Sea Level Rise Adaptation Planning in Tybee Island, Georgia

November 14, 2012

National Sea Grant Climate Network Presentation
March 14, 2013

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Tybee Island

Most densely developed barrier island in Georgia

~1500 year round residents

~3000 seasonal residents

Popular tourist beach for Savannah area
Project goal

Provide facilitation and technical support for the City of Tybee Island to develop a climate adaptation action plan that prioritizes and addresses the community’s vulnerabilities to sea level rise.
Sea level rise at Ft. Pulaski
1935 – 2010

Local trend of approximately 1 foot rise over past 100 years

Data source: Natural Environment Research Council
Data authority: National Oceanographic and Atmospheric Administration
Tybee Island – US80 (2011)

http://3.bp.blogspot.com/_UZCeUDMh1X4/SxV0euA9iAI/AAAAAAAADak/9kISbAkCgdk/s400/Tybee+Roads.jpg
US80 to Tybee Island
Sea Level Rise and US 80 Flooding

Tide events/yr greater than 9.2 feet (MLLW)

- 2060 High Sea Level Rise
- 2060 Intermediate Sea Level Rise
- 2060 Linear Trend Sea Level Rise
Tybee Island “King Tide”
November 14, 2012
November 14 & 15 “King Tides”
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Project Approach

1. Facilitated town hall meetings using a modified VCAPS (Vulnerability Consequences Adaptation Planning Scenarios) methodology (Seth and Tuler 2012)

   – Following example of SC and MIT Sea Grants
Meeting 1: Tybee Island VCAPS diagram

May 7, 2012
Project Approach

1. Facilitated meetings using a modified VCAPS (Vulnerability Consequences Adaptation Planning Scenarios) methodology (Seth and Tuler 2012)

2. Benefit–Cost Modeling using Coastal Adaptation to Sea Level Rise Tool (COAST)
“Round 2” Townhall Meetings: August 6 & 7, 2012

Lead facilitation support by Dr. Sam Merrill, University of Southern Maine & Catalysis Adaptation Partners, Inc.
Plan for rate of 2060 sea level rise equivalent to

1.8 feet (High)
1.2 feet (Intermediate)

We also included linear trend sea level rise:

0.6 feet (Low)
Adaptation actions for benefit–cost modeling
Meeting 2 Decisions

- Raise US80 to 4 feet above current grade
- Continue renourishing beaches to keep up with sea level rise
- Raise water well facilities above 100 year flood height
- Upgrade drainage infrastructure in southwest island
- Build 4 foot high sea wall in southwest island
Summary of modeling decisions
August 2012 meetings

- Costs of adaptation actions measured against losses to **economic activity** in “No action” scenarios

- Economic activity georeferenced to building addresses based on local **hotel/motel tax receipts**
  - **Avoided property damage** to tax-assessed building polygons also included in final model runs

- Depth damage functions applied for flood height and frequency
Fast forward to last week…
“Round 3” Townhall meetings, March 4 & 5, 2013

Benefit/Cost Results for Adaptation Actions
Vulnerability: Tidal flooding in low-lying southwest island
Image Source:
NOAA Sea Level Rise Viewer
http://www.csc.noaa.gov/slr/viewer/#

3 feet sea level rise
Adaptation Action Steps

Upgrade stormwater infrastructure to lessen tidal and freshwater flooding risks

Construct engineered seawall (4 feet above MHHW) on southwest island to prevent regular tidal flooding from sea level rise
King tide flood with 6 inches sea level rise

Pipe Flow Model

(Based on Georgia Coastal LiDAR Elevation DEM at 3ft cell size)
November 14 & 15 “King Tides”
King tide flood 6 inches sea level rise

Tide Gate Model

(Based on Georgia Coastal LiDAR Elevation DEM at 3ft cell size)
SW Tybee Island Tide Gates and Pipe Upgrade

Constructed 2011, ~$450,000
### What to spend on stormwater upgrades in SW island?

<table>
<thead>
<tr>
<th>Sea Level Rise by 2060</th>
<th>Avoided building damages and economic activity loss (Net Present Value)</th>
<th>Approximate year that annual bank overflow begins (~0.75 feet of sea level rise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Trend (0.6 feet)</td>
<td>$2,100,000</td>
<td>2060 – 2070</td>
</tr>
<tr>
<td>Intermediate (1.3 feet)</td>
<td>$3,500,000</td>
<td>2040 – 2050</td>
</tr>
<tr>
<td>High (2.3 feet)</td>
<td>$3,300,000</td>
<td>2030 – 2035</td>
</tr>
</tbody>
</table>

All values from *saltwater flooding of buildings only*

Consensus of a “no regrets” action under any scenario
Sea wall action

- Estimated ~4600 feet of engineered sea wall at 4 feet above MHHW
Back island sea wall: Jekyll Island, GA
# Sea wall analysis

<table>
<thead>
<tr>
<th>Sea Level Rise</th>
<th>Avoided structure damage and economic activity loss through 2060 from sea wall (Net Present Value)</th>
<th>Estimated cost * ($3500 /linear foot and 2.5% annual maintenance)</th>
<th>Benefit:Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Trend (0.6 ft)</td>
<td>$510,000</td>
<td>$25,000,000</td>
<td>0.02</td>
</tr>
<tr>
<td>Intermediate (1.3 ft)</td>
<td>$6,500,000</td>
<td>$25,000,000</td>
<td>0.26</td>
</tr>
<tr>
<td>High (2.3 ft)</td>
<td>$26,000,000</td>
<td>$25,000,000</td>
<td>1.04</td>
</tr>
</tbody>
</table>

*Permitting and potential mitigation costs not directly factored

Local “patch up” of existing shoreline and private bulkheads likely to provide similar benefits for over two decades
King tide at 1 foot of sea level rise
1 Foot of Sea Level Rise

Total Annual Property Flood Loss = $5.1 million

(Present Values)
1 Foot of Sea Level Rise With Southwest Seawall

Total Annual Property Flood Loss = $4.9 million

(Present Values)
Next steps

- Year 2 of project and adaptation plan development referred to two City Committees:
  - Community Resources Committee
  - Infrastructure Committee
Project partners

**Primary funding**
NOAA Sea Grant Community Climate Adaptation Initiative
(February 2012 – January 2014)

**Partners**
City of Tybee Island
Georgia Sea Grant
  • Lead investigator
Carl Vinson Institute of Government
  • Lead facilitation and geo-spatial benefit/cost modeling
Catalysis Adaptation Partners, Inc.
  • Facilitation support and adaptation costing
Georgia Department of Natural Resources Coastal Resources Division
Chatham–Savannah Metropolitan Planning Commission