



Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Project

Phase 2 Report:
Recommendations,
Accomplishments and
Lessons Learned



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October 2016



Acknowledgments

The Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Project Phase 2 Report: Recommendations, Accomplishments and Lessons Learned was developed through a collaborative process that included the active participation of the Working Group and Advisory Committee Chairs, the Steering Committee, and other key stakeholders.

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- RADM Ricky Williamson** U.S. Navy, former Commander Navy Region Mid-Atlantic
- Heather Wood** former Sustainability Director, Port of Virginia; Kennedy Jenks Consultants
- Mayor Kenneth Wright** former Chair, HRPDC; Mayor, City of Portsmouth

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Executive Summary

After two years, the Hampton Roads Sea level Rise and Resilience Intergovernmental Planning Pilot Project (Intergovernmental Pilot Project or IPP), convened at Old Dominion University, has come to a successful close. Although the conclusion of the project is different than originally imagined by the drafters of the IPP Charter, the process in and of itself brought hundreds of stakeholders together, built lasting and ongoing relationships, and produced many workable recommendations for the region that can be accomplished by a variety of partnerships. The key deliverables include a whole of government mitigation and adaptation planning process and an integrated regional recommendation, both which can serve as a template for other regions. Additionally the IPP demonstrated a new role for an urban campus to act as a community convener, matching focused research and curriculum development with public service across the university and the region.

Initiated in June 2014, the IPP was an effort to use the knowledge, skills and expertise of all regional stakeholders to create a framework or template for intergovernmental strategic planning that could be used outside the region; and, to implement that integrated strategy in Hampton Roads, Virginia, creating an effective and efficient method for planning holistically for sea level rise and recurrent flooding. This “Whole of Government and Community” effort would not have been successful without the hundreds of stakeholders and volunteer leaders from across all levels of government, academia, and the community who participated out of a sense of duty to their community and commitment to the collaboration.

Knowing water knows no jurisdictional bounds, a high level of intergovernmental collaboration is necessary to develop integrated regional solutions and implement effective sea level rise preparedness and resilience strategies. Additionally, the wider community in Hampton Roads recognizes that they too will be affected by not only sea level rise itself, but also the adaptation strategies implemented in preparation.

Phase 1 of the project, from June 2014 through June 2015, saw the drafting and signing of a Charter, the recruitment of a steering committee, a host of events, and the development of working group and advisory committees comprised of subject matter experts. Phase 2, from June 2015 through June 2016, included heavy discussion with regard to ongoing strategies for intergovernmental collaboration as well as research, a number of case studies carried out by committees and working groups, and the careful development of recommendations for the region.

The IPP concludes successfully with a series of recommendations from each working group and committee as well as a final resolution drafted by the Legal Working Group and containing the consensus views of steering committee members. Though the recommendations vary in specificity and subject area, a few themes are clear. In order to move forward regionally, local stakeholders need to maintain, institutionalize and build relationships with each other in order to facilitate effective collaboration and information sharing. Institutionalizing these relationships and partnerships is key, as people shift positions throughout their careers. Additionally, while more data is needed, the methods by which that data is integrated and shared are equally important. Further, some form of the Whole of Government and Community approach that focuses on the watershed as opposed to jurisdictional boundaries is essential to accomplishing the recommendations set forth in this report.

The IPP has been a success because of the dedicated volunteers committed to a resilient Hampton Roads. During the last two years, this project advanced regional adaptation through the evaluation and recommendation of a future governance structure, the development of working group and committee recommendations, building public awareness, building awareness of the need for federal agency involvement locally and building relationships among numerous organizations involved in the Pilot Project. All of this work, which in pieces may be specific only to a unique circumstance or area, when taken as a whole, brings foundational change. It builds on previous work accomplished by other leaders in the Hampton Roads region and should be leveraged in the future to accelerate regional adaptation.





1. Introduction & Background

1.1. Sea Level Rise and Flooding in Hampton Roads, Virginia

Hampton Roads, Virginia, for purposes of the Hampton Roads Sea Level Rise and Resilience Intergovernmental Planning Pilot Project (Intergovernmental Pilot Project or IPP) was defined as the seventeen localities within the borders of the Hampton Roads Planning District Commission. The Steering Committee and stakeholders recognize that this creates an artificial political boundary, one which the water does not recognize. However, for the purposes of this two-year-long experiment, the steering committee agreed to limit the area considered. In order to consider living with the water in Hampton Roads, the region must join together and act innovatively and proactively.

The Phase 1 of the IPP report contains a careful detailing of the region, its localities, and the economy, which is largely reliant on the heavy defense presence in the area. In short, the region is one of the nation's most vulnerable to coastal hazards, with CoreLogic estimating that the total homes vulnerable to all categories of hurricanes regionally as 385,084.¹ Additionally the region faces a high relative rate of sea level rise due to the convergence of multiple factors in the mid-Atlantic region.²

¹ Howard Botts, et al. (2016). *2016 CoreLogic Storm Surge Report*, CORELOGIC .

² Ezer, T., & Atkinson, L. P. (2014). Accelerated flooding along the US East Coast: on the impact of sea-level rise, tides, storms, the Gulf Stream, and the North Atlantic oscillations. *Earth's Future*, 2(8), 362-382.

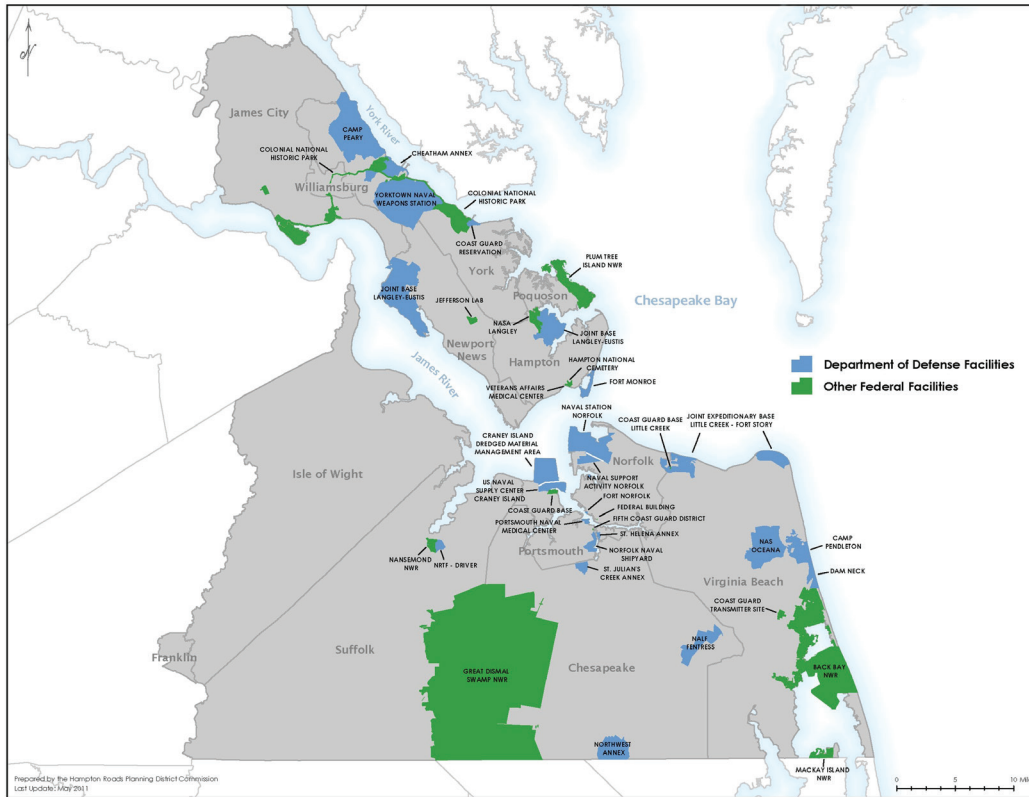


Figure 1-1. Hampton Roads Region Municipalities and Federal Facilities, Image Courtesy of the Hampton Roads Military and Federal Facilities Alliance

The Virginia Institute of Marine Science (VIMS) Recurrent Flooding Study for Tidewater Virginia (2013) report commissioned by the Virginia General Assembly highlighted the cities of Virginia Beach, Portsmouth, Norfolk, Chesapeake, Hampton, and Poquoson as confronting significant challenges related to sea level rise, assuming a 1.5-foot rise in sea level and a 3-foot storm surge. The study found that in these localities the percentage of the total land area vulnerable to flooding ranged from 11% to 69%.³

The region has a population of over 1.7 million, many of whom depend on the waterways indirectly for employment or for recreation, as well as a high concentration of valuable commercial, industrial, and military assets benefiting from their direct access to water-dependent assets. Along with other federal facilities, Naval Station Norfolk, the largest naval base in the world, and the Port of Virginia, which generates \$60 billion in annual spending,⁴ are key economic drivers in the region. Supporting industries including shipbuilding and repair, defense contracting, rail transport and truck transport play a key role economically. Commercial and recreational fishing, outdoor recreation, tourism and the associated real estate development, and many other industries take advantage of the shorelines, wetlands, and beaches. Institutes of higher

³ Virginia Institute for Marine Science (VIMS). (2013). *Recurrent Flooding Study for Tidewater Virginia*, available http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf.

⁴ Roy L. Pearson, *The Fiscal Year 2013 Virginia Economic Impacts of the Port of Virginia*, WILLIAM & MARY, RAYMOND A. MASON SCHOOL OF BUSINESS (Dec. 26, 2014) <http://www.portofvirginia.com/pdfs/POV%20Econ%20Impact%20Study%202014.pdf>.

education in the area, also economic drivers, boast strengths in water-related programs and research. These industrial, commercial, residential, and environmental assets and pillars of the economy are key to the region's success, but are at risk from the rising level of the very waters that drew them to Hampton Roads. However, if the region continues to act proactively with regard to these risks, there are many opportunities to develop new economies as the region adapts.

1.2. Other Coastal Resilience Initiatives

Throughout the course of the IPP many exciting initiatives and developments occurred throughout Hampton Roads and in the Commonwealth of Virginia with regards to sea level rise and resilience. The IPP and its stakeholders worked hard to ensure that efforts were not duplicated and that any IPP efforts supported other initiatives where possible. In fact, in most cases IPP participants were leaders in these other efforts. Below is a list of exciting and interesting sea level rise and resilience initiatives, but by far is not an exhaustive list of all of the activity in the region:

- The Commonwealth was awarded more than \$120.5 million through the Housing and Urban Development National Disaster Resilience Competition. These funds will build resilience in the Ohio Creek Watershed area of Norfolk and provide seed funding for a Coastal Resilience Laboratory and Accelerator.
- HRPDC has reinvigorated its work through its Coastal Resilience Committee. Local county and city administrators have appointed deputy administrators to serve on the committee and allocated funds for a coastal resiliency planner position.
- Hampton Roads Adaptation Forums have continued to be hosted by ODU and HRPDC and are now sponsored by private sector partners. The forums bring practitioners together quarterly for day-long workshops, presentations, and networking.
- The City of Norfolk launched its Resilience Strategy and is moving forward with its Vision 2100 process.
- Research has continued and expanded at ODU, VIMS, VCPC and other academic institutions on subjects from subsidence, housing recovery, data integration, and storm surge modeling and more.
- ODU, Hampton University, Virginia Sea Grant, and Wetlands Watch successfully collaborated on the Chesterfield Heights and other resilient design projects engaging students in developing innovative adaptation strategies.
- The Commonwealth Center for Recurrent Flooding Resilience (CCRFR) was established by 2016 General Assembly Authorization (HB 903) & Climate Change & Resiliency Update Commission Priority. The CCRFR will leverage the complementary strengths of ODU, VIMS, and VCPC to enable short- and long-term decision making by assisting with the integration and coordination of federal, state, local, and nongovernmental data, evaluating best practices, developing and testing innovative interventions, engaging stakeholders throughout Virginia, providing outreach, training, technical and non-technical services as requested.

1.3. Intergovernmental Pilot Project

1.3.1. Background

The IPP was a two-year project officially launched in June 2014 with a goal of using a Whole of Government and Whole of Community approach to resilience planning. A dual purpose initiative, the IPP worked to meet the needs of local stakeholders to build relationships and develop a process for collaborative planning and with federal stakeholders to create a model for Whole of Government resilience planning in one of the more complex and federally saturated regions in the nation.

The White House and Department of Defense each initiated three regional pilots following President Obama's Executive Order, "Preparing the United States for the Impacts of Climate Change." The Hampton Roads Intergovernmental Pilot Project was the only geographic location on both lists, and the only pilot convened by a university across a region as varied as Hampton Roads. Furthermore, this initiative was the only one exploring the Whole of Government/Community model and addressing coastal resiliency with a focus on regional resilience and local mitigation and adaptation to address national security concerns and economic impacts.

MISSION: The mission of the IPP is to establish in Hampton Roads a regional Whole of Government & Whole of Community organizational framework and procedures that effectively coordinate SLR Preparedness & Resilience Planning.

VISION: A regional Whole of Government and Whole of Community approach to sea level rise preparedness and resilience planning in Hampton Roads that also can be used as a template for other regions.

The IPP utilized the Whole of Government highlighted in the 2010 National Security Strategy⁵ to improve integration and collaboration across federal, state, and local governmental agencies in Hampton Roads to more effectively leverage limited resources in order to plan for sea level rise and coastal flooding. Because this was a cross-jurisdictional issue as floodwaters do not adhere to political boundaries, the application of the Whole of Government approach to sea level rise preparedness and resilience planning could benefit the region greatly.

The IPP has been a success based on the leadership of the volunteers working in the working groups and committees for two years. During the last two years, the Pilot Project has advanced regional adaptation through the evaluation and recommendation of a future governance structure, the development of working group and committee recommendations, building public awareness, building awareness of the need for federal agency involvement and building relationships between numerous organizations involved in the Pilot Project. This work builds on work of others in the region, and in turn, can be a launching point for implementing strategies and partnerships. It builds on previous work accomplished by other leaders in the Hampton Roads Region and can be leveraged in the future to accelerate regional adaptation. According to Ekstorm & Moser, on whom the IWG and PIC based their strategies, at early stages in the

⁵ See *National Security Strategy, 2010*, available https://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf. See also, Presidential Policy Directive (PPD-8): National Preparedness, available <http://www.dhs.gov/presidential-policy-directive-8-national-preparedness>.

adaptation process “merely advancing or continuing the process can be used as a proxy for success.”⁶

In a diverse region of 17 localities, the Whole of Government process does not come easily. The conveners of the IPP aimed to build bridges between levels of government and within the region and increase understanding and collaborative processes during the two-year experiment. Though the Whole of Government concept was the initial goal of the White House and Department of Defense pilots, the Whole of Community concept was added to bring regional ownership to the process. The IPP two-year process was an iterative one, with input gathered from all interested stakeholders in a manner that allows for adaptive management in response to changing information and conditions.

Over the course of the IPP, countless volunteer hours were logged via participation in events, working group and advisory committee meetings, and more. Participation in the IPP was completely voluntary for Steering Committee members and working group and committee members. While some organizations, agencies, and localities tasked staff members with participation, others have simply volunteered their time and expertise. Additionally, over the course of the IPP many graduate students conducted research on the IPP itself or participated in working groups and committees.

Old Dominion University (ODU) acted as the convener of the IPP and supported the IPP during the course of two years by supporting faculty and staff who dedicated time to the effort. William & Mary Law School’s Virginia Coastal Policy Center and the Virginia Institute of Marine Science also provided expert support throughout the duration of the project.

Importantly, the IPP was not funded by federal partners. ODU, as the convening organization, supported the project with significant staff time, communications support, the underwriting of various IPP events, and support of faculty where possible. Grants from a private foundation supported the Phase 2 work of the Infrastructure Working Group, Private Infrastructure Advisory Committee, Public Health Working Group, and Citizen Engagement Committees, making possible their detailed case studies. Because of limited funding the IPP held to its two-year schedule and the project ended during the summer of 2016.

1.3.2. Structure & Partnerships

The IPP structure consisted of a Steering Committee charged with directing the overall strategic direction for the pilot. The Steering Committee was informed and supported by a set of working groups and advisory committees. Steering Committee membership included private industry, state and local representatives as well as non-voting federal liaisons. Because one of the goals of the IPP was to propose a strategy for effective local planning, federal liaisons were active participants but not voting members of the committee.

Over the course of the two-year pilot project, many original steering committee members left their positions in the Navy or other employment due to the natural course of their work. For example, many military posts change command every two years. Where possible, steering committee members briefed their replacements prior to departure, which aided the group with

⁶ Moser, Susanne C., and Maxwell T. Boykoff, eds. *Successful Adaptation to Climate Change: Linking Science and Policy in a Rapidly Changing World*. New York: Routledge, 2013.97-113. Print.

the transition. However, these frequent transitions highlighted the need to incorporate the relationships developed during the IPP process into their scope of work not just between federal and state/local partners, but among all community leaders. The steering committee in place at the close of the IPP was as follows:

Steering Committee

- Randy Keaton - *Chair*Deputy Executive Director,
Hampton Roads Planning District Commission
- Shawn Talmadge – *Deputy Chair* . . .Homeland Security and Resiliency Staff Director,
Commonwealth of Virginia
- Mayor Kenneth Wright.Former Chair, HRPDC; Mayor, City of Portsmouth
- Kit ChopeVP, Sustainability Director, Virginia Port Authority
- Angela Navarro.Deputy Secretary of Natural Resources,
Commonwealth of Virginia
- Timothy FortuneEngineering Manager, Newport News Shipyard,
Huntington Ingalls
- Jim UtterbackVirginia Department of Transportation,
Hampton Roads Director
- Heather WoodConsultant to the Port, Kennedy Jenks
- Sharon BaxterDirector, Division of Environmental Enhancement,
Virginia DEQ
- Christine MorrisChief Resiliency Officer, City of Norfolk
- Phil DavenportDirector of Public Works, City of Virginia Beach

Federal Liasons

- RADM John C. Scorby.Commander Navy Region Mid-Atlantic
- COL Jason KellyUSACE, Commander Norfolk District
- CAPT George BonnerCommanding Officer USCG Shore Infrastructure
Logistics Center
- Andrew LawrenceUSCG District 5
- CAPT Dean VanderleyCommanding Officer NAVFAC Mid-Atlantic
- COL Caroline MillerCommander Joint Base Langley-Eustis

Convener

- CAPT Ray Toll (Ret.)Director for Coastal Resilience Research,
Old Dominion University

Working Group and Advisory Committee Chairs

- Roy HoaglandW&M VCPC, Chair, Legal Working Group
- RADM Ann Phillips (Ret)Chair, Infrastructure Working Group
- Dr. Michelle Covi.ODU/VASG, Co-Chair Citizen Engagement
Working Group
- Chris BonneyHRCCE, Co-Chair Citizen Engagement Working Group
- Dr. Steve BeckerODU, Chair Public Health Working Group
- Carol ConsidineODU, Chair Private Infrastructure Advisory Committee
- Dr. Larry AtkinsonODU, Co-Chair Science Advisory Committee
- Dr. Carl HershnerVIMS, Co-Chair Science Advisory Committee
- Dr. Chip FilerODU, Chair Economic Impacts Advisory Committee

Initial workgroups and advisory committees evolved slightly throughout the two-year process, and some groups started at different times or were more active than others. This is not a surprising result from a stakeholder initiative led by mostly volunteers.

The initial structure of the IPP, including the following working groups and advisory committees, with changes occurring over time as noted in parentheses:

1. Legal Working Group
2. Infrastructure Working Group
3. Land Use Planning Working Group (Dissolved December 2015)
4. Citizen Engagement Working Group
5. Public Health Working Group (Added in April 2015)
6. Economic Impacts Advisory Committee (Started Fall 2015)
7. Private Infrastructure Advisory Committee
8. Municipal Planning Advisory Committee (Never Initiated)
9. Senior Advisory Committee (Inactive)
10. Science Advisory Committee

The Legal, Infrastructure, Land Use Planning, and Citizen Engagement Working Groups were formed by the Charter, while the Public Health Working Group was formed at a meeting of the Steering Committee in April 2015 after acknowledgment of a planning gap. Advisory Committees were convened as well, to provide key information to the Working Groups and Steering Committee. Figure 3 shows the basic organizational structure with primary communication relationships between Steering Committee, Working Groups, and Advisory Committees. The structure of the IPP at its close is as follows:

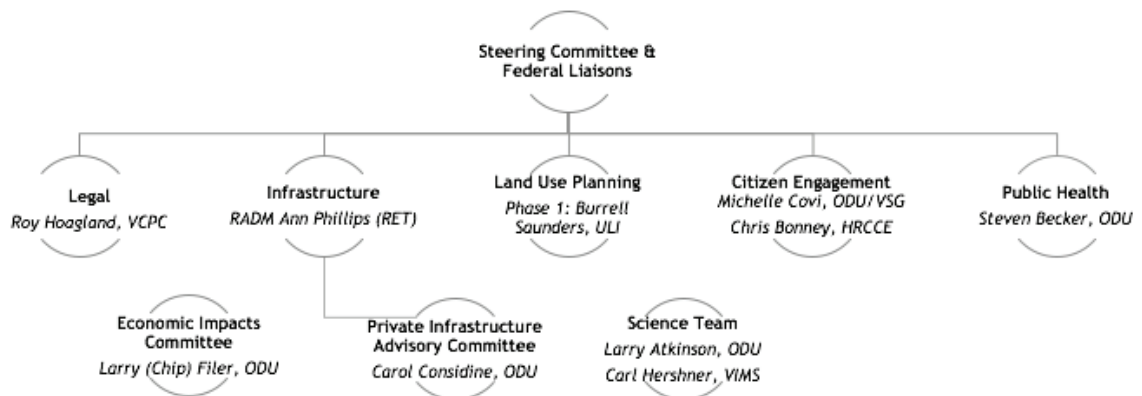


Figure 1-2 IPP Structure

The chairs of the working groups and advisory committees worked together regularly, sharing information and strategies. Additionally, members of the Legal Working Group and the Science Advisory Committee regularly attended other's meetings to answer questions where appropriate. Each active committee's strategy is summarized in this report and closely detailed in independent reports available in the Appendices for reference.

1.3.3. Phase 1

1.3.3.1. Summary

Beginning in June 2014, Old Dominion University convened the Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Project (Intergovernmental Pilot Project or IPP). The IPP was an effort to use the knowledge, skills and expertise of all regional stakeholders to create a framework or template for intergovernmental strategic planning that can be used outside the region; and to implement that integrated strategy in Hampton Roads, Virginia, creating an effective and efficient method for planning holistically for sea level rise and recurrent flooding.

Shortly after the official launch of the project, on June 30, 2014, political leaders met at ODU to discuss a bipartisan approach to flooding resilience as a part of the Pilot Project. With active stakeholders from the Department of Defense, federal agencies and the White House as well as the Commonwealth of Virginia and many localities across Hampton Roads, Virginia, the IPP was truly a Whole of Government effort. Knowing water knows no jurisdictional bounds, that level of intergovernmental collaboration is necessary to develop integrated regional solutions and implement effective sea level rise preparedness and resilience strategies. Additionally, the wider community in Hampton Roads recognizes that they too will be affected by not only sea level rise itself, but also the adaptation strategies implemented in preparation. As such, many academic and community partners actively participated, ensuring that this was a Whole of Community project as well.

Thus, IPP stakeholders include representatives from private industry, infrastructure, nonprofits, the real estate community, and vulnerable communities. Furthermore, while the IPP was conceived in Hampton Roads, the IPP recognizes that sea level rise affects the entire Commonwealth, and a successful "Whole of Government and Community" approach must eventually include regions beyond Hampton Roads and reach across Coastal Virginia and the Commonwealth as a whole.

The IPP was completely un-funded, except as supported by ODU and via stakeholders' donated time. It existed not as an entity, but as an attempt to bring together the community, and leveraging and building upon other initiatives including the Secure Commonwealth Panel's Subcommittee on Sea Level Rise, Urban Land Institute's Resilient Region Reality Checks, the City of Norfolk's experience with 100 Resilient Cities and the work of NOAA and NASA scientists, and more.

1.3.3.2. Deliverables

In October 2014, the Steering Committee signed the Charter and formation of the various working groups and advisory committees commenced. By July 2015, every working group and committee established by the Charter had a tentative chair or co-chairs except for the Economic Impacts Advisory Committee. Essential to the energy and support behind Phase 1 of

the IPP were the letters sent to federal agencies by United States Senator Tim Kaine in October 2014 encouraging participation in the Hampton Roads IPP project. Throughout the fall and winter, agencies responded with support and designated points of contact.

For the remainder of Phase 1, IPP stakeholders worked diligently to follow the intent of the Charter with limited staffing and funding while responding to the challenges of stakeholder engagement.

The Legal Working Group established several operating principles for consideration by the Steering Committee and worked to develop a "Legal Primer Version 1," which details federal, state, and local laws and regulations related to planning for sea level rise, serving as a reference document for the Steering Committee and the other working groups (See Appendix D-3).

All active working groups and committees developed action plans and/or a scope of work, and briefed the Steering Committee and Senior Advisory Committee on their efforts and requested feedback in March 2015. Though timelines were altered from the original Charter schedule, the focus remained on adapting to lessons learned in Phase 1 in the pursuit of establishing a regional entity focused on collaborative resilience planning, and many objectives remain the same.

At the conclusion of Phase 1, as a self-check to assess progress, challenges, and redefine goals half-way through the two-year pilot project, the Steering Committee, federal liaisons, working group and advisory committee chairs, and key stakeholders took part in a daylong strategic planning session. A facilitator led the group members as they worked to define a concrete path forward and ensure that knowledge from the first year was incorporated into the second phase of the project. As a result of this workshop, the project adapted as necessary to work toward proposing a Whole of Government and Whole of Community process for sea level rise preparedness and resilience in Hampton Roads that could also be used as a template elsewhere.

1.3.4. Phase 2

1.3.4.1. Summary

At the end of the IPP leadership's strategic planning session, Jim Redick, Emergency Manager for the City of Norfolk, and Randy Keaton were elected chair and co-chair of the Steering Committee. The group developed and held to a monthly meeting schedule, and established a timeline for completion of the project. In November of 2015, Jim Reddick stepped down as chairman, and the group elected Randy Keaton of the HRPDC Chair and Shawn Talmadge of the Secretary for Public Safety and Chief Resilience Officer as co-chair, continuing with the existing processes for meetings and timeline structure. In this way they were able to respond to questions and ideas from working group and advisory chairs as well as address key strategic questions posed by the Legal Working Group.

The working groups and advisory committees, having accomplished the bulk of the stakeholder engagement for the IPP during Phase 1, started case studies where applicable and then worked to develop recommendations carefully over the course of the second year of the project. Although the Charter initially planned on the addition of advisory committees during Phase 2, this was not initiated due to funding challenges, staffing constraints, and because of the logistical difficulties of bringing more groups into the project halfway through.

Though small feats when compared to the great efforts of the working groups, committees, and Steering Committee, Phase 2 was marked with two important events. First, in November, Secretary of State John Kerry visited Norfolk prior to attending the 2015 United Nations Climate Change Conference in Paris, France. During his visit he spoke with leadership at Naval Station Norfolk about the challenges faced on base from flooding and gave a speech at Old Dominion University stating that “unprecedented cooperation at all levels of government and the Pilot Program housed right here at Old Dominion University is the perfect example of the type of coordinated effort we need to deploy from sea to shining sea.” Additionally, midway through Phase 2, ODU hosted a large event to serve as a check-in and establish a network of regions so that IPP stakeholders could not only hear updates about activities in Virginia but also across the country; this event is discussed in Section 3.

1.3.4.2. Deliverables

According to the Charter, the goal of the second phase was to use the findings of the Steering Committee to draft a Memorandum of Understanding (MOU) among the members of the IPP establishing “an intergovernmental planning coordination organization that will commence operations upon conclusion of the Pilot Project.” Though the Steering Committee considered developing an MOU, the group decided that they were not yet ready to take that step and the groundwork was not in place to start a new entity. As such they took a more measured approach and worked closely with the LWG to consider first, what types of authorities would be useful for collaborative planning, and second, how those goals could be accomplished.

In addition to other issues, the LWG and Steering Committee carefully discussed the key issues as detailed in the Charter: (1) Authority, (2) Structure, (3) Governance, (4) Scope of Planning, (5) Resources, and (6) Execution. After careful consideration, analysis of a matrix of authorities and strategies for collaborative planning, and consideration of the recommendations of the other working groups and advisory committees, the Steering Committee opted to move forward with a resolution that addressed both short-term realities and long-term goals as opposed to an MOU. This resolution is available in Appendix C-1. Moreover, each working group and advisory committee developed overall recommendations as they related to their area of expertise. These recommendations are available in a summary chart in Section 4.1 as well as in each committee’s report.

1.3.4.3. Process for Developing Final Report and Recommendations

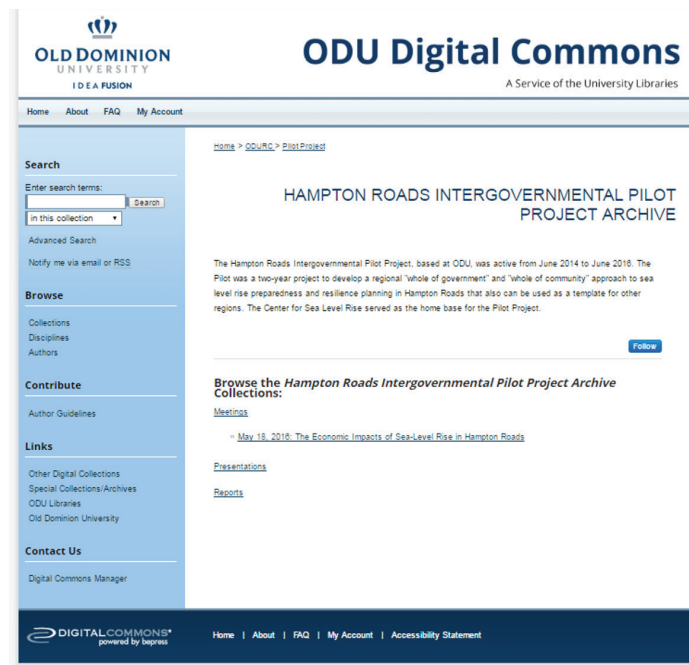
Throughout the IPP process the Steering Committee, working groups and advisory committees, with ODU as the convener, have maintained various communications strategies to ensure interested stakeholders were informed during the two-year pilot project. Each working group or committee was formed in a unique manner as appropriate for that sector and as determined feasible with limited time and resources. This is detailed in the respective committee and working group sections and in more depth in the independent Committee Reports where applicable.

Members of the Steering Committee, working group and advisory committee chairs, and the convener have all spoken at various conferences and smaller community events or meetings as well as offering and partaking in countless check-in and update phone calls and meetings with stakeholders throughout Hampton Roads, Richmond, and Washington, D.C.

The process for compiling this report was no different. First the Steering Committee agreed to a tentative schedule for working group and advisory committee submissions, as well as a template for those submissions and a tentative outline for the report. Each working group and advisory group worked together to compile recommendations and submit the requested information, sending multiple drafts out to committee members for comment and approvals and discussing the reports in meetings as necessary.

The report compilers then input that information into this report and included any additional information, resources, or reports in the Appendices for reference. Throughout the compilation process, working group and advisory committee chairs were offered the opportunity to comment, revise, and discuss, and provided input to the process and the content of the report to ensure it accurately reflected the many hours of work from volunteers across the region.

In an effort to increase usability, the body of this final report serves as a summary of more detailed stand-alone working group and committee reports as well as the overall IPP process. For a more detailed study of each committee and working group's actions, please refer to the independent committee reports, as they contain a wealth of information and represent many hours of stakeholder investment. The full body of each committee final report, including member lists, case studies, literature reviews, pertinent information, deliverables, etc., are located in the Appendices. Additionally, all IPP resources are archived permanently on ODU's Digital Commons and available at http://digitalcommons.odu.edu/odurc_pilot/. We welcome you to explore this wealth of resources.





2. Working Group and Committee Reports

2.1. Legal Working Group

2.1.1. History, Objectives & Strategy

The Legal Working Group assembled members by contacting every HRPDC jurisdiction and requesting each jurisdiction assign an attorney. The various military organizations volunteered to participate from the beginning and several private practitioners also volunteered later. The Legal Working Group was chaired by Roy Hoagland, then Director, now Co-Director, of the Virginia Coastal Policy Center at William & Mary Law School. William & Mary law students also provided essential support through the IPP process.

The group's primary function was to respond to the needs of the other working groups, advisory committees and the Steering Committee. Through thorough research and legal analysis, it produced the Legal Primer (See Appendix D-3) as a reference for use by the IPP partners. It also shared the extensive knowledge and expertise of its membership to guide the Steering Committee in fulfilling its Charter obligations and in producing a strategic plan for its early work. Most significantly, the group's evaluation of the various structural options of the IPP successor entity (See Section 3.3 and Appendix D-4) and production of the final Resolution of the Steering Committee (See Appendix C-1) provided the necessary closure for the IPP.

2.1.2. Actions & Accomplishments

The planned deliverables of the Legal Working Group are as follows and can be found in the Appendices:

1. Legal Primer
2. Memo to Steering Committee Re: IPP Outcomes- Final Structure
3. Chart of Potential IPP Steering Committee Successor Entity Structure Options and Features
4. Resolution of the Steering Committee and Federal Government Liaisons of the Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Project

2.1.3. Lessons Learned

The main purpose of the Legal Working Group was to use the knowledge and expertise of its members to respond to the needs of the Steering Committee and the other working groups. In doing such, the group found a repeated need to seek clear goals and decisive leadership on the part of the Steering Committee to effectively perform its duties. In addition, the group learned that more inclusive and formalized clarification of charges, roles and strategic planning at the initiation of the IPP would have enabled the group to produce helpful, accurate and useful materials in a more timely and efficient manner.

2.1.4. Recommendations

Due to its unique role in the IPP process, the LWG did not provide recommendations in the same manner as the other groups. Throughout the IPP the LWG provided nonbiased information to the Steering Committee in the form of a memo analyzing potential organizational structures and a chart of potential entity structures and features. The LWG provided resources deliverables and information throughout the process, and provided the resolution at the request of the Steering Committee based on its consensus decisions.

2.2. Infrastructure Working Group

2.2.1. History, Objectives & Strategy

The IWG was chaired by Ann C. Phillips, RADM, USN (Retired). The IWG worked to follow direction from the Charter to determine its initial goals and objectives. The IWG first developed a Mission Statement, shown below, and then, developed Objectives/Deliverables for Phase 1 and 2 of the Pilot project, which are included in the IWG Final Report.

Infrastructure Working Group MISSION STATEMENT

"The Infrastructure Working Group, in supporting the Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Planning Pilot Project Steering Committee, will review critical infrastructures in the Hampton Roads region, determine which are most suited to and will be most positively affected by adaptation planning, and make recommendations to the Steering Committee for intergovernmental coordination of that planning. The IWG will further coordinate with the Private Infrastructure Advisory Committee, to formulate recommendations to coordinate with privately owned infrastructure planning."

As a part of the formation of the Charter, a preliminary list of potential committee and working group members was developed and as working group and committee chairs came onboard, they were provided the tentative list of group membership and contact information. No organization on the initial list declined to participate, but often there were several different participants or names offered until the final representative sorted itself out with time, or the appropriate job title or focus could be identified.

The initial participation list for the IWG did not include any representatives from cities or municipalities, which was evaluated as a clear shortfall by the group. Initially the objective was that every city with any sea level rise impact would have representation, but this was not feasible, so an effort was made to ensure representation from the cities with the most near-term impact, and also that diversity of locale was represented within the IWG, in that cities from both the "Peninsula" and from the "Southside" of Hampton Roads were included.

Norfolk International Airport declined to participate throughout the project. They were initially contacted by the PIC Chair during Phase I, and then contacted again, by the PIC, IWG and Legal Working Group during Phase II once the study area had been defined, which included their property, and they again declined participation or even to accept a brief on the project. While this did not unduly impact the Pilot outcome it did present the unique circumstance of a public entity, under supervision of several federal, state and local agencies, most of whom were study participants (FAA, DOT, DHS, VDOT, City of Norfolk) vulnerable to sea level rise and storm surge impact over time, declining to participate in a regionally sponsored project to understand and better define collaborative efforts to mitigate, adapt, plan, and prepare for sea level rise impact.

The following is a summary of critical infrastructure sectors and their members included on the IWG:

- Government Facilities: Naval Facilities Engineering Command, Joint Base Langley-Eustis, Navy Region Mid Atlantic, Joint Expeditionary Base Little Creek/Fort Story, U.S. Army Corps of Engineers, City of Norfolk, City of Virginia Beach, City of Hampton, City of Newport News
- Sector Specific Agencies: DHS, DOT, DOE, HRPDC, HRTPO, HRSD, VDOT
- Transportation Systems: Port of Virginia on Steering Committee, VDOT, HRTPO on IWG
- Water and Wastewater Systems: HRSD, Cities of Norfolk, Virginia Beach, Hampton, Newport News

The first phase of the pilot project for the IWG focused on gathering and understanding the body of work in the form of studies and other documentation that addressed sea level rise in the Hampton Roads region, or was related to sea level rise in the region, or was related to sea level rise in other regions in a manner that may be useful to the IWG in determining and discovering deliverables as aligned with the goals and objectives of the pilot project. As studies were determined to be of particular interest, the IWG arranged opportunities to learn more about their specific objectives through on-site briefs, or through phone briefs or other contact with the authors of the work in question. The IWG was also looking for methodologies used in other projects that might be of use in making decisions for this project, and so also investigated areas of interest in that regard as such opportunities presented themselves. Once study and

methodology reviews were completed, the IWG turned its attention to understanding how to best select critical infrastructure, or critical infrastructures that would be suitable for a Phase II case study.

During Phase II of the Pilot, the IWG selected sea level rise scenarios for study that were suitable for consideration for the potential study areas once selected, and that represented feasible challenges to sea level rise, and resiliency and adaptation planning for the Hampton Roads region. Using the methodology from the DOT-sponsored Gulf Coast II study, the IWG created its own matrix of selection criteria to select an appropriate study area and solicited input from within the working group for areas that might be suitable and that were vulnerable to sea level rise impact under the scenarios chosen. The IWG then weighted those scenarios and selected the area that received the highest overall value. The area chosen was Little Creek/Pretty Lake which included the cities of Norfolk, Virginia Beach and the Department of Defense Joint Expeditionary Base Little Creek/Fort Story. In coordination with the PIC, the IWG then worked to identify critical infrastructure within the study area selected (using DHS Critical Infrastructure Taxonomy Criteria – see Appendix E-6 IWG reference list) and evaluated dependencies and interdependencies of this infrastructure using a matrix developed by the PIC and adopted by the IWG. Once dependencies and interdependencies were evaluated, the IWG considered challenges and impediments to adaptation planning and made recommendations to facilitate intergovernmental coordination of that planning.

2.2.2. Actions & Accomplishments

The IWG was tasked to conduct a thorough review of existing studies related to sea level rise impact in the Hampton Roads region, and to consider other relevant studies that while not specific to Hampton Roads, might contribute to gaining better insight and understanding of the challenges related to whole of government and community sea level rise adaptation planning. They were further tasked, initially, to identify and prioritize sea level rise-vulnerable critical infrastructures in the Hampton Roads region, determine those critical infrastructures with the greatest impact to the most municipalities, and federal, state, and local agencies, and to then make recommendations to the Steering Committee as to which of those infrastructures might be best suited to adaptation planning (for Phase II) at a regional level to ensure future resiliency. By the end of Phase 1 of the Project, the IWG determined that identification and prioritization of all critical infrastructures vulnerable to sea level rise within the Hampton Roads region, while essential for future regional planning, was beyond the scope of the working group's ability in the time and circumstances of the Pilot. Instead, the group focused on selection of infrastructure, or infrastructures that best defined the objectives of the Charter, to identify impediments to and determine solutions and recommendations for whole of government and community planning.

2.2.2.1. IWG Case Study Selection Process

Early in the study review process, the IWG, with the help of IWG representatives from the Department of Transportation, identified the "Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: The Gulf Coast Study, Phase 2" (referred to as the Gulf Coast II Study) as relevant to both of these tasks. Of particular interest was the methodology matrix, referred to as a Criticality Assessment tool used by U.S Department of Transportation,

Mobile Metropolitan Planning Organization and the South Alabama Regional Planning Commission (SARPC) and supporting engineering firms to determine which transportation infrastructures were most critical and most vulnerable to, in this case, storm surge along the Mobile, Alabama, Gulf Coast.

The IWG initially attempted to use the GC II matrices exactly as designed but modified for the Hampton Roads region in the selection of the case study area for Phase II of the Pilot project, but, decided that a full modification of the matrices, while essential for future regional planning and infrastructure criticality prioritization, was far too complex for the scope of the pilot project. Instead, the IWG designed a similar, but much simplified, version of the GC II matrix for use in determining selection of an appropriate critical infrastructure case study area. The IWG matrix (See Figure 2-1) used some of the criteria selected by the GC II study, and then added in its own recommendations, most specifically to include an area that stressed the whole of government and community planning challenges by including more than one city or municipality and at least one federal or state agency in the study area.

After assessing the criticality and vulnerability of a number of locations in the Hampton Roads region, using the criteria outlined in the matrix, three areas that scored highly in the evaluation were voted on by the IWG members for a final case study location selection. The Little Creek/Pretty Lake area was selected as most suitable for the Pilot's objectives (See map in Figure 2-2).

2.2.2.2. IWG SLR Scenarios Selection Process

Once the IWG selected the critical infrastructure area of Little Creek/Pretty Lake, it next turned to the selection of sea level rise scenario curves to consider the impact of sea level rise and storm surge under varying conditions on the study area. One of the challenges to making such a determination is which curves to use, as NOAA and U.S. Army Corps of Engineers, both using National Climate Assessment (NCA) Data (from year 2014), have generated scenario curves with very different projected sea level change predictions. Further, the Virginia Institute of Marine Science (VIMS), also using the latest NCA data, but modifying it for Hampton Roads' specific sea level rise and subsidence measurements, has also developed its own set of scenario curves - specific to this region, which closely trend with the NOAA curves (See NOAA curves 2014 and VIMS 2015 curves in Figure 2-3). In addition, cities and municipalities within the Hampton Roads region have worked with engineering firms, and have developed scenario curve interpretations that, while using the same data as the federal and VIMS curves, interpret the potential timelines to achieve the projected scenario elevations in different ways, in large part due to planning considerations for their individual cities. While aware of these different interpretations by cities and municipalities, the IWG chose to use the VIMS NCA-based projections, modified for the Hampton Roads region, as in keeping with the best available science, and initially selected a series of three specific timeframes (near, medium, far) and then selected sea level rise scenario curves within those timeframes to use to evaluate the impact on critical infrastructure within the Little Creek/Pretty Lake study area. In addition to the scenario projections for sea level rise, the IWG also added the consideration of the further impact of a 100-year flood on the area, or the additional depth of water projected by a flood with a 1% chance of occurring, being equaled or exceeded in any given year for these scenarios.

Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Project

Assessing Criticality and Vulnerability - Hampton Roads, Virginia												
Infrastructure Planning Working Group, Hampton Roads Intergovernmental Planning Pilot Project												
Final Version 13 July 2015												
Factor Weights	Screen	Screen	Screen	2	1	1	2	2	3	1	2	
	Feasibility	Data Availability	More than 1 Agency (Ownership, Risk Regulation)	More than 1 Municipality (Location)	All but 1 Private Utility	Lack of Redundancy	Known Problem Area	Evacuation Route	National Security Impact	Vets (1/13/15) End of Meeting	Regional Economic Impact	Score
Little Creek and upstream lakes	1	1	1	1	1	0	1	0	0	7	0	12
HOV3 & Approaches	0	1	1	1	1	0	0	1	1	1	1	6
Hampton Blvd. (NIT, NOB, ODU) Lafayette River (Approaches)	1	1	1	0	1	0	1	0	1	4	1	12
Sentara/Fort Norfolk/Brambleton/Mid-Town Tunnel Area	1	1	1	0	1	0	1	1	0	1	1	8
Atlantic Ave and/or I-64 in VBI	1	1	0	0	1	1	1	0	0	1	1	0
Port Access to NIT (S, VAC & RT out of Hampton)	1	1	0	0	1	0	1	0	1	1	1	0
Elizabeth River Shipyard (only NIOS)	1	0	1	1	1	0	1	0	1	1	1	0
Wetlands as it relates to fishing industry	0	1	1	1	1	1	1	0	0	1	1	0
Surry Nuclear Power Plant	0	0	1	0	1	1	0	0	1	1	1	0
Newport News Reservoir	1	1	0	1	1	1	1	0	0	1	1	0
Newport News Shipbuilding (HN)	1	0	1	0	1	1	1	0	1	1	1	0
Langley	1	0	1	0	1	1	1	0	1	1	1	0
NOB	1	0	1	0	1	1	1	0	1	1	1	0
Airport (ORS)	1	0	1	0	1	0	1	0	0	1	1	0
Norfolk & Portsmouth Beltline	1	0	1	1	1	0	0	0	0	1	1	0
										12		

Figure 2-1 Infrastructure Working Group Evaluation Matrix

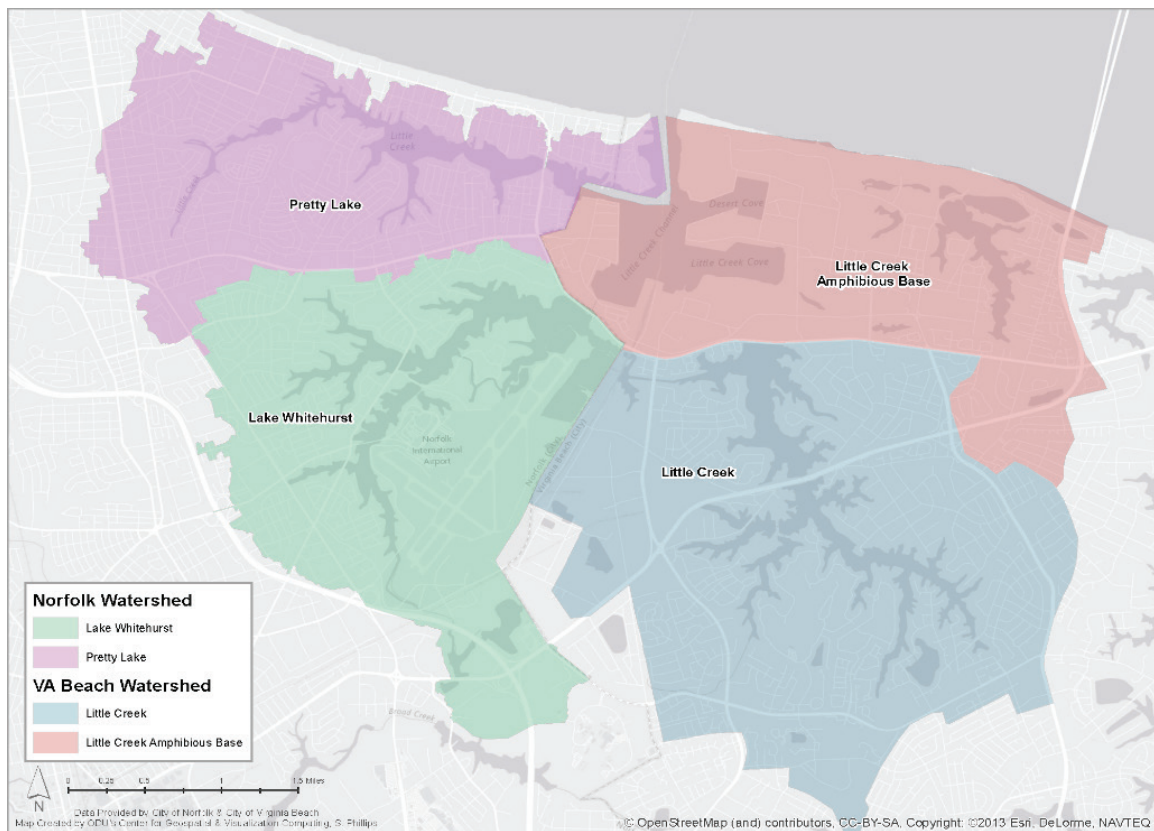


Figure 2-2 Little Creek/Pretty Lake Case Study Area

After evaluation by planning departments in several of the cities participating in the Pilot project, there was concern that the scenarios selected, and the timeframes chosen, portrayed sea level rise elevations that exceeded those under current use by those cities, and in particular exceeded levels they used to address sea level rise planning with their constituents. The cities requested that the IWG consider modification of the scenarios selected to more closely align with those in current use by the cities, and specifically requested any timeframes related to those scenarios be removed. Faced with the potential of study participants withdrawing from the project over this disagreement in projection timeframes and scenario levels, the IWG agreed to modify the scenarios used to evaluate the Little Creek/Pretty Lake study area to include ranges acceptable

to all participating cities, and to remove discussion of timeframes for specific scenario events. The final language chosen and scenario curves used are provided below:

“The Infrastructure Working Group and Private Infrastructure Advisory Committee will evaluate the impacts of relative sea level rise scenarios of 1.5 feet and 3 feet on selected infrastructure in Phase II of the pilot. In addition, they will consider the impact of a ‘100-year flood’ or the flood having a 1% chance of being equaled or exceeded in any given year on these two scenarios.”

Virginia Beach SLR/RF Analysis
8638610, Sewells Point, VA
NOAA's Published Rate: 0.01457 feet/yr
All values are expressed in feet relative to LMSL

Year	USACE Low NOAA Low	USACE Int NOAA Int Low	NOAA Int High	USACE High	NOAA High
1992	0.00	0.00	0.00	0.00	0.00
1995	0.04	0.04	0.05	0.05	0.05
2000	0.12	0.12	0.13	0.14	0.15
2005	0.19	0.20	0.24	0.25	0.28
2010	0.26	0.29	0.35	0.38	0.43
2015	0.34	0.38	0.49	0.53	0.61
2020	0.41	0.48	0.63	0.70	0.81
2025	0.48	0.58	0.79	0.88	1.04
2030	0.55	0.68	0.97	1.09	1.29
2035	0.63	0.79	1.15	1.31	1.57
2040	0.70	0.90	1.36	1.55	1.88
2045	0.77	1.02	1.57	1.81	2.21
2050	0.84	1.14	1.81	2.09	2.56
2055	0.92	1.27	2.05	2.39	2.95
2060	0.99	1.40	2.31	2.70	3.35
2065	1.06	1.54	2.59	3.04	3.79
2070	1.14	1.68	2.87	3.39	4.24
2075	1.21	1.82	3.18	3.76	4.73
2080	1.28	1.97	3.49	4.15	5.24
2085	1.35	2.12	3.83	4.56	5.77
2090	1.43	2.28	4.17	4.99	6.33
2095	1.50	2.44	4.53	5.43	6.92
2100	1.57	2.61	4.91	5.90	7.53

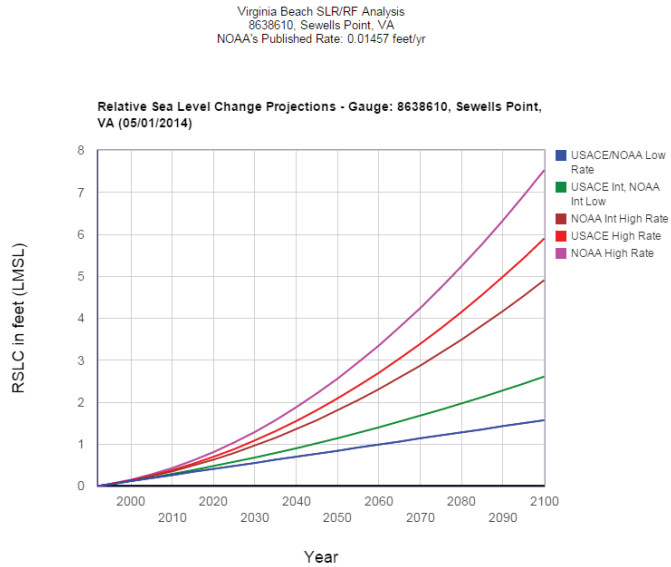


Figure 2-3 USACE and NOAA Relative Sea Level Rise Projections at Sewell's Point, 1 May 2014.

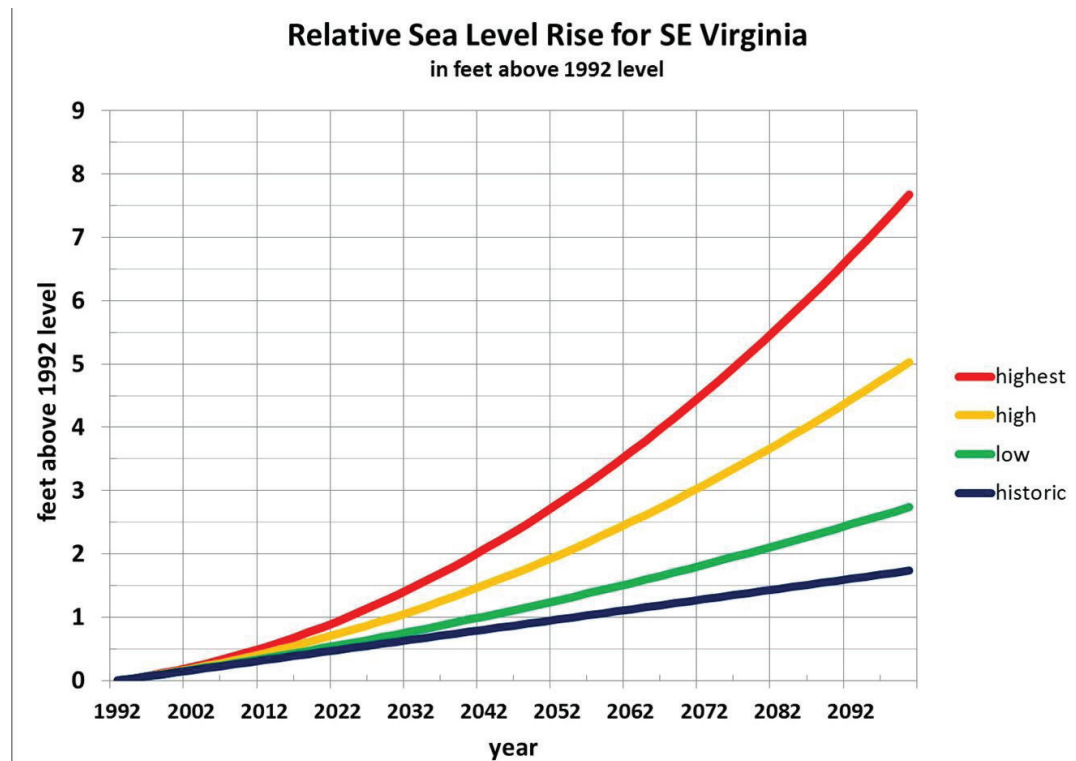


Figure 2-4 VIMS Relative Sea Level Rise Projections for Southeast Virginia

2.2.3. Case Studies

2.2.3.1. Pretty Lake - City of Norfolk Work – Understanding Criticality and Infrastructure Dependencies/Interdependencies

The Pretty Lake Study was completed by the City of Norfolk with the assistance of local engineering firms in 2012, and identified adaptation and engineering solution strategies to a 10% level of engineering effort for adapting the Pretty Lake area to reduce storm surge and flooding impact. Use of this region and study was suggested by a City of Norfolk Senior Stormwater Engineer, who was not a part of the IWG at the time, but was later asked to and did join the working group. As the IWG evaluated the study area, it decided to expand it to include the Navy base at Little Creek and the surrounding watersheds, including Virginia Beach watersheds 1 and 31 and Norfolk watersheds of Pretty Lake and Lake Whitehurst. This expanded area, Little Creek/Pretty Lake, became the case study area used in Phase II of the Pilot.

2.2.3.2. Gulf Coast II - Prioritization Methodologies for Criticality Assessment

The IWG spent two meeting sessions reviewing and taking briefs about the Gulf Coast II study completed by DOT in 2011 (ref GC 2 Study, Task 1), and Gulf Coast Study, Phase 2, by representatives from USDOT, Parsons Brinckerhoff, and ICF International. Of particular interest was the methodology used by U.S Department of Transportation, Mobile Metropolitan Planning Organization and the South Alabama Regional Planning Commission (SARPC) and supporting engineering firms to determine which transportation infrastructures were most critical and most vulnerable to, in this case, storm surge along the Mobile, Alabama, Gulf Coast. DOT and study engineering firms were given a list by the Mobile Metropolitan Planning Organization planning district of over 2,000 transportation infrastructures deemed critical, as developed by local, regional, state and federal inputs evaluating against socioeconomic, operational and health and safety criteria. They then worked through a detailed process of determining specific categorization criteria by which they developed a Criticality Assessment tool -- a matrix and methodology to prioritize which were the most vulnerable critical transportation infrastructures, and then, using DOT's 11-step Engineering Assessment Process, recommended adaptation modifications for those infrastructures.

2.2.3.3. NACCS – Validation of Pretty Lake Engineering Work, and Understanding Adaptation Strategies

The USACE North Atlantic Coast Comprehensive Study, a post-Hurricane Sandy study, provided a comprehensive review of the vulnerability of coastline along the Atlantic Coast to storm surge, and impending sea level rise. This study not only reviewed vulnerabilities, but also made suggestions for adaptation strategies in a broad sense for the full scope of coastline considered within the study confines. In addition, it selected several areas for specific review, one of which was Norfolk, Virginia, and in Appendix D of the NACCS (see IWG References, Appendix E-6), validated work done by the City of Norfolk for a number of critical infrastructure areas within the city, including the Pretty Lake area selected by the IWG for Phase II of the Pilot Project.

2.2.3.4. Little Creek/Pretty Lake Case Study

The IWG selection of the Little Creek/Pretty Lake case study area and the selection of the

scenarios used for evaluation have been described in Sections 2.2.2.1 and 2.2.2.2 of this report. The evaluation of infrastructure dependencies and interdependencies in the case study area can be found in the Private Infrastructure Advisory Committee section of this final report. In addition, a Little Creek/Pretty Lake Case Study Technical Report is included in Appendix X and includes a detailed overview of the Little Creek/Pretty Lake Case Study selection process and scenario selection process, a detailed description of the dependency/interdependency methodology and matrices used, as well as the outcomes and impacts to the study area.

2.2.4. Lessons Learned

The IWG participants repeatedly discussed the importance of community planning and managing the perception of the community. Planning should include high-level perspective, and be reasonable, manageable and executable. Perception of planning in logical steps does matter to get long-range planning started and accepted by an informed community. It is important to recognize that there are many solutions, whether engineering-based or science-based. Engineering-based solutions are not the answer to every SLR problem, therefore they should not be the only type of solution considered. Other key lessons include:

Adaptive redevelopment:

The cities and municipalities included in the Pretty Lake Study area and in the IWG felt that adaptive redevelopment was a key factor to long-range planning to prepare for sea level rise and ongoing recurrent flooding. Portions of the public infrastructure will undergo renewal as the infrastructure ages. It is essential that policies and standards are implemented so that during reconstruction and renewal, the new infrastructure is resilient into the future. This may mean that some infrastructure is reinforced, constructed at higher elevation, relocated or reconfigured.

Planning processes and prioritization:

As highlighted studies reviewed by the IWG, there is a difference between vulnerabilities and criticalities, and any future planning prioritization must consider both aspects. Some things that are vulnerable and important are not critical. It may be easier to measure or quantify vulnerability through a scientific or engineering assessment; criticality, on the other hand, can be more subject to individual perceptions and values, and involves some subjective judgments. Such values, whether they are on behalf of a government, community group or individual, are difficult to quantify, but may be nonetheless essential. These include military preparedness and emergency response capabilities.

Dependencies/Interdependencies:

As they completed the matrices, participants gained considerable insight that, even with their years of professional experience, was new to them. Entire systems must be understood to be able to understand how specific segments are impacted. It is difficult for every city representative to have that level of knowledge in a large city; collaboration among and between managing departments and regions is essential.

Collaboration:

The IWG emphasized the criticality of regional collaboration among all of the Hampton Roads localities and entities, as SLR does not recognize government boundaries. For future sea level

rise planning processes to work, representatives from each affected government entity must be at the table, working collectively to achieve standardization in planning actions, to review, de-conflict and prioritize strategies, standards, and future development policies and procedures.

2.2.5. Recommendations

1. This region should undertake development and formation of a functional process and organization to facilitate regional collaboration, including the local governments, regional, state, tribal and federal agencies, and other entities, that face the most imminent impact from and have the greatest interest in sea level rise. This organization might ultimately be evolved to be considered a "commission, board or council" under Virginia law. It should have authority to foster collaboration among federal, tribal, state and local agencies, with support from academia, and should serve as a collaborative agency to oversee regional matters of importance in facilitating regional sea level rise planning and actions.
2. Federal civil agencies and military branches and localities in the Hampton Roads region must have a way to work together directly, particularly as to determination and processes for approval of authorities and appropriations for funding. This process should begin as an MOU or set of MOUs between federal agencies and local governments or a regional entity representing them. When authority for federal collaboration with local governments is unclear or too restrictive to support effective planning, federal agency or branch headquarters should issue guidance providing their respective field offices and personnel with the authority needed to collaborate effectively with local governments. If a federal agency or branch determines that its ability to collaborate is constrained by federal statute, legislation should be sought to provide that agency authority to collaborate with local governments. Certain existing intergovernmental programs, such as the National Ocean Council and collaboration in the areas of homeland security and emergency management, provide models for legislation authorizing intergovernmental collaboration.
3. The region should establish and adopt a definitive set of regional sea level rise planning scenarios and standards, including a minimum base floor elevation and a standard vertical datum set. The affected local governments and regional, state, tribal, and federal agencies will then be able to work from the same set of scenarios in regional and local planning efforts to address sea level rise and recurrent flooding impacts, adaptation and mitigation.
 - The necessity for planning scenario development and use in decision making for planning is as stated in the April 2016 SERDP report : "Regional Sea Level Scenarios For Coastal Risk Management: Managing The Uncertainty Of Future Sea Level Change And Extreme Water Levels For Department Of Defense Coastal Sites Worldwide." SERDP, April 2016. "This report and its accompanying scenario database provide regionalized sea level and EWL scenarios for three future time horizons (2035, 2065, and 2100) for 1,774 DoD sites worldwide. The decision-making paradigm must shift from a predict-then-act approach to a scenario-based approach. The primary purpose of this report and its associated scenario database is to enhance and increase the efficacy of screening-level vulnerability and impact assessment for DOD coastal sites worldwide containing permanent or enduring assets." (Page ES-1 and ES-2.) With the significant federal presence in Hampton Roads, federal processes and

standards should be accounted for and considered when developing regional procedures and standards so that there is not inadvertent conflict resulting in negative impacts on regional planning efforts over time.

- Federal government leadership and input could make achieving federal standards clearer and simpler for regional efforts.
 - A definitive set of regional sea level rise scenarios is essential for addressing planning issues that overlap jurisdictional boundaries, particularly as to land use planning and critical infrastructure design, planning, project prioritization, and construction.
4. Regional identification, evaluation, and prioritization of critical infrastructure vulnerability to sea level rise impact within the next 30, 50, and 75 years should be undertaken. This work should include development of models and methods to understand and incorporate economic impact of adaptation, replacement, or relocation of such infrastructure, along with other relevant social and cultural factors.
 5. The IWG noted that the National Climate Assessment (NCA) was updated in 2014 and that it is updated every four years, with updates potentially forthcoming every two years. The IWG recommends that a Science Advisory Committee be established with responsibility for (i) reviewing the NCA and VIMS projections, and the projections used by federal agencies for their own planning (in particular those of DOD and DOT, as they have a considerable stake in the region's sea level rise challenges), and (ii) recommending to the regional planning organization what SLR curves should be used for regional planning. This IPP final report should acknowledge that there will be SLR scenario updates and that these updates should be incorporated into regional planning efforts – in addition to a collaborative decision as to which curves will be used regionally for planning purposes, and that planning scenarios will be updated on a timeline sufficient to address changes to these curves based upon best available science.

2.3. Citizen Engagement Working Group

2.3.1. History, Objectives & Strategy

The Citizen Engagement Working Group (CEWG) was formed in late 2014 to complement the IPP's Whole of Government approach with the perspective of the Whole of Community; that is, anyone in the Hampton Roads region who was not, or did not represent a municipal, state, regional or federal agency or branch of the Department of Defense. Over the course of the project the definition of "community" evolved to include all stakeholders, governmental and otherwise.

The working group chairs sought to complement the IPP by including in the working group a wide variety of non-governmental stakeholders from throughout the Hampton Roads region, including individuals and representatives of community, business, civic and social organizations and non-governmental institutional stakeholders. Almost all participants were volunteers.

The CEWG met on its own and in conjunction with other groups and events between December 2014 and June 2016. The group was co-chaired by Chris Bonney, a marketing researcher and

former chair of the Hampton Roads Center for Civic Engagement, and Michelle Covi, PhD, Assistant Professor of Practice with Old Dominion University and part of the Virginia Sea Grant extension program.

2.3.2. Actions & Accomplishments

The CEWG adopted the following objectives:

1. Create a partnership between the Whole of Community and the Whole of Government.
2. Develop engagement and communications strategies that enhance the capacity of Hampton Roads communities to:
 - a. Plan for flooding emergencies.
 - b. Prepare for sea level rise contingencies.
 - c. Strengthen social capital and resilience.
3. Create a flexible and scalable template that can be customized for different communities.

Because the working group lacked both the human and funding resources necessary to commission its own original research, the CEWG adopted an expert opinion approach that sought initially to focus on:

- Integration of the perspective of the non-governmental community into the IPP
- Providing opportunities for the non-governmental community to contribute to the IPP
- Development of recommendations for future citizen engagement working groups.

The CEWG engaged in a number of investigations through briefings from invited experts in community, governmental, and environment engagement. In addition, group members conducted several case studies through partnerships with outside groups, including participation in the Hampton Roads Chapter of the Urban Land Institute's March 2015 Sea Level Rise conference and a foundation-funded research study conducted by several academic members of the CEWG in the neighborhoods adjacent to the Little Creek Naval Amphibious Base.

2.3.3. Lessons Learned and Case Studies

2.3.3.1. Best Practices of Contemporary Civic Engagement

The typical civic engagement process includes:

- Stating the Issue
- Identify the Stakeholders
- Determination of Information Needs
- Information Distribution
- Issue Framing to Create Alternate Solutions
- Deliberation about Solutions
- Quantitative Measurement of Citizen Solution Preference
- Communication of Conclusions

2.3.3.2. Citizen Engagement and Sea Level Rise in Hampton Roads

Carefully considering and implementing best practices of civic engagement reveals a distinction between the best practices of good civic engagement process and the way that the sea level rise issue has been addressed in Hampton Roads, particularly in the way that discussion of the implications, challenges and solutions to sea level rise in Hampton Roads prior to the formation of the CEWG did not include serious or sincere citizen engagement. The following methods of citizen engagement were outlined from this discussion:

- Structured and facilitated small group conversation, e.g., deliberative dialogue, house party, book club, etc.
- Virtual town hall-type online interactive communication with government.
- Residents developing a neighborhood plan, for emergencies and/or long-term adaptation.
- Interested volunteers framing the regional problem and creating options for community-wide discussion.
- Activities, e.g., citizen science-like observing and recording seasonal changes, telling one's personal story to urge official action, rallies and public demonstrations, shoreline protection, recycling and using renewable energy, etc.

2.3.3.3. Resilient Region Reality Check (March 17, 2015)

The Hampton Roads Resilient Region Reality Check event was held on March 17, 2015, at Old Dominion University. The event was built on three key themes: a region-wide, multi-sector, and whole-of-community approach that is oriented toward actions to address SLR and flooding. This event was a collaboration between the Urban Land Institute Hampton Roads (HRULI), Old Dominion University (ODU), and the Community Engagement Working Group of the Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Planning Pilot Project.

Approximately 130 residents and stakeholders across government, nonprofit, business, and civil society sectors within the Hampton Roads region participated in the event. The event focused on encouraging discussion concerning three items:

- How flooding affects citizens?
- What can citizens do about flooding?
- What resources are needed to address flooding?

For each question, participants were also asked to discuss and identify two regional priorities. From these discussions, six key themes arose:

1. The impacts of sea level rise and flooding are multifaceted;
2. Sea level rise and flooding need to be incorporated into planning and decision making;
3. Land use planning plays an important role in building resilience;
4. Regional collaboration and regionally adopted solutions are needed;
5. Financial and non-financial resources are needed;
6. Civic engagement and outreach are important.

In an end-of-the-day prioritization activity, all attendees were asked to rank the top priorities, selecting from a list of discussion items that had surfaced during this event. Across attendees, the following top priorities appeared:

1. Pursue regional collaboration;
2. Revise zoning and land use;
3. Pursue public education/outreach;
4. Reduce carbon emissions;
5. Pursue natural solutions (e.g., coastal engineering, wetlands preservation).

2.3.3.4. Little Creek/Pretty Lake Research Study

The demonstration project used the Action-Oriented Stakeholder Engagement for a Resilient Tomorrow (ASERT) framework, to facilitate discussion of, knowledge about, and action to adapt to flooding and SLR. The foundation of this engagement framework is the presentation of relevant and accessible information, dialogue and two-way communication, and deliberative and participative mechanisms. The goal of the project is to demonstrate the efficacy of the engagement framework as a tool for facilitating community resilience building through engagement. The ASERT framework incorporates several key principles:

- An inclusive process that engages stakeholders across multiple social dimensions and across the whole-of-community spectrum
- A strong emphasis on surfacing local context and knowledge
- Integrated engagement where social and cultural factors are integral to the process of engagement
- Explicit consideration of change mechanisms, such as structured conversations, deliberative dialogue, and participatory mechanisms.

Conclusions from this initiative included:

1. Residents of the neighborhoods surrounding Little Creek Base identified several cultural and social elements in their community as assets, such as parks, churches, community centers, restaurants, and shops. Residents also identified the base itself as an important asset to the community that should be protected, as well as the Norfolk Airport and several other roads and bridges. The inability to access these important places and flooded streets in general is a major challenge.
2. Property losses such as vehicular loss and damage to residential properties were identified as being widespread throughout the community.
3. Preferred adaptation solutions among focus group participants included natural solutions such as beaches and dunes, flood warning and preparedness, and floodplain policy management.
4. In post-group evaluations, participants responded that they found both the participatory mapping and focus group discussions valuable. Residents were extremely grateful to have the opportunity to have their needs and concerns heard, but wanted more specific action items that they could implement for resilience.

2.3.3.5. Other Case Studies

The CEWG heard presentations from representatives of several organizations and municipalities that both regularly engage various stakeholders in Hampton Roads and are committed to resilience. Those interested in more details with regard to citizen engagement strategies should consult the full CEWG report, which contains detailed case studies. The following case studies were considered by the CEWG:

- *The Hampton Roads Transportation Planning Organization (HRTPO)*

The HRTPO is Southeast Virginia's regional transportation planning agency. As such, HRTPO communicates with a wide variety of regional stakeholders, ranging from elected municipal leaders, city and county managers, state and federal agencies and, increasingly, "grassroots" citizens. Here, the CEWG considered HRTPO's engagement strategy with Hampton Roads' citizens who are most vulnerable to social and economic disruption by natural conditions and local planning decisions.

- *City of Hampton Waterways Project*

The City of Hampton, Virginia, has been recognized as one of the nation's leading municipalities in terms of engagement with its citizens. The CEWG considered, for example, the strategies used during a year-long waterways planning project. The goal of Hampton's civic engagement initiatives has been to make local government process and decision making more transparent and to engage more citizens in this process.

- *Wetlands Watch: Chesterfield Heights Project*

The Chesterfield Heights Project (funded by Virginia Sea Grant) is a collaboration among Wetlands Watch, an environmental advocacy group, the architecture faculty at Hampton University, and Old Dominion University engineering faculty, to address the needs of a historic, low/middle income neighborhood in Norfolk. Bounded by the Elizabeth River and Interstate 264, Chesterfield Heights is a mostly African-American neighborhood of roughly 500 single-family homes, some of which have been divided into smaller dwelling units. Most of the neighborhood is no more than a few feet above mean high water level. The project sought to engage the neighborhood in a discussion of how it could adapt to increasing frequent tidal flooding and overall rising waters. Residents were introduced to landscape, hardscape and nature-based design solutions that could make residences in the neighborhood more resilient.

- *Lynnhaven River NOW*

Lynnhaven River NOW is a watershed protection group in Virginia Beach. One of their main goals is to educate and engage the community in restoring and protecting the Lynnhaven River. They have a number of restoration projects and try to engage a variety of groups including property owners, children, faith communities and private businesses. The programs have been very successful in improving water quality and educating the community.

- *Mothers Out Front*

Virginia Organizing Hampton Roads Environmental Justice team has been leading a

collaboration of organizations including the League of Women Voters and others to bring attention to climate change and sea level rise issues in the Hampton Roads area. They are using a program developed by Mothers Out Front, a Boston-based group that uses house parties among social networks to spread information and encourage engagement in climate issues.

- *Southeast Care Coalition Project*

Through a long-term effort of capacity building, empowerment and relationship building between the Southeast Community and the City of Newport News, this project seeks to create solutions that become cornerstones in the foundation for greater community resiliency. The main objective is to create the relationships and dialogue between city and community that will enable a positive collaboration for an evacuation plan before it is needed in a future crisis.

2.3.4. Recommendations

The CEWG study led the committee to believe that the optimum strategy for addressing sea level rise and identifying and implementing adaptation solutions does not lie in identifying separate Whole of Government and Whole of Community strategies, but rather in developing a single “whole of region” strategy that unites science, academia, engineering, planning, governance, and citizen/stakeholder participation in a collaborative environment.

The following steps are recommended:

1. Recognize that sea level rise is a serious issue that touches the entire region and that engagement on a piecemeal basis or on the basis of governmental purview, municipal boundaries, local political will or current levels of stakeholder interest is not a viable long-term strategy.

Rising waters do not observe municipal boundaries. Even those living in Hampton Roads municipalities not impacted directly by rising waters may be impacted by the economic ripple effect of rising waters. Therefore, addressing sea level rise and recurrent flooding on the basis of political boundaries or current perceived vulnerability is not an efficient or effective way to address this regional environmental challenge.

2. Identify a respected regional entity to “own” and be responsible for being the thought leader on sea level rise in Hampton Roads and for convening Whole of Community deliberations regarding sea level rise.

At the conclusion of the IPP no single entity will “own” thought leadership or responsibility for convening the region on issues related to sea level rise. Therefore, an entity having these characteristics must be identified:

- Geographic scope as large as the issue and not bounded by municipal or other political boundaries within the region.
- A record of dealing effectively with issues of a regional nature.
- Welcoming to both “grassroots” and “grasstops.”
- Credible organizer and convener of science, government, academia, citizen and other stakeholders.

- Trustworthiness.
 - Perceived impartiality.
 - Knowledge of the best practices of civic engagement.
 - Access to experienced civic engagement facilitators.
 - Experience communicating to the entire region.
3. Use the best practices of civic science—including good facilitation process and good methods for information dissemination and feedback—to engage all stakeholders in sea level rise deliberation and decision making from the very start.

Creating successful civic engagement partnerships depends on the presence of conditions that must be specifically developed, rather than left to chance:

- There must be clearly defined goals and expectations.
 - Goals must reflect not only the needs of the governmental factors or entities, but also the priorities of citizens.
 - The process must be open to all who have exposure to the impacts of sea level rise.
 - Participants in the process must have respect for and trust in each other.
 - Collaborations between citizens and government require respect for all parties involved.
 - There must be confidence in the collaborative process and that its outcome will be given respect.
4. Create benchmark and ongoing internal and external tracking metrics for assessing the performance and effectiveness of the engagement program and its impact on the ability of the Hampton Roads region to rise to the challenge of sea level rise.

To assure stakeholders, funders and other participants that the engagement of the entire region in addressing the challenge of rising waters is proceeding in an efficient and responsible manner, it will be necessary to establish internal and external benchmark and tracking metrics that monitor factors such as:

- Levels of participation and inclusiveness.
- Perceived levels of respect and trustworthiness in the process.
- Perceived levels of success in meeting the challenge of sea level rise.
- Awareness and understanding of the issues and implications of sea level rise among the general population.
- Awareness and knowledge of information and resources available for mitigating and adapting as waters rise.

2.4. Public Health Working Group

2.4.1. History, Objectives & Strategy

As noted in the Phase 1 Report, the Public Health Working Group (PHWG) was formed in April 2015, at a meeting of the Steering Committee. The working group is chaired by Steven M. Becker, PhD, Professor of Community and Environmental Health, College of Health Sciences, Old Dominion University. The aim of the Public Health Working Group is to make public health an integral part of sea level rise planning, adaptation and resilience efforts in the region.

Specific areas of focus include analyzing potential public health impacts of sea level rise in Hampton Roads; identifying ways to incorporate public health issues into planning, adaptation and resilience efforts; engaging the public health community in sea level rise projects; identifying special areas of expertise that public health can contribute (e.g., public health emergency preparedness, health and environmental risk communication, health-related community outreach, epidemiology, industrial hygiene, and working with vulnerable/special needs populations); identifying new and innovative ways of incorporating sea level rise issues into public health education and training in the region; and developing new and innovative solution-oriented projects to address public health aspects of sea level rise locally and around the nation.

Upon the formation of the committee in April 2015, area health agencies, including health departments, public health higher education programs, and public health research organizations, were contacted and invited to participate in the newly established Public Health Working Group.

2.4.2. Actions & Accomplishments

The PHWG's initial activities have been focused in three broad areas: (1) working to integrate sea level rise preparedness and resilience issues into graduate public health education in the region, (2) creating new linkages and collaborations for information exchange, practice and research on sea level rise and public health, and (3) assessing the public health implications of sea level rise in the region.

2.4.2.1. Integrating Sea Level Rise Preparedness and Resilience Issues into Graduate Public Health Education

Members of the Public Health Working Group have been working with faculty at area institutions of higher education to better integrate sea level rise issues into graduate public health education.

2.4.2.1.1. Curriculum

The effort began with the foundational course in environmental health that is taken by all first-year students in the Master of Public Health (MPH) program jointly offered by Eastern Virginia Medical School (EVMS) and Old Dominion University (ODU). The three-credit course, entitled Principles of Environmental Health (ENVH 600/MPH 613), now includes a two-part module on climate and sea level rise issues. Topics include health impacts of sea level rise, storm surge and coastal flooding; vulnerable populations; challenges for public health and healthcare system preparedness; and implications for public health planning and training. Additional content on sea level rise and health will be added to other courses in the 2016-2017 academic year. Furthermore, ODU is in the process of adding faculty positions specifically focused on climate and health. These will be based in the School of Community and Environmental Health in the

College of Health Sciences. Thus, in the near future, entire courses should be available on climate, sea level rise and health.

2.4.2.1.2. Practicum

A particularly innovative step to create links between public health professional education and sea level rise was taken in 2016 when a “community practicum” focusing specifically on sea level rise was created. All second-year MPH students are required to complete a 3-credit graduate course entitled Community Practicum (MPH 750). The practicum is intended to provide students with an in-depth supervised experience in an approved organization. Under the guidance of an on-site preceptor and an academic adviser, students work on real-world public health issues using the knowledge and skills gained in academic courses.

The 2015-2016 academic year saw the completion of the first community practicum on sea level rise. MPH student Christina Gumina was based with the IPP, where she worked under the direction of practicum supervisor Emily E. Steinhilber, Esq. (Assistant Director of Coastal Resilience Research) and academic adviser Dr. Steven M. Becker (Chair of the Public Health Working Group). Ms. Gumina’s multi-part project involved carrying out an overall literature review on public health impacts of sea level rise, focusing on a smaller subset of those impacts, and relating the findings to the Hampton Roads area. Ms. Gumina also attended committee and working group meetings, in a similar manner to the legal liaisons, to provide a public health perspective. In addition, the practicum paper offered a series of recommendations for follow-up work on public health and sea level rise. The paper is included as an appendix to this report (see Appendix G-2).



Figure 2-5 Assessing the Public Health Implications of Sea level Rise in the Region

2.4.2.2. Creating New Linkages & Collaborations for Practice and Research on Sea level Rise and Public Health

Another major area of emphasis for the Public Health Working Group involved the creation of new linkages and collaborations for practice and research. A notable example of this effort involved a special program that was held at ODU in March 2016. Co-sponsored by the Public Health Working Group, the program featured a special six-person delegation from the U.S. Environmental Protection Agency (EPA).

The delegation discussed a new interactive mapping tool for better understanding links between the environment and human health. Called EnviroAtlas, the tool enables users to access, view, and analyze local and regional environmental data to better understand how individual and community decisions can affect sustainability and resilience. Users can access, view, and analyze hundreds of local and regional environmental data layers to better understand the potential impacts of various decisions on sustainability and resilience. EnviroAtlas covers the contiguous U.S. at 30-meter and watershed resolutions, and selected urbanized areas at 1-meter and census block group resolutions. EnviroAtlas will include the greater Norfolk area as a featured community in 2017.

Although the initial focus of the tool has been on basic environmental features and health, future additions will include climate change metrics, land use scenarios, runoff and recharge metrics, and flood plain information. As such, EnviroAtlas has enormous potential to be helpful in understanding links between ecosystem services (benefits provided by nature and valued by people), flooding and related sea level rise issues, and human health.

2.4.2.3. Assessing the Public Health Implications of Sea level Rise in the Region

Because some of the most serious impacts of sea level rise are those affecting public health, and because these impacts are likely to be an important focus of concern across a wide variety of sectors involved in a Whole of Government/Whole of Community approach, public health issues need to be an integral part of sea level rise adaptive planning efforts. Toward this end, the Public Health Working Group has been carrying out a case study of potential SLR public health impacts and issues in the Pretty Lake Watershed. This work is being carried out as part of a broader project funded by the Blue Moon Fund. To date, the project team has been working to identify the range of potential public health impacts associated with SLR alone (1.5' and 3.0' sea level rise) and with storm surge situations (1.5' sea level rise + 100-year storm surge and 3.0' sea level rise + 100-year storm surge).

Potential public health impacts are being identified by drawing on the scholarly literature about SLR and public health, consulting documents about the watershed, utilizing infrastructure maps and other map products of the area, and via actual visits to parts of the Pretty Lake Watershed. An example of an SLR alone impact is a significantly increased problem with pools of standing water, which can enable the rapid growth of mosquito populations and result in the spread of infectious diseases. An example of an SLR + Storm Surge public health impact is water from flooding causing the growth of mold, resulting in an increase in allergic reactions and asthma. In addition to such traditional public health concerns, the case study is devoting attention to less-known potential impacts. This includes contamination of the environment with hazardous

materials that are found in a surprising number of facilities and locations, and that may be released under certain circumstances. Once the analysis of public health impacts has been completed for the Pretty Lake Watershed case study, key insights will be expanded to include the Hampton Roads region more generally.

2.4.3. Recommendations

The following conclusions and recommendations are provided by the PHWG:

1. Some of the most serious impacts of sea level rise are those affecting public health.
2. Consequently, there will be a continuing need for public health issues to be an integral part of current and future sea level rise adaptive planning efforts.
3. In the Hampton Roads region, it will be essential to continue and further expand the activities and the membership of the Public Health Working Group.
4. One important area of focus needs to be on understanding potential public health impacts of sea level rise, and the implications of those impacts for planning, training, preparedness, practice, and decision making.
5. Another area of focus should deal with how public health expertise in such areas as health and environmental risk communication, health-related community outreach, working with vulnerable/special needs populations, epidemiology, industrial hygiene, and public health emergency preparedness can best contribute to broader sea level rise adaptation efforts.
6. Research on the public health dimensions of sea level rise will be a continuing area of emphasis. In this regard, new tools such as EnviroAtlas have the potential to improve our understanding of environment-health relationships, and to enhance sea level rise adaptation planning efforts.
7. Preparing the next generation of public health professionals to grapple with sea level rise issues will also be vital. Curricular innovations, new practicum sites, new courses, and related initiatives such as those described above all have a role to play in contributing to this effort.

2.5. Land Use Working Group

In accordance with the Charter, the Land Use Working Group (LUWG) was to recommend which land-use related plans, programs, and policies in Hampton Roads require adaptation planning and to formulate recommendations for intergovernmental coordination. In consultation with the Municipal Planning Advisory Committee, the working group was to address land use planning, floodplain management, local government comprehensive plans, zoning, building codes and other plans, programs, and policies it identifies in the course of its work.

As detailed in the Phase 1 report, under the leadership of Burrell Saunders of the Urban Land Institute Hampton Roads and Saunders + Crouse Architects, the group initially developed an extensive work plan, which would have extended well beyond the duration of the IPP with the support of Urban Land Institute and university partners. This work plan aimed to address the ways in which we live, work, and do business in Hampton Roads and sought to (1) raise awareness, (2) define the approach, (3) explore the value proposition, and (4) advance the state of practice and policy. This work plan is attached in Appendix G.

The Land Use Working Group was dissolved during the course of Phase 2 of the IPP. Although land use planning is a critical component of regional resilience planning, the group never fully coalesced, and formally ceased when the Phase 1 chair, Burrell Saunders, resigned effective December 2015. The Steering Committee discussed this resignation in its next meeting and decided not to replace him. The group noted that land use planning is a key function of localities, and as such should be left to the individual localities; consequently, the steering committee was uncomfortable moving forward with such a committee.

While the Land Use Working Group as a part of the IPP ceased work prematurely, localities should still continue to work together using the best available science to incorporate resilient strategies into their zoning codes, building codes, comprehensive plans and other plans where appropriate. Moreover, collaborative Whole of Government initiatives in other geographical areas may benefit from an active land use committee where this region did not.

2.6. Science Advisory Committee

2.6.1. History, Objectives & Strategy

The initial meeting of the Science Advisory Committee (SAC) was on December 10, 2014, at a Federal Emergency Management Agency National Exercise Division event. Membership in the committee was not restricted and continued to grow over the next year under the leadership of Dr. Larry Atkinson, Slover Professor of Oceanography, ODU, and Dr. Carl Hershner, Director of the Center for Coastal Resources Management, VIMS. The SAC was co-chaired by Larry Atkinson, Old Dominion University, and Carl Hershner, Virginia Institute of Marine Science.

The original scope of work as defined by the Charter was as follows:

The Science Advisory Committee is responsible for providing the Executive Steering Committee with critical information based on relevant scientific research of interest to the IPP. Topics will include information on global mean sea level rise, local relative sea level rise, vertical land motion, dynamical ocean change, ocean fingerprinting, extreme water levels, decision frameworks, risk management, and uncertainty management in addition to any other scientific inquiries made by the Executive Steering Committee. Additional work includes providing updates on the activities of Federal agencies relevant to Hampton Roads, to other stakeholders, and developing a plan for and a mechanism to provide integrated information on science observations and information. The Science Advisory Committee will also develop a 'roadmap' or 'framework' for summarizing sea level rise knowledge, integrating information, and identifying gaps in sea level rise observation.

The SAC quickly evolved to being a coordinating organization between the various stakeholders in the region and federal agencies. It should be noted that the active members of this committee had jobs that specifically included activities directly related to goals of the committee; they were in general not volunteers.

2.6.2. Actions & Accomplishments

Teleconferences were scheduled approximately monthly. A framework for topics of discussion was developed following the first conference call, but requests for additional topics were accepted

as the project developed. Most of the original topics were covered during the scheduled calls. Several collaborative proposals were developed and are ongoing to address technical issues/needs which arose from the discussion.

2.6.3. Lessons Learned

The SAC learned that sea level rise science activities in the region are to a large extent done by either federal science agencies or academics, neither of which are strongly linked to the needs of the regional stakeholders. Strengthening that link so that the science can address stakeholders' needs is the challenge.

Sea level rise scenarios that cities will use in their planning will be determined by each city, which often will contract an engineering company. The projections they use will usually refer to authoritative federal government projects: for example, the National Climate Assessment or the USACE sea level rise calculator. It was not appropriate for this committee to develop projections –rather, to help stakeholders understand them.

Members of the SAC interacted with other committees in various ways. For example, some members interacted with the Citizen Engagement Working Group to discuss the timing of impacts to the school system with school superintendents. It became clear that there is a need for this type of very specific analyses and discussions of sea level rise impacts and that this should be a priority moving forward. Discussions of technical issues with local decision makers can lead to easily realized action which will improve resiliency.

2.6.4. Recommendations

The following recommendations were developed by the Science Advisory Committee:

1. We recommend that the function of the SAC continue regardless of the fate of the IPP.
2. We recommend that the newly funded Commonwealth Center for Recurrent Flooding Resiliency (CCRFR) function as the coordinating organization for the committee. The CCRFR will be responsible for forming the steering group for the Science Committee.
3. We recommend that the main goal of the SAC be to provide a mechanism to assure that the sea level rise science needs and requirements of regional stakeholders are addressed.
4. We recommend that the SAC include the following at a minimum: regional scientists and engineers familiar with RSLR, storm water managers and coastal engineers with the cities and HRPDC, engineers from the companies contracted by the cities and region, relevant Commonwealth agencies including water resources, federal agencies including NOAA/NOS, NOAA/NWS, Interior/USGS, NASA, DOD, Interior/FWS, Interior/NPS, local WFO Wakefield, etc.
5. We recommend that over the coming year the committee facilitate meetings with regional stakeholders to determine their specific requirements.
6. We recommend the following specific tasks -- subject, of course, to future revision. (Note – in many cases, the committee may facilitate an activity rather than provide that activity itself.)
 - a. Monthly or bi-monthly conference calls. These will be initiated by the CCRFR.
 - b. Topical conferences as appropriate. These may be done as part of the ongoing Hampton Roads Adaptation Forums hosted by HRPDC, ODU, Virginia Sea Grant and others.

- c. Topical reports – possible annual or bi-annual “State of the Region – Sea level rise and recurrent flooding.”
- d. Consider expanding beyond sea level rise and flooding to include other climate change variables: air temperature, rainfall, humidity, etc.
- e. Facilitate creation of a web services portal for all relevant sea level rise data in the region.
- f. Facilitate a knowledge database for sea level rise science relevant to the region, possibly using the ODU Digital Commons system supported by the ODU Libraries.
- g. Facilitate reports to federal agencies on needs/requirements. These would be developed by regional stakeholders.
- h. Coordination with Hampton Roads Adaptation Forums and other relevant organizations in the region. For example – professional engineering societies.
- i. Facilitate data telemetry and broad distribution of local real-time water level observations to all of Hampton Roads.

2.7. Private Infrastructure Advisory Committee

2.7.1. History, Objectives & Strategy

The PIC was chaired by Carol Considine, Associate Professor, Engineering Technology, Old Dominion University, and Pete Perritt, President, Building Constructive Solutions, was co-chair. Additional PIC members are listed in Appendix I in the independent PIC report.

The Private Infrastructure Advisory Committee (PIC) had an official public kickoff on December 10, 2014, at the Federal Emergency Management Agency National Exercise Division event, side by side with many other committees and working groups. This event was an opportunity to identify local businesses and citizens that were interested in advancing resiliency in the region. Participants at the event pertinent to the critical private infrastructure sectors, and firms that support this sector -- engineering, consulting, and construction -- were present and expressed support in moving forward as part of the PIC. While it is important to have a broad cross-section of participation and include critical infrastructure support companies, it was necessary to ensure that all private critical infrastructure sectors pertinent to the region were included in either the PIC or the Infrastructure Working Group (IWG) that included public infrastructure entities.

The Private Infrastructure Committee’s membership was developed from the Department of Homeland Security Critical Infrastructure Sectors list (<https://www.dhs.gov/critical-infrastructure-sectors>) and that list and membership are found in the Private Infrastructure Committee Report in Appendix I. The following is a summary of critical infrastructure sectors and their members included on the PIC:

- Commercial Facilities: Hampton Roads Realtors Association and Hampton Roads Association for Commercial Real Estate (Phase 1)
- Communications and Information Technology: Verizon
- Energy: Dominion Virginia Power, Virginia Natural Gas

- Healthcare and Public Health: Sentara Norfolk General Hospital
- Transportation: Virginia Maritime Association

Developing contacts within pertinent organizations can be difficult. The key to success in contacting the correct individual can be a combination of networking and persistence. In many cases, the correct person is a risk manager, facilities manager, or engineer within the organization. These are the people that will be tasked with solving problems related to sea level rise (SLR) and they have a vested interest in participation.

Not every organization contacted was interested in participating in the Pilot Project, for example, those contacted within the banking industry declined to participate. However, the final outcome/deliverables were not impacted by the missing critical infrastructure sectors or companies, though this may not always be the case.

The PIC used the Charter to guide its work. A scope of work was developed from the Charter in the spring of 2015 and work was completed based on that scope. The only change to the scope of work was that adaptive planning was completed for one infrastructure project instead of two infrastructure projects. The original intent was to have one of the adaptive planning projects to come from private infrastructure, specifically, the electrical sector; however, we found that Dominion Virginia Power had already hardened their substation facilities for hurricane preparedness to a level beyond the SLR and storm surge scenarios adopted by the IWG.

2.7.2. Actions & Accomplishments

The PIC was responsible for providing support to the IWG regarding critical private infrastructure for the Pilot Project. Support included identification of: critical private infrastructure, dependencies and interdependencies between private and public infrastructure, best practices of SLR adaptation by industry sector, and identification of restrictions and limitations (administrative, managerial, jurisdictional, or legal) to private/public SLR preparedness infrastructure planning. In Phase II of the Pilot Project, the PIC supported IWG in the adaptation planning for one selected infrastructure project in the Hampton Roads region.

The PIC organized the work plan to meet the list of deliverables noted in the final PIC report and during the two-year project focused on identification and engagement of privately owned critical infrastructure, identification of current practices and barriers to implementation of SLR adaptation measures, sharing of best practices related to SLR adaptation, identification of resources available for companies to plan for SLR adaptation, and outlining recommendations related to privately owned infrastructure for SLR adaptation.

During Phase II of the Pilot Project the PIC decided that it would be helpful in developing recommendations (resiliency strategies) to review the resiliency planning documents that have been completed in other regions of the United States. The New Orleans region and Southeast Florida region have both made significant progress in developing resiliency plans that are being implemented in their regions. It is significant to note that while neither region has legislated action related to these resiliency plans, the strategies and visions laid out in their regional documents are being implemented voluntarily by local governments to strengthen their regions' resiliency. These documents are available, respectively, at <http://resilientnola.org/wp-content/uploads/2015/08/>

Resilient_New_Orleans_Strategy.pdf and <http://www.southeastfloridaclimatecompact.org/compact-documents/>. There are additional coastal resiliency strategies that could be reviewed for guidance such as San Francisco, Boston, New York, and New Jersey.

2.7.3. PIC Methodology

The PIC organized its work to meet the list of deliverables noted in the full PIC report. This was accomplished primarily during scheduled meetings, using presentations and discussions. The following summarizes the significant presentations, meeting discussions and work product of the PIC, with a more detailed accounting in the full PIC Report in Appendix I:

2.7.3.1. Identification and Engagement of Privately Owned Critical Infrastructure

Using the Department of Homeland Security Critical Infrastructure Sectors list, provided in Table 1 under the Membership Development section of this report, firms listed were contacted and asked to participate in the Pilot Project. The committee had representation from the commercial facilities/real estate, communications, energy, healthcare, information technology, and transportation sectors. There was no representation from the financial sector. The private transportation sector was represented by the maritime industry but there was no representation of air or rail transportation. While the energy sector was represented by the electrical and gas industries, there was not representation from the oil transportation, coal, alternative energy, or storage industries.

The Pilot Project was focused on process, not final solutions. The lack of participation from all critical infrastructure sectors did not detrimentally impact the project but the process may have been enhanced by their participation. In addition, not all committee members attended every meeting or were fully engaged in the work of the committee. Recommendations for inclusion of private critical infrastructure in future SLR adaption planning include:

- Quarterly meetings may be more appropriate. Monthly meetings may require too much time from private companies.
- Education on SLR and storm surge impacts and risks, as well as how adaptive actions can be incorporated in operations and maintenance and capital improvement cycles, may increase interest in adaptation.
- Case studies looking at specific watersheds within the Hampton Roads region may make the SLR adaptation planning more pertinent to firms. Case studies allow examination of actual infrastructure in the case study area and demonstrate SLR scenarios, future impacts, and related risks of SLR.
- Municipalities may want to reach out to private critical infrastructure firms in their jurisdiction, encourage their participation, and educate them on the importance of their participation in regional resiliency efforts.

2.7.3.2. Identification of Current Practices for the Electrical Substations, Healthcare and Maritime Industries

There were two strategies employed to identify current practices related to SLR adaptation/resiliency: private infrastructure companies participating in the Pilot Project were given the

opportunity to present their resiliency/emergency planning efforts, and resources related to resiliency/adaptation standards for specific industries were researched and compiled.

Sentara Norfolk General Hospital and Dominion Virginia Power both provided presentations on their current efforts in resiliency/emergency management planning. Sentara Norfolk General Hospital specifically and the entire Sentara healthcare system are proactive in severe weather and emergency preparedness. The hospital system must comply with the standards of the American Society for Health Engineering. Part of these standards include the development of Hazard Vulnerability Analysis, which includes a matrix to determine risk exposure. Sentara is including adaptation/hardening of facilities in all capital improvement projects.

Dominion Virginia Power has been proactive in hurricane preparedness planning per Federal Energy Regulatory Commission (FERC) requirements. They have already elevated and hardened some of their facilities. They are active in CIGRE, the Council on Large Electrical Systems, which is an international nonprofit association that promotes collaboration and knowledge sharing with experts around the world to improve electrical systems.

While neither Sentara nor Dominion Virginia Power are incorporating SLR into current resiliency/emergency management planning, both agreed that it could be incorporated in future planning. Other committee members noted that they also have emergency management planning in place, but they do not include SLR into this planning. Suggestions to help the infrastructure sector include SLR in long-range planning include:

- Provide regional SLR scenarios for private industry to incorporate in long-range planning. This standardization will eliminate confusion across the region and enable companies and industries with facilities throughout the region to proactively adapt to SLR.

Virginia Maritime Association provided background on Virginia's ports including their importance and status nationally, as the second largest on the East Coast in tonnage and third in containers, and their impact on the Hampton Roads region, with over \$60 billion in annual spending and contributing 6.9% of the gross state product. They outlined the components of the marine transportation system and the varied and extensive manufacturing and distribution facilities in Virginia that are reliant on Virginia's port operations. They noted that the maritime industry appears to have a varied response to SLR based on size of company and resource availability. Larger companies recognize the risk and are starting to think in terms of capital reinvestment, but smaller firms do not have the capacity to move in this direction.

Williams Mullen staff provided background on the regional benefits of coastal/shoreline property, related industries, and the importance of the supporting infrastructure. They presented a summary of physical impacts and risk factors related to SLR, the need to consider the physical, operational, environmental, and legal ramifications of the impacts and risk. They discussed the financing needs to adapt to SLR risk and recognized the business opportunities that will be developed as companies implement resiliency/adaptive strategies.

Of importance to the Hampton Roads region as it moves forward in SLR planning, is the recognition that private and public infrastructure systems are coupled and cannot be separated, requiring collaborative problem solving across all infrastructure systems. An example of this related to the ports is that while the ports may be publicly owned and operated, they are served

by the private operations of the terminals for transportation of goods. Both are necessary for economic success.

Suggestions related to coastal/shoreline industries provided by Williams Mullen included:

- Education and vulnerability messaging for coastal businesses is necessary and should include the risk, assessment tools, planning strategies, resources, adaptation strategies, etc.
- Incentives for investment in capital improvements for resiliency/adaptive actions should be made available. (Resiliency enhancement = tax break)
- Industry associations are an excellent resource and should be leveraged for education on SLR and resiliency planning strategies.
- The maritime industry is lacking in resiliency planning resources when compared to other industry sectors and development of those resources would be beneficial.
- Federal, state, regional, and municipal governments should provide leadership to industry in terms of SLR planning scenarios.
- Environmental hazards and cleanup of environmental sites along the coastline need consideration in regional SLR planning.
- Develop strategies and opportunities for new business development in the area of SLR adaptation. Examples: green infrastructure business, flooding applications, etc.

The identification of current practices noted above is limited in scope to three infrastructure sectors from three specific perspectives. Additionally, the region should conduct further research on current industry practices related to SLR planning to include all industry sectors and all business sizes.

2.7.3.3. Identification of Business Risk Related to SLR and Coordination with Emergency Management Services

Williams Mullen also provided background on the operational, capital, financial, and legal risk factors associated with SLR. The presentation highlighted the importance of the shoreline and water as a key factor in the regional economy and the reliance of that economy driver on other infrastructure that is compromised during flooding events.

Physical impacts and economic impacts were discussed in terms of how they may create changes in land use planning, government and private funding available for investment, demographic shifts and lifestyle changes. These changes, if managed well, can create opportunities in the region. Local business enterprises need to evaluate business risk associated with SLR considering all risk factors and their impact to earnings, and liquidity property/assets market value. Evaluating risk is difficult when the risk, like SLR, is uncertain and the options to minimize or mitigate risk are complex, costly and evolving. Both public and private investment will be necessary for financing of infrastructure, resiliency costs, and for new business development in the areas of resiliency.

The City of Virginia Beach's Deputy Emergency Management Coordinator, Erin Sutton, joined the PIC to discuss critical infrastructure. She explained how critical infrastructure is prioritized in the Commonwealth and introduced the DHS-funded Port Security Risk Assessment that is underway to identify critical infrastructure, dependencies and interdependencies. She discussed

the local emergency planning committee strategies and actions taken to engage private facilities in emergency planning and highlighted the partnerships that have been created with federal, Commonwealth, and private industry in the region.

2.7.3.4. Identification of Resources

The PIC has identified resources for private industry use that include best practices for adaptation to climate change and SLR. It is limited in scope and the listing of a resource is not a recommendation for use. It is recommended that the additional resources be identified and that a resource library be made available to the region. The list of resources identified is located in the Key Resources/Literature section of the full PIC report in Appendix I.

During the process of resource identification, it was noted that individual industry sectors are developing their own best practices and updating industry regulations and requirements to incorporate resiliency/adaptation standards. Examples of this are the CIGRE publication, Air Insulated Substation Design for Severe Climate Conditions, B3.31, 2014, which Dominion Power has contributed to, and the standards for the American Society for Health Engineering. Additional resources by industry sector should be identified as needed.

The U.S. Climate Resiliency Toolkit is a useful starting point for all industries. (<http://toolkit.climate.gov/get-started/overview>). This resource includes a five-step process to build climate resilience: (1) Identify the Problem; (2) Determine Vulnerabilities; (3) Investigate Options; (4) Evaluate Risks & Costs; (5) Take Action. The toolkit provides a framework for individuals, businesses, and communities to respond to the challenges of climate change.

2.7.4. Case Studies

2.7.4.1. EIMA

The U.S. Department of Energy, Energy Infrastructure and Modeling and Analysis Division (EIMA) recently completed a study to assess the potential exposure of energy facilities in the Hampton Roads region to a general rise in sea level and from storm surge at these higher sea levels. The analysis focused on the risk in 2050 and 2100, and included electricity assets, natural gas assets, and petroleum assets. The results of the study indicate that these assets would not be inundated under the National Climate Assessment (NCA) Intermediate-High SLR Scenario in 2050. However, there is significant risk to these assets when a storm surge associated with a Category 4 storm is considered. In addition, the NCA Intermediate-High Scenario predicts 5 feet of SLR by 2100, which would inundate multiple energy assets in Hampton Roads. A Category 1 storm in addition to the 5 feet of SLR would cause extensive inundation of energy assets. The results of this report are being shared with respective energy providers for their consideration in SLR planning and adaptation efforts.

2.7.4.2. Little Creek/Pretty Lake Case Study

The IWG selected the Little Creek/Pretty Lake Case Study area and SLR and storm surge scenarios that were evaluated as part of the case study. Please refer to the IWG report and/or Case Study Technical Report summary in the appendix for this information.

Tom McNeilan of McNeilan and Associates was involved in preliminary design work for the City of Norfolk Pretty Lake storm surge barrier. He provided a context of the study, that it was

completed prior to Superstorm Sandy and also pre-dated the current thinking on incorporating blue and green infrastructure into solutions. He indicated that at the time of the study, the City of Virginia Beach was approached to see if they were interested in working together with the City of Norfolk on a solution to the Little Creek/Pretty Lake watershed and that they declined involvement at that time. He acknowledged that while a storm surge barrier at Shore Drive to protect Pretty Lake could increase flooding risk at Little Creek Amphibious Base and Little Creek watershed, the impact is not likely to be significant.

He outlined the geological and subsurface conditions of the area highlighting that the area is relatively flat with a median elevation of 9 feet and that 25% of the watershed is below 7 feet in elevation. It is not unusual for low ground in East Ocean View to be moderately inundated in severe storms and both storm surge and sea level rise are issues for the area. When considering protection of the Pretty Lake area, it is important to recognize that the watershed is relatively large in comparison to the outlet, and that flood protection is required at the outlet of Pretty Lake and also at the shore along the Chesapeake Bay.

The current Dutch water management perspective was discussed, which includes consideration of water as where the environment meets the economy. While barriers are needed in some cases, you cannot depend on them exclusively. Hybrid solutions of gray and green infrastructure are necessary and can be an avenue for providing multiple lines of defense. Water strategies that are implemented should include options that slow the water down, store and use the water, and then drain the water after an event is over.

2.7.4.3. Mapping Infrastructure Dependencies

In order to understand critical infrastructure internal and external dependencies, a spreadsheet was developed that enabled infrastructure systems to map internal dependencies, dependencies within their own systems, and external dependencies, dependencies upon other infrastructure systems. Two spreadsheets, Internal Factors and External Dependencies, were developed and infrastructure sectors were asked to complete an analysis of their systems. We limited the analysis to the Little Creek/Pretty Lake area based on the scope of the Pilot Project; however, this should be done for the entire Hampton Roads region.

The Internal Factors spreadsheet required each infrastructure system to develop a list of internal factors that they are dependent on for operations. For example, hospital systems' internal factors might be: water, power, communications, staff, sanitary, HVAC, security, computer systems, medical gas, and sustenance and supplies. Once a list of internal factors was established, that list was evaluated within the selected geographic area based on SLR and storm surge scenarios. The evaluation of internal factors was completed based on the questions of: Are these internal factors vulnerable under this scenario; and how vulnerable are they under this scenario? The evaluation of vulnerability was based on a scale of: not vulnerable (no impact); low vulnerability (less than 33% of impact); medium vulnerability (less than 66% of impact) and high vulnerability (system impact greater than 66%).

Each system was then evaluated based on the dependencies of the internal factors on external infrastructure systems. For example, a hospital's internal factors would be evaluated against the following external infrastructure systems: city water, electric, gas, communications (data/

internet), communications (voice), transportation (air), transportation (roads), transportation (rail), transportation (vessel), sanitary, sanitary treatment, medical facilities, federal facilities, emergency services, and vehicle fuel. The evaluation of internal factor dependency on external infrastructure was completed based on the question of: How dependent are your internal factor operations on the external infrastructure system? The evaluation of threat to internal operations was based on a scale of: no threat (no impact); low threat (less than 33% impact); medium threat (less than 66% impact) and high vulnerability threat (system impact greater than 66%). In evaluating threat to internal operations, the existence of emergency planning was taken into account. For example, hospital systems may have a 72-hour emergency electrical supply or sanitary pumping stations may have a 24-hour emergency power backup system. These worksheets can be found in Appendix X.

2.7.5. Lessons Learned

2.7.5.1. Lessons Learned from Little Creek/Pretty Lake Case Study

The Little Creek/Pretty Lake Case Study includes the example and results of the infrastructure internal and external dependencies evaluation that was completed as part of the Pilot Project. As noted earlier, the results of the evaluation of critical infrastructure will vary based on the location in which the analysis is done within the region and the vulnerability of the area to SLR and flooding. The following is a summary of the impacts to infrastructure systems evaluated in the case study area:

- The scenario of 1.5' of SLR will have no threat to critical infrastructure systems. Systems have already been hardened or are located at elevations at which there is not an impact.
- The scenario of 1.5' of SLR + 100-year storm surge will have some threat to all infrastructure systems evaluated. There is a low threat to the medical facility, and City of Norfolk water supply and water distribution systems. There is a medium threat to electrical infrastructure and City of Norfolk sanitary and a low threat to City of Virginia Beach sanitary and water distribution.
- The scenario of 3.0' of SLR will have relatively low threat to City of Norfolk water supply, water distribution and sanitary systems. The City of Virginia Beach has a low threat to the collection system of their sanitary but no threat to the other parts of the system.
- The scenario of 3.0' of SLR + 100-year storm surge will have a high level or threat to a portion of infrastructure systems evaluated in the case study area except Sentara Independence, which is located on relatively high ground just outside the case study area.

During the process of evaluating infrastructure systems in the case study area, the following insights were noted:

- In the case study area, SLR (limited to 3 feet) will not have a major impact on infrastructure systems analyzed but the addition of storm surge to SLR will create significant problems. However, low-lying roads will be inundated, which will impact residents significantly.
- Infrastructure evaluation results will vary based on the location within the region in which the analysis is completed and the vulnerability of the specific area to SLR and flooding related to storm surge.

- The City of Norfolk and the City of Virginia Beach use different power backup systems for pumping stations, with the City of Virginia Beach using natural gas for backup power and the City of Norfolk using petroleum-based backup generators. This information was previously not shared between jurisdictions.

2.7.5.2. Barriers to implementation of SLR Infrastructure Adaptation Measures

During Phase I of the Pilot Project, the PIC identified challenges and barriers to the regional infrastructure planning for SLR that included the following items:

- Identification of infrastructure, interdependencies between private and public infrastructure, and vulnerabilities;
- Private industry needs to know what SLR amount that they should be using for planning in short and long term;
- Uncertainty on how public and private organizations will work together;
- Proprietary information, how will it be shared and protected;
- Codes regarding construction standards related to SLR vary by city, therefore, a regional or Commonwealth code requirement should be implemented to eliminate confusion;
- Underwriter insurance requirements may differ from code requirements, causing confusion; and
- Financial/funding barriers.

During the process of working through the case study in the Little Creek/Pretty Lake area, the IWG and PIC experienced these examples of institutional governance barriers:

- Fragmentation, lack of formal interaction with government – not all critical infrastructure entities were invested in participating in the Pilot Project and not all that did participate were invested in evaluating infrastructure interdependencies in the case study area. This included both public and private infrastructure entities.
- Stove-piped functionality of agencies – that is the nature of our infrastructure systems and the exercise of mapping of interdependencies between critical infrastructure systems had not been done previously in Hampton Roads (exclusive of federal facilities).
- Government department and sector-based structures of agencies – prior to the IPP the municipalities had not received infrastructure information (example: storm water loading) from adjacent jurisdictions.
- Legal barriers – National security requirements prevent the sharing of information from federal facilities and Protection of Critical Infrastructure Information (PCII) also creates a legal barrier for sharing of critical infrastructure information.

While the region has exceptional scientific resources and support, including the strength of the Science Advisory Committee participation in the Pilot Project, science remains a barrier in the region. Specifically, the type of information that is needed in terms of more certainty are the rates of SLR or local data on storm intensity and frequency, flooding impacts and vulnerabilities.

The PIC also identifies resources and funding as barriers to infrastructure adaptation moving

forward. A regional approach to funding will provide more opportunities for success. Individually only one city, Virginia Beach, is ranked in the top 50 cities in the United States (www.census.gov). By comparison, the combination of the population in Virginia Beach, Norfolk, Newport News, Portsmouth, and Hampton puts the region in a comparable position with the top 10 cities in the United States.

2.7.5.3. Solutions to Barriers to Implementation of SLR Infrastructure Adaptation Measures

It is important to note that Hampton Roads has been building regional capacity for adaptation to SLR, which provides a pre-existing advantage, based on the work of municipalities, agencies, non-profits, and universities. Entities involved in this work include but are not limited to: Norfolk, Virginia Beach, Newport News, Hampton, Portsmouth, Hampton Roads Planning District Commission (HRPDC), Hampton Roads Transportation Planning Organization (HRTPO), Wetlands Watch, Urban Land Institute (ULI), Old Dominion University (ODU), Virginia Institute of Marine Science (VIMS), and William & Mary.

The IWG and PIC committees found success using the following strategies outlined by Ekstrom and Moser in their committee work:

- *Gathering data* – the committees gathered data from many existing studies, national and from the Hampton Roads region, which were reviewed and referenced in the committee work. These references are outlined in the reference sections of both the IWG and PIC reports. This strategy also led into self-education and learning and information sharing strategies.
- *Networking/formal partnerships* – the IWG and PIC were able to break down institutional stove piping barriers using department and sector-based structures of agencies to coordinate and share information (engineers/planner). This strategy was extremely successful and should be implemented in the future regional SLR organization. While formal partnerships were not developed, informal partnerships have been formed that will be beneficial for future infrastructure analysis and planning. In addition, the final recommendations from the Pilot Project will outline a governance structure for the region that can support continuing efforts of regional adaptation.
- *Leadership* – the IWG and PIC committees provided leadership in the Pilot Project by the selection of the case study area of Little Creek/Pretty Lake. This case study area was also adopted by the Citizen Engagement Working Group and the Public Health Working Group.
- *Funding and Policy & Management Changes* – Both the IWG and PIC final recommendations include recommendations that address funding and policy and management recommendations for the Hampton Roads region moving forward. It was beyond the scope of the Pilot Project to implement actions in either of these areas.

2.7.6. PIC Recommendations

1. Federal agencies are going to be instrumental partners in SLR planning and adaptation moving forward. The Department of Defense agencies and other federal agencies should be considered as partners with a formal role in decision making. This may require legislative changes at the federal and state level.

2. Funding for adaptation in Hampton Roads should be sought from public and private sources. Every year NOAA compiles a list of currently available, climate-related funding opportunities. The current list can be found in Appendix I-2 and was last updated on January 15, 2016.
3. Interdependencies between private infrastructure and public infrastructure systems will require collaborative problem solving across all infrastructure systems. Private critical infrastructure needs to be accounted for in these efforts for SLR adaptation planning.
4. Private infrastructure systems need reliable information and guidance in planning for SLR. Provide regionally recognized science-based SLR scenarios for private industry to incorporate in long-range planning. This standardization will eliminate confusion across the region and enable companies and industries with facilities throughout the region to proactively adapt to SLR.
5. The region should develop or adopt a tool for evaluation of SLR impacts on critical infrastructure, including internal and external dependencies. A regional assessment by watershed is necessary to understand infrastructure dependencies and to develop resiliency plans for implementation.
6. Develop building code strategies that can be implemented on a regional basis for construction and substantial improvements to existing structures to mitigate against flooding, severe wind and SLR. Some strategies for consideration include: freeboard regional standard, 500-year flood plain management, etc.
7. Ensure business and industry (and related trade groups) are active participants in shaping regional strategies and methods to address SLR and related risks and concerns and the development of any regional organization that may facilitate planning and/or implementation efforts.
8. Incent business and industry action and innovation to address SLR and related risk and concerns through financial and public recognition mechanisms.
9. The region should develop a business and industry outreach program that would:
 - Increase awareness among business and industry sectors, particularly small and mid-sized businesses, as to the concerns and risks associated with SLR, storm surge and coastal flooding trends
 - Develop toolkits or portals to toolkits that would serve the specific needs of business and industry in addressing such risks and concerns (i.e., data gathering/management, risk evaluation and operational, capital investment planning, economic opportunities arising from such risk and issues, and public policy notification and tracking). A resource that is useful is the U.S. Climate Resiliency Toolkit (<http://toolkit.climate.gov/get-started/overview>).

2.7.7. SLR Recommendations Drawn from New Orleans and Southeast Florida

The PIC and IWG understand the importance of looking to other cities and regions that are facing similar threats from SLR, and the committees specifically reviewed climate action/resiliency plans from New Orleans and Southeast Florida to understand their strategies as they may be

applicable to Hampton Roads. New Orleans and Southeast Florida have both developed climate action and resiliency plans with regional recommendations that are applicable to Hampton Roads. Many of these same recommendations were discussed during the course of the Pilot Project.

These recommendations should be viewed as a preliminary framework to help guide policies in the region. It is important to emphasize that these recommendations do not serve as a mandate for the region but rather options that a regional entity or municipality may adopt and utilize based on its interests and vision for the future. Over time, the region may enhance these recommendations as scientific data and projections are refined to develop best management practices for the region. Both committees voted unanimously to include the following recommendations for Hampton Roads.

2.7.7.1. SLR Recommendations from Southeast Florida

1. Develop regionally consistent sea level rise planning scenarios for the coming decades. Require update every four years, immediately after United States National Climate Assessment update, to include rapidly changing body of scientific literature.
2. Develop regionally consistent methodologies for mapping sea level rise impacts.
3. Develop regionally consistent criteria for risk assessment related to sea level rise using a jurisdiction's unique risk factors.
4. Develop land use strategies that may be implemented for sea level rise that consider adaptation, restoration and growth. These strategies support Virginia Code 15.2-2223.3 that require comprehensive plans to incorporate strategies to address projected sea level rise and recurrent flooding.
5. Develop regionally consistent flood maps reflective of risk assessment and mutually agreed-upon suite of storm events under future sea level rise scenarios to inform planning.
6. Identify regional infrastructure projects based on risk of flooding and tidal inundation to be used as a basis for identifying and prioritizing adaptation needs and strategies.
7. Evaluate existing water management (storm water and fresh water supply) systems and flood control/drainage structures under sea level rise and storm surge scenarios. Reflect the capacity and interconnectivity of the surface water control network and develop feasible regional adaptation strategies.
8. Identify regionally consistent analytical methods for application in analysis of infrastructure design, water resource management (storm water and fresh water supply) and hazard mitigation. Identify a common set of tools that consider both costs and consequences.

2.7.7.2. SLR Recommendations from New Orleans

1. Develop a regional urban water plan
2. Develop model watershed flood plain management plans for the Hampton Roads region
3. Design and implement a regional climate action plan
4. Develop a business resilience initiative

5. Implement balanced use of green infrastructure and blue infrastructure strategies regionally
6. Incentivize commercial and residential property owners to implement green and blue infrastructure on private property (storm water fee reductions)
7. Require new developments (>5000sf) and redevelopments to treat and or store first 1-1/4" of rainwater on site.
8. Provide incentives to commercial and residential property owners to adapt to SLR such as resources, capacity and expertise.
9. Develop a "water management" economy in Hampton Roads.

2.8. Economic Impacts Advisory Committee

2.8.1. History, Objectives & Strategy

The Economic Impacts Advisory Committee (EIAC) was formed at a much later stage than the other working groups and advisory committees. Dr. Larry Filer, Chair of the Department of Economics at Old Dominion University and Associate Director for the Center for Economic Analysis and Policy (CEAP), agreed to chair the group in the early fall of 2015. The first four months were dedicated to engaging committee members, contacting those individuals and securing commitments to serve. Tremendous efforts were made to include individuals from both academia and the private sector. There was a strong focus on commercial development, real estate and insurance with the private sector members. The academic members were chosen based on sea level rise work that was being done by faculty at the main flagship universities in the Commonwealth.

The choices from academia were influenced more by the organization than the individuals, though the representatives from William & Mary and UVA were known for their work on sea level rise/flooding issues. Some significant work was underway at The Virginia Coastal Policy Center at the College of William & Mary. Work on flooding resilience and sea level rise was also being conducted at the Cooper Center for Public Policy at the University of Virginia.

The private sector representatives were chosen based on the firm. Both Poseidon and Clark Nexsen are undertaking major commercial building projects in "at risk" coastal areas. This includes locations outside the Hampton Roads metro area and, in some cases, outside the state of Virginia.

The complete list of committee members is shown in the full committee report in Appendix J of this report.

2.8.2. Actions & Accomplishments

The advisory group served as a liaison to the working groups – providing guidance on related issues as they arose. The scope of work changed early in 2016 when the advisory group decided to establish a research agenda for the advisory group knowing that this research agenda would stretch beyond the length of the IPP. This work would be done in addition to the advisory work being done for the working groups, to take advantage of the human capital of the EIAC.

Early in the research process, it became apparent that a number of "impact" studies were being

conducted by various government agencies, consulting firms and regional organizations on behalf of localities in Hampton Roads. Therefore, the primary objective of the EIAC during Phase 2 was to convene a day-long conference where all of the agencies and consulting firms conducting impact studies could be brought together to present their scope of work, data limitations and initial or final findings. The goal of the event would be to provide an opportunity for collaboration and sharing among agencies that typically operate in isolation.

On May 18, 2016, the EIAC held The Economic Impacts of Sea level Rise in Hampton Roads: An Appraisal of the Projects Underway. The event was held in partnership with the Infrastructure Working Group from the Pilot Project. Presenters included:

- U.S. Department of Transportation
- U. S. Army Corps of Engineers
- Department of the Navy
- Hampton Roads Planning District Commission
- Department of the Interior
- Dewberry Consultants LLC
- City of Virginia Beach
- City of Norfolk
- RTI International



Figure 2-5. EIAC Appraisal of Projects

A number of common issues and themes emerged from the presentations. Recommendations for these issues have become part of the final recommendations from the EIAC.

The EIAC proposed three initial research focus areas for the group and presented this research plan to the Steering Committee for feedback. These areas would serve to guide the research agenda of the group beyond Phase 2. The three research areas are:

1. The impact of sea level rise on commercial development

This is going to include an intensive look into the new zoning requirements that coastal cities are using in flood-prone areas and whether commercial developers will be able to satisfy these requirements. If these requirements are too onerous, the outcome will essentially be empty, non-revenue-generating land.

2. The impact of sea level rise on business attraction

It is quite likely that coastal cities will face difficulty in attracting new business if it is not perceived that the city has its hands around the issue of recurrent flooding and inundation. There is some research out there that looks at residential migration from flood-prone areas, but little work has been done on firm relocation.

3. Regional cooperation and the HUD Community Rating System

Only 5% of the eligible localities in the U.S. participate in the HUD Community Rating System despite very large reductions in premiums on flood insurance for the residents. In an area like Hampton Roads, cooperation by all the localities on the same level might be helpful to get the largest joint benefit. Aggressive participation by Norfolk (for example) alone, would not matter much if Virginia Beach does nothing, and vice versa. As it stands, only Norfolk and Gloucester appear to be participating at all.

2.8.3. Recommendations

The EIAC:

1. Recommends all localities within the Hampton Roads Planning District maintain a consistent, updated database on properties. The data will include information on first floor elevation of structures. At the very least, localities would maintain information on the foundation type of the structure;
2. Recommends a database be kept, tracking all economic impact studies being conducted within the Hampton Roads region. The database would include information on the projects' scope, initial findings and delivery date. The database would be housed on a public website and be updated in a timely manner (perhaps the website of the new Commonwealth Center for Flooding Resiliency);
3. Urges ODU to hold an annual event that brings together government agencies, local government officials and consulting firms conducting studies of the economic impact of sea level rise and recurrent flooding on Hampton Roads;
4. Recommends that localities within the Hampton Roads Planning District coordinate with other localities, whenever possible, to conduct economic impact studies. This ensures that the studies are broader in geographical scope and provide a more regional view of the impacts of sea level rise.

2.9. Collaborations for Coastal Resilience

The event "Collaborations for Community Resilience" took place on December 10, 2015, at ODU, and served as not only an internal check-in with stakeholders locally, but also as an opportunity to learn from those facing similar climate impacts in New Orleans, Southeastern Florida, and Michigan.

The event had over 200 registrants and approximately that many attendees. Most guests stayed for the duration of the program, and the event was covered by a local television station on the evening news, increasing awareness among citizens on both the risks of sea level rise and the idea that our region is working toward innovative solutions.



Figure 2-6. Panel Discussion of Thriving with Water

The highlights of the event included keynote presentations by Dr. Jennifer Jurado of Broward County, Florida and Robin Barnes of Greater New Orleans, Inc. entitled “Regional Collaborative in the Face of Coastal Change” and “Creating an Economy from Resiliency,” respectively. Both of these topics are especially timely as our local leaders begin to work together more effectively and we look for ways to develop a regional industry cluster around the resilience concept. Other panels included information on alternative approaches to the DOD Pilot (Michigan Army National Guard), resilience in Virginia, a path forward for Hampton Roads, and federal perspectives from various agency representatives.

All events of this size encounter stumbling blocks in the planning phase. Here, a major challenge was recruiting guest speakers from the other pilots around the country, as initially planned. While representatives from the Chief Resilience Officer’s department in Colorado expressed interest, they had a scheduling conflict. The Pilot Projects in Idaho and Houston were less interested in an information exchange. We are very grateful that our guests from Florida, New Orleans, Michigan, and Washington, D.C., attended.

When the IPP concludes, stakeholders must continue to gather on a regular basis to share information, lessons learned and strategies. Extra-regional guests are incredibly important as Hampton Roads hopes to both learn from other regions’ successes and failures. Continued collaborations should be established, possibly through facilitation by ODU and other academic partners.



Figure 2-7. Robin Barnes of Greater New Orleans, Inc. Addressing the conference



3. IPP Recommendations

3.1. Summary of Recommendations and Selection Process

Recommendations of each working group and advisory committee are included in the respective section, and are also included in the summary chart below. These recommendations are the result of careful consideration over two years by invested stakeholders, but should not be construed as the recommendations of the Steering Committee or any participating organization.

While some recommendations chart specific paths forward or spell out specific tasks, there are many overall themes running through the recommendations. One of those themes include institutionalizing and formalizing relationships built during the course of the two-year pilot process. Many critical positions, especially those in our military partners, last only two to three years. While there are many benefits to this system, institutional knowledge of this unique subject and relationships are lost and must be rebuilt over time. In the natural course of career progression, others change positions too, whether within municipal governments, private infrastructure or other sectors. All committees felt that establishing more formalized relationships so that collaborative sea level rise and resilience planning was just a part of the defined scope of work was critical.

Furthermore, many committees recognized both research, data availability and data integration as priorities. Effective sharing of best available data enables decision makers at the local, state, and federal levels as well as within the private sector. Research across focus areas should remain a priority, however, equally important is the effective communication within the Hampton Roads community with regards to different studies, tools, and available data.

Also, both the Infrastructure Working Group and Private Infrastructure Advisory Committee carefully studied the history of collaborative planning for sea level rise and resilience in both New Orleans, Louisiana, and Southeast Florida, including Miami. Recognizing that each of these regions varies from Hampton Roads, successful initiatives and strategies from these regions were carefully adapted in the recommendations to fit the needs of Hampton Roads. Though the Pilot is intended to be a model for other regions, Hampton Roads is not the first region to address these issues and successful strategies employed in these regions could also be successful in Hampton Roads. Furthermore, many committees cited the importance of the Whole of Government and Whole of Community approach with regards to planning, implementing, and funding adaptation. As the region moves forward, collaboration and information and strategy sharing should remain a priority.

Working Group/Committee	Recommendations
<p>Working Group Consensus Recommendations</p>	<ol style="list-style-type: none"> 1. In an effort to capture the valuable expertise, relationships, and partnerships developed throughout the course of the IPP, working group, advisory committee chairs and members should be formally invited to participate in and meaningfully included in ongoing activities. 2. In furtherance of the above, the follow-on entity should work to formalize and institutionalize the relationships described above.
<p>Economic Impacts Advisory Committee</p>	<ol style="list-style-type: none"> 1. All localities within the Hampton Roads Planning District should maintain a consistent, updated database on properties. The data will include information on first floor elevation of structures. At the very least, localities would maintain information on the foundation type of the structure. 2. Create a database that keeps track of all economic impact studies being conducted within the Hampton Roads region. The database would include information on the projects' scope, initial findings and delivery date. The database would be housed on a public website and be updated in a timely manner (perhaps the website of the new Commonwealth Center for Recurrent Flooding Resiliency). 3. Urges ODU to hold an annual event that brings together government agencies, local government officials and consulting firms conducting studies of the economic impact of sea level rise and recurrent flooding on Hampton Roads. 4. Localities within the Hampton Roads Planning District should coordinate with other localities, whenever possible, to conduct economic impact studies. This ensures that the studies are broader in geographical scope and provide a more regional view of the impacts of sea level rise.
<p>Science Committee</p>	<ol style="list-style-type: none"> 1. The function of the committee should continue regardless of the fate of the IPP. 2. The newly funded Commonwealth Center for Recurrent Flooding Resiliency (CCRFR) should function as the coordinating organization for the Committee. The CCRFR will be responsible for forming the steering group for the Science Committee.

	<ol style="list-style-type: none"> 3. The main goal of the Science Committee should be to provide a mechanism to assure that the sea level rise science needs and requirements of regional stakeholders are addressed. 4. The Science Committee should include the following at a minimum: regional scientists and engineers familiar with RSLR, storm water managers and coastal engineers with the cities and HRPDC, engineers from the companies contracted by the cities and region, relevant Commonwealth agencies including water resources, federal agencies including NOAA/NOS, NOAA/NWS, Interior/USGS, NASA, DOD, Interior/FWS, Interior/NPS, local WFO Wakefield, etc. 5. Over the coming year the committee will need to facilitate meetings with regional stakeholders to determine their specific requirements. 6. Implement the following specific tasks (subject, of course, to future revision). Note: In many cases the committee may facilitate an activity rather than provide that activity itself. <ul style="list-style-type: none"> • Monthly or bi-monthly conference calls – These will be initiated by the CCRFR. • Topical conferences as appropriate – These may be done as part of the Adaptation Forums. • Topical reports – possible annual or bi-annual “State of the Region – Sea level rise and recurrent flooding.” • Consider expanding beyond sea level rise and flooding to include other climate change variables: air temperature, rainfall, humidity, etc. • Facilitate creation of a web services-based portal for all relevant sea level rise data in the region. • Facilitate a knowledge database for sea level rise science relevant to the region possibly using the ODU Digital Commons system supported by the ODU Library • Facilitate reports to federal agencies on needs/requirements – these would be developed by regional stakeholders. • Coordination with Hampton Roads Adaptation Forums and other relevant organizations in the region., e.g., professional engineering societies. • Facilitate data telemetry and broad distribution of local real-time water level observations to all of Hampton Roads.
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<p>Citizen Engagement Working Group</p>	<ol style="list-style-type: none"> 1. Recognize that sea level rise is a serious issue that touches the entire region and that engagement on a piecemeal basis or on the basis of governmental purview, municipal boundaries, local political will or current levels of stakeholder interest is not a viable long-term strategy for a challenge of this magnitude. 2. Identify a respected regional entity to “own” and be responsible for being the thought leader on sea level rise in Hampton Roads and for convening Whole of Community deliberations regarding sea level rise. 3. Use the best practices of civic science – including good facilitation process and good methods for information dissemination and feedback – to engage all stakeholders in sea level rise deliberation and decision making from the very start. 4. Create benchmark and ongoing internal and external tracking metrics for assessing the performance and effectiveness of the engagement program and its impact on the ability of the Hampton Roads region to rise to the challenge of sea level rise.
<p>Public Health Working Group</p>	<ol style="list-style-type: none"> 1. Some of the most serious impacts of sea level rise are those affecting public health. Consequently, there will be a continuing need for public health issues to be an integral part of current and future sea level rise adaptive planning efforts. 2. In the Hampton Roads region, it will be essential to continue and further expand the activities and the membership of the Public Health Working Group. 3. One important area of focus needs to be on understanding potential public health impacts of sea level rise, and the implications of those impacts for planning, training, preparedness, practice, and decision making. 4. Another area of focus should deal with how public health expertise in such areas as health and environmental risk communication, health-related community outreach, working with vulnerable/special needs populations, epidemiology, industrial hygiene, and public health emergency preparedness can best contribute to broader sea level rise adaptation efforts.

	<ol style="list-style-type: none"> 5. Research on the public health dimensions of sea level rise will be a continuing area of emphasis. In this regard, new tools such as EnviroAtlas have the potential to improve our understanding of environment-health relationships, and to enhance sea level rise adaptation planning efforts. 6. Preparing the next generation of public health professionals to grapple with sea level rise issues will also be vital. Curricular innovations, new practicum sites, new courses, and related initiatives such as those described above all have a role to play in contributing to this effort.
<p>Legal Working Group</p>	<p>See Appendix C-1 Draft Resolution</p>
<p>Infrastructure Working Group</p>	<ol style="list-style-type: none"> 1. This region should undertake development and formation of a functional process and organization to facilitate regional collaboration, including the local governments, regional, state, tribal and federal agencies, and other entities, that have the most imminent impact from and interest in sea level rise. This organization might ultimately be evolved to be considered a “commission, board or council” under Virginia law. It should have authority to foster collaboration among federal, tribal, state and local agencies, with support from academia, and should serve as a collaborative agency to oversee regional matters of importance in facilitating regional sea level rise planning and actions. 2. Federal agencies in the Hampton Roads region must have a way to work directly with the local governments, including determination and processes for approval of authorities and appropriations for funding. This process should begin as an MOU or set of MOUs between federal agencies and local governments or a regional entity representing them. When authority for collaboration with local governments is unclear or too restrictive to support effective planning, federal agency headquarters should issue guidance providing their field activities with the authority they need to collaborate effectively with local governments. If a federal agency determines that its ability to collaborate is constrained by federal statute, legislation should be sought to provide that agency authority to collaborate with local governments. Certain existing intergovernmental programs, such as the National Ocean Council and collaboration in the areas of homeland security and emergency management, provide models for legislation authorizing intergovernmental collaboration.

	<p>3. The region should establish a definitive set of regional sea level rise planning standards and scenarios to be adopted, along with a minimum base floor elevation, and a standard vertical datum. The affected local governments and regional, state, tribal, and federal agencies will then be able to work from the same set of scenarios in regional and local planning efforts to address sea level rise and recurrent flooding impacts, adaptation and mitigation.</p> <ul style="list-style-type: none"> • The necessity for planning scenario development and use in decision making for planning is as stated in the April 2016 SERDP report : “Regional Sea Level Scenarios For Coastal Risk Management: Managing The Uncertainty Of Future Sea Level Change And Extreme Water Levels For Department Of Defense Coastal Sites Worldwide” (SERDP, April 2016). “This report and its accompanying scenario database provide regionalized sea level and EWL scenarios for three future time horizons (2035, 2065, and 2100) for 1,774 DoD sites worldwide. The decision-making paradigm must shift from a predict-then-act approach to a scenario-based approach. The primary purpose of this report and its associated scenario database is to enhance and increase the efficacy of screening-level vulnerability and impact assessment for DOD coastal sites worldwide containing permanent or enduring assets” (Page ES-1 and ES-2). With the significant federal presence locally in Hampton Roads, federal processes should be considered in determining standards for regional procedures so that there is not inadvertent conflict resulting in negative impacts on regional planning efforts over time. • Federal government leadership and input could make achieving federal standards clearer and simpler for regional efforts. • A definitive set of regional sea level rise scenarios is essential for addressing planning issues that overlap jurisdictional boundaries, particularly land use planning and critical infrastructure design, planning, project prioritization and, ultimately, construction. <p>4. Regional identification, evaluation, and prioritization of critical infrastructure vulnerability to sea level rise impact within the next 30, 50, and 75 years should be undertaken. This work should include development of models and methods to understand and incorporate economic impact of adaptation, replacement, or relocation of such infrastructure, along with other social and cultural factors that should be considered.</p>
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Private Infrastructure Committee

1. Federal agencies are going to be instrumental partners in SLR planning and adaptation moving forward. The Department of Defense agencies and other federal agencies should be considered as partners with a formal role in decision making. This may require legislative changes at the federal and state level.
2. Funding for adaptation in Hampton Roads should be sought from public and private sources. Every year NOAA compiles a list of currently available, climate-related funding opportunities. The current list can be found in Appendix I-2 and was last updated on January 15, 2016.
3. Interdependencies between private infrastructure and public infrastructure systems will require collaborative problem solving across all infrastructure systems. Private critical infrastructure needs to be accounted for in these efforts for SLR adaptation planning.
4. Private infrastructure systems need reliable information and guidance in planning for SLR. Provide regionally recognized science-based SLR scenarios for private industry to incorporate in long-range planning. This standardization will eliminate confusion across the region and enable companies and industries with facilities throughout the region to proactively adapt to SLR.
5. The region should develop or adopt a tool for evaluation of SLR impacts on critical infrastructure, including internal and external dependencies. A regional assessment by watershed is necessary to understand infrastructure dependencies and to develop resiliency plans for implementation.
6. Develop building code strategies that can be implemented on a regional basis for construction and substantial improvements to existing structures to mitigate against flooding, severe wind and SLR. Some strategies for consideration include: freeboard regional standard, 500- year flood plain management, etc.
7. Ensure business and industry (and related trade groups) are active participants in shaping regional strategies and methods to address SLR and related risks and concerns and the development of any regional organization that may facilitate planning and/or implementation efforts.
8. Incent business and industry action and innovation to address SLR and related risk and concerns through financial and public recognition mechanisms.

	<p>9. The region should develop a business and industry outreach program that would:</p> <ul style="list-style-type: none"> • Increase awareness among business and industry sectors, particularly small and mid-sized businesses, as to the concerns and risks associated with SLR, storm surge and coastal flooding trends; • Develop toolkits or portals to toolkits that would serve the specific needs of business and industry in addressing such risks and concerns (i.e., data gathering/management, risk evaluation, and operational, capital investment planning, economic opportunities arising from such risk and issues, and public policy notification and tracking). A resource that is useful is the U.S. Climate Resiliency Toolkit (http://toolkit.climate.gov/get-started/overview).
<p>Private Infrastructure Committee/ Infrastructure Working Group Joint Recommendations</p>	<p><i>The PIC and IWG understand the importance of looking to other cities and regions that are facing similar threats from SLR. New Orleans and Southeast Florida have both developed climate action plans with regional recommendations that are applicable to Hampton Roads. Many of these same recommendations were discussed during the course of the Pilot Project. Both committees voted unanimously to include the following recommendations for Hampton Roads. These recommendations should be viewed as a preliminary framework to help guide policies in the region. It is important to emphasize that these recommendations do not serve as a mandate for the region but rather options that a regional entity or municipality may adopt and utilize based on its interests and vision for the future. Over time, the region may enhance these recommendations as scientific data and projections are refined to develop best management practices for the region.</i></p> <p>From Southeast Florida:</p> <ul style="list-style-type: none"> • Develop regionally consistent sea level rise planning scenarios for the coming decades. Require update every four years, immediately after United States National Climate Assessment update, to include rapidly changing body of scientific literature. • Develop regionally consistent methodologies for mapping sea level rise impacts. • Develop regionally consistent criteria for risk assessment related to sea level rise using jurisdiction unique risk factors.

	<ul style="list-style-type: none"> • Develop land use strategies that may be implemented for sea level rise that consider adaptation, restoration and growth. These strategies support Virginia Code 15.2-2223.3 that requires comprehensive plans to incorporate strategies to address projected sea level rise and recurrent flooding. • Develop regionally consistent flood maps reflective of risk assessment and mutually agreed-upon suite of storm events under future sea level rise scenarios to inform planning. • Identify regional infrastructure projects based on risk of flooding and tidal inundation to be used as a basis for identifying and prioritizing adaptation needs and strategies. • Evaluate existing water management (storm water and fresh water supply) systems and flood control/drainage structures under sea level rise and storm surge scenarios. Reflect the capacity and interconnectivity of the surface water control network and develop feasible regional adaptation strategies. • Identify regionally consistent analytical methods for application in analysis of infrastructure design, water resource management (storm water and fresh water supply) and hazard mitigation. Identify a common set of tools that consider both costs and consequences. <p>From New Orleans:</p> <ul style="list-style-type: none"> • Develop a regional urban water plan. • Develop model watershed flood plain management plans for the Hampton Roads region. • Design and implement a regional climate action plan. • Develop a business resilience initiative. • Implement balanced use of green infrastructure and blue infrastructure strategies regionally • Incentivize commercial and residential property owners to implement green and blue infrastructure on private property (storm water fee reductions). • Require new developments (>5000sf) and redevelopments to treat and or store first 1-1/4" of rainwater on site. • Provide commercial and residential property owners incentives to adapt to SLR: resources, capacity and expertise. • Develop a "water management" economy in Hampton Roads.
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3.2. Identified Barriers to Collaborative Whole of Government & Community Planning

At the outset of the IPP, the Charter, outwardly recognized a few initial barriers to collaborative planning. Local federal partners were delegated as federal liaisons instead of Steering Committee members. This designation was to prevent any appearance that federal partners were engaging in local governance, which they were not. Additionally, ODU agreed to convene the project out of a sense of duty to the community, and provided support over the course of the two-year project. Although this funding was limited, the success of the project was directly a result of the facilitation by a neutral and trusted academic partner. Not to be overlooked, VCPC and VIMS also provided countless hours of support and expertise over the course of the two-year project.

Throughout the course of the two-year IPP, the conveners, committee chairs, and Steering Committee members encountered several additional barriers to collaborative Whole of Government and Community. The IPP itself had multiple audiences: local and national. Local stakeholders were motivated by the opportunity to make progress locally and build new partnerships and strategies to combat flooding in Hampton Roads. Our federal stakeholders were interested not only in their own bases, but how these strategies could be employed elsewhere to combat a variety of challenges.

With regards to stakeholder engagement, many participants were recruited shortly following the execution of the Charter, by invitation to a FEMA National Exercise Program event at ODU on December 2, 2014. However, as referenced in committee reports, additional outreach was needed in order to recruit individuals who would commit to active participation. Even then, committee members were all volunteers, even those tasked by their organizations with participation. As such, their time and ability to complete work between meetings was often limited. Additionally, most military positions experience high rates of turnover in leadership and staffing, requiring constant updating of new officers and building new relationships. Nonetheless many volunteers committed many hours to the project, working with their own teams, and sharing information to move the project forward.

Another challenge, primarily involving the IWG and PIC, involved the challenge of choosing sea level rise and flooding scenarios by which to analyze infrastructure interdependencies. As noted by the PIC and IWG reports, there was concern that the timeframes that correlated with the selected scenarios portrayed conditions that exceed those under current use by those cities. The solution for this particular project was to remove specific timeframes from the scenarios selected. This solution does not solve the long-term challenge of rectifying the natural uncertainty of scientific research with engineers' and business owners' need for a specific number for which to plan. One frequent workaround is to plan for higher floodwaters for more critical infrastructure.

The Whole of Government nature of the project frequently highlighted the fragmentation between governments. There is no required interaction or planning for sea level rise and recurrent flooding impacts, and as such, not all critical infrastructure entities or governments were invested in participating in the Pilot Project. Additionally, this issue of fragmentation carries forward beyond the IPP. While municipalities now meet at HRPDC as a part of the

Coastal Resilience Committee, participation is not required and federal, state, academic, and community partners participate voluntarily as guests. Localities in Hampton Roads do not all face the same threat with regards to sea level rise and flooding, and as such have different levels of prioritization of the issue. One solution to this would be to create “coalitions of the willing” either outside of or inside of existing structures as has been done in Southeast Florida.

As noted by the PIC and IWG, our infrastructure and other systems are highly stove-piped, resulting in a variety of challenges. With regards to infrastructure, interdependencies had not been fully studied. Additionally, even within cities, different departments deal with different aspects of flooding and sea level rise and may not effectively communicate. Many cities are making great strides to overcome this by having sea level rise or flooding groups that meet across departments regularly, and the City of Norfolk, as a part of Rockefeller 100 Cities, has a Chief Resilience Officer to act in partnership with the various departments working on these issues.

Overall, there was a lack of communication about basic infrastructure and strategies between municipalities and neighboring bases prior to this project. Seemingly small victories occurred regularly throughout the work of the IPP when information was shared to more effectively enable planning in the neighboring municipality or base. However, this information was limited due to national security requirements and the inability of federal facilities to share certain infrastructure information.

IPP stakeholders worked diligently to overcome many of these barriers by building relationships and connecting and leveraging ongoing work in this area. The extensive list of proposed recommendations provides further steps to moving forward with collaborative planning for sea level rise resilience in Hampton Roads. Strong leadership from volunteers and support of ODU faculty was key to the success of the project and developing those essential relationships throughout the course of the IPP.

3.3. Other Considered Collaborative Strategies

Throughout the course of the IPP, the Steering Committee was tasked with determining what types of authorities and strategies would best allow for Whole of Government and Whole of Community preparedness and resilience. The LWG carefully analyzed 10 potential structure options, detailing various party’s ability to engage with such a structure, authority, funding, and more. Additionally, the matrix clearly showed where authority to establish such a structure already existed, required locality action, General Assembly action, or Congressional action. The matrix is available in Appendix D-4.

3.4. Proposed Resolution

At the request of the Steering Committee, the LWG prepared a draft resolution designed to effectively close the IPP. HRPDC had expressed a desire to lead a continued collaborative process through its Coastal Resilience and other committees, and the Steering Committee agreed that this was a natural next step. The resolution detailed the consensus positions of the Steering Committee as made clear to the LWG during the course of multiple meetings, as well

as charged the HRPDC with leading continued efforts. Working group and committee chairs, federal liaisons, and members of the Steering Committee agreed to move forward with the resolution after providing feedback to the LWG.

Consensus conclusions detailed the capacity of a regional entity charged with collaborative planning for sea level rise resilience, whether a new entity was created or an existing one altered. Additionally, the resolution acknowledged that HRPDC was the lead agency for collaborative planning. One primary conclusion was that the federal government and its agencies, including the uniformed services and the Virginia state government, participate to the full extent of their authority.

However, after presenting the resolution to the Hampton Roads Chief Administrative Officer Committee, the HRPDC provided comments to the resolution and noted that they could not sign as currently drafted. While the CAO Committee expressed support for the HRPDC to act as a leader in coordination of regional sea level rise and coastal resiliency planning efforts, they could not support the resolution as it focused on implementation in addition to planning, and requested that the HRPDC consider such entities as special service district authorities or joint exercise of local government powers by agreement (similar to the Southeast Florida Climate Compact) over the long term.

The resolution and official comments from HRPDC are attached in Appendix C-1 and Appendix C-2, respectively.



4. Conclusions

The goal of the IPP was two-fold: First, to provide a template for Whole of Government resilience planning useful to our federal partners, and second, to provide stakeholder-generated recommendations for moving forward with a Whole of Government and community planning process in Hampton Roads, Virginia.

Though the IPP recommendations and resolution are non-binding on participants, there is great significance in that many stakeholders from across the region and across sectors came together to propose these next steps and solutions to build resilience in Hampton Roads. Furthermore, the IPP shows that localities and federal agencies stand ready and willing to find new ways to collaborate when both become more resilient as a result. An example of this is the kickoff of the Joint Land Use Study, which will be led by HRPDC, and in a “first of its kind” approach, consider sea level rise as an encroachment. The study partners will include Virginia Beach and Norfolk and look to Joint Expeditionary Base Little Creek-Fort Story, Naval Air Station Oceana, Naval Station Norfolk and Naval Support Activity Hampton Roads and include an implementation strategy to ensure recommendations are realized. Furthermore, the Science Advisory Committee’s regular phone meetings have resulted in various collaborations including one between ODU researchers and NASA researchers looking to obtain accurate information with regards to localized subsidence data.

Though Hampton Roads is unique in that it is home to the largest Naval base in the world, a key port, and a unique history and geography, the lessons learned throughout the IPP can be utilized elsewhere. Following the Collaborations for Community Resilience event, guests from the Michigan Army National Guard considered moving forward with a Charter similar to the IPP for their resilience pilot project. While recommendations may be unique based on regional differences, many strategies will remain the same.

Furthermore, the IPP saw a successful new role for universities as noted by Secretary of State John Kerry when he visited ODU's campus in November 2015. As a neutral convener and non-partisan broker of expertise, ODU was proud to convene the IPP, but stands ready to change roles and lead other applied research efforts related to both local and global resilience whether through the Commonwealth Center for Recurrent Flooding Resilience, the ODU Resilience Collaborative, or other initiatives.

While the next steps for Hampton Roads remain with its localities and ultimately its citizens, the region has the tools and resources to move forward with a collaborative process for sea level rise planning and resilience.



Full Report & Appendices can be found on www.centerforsealevelrise.org