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Washing Away Our Heritage: The Impacts of Rising Sea Levels on National Historic Landmarks in Boston, Massachusetts and Charleston, South Carolina

Melanie Weston

Clemson University, melanie.jo.weston@gmail.com

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WASHING AWAY OUR HERITAGE:
THE IMPACTS OF RISING SEA LEVELS ON
NATIONAL HISTORIC LANDMARKS IN
BOSTON, MASSACHUSETTS AND CHARLESTON, SOUTH CAROLINA

A Thesis
Presented to
the Graduate Schools of
the College of Charleston and Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Historic Preservation

by
Melanie Jo Weston
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Barry Stiefel, Committee Chair
Carter Hudgins
R. Grant Gilmore III

ABSTRACT

Rising sea levels not only threaten coastal infrastructure and private property, but also the world's historic resources. This thesis examines the impacts of rising sea levels on the historic resources of Charleston, South Carolina and Boston, Massachusetts. These two cities are prominent in American history, home to a significant number of National Historic Landmarks, and are recognized as the cultural capitals of their regions. These cities will be studied closely in this work not only for their effects from rising sea levels but also for possible adaptations and mitigation policies against the predicted effects of sea level rise.

AWKNOWLEDGMENTS

This thesis is dedicated to my late grandfather, Richard M. Fereshetian. Thank you for passing on your stubbornness, work ethic, and inability to give up on your dreams. I also need to acknowledge the support of my family, most importantly my parents. This also includes my southern family, the Pintos. Thank you for feeding, supporting, and loving your “Yankee child.” To Kathy Noland, Kristin Threet, and my coworkers at the market shop of Historic Charleston Foundation, thank you for the tough love and having so much faith in me, often times more than I had in myself. I am so lucky to have been able to call such a wonderful group of people my work family. To Allisyn Morgan (Miller) and Mary Margaret Schley, thank you for being an ever needed friendly face, offering advice and reinforcement, and being constant guides through red tape. Finally, this thesis could not have been completed without the guidance, patience, and encouragement of my thesis advisor Barry Stiefel.

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CHAPTER I: INTRODUCTION

According to the National Aeronautics and Space Administration (NASA), estimates, one third of the world's population (roughly 2 billion people) lives within 60 miles of the coast. This statistic is often used in current discussions about the impacts of climate change and rising sea levels on human society and infrastructure. From a historic preservation perspective, the follow up question to this statistic is: How many of the world's historic and cultural resources are within 60 miles of the coast?

This thesis addresses the potential impact on historic resources of rising sea levels and what policies can be put into place to mitigate the effects. When looking at potential impacts, the physical impacts to specific structures and historic districts is discussed. However, the economic and social impacts that will occur from the loss or semi-destruction of these historic resources will also be delved into. This thesis assesses what policies are already in place on a local, state, national, and an international levels to help mitigate the effects of climate change to not only see which policies are working effectively and which ones are not, but to also serve as a guide when suggesting new policies. Coincidentally with the National Historic Preservation Act of 1966's 50th anniversary, the law will be up for review. This could prove to be an opportune moment to address the issues of climate change as it relates to historic preservation.

While this thesis deals solely with rising sea levels, this is not the only consequence of climate change that will have an impact on historic structures. Droughts worsening forest fires, worsening storms, etc. will all have a toll on the historic resources we value most. In the course of this paper, climate change will be referred to as the broad

spectrum of effects caused by the anthropogenically caused warming of the Earth. Rising sea levels is just an offshoot of this event.

Charleston and Boston were chosen as case studies for this thesis for a number of reasons. First, it would be almost impossible under the time constraints given to complete a thorough survey of historic resources that will be impacted by sea level rise on a global or even a national scale. It makes much more sense to compare and contrast the experience of two cities with similar pasts, but very different trajectories. Second, Charleston and Boston are two high profile examples of sea level rise impact. The way both cities have begun to handle climate change varies. Both have received significant media attention for this issue specifically and for their treatment of historic resources. Third, both cities have often been compared in historic literature and examining how both cities will adapt to climate change will continue that tradition.

Finally, both offer contrasting views of the subject matter. One city is located in the Northeast, the other in the Southeast. Historically, both have served as the cultural, economic, and political centers for their regions. However, the way both cities developed has differed drastically since the antebellum era.

In order to better understand why Boston and Charleston specifically will be impacted by rising sea levels, this thesis includes a brief overview of the history of both cities. Their geography, growth, and formation as cities will provide a context for the rest of the work. Specifically, this background history will focus on the major periods of construction and expansion in these cities. The use of fill to add usable land is closely examined. Fill is made of trash and the debris of damaged or destroyed buildings.

Understanding where fill was used as well as the layout and condition of the storm drain systems will help to understand why these two cities are especially vulnerable to rising sea levels. It is also necessary to consider previous disasters that affected these cities' histories. For instance, hurricanes Hugo and Sandy both had major impacts on Charleston and Boston, respectively. These hurricanes could be used as examples for what may happen in the future to these cities on a worse scale, if adaptive measures are not taken.

Boston has numerous works written on the building and environmental history of the city. These works are mostly books. Among them are *Gaining Ground: A History of Landmaking in Boston* by Nancy Seasholes and Michael Rawson's work *Eden on the Charles: The Making of Boston*. These books, among others, will be useful in creating a contextual history for the physical development of the city and how that relates to what the impacts of sea level rise will be. One book in particular, *Boston's Back Bay: The Story of America's Greatest Nineteenth-century Landfill Project* by William A. Newman, will help to show how infill within the city makes it particularly vulnerable to rising sea levels.

Charleston, however, only has one book written specifically on the construction and development of the city. *Building Charleston: Town and Society in the Eighteenth-century British Atlantic World* by Emma Hart, was published in 2010 by the University of Virginia Press. While it discusses urban growth and is useful in creating a context for readers, it is not as specific to building history as the sources on Boston. There are other longer and shorter books on overall Charleston history as well as books specifically detailing the architecture of the city such as *The Buildings of Charleston* by Jonathan H.

Poston. However, these books written as a guide to specific buildings will only be useful to discuss landmarks on their own and not the city as a whole.

Both Charleston and Boston are known for a concentration of historic resources. This focus has been narrowed even further to concentrate only on the National Historic Landmarks (NHL) within each city. In 1935, the Historic Sites Act was passed, giving the Secretary of the Interior the authority to designate properties as having “national historic significance.” The Secretary of the Interior designates NHLs through a nomination process done by the National Park Service. Currently, there are only about 2,500 NHLs in the country. NHLs are buildings, sites, or objects that are of national significance. There are also National Historic Landmark Districts (Beacon Hill Historic District in Boston and also Charleston’s Historic District are NHLs). NHLs were chose to serve as the sample of these cities’ historic resources because they represent, by current preservation standards, the most nationally significant buildings or sites within these cities.

Restricting the focus of this study to NHLs does come with some drawbacks. NHLs offer a very limited representation of a city’s historic resources. They are normally dominated by examples of high architectural style and the majority of these properties were nominated over thirty years ago. While these structures and sites are of course essential to these cities’ understanding of their history and culture, the NHLs represent only a sample of the historic resources that are at risk within these two cities.

In the Boston area there are currently 58 NHLs. Charleston has 39 NHLs,¹

¹ The full list of these NHLs can be found in Appendices A and B.

including the Charleston Historic District, three former navy vessels now in harbor at Patriot's Point in Mt. Pleasant, and Fort Sumter which was declared a historic landmark by the National Park Service prior to the 1960 creation of NHLs. Not all will be discussed in detail. Some, especially the NHLs that are not within the downtown historic districts, will play less of an important role in the analysis. For the purpose of this thesis, Charleston's NHLs have been limited to those located on the peninsula and Ft. Sumter. Boston's NHLs have been limited to those on the peninsula as well as in the Back Bay neighborhood.

Historic preservation and climate change are topics not often discussed in the same tandem. There are very few sources written on what impacts climate change, specifically rising sea water levels, will have on historic resources and what historic preservation can do to help mitigate those effects. While there have been conferences on the topic and a few scientific organizations have come out with small reports on the issue, the overall literature seems content to keep historic resources relegated to only a brief mention. Infrastructure, urban development, gas emissions, economic factors, erosion, etc. are often the more discussed topics when it comes to mitigation or the impacts of rising sea water levels. In the past year, climate change and rising sea levels is becoming a much more prominent topic of discussion among preservationists. However, at the 2014 National Trust Conference in Savannah, Georgia, several workshops and panels addressed the subject matter.

A large amount of the sources for this thesis have been reports from various agencies and organizations. In the past decade, especially within the past five years,

numerous reports have been released on climate change. These reports have been produced by government agencies on all levels: national, state, local, and non-government. Scientific organizations have also released reports on their own findings and data. These reports prove helpful not only because they have current data on climate change but also because they reflect whom these issues are significant to. They provide scenarios and plans for adaptations in different regions, which will help to inform the recommendations issued at the end of this work. However, these reports also come with their own biases. Many state and even national agencies have long denied the urgency of climate change. Their adaptation plans often reflect what is important to a certain group, but not another. It is important to analyze these reports to identify their usefulness as well as their detriments.

On an international level, the most helpful report for this topic will be the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report on Climate Change. The IPCC produced its Fifth Assessment Report (AR5) was finished in 2013 and was approved in October of 2014. The AR5, and the assessment that came before it, was produced to evaluate current knowledge on climate change. These assessment are intended to inform the United Nations, who helped to set up the IPCC in 1988, and policy makers on the scientific data behind climate change, what the likely impacts will be, and to make suggestions on what possible mitigation options there are.

The AR5 has over 300 authors from 70 different countries. The document was broken into three “working groups.” The first working group is titled “The Physical Science Basis.” This section provides hundreds of pages of data and analysis on the

current scientific evidence that supports the reality of climate change. Up to date and accepted by the majority of the world's scientific community, this data has proven useful in helping support the arguments in this paper. The second working group, "Impacts, Adaptation, and Vulnerability," played the most important role in this thesis. This section uses scenarios to help policy makers inform their own decision-making processes. Urban planning as well as sustainable development is discussed in this section. The second working group also looks at how different regions of the world will be affected differently. The final working group is "Mitigation of Climate Change." Mitigation in this sense discusses what we can do presently to offset the damage that is already occurring.²

This report, even though influenced partly by government entities, provides the clearest synthesis on climate change in one document. While lengthy, it in and of itself is a literature review on climate change while also providing scenarios and ideas on policies for adaptation. It is not intended to explicitly inform government in their decisions on policy, but instead to provide the facts and has been extremely helpful for this thesis.

On a national level, the third National Climate Assessment (NCA) was released in 2014. Similar to the IPCC assessments, the NCA reports reflects the opinions of hundreds of experts who are led by sixty-member Federal Advisory Committee. These reports are reviewed not only by experts in the fields relating to climate change, but also by federal officials and the public before being released for publication. The basis for these reports comes from the Global Change Research Act of 1990, which requires federal funding to

² Intergovernmental Panel on Climate Change, *Fifth Assessment Report on Climate Change* (Geneva, 2013).

support research into global warming and that also a report be submitted to Congress on climate change every four years.

The NCA, like the IPCC assessment, consolidates knowledge on the current data and impacts of climate change into one source. One benefit of the NCA is that it is focused specifically on the United States. This is helpful when determining specific effects of climate change and rising sea levels on sites within the U.S. However, unlike the IPCC, the public and government officials prior to its release critically review the NCA report. It is hard to say what research or data has been omitted or put into the report based on opinions and views of those reviewing the document.³

State level reports are more numerous than national level reports, but the same set of biases are often present. Different organizations and agencies will release reports on climate change, but their focus on impacts and mitigation policies is drastically different depending on the author or what resource they are most interested in protecting. South Carolina, for instance, has several state reports released on climate change, but all are released from different agencies. In 2010, the Shoreline Change Advisory Committee released its report titled *Adapting to Shoreline Change: A Foundation for Improved Management and Planning in South Carolina*. This report's main focus is responsible planning and development in coastal areas and flood zones.⁴ Three years later, the Department of Natural Resources released a report focusing specifically on the impacts of

³ Jerry M. Melillo, Terese M.C. Richmond, and Gary W. Yohe, eds., *Climate Change Impacts in the United: The Third National Climate Assessment States* (U.S. Global Change Research Program, 2014).

⁴ Shoreline Change Advisory Committee, *Adapting to Shoreline Change: A Foundation for Improved Management and Planning in South Carolina* (South Carolina Department of Health and Environmental Control, 2010).

climate change on natural resources including wildlife habitat, marsh lands, certain species of wildlife, etc.⁵ These reports focus on different areas of need, but will play a role in forming a discussion on what issues relating to climate change have gotten attention in South Carolina. In Massachusetts at the state level, the Office of the Coastal Zone Management issued a report in 2013 titled *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning*. As the title implies, the report is focused mostly on using the sea level rise data and creating scenarios to inform future planning decisions.⁶

Boston had a series of reports written on the impacts climate change will have on the city. This includes *Climate's Long-term Impacts on Metro Boston (CLIMB)*, a report written by Tufts University's Civil and Environmental Engineering Department, which mostly focuses on the impacts to the city's infrastructure.⁷ There is also a movement by the city of Boston, called Green Boston, to help promote environmentally friendly policy. In 2010, Green Boston released a report with recommendations for a climate action plan.⁸ This report was followed up a year later with an update to the climate action plan. Both of these reports make specific recommendations to how the city should prepare and adapt to rising sea levels.

⁵ Bob Perry, ed., *Climate Change Impacts to Natural Resources in South Carolina* (Department of Natural Resources SC, 2013).

⁶ Massachusetts Office of Coastal Zone Management, *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning* (December 2013).

⁷ Paul H. Kirshen, William P. Anderson, and Matthais Ruth, *Climate's Long-term Impacts on Metro Boston (CLIMB)* (Civil and Environmental Engineering Department, Tufts University, 2004).

⁸ Green Boston, *Sparking Boston's Climate Revolution: Recommendations of the Climate Action Leadership Committee and Community Advisory Committee* (City of Boston, April 2010).

In contrast, Charleston on the other hand has had only one report written on climate change published within the last decade. The Charleston City Council created the “Charleston Green Plan” in 2010. This plan set forth guidelines for making the city more environmental sustainable, but also set up a plan of action to help the city adapt to climate change, specifically rising sea levels. This plan, however, was never adopted or put into place by the City Council.⁹ Instead, another report was created. The “Century V Plan” was presented to the City Council in September of 2010, revised in October of the same year, and adopted in February of 2011. The “Century V Plan” is very similar to its predecessor though there is no mention of climate change or any plans for adaptation.¹⁰

Besides reports released by governmental agencies, there are a number of reports released scientific organizations, such as the Union of Concerned Scientists. In fact, it is the Union of Concerned Scientists who have released the *only* report that is dedicated specifically to climate change impacts on historic resources. Released in 2014, the report titled *National Landmarks at Risk: How Rising Seas, Floods, and Wildfires Are Threatening the United States' Most Cherished Historic Sites*, uses multiple case studies to shed light on an important issue that is often overlooked: that many of America’s most important historic resources will be lost due to the effects of climate change. This report brought about a great deal of national attention through the media to this issue and hopefully will bring further academic consideration.¹¹

⁹ Charleston City Council, *Charleston Green Plan* (February 2010).

¹⁰ Charleston City Council, *Century V Plan* (September 2010).

¹¹ Debra Holtz et al., *National Landmarks at Risk: How Rising Seas, Floods, and Wildfires Are Threatening the United States' Most Cherished Historic Sites* (Union of Concerned Scientists, 2014).

Journal articles have been the most important secondary source for information relating to background data on climate change and rising sea water levels. Peer reviewed academic journals, like the reports mentioned earlier, have the largest amount of current data on climate change. Journal articles also tend to narrow their topics more specifically than books or larger scale reports to. For instance, there are several journal articles discussing the impact of rising sea levels on South Carolina specifically. Some even narrow the topic to focus specifically on the impact on South Carolina's economy.

Other than journal articles, there are also quite a few books included in this bibliography specifically pertaining to climate change. Starting in the 1980s, there has been an increase in the publication rate for books on climate change. As data and scientific evidence advances rather quickly, this thesis makes of books published primarily within the last decade. This is true also of journal articles. Many of the academic books on climate change will be useful in gaining an understanding of the background and scientific aspects of climate change. Few of these sources make little reference to architecture and almost none make any sort of reference to historic resources. Also, in many of these texts, mitigation and adaptation refers to lessening our population's carbon footprint and not to any physical changes to our built environment, which this paper is more interested in focusing upon. Some of these books do look at scenarios and adaptation of infrastructure, but the majority are interested in greenhouse gas emissions.

While there is a significant amount of current literature on climate change, few of the sources mention what impact climate change will have on historic resources. In order

to gain a better understanding on the topic this paper intends to broach, it will be imperative to gather sources from a multitude of different subjects and interpret them together.

Primary sources have been used to help better understand the current data on climate change. This includes lectures and talks given at conferences on climate change. These presentations are particularly enlightening to help fill in the blanks surrounding new ideas of how to incorporate preservation with climate change adaptation. Newspaper articles are also of critical importance. Newspapers are useful in better understanding local and national perspectives on climate change, specifically regarding the politics involved. Newspapers also provide critical insight into how localities are preparing and adapting to climate change.

While Boston and Charleston are the primary focus of this thesis, it will make note what other localities are doing to prepare for climate change. This thesis looks at examples from the United States, including Annapolis, Maryland and Jamestown, Virginia, as well as the international examples of Venice and the Netherlands. These smaller case studies will be looked at for the strength and weaknesses of their adaptation policies in order to inform the recommendations this thesis has prepared.

This series of recommendations provided for both cities was created around a set of scenarios. These scenarios will include whether the city decides to do nothing, provide for moderate mitigation of their historic resources (such as elevation or relocation certain structures), or attempt to completely save their historic resources, whether that be by creating a sea wall or some other measure.

While the subject of rising sea levels is often one that is left to scientists and environmentalists, this thesis will approach the topic from the perspective of a preservationist. The current scientific data, evidence, and literature on the topic will be discussed at some length in the first chapter. However, the majority of this thesis will relate this data and literature directly to the impact of rising sea levels on historic resources. This work is not intended to change the readers' opinions on the causes of climate change or to be considered a scientific report. It is intended instead to argue that the issue of rising sea levels is of serious concern in the field of historic preservation.

The 2014 report released by the Union of Concerned Scientists of historic landmarks at risk had this to say about Jamestown, Virginia: "By the end of this century, the only way to experience 'America's birthplace' may be by reading about it in history books or online." Now take this statement and apply it to the vast majority of America's historic resources scattered within a stone's throw of a coast line. What do we stand to lose? What have we already lost?

Charleston and Boston are only two cities that highlight a much larger crisis that the field of preservation will have to grapple within the coming decades. As public awareness and civic concern grows on the issue of rising sea levels, preservationists should begin to take a prominent role in the adaptation and mitigation planning process. Preservationists are specifically trained in the protection of historic structures, sites, and landscapes. Climate change and rising sea levels will prove to be one of the most significant threat to the world's historic resources in the coming decades. Should those of us who are most prepared to take action to save and protect those resources fail to do so,

the majority of our heritage will be lost. Future generations will learn about it as they will Jamestown: from a book, a website, or a scuba diving expedition.

CHAPTER II: THE IMPACTS OF SEA LEVEL RISE

The debate over climate change in the United States is highly political. Internationally, the controversy is not as severe. Most experts in the field of environmental and climate science are in agreement. Climate change and rising sea levels are not debatable. They are accepted fact. Currently in the United States, we are distracted by the debate on the causes of climate change and are unable to discuss a post sea level rise world. It is not the intention of this thesis to debate the cause of climate change. Forgoing the arguments surrounding what causes climate change and rising sea levels, this thesis instead concentrates on the impacts from sea level rise on our nation's historic resources.

To discuss the impacts of rising sea levels, we first must discuss the estimations and the current data that is available on the subject matter. Sea level rise is mainly caused by the expansion of the ocean as temperature in the atmosphere increases. Another source of sea level rise is the transfer of water once stored on land (most often in the form of ice sheets and glaciers) into the ocean.¹² Global mean sea level rise by 2100 is estimated to be between 0.52 to 0.98 meters with a rate of 8 to 16 mm per year.¹³ These numbers will vary dramatically on a regional level, however this is the projected rise on a global scale.

¹² IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 688 pp.1142.

¹³ IPCC, 2014, p. 1140.

While there are few models projecting sea level rise after the year 2100, there is also no evidence to suggest that rise in sea levels will slow after a century either.

Estimates on sea level rise vary based on two different things: geography and the melting of the polar ice sheets. Firstly, sea levels will not rise consistently across the world's coastlines. The rise will vary from one part of the world to another based on an area's terrain, erosion, tectonics, etc. Areas like Charleston and Boston that have seen extensive building campaigns using infill will see different types of damage. In other parts of the world, like Venice, land is even sinking. On the other hand, Alaskan coastlines are gaining land as glaciers recede.

Second, many of the estimates on how fast and how high sea levels will rise is entirely dependent on how quickly the Greenland and Antarctic ice sheets recede. The sooner they melt, the faster and higher sea levels will rise. This does not mean the data given by reports cited is inaccurate (or that climate change is not happening). Instead these numbers are based on estimates and averages. Additionally, thermal expansion due to warmer oceans will also magnify sea level rise affects.

At present, in Charleston, the mean average sea level rise is 3.16 mm per year.¹⁴ In Boston, it is 2.81 mm per year.¹⁵ These number equal about one foot in a hundred year period. However, there is evidence to suggest that the rate of these numbers are rising. In

¹⁴ NOAA. "Mean Sea Level Trend - Charleston, South Carolina." Tides and Currents. October 15, 2013. Accessed June 5, 2015.
[http%3A%2F%2Ftidesandcurrents.noaa.gov%2Fsltrends%2Fsltrends_station.shtml%3Fstnid%3D8665530](http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8443970).

¹⁵ NOAA. "Mean Sea Level Trend - Boston, Massachusetts." Tides and Currents. Accessed June 5, 2015.
http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8443970.

the past 40 years, sea levels have risen more than five inches in Charleston and that number continues to increase.¹⁶

Sea level rise alone is not the only concern for coastlines. The issue of rising sea levels exacerbates erosion, worsening storms, storm surges, and tidal flooding. Tidal flooding specifically is of serious concern for both Boston and Charleston. As of now, tidal flooding in both cities is considered merely a nuisance. In Charleston, tides cause flooding about two dozen times per year. However, this number has doubled since 1970 and is expected to more than triple in the coming decades. By 2045, Charleston will see more than 180 tidal floods a year. That is almost every other day.¹⁷ In Boston, the numbers are similar. Tidal flooding has quadrupled since 1970 to nearly nine times a year. By 2045, Boston will experience 70 tidal flooding events a year.¹⁸

The impacts from climate change go beyond the environmental and broach into the economic and social. In South Carolina, 88,000 people, 62,000 homes, and 384,000 acres of land are at risk from rising sea levels.¹⁹ The situation will get worse as coastal development continues unabated. Many of the communities at risk play a major role in the state's economy. Tourism brings 30 millions visitors to the state each year and is responsible for 11 percent of the state's employment. This is an important factor when

¹⁶ Spanger-Siegfried, Erika, Melanie Fitzpatric, and Kristina Dahl. *Encroaching Tides: How Sea Level Rise and Tidal Flooding Threaten U.S. East and Gulf Coast Communities over the Next 30 Years*. Report. Union of Concerned Scientists, October 2014. 29.

¹⁷ Ibid.

¹⁸ Ibid. p. 44.

¹⁹ Climate Central. "Fact and Findings: Sea Level Rise and Storm Surge Threats for South Carolina." Accessed June 6, 2015.

considering the towns of Myrtle Beach and Charleston. Also, almost 60 percent of the state's tax revenue comes from coastal counties.²⁰

Boston does not fare much better. In fact, a study conducted by the Organization for Economic Cooperation and Development lists Boston as the eighth most at risk city in the world from rising sea levels. The study stated that in 2005, average losses from flooding was \$6 billion in coastal cities like Boston. By 2050, this number will be closer to \$52 billion.²¹ In Boston specifically, the Commonwealth of Massachusetts has calculated that rising sea levels by 2050 could cause \$464 billion in damage to infrastructure.²²

In the discussion on what will be impacted by climate change, very few reports mention cultural resources. The Union of Concerned Scientists is the only organization to release a report in the U.S. solely on this issue. Their report titled *National Landmarks at Risk*, was released in the spring of 2014. It details a number of significant historic sites in the U.S. including Jamestown, as well as Charleston and Boston. The report is focused on all the impacts of climate change: worsening wildfires, sea level rise, etc.²³

In Charleston and elsewhere in South Carolina, there have been no reports that have brought up the threat to historic resource, though few reports on the impacts of

²⁰ Von Lehe, Art. "Climate Change and South Carolina's Economy." *Southeastern Environmental Law Journal* 16, no. 2 (Spring 2008): 359-90.

²¹ "Which Coastal Cities Are at Highest Risk of Damaging Floods? New Study Crunches the Numbers." The World Bank. August 19, 2013. Accessed June 17, 2015. <http://www.worldbank.org/en/news/feature/2013/08/19/coastal-cities-at-highest-risk-floods>.

²² Executive Office of Energy and Environmental Affairs, and Adaptation Advisory Committee. *Massachusetts Climate Change Adaptation Report*. Report. September 2011.

²³ Holtz, Debra, Adam Markham, Kate Cell, and Brenda Ekwurzel. 2014.

climate change have been released in the state as it is. In Boston, the same is true. One report, *Preparing for the Rising Tide*, released in February 2013, did feel the need to discuss the impact of rising sea levels to Boston's historic districts and neighborhoods because they represent a large portion of the city.²⁴

However, the fact remains that historic resources not only represent a piece of these cities' cultural identity, but also are a large part of their social and economic lifeblood. People travel to Boston and Charleston to view the well preserved historic structures and districts. People spend money, go on vacation, and buy property in these cities because of the historic character and landscape. People choose to study at the institutions of higher learning in these cities because of the historic ambiance of collegial charm. The economic and cultural impact to these cities from rising sea levels will not just come from damage to infrastructure or the displacement of communities. It will come at the price of the loss of irreplaceable pieces of American history. The sites where the Boston Massacre and the Boston Tea Party occurred, the oldest synagogue in continuous use in the U.S., the fort where the first shots of the American Civil War were fired, homes of signers of Declaration of Independence and the Constitution, and the list goes on and on. All of these sites and more will forever be lost, or damaged beyond repair, should preservationists sit back and ignore the coming impacts of rising sea levels.

²⁴ Douglas, Dr. Ellen, Dr. Paul Kirshen, Vivien Li, Chris Watson, and Julie Wormser. *Preparing for the Rising Tide*. Report. Boston Harbor Association, February 2013.

CHAPTER III: A TALE OF TWO CITIES

Understanding the cities' evolution in this study is just as important as understanding the scientific data. A city's history not only provides insight into the cultural and economic significance of these two case studies, but also shows why these two locations are particularly susceptible to the impacts of climate change. As stated in the previous chapter, rising sea levels will not affect every geographic area in the same way. Charleston and Boston are prime examples of this. Both cities are located on peninsulas and highly susceptible to flooding. Also, both cities have had massive infill projects to expand land use, which makes the risk of flooding even greater.

There have been dozens of books written chronicling the history of both these cities. This chapter does not aim to reinvent the wheel and give a detailed account of the history of Boston and Charleston. Instead, this chapter will focus only on specific areas of the chronology or events that are important to the discussion of climate change and the impact on historic resources within these two cities.

There are many parallels in the histories of Charleston and Boston. Their development as early colonial cities is very similar. Both cities were founded on highly defensible peninsulas after failed attempts at other nearby settlements. Ironically, both of these failed settlements were named Charlestown. Large-scale infill projects expanded opportunity for building and growth in the two cities. Until the mid-nineteenth century, both cities had similar populations. In the antebellum era, the two cities began to evolve

in different directions, however the current effects of climate change on the two cities remains very similar. How the two cities will cope with the impacts remains to be seen.

The first colonist in Boston arrived in 1625. Reverend William Blaxton built a house and began a small farm near what is now Beacon Hill. Five years later, a group of settlers arrived as part of the Massachusetts Bay Company under the leadership of John Winthrop. They first settled in Charlestown across the river, but after finding a lack of fresh water moved to the peninsula, known by Native Americans as “Shawmut.”²⁵ The Town of Boston was officially founded in 1640. William Wood, who visited the area in 1634, published the first written description of Boston. He describes Boston as a square peninsula, connected to the town of Roxbury by a neck that is less than an eighth mile wide. He went on to write, “Up higher it is a broad bay, being above two miles between the shores, in which run Stony-river and Muddy-river. Towards the southwest in the midst of this bay, is a great oyster bank.”²⁶ He was describing the Back Bay.

Almost fifty years after John Winthrop arrived at Boston, a group of ninety-three settlers made landfall at what they named Albemarle Point, Carolina in April 1670. The settlement became to be known as Charlestowne after King Charles II. The first settlement was located in present day West Ashley, across the Ashley River from what was called Oyster Point, the more highly defensible peninsula to the east. Oyster Point was named for the prominent shell mounds left by Native American at what is now White

²⁵ Walter Muir Whitehill, *Boston; a Topographical History* (Cambridge, MA: Belknap Press of Harvard University Press, 1968), p. 4.

²⁶ William A. Newman and Wilfred E. Holton, *Boston's Back Bay: The Story of America's Greatest Nineteenth-century Landfill Project* (Boston: Northeastern University Press, 2006), pps. 13-14.

Point Gardens.²⁷ Land grants had been given out for the peninsula since the first settlers arrived and it took only a few years before the settlement was moved to peninsula permanently.

Land expansion in Charleston began almost immediately along with the efforts for the most prominent building project in the city's history: the walled city. Charleston is well known for being the only fortified walled city in the American colonies. The construction of these defenses began in 1704. The town's major battery, Granville Bastion was enlarged.

The remnants of this structure still remain under 40 East Bay Street (now the headquarters for Historic Charleston Foundation). Beside the Bastion, a fifteen-foot high brick wall was

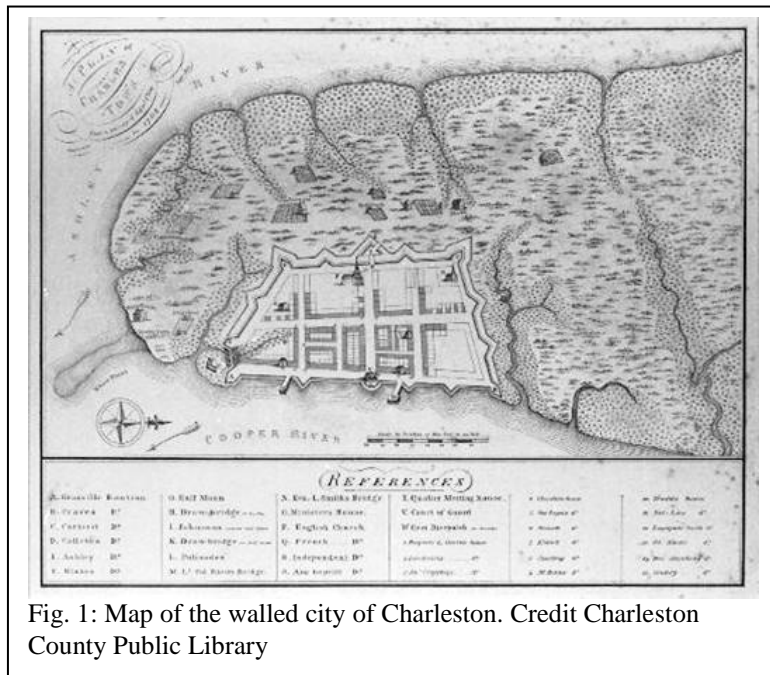


Fig. 1: Map of the walled city of Charleston. Credit Charleston County Public Library

built on infill of oyster shells, soil, palmetto logs, and cypress planks. The wall ran from the Granville Bastion to a half-moon battery located near the intersection of Broad and

²⁷ Walter J. Fraser, *Charleston! Charleston!: The History of a Southern City* (Columbia, SC: University of South Carolina Press, 1989), pps. 3-4.

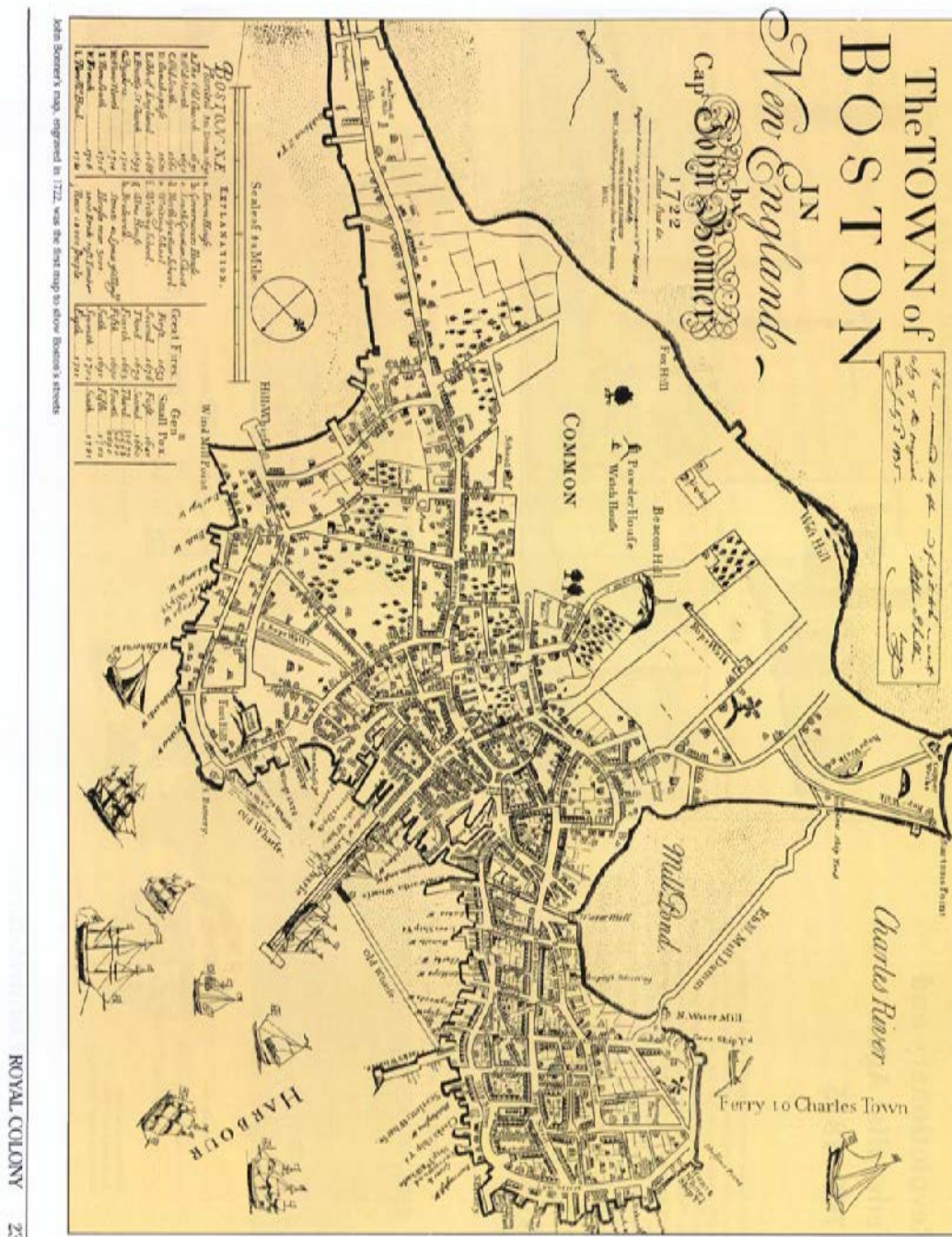


Fig. 2: 1722 Map of Boston, prior the infill of the Back Bay.

East Bay Streets. A portion of this sea wall was uncovered in the basement of the Old Exchange Building and Provost Dungeon.²⁸

Infill projects did not stop within the walled city. Within a few decades, population increase forced land expansion projects to continue in the areas outside the walled city. In the 1760s and 1770s during a period of great expansion, two developers, William Gibbes and Edward Blake, filled in marshland that would become White Point at the very southwestern end of the peninsula.²⁹ In 1819, the city seawall was completed. The creation of the Battery allowed for the development of new lots. This area of town is now home to many prominent mansions, including a few NHLs.³⁰ Prior to the nineteenth century, the area west of King Street to the Ashley River was predominantly wetlands. In 1909, Andrew Buist Murray, a prominent businessman, infilled fifty acres of marsh south of Tradd Street. By 1911, the Battery had expanded to protect this new boulevard and the lots that had developed upon it.³¹

The need for more land on the Boston peninsula became clear very early as well. What sparked the first infill project in Boston was the manufacturing of rope. Ropewalks, the area where ropes were created, were prone to fires and in 1796 six ropewalks burned destroying over ninety buildings in the center of Boston. The ropemakers were granted three hundred feet of land west of Boston Commons, mostly marshland. They were required to create a sea wall and fill the marsh themselves. However in 1807, “Boston

²⁸ Ibid. p. 12.

²⁹ Ibid. p. 120.

³⁰ Jonathan H. Poston, *The Buildings of Charleston: A Guide to the City's Architecture* (Columbia, SC: University of South Carolina Press, 1997), p. 129.

³¹ Ibid. p. 294.

had to add more fill to a ten-foot-wide strip of Charles Street beside the Common because of flooding during high tides. The land used then for the new ropewalks would become part of the Public Garden a few decades later.”³²

The infill in Boston did not stop with the Commons. Soon, the Back Bay was being eyed for a large-scale infill project. This was largely due to overcrowding on the peninsula, pollution, and pressure from the upper class due to immigration. The population of Boston quadrupled between 1800 and 1840, reaching 93,383. Eighty three percent of these people lived on the peninsula in Boston’s heart.³³ As immigration increased into the city, Boston’s old elite began to demand new areas to expand that would be free of immigrant and lower class individuals. Pollution caused by increasing numbers of mills in the city also helped the case for infill. New dams from the mills were causing “noxious substances, and sources of filth, to rest and remain on said flats, to the great injury of citizens.”³⁴

In 1848, the General Court established the Commissioners on Boston Harbor and the Back Bay. This commission completed a report in 1852, recommending the infill of the Back Bay, however due to legal issues and disputes between government agencies, an agreement was not signed until 1856 to begin the project. The Tripartite Indenture brought together the Commonwealth of Massachusetts, the city of Boston, and Boston Water Works to finalize the plans for the laying of sewer lines and levels of grade. These sewer lines would help to pump the water out of the former bay and away from the newly

³² Newman, 2006. P. 20.

³³ Ibid. p. 43.

³⁴ Ibid. p. 35.

created neighborhood. Today, the Back Bay is one of the most highly sought after neighborhoods in Boston. Famous landmarks, including Trinity Church and Boston Public Library, are located here.

Of the NHLs being analyzed in this work, seven in Boston are located within the Back Bay neighborhood. Now one hundred and fifty to two hundred years old, the infill projects of Boston and Charleston remain some of the most popular neighborhoods within their respective cities. The Back Bay in Boston as well as the Battery and Murray Boulevard areas of Charleston still maintain some of the highest real estate prices in these



Fig. 3: Kayakers inside the Charleston City Market during a period of flooding. Credit Charleston City Paper.

cities. However, these areas of infill are precarious at best. The Back Bay is riddled with unstable foundations. The Charleston City Market resorts back to its roots as a creek during periods of heavy rain at high tide. While these infill projects have expanded these cities to the thriving and sought out destinations they are today, it could also endanger them to the ever

increasing risks associated with rising sea water levels.

While Boston and Charleston were settled and expanded in their respective peninsulas for a number of reasons – defensibility, trade, resources, etc. – the location also made them especially exposed. These two cities location on the Atlantic has also made them extremely vulnerable to severe storms. This has been true for hundreds of

years. In 1728, Charleston was not only plagued by draught and disease, but a “violent hurricane” swept through that damaged ships in the harbor, destroyed wharves, fortifications, and the houses along Bay Street.³⁵ A more recent account written by the “Harvard Crimson” tells of a storm that swept through Boston in 1962 (supposedly the worst storm in almost a decade). The combination of a two-day Noreaster and the effects of Hurricane Daisy, caused nineteen deaths in New England, put the Kennmore MTA station under eight feet of water, and caused more than 3000 cellars to flood throughout

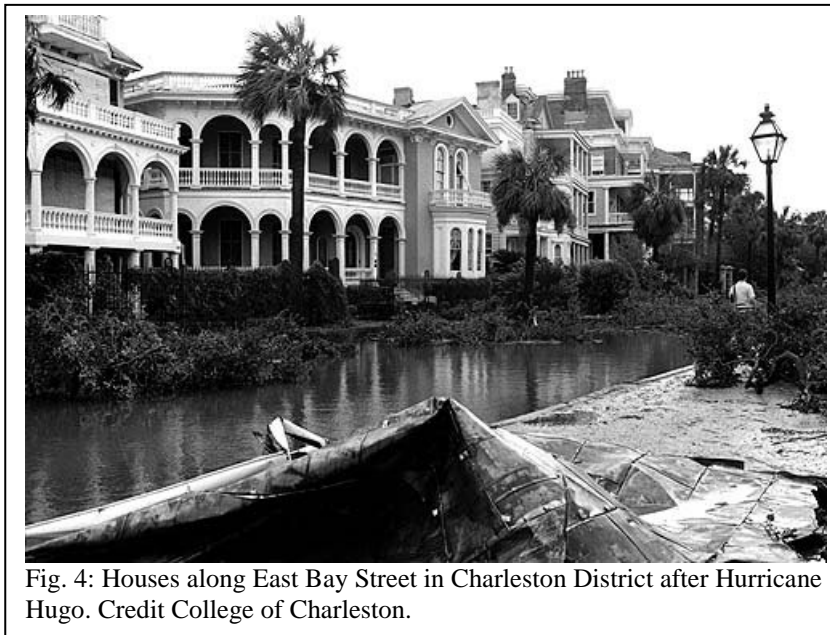


Fig. 4: Houses along East Bay Street in Charleston District after Hurricane Hugo. Credit College of Charleston.

the Boston metro area.³⁶ However, in more recent history, both of these cities have seen the impact of severe storms.

On September 21, 1989, Hurricane

Hugo made landfall just north of Charleston in the town of McClellanville. The storm surge in Charleston Harbor was measured at between 12 to 17 feet. The islands to the south and north of Charleston took the brunt of the damage. Folly Beach saw eighty

³⁵ Fraser, 1989. p. 44.

³⁶ Cotton, Richard. "Weekend Torrents Hit Boston, Cause Floods." *The Harvard Crimson*. Harvard University, 8 Oct. 1962. Web. 25 May 2015.

percent of its homes destroyed. In downtown, the damage to historic structures was immense. Many of the NHLs being analyzed in this work saw at least minor damage if not more. Hibernian Hall and Market Hall both lost their roofs and suffered water damage. Over 3,500 significant buildings in the city saw some type of damage from the storm according to the preservation societies who after the storm conducted a survey.³⁷

While less severe in damage to Boston than Hugo was to Charleston, Hurricane Sandy still brought a great deal of awareness to the city and northeast in general on worsening storms. Throughout the state of Massachusetts, there was \$20.8 million in damage.³⁸ In fact, by the time Hurricane Sandy made landfall, it was not even classified as a Hurricane any longer, making its effects even more troubling. Of more concern has been Noreasters, winter storms which cause tidal flooding. In 2014, winter storm flooding at high tides exceeded the flooding caused by Hurricane Sandy.³⁹

As the effects of rising sea levels continue to impact the cities of Boston and Charleston, the maps will slowly begin to revert back to those of the earliest settlers. Land expansion, while necessary at the time they took place, will prove a detriment to these cities as water continues to rise. It may be an option to simply let water retake these landscapes once more. In further chapters we will discuss a plan formulating in Boston to do just that. However, these districts have become not only historically significant in

³⁷ Fraser, 1989. Pps. 439-442.

³⁸ "Storm Events Database." *National Climactic Data Center*. National Oceanic and Atmospheric Administration, n.d. Web. 25 May 2015.

³⁹ Spanger-Siegfried, Erika, Melanie Fitzpatric, and Kristina Dahl. *Encroaching Tides: How Sea Level Rise and Tidal Flooding Threaten U.S. East and Gulf Coast Communities over the Next 30 Years*. Report. Union of Concerned Scientists, October 2014. p. 44.

themselves, but also essential to the economic and cultural backdrop of these communities.

Understanding the history of these two cities will help to make educated decision regarding adaptations to climate change. The frontline of sea level rise and climate change in these two cities is their historic neighborhoods. Having an accurate perception of how these cities were developed is vital in creating policies towards mitigation and adaptation. With respect to the historic landmarks that these neighborhoods house, it is also of the utmost importance to understand the historical significance behind these structures and sites. The day will come – sooner than preferred– when the tough call will have to be made about what can be saved and what will have to be sacrificed.

CHAPTER IV: THE CURRENT EFFORTS

Boston and Charleston have divergent paths when it comes to their approach to addressing climate change. Boston has set a prominent example for the country in its long term-planning and community outreach efforts to adapt to the climate change effects, especially rising sea water levels. Charleston, on the other hand, has difficulty even using the term “sea level rise” in their official city reports. Long term planning or even the establishment of a city wide task force to explore future policies is in the future for Charleston, however how long off these goals may be is still unclear.

Both cities seem to have taken their cues on how to react to climate change from their respective state governments. The Commonwealth of Massachusetts has been extremely proactive in setting into place policies for adaptation and mitigation. South Carolina, on the other hand, has been accused of burying reports that speak about the realities of climate change and what the impacts will be on the state. Like the City of Charleston, South Carolina also appears to have trouble even using the term “climate change” in any of their official reports.

Long-term protection of the nation’s historic resources from the effects of rising sea levels will depend on the efforts of national, state, and local government agencies to create policies that will not only actively address the threat but put into action plans for mitigation. Again, local municipalities like Boston and Charleston will take their cues from state and national policies. Thus far, the only active policies we have seen regarding rising sea water levels have been at the state and municipal levels, and none of them have addressed the threat to historic resources.

On the national level, the debate surrounding climate change still has set back any action on the issue. Other than the release of the *National Climate Assessment*, which only issues information and data on climate change to the government, there are few policies in place that even address climate change. One of the few laws that actually deal specifically with climate change is the Coastal Zone Management Act. In this law, there is a clause that states that sea level rise is happening.

Surprisingly, the United States Navy has taken the most active and vocal approach at the national level to move ahead of climate change. The U.S. Navy has declared climate change a “national security challenge.” Beginning in 2009, the Navy began a task force to not only understand the implications of climate change, but to also develop strategies for future policies and planning.⁴⁰

In South Carolina, several state level agencies have made headway in acknowledging the reality of climate change and the impacts it will have on the economy, environment, and infrastructure. However, these agencies have done little to introduce active policies leading to adaptation or mitigation and there is no mention of the protection of historic resources. In 2012, the South Carolina Department of Natural Resources released a report titled “Climate Change Impacts to Natural Resources in South Carolina.”⁴¹ While the report is forward thinking in that there is an entire section devoted to sea level rise, the majority of the report is concerned with the impact to

⁴⁰ Task Force Climate Change / Oceanographer of the Navy. *U.S. Navy Climate Change Road Map*. 2010.

⁴¹ South Carolina Department of Natural Resources. *Climate Change Impacts on Natural Resources in South Carolina*. 2012.

wildlife and habitats. What is more interesting is the fact that this report was apparently “buried” by state officials. It is now only used on an “information only” basis.⁴²

In 2010, the Shoreline Change Advisory Committee issued a report on climate change and how it would affect South Carolina’s coastal communities. The report issued a series of recommendations on how coastal cities and towns could adapt to climate change, specifically rising sea levels. However, these recommendations were just that, recommendations.⁴³ The following year, the state appointed a “blue ribbon on beachfront management” committee to explore regulations surrounding beachfront management and what laws could be changed. The committee used the 2010 report, but in their final report released in 2013, there was no mention of the term “climate change” and “sea level rise” was only brought up once.⁴⁴

The Commonwealth of Massachusetts has gone beyond simply admitting that climate change is happening and has begun enacting state laws that will actively work towards adaptation and mitigation. In Massachusetts, it is now state law that all state agencies when “issuing permits, licenses, and other administrative approvals and decisions,...consider reasonably foreseeable climate change impacts...such as predicted sea level rise.” There is also a statewide Climate Change Adaptation Advisory Committee that is tasked with developing strategies of adaptation.⁴⁵ This proactive stance

⁴² Peterson, Bo. "Shelved S.C. DNR Climate Warming Report Edgy but Not over the Edge." *Post and Courier* (Charleston, SC), March 5, 2013.

⁴³ Shoreline Change Advisory Committee, 2010.

⁴⁴ Blue Ribbon Committee on Shoreline Management. *Final Report*. Report. 2013.

⁴⁵ Green Boston, April 2011. p. 9.

on the part of the state has encouraged towns and cities within the state to take action as well. It has sparked an attitude of adaptation rather than simply ignoring the issue.

On a local level, the biggest hurdle to the protection of historic resources from the impacts of rising sea levels will be the issue of ownership. Private owners, mostly as private residences but some as businesses, own the majority of NHLs in Charleston and Boston. There are some instances where these privately owned NHLs are public institutions. In Charleston, the College of Charleston is the city's largest NHL, consisting of several city blocks. In Boston, one of the NHLs is owned by Massachusetts General Hospital, one of the oldest hospitals in the country, but now one of the largest. Many other NHLs are religious institutions. In Charleston, the denominations of the congregations vary. In Boston, however, many of the churches that are NHL are under the ownership of the Episcopalian Church.

Local government agencies operate the remaining NHLs. The Charleston City Market and Quincey Market, both of which generate a great deal of tourist traffic and commerce within their respective cities, are both owned by the city. In Boston, however, there is also the Massachusetts State House, which is under the guardianship of the Commonwealth of Massachusetts. In Charleston, the most recognized NHL, Ft. Sumter, is owned and operated by the National Park Service.

With all of these different players involved and the range of stakeholders, the process towards adapting for climate change is made more difficult. The question then is should these individual players themselves create plans for adaptation or should there be a citywide effort towards adaptation and mitigation? Boston and Charleston have both

taken different paths in their approaches. Which path will be the most effective, time will only tell.

In Boston, the local government has been the forerunner not only in the city but also in the country for climate change policies. In 2007, Mayor Thomas Menino of Boston issues an executive order on climate change. This put into place policies that would actively start to reduce greenhouse gas emissions from the local government and begin long-term planning to adapt to the effects of climate change.⁴⁶ It is the attitude of Boston city government, that it should be the job of the local government to take the lead in efforts to mitigate and adapt to climate change and to engage the community on the issue. A working group was developed, which includes eight city agencies and departments, to coordinate efforts. However, even in their official reports, the city admits, “sea-level rise in Boston Harbor will involve many property owners and businesses, a dozen communities and municipal, state, and federal authorities...Climate adaptation will require action by and support from Boston residents, businesses, and institutions.” This public outreach is not just in foresight. In fact, this working group has conducted forums with business owners and town hall meetings in the East Boston and Dorchester neighborhoods.⁴⁷

Aside from gaining community support, Boston has taken proactive efforts in long-term planning to adapt to climate change. The Boston Redevelopment Authority, which administers the Boston Zoning Code and reviews all large projects, has now begun asking developers to analyze what effects climate change will have on their sites. In

⁴⁶ Ibid. p. 4.

⁴⁷ Ibid. p. 8.

2010, the BRA required a developer of 6.3 million square-foot project in South Boston to “comply with applicable State and City strategies for addressing sea-level rise and climate change.”⁴⁸ The Boston Water and Sewer Commission also began a project in 2010 that will begin a 25-year assessment of the water and storm drain system in the city. The project is meant to look at the projected effects of climate change over the next century.⁴⁹

Unlike in Boston, the city of Charleston has done very little to even acknowledge the reality of rising sea water levels. One attempt was made to better prepare the city for the effects of climate change, however it failed. In 2007, the Charleston City Council established the “green committee.” The purpose of this group was to develop sustainability and climate change action plan. The committee released their “Green Plan” in 2010. In this report they made several recommendations: reduce greenhouse gas emissions, establish a renewable energy goal, and establish a sea level rise adaptation plan.⁵⁰ The “Green Plan” was never adopted by the city council.

Instead, the city decided to adopt the “Century V Plan.” This second plan was not a climate change or sustainability action plan. It was simply an update of the city’s comprehensive plan with hints of “green” principles intermixed. The “Century V” plan has no mention of climate change or rising sea levels, and no city issued report has been released since to put into place active policies regarding these issues.⁵¹

⁴⁸ Ibid. p. 11.

⁴⁹ Ibid. p. 9.

⁵⁰ Charleston City Council. *Charleston Green Plan*. Report. February 2010.

⁵¹ Charleston City Council. *Century V Plan*. September 2010.

The majority of progress made in Charleston to raise awareness and bring about policy changes regarding climate change has been by local citizens, primarily business owners. The city's Small Business Chamber of Commerce, led by Frank Knapp, has been the most vocal about the issue and has called upon the city to start a task force. The Chamber began the South Carolina Business Acting on Rising Seas and has been engaging local business owners on the impacts of climate change – encouraging them to lower their carbon footprint, support renewable energy, and realize the risk of rising sea levels. The Chamber has asked many to place a strip of blue tape on the wall of their business to show where a 6-foot sea level rise would reach.⁵²

Why exactly Boston and Charleston differ so drastically in their attitudes towards climate change and sea level rise is unclear. Partially, it could be due to the policies created in both state towards climate change. The political atmosphere influences the local municipalities and encourages their actions. In Boston, it has set up a trend of looking forward and preemptive planning. In Charleston and South Carolina, the conservative attitude still remains that climate change is not something to be discussed as fact. While this may be the case on the government level, it is obvious by the action of concerned citizens in Charleston and throughout South Carolina, that the realities of climate change are beginning to worry many. While the City of Boston has taken the lead in adapting to climate change, in Charleston it may not be the city itself that has to take action towards mitigation and adaptation, but the general public.

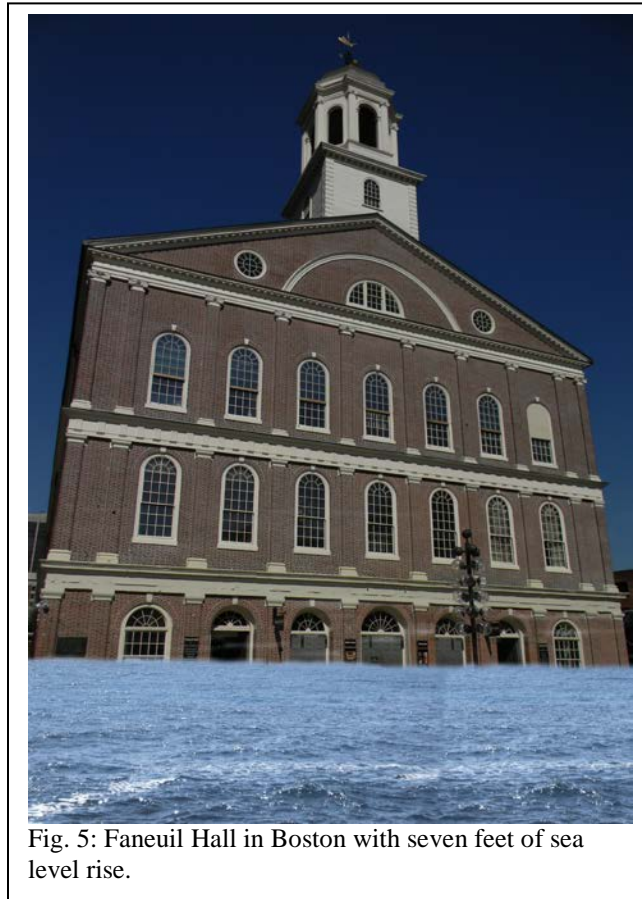
⁵² Bowers, Paul. "Small Business Chamber Head Urges City Officials to Prepare for Rising Sea Levels." *Charleston City Paper* (Charleston, SC), April 9, 2014.

While progress has been made in both Boston and Charleston on the issue of climate change, success varies based on the intensity of action taken and speed to admit the reality of climate change. Both cities have one thing in common in the policies they have adapted so far: neither one of these cities has so much as mentioned the impact climate change and rising sea level will have on their historic resources. The economy, tourism, the importance of preserving the environment, etc., all of these factors have been discussed and in some instances planned for. However, a large part of what makes these cities significant to our country's heritage and to their tourism economies is their historic resources. While the work of preparing for climate change is still underway – or just beginning in the case of Charleston – it would be imprudent to prepare these cities for adaptation and leave behind some of their most valuable assets.

CHAPTER V: THE BOSTON AND CHARLESTON CASE STUDIES

The impacts from rising sea levels are already beginning to show themselves among the historic structures of Boston and Charleston. Nuisance flooding is a common occurrence during storms at high tide and only grows more frequent with every passing year. Some of the material aspects of these structures give signs to the encroaching threat of water and the damage to come. However to reality of cities under several feet of water is hard to fathom without a little imagination even though the fantasy is not far into the future.

For this study, the author conducted a survey of both Charleston's and Boston's National Historic Landmarks. All



of Charleston's NHLs were photographed and observed visually for impacts from rising sea levels. The same was done in Boston, however limited time in the city meant only about 60% of the NHLs were observed in person. Spreadsheets were created to describe each NHL and its threat from rising sea levels. These can be found in appendices A and B.

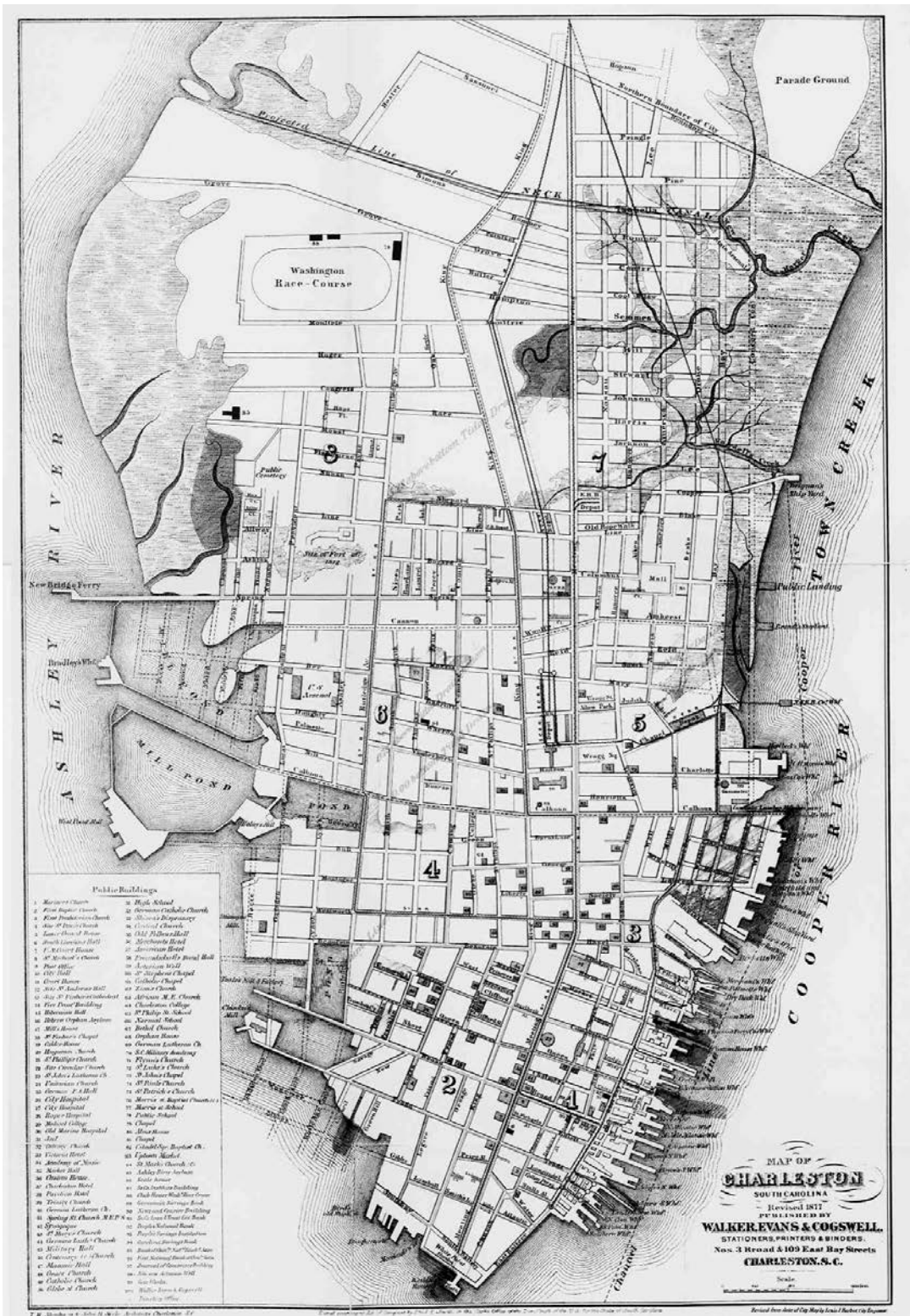


Fig. 6: Historic map of Charleston. Credit Hargrett Library Rare Map Collection.

While surveying these structures, some sites already showed signs of water damage and water intrusion. Many of these issues stemmed from rising damp and were concentrated mostly in the areas around the foundation. Biogrowth and issues with the masonry were predominant. Loss of mortar, brick loss, etc. were both common, especially in buildings that were close to the water. These issues could be due to causes other than water damage, but they do foreshadow what is to come with rising sea levels.

Locations of the NHLs were placed onto maps that used sea level projections to depict future flood

levels. For

Charleston, NHLs

were placed on a map

created by the NOAA

Office for Coastal

Management

depicting 7-foot tide,

with a sea level rise

of 1.6 feet (Figure 8).

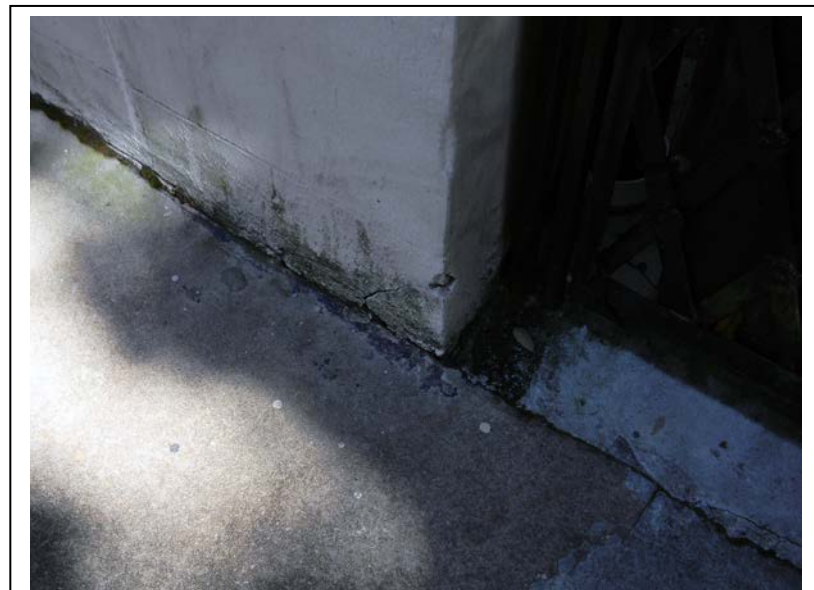


Fig. 7: Signs of cracking and biogrowth on the foundation of the Dubose Heyward House on Church Street in Charleston. Photo by author.

For Boston, they

were placed on a map created by Drs. Paul Kirshen and Ellen Douglas as well as Chris

Watson for the Boston Harbor Association, depicting a 5-foot sea level rise. (Figure 9)

These maps were

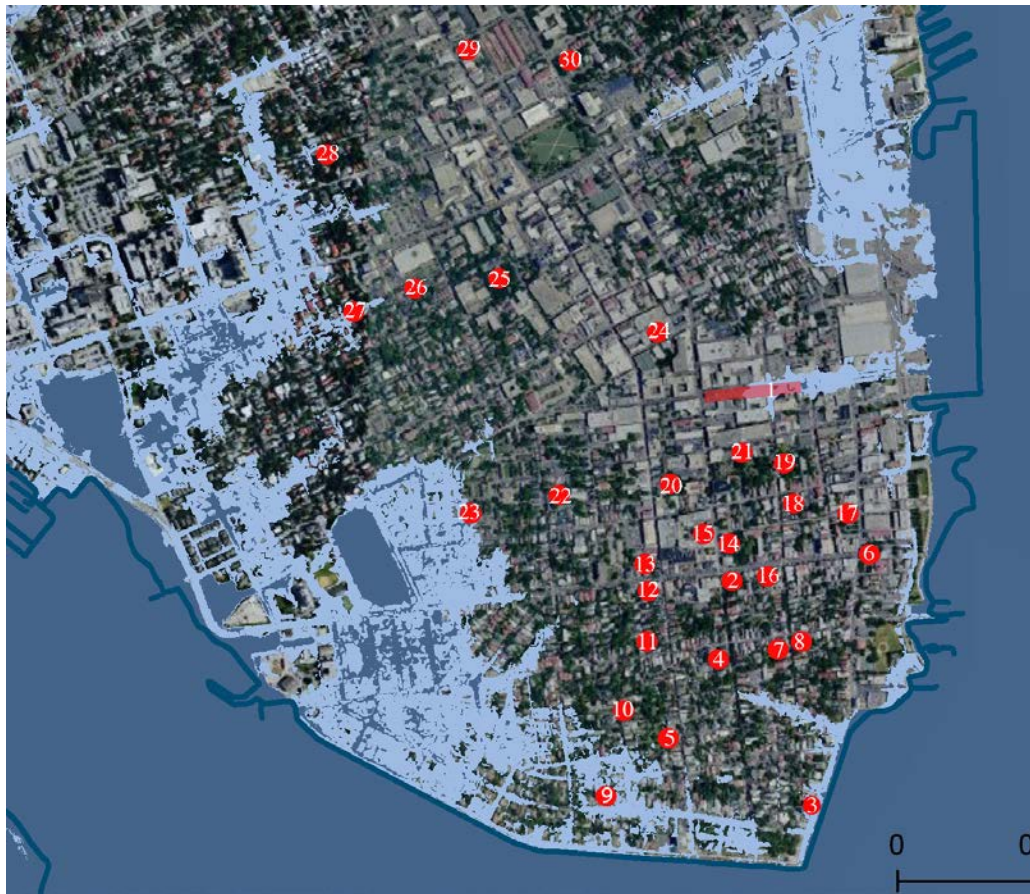


Fig. 8: Locations of NHLs in Charleston on map of flood inundation.

FIGURE 7 – KEY

- | | |
|--------------------------------|---------------------------------------|
| 1 – Charleston City Market | 16 – Clark Mills Studios |
| 2 – St. Michael’s Church | 17 – Farmers’ Bank and Exchange |
| 3 – Roper Mansion | 18 – Huguenot Church |
| 4 – Nathaniel Russell House | 19 – St. Philips Church |
| 5 – Miles Brewton House | 20 – Circular Church and Parish House |
| 6 – Old Exchange and Provost | 21 – Powder Magazine |
| 7 – Robert Brewton House | 22 – Unitarian Church |
| 8 – Dubose Heyward House | 23 – Old Marine Hospital |
| 9 – William Gibbes House | 24 – KKBE |
| 10 – Simmons-Edwards House | 25 – College of Charleston |
| 11 – Colonel John Stuart House | 26 – Blacklock House |
| 12 – Edward Rutledge House | 27 – Denmark Vesey House |
| 13 – John Rutledge House | 28 – Robert Barnwell Rhett House |
| 14 – Fireproof Buildings | 29 – William Aiken House |
| 15 – Hibernian Hall | 30 – Joseph Manigault House |

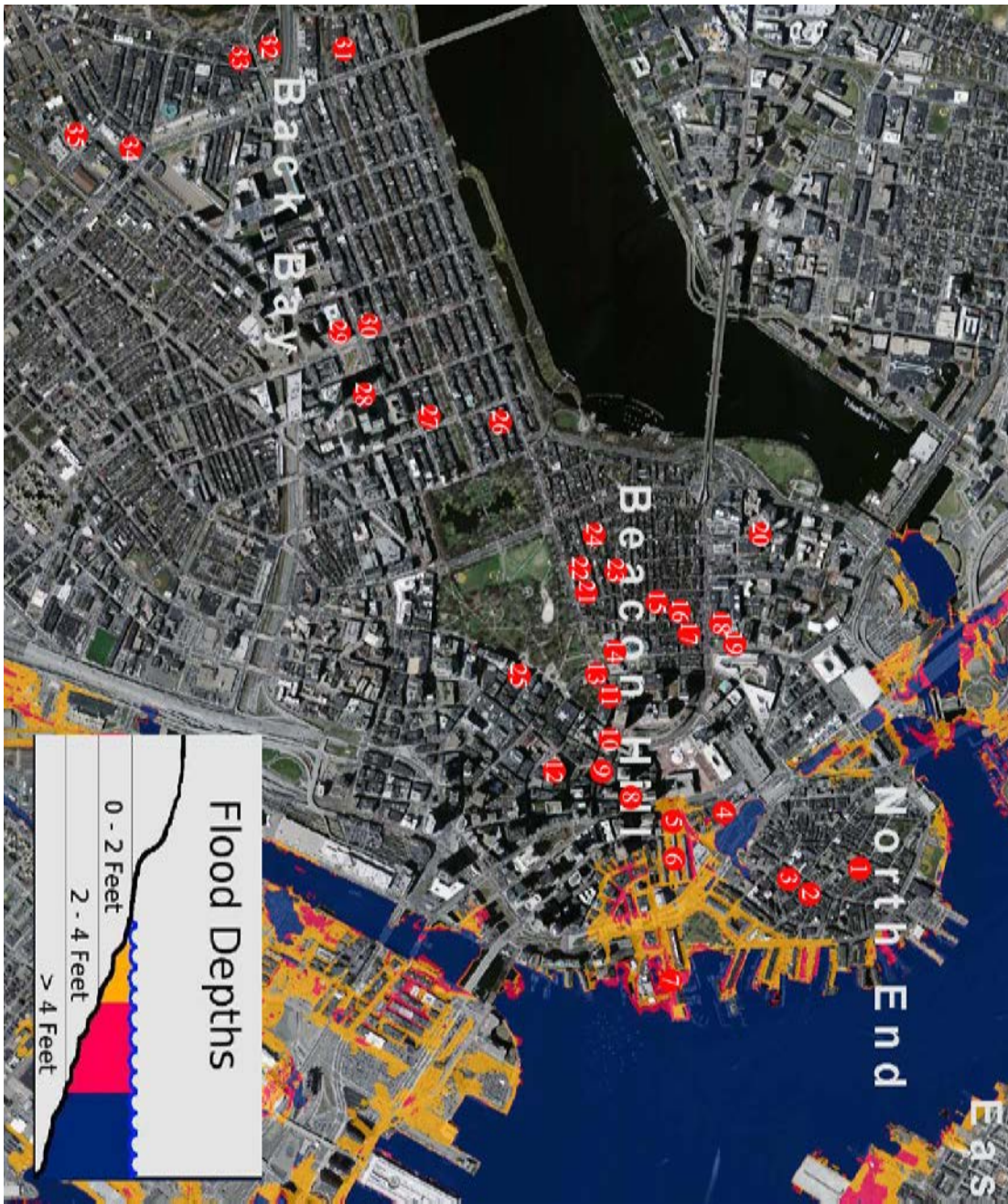


Fig. 9: Locations of NHLs in Boston on map of sea level rise.

FIGURE 8: KEY

- 1 – Old North Church
- 2 – Paul Revere House
- 3 – Pierce Hichborn House
- 4 – Union Oyster House
- 5 – Faneuil Hall
- 6 – Quincy Market
- 7 – Long Wharf and Custom House
- 8 – Old State House
- 9 – Old City Hall
- 10 – King’s Chapel
- 11 – Boston Athenaeum
- 12 – Old South Meeting House
- 13 – Chester Harding House
- 14 – Massachusetts State House
- 15 – African Meeting House
- 16 – William C. Nell Residence
- 17 – Charles Sumner House
- 18 – First Harrison Gray Otis House
- 19 – Old West Church
- 20 – Ether Dome and Massachusetts General Hospital
- 21 – Nathan Appleton Residence
- 22 – David Sears House
- 23 – Samuel Gridley and Julia Ward Howe House
- 24 – Francis Parkman House
- 25 – St. Paul’s Church
- 26 – Gibson House
- 27 – Central Congregational Church
- 28 – Trinity Church
- 29 – Boston Public Library
- 30 – Old South Church
- 31 – Frederick Ayer Mansion
- 32 – Fenway Studios
- 33 – Massachusetts Historic Society Building
- 34 – Symphony Hall
- 35 – New England Conservatory of Music

created to better illustrate which areas within the city and which NHLs will face greater impact from rising sea water levels. Compare these created maps to the historic map of Charleston in figure 6. Rising sea levels will inevitably revert Charleston and Boston back to the historic borders.



Images were also created to help readers better understand exactly what is being described in this paper. It is easy to read about a seven-foot sea level rise. It is easy to look at it on a map, but it is another story all together to see a seven-foot wall of water rippling against a historic landmark. These images are based off accurate measurements. For instance, the first

photograph is about a seven-foot sea level rise as the author counted the bricks on the wall of the structure to obtain that height. The purpose of these images is to give the reader an idea of what will be the new realities for our historic structures should we as preservationists and a nation sit back and do nothing.

Some of these NHLs are beginning to take a proactive stance and prepare for climate change. Fort Sumter, under the guidance of the National Park Service, has conducted a study of the site and what the impacts will be from rising sea levels. The College of Charleston has created a sustainability plan with a segment on historic preservation that specifically mentions rising sea levels, however, this plan has not yet

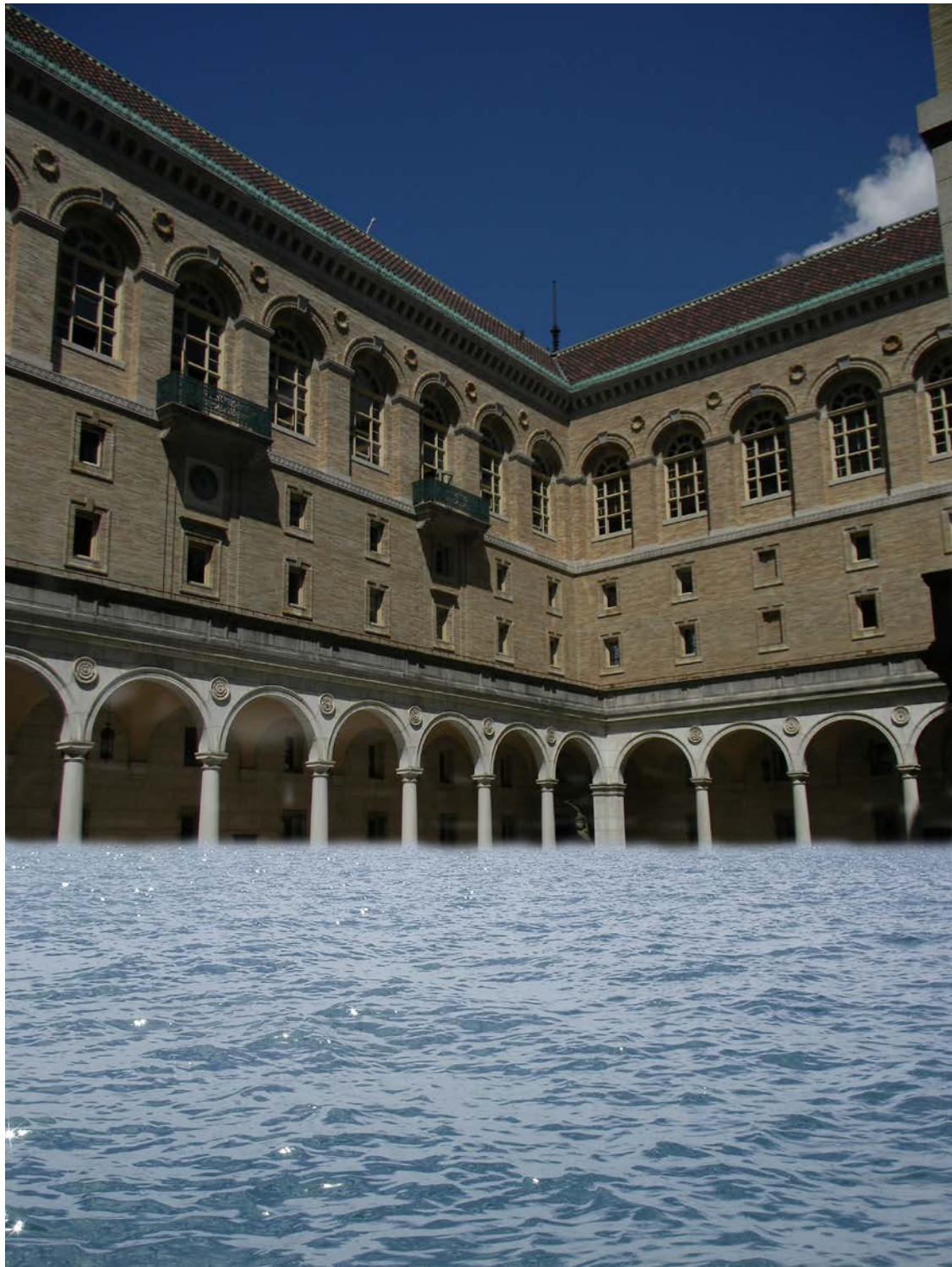


Fig. 11: The courtyard of Boston Public Library with six feet of sea level rise

gone into effect. While these are important steps forward, the fact remains that little has been done yet to change the reality of what is to come.

The study done for this project is only a minute portion of the work that needs to be conducted in these two cities and inevitably across the globe. For these two cities alone, there are hundreds, if not thousands, of other historic resources on and off the National Historic Register that are left to be documented and assessed for their impact from rising sea levels. This work needs to be done immediately before these photoshopped pictures become the daily life of our most important historic structures.



Fig. 12: The Joseph Manigault House in Charleston with five feet of sea level rise.

CHAPTER VI: OUTSIDE EXAMPLES

Sea level rise is not happening in a bubble. While the impacts will be localized in certain instances and the adaptation policies will need to reflect this, municipalities and governments will gain nothing by burying their collective heads in the sand and ignoring what other parts of the country and the world are doing to mitigate the effects of sea level rise. Within the United States, there are several towns and historic sites that have already taken a proactive stance on sea level rise. On a larger scale, certain towns such as Annapolis have begun to set into motion plans to document their historic resources and decide what actions they can take to mitigate the effects of sea level rise. It is also important to look outside the United States. Many areas of the world, such as the Netherlands, have been facing issues of water intrusion and fighting off the impacts for hundreds of years. Taking a leaf from their book could not only prove useful, but imperative.

Jamestown, Virginia known to many as the earliest permanent English settlement in North America, has become the poster child for the National Park Service's fight to spread awareness about rising sea water levels. The James River has overtaken portions of the island already and, in 2003, Hurricane Isabel destroyed thousands of artifacts that had been recovered from the numerous archaeological digs conducted at the site. A rise of 1 ½ feet in sea levels could put 60 percent of the Jamestown site underwater, 4 feet would put 80 percent of the site underwater. "It's very clear we have global warming and

sea level rise and this is a hot spot for it. And what's at risk is the history of our country," said Interior Secretary Sally Jewell during a visit to Jamestown in 2014.⁵³

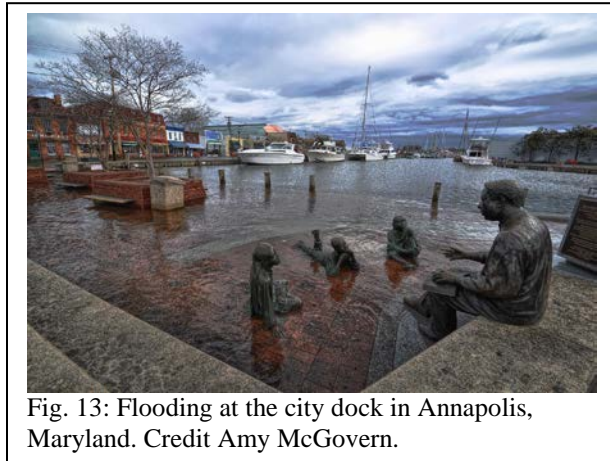
Efforts are currently underway at Jamestown to try and protect at least some of the island as well as the facilities that house the artifacts found during the excavations. Other sites within the U.S. have undertaken larger scale projects. Cape Hatteras Lighthouse is one such project. The lighthouse was the world's tallest brick structure when it was built in 1870 on the coast of North Carolina. At that time, it was 1,500 feet from the shore. By 1999, it was 120 feet. In September 1999, the National Park Service moved the lighthouse a half a mile inland.

The example of Cape Hatteras not only sheds light on a potential solution to rising sea levels – moving a structure – but also to a population of structures that are highly vulnerable to sea level rises. At one time, there were 3,000 lighthouses along American shores. Now there are roughly 600. In Martha's Vineyard, Massachusetts, residents are trying to save another historic lighthouse. Engineers estimate that it will cost \$3million to move the Gay Head Lighthouse from its current location on a cliff into the village. Similarly in Florida, preservationists have raised most of the \$500,000 required to move the Cape San Blas Lighthouse 12 miles inland from the Panhandle.⁵⁴ While moving structures, especially ones as large and in sometimes such precarious locations as lighthouses, comes at an extremely high monetary cost, it is one option for mitigating the

⁵³ Szkotak, Steve. "Jamestown: Could Rising Seas Reclaim America's History?" *The Christian Science Monitor*. June 6, 2014. Accessed July 03, 2015. <http://www.csmonitor.com/Environment/Latest-News-Wires/2014/0606/Jamestown-Could-rising-seas-reclaim-America-s-history>.

⁵⁴ Drye, Willie. "Can an Iconic Lighthouse Site Be Saved From the Sea?" *National Geographic*, March 28, 2014.

effects of rising sea levels on historic structures. In Charleston, the Morris Island Lighthouse is facing a destruction from encroaching water. While the community actively works to protect it, moving it at this point may be impossible.



However, moving one structure may not fully answer the question of what to do when an entire district is involved. The town of Annapolis in Maryland has already begun to tackle this question. Annapolis has already had to deal with years of nuisance flooding and the effects of sea level rise. “Minor nuisance flooding around the City Dock (currently) begins to occur when tides rise above 1.9 feet. At that level, water begins to flow out of the existing storm drain system even during sunny days. Projecting to the year 2050, the occurrence of nuisance flooding is expected to more than double.”⁵⁵

Annapolis’s response to rising sea levels has been one of “protection and preservation.” After Hurricane Sandy hit in 2012, Annapolis developed a Cultural Resource Hazard Mitigation Plan. The city received funding from the state and federal levels to conduct a survey, inventory, and risk assessment of properties within the 100-year flood plain. In 2013, The National Trust gave Main Streets Annapolis Partnership a \$25,000 grant for storm disaster prevention planning. A year later, they received a \$5,000 grant to educate business and property owners on flood protection strategies. In 2014, the

city was also working on a long term, \$500,000 project to improve flood protection and storm water management.⁵⁶

While Annapolis may be a smaller city than both Charleston and Boston, there are many things that these larger cities can learn from their smaller counterpart. Firstly, this proactive approach to assessing and surveying their historic resources is to be commended. Adaptation and mitigation planning cannot begin until all the risks and what is at risk is known. Secondly, Annapolis has fully taken advantage of all the funding available to them, at the government and non-profit level. There is funding out there for such projects, which can take the burden off of taxpayers and municipalities. These expenses are necessary, however the monetary burden does not need to be taken on alone.

In Europe, cities have gone beyond surveying and planning, to implementing actually mechanisms of flood control. The city of Venice, which has for centuries been plagued by nuisance flooding, is nearing completion of the Experimental Electromechanical Module (MOSE). The MOSE is a long gate, which consists of a series of blocks. The gate sits on the ocean sea floor. The blocks themselves are hollow. During a normal tide, the blocks fill with water and sink to the bottom of the sea floor. During an exceptionally high tide, the blocks expel the water and rise up with compressed air. The blocks then form a gate, protecting the lagoon from the flooding. While this new technology is experimental, it could prove to be a savior for the historic city. It could also

⁵⁶ Sauers, Elisha. "National Trust Highlights Annapolis for Sea Rise Case Study." *Capital Gazette*. October 23, 2014. Accessed July 01, 2015. <http://touch.capitalgazette.com/#section/-1/article/p2p-81757952/>.

prove to be a prototype for numerous such gates that could be potentially constructed in similar port cities around the world.⁵⁷

The technology used in the Netherlands to protect against flooding is not nearly as untested. The Dutch have been combating flooding for centuries, but in the last hundred years have come up with innovative and large scale solutions to their watery problems. Large portions of the Dutch coastline are below sea level, some provinces being up to 12 feet below sea level. Historically, flooding has been fought off with thousands of miles of dikes.

However, after a series of deadly storms in the early twentieth century, the Dutch government decided that



Fig 14: Maeslant Storm Surge Barrier. Credit Forbes.

reform was needed. Instead of raising and repairing dikes, a series of dams were constructed along rivers estuaries and inlets. This shortened the coastline, but also greatly

⁵⁷ Charlton, Corey. "Venice's Last Line of Defence: New Anti-flood System Aims to Protect Historic Italian City from Rising Waters." Daily Mail. November 28, 2014. Accessed July 07, 2015. <http://www.dailymail.co.uk/news/article-2853457/Venice-s-line-defence-New-anti-flood-aims-protect-historic-Italian-city-rising-waters.html>.

reduced the amount of land exposed to storm surges. Waterways that were used for shipping traffic instead had movable barriers installed. Dutch engineering firms are currently working to plan similar feats for American cities. However, it is not simply a matter of constructing dams and barriers, but also a matter of changing our way of thinking. As Wim Kuijken, the senior official in charge of the Dutch water control policy puts it, "The U.S. is excellent at disaster management, but working to avoid disaster is completely different from working after a disaster."⁵⁸

There are other examples of what could happen to Boston and Charleston should the worse case scenario happen. Should nothing be done to adapt these cities for the impacts of rising sea levels, they could become popular destinations for underwater archaeology. The cities of Alexandria, Egypt or Baiae, Italy are two perfect examples of what Charleston and Boston could look forward to should they be left unaltered. Port Royal, Jamaica is probably the most similar to these two American cities. Built in the same time period as Boston and Charleston, it was destroyed by an earthquake and is now completely underwater. The only way to explore these cities, learn anything of their buildings, culture, etc. is by outside sources or through maritime archaeology.

Boston has already begun to take notes from its European counterparts to come up with creative ways to adapt to sea level rise. In 2014, the Urban Land Institute gathered engineers, architects, developers, and insurance specialists to brainstorm strategies to prevent water inundation from the projected sea level rise that will inevitably impact

⁵⁸ Higgins, Andrew. "Lessons for U.S. From a Flood-Prone Land." The New York Times. November 14, 2012. Accessed July 07, 2015. http://www.nytimes.com/2012/11/15/world/europe/netherlands-sets-model-of-flood-prevention.html?_r=0.

Boston in the next century. One of the ideas that gained the most attention was the creation of canals, effectively turning Boston's Back Bay into a Venice-like landscape.

The system of canals would turn certain alleyways and streets into waterways. Flood gates and artificial wetlands would be installed to help control the flow of water. Bridges would be placed over these canals to maintain a "walkable" city. This was by far the most dramatic plan that came out of the report released by the Institute; however, it does show a shift in attitude in the United States towards sea level rise adaptation. As Dennis Carlberg, the director of sustainability at Boston University, put it, "This is a change that's coming whether we want it or not. Instead of being afraid of the problem, we need to embrace it and think about opportunities it offers us."⁵⁹

While Boston has begun to look to outside examples for solutions, Charleston has yet to acknowledge the realities of sea level rise. Both cities, however, should make a concerted effort to look more closely at what the rest of the world is doing, both at home and abroad. Engaging in a dialog with communities who are undergoing the same impacts – or who have been undergoing these impacts for centuries – will prove beneficial in the upcoming planning process.

⁵⁹ Ross, Casey. "Venice on the Charles? Boston's Solution to Rising Seas Includes Novel Canal System in Back Bay Canals - The Boston Globe." Boston Globe. September 30, 2014. Accessed July 07, 2015. <https://www.bostonglobe.com/business/2014/09/29/venice-charles-boston-solution-rising-seas-includes-novel-canal-system-back-bay-canals/F7u38NjMW9htumJ9GK2VnI/story.html>.

CHAPTER VII: RECOMMENDATIONS

First and foremost, for any adaptation or mitigation to the effects of sea level rise and climate change to take place, policy makers must first accept the realities of climate change. The term and the science behind it cannot be treated as a taboo. Arguing at this point about the causes of climate change is senseless.⁶⁰ The effects from it are not debatable. We can either continue to argue until nothing valuable can be done to save our cities and infrastructure, or we can end the debate now and begin the process of adaptation. The full scope and impact of climate change needs to be accepted before any actual efforts to combat the effects of sea level rise can be implemented.

As the effects of sea level rise will vary from locale to locale, the most important policies of adaptation and mitigation will come from local governments. The most effective tool city governments can use is to create city plans that outline long term, proactive goals towards adaptation. Boston has already begun this process, however, their current plan does not discuss the impact on historic structures or any mitigation to this impact. Charleston's environmental plan currently does not even mention sea level rise. Clear short term and long term goals need to be created on a municipality basis in order to create a local atmosphere of change that community members can in turn use to guide their own efforts.

Inevitably, one of the most necessary actions cities need to take is engaging in a community dialog. As shown by the vast representations of ownership among NHLs, civic infrastructure is not the only thing at risk. Home owners, business owners, colleges

⁶⁰ However, even the Pope of the Catholic Church has now stated publicly that climate change is not only happening, but also caused by anthropogenic means.

and universities, medical institutions, museums, religious communities, etc. all need to be brought together on the dialog of climate change and adaptation. The decisions of these individual groups or people will make the most significant impact on how Boston and Charleston adapt. However, if they can be united under a regional plan that is arbitrated by the local government, these decisions can be consolidated and made more effective.

Local governments also need to develop close relationships with state and federal government agencies in order to afford adaptation policies. Funding will inevitably need to come from the higher levels of government. If these relationships are not formed, or if state and federal policies do not match the needs and intentions of local governments, any plans for adaptation will be ineffective.

On the national level, there are policy changes that can be made in the coming years to help mitigate the damage to historic structures from sea level rise. The National Historic Preservation Act (NHPA) will be up for extension in 2016. While many preservationists are scared that certain sections of the act will be cut, among them section 106, this review provides an opportune moment to implement preservation policy that will be beneficial to structures and sites facing damage or complete annihilation from sea level rise.

Firstly, this act sets up the criteria for the National Register of Historic Places. Specifically in these criteria, there is policy regarding the moving of a structure. While some structures that have been moved may retain or gain Register status, it is usually up to the discretion of SHPOs or the Keeper as to whether or not the building was moved for a legitimate reason. By adding specific sections to this criteria that state if a building is

moved due to the impending impacts of sea level rise or climate change it can retain its status on the register, this would not only encourage that mitigation of impacted structures but would also allow owners to maintain access to often site saving funds and grants.

As far as national funding is concerned, there is already a program at the federal level that provides tax exemptions and credits for historic structures that are undergoing rehabilitation. Like with the National Register, many of these buildings need to meet a certain amount of criteria: be income producing, be eligible for the National Register, etc. A majority of states have similar tax credit programs that add to federal benefits and have proven detrimental in the reuse and rehabilitation of historic structures.

Where rising sea levels and climate change are concerned, these federal and state tax programs could go further to offer similar benefits to owners who are flood proofing their historic property or doing some other sort of adaptation whether it be raising or moving. Many owners are discouraged from these types of mitigation to their properties due to the sheer cost of these acts. At the moment, there is little to no federal or state aid to help in these types of activities. However, by providing tax exemptions, this type of mitigation could become encouraged and save countless historic structures.

Obviously, not all owners would take advantage of these types of incentives and not all properties may be eligible. This raises probably the most important issue when it comes to the impact on historic structures from sea level rise: not everything can or will be saved. This is an issue that all preservations face on a daily basis as it is. With sea level rise and climate change, this elephant in the room is multiplied to a heard. Should a

large-scale project not be undertaken to protect an entire municipality, it will be impossible – both financially and physically – to save all of the structures that are endangered.

That does not mean that we should simply accept defeat. Whether or not a building or site can be physically saved is second to the first and probably most important step in any preservation project. Documentation in the instance of climate change will be detrimental. Documentation, whether it is in the form of photography, measured drawing, written descriptions, or hopefully all of the above, will provide preservationists with a wealth of information in order to make the hard decisions when it comes to what is salvageable and what can be sacrificed. Documentation not only provides a clear picture of what resources are out there, but it will also serve as a record for posterity. Should a site not be saved, at least the very least there will be something left for future generations to return to other than the use of underwater archaeology.

Annapolis, Maryland has already taken steps to begin this process as shown in the previous chapter. Other cities like Charleston and Boston should take note of the efforts in Annapolis and begin their own studies into which of their historic resources will be most affected. Ideally, a large, national scale documentation project could take place to assess all of the resources endangered by rising sea levels. However, it will take the leadership and effort of local groups and municipalities to front this effort.

Once the conversation has taken place on what can and should be saved, the next discussion needs to be on how. There are a number of options when it comes to rescuing individual buildings from rising sea levels. There is raising a building above the flood

levels, though this may prove to only be a fix for a matter of decades, not indefinitely. Moving structures is also an option, as shown in the example of Cape Hattaras lighthouse. The choice will have to be dependent on the needs and limits of the individual structure. However, there are some arguments for and against both methods.

For some structures it may be impossible to move them, but raising them is an option. At the same time, raising a building might change its architectural significance to the point where it is no longer recognizable. Also, raising a building may only be a short-term solution when rising sea levels are not going to retreat. If a building is raised, who is to say that it won't eventually have to be moved later on in its lifetime anyway? However, moving a building also takes it out of its original context, though that context may have already been altered by rising sea levels beyond recognition.

Again, however, there are some buildings that may simply not be able to be moved. While engineers have conducted amazing feats in moving structures in the past few decades and their abilities are only improving, certain historic buildings simply cannot – or should not – be moved. Fort Sumter, for instance, would be nearly impossible to move. Not only would it cost an inordinate amount of money, but also moving the Fort would remove it completely from its historical context and what makes it significant.

The Chinese have faced similar questions in recent years about the fate of their historic resources to raising water, however not due to rising sea levels but due to man made issues. The Three Gorges Dam on the Yangtze River was completed in 2009. Because of flooding from the dam, 13 cities, 140 towns, and over a thousand villages were flooded. When the reservoir from the dam was filled, 2,000 known archaeological



Fig. 15: Shibaozhai Temple on the Yantze River in China.
Credit Mindy Poder.

sites were submerged. Countless historic structures have been impacted by the dam project as well. The 1,700 year-old Zhangfei Temple was dismantled and moved to higher ground. Other structures, however, could not be moved. The 500 year old, twelve story Shibaozhai Temple,

for instance, could not be dismantled without potentially being destroyed. Instead of letting water claim the structure, a massive concrete dike was constructed around the temple, effectually creating an island around the site.⁶¹

However, how effective is it to focus only on individual buildings when, especially in the cases of Charleston and Boston, entire historic cities are at risk? A large-scale effort for mitigation might prove more beneficial, though it may be more expensive. The systems of large scale gates and dams that are in place in Venice and the Netherlands may not be completely appropriate for Boston or Charleston, but similar ideas should be considered nonetheless.

The benefits of such a large-scale solution are great. Less money would have to be spent on individual properties. The damage from future storms would be greatly

⁶¹ See, Lisa. "Waters of Three Gorges Dam Will Wash Over World Culture." Los Angeles Times. June 08, 2003. Accessed July 07, 2015. <http://articles.latimes.com/2003/jun/08/opinion/oe-see8>.

reduced. Nuisance flooding could hypothetically become a thing of the past. Boston's coastline could potentially be capable of housing such a works. Charleston and the Lowcountry, however, may need a more creative solution. Damming off a large section of the Charleston coastline would not only require cutting off the area surrounding the city and the Cooper and Ashley Rivers. There is also the Intercoastal waterway to consider. Much of the area is defined, culturally and environmentally, by its marine life. The impact on the environment by such a project would need to be taken into account. Also, Charleston is now one of the busiest ports in the country. Shutting off this port would be a huge detriment to the city's economy. It would help mitigate flooding, but at what cost?

The last option for Charleston and Boston, as well as the rest of the world, is to simply do nothing. The cities could be left essentially fallow. Water would reclaim the historic boundaries of these cities and cities like them. Eventually, the most significant historic structures and sites would be partially or completely underwater. These areas could then take advantage of a new kind of tourist activity: underwater archaeology. Essentially, this is the option that Charleston is already exploring by sitting back and doing nothing. As of now, money is being spent to repair structures that will face an uncertain future. Historic Charleston Foundation, for instance, one of the major preservation organizations in Charleston, has hundreds of easements on properties that are endangered by rising sea levels. Instead of focusing on the savior of these structures from rising tides, they are more concerned with the color of the exterior.

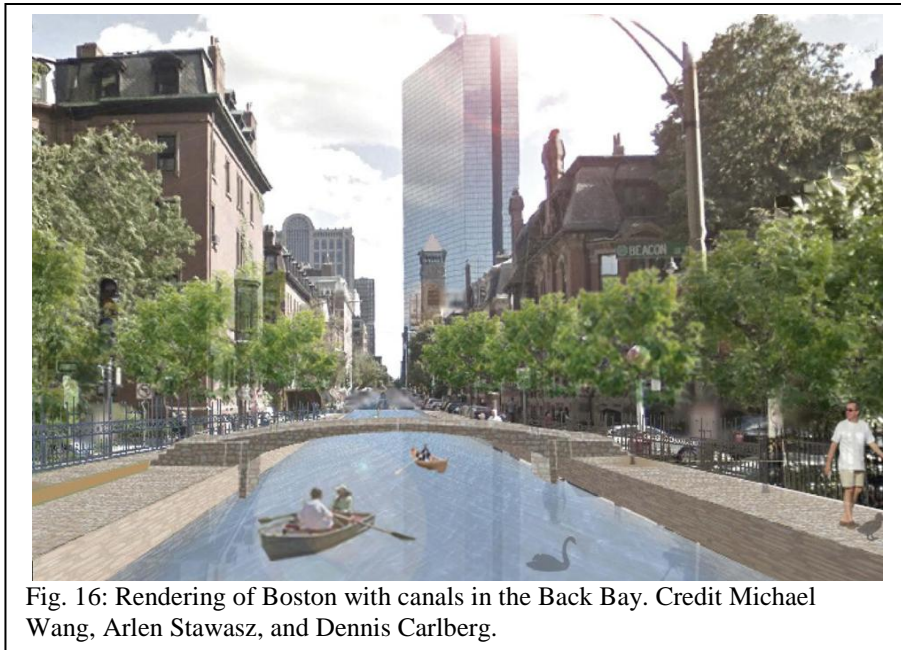


Fig. 16: Rendering of Boston with canals in the Back Bay. Credit Michael Wang, Arlen Stawasz, and Dennis Carlberg.

All of these questions of costs and benefits, pros and cons, etc. need to be discussed. Both Boston and Charleston need to effectively decide what options make the most sense for their city. However, these questions do need to be asked. No productive work can begin until these questions are asked.

Boston has already begun this process. Creative and innovative options for mitigation are on the table and up for discussions. Plans looking into the next century of Boston's future are in the process. The conversation has started in Boston and the process for adaptation has begun. In Charleston, these questions are not even within earshot. In Charleston, it is still a question of whether or not climate change and rising sea level is happening and if so, by how much. We need to move past the questions of if and how and onto the discussion of where and when: where will we prepare for rising sea levels and when will we begin to implement these preparations?

CHAPTER VIII: CONCLUSION

In less than a century, the majority of America's historic coastal cities and historic sites will be underwater or inundated with regular flooding. A century may feel like a long time, but in the larger scheme of our country's history, it is only a chapter. The United States has been in existence for less than three hundred years. The oldest city in this country, St. Augustine, is only five hundred years old. Compared to Europe's oldest cities, America's oldest places are mere infants. The historic structures and sites we value in the country the most are required to be over fifty years old before they can receive recognition or protection. However, in that time frame many of those sites will disappear or be damaged beyond recognition.

Charleston, South Carolina and Boston, Massachusetts will both prove to be prime examples of what will happen to the world's historic resources due to climate change and rising sea levels. As two of the oldest cities in the United States, they hold prominent places in American history. Old port cities, built on the water for defensive and economic reasons, both played important roles in the founding of this country. Charleston was one of the prominent cities in the South prior to the Civil War; Boston exploded in the postbellum era and industrialization. Both cities are known for their historic districts. Without them, a large portion of both cities' identities would be lost, as well American history.

Boston has taken a proactive stance, preparing and adapting to climate change. However, small steps have been done to make plans or mitigation measures for the city's

significant historic structures and districts. Charleston, on the other hand, has avoided the issue of climate change altogether. The subject itself remains a taboo. The way these two cities adapt or refuse to adapt reflect how the rest of the world reacts to these issues. Boston and Charleston have been forerunners in preservation since beginning of the field. How these two cities choose to move forward with plans for rising sea water levels and their impacts on their historic structures and sites will serve as guidance for the rest of their regions and the rest of the country.

Boston has taken the first step in adaptation for climate change by implementing long term planning, both for infrastructure and for the environment. At the same time, Boston has said little about their historic resources. Charleston has proven time and time again their commitment to their historic resources. Currently, Charleston is even undergoing the long process of getting their historic district named a UNESCO World Heritage Site. However, all of Charleston's passion for its history will be in vain if no protections or planning is put into action against the coming impacts from climate change.

The realities of climate change and rising sea water levels are just that: a reality. This is not a "new theory." The majority of the world's scientists are in agreement that climate change is happening and that sea levels are rising. The data is credible and widely accepted by most international institutions. The only issue really left to debate – besides how high and how fast – is what the world can do to prepare. Many federal agencies, including the National Park Service and the United States Navy, have already acknowledged that the impacts of climate change and rising sea levels are a huge risk to

the country. It is high time that the rest of the U.S. followed suit and began to actively pursue policy changes and begin the process of adaptation.

Preservationists can be at the forefront of this process in many ways. This includes at all levels of government, be it federal, state, and local. With the review of the National Historic Preservation Act coming up next year, this will prove an opportune moment for preservationists to make an active change in sea level rise mitigation. Under the current law, there is no protection for structures and sites that will be damaged or destroyed by rising sea levels. Changing or editing this law to allow for such protections could save countless properties.

At the state and federal level, preservationists could also lobby for monetary funding to help in the mitigation process. This will be instrumental in helping properties with floodproffing, raising, or even moving. Even larger scale projects such as dykes or levees will need fiscal subsidies. Preservationists can add their voices to the argument for such projects, making the case that such large scale projects could save far more properties than a single floodproffing or moving project could.

On the local level, preservationists need to join ranks with environmentalists, business owners, property owners, and politicians to encourage their own municipalities to begin the long process of adaptation and mitigation planning. In areas like Annapolis and Boston, these types of long term planning projects have already begun. However, in areas like Charleston, the voices of preservationists and their counterparts are direly needed. The longer we wait to begin the process of adaptation, the more we risk losing.

As preservationists, we are specifically trained to protect these structures and sites from destruction and damage. It is our profession and trade to document, advocate, and educate. While terms like climate change and rising sea levels may not appear to be apart of our vocabulary, words like adaptation and mitigation are apart of our job descriptions. Environmentalists are not going to know whether it is better to raise or move a structure. Politicians are not trained in how to correctly document a historic building or landscape. Business owners are not going to be aware whether floodproofing will damage the historic significance of their property. These issues need to be left to preservationists and preservationists need to be willing to take up the call.

This thesis has embarked on only a small portion of the work that needs to be undertaken by preservationists in the fight to protect historic landmarks from rising sea levels and climate change over all. Surveying NHLs, assessing their threat level, and analyzing the current effort of two case studies is just the beginning. These same efforts need to be magnified and used in cities across the nation, if not the world.

Preservationists, to date, have chosen to sit in the backseat of the climate change discussion, if they have been in attendance at all. This needs to change. Infrastructure, population, environmental conservation, etc. are all warranted topics of discourse when it comes to the impacts from climate change but the history of human society also needs to have a seat at the table. If we lose our heritage, we lose the record of who we are as a people. When sites like Jamestown disappear, all we will have left are artifacts in museums and 3D models on the Internet. If it is not the preservationists' job to stand up and fight for the protection and savior of humanities historic resources, whose is it?

APPENDICES

APPENDIX A:

NATIONAL HISTORIC LANDMARKS, BOSTON

NAME OF SITE	LOCATION	DATE LISTED	SIGNIFICANCE	THREAT LEVEL	OWNER
African Meeting House	8 Smith Ct	30-May-74	Oldest black church still standing in the US	Low	Private
Nathan Appleton Residence	39-40 Beacon St	Dec. 22, 1977	Industrialist, style.	Low	Private
Frederick Ayer Mansion	395 Commonwealth Ave	5-Apr-05	Interior designed by Tiffany, exterior has only surviving instance of Tiffany mosaic	High	Private
Beacon Hill Historic District		Dec. 29, 1962		High	
Boston Athenaeum	10 1/2 Beacon St	Dec. 21, 1965	One of the country's oldest and largest independent libraries	Medium	Private
Boston Common	Beacon Hill	Feb. 27, 1987	Oldest public park in US	Medium	Local
Boston Public Gardens	Back Bay	Feb. 27, 1987	Nation's first botanical garden	High	Local
Boston Public Library	230 Dartmouth St	Feb. 24, 1986	Style	High	Local
Central Congregational Church	67 Newbury St	Oct. 16, 2012	Largest intact Tiffany-designed ecclesial interior in America	High	Private
Ether Dome, Mass. General Hospital	55 Fruit Street	Jan. 12, 1965	Site of first public demonstration of the use of ether	Medium	Private

Faneuil Hall		Oct. 9, 1960	Market, site of public meetings during Revolution	High	Local
Fenway Studios	Fenway-Kenmore	Aug. 5, 1998	Studios for artists in arts and crafts style	High	Private
First Harrison Gray Otis House	141 Cambridge St	Dec. 30, 1970		Medium	Private
Gibson House	137 Beacon St	Aug. 7, 2001	House museum, style	Low	Private?
Chester Harding House	16 Beacon St	Dec. 21, 1965	Federal style, portrait artist	Low	Private
Samuel Gridley and Julia Ward Howe House	13 Chestnut St	30-May-74	Noted abolitionists	Low	Private
King's Chapel	Tremont and School St	Oct. 9, 1960	built on the site of the first Anglican church in Boston	Medium	Private
Long Wharf and Custom House Block	Foot of State St	Nov. 13, 1966	One of the busiest ports in the colonies, has been shortened by land reclamation	High	Private
Massachusetts General Hospital	55 Fruit Street	Dec. 30, 1970	Original building, one of nation's oldest public hospitals	High	Private
Massachusetts Historical Society Building	1154 Boylston St	Dec. 21, 1965	Oldest historical society in the nation	High	Private
Massachusetts Statehouse	Beacon Hill	Dec. 19, 1960	Capitol building	Medium	Commonwealth of Massachusetts

William C. Nell Residence	3 Smith Ct	11-May-76	Abolitionist and education advocate	Low	Private
New England Conservatory of Music	30 Gainsborough St	19-Apr-94	Jordan Hall	High	Private
Old City Hall	45 School St	Dec. 30, 1970	One of the first Second Empire style buildings in the country	Low	Local
Old North Church	193 Salem St	Jan. 20, 1961	Oldest active church building in Boston	Medium	Episcopal Church
Old South Church	645 Boylston St	Dec. 30, 1970	Home of one of the city's oldest congregations	Medium	Private
Old South Meeting House	310 Washington St	Oct. 9, 1960	Where Boston Tea Party was planned	Medium	Private
Old State House	206 Washington St	Oct. 9, 1960	Boston Massacre	Medium	The Bostonian Society
Old West Church	131 Cambridge St	Dec. 30, 1970		Medium	Private
Francis Parkman House	30 Chestnut St	Dec. 29, 1962	Person	Low	Private
Pierce-Hichborn House	29 North Square	Oct. 18, 1968	Rare pre-Georgian brick	Medium	Private (Paul Revere Memorial Association)
William H. Prescott House	55 Beacon St	Dec. 29, 1964		Low	Private

Quincy Market	South Market St	Nov. 13, 1966	Built on land made by filling part of the harbor	High	Local
Paul Revere House	19 North Square	Jan. 20, 1961	Oldest surviving house in Boston	Medium	Private
St. Paul's Church	130 Tremont St	Dec. 30, 1970	First Episcopalian church built in post-independence Boston	High	Episcopal Church
David Sears House	42-43 Beacon St	Dec. 30, 1970	Federal style, Boston developer	Medium	Private
Charles Sumner House	20 Hancock St	Nov. 7, 1973	US Senator and abolitionist	Medium	Private
Symphony Hall	301 Massachusetts Ave	Jan. 20, 1999	Home of Boston Symphony Orchestra since 1900, designed by McKim, Mead, and White	High	Private
Tremont Street Subway		Jan. 29, 1964	Oldest subway tunnel in North America	High	Local
Trinity Church	Copley Square	Dec. 30, 1970	Richardsonian Romanesque	High	Episcopal Church
Union Oyster House	41-43 Union St	27-May-03	Oldest operating restaurant in America	High	Private

APPENDIX B:

NATIONAL HISTORIC LANDMARKS, CHARLESTON

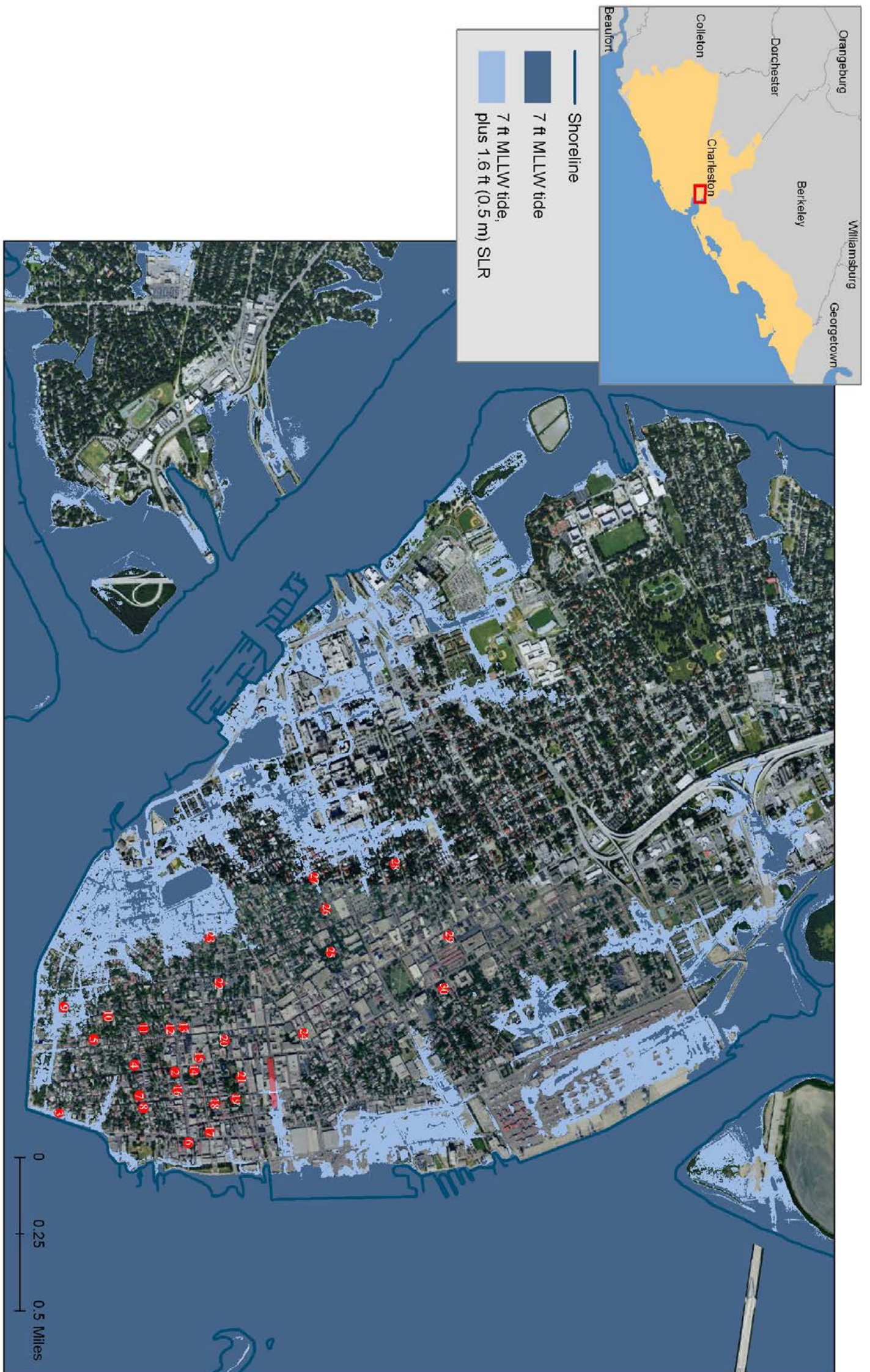
NAME OF SITE	LOCATION	DATE LISTED	SIGNIFICANCE	THREAT LEVEL	OWNER
William Aiken House and Associated Railroad Structures	456 King Street	Nov. 4, 1963	Structures of S.C. Canal and Railroad Company, longest operating railroad in the world in 1833 and home of founder William Aiken	Low	Private
William Blacklock House	18 Bull Street	Nov. 7, 1973	Arch., Adamesque, Gabriel Manigault	Medium	CofC
Miles Brewton House	27 King Street	Oct. 9, 1960	Arch., "Double House" (four main rooms per floor)	High	Private
Robert Brewton House	71 Church Street	Oct. 9, 1960	Oldest "single" house	High	Private
Charleston Historic District		Oct. 9, 1960	81 contribution properties and 700 others	High	
College of Charleston		Nov. 11, 1971		Medium	Private
Exchange and Provost	122 E Bay Street	Nov. 7, 1973	Customhouse, exchange, military prison, post office, meeting place of Legislature in 1790	High	Private
Farmers' and Exchange Bank	141 E Bay Street	Nov. 7, 1973	Arch., Moorish-style bank, 1854	High	Private

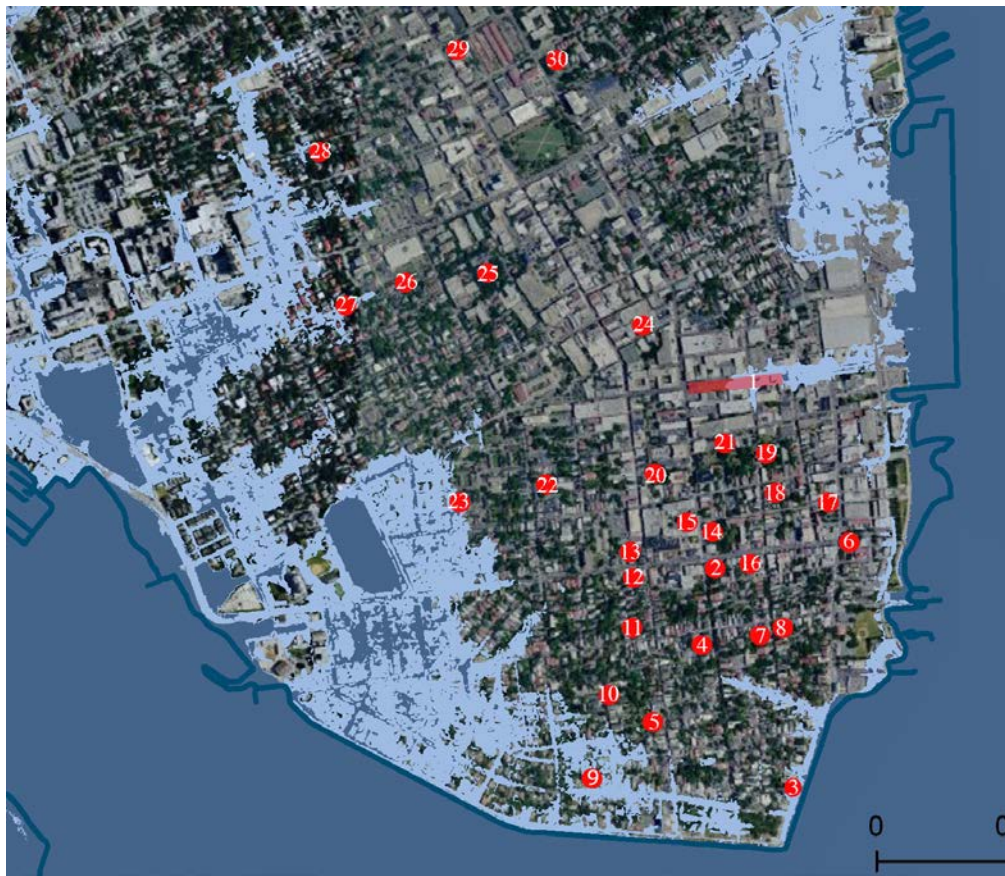
Fireproof Building	100 Meeting Street	Nov. 7, 1969	Designed by Robert Mills to be the most fireproof building in America	Medium	Private (SC Historical Society)
William Gibbes House	64 S Battery	15-Apr-70	Arch., Adamesque	High	Private
Dubose Heyward House	76 Church Street	Nov. 11, 1971	Home of author, wrote novel <i>Porgy</i>	High	Private
Heyward-Washington House	87 Church Street	15-Apr-70	George slept here...once	High	Charleston Museum
Hiberian Hall	105 Meeting Street	Nov. 7, 1973		Medium	Private (Hibernian Society)
Huguenot Church	136 Church Street	Nov. 7, 1973	Arch., Gothic Revival, 1844 by E.B. White	Medium	Private
Kahal Kadosh Beth Elohim	90 Hasell Street	19-Jun-80	Arch., Greek Revival, 1840, second oldest synagogue in continuous use in U.S.	Low	Private
Joseph Manigault House	350 Meeting Street	Nov. 7, 1973	Designed by Gabriel Manigault for his brother	Medium	Charleston Museum
Market Hall and Sheds	188 Meeting Street	Nov. 7, 1973	Greek revival hall and 2 blocks of sheds	High	Local
Clark Mills Studio	51 Broad Street	Dec. 21, 1965	Studio of sculptor Clark Mills	Medium	Private

Old Marine Hospital	20 Franklin Street	Nov. 7, 1973	Arch., Gothic Revival, Robert Mills, 1833 for sick sailors and transients	High	Local (Offices for Housing Authority of Charleston?)
Parish House of the Circular Congregational Church	150 Meeting Street	Nov. 7, 1973	Robert Mills	Low	Private
Powder Magazine	79 Cumberland Street	Sept. 27, 1989	Oldest public building in the city	Medium	Private
Robert Barnwell Rhett House	6 Thomas Street	Nov. 7, 1973	Home of leading fire-eater at Nashville convention of 1850 which failed to endorse his aim of secession	High	Private
Robert William Roper House	9 E Battery	Nov. 7, 1973		High	Private
Nathaniel Russel House	51 Meeting Street	Nov. 7, 1973	Arch., adamesque, 1811	Medium	Private, HCF
Edward Rutledge House	117 Broad Street	Nov. 11, 1971	Home of signer of Dec. of Independence and a gov. of S.C.	Low	Private
John Rutledge House	116 Broad Street	Nov. 7, 1973	Home of gov. and signer of constitution	Low	Private
Saint Michael's Episcopal Church	71 Broad Street	Oct. 9, 1960	1750s, oldest church in Charleston	Low	Private

St. Philip's Episcopal	142 Church Street	Nov. 7, 1973	E.B. White designed steeple	Medium	Private
Simmons-Edwards House	14 Legare Street	Nov. 7, 1973	"Pineapple Gate House"	High	Private
Colonel John Stuart House	104-106 Tradd Street	Nov. 7, 1973	Home of...	Medium	Private
Unitarian Church	4 Archdale Street	Nov. 7, 1973	1772 and reworked gothic style 1852-1854	Medium	Private
Denmark Vesey House	56 Bull Street	11-May-76	"Said to be" home of man accused of plotting slave rebellion in 1822	High	Private
Fort Sumter National Monument		28-Apr-48	First shots of American Civil War fired on Jan. 9, 1861	High	National

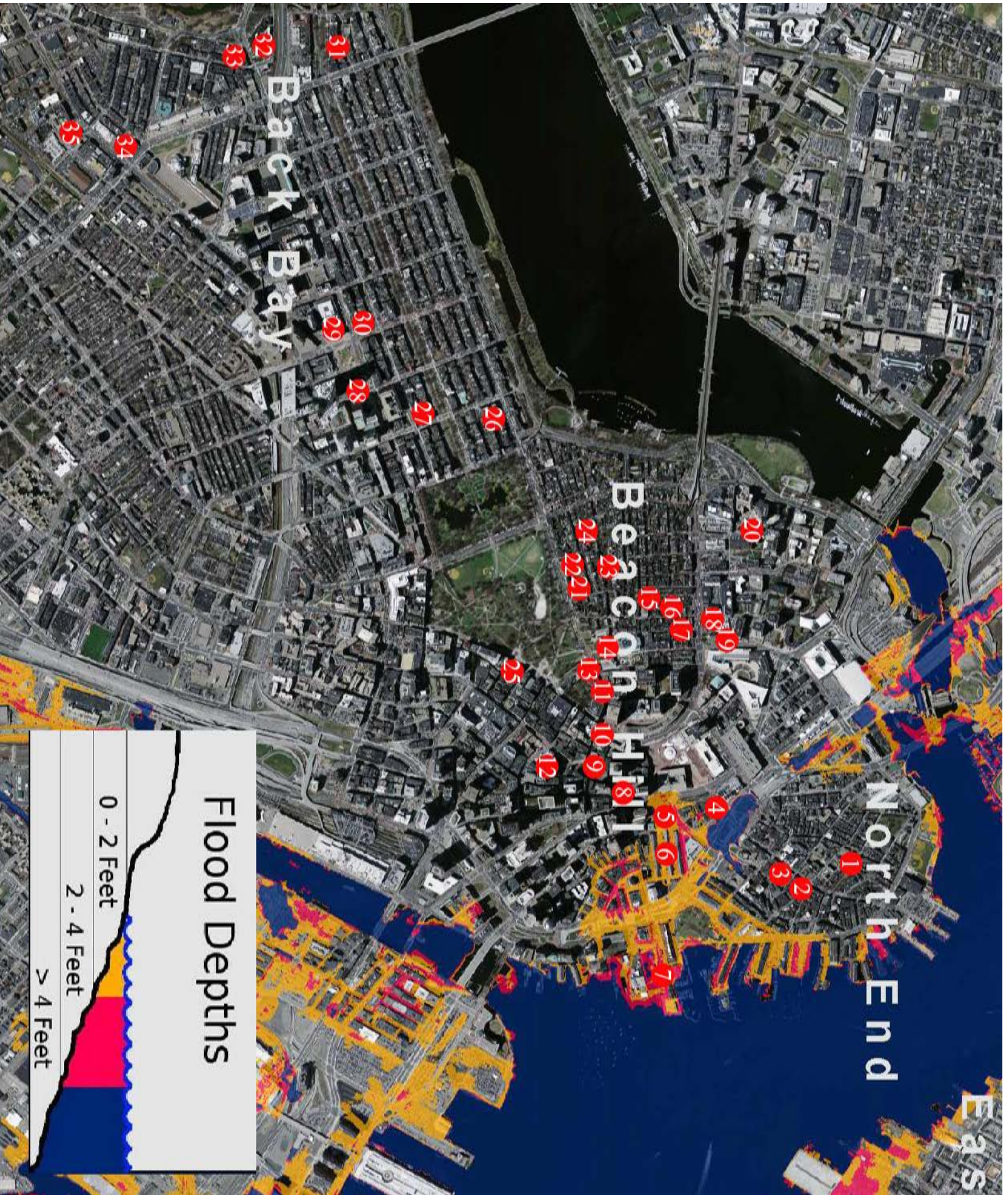
APPENDIX C: MAPS





KEY

- | | |
|--------------------------------|---------------------------------------|
| 1 – Charleston City Market | 16 – Clark Mills Studios |
| 2 – St. Michael’s Church | 17 – Farmers’ Bank and Exchange |
| 3 – Roper Mansion | 18 – Huguenot Church |
| 4 – Nathaniel Russell House | 19 – St. Philips Church |
| 5 – Miles Brewton House | 20 – Circular Church and Parish House |
| 6 – Old Exchange and Provost | 21 – Powder Magazine |
| 7 – Robert Brewton House | 22 – Unitarian Church |
| 8 – Dubose Heyward House | 23 – Old Marine Hospital |
| 9 – William Gibbes House | 24 – KKBE |
| 10 – Simmons-Edwards House | 25 – College of Charleston |
| 11 – Colonel John Stuart House | 26 – Blacklock House |
| 12 – Edward Rutledge House | 27 – Denmark Vesey House |
| 13 – John Rutledge House | 28 – Robert Barnwell Rhett House |
| 14 – Fireproof Buildings | 29 – William Aiken House |
| 15 – Hibernian Hall | 30 – Joseph Manigault House |



KEY

- 1 – Old North Church
- 2 – Paul Revere House
- 3 – Pierce Hichborn House
- 4 – Union Oyster House
- 5 – Faneuil Hall
- 6 – Quincy Market
- 7 – Long Wharf and Custom House
- 8 – Old State House
- 9 – Old City Hall
- 10 – King's Chapel
- 11 – Boston Athenaeum
- 12 – Old South Meeting House
- 13 – Chester Harding House
- 14 – Massachusetts State House
- 15 – African Meeting House
- 16 – William C. Nell Residence
- 17 – Charles Sumner House
- 18 – First Harrison Gray Otis House
- 19 – Old West Church
- 20 – Ether Dome and Massachusetts General Hospital
- 21 – Nathan Appleton Residence
- 22 – David Sears House
- 23 – Samuel Gridley and Julia Ward Howe House
- 24 – Francis Parkman House
- 25 – St. Paul's Church
- 26 – Gibson House
- 27 – Central Congregational Church
- 28 – Trinity Church
- 29 – Boston Public Library
- 30 – Old South Church
- 31 – Frederick Ayer Mansion
- 32 – Fenway Studios
- 33 – Massachusetts Historic Society Building
- 34 – Symphony Hall
- 35 – New England Conservatory of Music

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