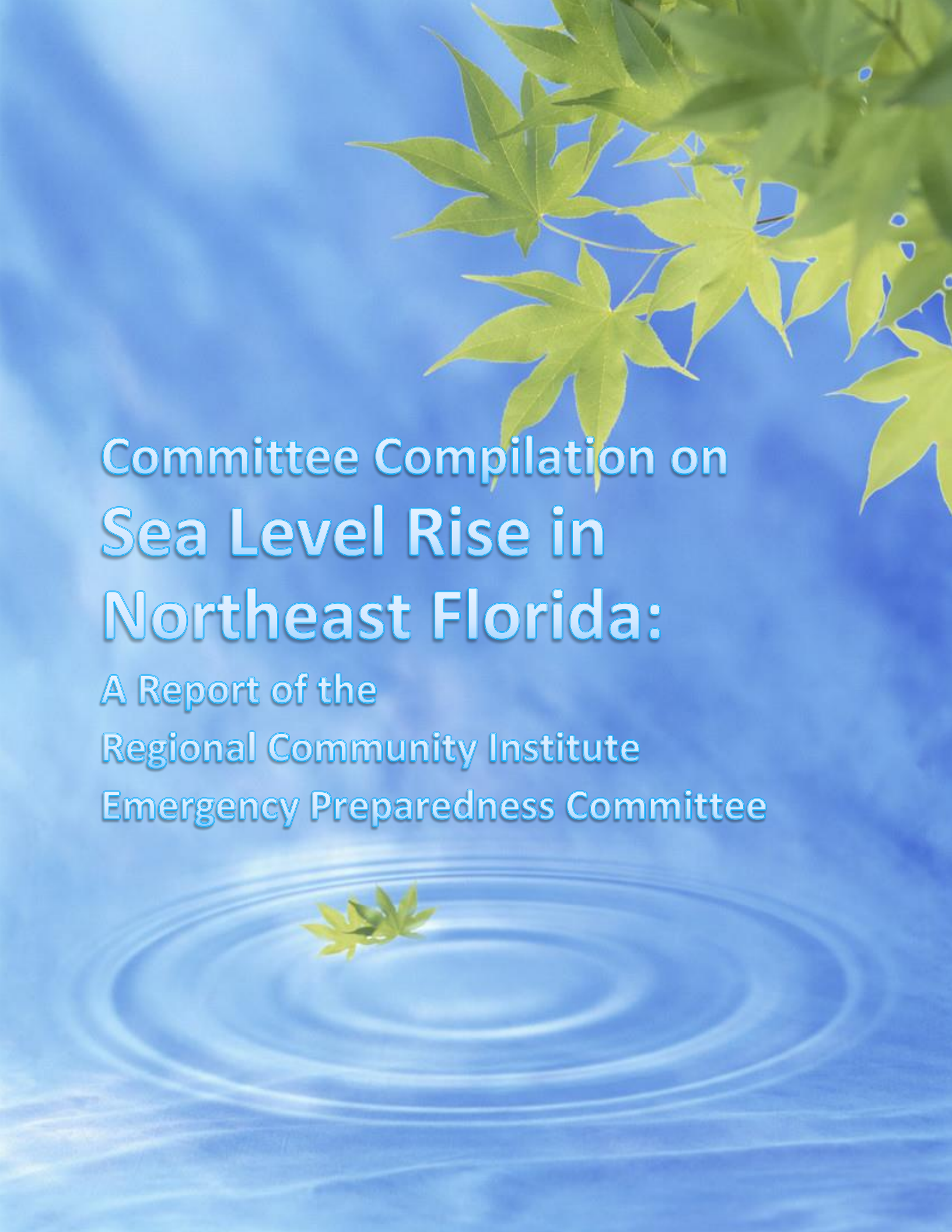

Committee Compilation on Sea Level Rise in Northeast Florida:

A Report of the Regional Community Institute Emergency Preparedness Committee

Contents

Background 2

Assumptions and Scenarios for Level of Rise and Timeframes 3

Community Resiliency Assessments: Observations 10
- Vulnerability of Community Assets 11
- Mitigation Measures 11
- Social Systems 12
- Stakeholders 12
- Background 12

Policy Recommendations and Action Items 13
- Monitoring Sea Level Rise 13
- Risk Assessment 15
- Land Use 16
- Adaptation and Public Infrastructure. 19
- Protecting Water Quality 21
- Standard Storm Water Management and Low-Impact Development 23
- Water and Wastewater Systems 24
- Natural Systems and Diversity 25
- Protected and Vulnerable Species in Upland and Coastal Habitats 25
- Protected and Vulnerable Species in the St. Johns River and Aquatic Habitats 26
- Agricultural Lands 27
- Natural Resource Acquisition 27
- Natural Resource Management 28
- Public Outreach 28
- Risk Mitigation 30
- Long Term Regional Resiliency 33
- Federal or State Leadership Could Help Us to Accomplish Goals 38

Distinguished Presenters and Experts 41

Appendix 1 42

Appendix 2 44

Appendix 3 45

Committee Compilation on Sea Level Rise in Northeast Florida: A Report of the Regional Community Institute Emergency Preparedness Committee

September 2013

Background

The ***Regional Community Institute of Northeast Florida, Inc***. (RCI) is a non-profit created by the Northeast Florida Regional Council (NEFRC) to consider policy issues. In January 2012, NEFRC put out a call for information and opinions related to climate change in Northeast Florida, in response to an action item contained in First Coast Vision, the 2011 RCI-created vision for growth and development in Northeast Florida for the next 50 years. The overwhelming response to the outreach on climate change was information and opinions related to sea level rise. In August 2012, NEFRC assigned sea level rise as a policy issue to RCI. RCI assigned the topic to its Emergency Preparedness Committee. Their one-year work program included determining whether the seven county region (Baker, Clay, Duval, Flagler, Nassau, Putnam, and St. Johns counties) is vulnerable to sea level rise. If they deemed the region vulnerable, they were to review the available information and make assumptions as to range and level of rise and planning timeframe. They were then to work with coastal or waterfront local governments on community resiliency assessments, using the assumptions. Their final task was to take the best practices and lessons learned from the local government experience and make policy recommendations to the NEFRC in September 2013.

RCI's first action was to assemble a working committee of volunteers from diverse perspectives and with relevant experience and knowledge. This effort was introduced at a well-attended meeting on November 8, 2012. Participants expressed their interest in and recommendations for committee membership. Ultimately, the RCI Emergency Preparedness Committee on Sea Level Rise in Northeast Florida was formed, with the membership listed as Appendix 1.

The first decision the Committee was required to make was whether the region was vulnerable to sea level rise. At their January 2013 meeting, the Committee was given a presentation by Glenn Landers, P.E., of the US Army Corps of Engineers (USACE), which included information

regarding historic levels of rise from tidal gauges and the guidance that federal agency is currently using as they consider the impacts of sea level rise related to projects. Mr. Landers provided the following summary to the Committee after his presentation:

- Global sea level rise is caused by three things – thermal expansion of ocean waters as part of overall global warming, melting of ice and snow currently on land, and modern groundwater withdrawals around the globe for agriculture and other uses. (The last item has a small influence and 99% of SLR is caused by the first two items.)
- SLR projections vary depending on the assumptions of different authors, but rules and laws do not impact SLR projections. Different communities may pass different rules and laws regarding SLR adaptation planning and building requirements.
- Building on guidance from the National Research Council of the National Academies of Science, the U.S. Army Corps of Engineers considers three plausible future sea level rise scenarios. These scenarios are (1) a historic rate of sea level change, (2) an intermediate rate of sea level change (based on NRC Curve 1), and (3) a high rate of sea level change (based on NRC Curve 3). All USACE sea level change projections include adjustments for local uplift or land subsidence, if needed.
- The St. Johns River has a very flat water surface slope to the ocean, and may be highly vulnerable to salinity changes due to the combined impacts of SLR, droughts, increasing water withdrawals, navigation projects, pollution, and other factors. Need to consider the value of the river as a freshwater body versus a brackish to saltwater body, and what might be done to slow or minimize this change.
- Adaptation planning needs short and long-range goals. Consider existing developments, and how to provide appropriate exit strategies as needed. Need long range risk reduction plans to help encourage development in lower risk areas.

Based on this discussion, the Committee agreed that the region is vulnerable to sea level rise.

Assumptions and Scenarios for Level of Rise and Timeframes

The next Committee task was to decide on working assumptions to use in policy consideration and especially in the next phase of work, Community Resiliency Assessments.

Mr. Landers presented the assumptions being used by US Army Corps of Engineers (USACE) and by the SE Florida Regional Climate Change Compact. He later provided the Committee with assumptions that were based on more local data, such as the tide gauges at Fernandina Beach and Mayport, as well as a comparison of estimates of global sea level rise. Figures 1-6 were provided by Mr. Landers on behalf of the USACE.

Historic Relative Sea Level Change - Florida Atlantic Coast	
Relative Sea Level Change = Estimated Global Sea Level Trend (1.7 mm/yr) + local Vertical Land Motion Reference: NOAA Technical Report NOS CO-OPS 065, *Estimating Vertical Land Motion from Long-Term Tide Gauge Records*, May 2013	
Tide Station (# and Name)	**mm/yr**
8720030 Fernandina Beach	2.30
8720218 Mayport	2.29
8721120 Daytona Beach *(Inactive)	2.32*
8723170 Miami Beach *(Inactive)	2.39*
8723970 Vaca Key **(<40 years)	2.90**
8724580 Key West	2.20

Figure 1 – Historic Relative Sea Level Change

Florida Atlantic Coast Tide Elevations (Starting Elevations) for Relative Sea Level Rise Scenarios, feet (NAVD88)

Source: http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=Datums&state=Florida&id1=872

NAVD88 = National Vertical Datum of 1988 ; MHHW = Mean Higher High Water
MSL = Mean Sea Level; HAT = Highest Astronomical Tide predicted for current 19-year tidal epoch

Tide Station (# and Name)	NAVD88	MSL	MHHW	HAT
8720030 Fernandina Beach	0.00	-0.53	2.74	4.38
8720218 Mayport	0.00	-0.53	1.94	3.35
8721120 Daytona Beach	0.00	-0.11	2.22	Inactive
8723170 Miami Beach	0.00	-0.96	0.33	1.53
8723970 Vaca Key	0.00	-0.83	-0.36	0.35
8724580 Key West	0.00	-0.87	0.05	0.89

Figure 2 – Florida Atlantic Coast Tide Elevations

Figure 3 - Relative Sea Level Rise Scenarios for Mayport, FL

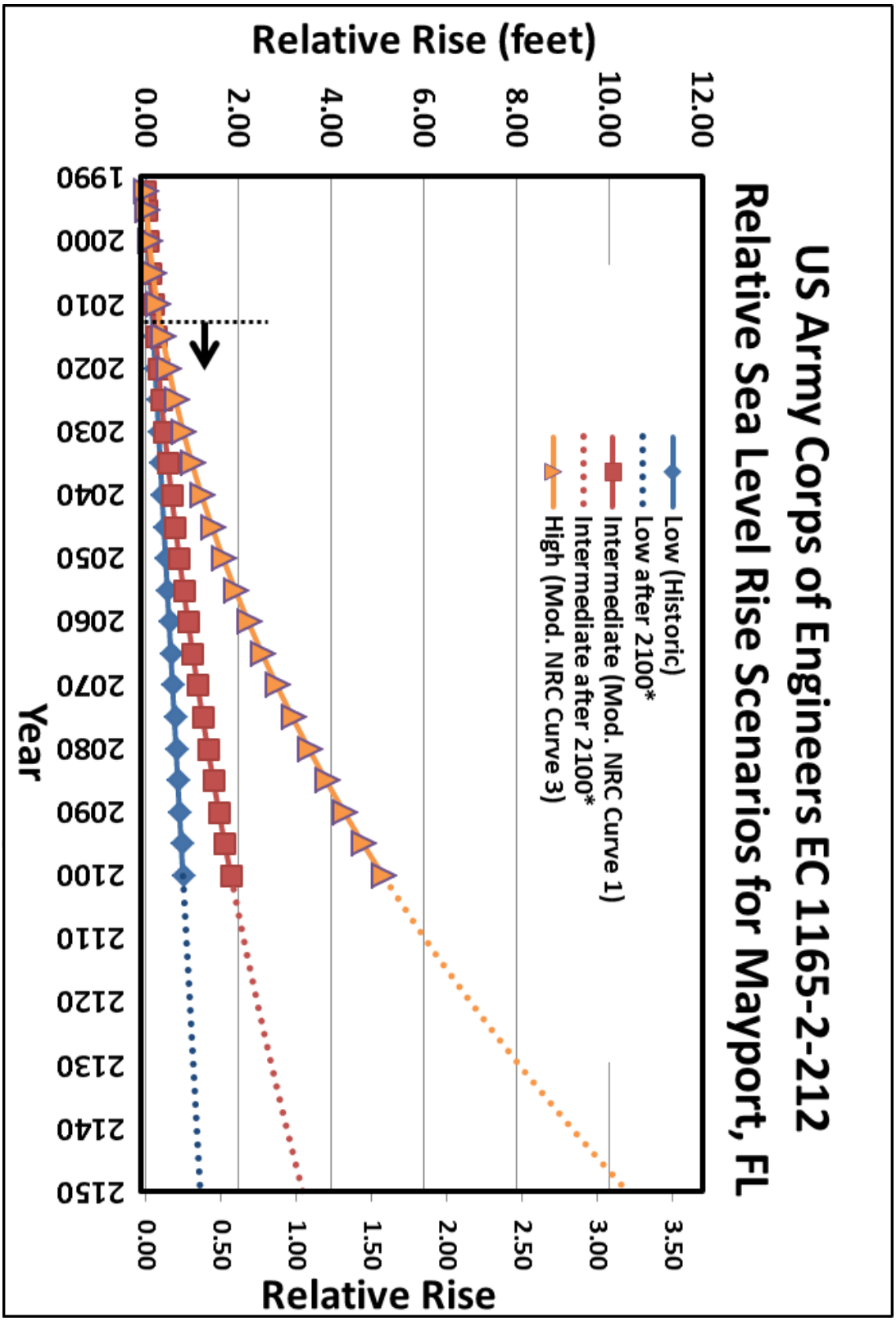

Figure 4 - Relative Sea Level Rise Scenarios for Mayport, FL

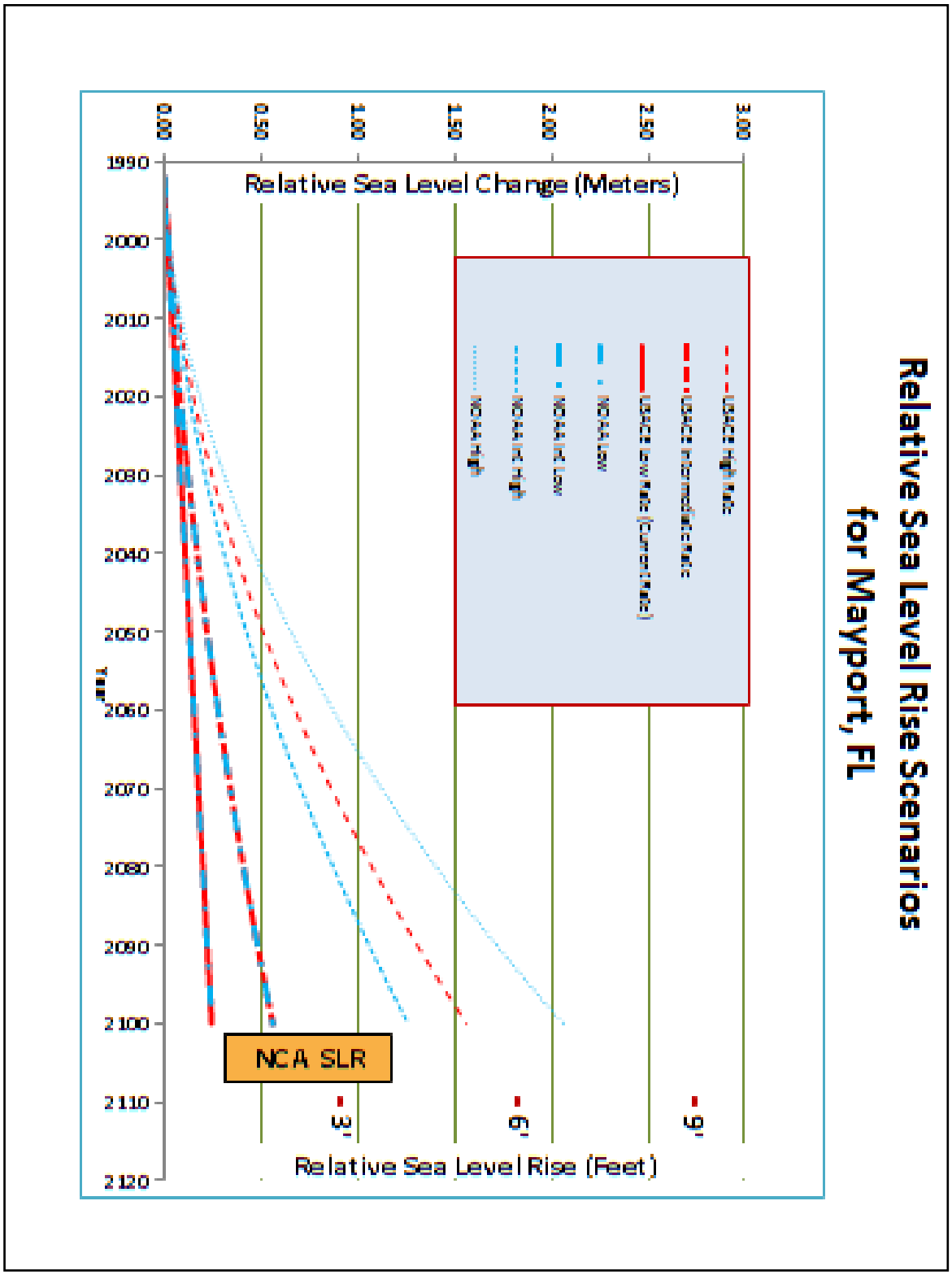

Figure 5 – Relative Sea Level Change Scenarios

Relative Sea Level Change Scenarios for Mayport, FL (feet)

Year	USACE NOAA Low	USACE Int. NOAA Int-Low (Mod. NRC Curve I)	NOAA Intermediate High	USACE High (Mod. NRC Curve III)	NOAA High	National Climate Assessment Draft Jan. 2013
SLR Scenario	Local Historic SLR	Global SLR +0.5m by 2100	Global SLR +1.2m by 2100	Global SLR +1.5m by 2100	Global SLR +2.0m by 2100	Global SLR +0.3m to +1.2m
1992	0.0	0.0	0.0	0.0	0.0	
2010	0.2	0.2	0.2	0.3	0.3	
2060	0.5	0.9	1.8	2.2	2.9	
2100	0.8	1.8	4.1	5.1	6.8	1.0 to 4.1
2110	0.9	2.1	5.6	6.0	8.0	

Notes: USACE projections are for historic, modified NRC Curve I and modified NRC Curve III rates of sea level change developed for Northeast Florida per USACE Engineering Circular (EC) 1165-2-212. This EC is based on guidance in the National Research Council (NRC) report, *Responding to Changes in Sea Level; Engineering Implications* dated September, 1987. The projections are developed using the historic rate of sea level rise at Mayport as reported by NOAA (2.29 mm/yr). NOAA projections use the same EC equations modified for different global SLR scenarios. The NRC, USACE and NOAA guidance documents do not address dates beyond 2100. All projections start from 1992 control for the national survey datum per EC 1165-2-212. NOAA guidance: http://cpo.noaa.gov/Home/Home/AllNews/TabId/315/ArtMID/668/ArticleID/80/Global-Sea-Level-Rise-Scenarios-for-the-United-States-National-Climate-Assessment.aspx National Climate Assessment, Draft Report for Public Review, Jan 2013: http://ncadac.globalchange.gov/

Comparison of Peer-Reviewed Research Estimates: GLOBAL Sea Level Rise by 2100

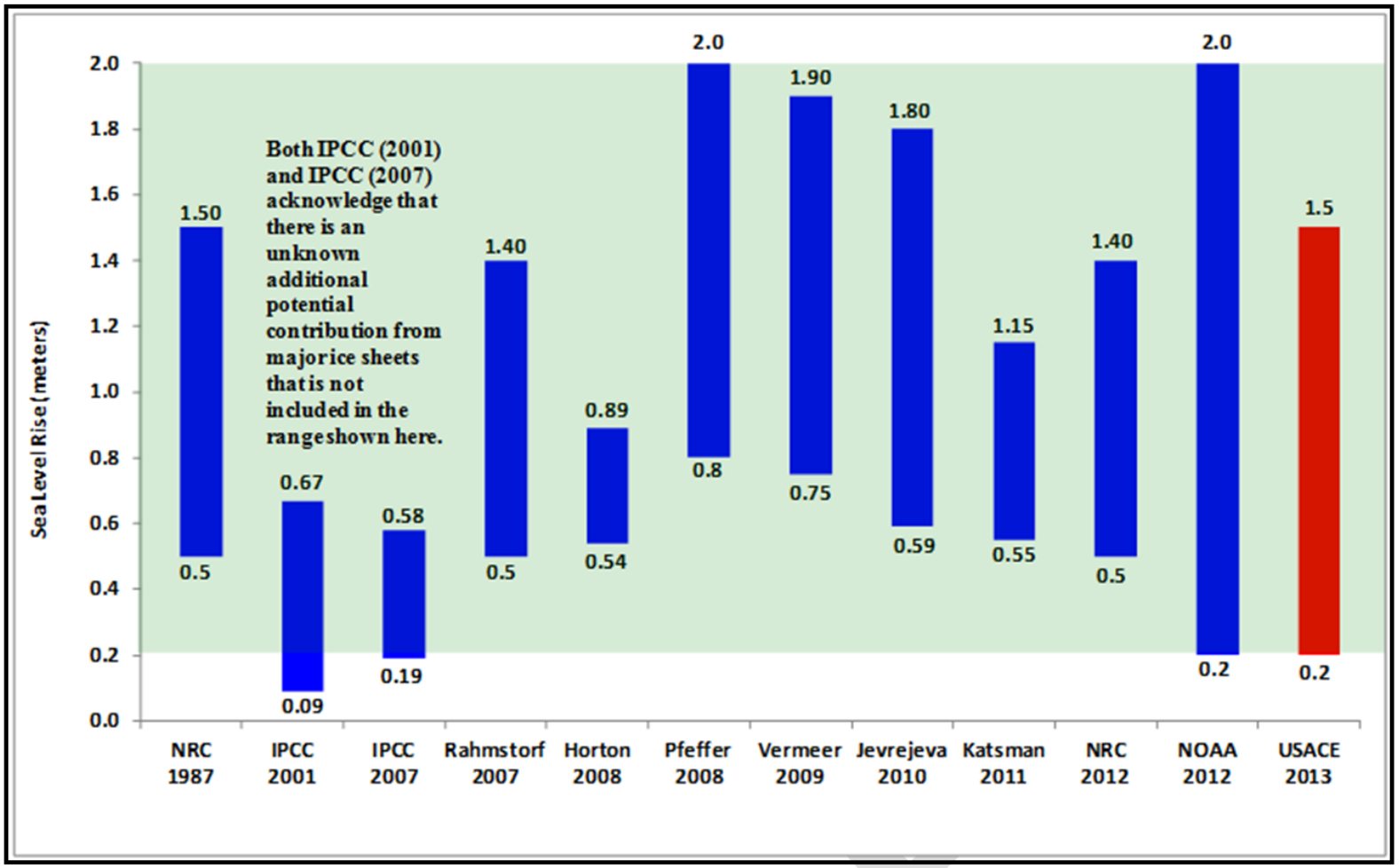

Figure 6 – Comparison of Estimates of Sea Level Rise

While current USACE guidance utilizes an upper limit of 1.5 m sea level rise by 2100, 2 m is also recognized as a reasonable upper limit.

Update: While considering recommendations, the Committee became aware of a report related to Southeast Florida: Southeast Florida's Resilient Water Resources: Adaptation to Sea Level Rise and Other Impacts of Climate Change, Center for Environmental and Urban Solutions, FAU, 2009. This report says that sea level rise of 3 to 6 inches could intensify saltwater intrusion into potable water sources, and compromise the effectiveness of coastal flood control structures, reducing their capacity by 20 to 40% by 2030. As the Committee was not able to do independent analysis such as that done by Southeast Florida, it was decided that the Committee would recommend that going forward, where appropriate to the circumstances, Northeast Florida consider the impacts of 6 inches of rise, in case our region shares some of the vulnerabilities of Southeast Florida.

The Committee also received a briefing on the work being done in the region related to sea level rise in Matanzas Basin. In February, 2013, Ms. Emily Montgomery, former Coastal Training Coordinator for the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM NERR), gave an overview of the three year project underway with the University of Florida to understand the implications of sea level rise on the natural resources (in particular) of the Basin, as well as other impacts. The project identified 3' of sea level rise as the level at which significant impacts to the Basin occur, and is using that level for analysis.

In light of the information from USACE and GTM NERR, the Committee agreed to base its assumptions on the USACE guidance but to take into account the findings related to Matanzas Basin. For the purposes of Community Resiliency Assessments, the Committee agreed to consider 1' to 3' of rise by 2060, and 3' to 6' of rise by 2110. Using 1' to 2' of rise by 2060 would have been closer to USACE guidance, but it was decided that it would be more useful to use a data point that could be used for comparison with the Matanzas Basin project.

Observation and Action

Achieving a goal of universal participation in the CRS is an area where a regional approach and partnerships may make a difference.

Community Resiliency Assessments: Observations

Rather than perform a regional resiliency assessment of the vulnerability of regional and community assets the committee felt to be important, the committee left it to communities to identify the assets they wanted to consider in the context of sea level rise. In an effort to begin a dialogue with local government representatives, the Committee proposed a free Community Resiliency Assessment to all local governments in the region. Planning staff were asked to decide what assets they wanted depicted

on a map, to which 1', 3', and 6' of sea level rise would be applied and discussed at a meeting. The meeting would also cover what mitigation approaches were already in use by communities, the existing social systems, what stakeholder groups were represented at the meetings, and some background on community experience with sea level rise and insurance. The intent of the assessments was to begin a dialogue on vulnerability to sea level rise. Each meeting began with a review of the caveats. The 1', 3', and 6' coverage used to show sea level on the maps only show the sea rising related to elevation, and as such, only provide an indication of potential vulnerability. Decisions should not be made regarding specific sites based on this effort, but one of the more robust tools available should be used to do further analysis. The maps produced would be available to the communities but would not be included in the final RCI report. Ultimately, 9 communities participated in a Community Resiliency Assessment. They were: Atlantic Beach, Fernandina Beach, Green Cove Springs, Jacksonville Beach, Nassau County, Neptune Beach, Palatka, Palm Coast, and St. Johns County.

Observation and Action

All parts of the community are important. This includes participation in both learning about sea level rise and deciding what to do about it. If communities cannot easily rely on social systems in all sectors, those sectors might be addressed at a regional level. It was noted that many of the cultural and ethnic organizations in our area are regional and have the ability to reach out to members in local communities. Universities also have a regional reach, and it may be appropriate for the regional council to establish partnerships with both types of entities.

Vulnerability of Community Assets

As these were completely at the discretion of each community and came from different sources, no fair comparisons can be made between communities. In general, most communities chose as community assets for this planning effort a list similar to the critical facilities considered in county local mitigation strategies. Several added other categories to that basic list. Overall, communities identified assets in the following categories: Bridges/Roads, Police/Fire, Electrical Substations, Water/Sewer Facilities, Schools, Public Buildings, Parks/Cultural Sites, and Hospitals/Nursing Homes/Assisted Living Facilities, Churches and Mobile Home Parks.

Mitigation Measures

As a region with a strong perception of vulnerability to flooding among its planners, it was not surprising to learn that there is strong familiarity with mitigation approaches. All communities participate in the National Flood Insurance Program and participation in the Community Rating System (CRS) program is widespread but not universal (see Appendix 2). Failure to participate in the former could mean that that flood insurance is simply not available in that jurisdiction, which has implications for bank financing of real estate. Communities may find participation in

CRS onerous, but failure to participate results in higher flood insurance rates in their communities.

> ***Observation and Action***
> Participants recognized there are communities that are already using adaptation techniques or mitigation strategies that are working. We can use that regional experience as the basis for strong recommendations based on success.

Social Systems

Using as a model an assessment tool[1] developed for the Gulf Coast by the National Oceanic Atmospheric Administration (NOAA) and Sea Grant, questions were asked about the social systems existing in each community, to give the Committee some guidance as to approaches that might use these systems as they consider recommendations. Most communities identified strong systems in the areas of faith-based, neighborhood, business and civic networks, and noted a strong involvement of the community in schools. Not all were able to indicate that they had strong networks based on ethnic or cultural identity or that that students or universities were strongly involved in the community.

> ***Observation and Action***
> There was lively discussion at each assessment about planned improvements and the lifespan of existing community assets. It was expressed that a tool to assist with identifying the options for types of assets and quantifying the costs and benefits associated with each would be of use.

Stakeholders

As the assessments were only a first step and public education has not really begun in Northeast Florida, the Committee consciously designed them for public officials. Planners, city engineers, public works staff, and utility staff made up the bulk of participants at assessments. Elected officials and police attended one assessment, which was held as a noticed public meeting.

Background

The final assessment questions were baseline but very informative. A few communities were already considering sea level rise. One is looking at replacing a public building very near the water, and has added potential for sea level rise as a consideration based on the assessment. One has already incorporated sea level rise assumptions (based on USACE guidance) into their storm water management plan, and requires a minimum floor elevation of 8.5’ for any new structure, which is higher than the minimum requirement in some parts of the city. One builds roads at a minimum elevation of 2’ above peak seasonal high tide. One has a policy requiring planning for sea level rise in their comprehensive plan. Most have seen insurance companies withdraw from their areas.

[1] Coastal Resiliency Assessment, available at masgc.org/ri

Policy Recommendations and Action Items

Policy recommendations came from one of two sources in this policy effort. They either were recommended by one or more participants at a community resiliency assessment, or were recommended by the Committee. In some instances, subcommittees went beyond the impacts of sea level rise and recommended policies that might address its causes. All are worthy of consideration in Northeast Florida.

Recommendations differ from action items. Recommendations are policies that are appropriate for implementation or inclusion in plans, once they have been considered and individualized to suit the region, a particular community, or an individual. Action items are strategies that can be implemented now, at the discretion of a clear "owner".

We Learned About Monitoring Sea Level Rise

There is a balance to be struck in this area. Work is being done throughout the world on the topic of sea level rise, by many entities using various approaches. This allows skeptics to rightly observe that we do not know what will happen, and a great deal of time and effort could be spent keeping abreast of all of the work being done. The approach the committee used for assumptions and scenarios was to hear from credible regional experts and agree on assumptions that allow the region to consider a range of scenarios, so that decision makers can make informed choices. It was agreed these scenarios should be revisited as significant new information or tools become available, but not so frequently as to be onerous. If the rate of sea level rise accelerates from historic levels of the last 100 years, as we believe it will, this trend will be observable and will influence scenarios. In the near term, however, recommending that decision makers consider the consequences of their decisions if there is SLR of 6", 1', 3' and 6', depending on the nature and lifecycle of the

NEFRC should include regional maps of 6", 1', 2', 3', and 6' of sea level rise in the vulnerability maps called for in the Strategic Regional Policy Plan.

investment being considered, can only encourage more resiliency in the assets of the region.

Consider:

- Collaboration with other regions, states, and agencies in the Southeast to compare trends and data.
- Continued collaboration between local governments, the state, public/private partnerships, community and advocacy groups to share trends and data.
- Observation of growth and migration trends in the Southeast, to determine if Northeast Florida is taking advantage of growth opportunities in non-vulnerable areas.
- Reviewing trends at regular intervals, to see if they indicate a change of scenarios. The following, at a minimum, are recommended to be considered as key parameters:
    a. rate of sea level rise
    b. saltwater intrusion boundary and monitoring wells
    c. landscape-level vegetation patterns
    d. water temperature and pH levels
    e. occurrence and range of invasive and exotic plants and animal species, and marsh grasses.
- Regional support for the establishment of a formal coordination program with the NOAA regarding trends in rainfall patterns.
- Monitoring of water temperature, salinity, and tidal patterns.
- Monitoring changes in rainfall patterns to better predict future wet-season and dry-season rainfall as well as the salt content of the wells of agricultural lands.
- The Northeast Florida Sea Lake and Overland Surge from Hurricanes (SLOSH) Basin has been greatly refined from its older iterations. Previously, the Jacksonville Basin utilized in the 2010 Northeast Florida Regional Evacuation Study contained 7,885 grid squares. The newly released 2012 Jacksonville Basin contains 126,160 grid squares. Smaller grid squares are used in denser areas, allowing for greater precision. The Northeast Florida/Jacksonville Basin is now one of the finely resolved Basins in the Nation. Bear in mind this data opportunity as tools are needed or refined and as emergency preparedness and growth management planners work more closely together on sea level rise, and bridge the gaps between data sets.

We Learned About Risk Assessment

While community resiliency assessments could not be considered definitive on the vulnerability of any specific community asset, they provided invaluable guidance to the committee in this area. One observation points to a recurring theme, that of the need for collaboration between community and emergency planners. Most of the assessment communities identified critical facilities as defined in emergency plans as community assets. In some cases, counties and utilities control this data more closely than other public data because it is used by emergency managers and homeland security professionals, and raises security issues. This may make it difficult for community planners to access data.

There was, in our assessment experience, a strong link between the categories of assets chosen by Northeast Florida communities and emergency preparedness categories that are frequently considered for their vulnerability, many of which are publicly owned or contain populations most vulnerable in an emergency. This is a logical place to start. Further vulnerability assessment will be required to review the potential for impact to assets, which can affect the residential and commercial tax base.

It was clear from the assessment discussions that communities have been considering floodplain and vulnerability to storm surge in their infrastructure siting decisions, thereby limiting the risk to publicly owned community assets. With tools and expertise that can combine sea level rise with what is already being considered, communities can continue to limit their risk.

There is a current program by the Jacksonville Marine Transportation Exchange (JXMTX) with the NOAA in cooperation with the Jacksonville University (JU) Marine Science Research Institute (MSRI) to collect and study data and trends for biological communities. Physical Oceanographic Real-Time Sensors (PORTS) will be monitored by the National Weather Service and will go online later this year.

Consider:

- In the short term, for the purposes of vulnerability assessment in Northeast Florida, consider 6" of rise by 2030, 1' to 3' of rise by 2060, and 3' to 6' of rise by 2110.
- Performing vulnerability assessments for all coastal and inland communities susceptible to flooding. These assessments should consider the vulnerability of people and private property, the natural and built environment, public infrastructure; and opportunities to build adaptive capacity. Such assessments should be done with knowledgeable members of the community: the Emergency Preparedness Officer, Public Works, Building Official, Floodplain Manager, and Planning and Zoning Official. The process should be inclusive and incorporate not only local governments, but Federal, State, and regional organizations with related functions, U. S. Navy installations, the Jacksonville Port Authority, regional utilities, the business and development communities, and the environmental community.
- The various county and municipal government offices are organized differently, so some of these capacities may be carried out by the same individuals. It is also important to include a representative of the local electric utility and the water and sewer authority.
- Performing vulnerability assessments for all regional assets: ports, airports, power plants, water and sewer treatment facilities, hospitals, military bases, and transportation infrastructure including roads and bridges. Consider life cycle of investments and structures. Inform the local governments, owners, and operators of these assets of the assessment results.
- Once community and regional vulnerability assessments are complete, begin a community dialogue on the results and the options to address possible scenarios.

We Learned About Land Use

As described on the Florida Department of Economic Opportunity (DEO) website (**http://www.floridajobs.org/fdcp/dcp/AdaptationPlanning/AAAPolicy.pdf**), the 2011 Florida Legislature passed the Community Planning Act making significant changes to the state's growth management laws, including the addition of optional adaptation planning for coastal hazards and the potential impacts of SLR. The defined Adaptation Action Area is an optional comprehensive plan designation for areas that experience coastal flooding and that are vulnerable to the related impacts of rising sea levels.

In January 2011, NOAA approved the Florida Coastal Management Program's strategy, including a funded DEO initiative to address "Community Resiliency: Planning for Sea Level Rise." This five-year project will examine the statewide planning framework and determine how to best integrate adaptation into existing processes and how to coordinate adaptation efforts

statewide and field test the guidance by developing adaptation plans for two pilot communities.

Within the Northeast Florida region is a multi-tiered array of public and private planning entities and activities at the Federal, State, regional, and local levels which should be integrated with local public planning for SLR. At the Federal level the U. S. Army Corps of Engineers, local military installations, and floodplain delineation and emergency preparedness are notable examples. Notable at the State or district level are coastal zone, natural resources, water supply and quality, wastewater, and transportation planning and management. The public regional planning entity is the Northeast Florida Regional Council. Other significant entities include the water management district, utilities, ports, the business and development communities, and the environmental community.

Public land use planning and management is a key to minimizing the impacts of SLR, optimizing community response, and creating a compelling vision of community resilience in Northeast Florida. The key to developing a coordinated and continuing framework integrating the multi-tiered and diverse planning entities and activities in the region is to develop an inclusive, continuing SLR planning framework with the capacity to monitor and alter related land use planning activities to changes in rates of SLR and the results of implemented management measures.

It is important that emergency management planning and land use planning be aligned. The Local Mitigation Strategy (LMS) is a plan developed by counties to reduce and or eliminate the risks associated with natural and man-made hazards. These plans must, in accordance with the Disaster Mitigation Act of 2000 (DMA 2000), be a mechanism for collaboration between state and local entities that encourages pre-disaster planning, recognizes need for mitigation, and designates funding for projects through Federal grant opportunities. The Florida Division of Emergency Management Mitigation Planning Unit assists counties in the update and review process of the LMS. They serve as a resource for technical advice, knowledge of funding sources, and general information regarding hazard mitigation. Without an approved LMS a county will be unable to apply for many Federal grants, and the LMS must be updated every five years to remain compliant.

The local comprehensive land use planning process and its tools for implementation—zoning and building codes, development codes, capital improvements programs, floodplain ordinances, transportation and utility plans—will be the primary framework for the guiding development and redevelopment to minimize the impacts of SLR over an extended time period. Within this framework, local governments may study and identify potential SLR impacts (erosion, flooding, and storm surge), assess area vulnerabilities; designate areas requiring special protection; site future public infrastructure outside vulnerable areas; identify the

specific land-use tools that will be used to respond to SLR threats in different areas; and create a schedule for implementation.

Local public land use planning activities to address SLR should initially be conducted within the current land use planning and management structure. As a first step to implementing adaptation tools, local governments may amend their comprehensive plans. A 2011 amendment to the Community Planning Act [§163.3164(1) F.S.] has added the option of identification and designation "adaption action areas" in the coastal management element of a local government's comprehensive plan for areas that experience coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea levels. In such areas [§163.3177(6)(g)(10) F.S.], the local governments may consider policies within the coastal management element to improve resilience to coastal flooding resulting from high-tide events, storm surge, flash floods, storm water runoff, and related impacts of sea-level rise. Criteria for the adaptation action area may include, but need not be limited to, areas for which the land elevations are below, at, or near mean higher high water, which have a hydrologic connection to coastal waters, or which are designated as evacuation zones for storm surge.

In their *Regional Climate Action Plan*, the Southeast Regional Climate Change Counties recommended that the definition of Adaption Action Areas (AAA) be incorporated into municipal and county comprehensive plans and that existing or new vulnerability analysis be conducted to identify areas and critical facilities or systems vulnerable to sea level rise, tidal flooding, and other related impacts of climate change. The vulnerability assessment conducted by the Southeast Florida Regional Climate Change Compact, Analysis of the Vulnerability of Southeast Florida to Sea Level Rise (http://southeastfloridaclimatecompact.org/pdf/vulnerability-assessment.pdf) describes the elevation-related datasets and mapping methods used by the Compact Counties and the South Florida Water Management District (SFWMD) to develop regional sea level rise (SLR) inundation vulnerability surfaces. They also identified planning parameters that would be part of the regional SLR vulnerability assessment such as physical features (e.g. power plant, schools, hospital, emergency shelters etc.) and the result of analysis (e.g. taxable value of property, land use, habitats etc.).

They suggested the determination of three areas:

1. *Adaptation Areas*–designate areas within the AAA that include developed vulnerable land targeted for infrastructure improvements or modified land use and/or development practices in order to reduce risks and improve hazard mitigation. In these areas, the high cost of retrofitting, building and maintaining infrastructure is outweighed by the return on investment.

2. *Restoration Areas* - designate areas within the AAA that include vulnerable lands that may or may not be already developed and could include Coastal High Hazard Area and high storm surge areas. Local governments should place priority on the acquisition of land in these areas for restoration, agriculture, or recreational open space.
3. *Growth Areas*–to consist of areas outside of the AAA where growth is encouraged due to higher topographic elevations and the presence of existing transportation infrastructure. These designated areas should be developed with Urban Design guidelines that address character of urban place and provide a high quality pedestrian experience through landscaping, and the creation of public space.

Consider:

- To ensure that Northeast Florida can access technical assistance and funding that may become available, develop an "Adaptation Action Plan" for areas subject to flooding and sea level rise outlining strategies to target infrastructure improvements, new infrastructure, modify land use and/or development practices to reduce vulnerability and/or improve community resilience. Local governments and NEFRC should incorporate this into their comprehensive plans and the strategic regional policy plan.
- Incorporate evacuation, relocation, and redevelopment strategies into regional and jurisdictional Comprehensive Plans (including Future Land Use Element/Map & Capital Improvement Plan), TPO Long Range Transportation Plan, and Local Mitigation Strategies.
- Public planning and adaption strategies should both address sea level rise and the potential effects of severe weather events such as hurricanes.

We Learned About Adaptation and Public Infrastructure.

Public land use planning to address sea level rise should be conducted within and inclusive, coordinated multi-tiered framework with an essential continuing structure and program capable of making the adjustments explicit in an adaptive public planning process. The process should be initially conducted within the current organization of public planning processes and tools and the State's statutory authority for adaptation planning for coastal hazards and the potential impacts of sea level rise.

Adaptation to sea level rise is the steps a community takes to become more resilient to the impacts of rising seas over a period of time. The three main strategies a community may use to adapt are:

1. *Protection*--allows "hard" and "soft" structurally defensive measures for location dependent areas and critical structures or systems and continued development of new structures in vulnerable areas.
2. *Accommodation*--allows continued development of new structures but manages risks by conditioning development to require that structures be built or retrofit to be more resilient to SLR impacts.
3. *Retreat and Redirection*—involves the actual removal of existing development and possible relocation to other areas, the prevention of future development in these high risk areas, and redirection of new facilities, systems, and development to areas which are projected to be safe for the useful life of the projects.

Public land use planning and implementation for SLR should reflect the constraints of Northeast Florida's geology and topography and integrate the benefits and protection of natural systems and resources. Northeast Florida is underlain with porous sedimentary layers and transmissive groundwater movement, which could inhibit the effectiveness of "hard" management, practices. Areas with relatively flat terrain will be especially vulnerable to incremental increase in sea and river levels, particularly for areas adjacent to the extremely low gradient upper section of the St. Johns River and tributaries.

In addition to guiding future growth from high-risk locations, public land use planning for SLR should also address specific related or functional components as: protection of beneficial natural systems and services, existing and planned public utilities and services, transportation, emergency preparedness and management and the identification and protection of critical infrastructure and services; proactive management of existing and projected vulnerable areas; and post-disaster management of vulnerable areas.

Consider:

- As identified at community resiliency assessments, long range projects that are being considered now should be reviewed in the context of sea level rise, so that community assets are not created in areas where they will be vulnerable, but are located in areas that ensure their long term viability.
- Based on vulnerability analysis, develop strategies for hardening or relocation, and redevelopment of impacted infrastructure.
- The North Florida Transportation Planning Organization should address sea level rise and adaption in the 2045 update of the Long Range Transportation Plan.
- FDOT should set an example for local governments by modifying or developing new design standards for transportation infrastructure located in vulnerable areas to include environmentally supportive road materials, bridge design, elevation, and storm water management. These designs should include different pitches combined with storm water design to effectively remove water from the roadway and explore roadway materials that may be utilized in road construction that are more tolerant of extended periods of extreme temperature.
- Encouraging government at all levels to begin immediately limiting development and investment in areas identified by the US Army Corps of Engineers as being at risk of 2" to 7" sea level rise by 2030 to reduce the financial and physical loss of public infrastructure.
- The implications of location of utility infrastructure underground should be considered in the context of sea level rise.

We Learned About Protecting Water Quality

A sustainable water supply is essential for the continued environment and economic health of the area. The region depends for its potable water on a network of underground sources, both near surface and deep, the most important of which is a porous deep limestone stratum called the Floridan Aquifer. Most water withdrawal from the Floridan Aquifer is through consumptive use permits issued by the St. Johns River Water Management District.

Rainfall is also a significant component of any water use policy. Sea level rise may also bring about associated changes in rainfall patterns including frequency, quantity, and intensity in any given rainfall event or even seasonally. The extent of such changes cannot be known, but planning and alternative water usage should be considered

Sea level rise will present challenges to any future water supply planning and water management efforts. The influences of changing rainfall patterns, groundwater elevations, and sea level rises will present complex situations that will require innovation and creative planning

for to regional and local efforts to provide effective flood control, sustainable water supplies; and storm water and wastewater management.

A long-term challenge to a viable groundwater regime is salt-water intrusion, in which seawater is able to percolate into fresh water strata because of either an increase in salt-water pressure, or a decrease of fresh water pressure. While many factors affect hydrostatic pressures, two primary causes of a pressure drop on the fresh-water side result from development: increased demand and reduced supply.

As sea levels rise over time, salt-water pressure will only increase. Since the reduction of fresh water pressure is partly the result of policy decisions made above the surface, municipalities may want to consider the long-term impact of their storm water policies on protecting the water supply.

Consider:

- A regional inventory of existing potable water, wastewater, and storm water treatment systems, including an assessment of the status of each component with strategies developed for utilities and/or infrastructure, which may require replacement, reinforcement, or relocation to ensure the long-term viability of the system.
- Developing an effective water use policy that combines the consumptive use permitting process with innovative and meaningful alternative water sources including increasing reuse and storm water storage.
- Identifying opportunities for reuse and recharge that will offer beneficial uses of storm water and reclaimed water to reduce potable water demands and provide aquifer recharge and implement as appropriate, as an alternative to disposal. These can include incentives for individual homes and small businesses to use small cisterns or water storage systems for non-potable water needs.
- Evaluating the impacts of rising sea and groundwater levels on soil storage, infiltration rates, and inflow to storm water and wastewater collection and conveyance systems.

In 2010, the City of Jacksonville began developing a Low Impact Development Manual for Duval County, in cooperation with state agencies and area stakeholders. The manual is part of a larger effort to promote "green infrastructure" to address a variety of environmental issues. The Manual is being added in 2013 to the City Design specifications and to the Land Development Procedures Manual (Redbook) as an option for developers, engineers, and planners, and will be available on the City web site. Communities in Northeast Florida can use this work as a model.

In addition, LID has been mandated for all Federal agencies by Act of Congress since 2007, and numerous existing BMPs have been installed at Naval Air Station Jacksonville. The installation's Environmental staff can provide site visits and information by prior arrangement.

- Considering regional projects and opportunities to gain efficiencies through collaborative approaches and projects.
- Expand JEA's reclaimed water network in order to reduce demand from Floridan Aquifer
- Promote reclaimed water programs at corporate and residential levels.
- Encourage rainwater-harvesting programs, which reduce demand for withdrawal from the Floridan Aquifer.
- Do storm water planning based on ultimate development. Plan based on future conditions. Offer density bonus to stay out of floodplains.

We Learned About Standard Storm Water Management and Low-Impact Development

All construction increases the impervious surfaces on a site (e.g., roofs and pavements), and thus increases the storm water runoff. Under prevalent storm water practice, this runoff is removed and conveyed to the nearest large water body, reducing the recharge of near-surface ground water. The result is an alteration in the site's hydrology, with various consequences that include a drop in water pressure and increased salt-water intrusion.

An alternative approach to storm water management, called "Low Impact Development" (LID), has gained currency across much of the country since the 1990's as an improved means of protecting the water supply and improving water quality. LID uses a suite of Best Management Practices (BMPs), applied throughout a site, to maintain as closely as possible after development the natural hydrologic functioning of the pre-development landscape. This goal is well suited to protecting the regional groundwater regime.

Typical practices used in LID include vegetated swales and bio filtration areas ("rain gardens"); pervious parking such as turf blocks or structural plastic soil- or gravel-filled grids; rainwater harvesting for non-potable use on site

(e.g., irrigation, toilets); green roofs; disconnection of roof drains; and grading for longer flow paths. The signature look of LID is the use of water-tolerant native plants in vegetated BMPs that double as landscaping and disguise the function of the BMP as a utility system; these nutrient-hungry plants are responsible for large gains in water quality characteristic of LID.

We Learned About Water and Wastewater Systems

The majority of the seven county study area receives its potable water supply from the Floridan Aquifer which generally flows from recharge areas to the west towards the ocean to the east. JEA is the largest supplier, providing both water and wastewater services for most of Duval County and parts of Nassau, Clay, and St. Johns Counties. Counties and municipalities throughout the region are water providers, and there are numerous private wells and septic systems. With sea level rise, there may be a trend toward salt-water intrusion into the aquifer thus compromising these systems. JEA addressed the committee and indicated that the potential impact of sea level rise on their systems would be investigated, beginning in the coming fiscal year.

Wastewater systems in the region are comprised of treatment plants and pump stations. For areas near the St. Johns River, the design of the wastewater system is such that the end of pipe, excess-treated water not used by reclaimed water customers is directed to the St. Johns River. This is the case with six of JEA's thirteen treatment plants. Plant designs rely on historical data on tidal changes to determine outflow of the system. With sea level rise there is potential compromise of this outflow, which could compromise the wastewater handling capacity of systems. Individual septic systems and drain fields could also be compromised with sea level rise.

Consider:

- Identify wells, both utility/publically owned and private, with the greatest potential of saltwater intrusion with the advent of sea level rise.
- Locate new wastewater treatment plants relative to elevation above sea level and map impacts to these critical assets with regards to sea level rise. Analyze impacts of sea level rise to treatment plants' outflow capabilities. Harden these facilities when indicated.
- Identify areas within the seven county region where residences are on septic tanks with drain fields and include these areas in vulnerability maps illustrating sea level rise implications.
- Develop policies/ programs that identify and resolve potential issues.

We Learned About Natural Systems and Diversity

Sea level rise may cause changes in estuarine and isolated wetland systems. It will become increasingly important to examine any effort for mitigation such that habitat and species diversity are maintained or increased.

Close collaboration between NEFRC efforts and the Matanzas Bay study is essential, so that its analysis, recommendations, and outreach are fully integrated into the actions recommended in this report. Ensure consistent and aligned messaging and education.

Consider:

- Any potential species and habitat vulnerability be identified as to their reaction to extremes in rainfall, including extended drought and intense storms, combined with higher temperatures.
- Examining the use of climate models to maintain or restore impacted habitat as a result of sea level rise.
- Maximize habitat and species diversity by avoiding the use of habitat-homogenizing practices. Monitor exotic plant and animal species for introductions, colonization, establishment, and/or connections with other populations.
- Encourage federal, state, and regional marine resource agencies to maintain natural systems, such as estuarine habitat and other natural coastal barriers, including oyster reefs, sand dunes and salt marshes that will provide storm surge protection and will maintain coastal biodiversity.

We Learned About Protected and Vulnerable Species in Upland and Coastal Habitats

In the coastal areas, higher elevation plant species may be at more of a risk from sea-level rise than the surrounding freshwater marsh. Isolated freshwater ecosystems can migrate inland, but typically the coastal berms may be isolated and their dependent species have no path for migration.

We Learned About Protected and Vulnerable Species in the St. Johns River and Aquatic Habitats

Aquatic species may also be impacted by sea level rise and the shifting salinities of aquatic systems. Marine mammals, such as manatees and dolphins, may see their food resources shift south in the St. Johns River as salinities increase near the mouth. Food resources, such as fish, shrimp, and submerged aquatic vegetation are sensitive to salinity changes and their populations may have to relocate. Policies will need to be examined that limit salinity changes in the tidal ecosystems. Natural processes such as rainfall, drought, and hurricanes will continue to cause large variation in salinity.

Consider:

- Identifying those narrow beaches lacking natural dunes which might possess high turtle-nesting density but which might also be prone to high nest mortality due to nest wash-out during more frequently expected storms and identify more stable 'receiving' beaches to which nest may be relocated.
- Develop long-term turtle-nesting beach preservation strategies and methods in advance of anticipated coastal armoring which might result in loss of beach nesting habitat.
- Identify zoos, aquariums, herbariums, and gardens that might be the repository for seed stock and captive breeding programs for those listed plants and animals under imminent threat of local extirpation due to sea-level rise.
- Compile species information for rare plant species in coastal hardwood hammocks and upland forests and develop adaptation plans that include, at a minimum, seed bank repository collection and assisted propagation.
- Identifying submerged aquatic vegetation, salt marsh communities, and coastal freshwater marsh environmental tolerances to changing factors such as salinity, water depth, substrate, and nutrients. Use this information with climate and hydrological modeling to aid management.
- Collaboration between emergency, community and natural resource planners to Identify linkages between marine ecosystem (e.g. salt marsh and mangrove wetlands) area/condition and hazard risk reduction.
- Compatible dredge material be utilized in the restoration of previously existing or establishment of new wetland systems
- Ensuring that zoning regulations allow for the ability of plant and animal species to migrate inland as sea levels rise (e.g., limit armoring.) Ensure that land acquisition priorities consider landscape features which may limit species ability to migrate in response to sea level rise and other impacts related to climate change.

We Learned About Agricultural Lands

Sea level rise may result in land use patterns such that areas used historically for agriculture may no longer be suitable for crop production.

Consider:

- Review and documentation of the potential responses of traditional agricultural crops to saltwater intrusion.
- Establishment of a program that will monitor root-zone salinities impacts and changes to vegetation communities.

We Learned About Natural Resource Acquisition

Northeast Florida has a rich diversity of habitat for both flora and fauna. Recognizing this and how in many ways, natural systems improve the region's resiliency, acquisition of land should recognize existing habitat preserves, wildlife corridors, and mitigation banks with an appreciation of future impacts of elevated saline waters, ground water, and changing rainfall patterns.

Consider:

- Developing resource acquisition priorities in a regional setting to:
  - Ensure the preservation of many habitat types, including the corridors that connect them, with an appreciation of how rising sea and ground water levels as well as rainfall patterns affect them.
  - In keeping with issues regarding water storage, protect high quality drinking water supply.
  - Map out and identify areas of high aquatic and terrestrial biological diversity and ensure that those locations are either protected of identified for future acquisition.
  - Identify and protect areas where current species might retreat as water levels rise.
- Acquisition priorities are set in light of projected elevated saline and groundwater levels and their impact on the migration of vulnerable species.
- Incorporate natural resource systems into "Adaptation Action Areas", then to be incorporated into local comprehensive plans and regional planning documents. Such documents should represent shared priorities among the various regulatory agencies in the region being represented.
- Promoting federal, state, and local government conservation land acquisition programs that include fee simple and less-than-fee approaches to conserve natural areas, protect

open space and create or maintain resilience and adaptive capacity by maintaining or creating connectivity among natural areas from the coast to inland/upslope.

- Tracking a regional metric that links the rate of new construction permit issuance to the conservation land acquisition rate.
- Monetizing ecological services provided by natural systems and create a sustainable mechanism for their protection and management.

We Learned About Natural Resource Management

Sea level rise has the potential to allow for a rapid introduction of new exotic species. Some control measures used historically to destroy invasive plant species, such as prescribed fire, are already becoming more difficult to implement. Regional cooperation will become much more essential and require effective collaboration between various effected agencies and companies.

Consider:

- Coordination of regional invasive exotic species prevention and control efforts emphasizing prevention of new invasions and early detection.
- Coordination of regional efforts that emphasize frequent, low intensity prescribed fires in wetland and forest systems to maximize habitat diversity.
- Coordination of "living shorelines" objectives at regional scale to foster use of green infrastructure (e.g. oyster reefs and salt marsh wetlands) instead of or in addition to hardened bulkheads.

We Learned About Public Outreach

Public Education, Awareness, and Outreach are imperative to a collaborative effort. The goal is to communicate the risks related to sea level rise and the value of adopting policies and practices to achieve resilience through the region. This includes policy makers and stakeholders such as residents, the business community, government and educational agencies and the non-profit community.

Consider:

- Begin and end with an equity framework. Engage all communities from the beginning of dialogue on sea level rise.
- Identifying existing programs and agencies such as the University of North Florida's Port and Coastal Engineering Focus, University of North Florida Environmental Center, Jacksonville University's Marine Science Research Institute, Flagler College Coastal Environmental Science, the GTM National Estuarine Research Reserve, St. Johns RiverKeeper, St. Johns River Alliance, Putnam County Environmental Council, St. Johns River Water Management District, Florida Department of Environmental Protection, the

Sierra Club, Northeast Florida Land Trust, Trust for Public Lands and others. Determine the strengths of each and work to make even stronger in terms of research, breadth, and depth of trends and data, education and initiatives.

- Use regional and academic resources to address the shortcomings some communities identified in their social systems as they were doing community resiliency assessments, to engage students and ethnic groups with the community.
- Make full use of the social systems that Northeast Florida communities consistently indicated as robust, including faith-based, neighborhood, business, and civic groups.
- Maximize the potential of strong involvement of the community in schools.
- Creating a Regional campaign using local and regional agencies that have an interest in protecting natural resources and infrastructure.
- Using a wide variety of Social Media to reach a broader range of stakeholders. Link all related agencies to one main location (website and/or blog). Use Facebook, Twitter, LinkedIn, Google Plus, Instagram, and Pinterest at a minimum.
- Collaborating among counties, municipalities and appropriate agencies to develop and carry out outreach and educational programs to increase public awareness of sea level rise and adaptation strategies to minimize damage and risk. Prepare and implement messaging programs associated with the impact of sea level rise on natural areas including upland, wetland, marine, coastal, near shore, and riverine environments.
- Providing outreach to residents, stakeholders and elected officials on the importance of addressing sea level rise adaptation and preparedness and develop a program to educate specific interest groups about the benefits of proposed actions.
- Initiating a public education campaign to educate residents, business owners, and policy makers on the merits of preserving open land as an aid to adapting to sea level rise in the region.
- Creating a working group to develop awareness of the need for efforts to deal with the effects of sea level rise on the food supply, water supply, energy supply, drainage, community stability, and housing in the region, so as to foster the development of sustainable and resilient communities.

NEFRC and UNF Environmental Center should collaborate on developing the expertise in the region to execute the economic methodology included in the NOAA "What will Adaptation Cost?" to assist local governments as they consider new or renovated community infrastructure. This experience should allow for an approach to analysis of private investment as well.

We Learned About Risk Mitigation

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS:

- Reduce flood damage to insurable property;
- Strengthen and support the insurance aspects of the NFIP, and
- Encourage a comprehensive approach to floodplain management.

We learned from the Insurance Services Offices, Inc.[2] that their Building Code Effectiveness Grading Schedule (BCEGS®) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses

- NOAA, Florida and Georgia SeaGrant College Programs, the University of Georgia, NEFRC and the City of Fernandina Beach are planning a Northeast Florida/Southeast Georgia workshop targeted at local government officials to begin education and further engagement on sea level rise.
- NEFRC should create and maintain a clearinghouse for regional sea level rise data, with links and resources:
  - Link to another page for the individual, with some explanation and links on how to check the elevation and flood zone of your property, what that means in your location as to how you must build and flood Insurance rates, and what your options are to mitigate risk and lower insurance rates. Maximize the impact of existing resources, such as those available at http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/the_cost_of_flooding.jsp.
  - Link to another page for local governments, with links and some explanation of the tools available to create scenarios of rise for planning purposes. Refer to the DEO Statewide effort to compile all tools and provide guidance as to their strengths and weaknesses.
  - Link to another page with descriptions of adaptation approaches and links to research communities that have used them.
  - Link to the NOAA Coastal Services Report: What will Adaptation Cost?
  - Link to Regional Vulnerability Maps showing 1',3' and 6' of rise, with regional resources included on the maps based on the Strategic Regional Policy Plan.
  - Link to the report and background committee documentation.

[2] http://www.isomitigation.com/bcegs/0000/bcegs0001.html

from natural hazards. Florida does well relative to other states in building code enforcement. This can be capitalized upon. The concept is simple: municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The prospect of lessening catastrophe-related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously.

It is not uncommon for communities to issue Tax Deeds on flood prone properties for non-payment of property taxes. Communities should be encouraged to obtain fee simple ownership of flood prone properties as cost effective opportunities are presented. Contact your local Tax Official for details about the tax deed process.

Consider:

- Just as the insurance industry has incentive to explore ways to mitigate for wind risk, homebuilders and the construction industry will have incentive to explore ways to build on the First Coast that will offer buyers mitigation choices for flood and sea level rise. Engage homebuilders now so they understand the issues and are ready for the shift when market demand begins to take hold for flood resistant buildings.
- Consider partnership with Florida Alliance for Safe Homes (FLASH) to mainstream the science of safety related to flood.
- Incorporate hardening of foreclosed homes into affordable housing programs, or acquisition if they are repetitive loss or very vulnerable.

The recommendation was made at several community resiliency assessments that the Regional Council should find a way to work with communities to facilitate their participation in CRS. The potential for financial benefits to communities is part of the message on sea level rise that is most likely to resonate in Northeast Florida. This could take the form of creating partnerships to perform CRS functions. In addition, the educational tools that CRS-participating communities need could be developed at the regional level and made available to all, thereby eliminating the need for duplication of effort.

- Explore the “Fortified” program standard re: individual building owner risk mitigation.
- Mobile homes in vulnerable areas present an opportunity, given their shorter life cycle. Consider incentives to relocate and new approaches to make them safer in less vulnerable areas.
- Bridge the practical gap between emergency preparedness and sea level rise, and between the immediate timeline of a disaster and worsening flooding exacerbated by sea level rise. In theory, once your home is flood-hardened you might be able to shelter in place, but this strategy, if it were to work, would only work if emergency preparedness experts are engaged it its development.
- Enforcement of Coastal Construction Line and Coastal High Hazard Area designations. Develop policies and regulations that will serve to reduce future risk and economic losses associated with sea-level rise and flooding in these designated areas through infrastructure improvements, insurance subsidization of high- hazard development and by directing development and growth to non-vulnerable areas.
- Avocation for more resilient construction standards through educational outreach.
  - Understand how floodplains and lands susceptible to flooding function and what natural services these areas provide for your community. These areas may provide storm and flood water retention, flood water diversion, and protection from wave energy and storm surge.
  - Explain how to reasonably plan for uncertain future conditions.
  - Recommend provisions to build above current flood elevation standards, based on the anticipated service life of proposed new and renovated structures.
- Active participation by all communities in the National Flood Insurance Program (NFIP)
- Consideration of membership in the Florida Floodplain Managers Association.
- Active participation in and improvement to the rating of communities in the region in the Community Rating System (CRS) Program, with resulting reduction in the flood insurance rates for communities.
- Creating higher freeboard requirements for new construction and substantial improvement of existing structures.
  - Freeboard is a margin of safety added to the base flood elevation (BFE) to account for waves, debris, and miscalculations or lack of data.
  - Not required by the NFIP standards, but communities are encouraged to adopt at least a 1-foot freeboard to account for the 1-foot rise built into the concept of designating a regulatory floodway and the encroachment requirements where floodways are not identified. For example, Sanibel Island requires 10 feet above BFE. Structures built to this higher standard have survived multiple hurricane related storm surge events. Atlantic Beach requires 8.5 feet above BFE, which is more than the minimum FEMA requirement in part of the City.

- Freeboard helps to mitigate the effects of climate variability such as higher storm surges and greater runoff by anticipating future conditions.
- Expand PACE to cover flood risk mitigation, such as elevating or hardening structures.
- Retrofit needs to be an area of focus, as 80% of FL housing stock predates 1993.
- While housing targeted at low-income residents focuses on affordability, it should be sited to avoid vulnerable areas and designed with risk mitigation in mind, just as more expensive housing should be.
- Communities should develop a consensus on desirable elevations for new construction, even if they are not requirements, and builders should talk to potential buyers about their choices.
- Communities are encouraged to maintain the public ownership of lands determined to be located within floodplains and particular special flood hazard areas.
  - Maintenance of viable and functional flood plain.
  - Maintenance of storage capacity of floodwaters.
  - Avoidance of alteration and/or redirection of floodwaters.
  - Prevention of unauthorized alteration of flood plain.
  - Avoidance of claims of takings.
  - Avoidance of requests to provide costly public services to subsidize unsustainable development.

We Learned About Long Term Regional Resiliency

Private development clusters along the oceanfront and waterfront in the areas are most vulnerable to sea level rise. These high value properties have the highest probabilities of losses. While models vary, projections go as high as Tufts University Economics Professor Frank Ackerman's 2007 model that predicted Florida would lose 10 percent of land mass resulting in a loss of homes for 1.5 million by 2100. This is one of the most aggressive models of a defined "vulnerable zone," but its analysis is not unique.

While regulations could accomplish the same risk mitigation, smart builders and occupants can make choices now and in the future that can lower the risk of flood and sea level rise. Some examples of things to avoid:

- **Placing boilers, heaters, generators, chillers, servers or other expensive or important building or business infrastructure in the basement or on the ground floor level.**
- **Allowing building design to include below grade openings into basements.**
- **Placing electrical equipment and utility infrastructure in pits below the sidewalk.**
- **Building slab on grade buildings in FEMA Special Flood Hazard Areas or those where flooding is possible. Buildings in those zones should be elevated on fill, pilings or stilts or designed to allow the first story to "wash through" without damage to living or working areas.**

Littoral rights or those appurtenant to oceanfront properties already conflict with public right of access to and along the beaches. FEMA estimates that 24% of littoral parcels along the gulf and oceanfront states' shores are prone to erosion. Florida joins other ocean and Gulf front states in facing policy decisions on whether to renourish, armor, or leave alone beaches that erode. This heavily litigated and expensive battlefield only becomes more contentious if sea levels continue to rise. Ironically, if the sea retreats or the beaches advance, the very same ownership and use issues occur – only in reverse. The Florida Beach and Shore Preservation Act, at Chapter 161, Fla. Stat., regulates the rights of littoral property owners to protect their properties as well as the public need to preserve beaches and dune systems.

Hard shoreline armoring is a common historical method of protecting against erosion and other impacts of the sea upon the shore. It is seldom used today in the state. This is due to several reasons. It is expensive. It eliminates beach systems and habitats. Additionally, it is of limited benefit in the substantial portions of Florida that contain well-draining sand and limestone.

Soft armoring better adapts to natural surroundings as it uses the natural ability of coastal landforms to buffer against flooding. Living shoreline and wetlands restoration are examples. While it might make better sense than hard armoring in most current cases, soft armoring without substantial addition or acquisition would do little to address impacts of any substantial sea level rise.

Public entities have multiple options to address possible continuing sea level rise. These include ceasing to provide infrastructure, issuing building moratoria and creative development tools such as transfer of development rights and rolling easements. The principal limitation on these tools is the possible imposition of direct takings or inverse condemnation liability. Regardless, public sector options are available on a far broader scale and depth than are private responses.

Chambers of Commerce and similar organizations, as well as realtors, are influential in siting. They can be pivotal in disclosure of vulnerabilities and in encouraging siting in areas that are less vulnerable. Good will toward the region is unlikely to remain in the heart of a new resident or business who feels they were not told of the risks associated with vulnerable areas, especially when Northeast Florida has plenty of growth opportunities in non-vulnerable areas. On the other hand, locating in a vulnerable area with a clear view of the adaptation measures that will make your occupancy work allows for realistic expectations, public safety, and investment that is more resilient. Bankers too are key stakeholders. The Dodd Frank bill will make it harder for local banks to take risks, so they need to be educated on risk mitigation and be willing to work with local communities and regions.

Private development will re-locate to non-vulnerable areas if sea levels continue to rise. In the interim, the principal options private parties in vulnerable zones have are: 1. construction on

- Create a Public/Private Regional Resiliency (P2R2) Committee under the auspices and with the staffing of NEFRC, with the following goal: Develop a regional strategy that will incentivize population and private development to locate outside of vulnerable areas.

  P2R2 should measure progress by the following metrics: Property values and number of private owners of lands in Northeast Florida at risk under a 1', 3' and 6' sea level rise scenario, percentage of Northeast Florida tax base at risk from a major hurricane like Sandy, and percentage of tax base in non-vulnerable areas.
- P2R2 should set progressive targets for reducing the number of private owners and the percentages of at-risk tax base.
- P2R2 should consist of representatives of the following sectors: Homebuilding, Mortgage Banking, Law, Engineer, ULI North Florida, JaxUSA Partnership, Realtor, Economist, NEFRC, RCI, County Government, Municipal Government, and Planning.
- P2R2 should meet at least twice a year, and consider the strategy they believe appropriate to Northeast Florida. Once it is agreed upon, they should present it to the NEFRC. Further meetings should consider the results of the various policies, action items and trend metrics included in this report and recommendations regarding if, how and when to implement the strategy.

pilings and with other protections such as breakaway walls against short wave tidal impacts and long wave level increases; and 2. Provision of insurance against the impacts of any sea level rise. Federally insured flood insurance is already unavailable in substantial portions of Congressionally determined vulnerable coastal areas. We can reasonably anticipate that private policies would have to fill the gap as those areas expand as sea levels rise. There are approaches, such as transfer of development rights that could allow property owners in vulnerable areas to realize the value of their property while directing development to non-vulnerable areas.

The inevitable result of any additional sea level rise damage will be properties in vulnerable areas, which will experience a dramatic loss in value. We expect a corresponding dramatic increase in value in non-vulnerable re-location areas.

We learned several things in coming to this conclusion. We do not have to wait for state or federal leadership to address sea level rise, although we can advocate for such leadership. We can be positioned to accommodate the expanding market in non-vulnerable areas in our region as sea level rise impacts other regions, causing migration. We can collaborate on risk mitigation and deal with insurance companies as a region. This can have some impact on rates, even if the private market does not ensure against flood. We can develop strategies that maximize the use of the Community Rating System to keep flood insurance costs down, while developing strategies that reduce regional risk to flood insurance rate increases and to the potential for failure of Citizens Property Insurance. If we implement strategies to incentivize movement out of vulnerable areas, we

limit the impact on our communities of storms that involve flooding, of sea level rise, of failure of the State's insurance safety net, and of expensive changes in the Federal Flood Insurance Program.

The Committee had a very enlightening conversation with an insurance expert. The conversation began with a reminder that insurance works only when many customers pay into a common fund, and only a small percentage of customers experience losses which the fund can pay for out of the total premiums collected from customers. An important point was that private insurance companies do not offer flood insurance because damages can cover a very large area and impact an unacceptably high percentage of customers with the risk that losses could exceed premiums collected and bankrupt the company. According to this spokesperson, the National Flood Insurance Program (NFIP) was implemented (in part) because the federal government was the only organization with a big enough "customer" base to manage the broad risks from a flood insurance program.

Private insurers often work with businesses to implement safe driver training programs to reduce risks and minimize insurance costs. They also work with cities and businesses on fire safety programs to reduce costs by equipping buildings with fire alarms and sprinkler systems, plus increasing city fire fighting capabilities. There is a model here for practical solutions, if the government is in the insurer role, or if the private sector is insuring in areas of some vulnerability.

Consider:

- The P2R2 Committee consider the full range of options available to make our region resilient:
  - Identify and guide future growth from high-risk locations—various tools and techniques such as planning and zoning, building and development codes, floodplain management practices, local disaster mitigation strategies, capital improvements programs, extension of utilities, transportation planning, etc., are currently available are currently available to guide future development to low-risk areas.
  - Devise appropriate adaptive proactive planning and management strategies for existing and projected vulnerable areas—adaptive planning and management approaches varying from protection, to accommodation, and retreat or redirection are available to address existing, new or redevelopment in currently or eventually vulnerable areas. The identification of the most effective menu of management practices or strategies for a particular areas or activities will vary the degree of the threat, available resources, useful life of the structures or project, etc. However, the essential point is to establish the foundation and

process to proactively plan and devise strategies for addressing SLR and storm surges in these areas.

- Include emergency preparedness and the identification, management, and protection of critical infrastructure and services—evaluate the effects of SLR on emergency evacuation routes and critical emergency facilities and functions incorporate those effects into Local Mitigation Strategies (LMS). Update local risk assessments to include SLR in the hazards analysis and vulnerability assessment section of the LMS. Account for SLR during updates of the regional hurricane evacuation study.
- Devise plans and strategies for post-disaster management of vulnerable areas—one essential component of a process to address the effects of SLR in the Northeast Florida Region will, as demonstrated by the aftermath of Super storm Sandy, is to devise a general process to address post-disaster recovery and the range of feasible redevelopment to relocation options in advance of such potential disasters.
- Incorporate SLR considerations into the selection, execution, and siting of public capital improvements—the selection, design, and siting of new or renovated public improvements should consider potential impacts of future SLR within the context of the useful and should not support services to or support the development of vulnerable areas.
- Amend local floodplain management—local floodplain ordinances could be revised to reflect the impacts of SLR disclosed by regional vulnerability assessment.
- Ensure the maintenance of the integrity and benefits of natural systems—these must be an integral and equal component of the process of public land planning process for SLR. Coastal dunes provide storm surge protection, wetlands and floodplains provide storm storage, aquifer recharge areas provide conduits for replenishing dwindling water levels in the primary source of water for the Region, productive agricultural lands provide food for the region, and deciduous and coniferous trees and coastal marshes sequester carbon and generate oxygen.

- Discussion of NE FL community and regional risks and potential risk reduction targets.
- Analysis and educations on how much of our region's tax base is vulnerable to 100 yr flood now? In 50 and 100 years based on high rate SLR and current development guidelines?
- Consideration of who benefits and who pays currently for risk insurance and recovery costs.

- Presenting a short history of regional growth over past 100 years. The message is that things change, and the question is where we want to be in 100 years with SLR and associated impacts.
- Consideration of the full range of potential climate change. SLR is just one direct impact. Changes in rainfall patterns and impacts on water supply would be another. Indirect impacts will include population growth in Northeast Florida over the next 20, 50, and 100 years, as it gets increasingly expensive to live in highly vulnerable areas such as South Florida.
- Those who choose to invest in high-risk areas need to be more directly responsible for potential losses.
- A potential pilot with FEMA and others to identify community and regional flood insurance risks and future rates with SLR, plus ways to reduce future rate increases.

We Learned that Federal or State Leadership Could Help Us to Accomplish Goals

To avoid sharp increases in community risks and insurance costs, and to create resilient communities, will require serious actions to reduce risks. One of the approaches is to regulate allowable insurance risk if and as sea level rises. Insurance regulations would need to change, included turning to private coverage in the highest risk areas. It only works if there are changes in the federal approach to insurance, so the region can advocate for such leadership but prepare with a plan implementable at the regional level should the leadership not be forthcoming.

Sea level rise, with the potential long term and very large-scale impacts along the total coastline of the U.S., represents an unacceptable financial risk even for our national government. Accordingly, it would be wise for the U.S. government, perhaps through the USACE, to develop guidance and take action to reduce SLR risks and minimize future financial losses to public and private interests. The existing USACE watershed planning authority might be a useful tool to help facilitate development of appropriate sub-regional scale (or multi-project) plans.

STRUCTURAL flood damage risk reduction measures for SLR (levees, gates, pumps, beach restorations, etc.) have limited life since SLR is ongoing and anticipated to accelerate significantly over the coming century. Uncertainties or risks include the future rate and duration of SLR, changes in patterns, frequency and intensity of extreme weather events, changes in insurance and maintenance costs, etc.

NON-STRUCTURAL flood damage reduction measures are primarily actions that help eliminate current and future risks. This could include buyouts/forced relocations and voluntary relocations encouraged through development incentives for low risk areas. Incentives could include offering multiyear fixed cost flood insurance rates for high-risk developed areas in return for pre-storm commitments to accept automatic buyout payments if/when future

storms significantly damage the majority of homes in a high risk area. Non-structural plans may cost more in the beginning, but will be more financially sustainable for the nation than structural plans in most areas. They are more likely to have overall long term public and private cost savings and social benefits, but will meet resistance from residents if they feel forced to move far in advance of an obvious near term risk.

HYBRID flood damage risk reduction plans would include limited SLR flood damage reduction improvements for existing developments, AND concurrent infrastructure investments with supporting interagency programs to encourage most new development to locate in low risk areas. A typical 50-yr interagency program goal could be to voluntarily get 100% of critical infrastructure and 80% or more of the community businesses and residences above the 100 yr flood plain based on the current 100 yr NOAA high rate SLR projection. Experience with implementation of the Interstate Highway system shows the power of large-scale infrastructure investments to help shape future community growth.

Limited SLR flood damage risk reduction for existing developments could seek to maintain existing levels of service for a definite time period of not to exceed the next 10-20 years with an option for local interests to pay 100% of the costs for continuing this protection beyond the initial 20 year period. This would establish a firm date and exit strategy to end federal funding for unsustainable flood damage reduction programs. This change would require those in an area vulnerable to SLR to pay most of the costs for maintaining long term flood damage reduction measures, and these costs could provide strong economic incentives to voluntarily relocate to lower risk areas.

The Committee struggled with actions the region could achieve on its own, and those where state and federal leadership would be required. For comparison of alternative non-structural, structural and hybrid plans, above, long term structural SLR risk reduction measures could include the cost to establish a community emergency adaptation fund equal to, say, 50% or more of the structural plan construction cost. This fund would be held for local communities so they can quickly adapt without waiting on federal funding in the event of a low probability, high consequence event such as an unanticipated rapid increase in future SLR rates. The goal is to provide an exit strategy that limits federal assistance to unsustainable flood damage reduction plans and encourages investment in long term solutions.

Sea level rise, with the potential long term and very large scale impacts along the total coastline of the U.S., represents an unacceptable financial risk even for our national government. Accordingly, it would be wise for the U.S. government, perhaps through the USACE, to develop guidance and take action to reduce SLC risks and minimize future financial losses to public and private interests. To avoid sharp increases in community risks and insurance costs, and to create resilient communities, will require serious actions to reduce risks. One of the approaches

is to regulate allowable insurance risk if and as sea level rises. Insurance regulations would need to change, included turning to private coverage in the highest risk areas.

Consider:

- Regional Advocacy for changes to federal programs to allow implementation of this concept:
- Slowly Reduce Publicly Funded or Backed Insurable Value of Vulnerable Properties
- Establish the authority of USACOE and/or FEMA vulnerability zone maps with 1 foot, 3 foot and 6 foot sea level rise areas. If and as sea level rises from established baselines, the properties in these zones must turn increasingly to privately available insurance and therefore rely on the market rather than the government for coverage. Coverage could be regulated in some regard by mandating structural and use alterations that would raise the structures and reduce the impact of sea level rise on a given structure. Make this a "living document and standard" by revisiting the zone contours regularly (every three to five years).
    - High Vulnerability Zone (1 foot)
    - Medium Vulnerability Zone (3 foot)
    - Low Vulnerability Zone (6 foot)
- Consider stepping down the federal coverage over time in at least the High Vulnerability Zone:
- Assume 100% of value will be lost in 50 years
- Reduce allowable federally funded or backed property casualty coverage by 2% of base year per year for 50 years.
- After 50 years, no homes in at least the high vulnerability zones can be federally insured.
- Institute strict re-building restrictions if and as damage occurs.
- Since there are concerns about the National Flood Insurance Program and the Biggert-Waters Reform Act of 2012 Bill will phase in higher rates, the state should do analysis for Florida's Citizens Property Insurance in light of these changes, so that communities can assess the likelihood of Citizens providing a "safety net" long-term. Residents and property owners should have as much information as possible so they can make informed decisions as they consider investment or occupancy in vulnerable areas.
- Invest post disaster aid into pre-disaster planning, education and adaption option information.

Distinguished Presenters and Experts

The Committee is indebted to the following presenters, listed in the order of their presentations, who shared their time and expertise during the Committee's work:

- Glenn Landers, P.E., Planning and Policy Division, US Army Corps of Engineers, Jacksonville District
- Emily Montgomery, Former Coastal Training Program Coordinator, Guana Tolomato Matanzas National Estuarine Resources Reserve
- George Porter, P.E., Water and Wastewater Systems Planning Specialist, JEA
- Jim Murley, Executive Director, South Florida Regional Planning Council
- Scott C. Hagen, Ph. D., P.E., D.CE, D. WRE, Professor, Director CHAMPS Lab, University of Central Florida
- Peter Sucsy, Ph. D., Supervising Engineer Scientist, Division of Water Resources, St. Johns River Water Management District
- Liz Reynolds, CPCU, API, State Affairs Manager- Southeast Region, National Association of Mutual Insurance Companies
- Adrienne Burke, Community Development Director, City of Fernandina Beach
- Thomas Ruppert, Esq., Coastal Planning Specialist, Florida Sea Grant College Program

Appendices

1. Committee Membership
2. Northeast Florida Communities participating in the NFIP Community Rating System
3. Notable Sea Level Rise Initiatives in Florida

Appendix 1

Regional Community Institute Emergency Preparedness Committee on Sea Level Rise: Active Members

LAST NAME	FIRST NAME	SECTOR REPRESENTED	COMPANY/JURISDICTION
Alexander	Jeffrey	Emergency Planning	NEFRC
Allen	Shauna	Natural Resources	National Parks Service
Bevan	Denise	Planning	City of Palm Coast
Bishop	Teresa	Planning	St. Johns County
Brown	Mike	Planning	Putnam County
Bunnewith	Denise	Transportation	North Florida TPO
Burke	Adrienne	Planning	City of Fernandina Beach
Carvalho	Alexandra	Environmental and GIS	CMar Consulting, LLC
Crowe	Thad	Planning	City of Palatka
Fleet	Janis	Planning	City of Green Cove Springs
Gordon	Tina M.	Natural Resources	GTM NERR
Griffin	Michael	Planning and Flood Plain Management	City of Atlantic Beach
Kaufman	David	Ports	Jax Port
Kershner	Matt	Technical Advisor	FDEP
Lambert	J. David	Academia	UNF
Landers	Glenn B.	Technical Advisor	U.S. Army Corps of Engineers
Lukacovic	Ed	Planning	City of Jacksonville
Maher	James R.	Technical Advisor	FDEP
McCrary	Marshall D.	Planning and Municipal Administration	City of Fernandina Beach
McDowell	Doug	Planning	Nassau County
McGowan	Ted	Engineering	Reynolds Park - Clay County Port
Mikalsen	Ted	Environmental Management	Retired - GA Environmental Protect.
Miller	Joe	Ports	Jax Port
Moehring	Margo	RCI Staff	
Montgomery	Emily	Natural Resources	GTM NERR (former)
Morgan	Carolyn	Planning	Clay County
Overly	Rob	Building/Architect	Self
Owen Gledhill	Sarah	Natural Resources	Florida Wildlife Federation
Page	Bob	RCI Board Chair	City of Green Cove Springs
Paradise	Brian	Risk Management	Self
Preston	Ed	Planning	Baker County

Reed	David	Committee Chair/Utility	JEA
Richardson	James	Environmental Protection	COJ EPB
Sample	Geoffrey	Technical Advisor	SJRWMD
Tappouni	Mary	Builder/Developer	Breaking Ground Contracting
Teeple	Brian	Regional	NEFRC
Tilley	Allen	Journalism	Retired - UNF
Weise	Gary	SME Environmental	Retired - COJ P.E.
White	A. Quinton	Academia	JU
Young	John K.	Military	Navy

Appendix 2

Participate in CRS	Does not Participate
Atlantic Beach	Baldwin
Baker County	Beverly Beach
Clay County	Bunnell
Fernandina Beach	Callahan
Flagler Beach	Crescent City
Jacksonville/Duval County	Flagler County
Jacksonville Beach	Glen St. Mary
Neptune Beach	Green Cove Springs
Palm Coast	Hastings
St. Augustine	Hilliard
St. Augustine Beach	Interlachen
St. Johns County	Keystone Heights
	Macclenny
	Marineland
	Nassau County
	Orange Park
	Palatka
	Penney Farms
	Pomona Park
	Putnam County
	Welaka
As of May 1, 2013	

Appendix 3

Look for references and selected resources to be placed on the clearinghouse webpage.

Notable sea level rise initiatives and planning activities in Florida include:

- The Southeast Florida Regional Climate Change Compact and Constituent Planning Activities--The Southeast Florida Regional Climate Change Compact is a unique and collaborative effort among Palm Beach, Broward, Miami-Dade, Monroe Counties, their municipalities and partners to address the impacts of climate change and see level rise in the region. Much of the Compact's work up to this point has served to unite, organize, and assess the region through the lens of climate change in setting the stage for action and provide the foundation for this Regional Climate Action Plan, The Compact's Action Plan, completed in October, 2012, provides a regional framework for mitigation and adaptation measures to prepare for the impacts of climate change on Southeast Florida. The City of Ft. Lauderdale and Broward County are notable local examples of plan development and initiation which will serve as pilot projects for the Florida Coastal Management Program/Department of Economic Opportunity initiative to (DEO) titled "Community Resiliency: Planning for SLR." www.sfrpc.com/gis/slr.htm and southeastfloridaclimatecompact.org.
- Lee County Climate Change Resiliency Strategy--Lee County followed up a 2010 Climate Change Vulnerability Assessment with the Climate Change Resiliency Strategy. This strategy includes approaches to mitigate and adapt to the effects of climate change while also positioning the County to take advantage of potential economic development opportunities associated with climate change. http://www.swfrpc.org/content/Natural_Resources/Ecosystem_Services/Lee_County_Climate_Change_Resiliency_Strategy.pdf.
- City of Punta Gorda Adaption Plan--The City of Punta Gorda completed a publicly lead adaptation planning process at the city-level to address SLR in their downtown area in November 2009. This report is both an assessment of economic and physical vulnerabilities to the city of Punta Gorda, Florida, as well as an adaptation plan to respond to the highest priority vulnerable areas. http://www.cakex.org/sites/default/files/Punta%20Gorda.pdf
- City of Satellite Beach: Municipal Adaptation to Sea-Level Rise--In 2009, the City of Satellite Beach, Florida, authorized a project designed to assess municipal vulnerability to rising sea level and initiate the planning process to properly mitigate impacts. The s generated both a technical report and policy recommendations based on that data. Recommendations included proposed amendments to the city's current comprehensive plan included to expand some existing policies to include SLR, and to add a new section addressing adaptive management. The SLR Subcommittee provided its results to the

CPAB, where it was reviewed, amended, and adopted unanimously as a recommendation to City Council in July 2010.

- U of F/GTM, National Estuarine Research Reserve Pilot SLR Adaptation Planning Process for the Matanzas Basin--The University of Florida and the Guano, Tolomato, Matanzas National Estuarine Research Reserve (GTM NERR) have received a highly competitive NERRS Science Collaborative Grant to pilot a SLR adaptation planning process in the Matanzas Basin near St. Augustine. http://planningmatanzas.org/.
- Charlotte Harbor National Estuary Program—Has been has been selected by the Environmental Protection Agency (EPA) as a case study for local action to protect sensitive coastal ecosystems and economies from the potential effects of climate change. This is the first step in EPA's new Climate Ready Estuaries effort to build local ability in its 28 national estuary programs to adapt to climate change. http://www.swfrpc.org/content/Natural_Resources/Ecosystem_Services/Lee_County_Climate_Change_Resiliency_Strategy.pdf.
- The Space Coast Climate Change Initiative (SCCCI)--is a regional consortium established in 2007 to encourage and assist local governments in development and implementation of adaptive management plans to address global climate change and the impacts on Florida's coastal communities. It's objectives are to: convince local governments to identify climate change issues relevant to their constituency and specific recommendations on how best to proceed; ensure local governments comply with the specific recommendations formulated to address climate change; and insure the plans, policies, and/or programs implemented by local governments to address local climate change issues are periodically reviewed and updated to reflect available information. http://spacecoastclimatechange.com/