COASTAL RESILIENCE IN THE SOUTHEAST: LOCAL GOVERNMENT PERSPECTIVE

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Wetlands Watch

Closing Arguments

It's rising due to global warming!

It's rising due to natural causes!
What is happening locally?

Mean sea level trend = 4.42 millimeters/year (1.45 feet/century)

Avg. SLR in Chesapeake Bay
- 2.5 mm/y for 1953-1983
- 4.7 mm/y for 1983-2013
- 5.4 mm/y for 1996-2014
What effects do we see?

New Jersey, post Hurricane Sandy
“the elevation and condition of wetlands and adjacent uplands will determine the ultimate consequences of projected sea level rise”

DEQ Coastal Needs Assessment 2011-2016
# Future Storm Surge in Hampton Roads

<table>
<thead>
<tr>
<th>DATE</th>
<th>STORM TYPE/NAME</th>
<th>ABOVE MHHW</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 23, 1933</td>
<td>Hurricane</td>
<td>5.26 feet</td>
</tr>
<tr>
<td>September 18, 2003</td>
<td>Hurricane Isabel</td>
<td>5.13 feet</td>
</tr>
<tr>
<td>November 12, 2009</td>
<td>Veterans Day Nor’easter</td>
<td>4.99 feet</td>
</tr>
<tr>
<td>August 28, 2011</td>
<td>Hurricane Irene</td>
<td>4.76 feet</td>
</tr>
<tr>
<td>March 7, 1962</td>
<td>Ash Wednesday Storm</td>
<td>4.46 feet</td>
</tr>
<tr>
<td>October 29, 2012</td>
<td>Hurricane Sandy</td>
<td>4.09 feet</td>
</tr>
<tr>
<td>September 18, 1936</td>
<td>Hurricane</td>
<td>3.96 feet</td>
</tr>
<tr>
<td>November 22, 2006</td>
<td>Thanksgiving Nor’easter</td>
<td>3.87 feet</td>
</tr>
<tr>
<td>February 5, 1998</td>
<td>Twin Nor’easter (#2)</td>
<td>3.82 feet</td>
</tr>
<tr>
<td>October 6, 2006</td>
<td>Columbus Day Nor’easter</td>
<td>3.76 feet</td>
</tr>
<tr>
<td>April 27, 1978</td>
<td>Nor’easter</td>
<td>3.65 feet</td>
</tr>
<tr>
<td>April 11, 1956</td>
<td>Nor’easter</td>
<td>3.56 feet</td>
</tr>
<tr>
<td>September 16, 1933</td>
<td>Hurricane</td>
<td>3.36 feet</td>
</tr>
<tr>
<td>January 28, 1998</td>
<td>Twin Nor’easter (#1)</td>
<td>3.28 feet</td>
</tr>
<tr>
<td>September 16, 1999</td>
<td>Hurricane Floyd</td>
<td>3.21 feet</td>
</tr>
</tbody>
</table>

+1.5 feet by 2050
Nuisance Flooding

Tidal Flooding: November 2019
Observed Impacts of Tidal Flooding

Hours per year that streets start to flood in the Hague, Norfolk, VA
(source: T. Ezer & L. Atkinson, Old Dominion University)

- Hurricane of 1933
- Ash Wednesday storm (1962)
- Hurricane Isabel (2003)
- Thanksgiving nor’easter (2004)
- Veterans Day nor’easter (2009)
- Twin nor’easters (1998)
- Storm Sandy (2012)
Future Impacts of Tidal Flooding

Hours per year of nuisance floods in Norfolk (MHHW+0.3m)

(source: T. Ezer & L. Atkinson, Old Dominion University)

Future Projections (SLR=8mm/y)

Future Projections (SLR=4mm/y)

Past Observations

WETLANDS WATCH

WWW.WETLANDSWATCH.ORG
Critical Infrastructure Impacted
### Future Rainfall

- Strong evidence of *already observed* increases in heavy precipitation occurrence and intensity at Norfolk and regionally
  - Significant changes have occurred since 2000
  - Uncertainty is increasing about using the stationarity assumption

- Future precipitation-frequency curves increase most notably for 1-10 year events; ex: 2-year event increases by 30%

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.4</td>
<td>1.3</td>
<td>-8%</td>
<td>1.7</td>
<td>+21%</td>
</tr>
<tr>
<td>2</td>
<td>3.2</td>
<td>3.7</td>
<td>+17%</td>
<td>3.9</td>
<td>+22%</td>
</tr>
<tr>
<td>5</td>
<td>4.4</td>
<td>5.4</td>
<td>+21%</td>
<td>5.6</td>
<td>+25%</td>
</tr>
<tr>
<td>10</td>
<td>5.4</td>
<td>6.6</td>
<td>+22%</td>
<td>7.0</td>
<td>+28%</td>
</tr>
<tr>
<td>20</td>
<td>6.5</td>
<td>8.0</td>
<td>+23%</td>
<td>8.5</td>
<td>+32%</td>
</tr>
<tr>
<td>50</td>
<td>8.0</td>
<td>10.0</td>
<td>+24%</td>
<td>11.0</td>
<td>+37%</td>
</tr>
<tr>
<td>100</td>
<td>9.4</td>
<td>11.7</td>
<td>+24%</td>
<td>13.3</td>
<td>+41%</td>
</tr>
</tbody>
</table>
Sudden Rain Events = Closed Streets
State Action

- Regional Greenhouse Gas Initiative (RGGI)
  - Carbon Cap and Trade System
  - Initial annual revenue estimated at $100 million annually
  - Funds to be used for flood preparedness and energy efficiency
State Action

- Executive Order #24
- Coastal Master Plan
- State Flood Risk Management Standard

Virginia Flood Risk Management Standard
Freeboard Standards for New State-Owned Buildings in Flood-Prone Areas

Sea Level Rise Inundation Area and any Special Flood Hazard Area or Shaded X Zone

- Measured from the bottom of the lowest horizontal structural member of the lowest floor.
- * Base Flood Elevation (BFE) or Water Surface Elevation (WSE)
- Ground Elevation

Sea Level Rise Inundation Area Only

- Measured from the bottom of the lowest horizontal structural member of the lowest floor.
- Mean Sea Level
- Ground Elevation

Coastal Special Flood Hazard Area or Shaded X Zone

- Measured from the bottom of the lowest horizontal structural member of the lowest floor.
- * Base Flood Elevation (BFE) or Water Surface Elevation (WSE)
- Ground Elevation

Riverine Special Flood Hazard Area or Shaded X Zone

- Measured from the top of the lowest floor.
- * Base Flood Elevation (BFE) or Water Surface Elevation (WSE)
- Ground Elevation

Outside of Flood-Prone Areas

- No elevation standards apply.
- Ground Elevation

* If in Special Flood Hazard Area (500 year floodplain), use BFE.
* If in Shaded X Zone (500 year floodplain) use WSE.

Images are not drawn to scale.
Code of Virginia, § 15.2-2223.2: Comp. Plans must include a Comprehensive Coastal Resource Management Plan [required for localities within the Tidewater Region]

Code of Virginia, § 15.2-2223.3: Comp. Plans must incorporate strategies to combat projected SLR [required for localities within the Hampton Roads Planning District Commission]
ADDRESS DATA NEEDS AND INCONSISTENCIES
SEA LEVEL RISE SCENARIOS
HAMPTON ROADS PLANNING DISTRICT COMMISSION - Member localities resolution to adopt following for planning purposes

<table>
<thead>
<tr>
<th>Period</th>
<th>Feet Sea Level Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018-2050</td>
<td>1.5 ft</td>
</tr>
<tr>
<td>2050-2080</td>
<td>3.0 ft</td>
</tr>
<tr>
<td>2080-2100</td>
<td>4.5 ft</td>
</tr>
</tbody>
</table>

Designing for Future Water Levels
The diagram above illustrates the water level (Mean High Water) in 2070 with 3' of relative sea level rise, the "high" curve in the top graphs.
Military Infrastructure

Hampton Roads infrastructure

Potential impact of sea level rise on military sites

Reference Sea Level rise may approach 1 meter by 2100. A 10-foot storm surge today would exceed the 3-meter rise shown.

1 meter sea level rise
3 meter sea level rise

Source: Environmental Protection Agency
NOTE: Not to scale, for illustration only
Regional Action

Joint Land Use Studies (JLUS) “community-driven, cooperative, strategic planning processes among localities, states, and military installations”

Link
LOCAL ACTION: NORFOLK

Citywide Resilience Zoning Strategy

1. Ground-floor elevations 16” to 3ft above grade
2. Resilience quotient
3. Enhanced buffering, landscape, open space standards
4. Incentivizing adaptive re-use and retrofits of existing buildings

5. Coastal Resilience Overlay
6. Upland Resilience Overlay
7. Neighborhood Resilience Overlay
Ohio Creek Project

Images Source: Waggoner & Ball, City of Norfolk Ohio Creek Project
LOCAL ACTION: VIRGINIA BEACH

- Virginia Beach SLR Strategy
- Increased Stormwater Standards
- Saying No to Unwise Development
HAMPTON: VEHICULAR NO WAKE ZONES IN LOCALITIES

[Image of a road with a 'No Wake Zone' sign on a pole with a car parked alongside.]
Major Challenges Remain

FEMA Funding is insufficient

<table>
<thead>
<tr>
<th>Locality</th>
<th># of Repetitive Loss Properties</th>
<th>Average Cost of Mitigation</th>
<th>Total Cost of Mitigation</th>
<th>Average Annual FEMA Funding</th>
<th># of Years to Mitigate w/ FEMA Funding Alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chesapeake</td>
<td>409</td>
<td>$250,000</td>
<td>$102,250,000</td>
<td>$787,500</td>
<td>130 years</td>
</tr>
<tr>
<td>Hampton</td>
<td>863</td>
<td>$75,000*</td>
<td>$64,725,000</td>
<td>$833,333</td>
<td>78 years</td>
</tr>
<tr>
<td>Norfolk</td>
<td>900</td>
<td>$162,500</td>
<td>$146,250,000</td>
<td>$778,000</td>
<td>188 years</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>186</td>
<td>$75,000*</td>
<td>$13,950,000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Virginia Beach</td>
<td>561</td>
<td>$185,000</td>
<td>$103,785,000</td>
<td>$725,000</td>
<td>143 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,919</strong></td>
<td><strong>NA</strong></td>
<td><strong>$430,960,000</strong></td>
<td><strong>NA</strong></td>
<td><strong>NA</strong></td>
</tr>
</tbody>
</table>

*No average mitigation costs were available, so the statewide average of $75,000 was used.

FEMA Funding Levels:
- Hampton has received $2,500,000 since 2011
- Chesapeake has received $6,300,000 since 2006
- Norfolk has received $3,890,000 since 2009
- Virginia Beach has received $2,900,000 since 2010

Note: The most recent data available for Chesapeake, Norfolk, and Virginia Beach is from September 2014; for Hampton, data is from 2013.
Incentivizing Green Infrastructure Mitigation and Adaptation - A Strategy in Development

Link
ADAPTVA

Evidence-based planning for changing climate

FORECASTS
Forecasting water levels, temperature, and precipitation helps mitigate impacts and plan resilient communities. Access a tide forecast & sea level projections for Virginia.

ADAPTATIONS
Case studies and story maps illustrate how adaptation works, and can be financed, through zoning, planning, engineering, and policy practices.

TOOLS
Tools assess risk and inform preparation and response to a changing environment. Access flood risk maps, shoreline recommendations, and an interactive comprehensive map of adaptation strategies.

DATA
Adapt Virginia’s comprehensive Geoportal provides easy and convenient ways to access, download, and share geospatial data. Search for data via map or search engine.

PLANNING & POLICY
Management strategies from local and State code to socioeconomic issues and the Community Rating System. Learn about social vulnerability, relevant local ordinances, state legislation, and legal issues.
MAJOR CHALLENGES REMAIN

- Virginia: Buyer Beware on Flood Risk
  - HB 858
- Significant Barriers to Grant Applications for Localities
- Army Corps Cost Benefit Analysis
- Atlas 14 Update
- Funding, Funding, Funding

Virginia in 2040

$31.2 BILLION FOR SEAWALLS
4th most costly state

4,063 MILES OF SEAWALLS
4th most miles of seawalls

Link
THANK YOU!

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