

ABSTRACT

Title of Document: INCORPORATING CULTURAL RESOURCES
INTO RESILIENCE PLANNING

Imania G. Price, Masters of Historic
Preservation, 2016

Directed By: Dennis J. Pogue, PhD, Adjunct Associate
Professor

The built environment along the shoreline of low-lying coastal communities is being threatened by the effects of sea level rise related to climate change. Threats such as intense storm surges, increased flooding, and coastal erosion are forcing these communities to develop plans to reduce the impact these hazards may have on infrastructure, private property, and public spaces. This paper explores how coastal communities can incorporate cultural resources into local resilience plans by identifying useful planning tools and strategies. Two examples of resilience plans being carried out in Staten Island, New York, and Annapolis, Maryland, provide guidance for historic preservationists to incorporate cultural resources into this planning process.

INCORPORATING CULTURAL RESOURCES INTO RESILIENCE
PLANNING

By

Imania Grace Price

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Historic
Preservation
2016

Advisory Committee:
Dennis Pogue, Chair
Frederick Stachura
Victoria Chanse

© Copyright by
Imania Grace Price
2016

Preface

It seems obvious that historic preservationists should have a better understanding of the importance of preparing for and mitigating hazards related to vulnerable cultural resources. I noticed that the topics of climate change and sustainability were becoming important trends for planners, architects, and real estate developers. I knew it was going to be just as important for historic preservationist to join this conversation.

Maryland's vulnerability to sea level rise is a growing concern for the state. As I became involved with different state and city planning departments, I noticed a common apprehension for how to address this issue in our communities, especially when it came to cultural resources. These experiences and conversations have led me on this undertaking to help historic preservationists deal with the impacts of sea level rise.

While it was difficult to focus on one main solution, the two things I found most important are multi-discipline collaborations and community engagement. I commend the historic preservation officers and staffs who are working diligently to partner with different departments and offices to encourage planning that protects cultural resources while building more resilient communities. I hope that this project may encourage others to act now and consider cultural resources in the dialogue of resilience planning.

Acknowledgements

I would like to acknowledge the support of Nell Ziehl and Jennifer Sparenburg from the Maryland Historical Trust for letting me work with them on the state's historic preservation position on hazard mitigation during the research and writing of this paper. I would also like to express my gratitude to Lisa Craig and Karen Theimer-Brown in the City of Annapolis Planning Department for taking me under their wings and allowing me to work with them in their office on these planning efforts; their insight and knowledge were invaluable in gaining a perspective of programs and efforts to preserve and protect historic site from flooding and sea level rise.

I would like to especially thank my advisory committee members, Professor Victoria Chanse and her Climate Change Planning, Design, and Communication course that helped me gather much of the material I needed to understand the topic of climate change; and Frederick Stachura from Maryland-National Capital Park and Planning Commission for his advice and support on this paper. I would like to acknowledge my advisory committee chair Dennis Pogue; he has been of great importance in the research and writing of this paper.

My family has been invaluable and incredibly supportive during my studies over the last two years. I would like to thank Mom and Dad for helping me in a variety of ways. Your support is truly appreciated.

Table of Contents

PREFACE	IV
ACKNOWLEDGEMENTS.....	V
TABLE OF CONTENTS.....	VI
LIST OF FIGURES.....	1
CHAPTER 1: INTRODUCTION.....	2
CHAPTER 2: SEA LEVEL RISE.....	8
CHAPTER 3: PROTECTING CULTURAL RESOURCES.....	19
CHAPTER 4: TOOLS AND SOLUTIONS.....	29
CHAPTER 5: CASE STUDIES.....	45
CHAPTER 6: CONCLUSION AND RECOMMENDATIONS.....	74
BIBLIOGRAPHY.....	79

List of Figures

Figure 1: Global Sea Level Rise From 1800 To 2100.....	8
Figure 2: Chart Of 420,000-Year History: Temperature, CO2, Sea Level.....	11
Figure 3: Climate Parameters Used By The Scientific Community To Identify The Greatest Global Climate Change Risks And Impacts On Cultural Heritage.....	14
Figure 4: Climate Change Impacts On Cultural Resources.....	15
Figure 5: Drayton Hall.....	20
Figure 6: Worksheet On Mitigations Actions.....	22
Figure 7: NOAA Sea Level Rise And Coastal Flooding Impacts Viewer.....	31
Figure 8: Climate Central Surging Seas Risk Zone Map.....	33
Figure 9: Worksheet Inventory.....	34
Figure 10: Types of Protective Mitigation Measures	36
Figure 11: Louisiana Elevation Models.....	38
Figure 12: Risk Zone Map Of Annapolis.....	45
Figure 13: Annapolis City Dock Area.....	46
Figure 14: Annapolis City Dock Area.....	48
Figure 15: Annapolis Survey Area.....	49
Figure 16: Weather it Together Logo.....	51
Figure 17: Weather it Together Survey.....	54
Figure 18: Weather it Together Survey Responses.....	55
Figure 19: The Study Area For Staten Island East And South Shore Community.....	59
Figure 20: Superstorm Sandy Damage To An Area On The East Shore Of Staten Island.....	61
Figure 21: NYRCR Six Features Of Proposed Projects.....	61
Figure 22: Risk Assessment Survey Of Natural And Cultural Resources In East And South Shore Staten Island.....	64
Figure 23: Inventoried And Assessed Natural And Cultural Resources Map.....	65
Figure 24: Living Breakwaters Projects.....	67
Figure 25: Conference House Park.....	69
Figure 26: Living Breakwaters Project.....	71

Chapter 1: Introduction

As many as 99% of climatologists now believe that global climate change is occurring.¹ The impact of climate change has already affected several aspects of our environment and sea level rise is the most serious threat facing communities connected to the water. Unprecedented flooding, shoreline erosion, coastal inundation, and increased storm surges are threatening low-lying shorelines all along the coastal zone of the United States. In order to adapt to these environmental changes, vulnerable areas have begun developing strategic long-term plans and projects to help threatened communities become more resilient to the impact of climate change by adapting their infrastructures to cope with the changing environment.²

Cultural resources define our coastal communities' character and remind us of our nation's connection to the water. A significant number of the nation's most treasured cultural resources, such as the Statue of Liberty and Ellis Island, are susceptible to the impacts of sea level rise.³ The devastating impact of Hurricane Sandy in 2012 motivated cities all along the East Coast to develop comprehensive resilience plans that addressed solutions to coastal storm surges

¹ United States. National Park Service. "Do Scientists Agree about Climate Change? (U.S. National Park Service)." National Parks Service. Accessed May 18, 2016.

² Susan, Roaf, David Crichton, and Fergus Nicol. *Adapting Buildings and Cities for Climate Change: A 21st Century Survival Guide*. Amsterdam: Architectural Press, 2005.

³ Debra Holtz, Adam Markham, Kate Cell, and Brenda Ekwurzel. "National Landmarks at Risk (2014)." Union of Concerned Scientists. May 2014. Accessed May 10, 2016. http://www.ucsusa.org/global_warming/science_and_impacts/impacts/national-landmarks-at-risk-from-climate-change.html.

and floods, and include preventive measures to mitigate the impact of sea level rise.⁴

Understanding key terms such as resilience and adaptation are essential to navigating climate change literature and management. Resilience is defined as the “capacity of a community to cope with hazards in a timely and efficient manner.”⁵ Adaptation is defined as the “adjustment of natural or human systems in response to actual or expected climatic stimuli and their effects, which may harm or exploit beneficial opportunities.”⁶ In other words, resilience is the ability for communities to cope with threats and adaptation is the action a community takes to adjust.

Resilience plans are documents that address how a community will manage environmental threats such as sea level rise and provide adaptation options as implementable outcomes of these plans. Resilience is different from sustainability, green, and disaster risk reduction because rather than just offering strategies for coping or adaptation, it is a transformative, holistic action that helps cities perform better all around.⁷ This type of plan can and should build and improve on other comprehensive plans already in place. These resilience plans are developed using tools such as interactive GIS maps and vulnerability

⁴ Vincent Lee. "Arup | Thoughts | Sandy's Lessons for Resilience Planning." ARUP. November 12, 2012. <http://thoughts.arup.com/post/details/252/sandys-lessons-for-resilience-planning>.

⁵ IPCC. "Annex II Glossary of Terms." A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). 2012. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf, 563.

⁶ Ibid., 556.

⁷ National Institute of Standards and Technology. "Community Resilience Planning Guide." NIST Engineering Laboratory. October 29, 2015. Accessed May 18, 2016. <http://www.nist.gov/el/resilience/guide.cfm>.

assessments. These tools enable planners and stakeholders to visualize the impact that sea level rise will have on its assets and identify which assets are most vulnerable.

Scientific data and research from leading institutions and experts, policies and initiatives generated by state and federal agencies, and local design guidelines and comprehensive plans are key to an effective resilience plan. Although scientists may agree on climate change, it is politicians and officials who must implement the solutions. Since climate information varies from community to community, there is no single document or solution that is applicable to every neighborhood. Therefore each plan must be developed in cooperation with multiple agencies, departments, stakeholders, residents, and community organizations. This cooperation should come together at a local level to ensure as much community engagement as possible to formulate a community-centered resilience plan.

To begin to address the question of how best to carry out community-centered resilience plans it is crucial to review the current climate science data on sea level rise and its impacts on coastal communities. As technological tools have improved, the scientific data is now more detailed.⁸ Cultural resources can also be utilized in research to help scientists record environmental changes and assess the

⁸ Robert M, Deconto and David Pollard. "Contribution of Antarctica to past and Future Sea-level Rise." *Nature* 531, no. 7596 (March 30, 2016): 591-97. doi:10.1038/nature17145.

impact of climate change over time on historic structures.⁹ Being up to date on the most current research and data available allows communities to best plan for future changes, but as the data evolves, these plans must be flexible and adaptable.

The significant body of literature and wide variety of policies relevant to issues of climate change help to incorporate cultural resources into resilience planning. Highlighted here are the scholarly documents and policies that represent the types of information that are available to guide historic preservationists in conducting resilience planning. The third chapter identifies resilience-planning tools used to help planners develop scenarios to visualize and evaluate different resilience options. These tools are used as a way to assess vulnerabilities and involve community members in the planning process. The chapter also explores adaptation solutions for cultural resources and the challenges they face. The specific methods are not critiqued and the options are not analyzed in detail, but the review suggests how cultural resources can be incorporated into resilience-planning strategies.

Two communities that are at different stages of the resilience-planning process have been selected for analysis, with a specific focus on how they have incorporated cultural resources into their resilience planning process. Along with many other parts of New York City, Staten Island was heavily damaged by the

⁹ Marcy, Rockman. "An NPS Framework for Addressing Climate Change with Cultural Resources." *The George Wright Forum* 32, no. 1 (2015): 46.
<http://www.georgewright.org/321rockman.pdf>.

impact of Hurricane Sandy in 2012. The government of the city of New York quickly took the lead and developed a resilience plan for the city and funded adaptation projects that focused on protecting its boroughs from sea level rise. The New York City Department of City Planning created a community resilience plan for the East and South Shore of Staten Island that included adaptation projects that addressed community planning, resilience, infrastructure, and natural and cultural resources. This case study provides a detailed portrait of a community based resilience plan and an adaptation solution that seeks to build on the area's cultural heritage as a source of social engagement.

The City of Annapolis Department of Planning and Zoning is currently developing a Cultural Resource Hazard Mitigation Plan, which will incorporate cultural resources into the mitigation process. Although the plan is narrower in scope than the planning effort for Staten Island, the Annapolis community engagement program created by the city's Historic Preservation Officer brings together stakeholders, city officials, state and federal agencies, local organizations, and residents into the planning process.

Several other cities along the U.S. coastline have developed, or are in the process of creating resilience-planning documents and adaptation projects.¹⁰

Staten Island and Annapolis were selected as case studies for this project because of their high levels of community engagement, and their use of cultural heritage

¹⁰ Zhenghong Tang, Samuel D. Brody, Courtney Quinn, Liang Chang, and Ting Wei. "Moving from Agenda to Action: Evaluating Local Climate Change Action Plans." *Journal of Environmental Planning and Management* 53, no. 1 (2010): 41-62. Accessed May 10, 2016. doi: 10.1080/09640560903399772.

as a way to stimulate dialogue on resilience and on ways that communities can adapt while also protecting their historic identity. These plans focus on relatively small local areas and are following, or have followed specific criteria that I identified from my research. These criteria address the type of threat, the tools used, the community engagement strategy, and the outcome or deliverable.

The final section concludes with recommendations for historic preservationists on how they can incorporate cultural resources into resilience planning documents and projects. These five recommendations constitute an approach to effectively incorporate cultural resources into the resilience planning process. While not new in concept, adopting them in the context of resilience planning will enhance the efforts to incorporate and ultimately preserve those cultural resources.

Chapter 2: Sea Level Rise

Coastal communities are experiencing tidal and nuisance flooding, storm surges, and coastal erosion that have increased dramatically in number and severity over the recent decades.¹¹ Earlier projections called for the global mean sea level to rise between 7 and 23 inches by 2100, but more recent studies indicate that those levels will increase much more dramatically, by 5 or 6 feet at the end of the century.¹²

Past and Projected Changes in Global Sea Level

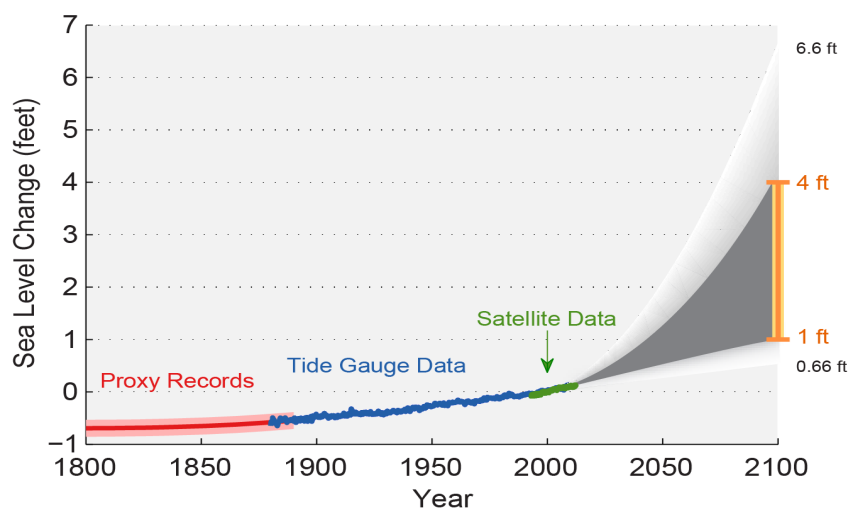


Figure 1: National Climate Assessment Report. 2012. Chart depicting estimated, observed, and possible future amounts of global sea level rise from 1800 to 2100, relative to the year 2000.

¹¹ Erika Spanger-Siefield, Melanie Fitzpatrick, 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*. Technical paper. October 2014. <http://www.ucsusa.org/sites/default/files/attach/2014/10/encroaching-tides-full-report.pdf>.

¹² DeConto. Contribution Of Antarctica To Past And Future Sea-Level Rise. *Nature*, 2016; 531 (7596): 591 DOI:[10.1038/nature17145](https://doi.org/10.1038/nature17145).

"We're looking at the potential for a rate of sea level rise that we will be measuring in centimeters (rather than milliliters) per year," concluded Robert DeConto of the University of Massachusetts, Amherst, and author of a 2015 study on sea level rise. In an interview with CNN, he asked, "Can we build walls and levies and dikes fast enough to keep up with that? At that point you're sort of looking at managed retreat essentially, rather than geoengineering in a lot of places."¹³ This statement highlights that strategic long term planning is essential in addressing the impacts of sea level rise. Resilience planning goals will require years to implement and must account for sea levels that might adjust over time. Planners must understand the drivers that are causing these changes in sea level and anticipate how they will impact the built environment.

Sources of Sea Level Rise

The Intergovernmental Panel on Climate Change (IPCC) defines sea level change as the difference in sea level, globally or locally, "due to (i) changes in the shape of the ocean basins, (ii) changes in the total mass and distribution of water and land ice, (iii) changes in water density, and (iv) changes in ocean circulation."¹⁴ The rise in sea level is largely driven by continental ice cap and

¹³ Don Melvin and Ray Sanchez, "Ice melt could make seas rise 6 feet by 2100, study says," CNN.com, last modified April 2, 2016, accessed May 1, 2016, <http://www.cnn.com/2016/03/31/tech/study-melting-antarctic-ice/>.

¹⁴IPCC. "Annex II Glossary of Terms." A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). 2012. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf, 563.

sheet melt and ocean thermal expansion.¹⁵ The rise in temperatures is largely due to the increased atmospheric loading of carbon dioxide emissions, which are melting the world's glaciers and ice sheets.¹⁶ Carbon dioxide emissions are a naturally occurring gas in the earth's atmosphere; a byproduct of burning fossil fuels, land-use changes and other industrial processes; and the principal human-caused greenhouse gas that affects the earth's radioactive balance.¹⁷ The increasing levels of carbon dioxide in the air have begun warming the earth's atmosphere, which in turn is warming the ocean.

¹⁵ Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan, 2013: Sea Level Change. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

¹⁶ DeConto. Contribution of Antarctica to past and future sea-level rise. *Nature*, 2016; 531 (7596): 591 DOI:[10.1038/nature17145](https://doi.org/10.1038/nature17145).

¹⁷ IPCC, 2012: Glossary of terms. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555-564.

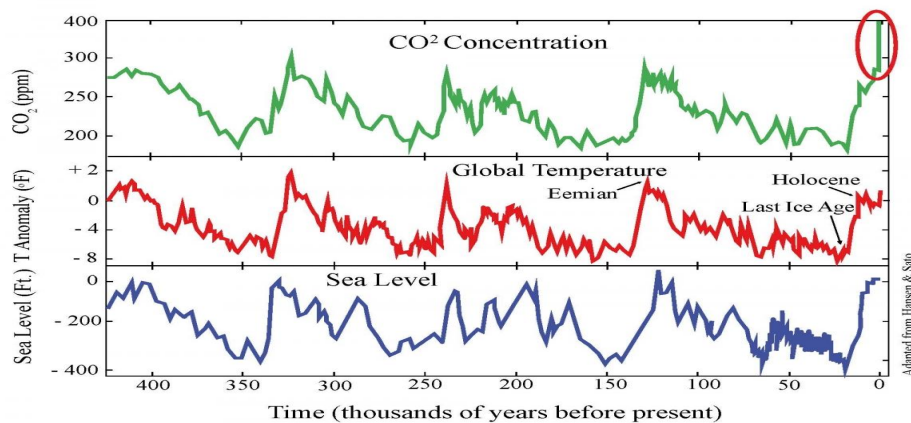


Figure 2: 420,000-year history of temperature, CO₂, Sea Level Rise. 2016. Chart depicts carbon dioxide and temperature fluctuates naturally every few thousands years or so for various reasons. www.johnenglander.net.

Even if greenhouse gases in the atmosphere stabilize, sea level will continue to rise over many centuries due to the extremely slow response of the oceans to air temperature. John Englander, author of *High Tide on Main Street*, describes the warming oceans as akin to an open bottle of soda that goes flat more quickly after being warmed because the heat forces it to release its carbon dioxide bubbles faster.¹⁸

In addition to rising temperatures, the ocean's thermal expansion is calculated to contribute 55-70% of sea-level rise due to an increase in the volume of the world's oceans by 2100.¹⁹ It is important that cultural resource managers understand and cite specific measures in their planning documents with the

¹⁸ John Englander. *High Tide on Main Street: Rising Sea Level and the Coming Coastal Crisis*. 2nd ed. Boca Raton: Science Bookshelf, 2014.

¹⁹ Mary Caffrey and Rebecca Beavers, "Planning for the impact of sea-level rise on U.S. national parks," *Park Science* 30, no. 1 (Summer 2013): 7.

understanding that these numbers may well change over time. The mapping tools examined later on in this paper will help provide planners and managers with increasingly accurate projections to develop sea level rise models and scenarios for planning.

Cultural Resources and Climate Change

Until recently the discussion of the issue of climate change in the United States has been largely confined to scientific forums. But as increased flooding and storm surges are impacting coastal cities, the topic of climate change has entered the public conversation, and affected communities are looking for solutions and answers. More public awareness, along with information on mitigation strategies aimed at property owners, and a consistent message from public officials, are needed.

Marcy Rockman, the Climate Change Adaptation Coordinator for Cultural Resources for the National Park Service (NPS), observes that cultural resources have always been subject to environmental forces, but climate change presents an intensification, acceleration, or new combination of those environmental forces.²⁰ In 2007, the UNESCO World Heritage Centre published a report on *Climate Change and World Heritage*, which assessed the impacts of climate change on World Heritage sites and outlined appropriate management responses. The report outlined various social, as well as, physical impacts on cultural heritage sites

²⁰ National Park Service, comp. *Preserve Coastal Heritage: Summary Report* (Washington: GPO, 2014), 9.

including organic building materials, archaeological evidence, and fragile moveable artifacts.²¹ Impacts are defined as the effects on natural and human systems of physical events, of disasters, and of climate change.²² The report also stresses the indirect social impact that climate change would have on how communities relate to their social structures, which could lead to changes in, or even the migration of, entire societies. A helpful tool provided by the report consists of a list of different climate change risks and the impacts they could have on cultural heritage. Figure 3 provides cultural resources managers with a tool to begin assessing the vulnerability of their cultural resources as it relates to the diverse impacts of climate change, including sea level rise.

²¹ Augustin Colette ed. *Climate Change and World Heritage Report on Predicting and Managing the Impacts of Climate Change on World Heritage and Strategy to Assist States Parties to Implement Appropriate Management Responses*. Report. UNESCO, 2007. May 2007. http://whc.unesco.org/documents/publi_wh_papers_22_en.pdf.

²² IPCC, 2012: Glossary of terms. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555-564.

Table 1. Principal climate change risks and impacts on cultural heritage		
Climate indicator	Climate change risk	Physical, social and cultural impacts on cultural heritage
Atmospheric moisture change	<ul style="list-style-type: none"> - Flooding (sea, river) - Intense rainfall - Changes in water-table levels - Changes in soil chemistry - Ground water changes - Changes in humidity cycles - Increase in time of wetness - Sea-salt chlorides 	<ul style="list-style-type: none"> - pH changes to buried archaeological evidence - Loss of stratigraphic integrity due to cracking and heaving from changes in sediment moisture - Data loss preserved in waterlogged / anaerobic / anoxic conditions - Eutrophication accelerating microbial decomposition of organics - Physical changes to porous building materials and finishes due to rising damp - Damage due to faulty or inadequate water disposal systems; historic rainwater goods not capable of handling heavy rain and often difficult to access, maintain, and adjust - Crystallisation and dissolution of salts caused by wetting and drying affecting standing structures, archaeology, wall paintings, frescos and other decorated surfaces - Erosion of inorganic and organic materials due to flood waters - Biological attack of organic materials by insects, moulds, fungi, invasive species such as termites - Subsoil instability, ground heave and subsidence - Relative humidity cycles/shock causing splitting, cracking, flaking and dusting of materials and surfaces - Corrosion of metals - Other combined effects eg. increase in moisture combined with fertilisers and pesticides
Temperature change	<ul style="list-style-type: none"> - Diurnal, seasonal, extreme events (heat waves, snow loading) - Changes in freeze-thaw and ice storms, and increase in wet frost 	<ul style="list-style-type: none"> - Deterioration of facades due to thermal stress - Freeze-thaw/frost damage - Damage inside brick, stone, ceramics that has got wet and frozen within material before drying - Biochemical deterioration - Changes in 'fitness for purpose' of some structures. For example overheating of the interior of buildings can lead to inappropriate alterations to the historic fabric due to the introduction of engineered solutions - Inappropriate adaptation to allow structures to remain in use
Sea-level rises	<ul style="list-style-type: none"> - Coastal flooding - Sea-water incursion 	<ul style="list-style-type: none"> - Coastal erosion/loss - Intermittent introduction of large masses of 'strange' water to the site, which may disturb the metastable equilibrium between artefacts and soil - Permanent submersion of low lying areas - Population migration - Disruption of communities - Loss of rituals and breakdown of social interactions
Wind	<ul style="list-style-type: none"> - Wind-driven rain - Wind-transported salt - Wind-driven sand - Winds, gusts and changes in direction 	<ul style="list-style-type: none"> - Penetrative moisture into porous cultural heritage materials - Static and dynamic loading of historic or archaeological structures - Structural damage and collapse - Deterioration of surfaces due to erosion

Figure 3: Climate Change and World Heritage Report. 2006. This is a list of parameters used by the scientific community to identify the greatest global climate change risks and impacts on cultural heritage.

Table 1. Climate change impacts on cultural resources. This table incorporates data from the UNESCO World Heritage Centre (Colette 2007) and NPS field observations.			
<i>Impact</i>	<i>Environmental Forces</i>	<i>CR Affected</i>	<i>Rate</i>
Submersion	SLR	AS, B/S, CL, E	Trend
Erosion	SLR, Storm surges	AS, B/S, CL, E	Event, Trend
Inundation	SLR, Storm surges, Flooding	All	Event
Saturation	SLR (rising water tables)	1st: AS, B/S, CL, E 2nd: MC	Trend
Deterioration	Precipitation variation	AS, B/S, CL, E	Trend/event
	Temperature variation	AS, B/S, CL, E	Trend/event
	Wind variation	AS, B/S, CL, E?	Event/trend
Dissolution	Temperature increase (permafrost)	AS, B/S, CL, E	Trend
	Ocean acidification	AS (terrest..., underw.?)	Trend
Destruction	Flooding	All	Event
	Storm (rain/wind)	All	Event
Oxidation	Increase atmospheric moisture	B/S	Trend
Depletion	Ecosystem changes due to human development	AS, B/S, CL, E	Event, Trend
Conflagration	Fire (Drought) (Temperature extremes +/- Insect effects)	All	Event
Dessication	Temperature extremes	AS, B/S, CL, E	Event (trend?)
	Drought	AS, B/S, CL, E	Long event
Invasion	Invasive species	AS, BS, CL, E, MC	Trend
	Mold	BS, MC	Event
Disruption	Loss of species	E	Trend/event
	Loss of access	E	Event/trend
	Looting	AS	Event
Key: SLR = sea level rise, AS = archaeological sites, B/S = buildings and structures, CL = cultural landscapes, E = ethnographic resources, MC = museum collections.			

Figure 4: NPS. 2012. Table depicting climate change impacts on cultural resources from the UNESCO World Heritage Centre and NPS field observations.

In 2012, the National Park Service incorporated data from their field operations to show the climate change impacts on sites managed by the agency. Figure 4 provided a framework for the NPS to identify the levels of impacts that climate change will have on archeological sites, buildings and structures, cultural

landscapes, and ethnographic resources.²³ The impacts of sea level rise on these resources include factors such as submersion, erosion, inundation, and overall destruction of historic sites. As illustrated in Figure 4, cultural resources will be negatively impacted by rising sea level if steps are not taken to help them adapt to the changing climate.

The National Park Service defines cultural resources as the physical evidence or place of past human activity.²⁴ The NPS director, Jonathan Jarvis, stated, “cultural resources are primary sources of data regarding human interactions with environmental change.”²⁵ This idea encourages the use of cultural resources as a tool for climate research and analysis. NPS highlights cultural resources as a wealth of information on past long-term human impacts on the environment, which can help predict climate change trends and inform planning decisions and action. Cultural resources such as prehistoric shell mounds can help scientists study past climates; this catalogue of past architectural and landscape techniques may have been better suited to the changing local environments.²⁶ The key to protecting cultural resources is recognizing their value as a research opportunity as well as an asset.

²³ Marcy NPS Framework for Addressing Climate Change with Cultural Resources." The George Wright Forum. 41.

²⁴ United States. National Park Service. "Cultural Resources." National Parks Service. Accessed May 14, 2016.
https://www.nps.gov/acad/learn/management/rm_culturalresources.htm.

²⁵ Memorandum by Johnathan B. Jarvis, "Climate Change and Stewardship of Cultural Resources," February 10, 2014, Policy Memorandum 14-02.

²⁶ Marcy Rockman. "An NPS Framework for Addressing Climate Change with Cultural Resources." The George Wright Forum. 53.

Resilience Planning

When a community is threatened by hazards such as rising sea levels, the extent of recovery from that damage depends on a combination of the severity of the impact and the preparedness of communities to prevent incidents, mitigate risk, protect assets, and recover their community functions. The resilience plans are continuous, proactive, and collaborative guidelines and strategies to minimize the consequences of natural hazards by adapting a community's infrastructure to the environment. Communities without these plans are subject to the full impact of these hazards, which have negative effects on continuity of businesses, schools, and services. Increased community resilience can attract business investment and new residents by providing a plan that allows communities to anticipate threats and create a better place to live.²⁷ This paper focuses on the role of resilience plans in protecting community assets such as cultural resources from hazards related to sea level rise.

Conclusion

Scientific inquiry has demonstrated that the sea is rising as a result of the changing climate and that humans are contributing to the rapid rate of change. This data shows that there is no stopping the sea levels from rising and suggests that communities either will have to retreat or adapt to this new trend. Cultural

²⁷ National Institute of Standards and Technology. "Community Resilience Planning Guide." NIST Engineering Laboratory. October 29, 2015. Accessed May 18, 2016. <http://www.nist.gov/el/resilience/guide.cfm>.

resources are significantly threatened by different factors related to sea level rise, which include flooding of historic structures and loss of archeological sites. Cultural resources can be used to help scientists better prepare for future changes by examining past trends of development. NPS is incorporating cultural resources into resilience plans and has produced literature to help federal managers plan for protecting historic sites. These are stand-alone policies for NPS facilities, however, and do not yet incorporate other agencies, stakeholders, or the communities they are located within. The complexities of coastal adaptation combined with the limited guidance from the federal government makes the problem of protecting cultural resources from the impact of climate change all the more difficult.

Chapter 3: Protecting Cultural Resources

Literature Review

As recently as the late 1990s and early 2000s, most cultural resource mitigation literature focused on disaster preparedness and recovery from natural disasters, such as the Northridge Earthquake, the Midwest floods, or Hurricane Katrina. Publications such as *Protecting the Past from Natural Disasters*, by Carl L. Nelson, highlights the preservation responses to natural disasters and provides recommendations for how historic resources can be better prepared for similar events in the future.²⁸ While it is a good idea to build on the momentum of a disaster to stir action, it is important to note that adapting for sea level rise is not the same as recovering after the last big storm. That is not to say that climate change couldn't be addressed through disaster preparedness. However, disaster preparedness is often focused on immediate response and recovery after a disaster event rather than preparing for a long-term problem such as sea level rise. Nelson's book provides good information to gather information on preparedness.

²⁸ Nelson, Carl L. *Protecting the past from Natural Disasters*. Washington, D.C.: Preservation Press, National Trust for Historic Preservation, 1991.



Figure 5: Nelson, Carl. 1991. *Protecting the Past from Natural Disasters*. Drayton Hall with two thirds of its historic trees uprooted after Hurricane Hugo.

A document prepared by FEMA and published in 2005, *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*, is a guide that focuses on cultural resources and hazard mitigation.²⁹ The document provides step-by-step tools and resources on how to develop and implement a pre-disaster planning strategy for historic properties and cultural resources. Several cities, such as Tulsa, Oklahoma, have attempted to use the guide in their hazard mitigation planning efforts, but few have followed the guide in its entirety.³⁰ The Annapolis Historic District will be among the first communities to thoroughly complete the FEMA process to create their Cultural

²⁹ FEMA. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*. Technical paper no. 386-6. 2005. <http://www.fema.gov/media-library-data/20130726-1522-20490-2886/howto6.pdf>.

³⁰ "Tulsa Hazard Mitigation Plan Historic Preservation & Cultural Resources Annex." Telephone interview by author. March 7, 2016.

Resources Hazards Mitigation Plan. This guide can be an effective tool for communities seeking to incorporate cultural resources into their planning process. Many of the worksheets involve other agencies and will require a proactive team leader who has the time to work with other departments to help them complete each step. Importantly, the guide does not provide any information for how to incorporate sea level rise into the planning process, although it does focus on its impacts like flooding and coastal storms.

Identify Alternative Mitigation Actions for
Worksheet #6 Historic Properties and Cultural Resources **phase 3**
Worksheet Job Aid #1: Alternative Mitigation Actions by Hazard (page 1 of 2) **step 2**

Job Aid #1 from FEMA 386-3, Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies has been included in this guide for your convenience. You can use this job aid when filling out Worksheet #6. This job aid shows you at a quick glance the types of actions that can address the selected seven hazards. A description of each action is included in the glossary in Appendix A of FEMA 386-3.

Alternative Mitigation Actions	Prevention													
	Building codes	Coastal zone management regulations	Density controls	Design review standards	Easements	Environmental review standards	Floodplain development regulations	Floodplain zoning	Forest fire fuel reduction regulations	Hillside development regulations	Open space preservation	Performance standards	Shoreline setback regulations	Special use permits
Floods	■	■	■	■	■	■	■	■			■	■	■	■
Earthquakes	■		■	■	■	■				■	■	■		■
Tsunamis	■	■	■	■		■					■	■	■	■
Tornadoes	■			■		■					■			■
Coastal Storms	■	■	■	■	■	■	■	■					■	■
Landslides	■		■	■	■	■			■	■	■	■	■	■
Wildfires	■		■	■	■	■			■	■	■	■		■

Alternative Mitigation Actions	Property Protection					Public Education and Awareness			Natural Resource Protection						
	Acquisition of hazard-prone structures	Construction of barriers around structures	Elevation of structures	Relocation out of hazard areas	Structural retrofits (e.g., reinforcement, floodproofing, storm shutters, and/or bracing)	Hazard Information Centers	Public Education and Outreach Programs	Real Estate Disclosure	Best Management Practices (BMPs)	Dune and beach restoration	Forest and vegetation management	Sediment and erosion control regulations	Stream corridor restoration	Stream dumping regulations	Urban forestry and landscape management
Floods	■	■	■	■	■	■	■	■	■		■	■	■	■	■
Earthquakes	■			■	■	■	■	■	■						
Tsunamis	■	■	■	■	■	■	■	■		■		■			
Tornadoes					■	■	■	■							
Coastal Storms	■	■	■	■	■	■	■	■	■	■		■			■
Landslides	■			■		■	■	■	■		■	■	■		■
Wildfires	■			■		■	■	■	■		■				■

Figure 6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation. 2005. Worksheet Example of Mitigations Actions for Specific Hazards.

If a local government agency is looking for advisory data on climate change, then they should consider the Intergovernmental Panel on Climate Change (IPCC) which is one of the leading global organizations currently

working on climate change.³¹ The IPCC provide balanced and rigorous scientific information derived from thousands of scientists from all around the world for the benefit of decision makers. They have produced several reports on the current state of knowledge on climate change and its potential environmental and socio-economic impacts.³² Communities and agencies use these reports to help set policies with the benefit of the most up to date data available. The *Fifth Assessment Report* was published in 2014, which updated the scientific data, outlined mitigation strategies, and included vulnerability reports on climate change around the world.

The UNESCO report on *Climate Change and World Heritage* was based on the scientific data provided by the IPCC. A total of 125 World Heritage sites were listed in the report as specifically threatened by climate change.³³ Reports such as this are essential tools for cultural resource managers to stay on top of current scientific trends that might be affecting their cultural resources. The data provided in the reports helps planners make recommendations and provides information on different levels of actions that could be taken to protect cultural resources.

³¹"IPCC - Intergovernmental Panel on Climate Change." IPCC - Intergovernmental Panel on Climate Change. Accessed May 14, 2016. <http://www.ipcc.ch/organization/organization.shtml>.

³² "IPCC Fifth Assessment Report." IPCC Fifth Assessment Report. November 2014. Accessed May 10, 2016. <https://ipcc.ch/report/ar5/>.

³³ Colette Augustin, ed. *Climate Change and World Heritage Report on Predicting and Managing the Impacts of Climate Change on World Heritage and Strategy to Assist States Parties to Implement Appropriate Management Responses*. Report. UNESCO, 2007. May 2007. http://whc.unesco.org/documents/publi_wh_papers_22_en.pdf.

The document, *Surging Seas - Sea Level Rise Analysis*, prepared by the non-governmental agency, Climate Central, is another resource that is widely used to provide information for organizations and policy makers to make informed decisions on community mitigation and solutions for adaptation. One of the reports by Climate Central focuses on new research and analysis and found that the effect of sea level rise at a state level will vary. The report however only reflects best estimates from the research and not the actual raw data. Still NOAA, local coastal management organizations, and several states have used the Climate Central database in their planning process.

The 2012 report by Climate Central was one of the first to include estimates of the extent of land, population, and housing at risk. The report also evaluated the risk for every low-lying coastal town, city, county, and state in the contiguous U.S. It prepared localized timelines of storm surge threats integrating local sea rise projections and provided access to free downloadable interactive maps and data sets.³⁴ This report remains an excellent resource for communities looking for general information on sea level rise because it provides base estimates for how their community compares with others around the country. This publication has been a very useful visualization tool to provide to citizens and stakeholders. The Climate Central database also provides plans, actions, and state resources, as well as national level resources.

³⁴ Ben Strauss , Claudia Tebaldi, and Remik Ziemlinski. "Surging Seas:Sea Level Rise, Storms & Global Warming's Threat to the US Coast." *Surging Seas*. March 14, 2012. Accessed May 10, 2016. <http://slr.s3.amazonaws.com/SurgingSeas.pdf>.

Policies

Government policies on climate change in the United States lag behind other developed nations.³⁵ The Obama administration has nevertheless pushed initiatives to reduce carbon emissions, promote clean energy, and prepare for the impacts of climate change.³⁶ In the aftermath of Hurricane Sandy, one of the initiatives the President established was the Unified Federal Environmental and Historic Review Process (UFR), which specifically included a provision for cultural resources. This provision of the Sandy Recovery Improvement Act (SRIA) of 2013, expedited the environmental and historic preservation reviews that must be completed prior to the release of federal assistance or permits, so the disaster recovery projects could proceed without undue delays.³⁷ The White House also distributed grant money to states affected by Hurricane Sandy to aid in planning for the protection of cultural resources from further natural hazards due to sea level rise such as flooding and storm surges.³⁸ These and other national climate change policies have allowed states to develop their own policies to encourage resilience plans for the impact of climate change on their communities.

³⁵ English Heritage. "Climate Change and the Historic Environment." Historic England. January 18, 2008. <https://www.historicengland.org.uk/images-books/publications/climate-change-and-the-historic-environment/>.

³⁶ Executive Office of the President. "President's Climate Action Plan - White House Gallery." June 2013. <http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

³⁷ Advisory Council on Historic Preservation. "Unified Federal Review." ACHP | Unified Federal Review. 2013. Accessed May 11, 2016. http://www.achp.gov/unified_federal_review.html

³⁸ Executive Office of the President. "President's Climate Action Plan - White House Gallery." June 2013. <http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

The Chesapeake Bay coastal zone of the State of Maryland is particularly vulnerable to the effects of sea level rise and has already begun experiencing increased flooding, large storm surges, and land subsidence.³⁹ As a result, many policies that address sea level rise have been formulated and are administered through the Maryland Department of Natural Resources (DNR). One of the Maryland regulations requires the Department to evaluate tidal wetlands license or permit applications to consider, among other things, the degree to which “danger may arise because of the location of proposed structures from hurricanes, floods, sea-level rise, or other determinable and periodically recurring natural hazards.”⁴⁰

In December 2012, the Maryland Climate Change and CoastSmart Construction Executive Order “directed that all new and reconstructed state structures, as well as other infrastructure improvements, be planned and constructed to avoid or minimize future flood damage.”⁴¹ The order enacts a number of policy directives, including “directing all state agencies to consider the risk of coastal flooding and sea level rise when they design capital budget projects, and charging the Department of General Services with updating state

³⁹ Maryland Commission on Climate Change Adaptation and Response Working Group. Comprehensive Strategy for Reducing Maryland’s Vulnerability to Climate Change Phase I: Sea-level Rise and Coastal Storms. Report. September 12, 2008.

⁴⁰ Maryland. Regs. Code § 01.01 2012.29.

⁴¹ Maryland. Regs. Code § 01.01 2012.29.

architecture and engineering guidelines to require new and rebuilt structures to be elevated two or more feet above the 100-year base flood level”.⁴²

Other states, such as New Jersey, Rhode Island, and Massachusetts, have policies similar to Maryland’s. For example, recently adopted regulations in Massachusetts require that “new buildings within a flood zone intended for human occupancy and not intended for water-dependent uses be designed and built to incorporate projected sea-level rise during the building's design life, in a manner consistent with projected sea-level rise.”⁴³ These and similar policies that have enacted around the country provide a political platform for planners to develop strategies for addressing sea level rise.

Conclusion

It is important to understand the current literature and policies on sea level rise in order to develop an effective, politically balanced resilience plan. The literature provides scientific context and detailed facts to inform any plan. The literature can also help to educate the community and build a consistent language. Policies can encourage political willpower. Maryland’s proactive policies on addressing climate change helped propel its planning process in combating sea level rise far beyond those of less progressive but equally threatened states like

⁴² Maryland. Regs. Code § 01.01 2012.29.

⁴³Massachusetts’s policy guidelines; (310 CMR 9.37(2)(b)(2)).

South Carolina.⁴⁴ Literature and policies do not directly involve the community, but it is at the next planning and development stage that community engagement is most important.

⁴⁴ Jackie Judd. "Two Cities, Two Very Different Responses to Rising Sea Levels." PBS. July 2, 2015. <http://www.pbs.org/newshour/bb/two-cities-two-different-responses-rising-sea-levels/>.

Chapter 4: Tools and Solutions

The effects of sea level rise are no longer just a threat; it is a growing reality for communities along the coast. It is critical, therefore, that governments, regional authorities, and communities reduce their vulnerabilities to these impacts. Adaptation is an adjustment of systems in response to expected climatic changes and its effects. This adjustment includes mitigation measures and practices that will make communities resilient to the impact of sea level rise. These measures are often developed with planning tools such as GIS maps, vulnerability and risk assessments, and development incentives. These tools are instrumental in helping to build effective resilience plans that will implement long-term adaptation solutions. Most comprehensive plans tend to be overarching, big vision, documents that often offer no clear blueprint for how it will be implemented. Resilience planning is the transition from awareness of a problem to the construction of actual strategies and deliverables. Following are the tools used to develop resilience plans that focus on community centered adaptation solutions to protect and preserve cultural resources in coastal communities.

Planning tools can be defined as instruments that help guide organizational action steps related to implementation of an initiative, program, or intervention.⁴⁵

Resilience planning is not a problem-free process, nor will it satisfy everyone. An

⁴⁵ California Social Work Education Center. "Planning Tools." CalSWEC |. Accessed May 20, 2016. <http://calswec.berkeley.edu/toolkits/implementation-toolkits/planning-tools>.

effective adaptation solution requires vigorous planning, innovative ideas, incentives and opportunities, and careful risk assessment. The ability to predict and interpret climate science data is an important criterion for developing a useful resilience plan. One of the best ways for this data to be effective is as a mapping tool. Cities and states around the country are using map services to help communities and their stakeholders consider risk from future sea level rise. These maps often integrate the best available flood data with information from government reports.

Mapping

Several mapping tools are available through NOAA and FEMA that are particularly useful for planners to formulate strategies that most accurately reflect the latest projections and climate information. These agencies offer a list of governmental and non-governmental software tools to assist coastal communities and analyze and assess vulnerabilities due to sea level rise, storm surges, and sinking lands.⁴⁶ The NOAA Office for Coastal Management developed Digital Coast to meet the unique needs of the coastal management community.⁴⁷ This online database contains mapping viewers, predictive tools, training modules, and coastal news and information from various sources, which are vetted through the

⁴⁶ National Oceanic and Atmospheric Administration. "Preparing the Nation for Sea Level Rise and Coastal Flooding." Climate-Smart Nation. 2013. Accessed May 10, 2016. http://cpo.noaa.gov/sites/cpo/About_CPO/Coastal_Final.pdf.

⁴⁷ National Oceanic and Atmospheric Administration. "Digital Coast. More than Just Data." Digital Coast. Accessed May 14, 2016. <https://coast.noaa.gov/digitalcoast/>.

NOAA community. This database provides a wealth of applications for coastal planners to utilize in developing plans. Another tool developed by NOAA is called the Coastal Resilience. It is a web-based mapping tool designed to help communities understand their vulnerability from coastal hazards, reduce their risk and determine the value of nature-based solutions.

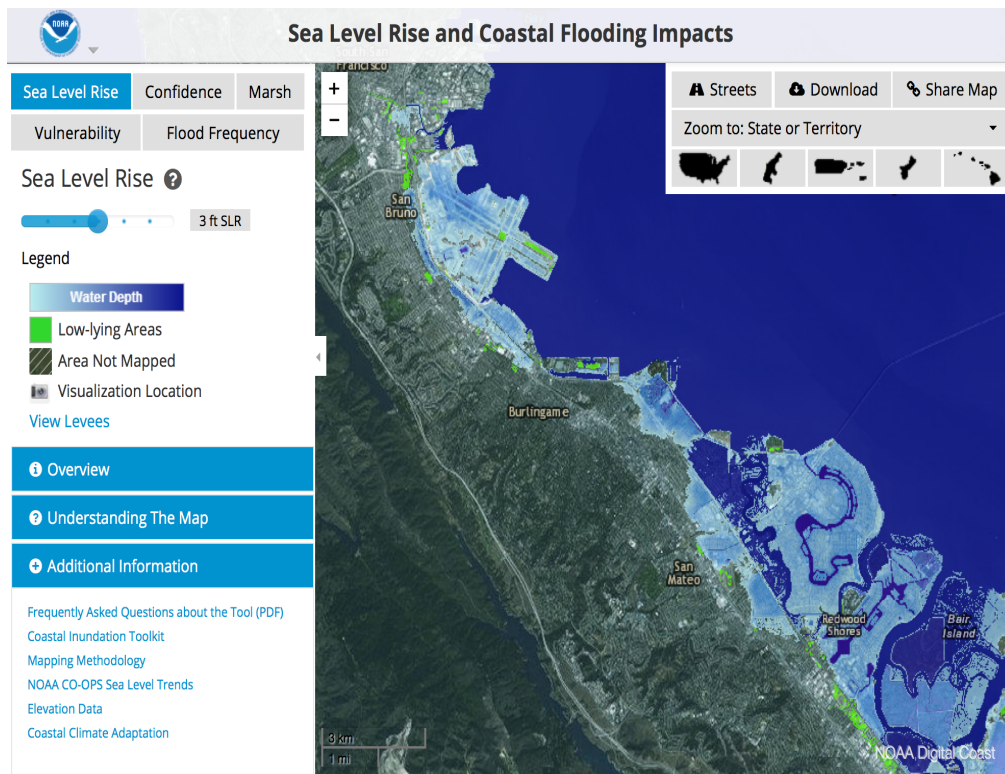


Figure 7: NOAA Sea Level Rise and Coastal Flooding Impacts Viewer. 2016.
<https://coast.noaa.gov/slr/>.

Precise mapping allows homeowners to reduce their vulnerability, and make long-term decisions that can also incorporate information on risk, such as sea level rise projections. FEMA has developed mapping products that depict flood risk and provide information for current flood insurance rates. They

encourage homeowners to build above their base flood elevation to mitigate their risk and potentially lower their flood insurance rates.

GIS has been used to provide geographical understanding of coastal inundation issues and contribute mapping methods through these different viewers.⁴⁸ Using GIS to map sea level rise allows planners to “overlay the potentially impacted areas with other data such as critical infrastructure, roads, ecologically sensitive areas, demographics, economics, and local cultural resource sites.”⁴⁹ Mapping can determine what areas are most vulnerable to sea level rise and help planners prioritize vulnerability assessments as essential in the resilience plan. These maps and graphics have been used to help planners move forward to create vulnerability/risk assessments to identify which resources are most threatened.

⁴⁸ National Oceanic and Atmospheric Administration. "Digital Coast. More than Just Data." Digital Coast. Accessed May 14, 2016. <https://coast.noaa.gov/digitalcoast/>.

⁴⁹ Doug, Marcy. et al. New Mapping Tool and Techniques For Visualizing Sea Level Rise. Report. Charleston: NOAA Coastal Service Center, 2011.

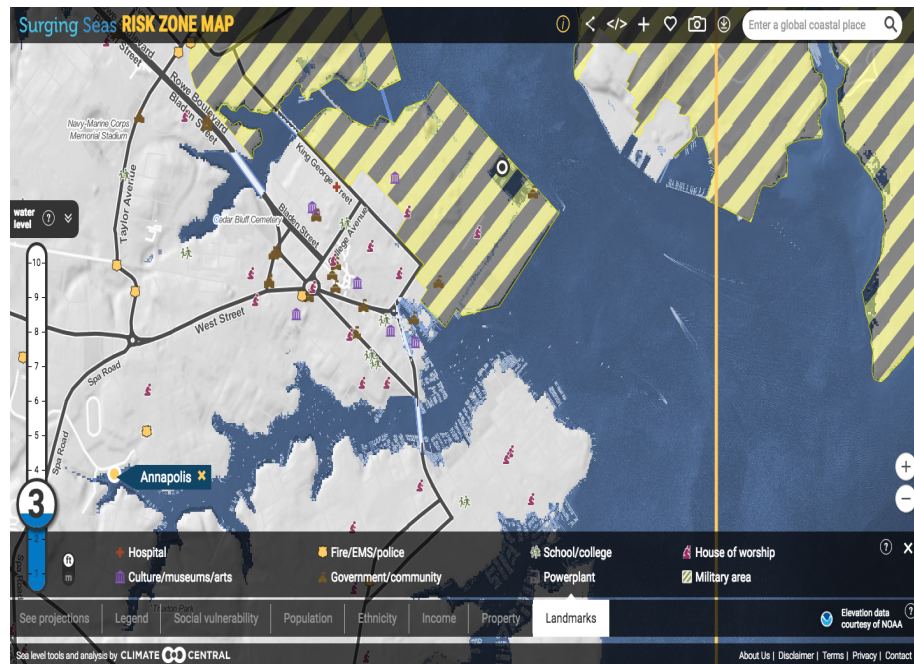


Figure 8: Climate Central Surging Seas Risk Zone Map. 2016. <http://ss2.climatecentral.org>.

Mapping tools can be used to engage the resident community as well.

They inform the community of past and present climate data and create visualization maps of scenarios that are likely to occur within the next half-century. Maps help communities visually understand the climate impacts on their community, and on their cultural resources. It will make the community more informed on climate science and relevant projections of sea level rise.

Vulnerability Assessment Tool

Vulnerability assessments help planners develop resilience plans with effective adaptation solutions based on community level assessment of assets in high-risk areas. A vulnerability assessment is a tool for evaluating the degree of risk and how it may affect a specific resource. This evaluation must identify

hazards that will affect the community, as well as determine hazard-prone areas, calculate the magnitude of each hazard, inventory vulnerable cultural resources, and estimate the range of potential losses.⁵⁰ There are several types of these assessment surveys. FEMA's assessment tools help analyze the threat, as well as assign values to assets, and determine vulnerability to ascertain the level of risk for each critical asset against each applicable threat.⁵¹ NPS has initiated an effort to standardize climate change and natural hazard vulnerability assessments of built assets in the national parks. They plan to establish a protocol for data collection and create best practices for data application.⁵² This tool is not yet available to local governments and planning offices, but FEMA and NOAA provide effective assessment templates as well. The FEMA document, *Integrating Cultural Resources in Hazard Mitigation Planning*, provides a worksheet example for risk assessment conducted cultural resources.

⁵⁰ FEMA. Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. Technical paper no. 386-6. 2005. <http://www.fema.gov/media-library-data/20130726-1522-20490-2886/howto6.pdf>.

⁵¹ FEMA. "Hazard Identification and Risk Assessment." Hazard Identification and Risk Assessment. Accessed May 14, 2016. <http://www.fema.gov/hazard-identification-and-risk-assessment>.

⁵² "NPS Climate Change Tool." Program for the Study of Developed Shorelines. 2015. <http://psds.wcu.edu/projects-research/nps-climate-change-tool/>.

By 2017, a Cultural Resource Vulnerability Index will be developed by Erin Seepkamp, a natural resources specialist at North Carolina State University. This index process will construct “an analytic deliberative decision context that integrates climate science that could enable the prioritization of types of cultural resources within a larger landscape; and evaluates how cultural resources’ significance, association and integrity may be altered when weighed in relation to the vulnerability of similar types of cultural resources within a regional

landscape.”⁵³ This and other vulnerability assessment tools that must be conducted early in the planning process as it a critical step in determining what assets will need to be adapted.

Adaptation Solutions for Cultural Resources

Cultural resources adaptation solutions should focus on promoting resilience—the capacity for buildings and sites to withstand change, while retaining their vital characteristics.⁵⁴ These solutions can help communities cope with the effects of climate change in many ways, such as constructing coastal barriers or wet and dry flood proofing. There are three main options for reducing the threat of sea level rise to cultural resources: (1) Protect in Place, (2) Modify, or (3) Relocate. After the risks are identified, cultural resources managers can begin to assess preferred alternatives for adaptation with the most minimal impact to historic sites and structures. It is important to remember that cultural resources are unique and diverse, and thus should be carefully considered for each site.

Protect in place is the most desired and emphasized option for cultural resources as it preserves the historical setting of the site and is beneficial for archaeological resources. The federal framework for historic preservation emphasizes conserving sites in place and suggests stabilization methods for

⁵³Erin Seekamp. "Connecting Climate Change and Cultural Resource Adaptation Decisions." - ScienceBase-Catalog. August 2015. Accessed May 10, 2016.
<https://www.sciencebase.gov/catalog/item/552bc2dae4b026915857df38>.

⁵⁴ National Park Service. Preserving Coastal Heritage. Report. April 4, 2014.
<http://www.achp.gov/docs/preserve-coastal-heritage.pdf>.

archeological sites and wet or dry flood-proofing measures for historic buildings threaten by flooding.⁵⁵ Another component of “protect in place” involves extensive documentation of a building’s structure. Archaeological sites and historic buildings that may become inaccessible due to submergence should be documented as completely as possible in order protect the information that will otherwise be destroyed.

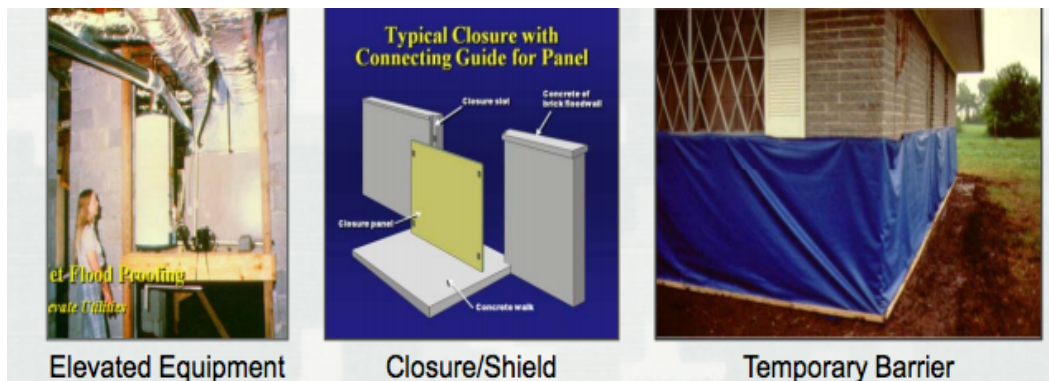


Figure 10: Types of protective mitigation measures. 2014. US Army Corps of Engineers, *Nonstructural Mitigation Assessment for the City of Annapolis Historic District Report*.

Modification is not highly recommended under federal policy, as it will often alter the integrity, design, or setting of the historic property, which may threaten its eligibility for listing in the National Register of Historic Places. However, this strategy would improve the resiliency of a resource to better withstand the impacts of SLR. For example, structures can be altered to better withstand increased moisture, wind, or an invasive species; building systems can

⁵⁵ Nell Ziehl, Mechelle Kerns, Anastasia Poulos, and Stephanie Sperling. *Adaptation Alternatives: Issues of Protection for Historic Properties*. Working paper. Annapolis, 2016.

be relocated to higher levels; and caps may be placed over archaeological resources in order to protect them from damage.⁵⁶

The most discussed modification for coastal historic structures affected by sea level rise are exterior elevations. Elevating historic buildings and homes can address increased flooding and storm surges. States such as Mississippi and Louisiana have already developed elevation guidelines for their historic districts. The goal of these guidelines is to achieve a balance between “two different public policy goals—risk reduction through more modest elevation, and protection and enhancement of existing historic buildings and historic districts.”⁵⁷ These guidelines attempt to respect long-standing traditions of raised house types, along with incorporating the beneficial technical aspects of contemporary building elevation.⁵⁸ Because the architectural character of buildings is different across the country, elevating buildings may not be a feasible approach for historic areas that are in traditionally mountainous or hilly areas. In addition, the Secretary of Interior has not ruled whether historic properties will lose their National Register designation as a consequence of these modifications.

⁵⁶ National Park Service. Preserving Coastal Heritage. Report. April 4, 2014.
<http://www.achp.gov/docs/preserve-coastal-heritage.pdf>.

⁵⁷ Mississippi Development Authority. Elevation Design Guidelines for Historic Homes in the Mississippi Gulf Region. Technical paper. Accessed May 10, 2016.
http://www.nj.gov/dep/hpo/hrrcn_sandy_pdf_files/mississippi.pdf.

⁵⁸ URS Group for Louisiana Office of Cultural Development. Elevation Design Guidelines For Historic Buildings in the Louisiana GO Zone. Report. 2014.

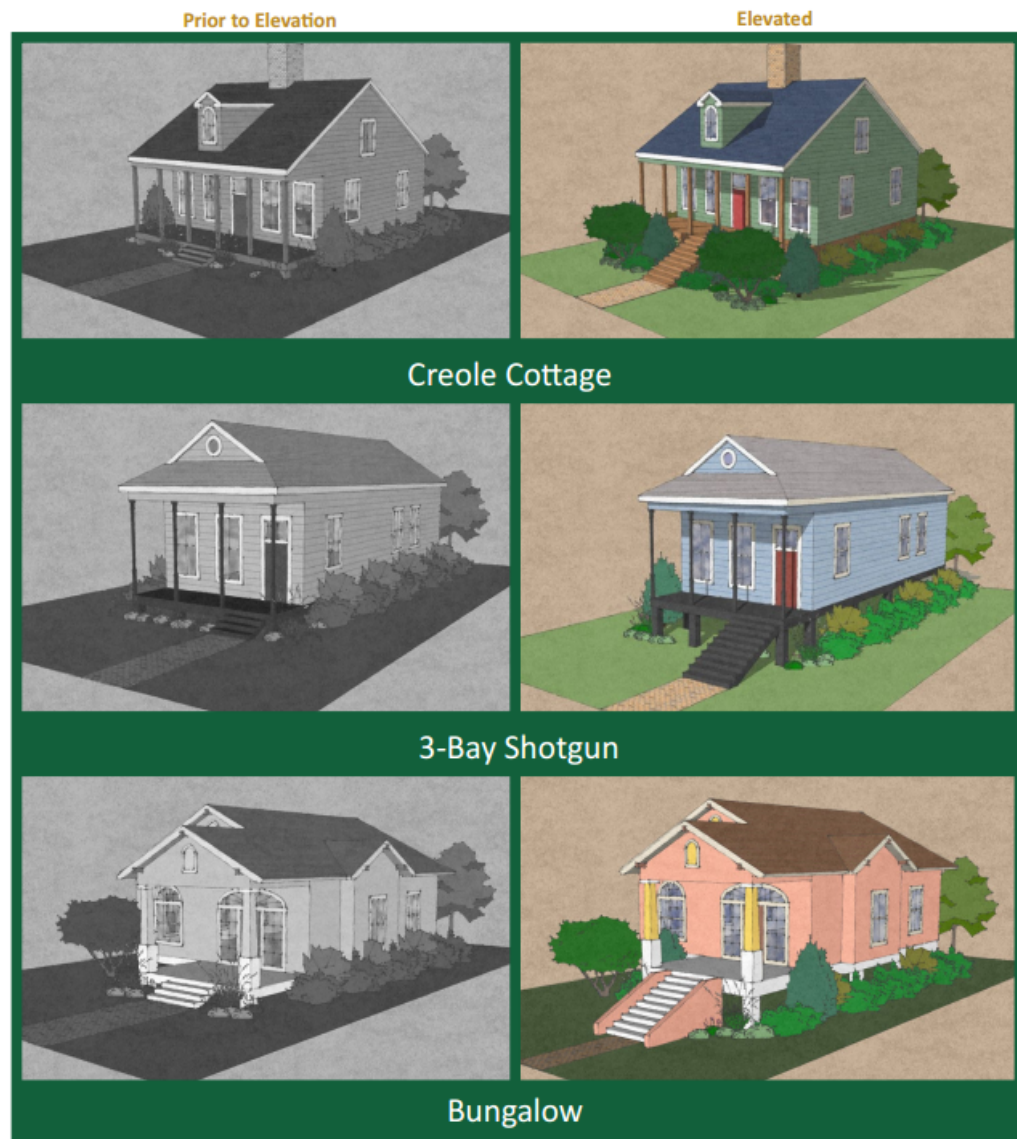


Figure 11: Elevations Models. 2015. Elevation Design Guidelines For Historic Buildings in the Louisiana GO Zone.

Other modifications include reinforcing the existing foundation system or relocating the structure. Relocation should be considered for high risk, high priority buildings that have historical significance and special community value.⁵⁹

⁵⁹ Nell Ziehl, Mechelle Kerns, Anastasia Poulos, and Stephanies Sperling. *Adaptation Alternative: Issues of Protection for Historic Properties*. Working paper. Annapolis, 2016.

These three adaptation options should only be considered at the local level and must involve the community. The community has a role in defining and creating adaptation solutions for cultural resources. Their engagement can also be a solution in itself. Communities have local knowledge and experiences that can be used to enhance the visibility of cultural resources. A way that actively engages the community in dialogue toward solutions is interpreting climate change based on its effects to shared local resources. For example, the NPS has a strategy to engage its visitors in climate change impacts to their resources by placing interpretive markers at the water line where a resource was submerged, and signs explaining freeze-thaw cracking in historic bricks.⁶⁰

Protecting cultural resources through collective and extensive documentation, prioritization, and relocation strategies can bring the community together to protect their cultural resources. A community that cares about its heritage is critical to any planning strategy relating to cultural resources. A community that is not engaged in its city politics, development plans, or cultural resources will present a challenge for planners.

Incorporating Cultural Resources into Resilience Planning

Cultural resources can help address building-specific and district wide adaptation solutions as *action drivers* and *community engagement plans*. As actions drivers, cultural resources are a focal point to hazard mitigation planning.

⁶⁰ National Park Service. Climate Change Action Plan. Publication. DC: Government Printing Office, 2012.

Historic preservationists and cultural resource managers often collaborate with city planners, state officials, stakeholders, and other organizations on zoning and permitting issues. By encouraging adaptation solutions that protect cultural resources and places of historical significance, they effectively use them as tools to guide development of resilience initiatives. The case study of Annapolis, Maryland, demonstrates this process and highlights the importance of integrating cultural resources into the entire city planning process specifically through its community engagement program.

Cultural resources promote community identity, enhance economic development and activity, and generate a heritage tourism industry; therefore they must be a part of any planning process. Public infrastructures like stormwater drainage or water pumps do not require much community involvement. However, plans related to property development, private property, and public spaces, generally involve the community engagement process. It has been said that “continuity of culture is a fundamental issue for many communities facing the threat of displacement.”⁶¹ Sea level rise threatens to change the shoreline landscape of many coastal communities. Incorporating historic resources can help mitigate the impact of changes to a community and help prepare for the new circumstances. The resilience planning on Staten Island, New York, demonstrates how a community’s cultural resources can influence an adaptation solution.

⁶¹ Anthony Oliver-Smith. *Sea Level Rise and the Vulnerability of Coastal Peoples*. Publication no. 7. Paffenholz, Bornheim: UNU-EHS, 2009.

Challenges of Incorporating Cultural Resources into Resilience Plans

The threat of rising sea level may not be sufficiently urgent to require immediate action, but it has serious consequences if planning is ignored. Governments and local communities have traditionally underestimated the complexity of resilience planning as a social process and overestimated the capacity of planning to deliver the intended outcome. There are several challenges that should be addressed in resilience planning. One of which is ensuring that cultural resources represent all parts of the community. Cultural resources organizations around the country are expanding their surveys to include sites associated with underrepresented groups, such as the LGBT and Latino communities.⁶² Updating documentation for local community's cultural resources can be a challenge for incorporating cultural resources in plans. Using cultural resources to highlight a community's identity will require planners to determine which heritage to highlight and how to incorporate those communities into the planning process.

A particularly daunting challenge for addressing cultural resources is securing funding to preserve and maintain the sites. Funds to support cultural resource protection are commonly provided through grants, federal agencies, and private donations. This can limit the capabilities for applying mitigation techniques to historic structures and sites. Federal programs are beginning to

⁶² United States. National Park Service. "Underrepresented Community Grants." National Parks Service. Accessed May 14, 2016. <https://www.nps.gov/preservation-grants/community-grants.html>.

provide funding for cultural resources to help mitigate the impact of climate change. However, since funding can be limited, strategies that require a long period of time must rely on a sustainable source of funding.

Finding financial support, documenting cultural resources at risk, and creating engagement programs for community members require dedicated staff and volunteers to complete these tasks. Many historic preservation offices have limited staff and also address several historic commission reports and permit issues as well. Without a staff dedicated to tackling climate change and hazard mitigation it will be difficult to encourage their planning offices to bring cultural resources to the local resilience discussion.

Conclusion

These tools and strategies provide examples of the options available to historic preservationists, city planners, and community leaders to begin planning for sea level rise. The options are intended to create a community centered resilience plan that incorporates cultural resources. A way to assess whether a plan/project will be able to incorporate historic resources into this planning process is to address these questions.

- Does the plan/project address sea level rise and current scientific data?
- Does the plan/project use tools such as GIS mapping and risk assessment surveys?

- Is the project aimed at specific adaptive solutions or general planning for a resilient community?
- Does it plan to protect and preserve cultural resources?
- Does the project have any specific outputs?
- Is the plan/project based on community engagement?

Considering these questions can ensure the planning process has taken into account sea level rise, cultural resources, and community engagement, and encourages using climate data and tools to find solutions that promote a resilient community. Applying this checklist was how I evaluated each case study and identified if their plans to build a resilient community adequately incorporated cultural resources.

Chapter 5: Case Studies

This chapter will focus on two case studies -- the Annapolis Historic District in Maryland and the South and East Shore of Staten Island, New York – and examine their plans for incorporating cultural resources into their resilience plans for sea level rise. Increased flooding, storm surges, and coastal inundation have heavily impacted both of these areas. There is no single approach to resilience; although these areas have similar issues, they approach resilience in two uniquely different ways. It is not clear how effective these solutions are or will be in the future. As with other resilience plans, these adaptation solutions are in the planning stages and have yet to establish evaluation metrics. However, these case studies will show how cultural resources strategies can help drive city-planning efforts and encourage community based resilience planning of sea level rise.

Annapolis Historic District

Background

Annapolis, Maryland, is located along the Chesapeake Bay at the mouth of the Severn River, about 25 miles south of Baltimore and 30 miles east of Washington, DC. It is the state's capital with a population of approximately 38,000. The Colonial Annapolis Historic District is located along the harbor waterfront and includes the Maryland State House and historic Saint John's College. The city's history as the state capital, and briefly as the nation's capital

after the American Revolution, echoes through its many colonial buildings that still stand along the city dock. The position of the Maryland State House within the historic district is instrumental to its preservation.

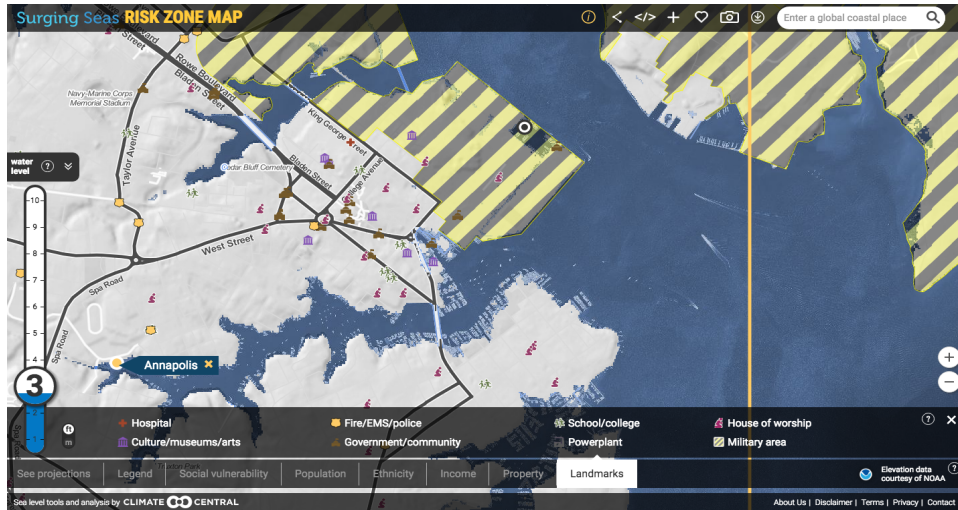


Figure 12: Map of Annapolis risk zone at 3 feet. Climate Central Surging Seas Risk Zone Map. 2016. <http://ss2.climatecentral.org>.

About 52 percent of the housing units are owner occupied.⁶³ Property values along the waterfront are higher than for property in the surrounding areas. In general, the housing market is dominated by the fact that there is less and less land available for new development, especially in the historic district, along with the resulting rise in the price of housing. Sea level rise exacerbates this problem by reducing the land along the shoreline by inundation and subsidence. The historic district is composed of small businesses, residences, and educational institutions. A large majority of these places are affected presently by nuisance

⁶³ City of Annapolis. "Comprehensive Plan." Annapolis Comprehensive Plan. October 5, 2009. <http://www.annapolis.gov/government/city-departments/planning-and-zoning/comprehensive-plan>.

flooding and storm surges.



Figure 13: Flooding along Annapolis City Dock. 2016. City of Annapolis Planning Office Weather It Together Facebook page.

The vulnerability of the district to the impacts of sea level rise from the Chesapeake Bay, along with its national recognition as a National Historic Landmark, and its resourceful strategy to help prepare the community for a changing climate, made Annapolis a suitable case study. In 2015, Annapolis celebrated its 50th year as a National Historic Landmark. As it celebrated its significance to national heritage, it also acknowledged its vulnerability to the encroaching sea. Its history as a working waterfront town is connected to the Chesapeake Bay, one of the largest estuaries in the world. As a coastal city, its citizens have become accustomed to coastal flooding that regularly disrupts its downtown streets. But that flooding has dramatically increased over the decades;

according to the NOAA Data Center, Annapolis saw 3.8 days per year of nuisance flooding from 1951-1963, then averaged of 39.5 days per year between 2007-2013.⁶⁴ The city experiences flooding as many as 50 times a year during high tides, even on sunny days with no wind or storms.⁶⁵ Annapolis is among today's more frequently flooding cities along the East Coast with a more than four-fold increase in tidal flooding since 1970. The sea level along the Annapolis shoreline has risen by more than a foot over the last century, more than twice the global average.⁶⁶ In 30 years, flood projections show that Annapolis may see another half-foot of sea level rise and a tripling of flood events.⁶⁷

The effects of flooding have put an economic strain on businesses and property owners in the city. In 2003, Hurricane Isabel caused severe flooding and immobilized the city for several days afterwards. There were a total of 15 local businesses and more than 570 homes that were declared uninhabitable as a result of flood damage, according to the county's Office of Emergency Management.

⁶⁴ NOAA. "'Nuisance Flooding' an Increasing Problem as Coastal Sea Levels Rise." NOAA News. October 31, 2014.
http://www.noaanews.noaa.gov/stories2014/20140728_nuisanceflooding.html.

⁶⁵ Spanger-Siefield, Erika, Melanie Fitzpatrick, 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. Technical paper. October 2014.
<http://www.ucsusa.org/sites/default/files/attach/2014/10/encroaching-tides-full-report.pdf>.

⁶⁶ Ibid.,2.

⁶⁷ Ibid.,2.



Figure 14: Flooding along in Annapolis City Dock Area. 2016. City of Annapolis Planning Office Weather It Together Facebook page.

In 2014, the US Army Corps of Engineers provided technical services to investigate and develop viable nonstructural mitigation solutions to reduce the risk of flood damage in Annapolis’s historic district. The *Nonstructural Mitigation Assessment for the City of Annapolis Historic District* study documented surveys of buildings, elevations, and historic structures and presented the findings to the City, to record the locations and elevations of their most vulnerable historic structures.⁶⁸ The assessment focused on viable nonstructural mitigation solutions to identify ways to protect structures without altering the

⁶⁸ U.S. Army Corps of Engineers. *Nonstructural Mitigation Assessment for the City of Annapolis Historic District*. Report. December 2014. <http://www.annapolis.gov/docs/default-source/planning-and-zoning-documents/nonstructural-mitigation-assessment-for-annapolis-historic-district.pdf?sfvrsn=0>.

integrity of its historic properties and landscapes. As a way to protect in place, this document assisted City resilience planning efforts and provided various recommendations on flood elevations for City managers and for property owners to consider as ways to reduce their flood risk. This tool has helped planners to begin to identify potential strategies for adapting the historic district to the impact of flooding and other sea level rise related threats.

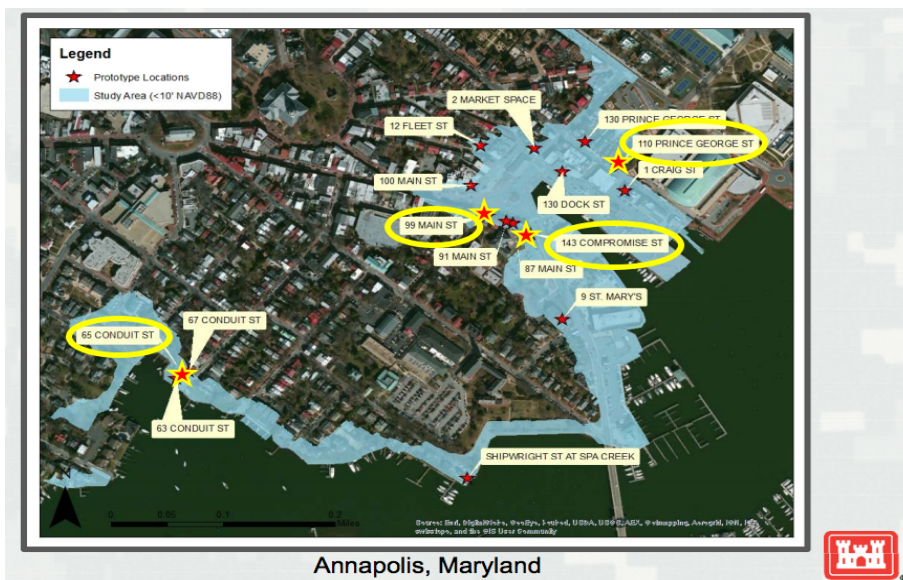


Figure 15: Map depicting the survey area with prototypes for mitigations projects highlighted. 2013. U.S. Army Corps of Engineers Non Structural Mitigation report.

Planning and Goals

By assessing the significance of cultural resources within the 100-year flood plain boundary, and the risk from flooding associated with those resources, planning for their preservation enables the City of Annapolis to better protect the architectural integrity of the historic district. The Nonstructural Mitigation Assessment is used to guide planning for other projects in the city as well,

including the Cultural Resource Hazard Mitigation Plan (CRHMP). The CRHMP will identify and mitigate potential loss to historic resources associated with natural disasters, primarily threats to sea-level rise, subsidence, and flooding. The goal of this plan is to:

- Incorporate hazard mitigation improvements in public and private property;
- Develop an economic development plan that identifies the protection of the historic district as an economic priority;
- Ensure support from the city council;
- Promote model mitigation strategies to property owners;
- Ensure city departments incorporate publicly owned cultural resources into their annual work plans;
- Ensure that scientific data, information, mitigation strategies, and planning documents are disseminated in a manner that encourages collaboration and resource sharing; and.
- Provide an overall approach to protecting the city's historic seaport as critical to the public safety, economic prosperity, and social well-being of Annapolitans.⁶⁹

⁶⁹ Lisa Craig. "Goals for Cultural Resources Hazards Mitigation Plan." Interview by author. February 2016.

The planning process for this document has brought together state and local officials, stakeholders, local organizations, residents, and area businesses. The chief preservation officer for the city leads this planning process and is an agent for integrating cultural resources into the city's efforts to adapt to sea level rise. Even though this plan focuses on cultural resources, it engages all aspects of the community, including storm water management and business management. This coordination has cumulated in a community engagement program called Weather It Together.



Figure 16: Weather It Together logo. 2016. www.annapolis.gov.

In 2015, the city's Historic Preservation Office led this initiative as a way to engage and educate the Annapolis community on the impacts of sea level rise. It has since held multiple meetings for community members to discuss concerns and questions about the city's plan to adapt to the impact of sea level rise. In April 2016, a Weather It Together design charrette brought together experts in different

fields to discuss adaptation ideas, and to consider ways that the city could adapt to sea level rise while keeping its historic character.

Tools

This program used GIS mapping software to help visualize scenarios of flooding in the historic district over the next few decades. Risk assessment and visual preference surveys were performed to help identify and prioritize vulnerable community assets. The city planners publicly engaged business owners and residents on recommendations to mitigate their own property. These and other tools will help the historic preservation office develop a Cultural Resource Hazard Mitigation Plan (CRHMP) and Historic District Sea Level Rise Mitigation and Elevation Design Guidelines. The city is looking to conduct an economic feasibility survey of sea level projects in the city as well.⁷⁰ The Weather It Together program shows a commitment to addressing these projects at a community level. Although the city has not reached a point to establish a specific adaptation project, they have been able to inform the community of the options and obtain information to help the city's planners continue the process to prepare a community-based resilience solution.

The planning process has also included raising money for various projects. Funding is an important part of planning and Annapolis has been successful in

⁷⁰Phil Davis. "Annapolis Officials Look to Study Economic Impact of Historic Preservation." Capital Gazette. April 28, 2016. <http://www.capitalgazette.com/news/annapolis/ph-ac-cn-annapolis-historic-preservation-0429-20160428-story.html>.

receiving funding from a number of federal, state, and local sources. The money provided to the city to address damages and develop mitigation efforts sustained from Hurricane Sandy has encouraged local governments to address sea level rise in its policies and programs; as a result, the city incorporated sea level rise planning in its policies. These grants helped spearhead the initial planning and survey work for the city.

This initial planning includes the risk assessment survey of cultural resources in the floodplain area of the historic district. The visual preference surveys and workshops for community residents and visitors helped to determine what resources were valued in the community. State guidance and policies such as *Adapting to Climate Change & Sea Level Rise: A Maryland Statewide Survey*, *Maryland Climate Change and Coast Smart Construction Infrastructure Siting and Design Guidelines*, and *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase I: Sea-level Rise and Coastal Storms* have provided advisory information from state agencies and support for developing a city wide resilience strategy.

Incorporating Cultural Resources

This planning process is not a significant change from how the city has normally engaged cultural resources. The field of historic preservation has been highly attuned to the threats of demolition, neglect, development, and vandalism. The Annapolis historic preservation office has used its National Historic

Landmark designation to drive the resilience-planning conversation to focus on protecting cultural resources and adapting the community to the threats of sea level rise. The identity of Annapolis as a historic community is threatened by sea level rise and any adaptation solution must encourage the preservation of that identity. The Weather It Together program conducted a visual preference survey to engage the community in identifying properties and places that are important to the architectural heritage, community character and resident / visitor experience in Annapolis.



Figure 17: Weather It Together Survey. 2015. www.annapolis.gov

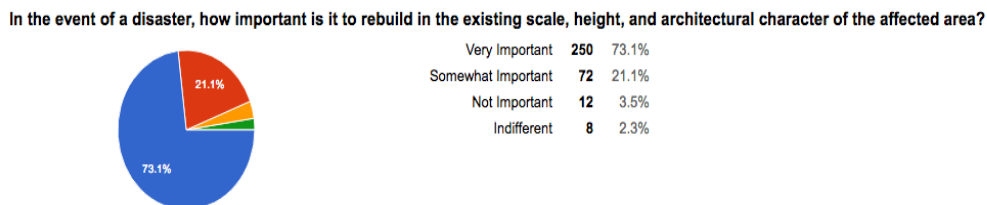
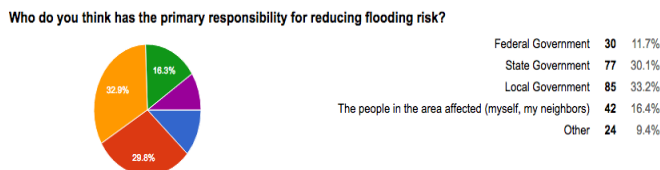
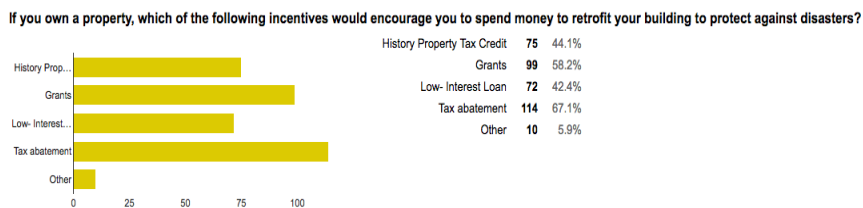
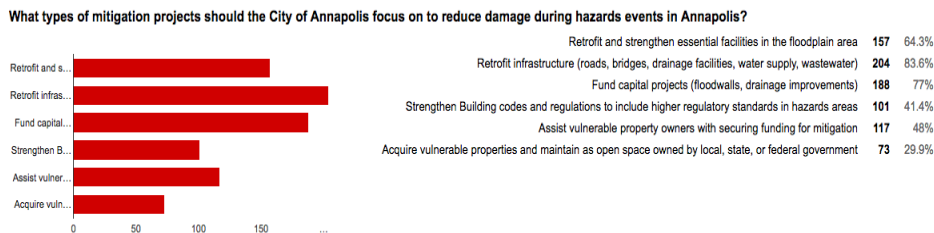
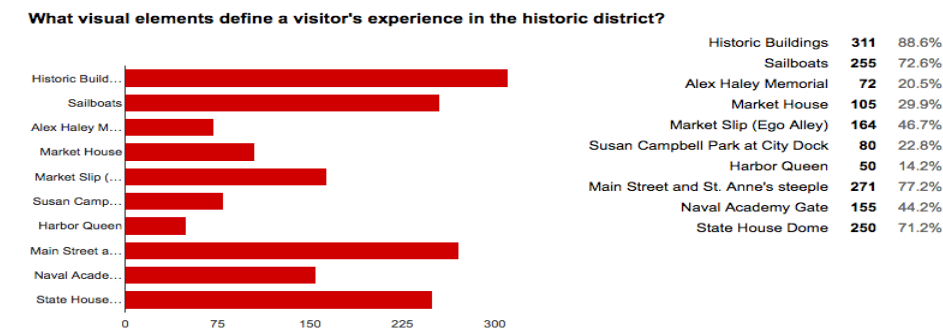


Figure 18: Responses to selected questions asked on the survey. 2015. City of Annapolis Planning Department.

This survey not only provided the city with useful information, it allowed community members to participate in the planning process. The exercise also

served as a platform to gauge the community's knowledge and opinions about preservation, sea level rise, and adaptation methods. The planning effort incorporated cultural resources into the sea level rise conversation as an asset to be protected but also as a tool for community engagement.

Challenges

Challenges for Annapolis's planning process include funding, limited staff, and future political pushback. The funding is not in a sustainable budget and is often tied to specific grants. This means that the city can only use the funding inside the provided guidelines and leaves no room for technical support. As the plan evolves, the city must invest and put a revolving fund in place to ensure its continuation. The city's historic preservation office has a small staff that conducts a full preservation agenda. As the Weather It Together program develops, the office will require additional staff to help balance the workload. Another challenge is that the state and county are not as close to establishing guidelines for incorporating cultural resources into their comprehensive documents as the city; therefore, the city might have to adjust their strategy to comply with state guidelines in the future. The last challenge is the potential for residents and property owners to hinder the process through debates based on negative political rhetoric or assumptions on climate change that are not based on facts.

Conclusion

The city of Annapolis has a community driven resilience plan that utilizes mapping tools to identify climate trends in the city. The plan uses state and federal surveys to understand its vulnerability to hazards and utilizes mapping tools to visualize the risk. The city has created an engagement program through this planning initiative that empowers the community and preserves its historic identity. While the city is not creating a comprehensive resilience plan, this document would encompass the information needed to create a more intensive resilience plan. Most important, the city's historic preservation office has taken the lead in this planning process and has engaged the community in a direction that focuses on cultural resources.

The East and South Shores of Staten Island

Background

Staten Island is one of the fastest growing counties in New York and sits at the southernmost part of the state.⁷¹ The island is bordered to the north and west by New Jersey, to the south by Raritan Bay, and to east the coastline extends into the Lower New York Bay. This case study area extends from the northern area of Fort Wadsworth and the Verrazano-Narrows Bridge to the southern neighborhoods of Tottenville and Charleston.

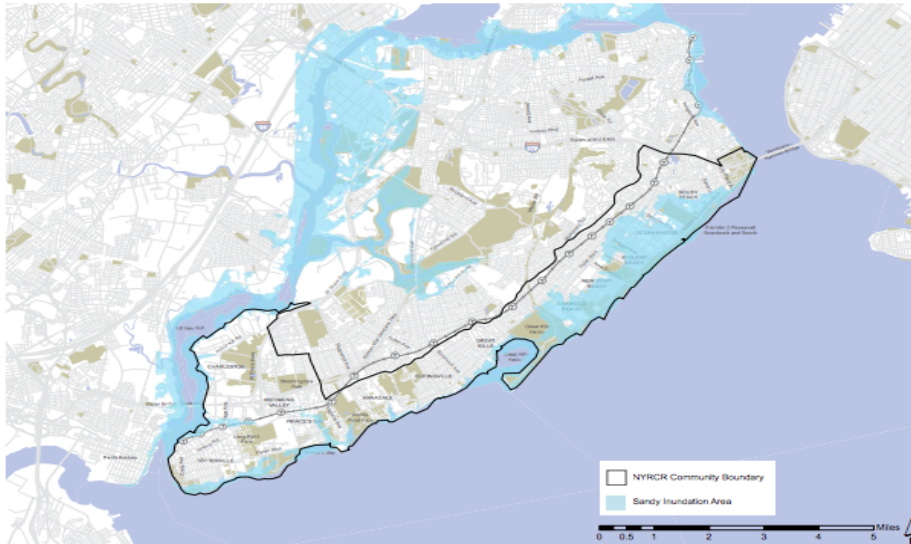


Figure 19: Map of identifying Staten Island East and South Shore Community. 2014. The Staten Island NYRCR Plan.

⁷¹ "East and South Shores of Staten Island." In *A Stronger, More Resilient New York*, edited by New York City PL. New York City, 2013. Accessed May 10, 2016. http://www.nyc.gov/html/sirr/downloads/pdf/final_report/Ch15_Staten_Island_FINAL_singles.pdf.

Approximately 140,000 residents reside on the East and South Shores of Staten Island.⁷² Prior to the 1960s, seasonal bungalows and tourist resorts characterized the shore. After the opening of the Verrazano- Narrows Bridge, which connects Staten Island to Brooklyn, there was increased development along the wetland areas and former summer homes were turned into permanent residences.⁷³ The area of the East and South Shores is overwhelmingly owner occupied, with 94% of residents owning their homes, and the economy is dominated by small businesses.⁷⁴ These small businesses are primarily in retail and service sectors and have annually generated revenues of roughly \$6.5 billion.

In 2012, the City of New York was severely impacted by Hurricane Sandy. Peak storm tides reached 16 feet on Staten Island, with waves up to six feet causing massive flooding and extensive damage along Staten Island's coastal areas.⁷⁵ The community's only hospital, Staten Island University Hospital, was incapacitated due to storm surges and power outages.

⁷² Perkins Eastman / BFJ Planning in Association with the Louis Berger Group, comp. East and South Shores Staten Island NY Rising Community Reconstruction Plan. Technical paper. 2014.11.

⁷³ Ibid, 20.

⁷⁴ Ibid, 11.

⁷⁵ Emily Gertz. "Sea-Level Rise Poses Hard Choice for Two Neighborhoods: Rebuild or Retreat?" TakePart. April 24, 2015. <http://www.takepart.com/feature/2015/04/24/new-york-sea-level-rise-sandy-ocean-flooding-rebuild-or-retreat>.



Figure 20: Superstorm Sandy damage to an area on the East Shore of Staten Island. 2014. The Staten Island NYRCR Plan.

Tragically, 23 individuals lost their lives on Staten Island due to Superstorm Sandy. Although most of the waterfront communities on Staten Island were impacted by the Superstorm, the most extensive damage occurred in the vulnerable low-lying East and South Shore areas. The shorelines were severely inundated, due to the area's low topography and overburdened storm sewers. Challenges that faced businesses impacted by Sandy included building damage, inventory losses, insufficient insurance, and a reduced customer base.

After Hurricane Sandy, Governor Cuomo announced a \$650 million planning and implementation process, called The NY Rising Community Reconstruction (NYRCR) Program, in April 2013.⁷⁶ This program was established to provide rebuilding and resiliency assistance to communities severely damaged by Hurricane Irene, Tropical Storm Lee, Superstorm Sandy,

⁷⁶NY Governor's Office. "Governor Cuomo Announces \$6.2 Million in Grants For Historic Properties Damaged By Superstorm Sandy." Governor Andrew M. Cuomo. August 04, 2015. [https:// www.governor.ny.gov/news/governor-cuomo-announces-62-million-grants-historic-properties-damaged-superstorm-sandy](https://www.governor.ny.gov/news/governor-cuomo-announces-62-million-grants-historic-properties-damaged-superstorm-sandy).

and the summer floods of 2013. The goal of the NYRCR Program was to provide the state's most impacted communities with the technical expertise needed to develop thorough and implementable reconstruction plans to rebuild New York's communities in a way that will mitigate against future risks and with increased resilience. Staten Island was a perfect candidate for this program.

In September 2013, a committee of Staten Island residents and civic leaders convened with the goal of creating a resilience plan to help the East and South Shores rebuild from the damage caused by Superstorm Sandy. The committee worked with a team of professional consultants, representatives of the Governor's Office of Storm Recovery, and the New York State Department of State to develop their NYRCR Plan for the East and South Shores of Staten Island.

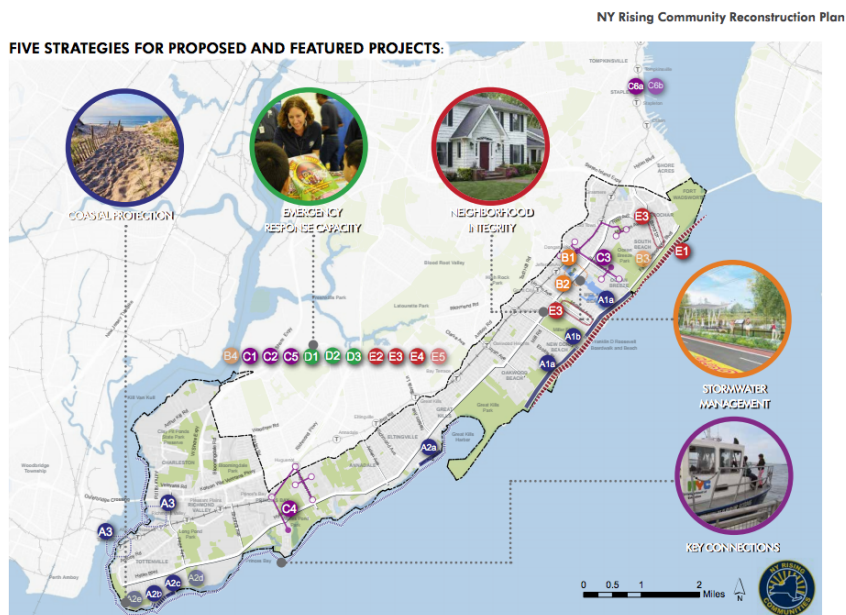


Figure 21: The six features of proposed projects. 2014. The Staten Island NYRCR Plan.

Planning and Goals

The NYRCR Plan is a guide for the East and South Shores to address Superstorm Sandy damage that capitalizes on social and economic assets in the area and rebuilds a more resilient community. The planning committee includes established local leaders, community organizations, and municipalities. They were responsible for defining the scope of its planning area, assessing storm damage, and identifying critical issues. This required the committee to survey critical assets in the community and evaluate their exposure to risk. Using the results of the survey, the committee discovered recovery and resiliency needs that also acknowledged opportunities and developed a series of comprehensive reconstruction and resilience strategies that identified adaptive projects and implementation actions.

A significant difference between the NYRCR plan and the Annapolis Cultural Resource Hazard Mitigation Plan is that the NYRCR plan is based on critical issues that were exposed by Hurricane Sandy. The NYRCR plan addresses the management of natural and cultural resources from a risk reduction and economic development perspective. However, the assessment of critical issues focused primarily on natural resources and cultural landscapes, rather than cultural resource sites and buildings. The critical issues identified for the natural and cultural resources consist of:

- Restoring parks and wetlands that were damaged by Superstorm Sandy to increase their capacity in absorbing flood and rainwater.

- Expanding the Staten Island Bluebelt to provide greater stormwater capacity.
- Evaluating changes in land use and stormwater regulations to further enhance and protect current and future locations of tidal and freshwater wetlands and natural infrastructure.⁷⁷

While the plan primarily focuses on the restoration of natural resources on the Island, protecting the area's natural resources to better withstand storm surges and high winds and to control nuisance flooding can help protect cultural resources as well.

Tools

The NYRCR incorporated several planning tools and advisory documents in their plan. Key regulatory and advisory plans the committee used for research on the document included, The New York State Coastal Management Program Document, Rebuilding After Hurricane Sandy: A Guide to New Code and Zoning Standards - For Industry Professionals; A Stronger, More Resilient New York; Coastal Climate Resilience: Urban Waterfront Adaptive Strategies; Climate Change Adaptation in New York City: Building a Risk Management Response; Global Sea Level Rise Scenarios for the United States National Climate

⁷⁷ Perkins Eastman / BFJ Planning in Association with the Louis Berger Group, comp. East And South Shores Staten Island NY Rising Community Reconstruction Plan. Technical paper. 2014, 29.

Assessment; and the US Army Corps of Engineers Regional Comprehensive Study.

The most analytical information provided in the plan was the Assessment of Risk and Needs section. The Assets Inventory and Risk Assessment identified those assets at highest risk for negative impacts from future storm events. These findings allowed the committee to know the community's needs and prioritized projects that reduce the risk to both natural and cultural resources assets.

Table 5: Natural and Cultural Resource Assets: Risk Level

Asset ID	Asset Name	Risk Score	Asset ID	Asset Name	Risk Score	Asset ID	Asset Name	Risk Score
N11	FDR Boardwalk, Extreme	High	N24	Oakwood Beach Natural and Cultural Resources Assets, Extreme	High	N6	Blue Heron Main Branch, High	High
N12	Franklin D. Roosevelt Boardwalk and Beach	High	N4	Arthur Kill	High	N18	Mill Creek Tributary, High	High
N13	Gateway Nat'l Rec Area (Fort Wadsworth-Great Kills)	High	N5	Blue Heron Main Branch, Extreme	High	N23	New Dorp-Midland Beach Natural and Cultural Resources Assets, High	High
N22	New Dorp-Midland Beach Natural and Cultural Resources Assets, Extreme	High	N21	Miller Field/ Gateway Nat'l Rec Area	High		Old Town-Dongan Hills-South Beach Natural and Cultural Resources Assets, High	High
N26	Old Town-Dongan Hills-South Beach Natural and Cultural Resources Assets, Extreme	High	N43	Wolfe's Pond, Extreme	High	N27	Stream near Sharrott's Shoreline, High	High
N31	Pond near Oakwood Beach	High	N7	Butler Manor	High	N41	Stream near Sharrott's Shoreline, High	High
N33	River near Oakwood Beach	High	N15	Gerat Kills Natural and Cultural Resources Assets, High	High	N10	Denise Tributary	High
N40	Stream near Great Kills Park	High	N20	Mill Creek, High	High		Charleston-Richmond Valley-Tottenville Natural and Cultural Resources Assets, High	High
N1	Annadale-Huguenot-Prince's Bay-Ellingville Natural and Cultural Resources Assets, Extreme	High	N25	Oakwood Beach Natural and Cultural Resources Assets, High	High	N9	Lemon Creek, High	High
N8	Charleston-Richmond Valley-Tottenville Natural and Cultural Resources Assets, Extreme	High	N29	Pond in Last Chance Pond Park	High	N32	Pond near Sharrott's Shoreline	High
N14	Gerat Kills Natural and Cultural Resources Assets, Extreme	High	N34	South Beach Wetlands	High	N38	Stream from Arthur Kill 2, High	High
N16	Lemon Creek, Extreme	High	N39	Stream in Last Chance Pond Park	High		Staten Island Jewish Community Center	High
N19	Mill Creek, Extreme	High	N28	Pond in Great Kills Park	High	N35	Stream from Arthur Kill 1	High
			N30	Pond in Ocean Breeze Park	High	N37	Stream from Arthur Kill 2, Extreme	High
			N44	Annadale-Huguenot-Prince's Bay-Ellingville Natural and Cultural Resources Assets, High	High	N42	Stream near Sharrott's Shoreline, Extreme	High
			N2	Resources Assets, High	High			
			N3	Arbutus Creek	High			

Figure 22: Risk Assessment Survey of Natural and Cultural Resources. 2014. The Staten Island NYRCR Plan.

The plan also included mapping which defined the areas at risk from coastal hazards in relation to their topography: FEMA flood zones, projected sea level rise, National Weather Service (NWS) shallow coastal flooding advisory thresholds, and natural shoreline features. The NYS Risk Assessment Maps were utilized for the NYRCR Plan to show the corresponding risk (extreme, high, and

moderate) for each of the asset categories. The keys to identifying these assets were research, analysis, and community input.

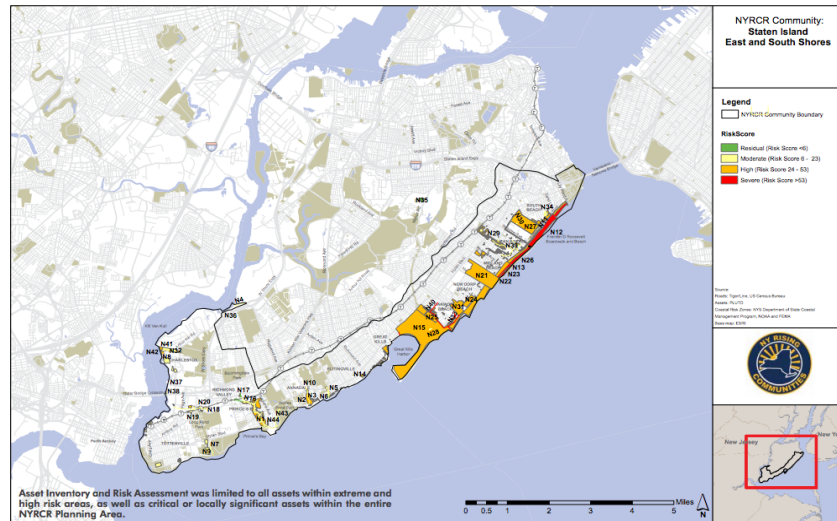


Figure 23: Map of inventoried and assessed natural and cultural resources. 2014. The Staten Island NYRCR Plan.

Community engagement was also a critical component of the entire NYRCR plan. All meetings were open to the public and planning materials were posted on the NYRCR Program’s website, which provided several ways for community members to submit feedback on materials in progress. The community engagement process for the Staten Island NYRCR plan included a Community Engagement Strategy.⁷⁸ This strategy complemented the overall goals and objectives of the plan, which successfully featured the support of the local communities. Their community outreach process identified stakeholders, included

⁷⁸Perkins Eastman / BFI Planning in Association with the Louis Berger Group, comp. East And South Shores Staten Island Ny Rising Community Reconstruction Plan. Technical paper. 2014, 151.

a website and social media outlet, engaged the press, and distributed flyers for meetings and information.

The goals of the program's community engagement were to:

- Lower barriers to participation and encourage more people and more diverse voices to participate in the community planning process.
- Engage with a significant number of stakeholders and a broad, representative cross section of the community in an efficient manner, including those displaced from their residences due to the hurricane and its aftermath.
- Establish ongoing, inclusive, meaningful, and responsive two-way communication with stakeholders.
- Ask the residents, businesses, relevant organizations, and officials of Staten Island to provide useful information that can inform the Community Reconstruction Plan.
- Develop practicable and strategic policy and project recommendations built upon a solid base of community support.⁷⁹

Incorporating Cultural Resources

Less than a year after Governor Cuomo's announcement, The East & South Shores Staten Island NY Rising Community Reconstruction Plan was completed on March 2014. This plan had four major sections: (1) Community

⁷⁹ Ibid, 151.

Overview; (2) Assessment of Risk and Needs; (3) Reconstruction and Resilience Strategies and; (4) Implementation – Project Profiles. The fundamental focus of the plan was on implementation, so the planning process incorporated extensive discussions with the city and state to confirm that specific projects could be implemented. As a result, the projects featured in the NYRCR Plan are supportive and complementary of regional and parallel resiliency efforts. The plan included six projects, each of which addressed five key strategies: Coastal Protection, Stormwater Management, Key Connection, Emergency Response Capacity, and Neighborhood Integrity.

One project, in particular, listed in the additional recommendations has gained recognition locally and nationally. This project is called Living Breakwaters. Although there were a number of projects under consideration by the planning committee that addressed the key strategies, this project is highlighted for its unique approach to incorporating the heritage of the area into its project's development.



Figure 24: Living Breakwaters Project along the East and South Shore of Staten Island plans to develop a breakwater that grows with the ecological environment while protecting the shoreline. 2014. <http://www.rebuildbydesign.org/project/scape-landscape-architecture-final-proposal/>.

The Living Breakwaters Project strategy integrates risk reduction with ecological regeneration, which will also foster a social and education-based resiliency. This project plans to embrace the water rather than creating a barrier, by introducing a string of breakwaters to buffer against wave damage, flooding and erosion.⁸⁰ The project identifies the bay's landscape as an ecological infrastructure that can help reduce the risk for sea level rise along the water's edge. Designing these breakwaters as "living systems" will create a bio-diverse and active bay shoreline that will build up in parallel with future sea level rise. This plan does not specifically advocate for the preservation of historic sites, but

⁸⁰ CHL. "Breakwaters." Coastal and Hydraulics Laboratory - Engineer Research and Development Center. Accessed May 14, 2016. <http://chl.erdc.usace.army.mil/chl.aspx?p=s>.

advocate for the protection of the areas cultural heritage and it includes a significant historic area in its pilot site.

The proposed Tottenville Phase I pilot will study the ecological benefits, wave reduction impacts, and the economic and recreational potential of the Living Breakwaters project and bring these benefits to the historic Tottenville community.⁸¹ The project anticipates this phase will stretch approximately 13,000 linear feet to protect the Tottenville community and the valuable parklands at the Conference House Park.⁸² The pilot project highlights the natural resources of the area, but does not mention the protection of the four historic buildings located along the park's shoreline.

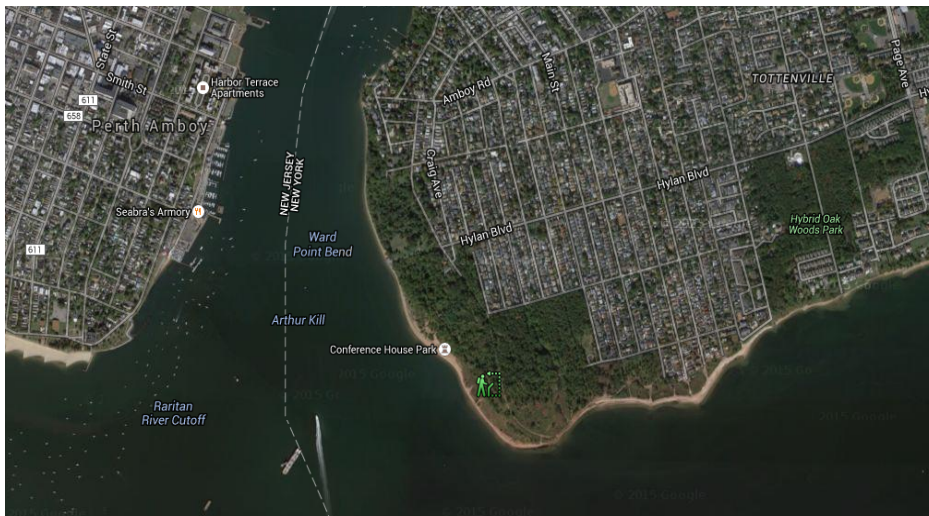


Figure 25: Aerial view of the Living Breakwaters project area near Conference House Park. 2016. Google Earth.

⁸¹ "SCAPE: Living Breakwaters." SCAPE: Living Breakwaters. Accessed May 10, 2016. <http://www.scapestudio.com/projects/living-breakwaters/>.

⁸² Ibid.,

Conference House Park is named for the 1680 stone building used during the American Revolutionary War in 1776 that stands in the middle of the park. In 2014, the state allocated \$5 million in grant aid to help repair 14 historically significant properties in the city, including an archeological site at Conference Park. While the stone house in Conference Park was able to withstand the Hurricane Sandy storms, it was the Waterside Bluffs in the park that sustained the most damage and exposed important Native American and Revolutionary War archeological artifacts.

The plan highlights the history of the oyster community and the cultural connection it has to Staten Island, and stresses how the project will help “preserve a cultural, lived relationship with the water.”⁸³ However, currently the plan only mentions creating a pier structure as the cultural space for potential showcases and events by the Tottenville Historical Society, not the protection of its historic sites. Although it is not explicitly stated, the project does provide the adaptation option of “protect in place” for this cultural resource as it mitigates the effects of flood damage to the historic setting.

The Living Breakwater project has the potential to incorporate historic preservation into their strategy of enhancing waterfront recreation and stewardship. The next steps for advancing the pilot project is more community engagement, regulatory approvals, data collection, and design refinement. In all of

⁸³ “SCAPE: Living Breakwaters.” SCAPE: Living Breakwaters. Accessed May 10, 2016. <http://www.scapestudio.com/projects/living-breakwaters/>.

those steps, historic preservationists must ensure that historic sites are addressed. Cultural resources have already been introduced as a social component of the project for building awareness, and as a strategy to reconnect to the Island's oyster heritage.

As planning continues, historic preservationists must participate in the community meetings and foster dialogue on how historic resources can be considered and preserve within this strategy. The NYRCR plan has already expressed a concern for the protection of cultural landscape of the area. It is the responsibility of historic preservationists to highlight other cultural resources that need to be resilient to the impacts of sea level rise as well.

As a winner of the Rebuild by Design competition, this project will be observed on a national and even global scale. Therefore, it was important that the project highlights how it incorporates cultural resources into their adaptation solutions.



Figure 26: Community outreach event by Living Breakwaters that provided the public with information about shoreline resiliency and restoration from Living Breakwaters project website. 2016. <http://www.rebuildbydesign.org/>

Conclusion

Overall, the Staten Island plan identified sea level rise as a hazard to their community and included it as a factor in their plan. They used information from previous plans, projects, and surveys done by the city and federal agencies to build their resilience plan. Those plans were critical to understanding what was already being done as well as what could be done. The plan identified cultural resources as an asset and identified ways to protect those assets, although the specific means of protecting the historic sites were not identified. The process benefited from a robust community engagement strategy that focused on ensuring the community had an input and understood the information in the plan.

Unlike Annapolis, the Staten Island plan had adaptation projects in its budget and will be implementing those in the near future, such as the Living Breakwaters plan. It is important to note that for Annapolis, the protection of cultural resources is the driver for adaptation solutions in the district, which was not the case for Staten Island. One significant difference between Staten Island's plan and the Annapolis plan is that Annapolis didn't have a recent trigger to develop a resilience plan like Staten Island had with Hurricane Sandy. Therefore the timeframe for Annapolis's plan is not complete and it may speak to why cultural resources were not fully incorporated into Staten Island's resilience plan.

Chapter 6: Conclusion and Recommendations

Conclusion

Based on factors identified throughout the paper, sea level rise is a serious issue for coastal communities. Flooding, shoreline erosion, coastal inundation, and increased storm surges threaten low-lying shores across the United States coastline. Plans to protect its assets and create a more resilient built environment will help communities adapt to these environmental changes. Cultural resources are vulnerable to the impacts of climate change, particularly sea level rise. Cities such as New York City have begun to develop comprehensive resilience plans in response to these threats. These resilience plans must be developed using planning tools such as interactive GIS maps and vulnerability assessments to enable an accurate evaluation of the risk to assets like cultural resources.

These plans must utilize scientific data and research, policies, guidance, and initiatives generated by state and federal agencies, and integrate with current local design guidelines and comprehensive plans. Planning must be developed in cooperation with multiple agencies, departments, stakeholders, residents, and community organizations. This cooperation must produce a community-centered adaptation solution.

Mapping scenarios to visualize and evaluate different adaptation options help planners assess vulnerabilities and engage community members in the planning process. There are several challenges that planners and historic preservationists face when developing these plans, including funding, government

coordination, and complex regulations; however, they should not be a deterrent from beginning the planning process.

Although the cases studies in this paper were at different stages of the resilience-planning process, they both had elements of cultural resources at different levels of development in their plan. The NYC Department of City Planning for Staten Island community resilience plan built on the area's destruction from Hurricane Sandy and also used cultural heritage it as a source of social engagement. Annapolis's planning process for developing their mitigation plan created a community engagement program led by the city's historic preservationists that brought together the city to fight the threat of rising sea level while including cultural resources as a critical element. The following recommendations were created based on factors seen in both case studies. This list can help historic preservationists ensure they are effectively incorporating cultural resources into their resilience planning process.

Recommendations

Based on the research compiled in this report, there are five key recommendations to effectively incorporate cultural resources into the resilience planning process.

1. Use Heritage For Joint Solutions;
2. Document Vulnerable Cultural Resources;

3. Utilize Mapping Tools And Risk Assessment Surveys For Cultural Resources;
4. Be A Leader In the Planning Process; and,
5. Create A Community Engagement Strategy.

First, historic preservationists must be innovative. The climate is changing faster than preservation plans are being updated. The preservation community must think of new ways to preserve cultural heritage. Using cultural resources as a way to engage with different partners and groups is a great way to put the preservation agenda in the planning conversation. It can become a bridge that links natural resources and the surrounding landscape. The Living Breakwaters project shows that a community's heritage can be a focal point for building new and innovate strategies that bring together disciplines for more adaptable and resilient communities.

Secondly, historic preservationists must identify and prioritize its cultural resources. There is no natural hierarchy or sequence for preserving sites, therefore surveys must be collected to determine the sites that are most vulnerable. The community can determine a structure's value, however it is difficult to think critically without all of the information collected. Cultural resources inventories must be updated and organized. Digitizing cultural resource data is imperative in the planning process. Funds must be allocated specifically to identify cultural resources in high-risk areas and to prioritize projects for the cultural resources that

are most vulnerable. Assessments are vital information for city planners to document into their resilience plans.

Historic preservationists must also integrate their data into planning tools such as local GIS mapping viewers and risk assessment surveys specifically for cultural resources. Annapolis's CRHMP and Staten Island's NYRCR plan both included assessments of their cultural resources located in high-risk areas and used mapping to highlight the vulnerability of those assets. The preservation community would benefit from creating a cultural resources vulnerability index based on climate change models, similar to a climate change vulnerability index. This identifies areas of risk by evaluating social, economic and environmental factors to combat climate change.⁸⁴ These and other tools will provide historic preservationists with the means to incorporate cultural resources into resilience planning documents. However, just providing the data is not enough to ensure historic resources are incorporated into the resilience plans.

My fourth recommendation is that historic preservation must become a key component in the planning process. It is not enough that cultural resources are included in the planning process; preservationists need to be key players in the conversation. Annapolis has demonstrated that cultural resources can be the lead organization in the city's resilience planning process. All states have a historic preservation office and many localities have a historic preservation department. These groups work closely with city officials, residents, business owners,

⁸⁴ "Latest Product News: Climate Change Vulnerability Index." Verisk Maplecroft. Accessed May 10, 2016. <https://maplecroft.com/about/news/ccvi.html>.

architects, and planners. It can be a natural fit for historic preservation groups to bring these parties together on the topic of sea level rise.

My fifth recommendation for incorporating cultural resources into resilience plans is to engage the local community in the planning process. Adaptation solutions will involve a variety of infrastructures, public spaces, and private property. Engagement is a way for the community to become educated on the risks, gain information and technical expertise on mitigation techniques, and contribute to the resilience of their neighborhood. Cultural resources offer tangible assets for the people to visually connect to when deciding on mitigation strategies or adaptation options. Community engagement allows for a smooth transition from awareness to implementation. These recommendations are not based on the success of the resilience planning process and implementation of these adaptation solutions. Further research on the success of these adaptation solutions and resilience plans will be needed.

Bibliography

- Perkins Eastman / BFJ Planning in Association with the Louis Berger Group,
comp. *EAST & SOUTH SHORES STATEN ISLAND NY RISING
COMMUNITY RECONSTRUCTION PLAN*. Technical paper. 2014.
- Advisory Council on Historic Preservation. "Unified Federal Review." ACHP |
Unified Federal Review. 2013. Accessed May 11, 2016.
http://www.achp.gov/unified_federal_review.html.
- USA. US Environmental Protection Agency. Office of Water. *Being Prepared for
Climate Change: A Workbook for Developing Risk-based Adaption
Plans*. 2014.
- CHL. "Breakwaters." Coastal and Hydraulics Laboratory - Engineer Research and
Development Center. Accessed May 14, 2016.
<http://chl.erdc.usace.army.mil/chl.aspx?p=s>.
- Care. "Welcome to the Toolkit for Community-Based Adaptation." Welcome to
the Toolkit for Community-Based Adaptation. Accessed May 10, 2016.
<http://careclimatechange.org/tk/cba/en/>.
- California Social Work Education Center. "Planning Tools." CalSWEC |.
Accessed May 20, 2016.
<http://calswec.berkeley.edu/toolkits/implementation-toolkits/planning->

tools.

Cassar, May. *Climate Change and the Historic Environment*. Report. London:

Centre for Sustainable Heritage, 2005.

<http://eprints.ucl.ac.uk/archive/00002082/>.

City of Annapolis. "Comprehensive Plan." Annapolis Comprehensive Plan.

October 5, 2009. <http://www.annapolis.gov/government/city-departments/planning-and-zoning/comprehensive-plan>.

City of Annapolis Historic Preservation Office. "Weather It Together Survey."

City of Annapolis Maryland. Summer 2015. Accessed May 10, 2016.

<http://www.annapolis.gov/government/city-departments/planning-and-zoning/cultural-resources-hazard-mitigation-plan/weather-it-together-survey>.

Colette, Augustin, ed. *Climate Change and World Heritage Report on Predicting and Managing the Impacts of Climate Change on World Heritage and Strategy to Assist States Parties to Implement Appropriate Management Responses*. Report. UNESCO, 2007. May 2007.

http://whc.unesco.org/documents/publi_wh_papers_22_en.pdf.

Craig, Lisa. "Goals for Cultural Resources Hazards Mitigation Plan." Interview by author. February 2016.

"Tools." Data.gov: Climate - Coastal Flooding. Accessed May 10, 2016.

<https://www.data.gov/climate/coastalflooding/coastalflooding-tools#tools-t6>.

- Davis, Phil. "Annapolis Officials Look to Study Economic Impact of Historic Preservation." *Capital Gazette*. April 28, 2016.
<http://www.capitalgazette.com/news/annapolis/ph-ac-cn-annapolis-historic-preservation-0429-20160428-story.html>.
- "Tulsa Hazard Mitigation Plan Historic Preservation & Cultural Resources Annex." Telephone interview by author. March 7, 2016.
- Deconto, Robert M., and David Pollard. "Contribution of Antarctica to past and Future Sea-level Rise." *Nature* 531, no. 7596 (March 30, 2016): 591-97.
doi:10.1038/nature17145.
- Englander, John. *High Tide on Main Street: Rising Sea Level and the Coming Coastal Crisis*. 2nd ed. Boca Raton: Science Bookshelf, 2014.
- English Heritage. "Climate Change and the Historic Environment." Historic England. January 18, 2008. <https://www.historicengland.org.uk/images-books/publications/climate-change-and-the-historic-environment/>.
- Environment Protection Agency. "Community-Based Adaptation To A Changing Climate." EPA Office of Policy. June 2015.
<http://www.epa.gov/communityhealth/community-based-adaptation-changing-climate>.
- Executive Office of the President. "President's Climate Action Plan - White House Gallery." June 2013. Accessed May 10, 2016.
<http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

FEMA. "Hazard Identification and Risk Assessment." Hazard Identification and Risk Assessment. Accessed May 14, 2016. <http://www.fema.gov/hazard-identification-and-risk-assessment>.

FEMA. *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*. Technical paper no. 386-6. 2005. <http://www.fema.gov/media-library-data/20130726-1522-20490-2886/howto6.pdf>.

Gertz, Emily. "Sea-Level Rise Poses Hard Choice for Two Neighborhoods: Rebuild or Retreat?" TakePart. April 24, 2015. <http://www.takepart.com/feature/2015/04/24/new-york-sea-level-rise-sandy-ocean-flooding-rebuild-or-retreat>.

Holtz, Debra, Adam Markham, Kate Cell, and Brenda Ekwurzel. "National Landmarks at Risk (2014)." Union of Concerned Scientists. May 2014. Accessed May 10, 2016. http://www.ucsusa.org/global_warming/science_and_impacts/impacts/national-landmarks-at-risk-from-climate-change.html.

IPCC. "ANNEX II Glossary of Terms." A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). 2012. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf.

"IPCC - Intergovernmental Panel on Climate Change." IPCC - Intergovernmental Panel on Climate Change. Accessed May 14, 2016. <http://www.ipcc.ch/organization/organization.shtml>.

- "IPCC Fifth Assessment Report." IPCC Fifth Assessment Report. November 2014. Accessed May 10, 2016. <https://ipcc.ch/report/ar5/>.
- Judd, Jackie. "Two Cities, Two Very Different Responses to Rising Sea Levels." PBS. July 2, 2015. <http://www.pbs.org/newshour/bb/two-cities-two-different-responses-rising-sea-levels/>.
- Kahn, Debra, and ClimateWire. "San Francisco Bay Area Enacts Sea-Level Rise Policy." Scientific American. October 7, 2011. Accessed May 10, 2016. <http://www.scientificamerican.com/article/san-francisco-bay-area-enacts-sea-level-rise-policy/>.
- Keeler, Andrew G. "Sea Level Rise, Government Policy, and Economic Efficiency." NC State Economist. September/October 2012. Accessed May 10, 2016. http://csi.northcarolina.edu/content/sept12_sea_level_rise.pdf.
- Lee, Vincent. "Arup | Thoughts | Sandy's Lessons for Resilience Planning." ARUP. November 12, 2012. <http://thoughts.arup.com/post/details/252/sandys-lessons-for-resilience-planning>.
- "Glossary of Terms." *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation Special Report of the Intergovernmental Panel on Climate Change*: 555-64. doi:10.1017/cbo9781139177245.014.
- Marcy, Doug, Nate Herold, Kirk Waters, NOAA Coastal Services Center,

- William Brooks, Brian Hadley, Keil Schmid, Mike Sutherland, I.M. Systems Group, Kyle Dragonovo, John McCombs, Sean Ryan, and The Baldwin Group. *New Mapping Tool and Techniques For Visualizing Sea Level Rise*. Report. Charleston: NOAA Coastal Service Center, 2011.
- Markham, Adam. "World Heritage Sites Among Many Cultural Resources Threatened by Climate Change." *Union of Concerned Scientists*, November 2014. Accessed May 10, 2016. <http://blog.ucsusa.org/adam-markham/world-heritage-sites-cultural-impacts-climate-change-723>.
- Maryland Coastal Zone Management Program. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change Phase I: Sea-level Rise and Coastal Storms*. Report. August 2008. Accessed May 10, 2016. http://climatechange.maryland.gov/wp-content/uploads/sites/16/2014/12/ian_report_1971.pdf.
- McFadden, Loraine, Robert J. Nicholls, and Edmund C. Penning-Rowsell. *Managing Coastal Vulnerability*. Amsterdam: Elsevier, 2007.
- Melvin, Don, and Ray Sanchez. "Ice Melt Could Cause Huge Sea Rise, Study Says." CNN. April 2, 2016. Accessed May 10, 2016. <http://www.cnn.com/2016/03/31/tech/study-melting-antarctic-ice/index.html>.
- Mississippi Development Authority. *Elevation Design Guidelines for Historic Homes in the Mississippi Gulf Region*. Technical paper. Accessed May 10, 2016. http://www.nj.gov/dep/hpo/hrrcn_sandy_pdf

files/mississippi.pdf.

Mitigation Assessment Team. *Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York*. Report no. FEMA P-942. November 27, 2013. http://www.fema.gov/media-library-data/1385587460719-189d039332273d129170ea2cabe30542/Sandy_MAT_Ch6_508post.pdf.

NOAA. "'Nuisance Flooding' an Increasing Problem as Coastal Sea Levels Rise." NOAA News. October 31, 2014. http://www.noaanews.noaa.gov/stories2014/20140728_nuisanceflooding.html.

NY Governor's Office. "Governor Cuomo Announces \$6.2 Million in Grants For Historic Properties Damaged By Superstorm Sandy." Governor Andrew M. Cuomo. August 04, 2015. Accessed May 10, 2016. <https://www.governor.ny.gov/news/governor-cuomo-announces-62-million-grants-historic-properties-damaged-superstorm-sandy>.

National Institute of Standards and Technology. "Community Resilience Planning Guide." NIST Engineering Laboratory. October 29, 2015. Accessed May 18, 2016. <http://www.nist.gov/el/resilience/guide.cfm>.

National Oceanic and Atmospheric Administration. "Digital Coast. More than Just Data." Digital Coast. Accessed May 14, 2016. <https://coast.noaa.gov/digitalcoast/>.

National Oceanic and Atmospheric Administration. "Preparing the Nation for Sea Level Rise and Coastal Flooding." Climate-Smart Nation. 2013. Accessed

May 10, 2016.

http://cpo.noaa.gov/sites/cpo/About_CPO/Coastal_Final.pdf.

National Park Service. *Climate Change Action Plan*. Publication. DC:

Government Printing Office, 2012.

National Park Service. *Preserving Coastal Heritage*. Report. April 4, 2014.

<http://www.achp.gov/docs/preserve-coastal-heritage.pdf>.

Nelson, Carl L. *Protecting the past from Natural Disasters*. Washington, D.C.:

Preservation Press, National Trust for Historic Preservation, 1991.

"East and South Shores of Staten Island." In *A Stronger, More Resilient New*

York, edited by New York City PL. New York City, 2013. Accessed May

10, 2016.

http://www.nyc.gov/html/sirr/downloads/pdf/final_report/Ch15_Staten_Island_FINAL_singles.pdf.

Oliver-Smith, Anthony. *Sea Level Rise and the Vulnerability of Coastal Peoples*.

Publication no. 7. Paffenholz, Bornheim: UNU-EHS, 2009.

Porpora, Tracey. "Three Historic Properties on Staten Island Damaged by

Hurricane Sandy to Be Repaired (with Photos)." SILive.com. July 28,

2014. Accessed May 10, 2016.

http://www.silive.com/news/index.ssf/2014/07/5_million_in_grant_awards_for.html.

"Five Principles for Successful and Sustainable Heritage Tourism."

Preservationnation. Accessed May 10, 2016.

- <http://www.preservationnation.org/information-center/economics-of-revitalization/heritage-tourism/basics/the-five-principles.html?referrer=https://www.google.com/#.VujQd5MrLdQ>.
- "NPS Climate Change Tool." Program for the Study of Developed Shorelines. 2015. <http://psds.wcu.edu/projects-research/nps-climate-change-tool/>.
- Staten Island living breakwaters. Digital image. Rebuild by Design. Accessed May 10, 2016. <http://www.rebuildbydesign.org/project/living-growing-breakwaters-staten-island-and-raritan-bay/>.
- Reeder, Leslie A., Torben C. Rick, and Jon M. Erlandson. "Our Disappearing Past: A GIS Analysis of the Vulnerability of Coastal Archaeological Resources in California's Santa Barbara Channel Region." *J Coast Conserv Journal of Coastal Conservation* 16, no. 2 (2010): 187-97. doi:10.1007/s11852-010-0131-2.
- Roaf, Susan, David Crichton, and Fergus Nicol. *Adapting Buildings and Cities for Climate Change: A 21st Century Survival Guide*. Amsterdam: Architectural Press, 2005.
- Rockman, Marcy. "An NPS Framework for Addressing Climate Change with Cultural Resources." *The George Wright Forum* 32, no. 1 (2015): 37-50. <http://www.georgewright.org/321rockman.pdf>.
- SCAPE / LANDSCAPE ARCHITECTURE PLLC. *LIVING BREAKWATERS*. Report. 2014.
- "SCAPE: Living Breakwaters." SCAPE: Living Breakwaters. Accessed May 10,

2016. <http://www.scapestudio.com/projects/living-breakwaters/>.

Seekamp, Erin. "Connecting Climate Change and Cultural Resource Adaptation Decisions." - ScienceBase-Catalog. August 2015. Accessed May 10, 2016.

<https://www.sciencebase.gov/catalog/item/552bc2dae4b026915857df38>.

Spanger-Siefield, Erika, Melanie Fitzpatrick, 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*. Technical paper. October 2014.

<http://www.ucsusa.org/sites/default/files/attach/2014/10/encroaching-tides-full-report.pdf>.

Spennemann, Dirk H.r., and Kristy Graham. "The Importance of Heritage Preservation in Natural Disaster Situations." *IJRAM International Journal of Risk Assessment and Management* 7, no. 6/7 (2007): 993. Accessed May 10, 2016. doi:10.1504/ijram.2007.014670.

"Staten Island Landmarks - Conference House Park." Digital image. Staten Island Landmarks and Points of Interest. Accessed May 10, 2016. <https://www.google.com/maps/d/viewer?ll=40.499866,-74.250197&spn=0.024769,0.033345&hl=en&t=h&msa=0&z=15&ie=UTF8&mid=1-7nteXb2ACWzuMWC0ApMRK-UnR0>.

Strauss, Ben, Claudia Tebaldi, and Remik Zlemlinski. "Surging Seas: Sea Level Rise, Storms & Global Warming's Threat to the US Coast." Surging

Seas. 2012. Accessed May 10, 2016.

<http://slr.s3.amazonaws.com/SurgingSeas.pdf>.

Strauss, Benjamin H., Scott Kulp, and Anders Levermann. "Carbon Choices

Determine US Cities Committed to Futures below Sea Level."

Proceedings of the National Academy of Sciences Proc Natl Acad Sci

USA 112, no. 44 (2015): 13508-3513. doi:10.1073/pnas.1511186112.

"Sea Level Rise and Coastal Flood Web Tools Comparison Matrix." Surging

Seas: Sea Level Rise Analysis by Climate Central. Accessed May 10,

2016. <http://sealevel.climatecentral.org/matrix/>.

Tang, Zhenghong, Samuel D. Brody, Courtney Quinn, Liang Chang, and Ting

Wei. "Moving from Agenda to Action: Evaluating Local Climate Change

Action Plans." *Journal of Environmental Planning and Management* 53,

no. 1 (2010): 41-62. Accessed May 10, 2016.

doi:10.1080/09640560903399772.

"Cultural Resources Hazard Mitigation Plan." The City of Annapolis Maryland.

Accessed May 10, 2016. [http://www.annapolis.gov/government/city-](http://www.annapolis.gov/government/city-departments/planning-and-zoning/cultural-resources-hazard-mitigation-plan)

[departments/planning-and-zoning/cultural-resources-hazard-mitigation-](http://www.annapolis.gov/government/city-departments/planning-and-zoning/cultural-resources-hazard-mitigation-plan)
[plan](http://www.annapolis.gov/government/city-departments/planning-and-zoning/cultural-resources-hazard-mitigation-plan).

U.S. Army Corps of Engineers. *NONSTRUCTURAL MITIGATION*

ASSESSMENT FOR THE CITY OF ANNAPOLIS HISTORIC DISTRICT.

Report. December 2014. [http://www.annapolis.gov/docs/default-](http://www.annapolis.gov/docs/default-source/planning-and-zoning-documents/nonstructural-mitigation-)

[source/planning-and-zoning-documents/nonstructural-mitigation-](http://www.annapolis.gov/docs/default-source/planning-and-zoning-documents/nonstructural-mitigation-)

assessment-for-annapolis-historic-district.pdf?sfvrsn=0.

URS Group for Louisiana Office of Cultural Development. *Elevation Design Guidelines For Historic Buildings in the Louisiana GO Zone*. Report. 2014. <http://www.crt.louisiana.gov/Assets/OCD/hp/uniquely-louisiana-education/Disaster-Recovery/Final Elevation Design Booklet 12-07-15 v2.pdf>.

US Army Corps of Engineers New York District. *SOUTH SHORE OF STATEN ISLAND, NEW YORK COASTAL STORM RISK MANAGEMENT*. Report. June 2015. <http://www.nan.usace.army.mil/Portals/37/docs/civilworks/projects/ny/coast/StatenIsland/June2015files/SouthShoreofStatenIsland-Draft-Feasibility-Report.pdf>.

United States. National Park Service. "Cultural Resources Adaptation." National Parks Service. Accessed May 10, 2016. <https://www.nps.gov/subjects/climatechange/adaptationforculturalresources.htm>.

United States. National Park Service. "Cultural Resources." National Parks Service. Accessed May 14, 2016. https://www.nps.gov/acad/learn/management/rm_culturalresources.htm.

United States. National Park Service. "Underrepresented Community Grants." National Parks Service. Accessed May 14, 2016. <https://www.nps.gov/preservation-grants/community-grants.html>.

United States. National Park Service. "Do Scientists Agree about Climate Change? (U.S. National Park Service)." National Parks Service. Accessed May 18, 2016. <https://www.nps.gov/articles/climatequestion02.htm>.

Velsey, Kim. "Built To Last: New York's Historic Houses and Ships Largely Unharmed By Hurricane." *Observer*. October 31, 2012. Accessed May 10, 2016. <http://observer.com/2012/10/built-to-last-new-yorks-historic-houses-and-ships-unharmed-by-hurricane/>.

"Latest Product News: Climate Change Vulnerability Index." Verisk Maplecroft. Accessed May 10, 2016. <https://maplecroft.com/about/news/ccvi.html>.

Ziehl, Nell, Mechelle Kerns, Anastasia Poulos, and Stephanies Sperling. *Adaptation Alternative: Issues of Protection for Historic Properties*. Working paper. Annapolis, 2016.

Maryland Commission on Climate Change Adaptation and Response Working Group. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change Phase I: Sea-level Rise and Coastal Storms*. Report. September 12, 2008. http://climatechange.maryland.gov/wp-content/uploads/sites/16/2014/12/ian_report_1971.pdf.

"What Is a Community-Based Adaptation Project?" WeADAPT. May 27, 2011. Accessed May 10, 2016. <https://www.weadapt.org/knowledge-base/global-initiative-on-community-based-adaptation-gicba/what-is-a-community-based-adaptation-project>.

