At the federal level, the Coastal Barrier Resources Act (CoBRA) of 1982 has protected barrier islands by limiting development in high risk areas in St. Johns County. Although CoBRA was not intentionally established as an adaptation to sea level rise, its programs lessen the impact of flooding, storm surge, and erosion on inland shoreline communities. The preservation of Guana River, Usinas Beach, and Conch Island through CoBRA will minimize the effects of sea level rise on the St. Augustine peninsula.²¹²

Decision-makers and Stakeholders

Adapting to increased flooding from higher tides and Category 1 hurricanes through the construction of a new seawall involved a broad-based group of decision-makers and stakeholders. At the local level, the Public Works department observed the need for a new seawall and elicited support from its citizen commission, city commissioners, and the mayor. The state was involved with the granting of the initial

CDBG grant. The federal government became engaged in the project with the Section 106 Report and later with the FEMA award that made the new seawall possible. The State Historic Preservation Office represented the preservation community in a planning and an advisory role during the Section 106 review, part of the decision-making process. The local Historic Architectural Review Board, a division of the city's Planning and Building Department, reviewed the Section 106 proposal, approving it with a Certificate of Appropriateness before construction on the project could begin. United States Representative John Mica advocated for the city to secure the FEMA grant.

The weir and stormwater system installations required decisions made by the Public Works department, its citizen commission, city commissioners, and mayor to implement the projects.

Prior to each local adaption, the St. Augustine city employees held public meetings at the proposal, design, implementation, and ribbon-cutting stages of the projects to involve citizen stakeholders.

The local staff of the National Park Service has a stakeholder position in how the city plans for adaptation. In addition, the St. Johns County Emergency Management, Environmental, Engineering, Land Management Systems, Planning and Zoning, Public Works, Tourism Development Council, and Transportation Planning divisions will become involved in the adaptation planning process.

Regional guidance on sea level rise vulnerability and its effects on the built environment will be available through the Northeast Florida Regional Council and the University of Florida and the Guana Tolomato Matanzas National Estuarine Research Reserve. All are stakeholders in the adaptation discussion.

As a stakeholder, the state of Florida will assist St. Augustine with the formulation of its future adaptation plans. The technical information and policy support under development will benefit the city of St. Augustine when it plans adaptation solutions specific to its geography, sea level vulnerability level, and man-made environmental needs.

Aside from the mandatory state and local historic preservation reviews for the new Avenidas Menendez seawall, the preservation community in the city has not addressed the implications of sea level rise on historic properties. On February 1, 2013, Kathryn Frank, a professor at the University of Florida, stated that the University of Florida Historic St. Augustine organization plans to analyze the risk of sea level rise on the properties it owns in the city.²¹⁴

Summary of Findings: St. Augustine, Florida

St. Augustine responds to present day flood conditions by applying adaptations, but has not preemptively planned adaptation solutions by considering sea level rise science. Both the City of St. Augustine Public Works Director and the NPS Chief of Interpretation and Education at the Castillo de San Marcos state that their employers have no immediate plans to assume a preemptive adaptation planning approach in the future. This strategy leaves the city and its historic districts vulnerable to damage associated with sea level rise.

Nonetheless, the city provides protection for the St. Augustine Town Plan, Model Land Company, and Lincolnville historic districts due to chronic flooding in those areas. The largest and most costly adaptation project, the Avenida Menendez Seawall,

illustrates the challenges of adaptation planning and implementation. As the historic seawall deteriorated after each storm, it was not until the wall was almost destroyed that federal funding became available for mitigation. Twelve years of community discussions, political approvals, and funding requests occurred before work could begin on the new seawall. Project construction was estimated to be one year. Like the Cape Hattaras Lighthouse relocation, the construction of the new seawall can be achieved in less time than the approval and funding process.

A multidisciplinary group of decision-makers and stakeholders contributed to the seawall project, a critical factor for success according to adaptation theorists and researchers. The city archaeologist, SHPO, and St. Augustine Historic Architectural Review Board represented the historic preservation community at the advisory and approval stages. The SHPO's and review board's endorsements for the new wall indicate the importance they placed on maintaining a remnant of the historic wall rather than lose it entirely to the impacts of the sea. The city included the community as an active participant in the seawall discussion. Theory and research from literature reveal that the involvement of the community in adaptation planning is necessary to establish local support for a project and ensures that residents' concerns are addressed in the final plan.

Although the Avenida Menendez seawall impacts all aspects of the historic seawall's integrity, other adaptations applied in St. Augustine do not affect historic district character. The stormwater management improvements, weir gates project, rip-rap wall at the Castillo, vegetative buffer zones, flood proofing, and flood resilience options for individual buildings protect historic districts from flooding without impacting integrity.

The University of Florida (UF), the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM NERR), and the state of Florida may eventually persuade the city of St. Augustine to preemptively plan for the effects of sea level rise. The UF and GTM NERR collaborative continues to educate the public and city government employees on sea level rise science and adaptation. As a leader in sea level rise policy, Florida's legislature encourages local communities to incorporate adaptation strategies into comprehensive plans. Additionally, the state offers scientific and technical support to communities, a practice endorsed by John Randolph in *Collaborative Resilience*.

Florida's gubernatorial and legislative acknowledgement of climate change and eagerness to develop adaptation programs will benefit St. Augustine's future adaptation needs. An active state that voices the need to adapt will attract federal attention in the quest for adaptation funding. The state level endorsement of Adaptation Action Areas within a city's comprehensive plan should encourage St. Augustine to consider the effects of sea level rise on its shoreline. The scientific data and planning information generated by the state will provide a framework for city employees to plan adaptively. The Fort Lauderdale pilot program should also assist St. Augustine in visualizing an adaptation plan that can be tailored to the city's unique characteristics.

ENDNOTES

118. Boeschstein, 265.
119. Historical Archaeology, "St. Augustine, FL: America's Ancient City," *Florida Museum of Natural History*, n.d., <http://www.flmnh.ufl.edu/histarch/sa.htm>.
120. National Park Service, "Florida Historic Places: St. Augustine Town Plan Historic District," n.d., <http://www.nps.gov/nr/travel/geo-flor/24.htm>.
121. "The History of Fort Mose," accessed March 10, 2013, <http://www.fortmose.org/history/history.html>.
122. Boeschstein, 262–263.
123. *Ibid.*, 264.
124. Peter Guinta, "Part of Seawall Destined to Fall," *St. Augustine Record*, December 13, 2000, http://staugustine.com/stories/121300/new_1213000003.shtml.
125. Guinta, "Part of Seawall Destined to Fall."
126. *Ibid.*
127. Historical Archaeology, "St. Augustine, FL: America's Ancient City."
128. *Ibid.*
129. Boeschstein, 267.
130. City of St. Augustine, Florida, "Maria Sanchez Lake Weir Project," accessed March 7, 2013, http://www.staugustinegovernment.com/the-city/featured-stories-archive/1_06/mariasan-lakeweir.cfm.
131. Boeschstein, 268, 270-271.
132. *Ibid.*, 272–273.
133. University of Florida, "University of Florida Historic St. Augustine Inc.," November 15, 2012, <http://www.staugustine.ufl.edu/>.
134. Boeschstein, 271.
135. *Ibid.*, 278.

136. United States Census Bureau, "St. Augustine (city) QuickFacts," January 10, 2013, <http://quickfacts.census.gov/qfd/states/12/1262500.html>.
137. Planning and Building Division, City of St. Augustine, "Architectural Guidelines for Historic Preservation," October 2011, 26, http://staugustinegovernment.com/your_government/documents/AGHP10.29.12.pdf.
138. City of St. Augustine, Florida, *Historic Preservation*, accessed January 4, 2013, 14, http://www.staugustinegovernment.com/your_government/harb-arch-guidelines/3%20-%20Historic%20Preservation.pdf.
139. Ibid.
140. Dora Crouch and Alex Mundigo, "The City Planning Ordinances of the Law of the Indies Revisited," *The Town Planning Review* 48, no. 4 (October 1977): 398–401, <http://www.jstor.org/stable/pdfplus/40103295.pdf?acceptTC=true>.
141. National Historic Landmarks Program, *Listing of National Historic Landmarks by State*, accessed March 4, 2013, <http://www.nps.gov/nhl/designations/Lists/FL01.pdf>.
142. National Park Service, "Castillo De San Marcos National Monument," accessed March 11, 2013, <http://www.nps.gov/casa/index.htm>.
143. Florida Division of Historical Resources, Florida Trust for Historic Preservation, National Park Service, "The Conservation and Preservation of Coquina" (symposium on Historic Building Material in the Coastal Southeast, St. Augustine, Florida, January 24-26, 2000), 9, 19.
144. National Park Service, "Castillo De San Marcos National Monument."
145. Florida Division of Historical Resources, "Florida's History Through Its Places: Historical Reports," accessed March 9, 2013, <http://www.flheritage.com/facts/reports/places/index.cfm?fuseaction=ListAreas&county=St.%20Johns#800>.
146. Planning and Building Division, City of St. Augustine, "Architectural Guidelines for Historic Preservation."
147. City of St. Augustine, Florida, "Proposed National Register Nominations," accessed March 8, 2013, http://www.staugustinegovernment.com/the-city/featured-stories-archive/3_07/nat_register_hist_dist.pdf.
148. Boeschstein, 267.
149. Student tour guide, "Flagler College Tour" (Flagler College, January 4, 2013).

150. Planning and Building Division, City of St. Augustine, "Architectural Guidelines for Historic Preservation."
151. City of St. Augustine, Florida, "Proposed National Register Nominations."
152. Florida Division of Historical Resources, "Florida's History Through Its Places: Historical Reports."
153. Peter Guinta, "Lincolnton Residents See Plans for Development," *St. Augustine Record*, January 22, 2013, <http://staugustine.com/news/politics/2013-01-22/lincolnton-residents-see-plans-development>.
154. City of St. Augustine, Florida, "Proposed National Register Nominations."
155. Planning and Building Division, City of St. Augustine, "Architectural Guidelines for Historic Preservation," 20.
156. City of St. Augustine, Florida, "Proposed National Register Nominations."
157. City of St. Augustine, Florida, "Nelmar Terrace Soon to Be Seventh on the National Register of Historic Districts," March 9, 2013, http://www.staugustinegovernment.com/the-city/featured-stories-archive/2_11/NelmarTerraceNR.cfm.
158. Planning and Building Division, City of St. Augustine, "Architectural Guidelines for Historic Preservation."
159. "Top 10 Cities for Historic Preservation," *Livability*, accessed March 7, 2013, <http://livability.com/top-10/top-10-cities-historic-preservation/st.-augustine/fl>.
160. Jennifer Edwards, "Forbes: City Among 'Top 10 Prettiest Towns'," *St. Augustine Record*, April 4, 2012, <http://staugustine.com/news/local-news/2012-04-04/forbes-city-among-top-10-prettiest-towns>.
161. Tabby is a man-made material—a mixture of lime, sand, and shells. In St. Augustine, tabby was used as a mortar as well as a material to build floors, walls, and roofs.
162. National Trust for Historic Preservation, "Heritage Tourism Assessment & Recommendations," *Citizens for the Preservation of St. Augustine, Inc.*, 2002, http://cpsa-staug.org/?page_id=86.
163. Ibid.

164. City of St. Augustine, Florida, "Fort Survey," August 2011, http://www.staugustinegovernment.com/the-city/featured-stories-archive/8_10/FortSurvey.cfm.
165. St. Johns County, Florida, "Tourism in St. Johns County," accessed March 12, 2013, <http://www.co.st-johns.fl.us/TDC/index.aspx>.
166. Crouch and Mundigo, 398–401.
167. Albert C. Manucy, *The Houses of St. Augustine, 1565-1821*, Florida: University Press of Florida, 1962), 11.
168. Ibid.
169. Ibid., 68.
170. United States Department of State Geographer, "Google Earth Elevation Data," 2013.
171. Martha Graham, Public Works Director, St. Augustine, discussion with author, February 1, 2013.
172. Jon Burpee, email correspondence with author, December 28, 2012. The date the parking lot was created through landfill is unknown.
173. Northeast Florida Regional Council, "Emergency Preparedness," in *Strategic Regional Policy Plan*, 1997, 58, <http://www.nefrc.org/pdfs/srpp/element3.pdf>.
174. Ibid., 58-59.
175. City of St. Augustine, Florida, "St. Augustine Seawall Flood Mitigation Project," August 22, 2011, http://www.ci.st-augustine.fl.us/the-city/featured-stories-archive/8_11/documents/seawallpresentation1Aa_001.pdf.
176. Northeast Florida Regional Council, *Volume 1-4: Northeast Florida Region Technical Data Report, Regional Hazards Analysis*, accessed March 5, 2013, 11-53, <http://www.nefrc.org/pdfs/SRESP%20web%20version/Vol%20One/VOL%20ONE%20CHAPTER%20II.pdf>.
177. Rhonda Parker, "TS Debby Impacts St. Augustine Sewer System, FEMA Aid Available for 11 Counties," *Examiner.com*, July 5, 2012, <http://www.examiner.com/article/ts-debby-impacts-st-augustine-sewer-system-fema-aid-available-for-11-counties>.
178. Northeast Florida Regional Council, "Emergency Preparedness," 58.

179. National Historic Landmarks Program, "St. Augustine Town Plan Historic District," accessed March 4, 2013, <http://tps.cr.nps.gov/nhl/detail.cfm?ResourceId=1028&ResourceType>.
180. City of St. Augustine, Florida, "St. Augustine Seawall Flood Mitigation Project."
181. Maurice Postal, Keith Joiner, and Tobin Lilly, *Northeast Florida*, The Likelihood of Shore Protection Along the Atlantic Coast of the United State, 2010, 331, <http://risingsea.net/ERL/shore-protection-retreat-sea-level-rise-Northeast-Florida.pdf>.
182. Ibid., 52.
183. National Oceanic and Atmospheric Administration, "Sea Level Rise and Coastal Flooding Impacts," accessed February 13, 2013, <http://www.csc.noaa.gov/slr/viewer/#>.
184. Ibid.
185. Cecile-Marie Sastre, "Historic St. Augustine Seawall, National Historic Preservation Act Section 106 Report," January 10, 2005, 11–12, <http://ufdc.ufl.edu/UF00095518/00002/1j>.
186. Manucy, 13.
187. National Park Service, "Castillo De San Marcos National Monument," May 6 and May 24, 2013, <https://www.facebook.com/CastilloNPS>.'
188. Allen Grove, "The Florida East Coast Railway Buildings at Flagler College," *A Photo Tour of Flagler College*, accessed March 11, 2013, http://collegeapps.about.com/od/phototours/ss/flagler-college-photo-tour_13.htm.
189. Sastre, 22.
190. Burpee, email correspondence with author, December 28, 2012.
191. Ibid.
192. Editorial staff, "Our View: Quick Federal Grant OK Needed for Seawall's Fix," *St. Augustine Record*, August 7, 2011, <http://staugustine.com/opinions/2011-08-17/our-view-quick-federal-grant-ok-needed-seawalls-fix>.
193. Guinta, "Part of Seawall Destined to Fall."
194. Ibid.

195. City of St. Augustine, Florida, "St. Augustine Seawall Flood Mitigation Project."
196. Ibid.
197. St. Augustine Record, "Mica Gets Funding for Seawall," *St. Augustine Record*, August 19, 2011, <http://staugustine.com/news/local-news/2011-08-20/mica-gets-funding-seawall>.
198. Jennifer Edwards, "Seawall Project Begins," *St. Augustine Record*, February 13, 2012, http://staugustine.com/news/local-news/2012-02-13/seawall-project-begins#.UTT_HhnpZQ6.
199. Ibid.
200. This calculation is based on NOAA's tide data stating the mean tide range in St. Augustine is 4.61 feet (1.4 meters); the spring tide range is 5.15 feet (1.6 meters).
201. Sheldon Gardner, "Downtown's Flooding Problem Not Expected to Improve," *StAugustine.com*, November 16, 2012, <http://staugustine.com/news/local-news/2012-11-15/flooding-problem-most-downtown-st-augustine-not-expected-improve>.
202. Ibid.
203. City of St. Augustine, Florida, "Code of Ordinances," *Municode*, n.d., <http://library.municode.com/index.aspx?clientId=10951>.
204. St. Johns County, Florida, "St. Johns County Flood Facts," 2012, <http://www.sjcfl.us/media/SJCFemaFlood.pdf>.
205. Postal, Joiner, and Lilly, 326.
206. Florida Atlantic University, National Commission on Energy Policy, *Florida's Resilient Coasts*, 2007, 14, http://www.cakex.org/sites/default/files/Fl_ResilientCoast.pdf.
207. Governor's Action Team on Energy and Climate Change, "Florida Climate Action Team: Technical Working Groups," 2013, <http://www.flclimatechange.us/Adaptation.cfm>.
208. Florida Department of Economic Opportunity, *Implementing "Adaptation Action Area" Policies in Florida*, 2012, <http://www.floridajobs.org/fdcp/dcp/AdaptationPlanning/AAAPolicy.pdf>.
209. Florida Atlantic University, National Commission on Energy Policy, *Florida's Resilient Coasts*, 16.

210. The Florida Division of Historic Resources has mapped National Register properties on GIS. This data can be overlaid on LiDAR maps to determine historic properties at risk.

211. Postal, Joiner, and Lilly, 342.

212. Ibid.

213. Kathryn Frank (Assistant Professor, University of Florida), telephone interview with author, February 1, 2013.