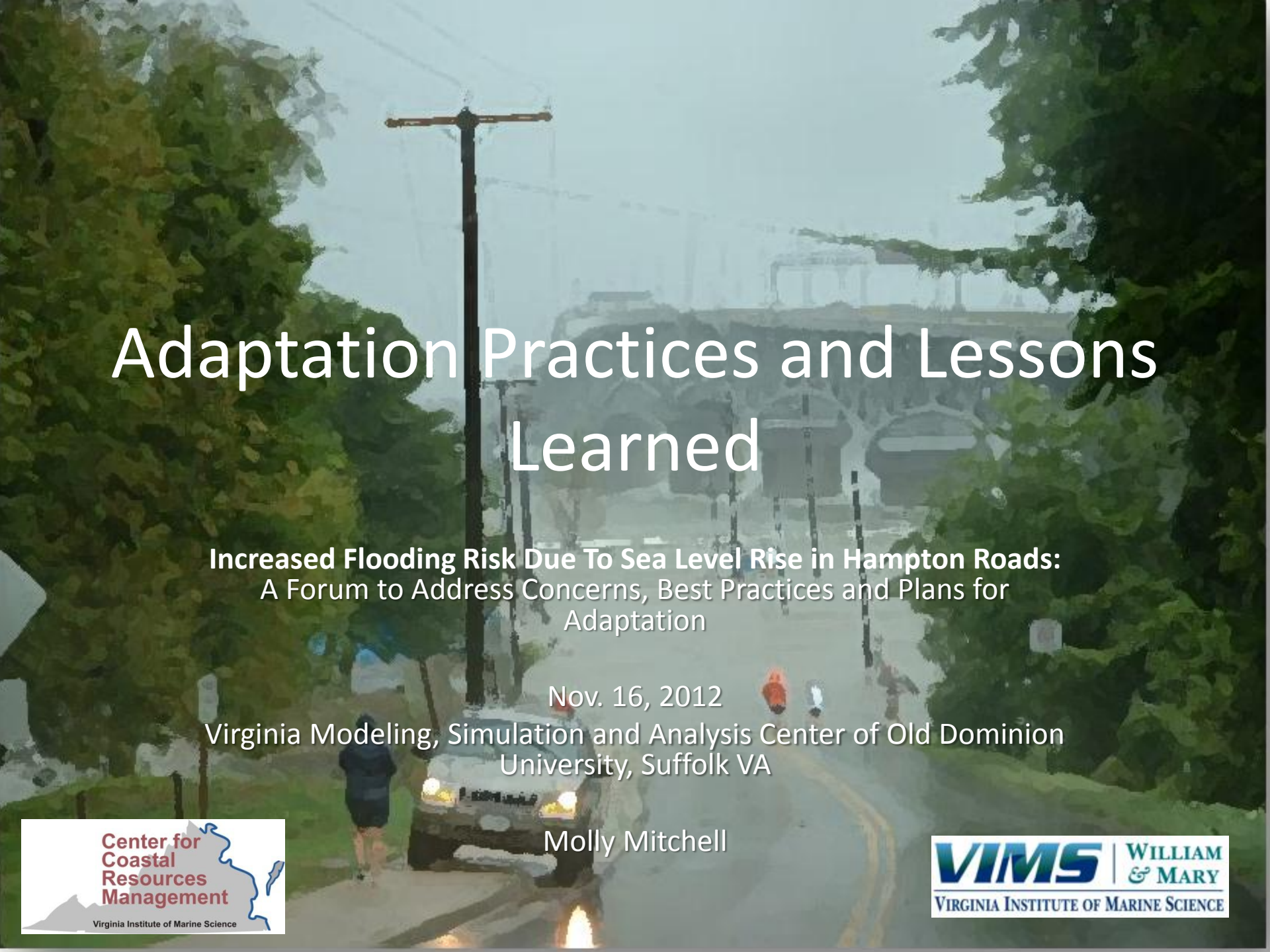
11-16-2012

Adaptation Practices and Lessons Learned

Molly Mitchell
Virginia Institute of Marine Science



Adaptation Practices and Lessons Learned

Increased Flooding Risk Due To Sea Level Rise in Hampton Roads:
A Forum to Address Concerns, Best Practices and Plans for Adaptation

Nov. 16, 2012

Virginia Modeling, Simulation and Analysis Center of Old Dominion University, Suffolk VA

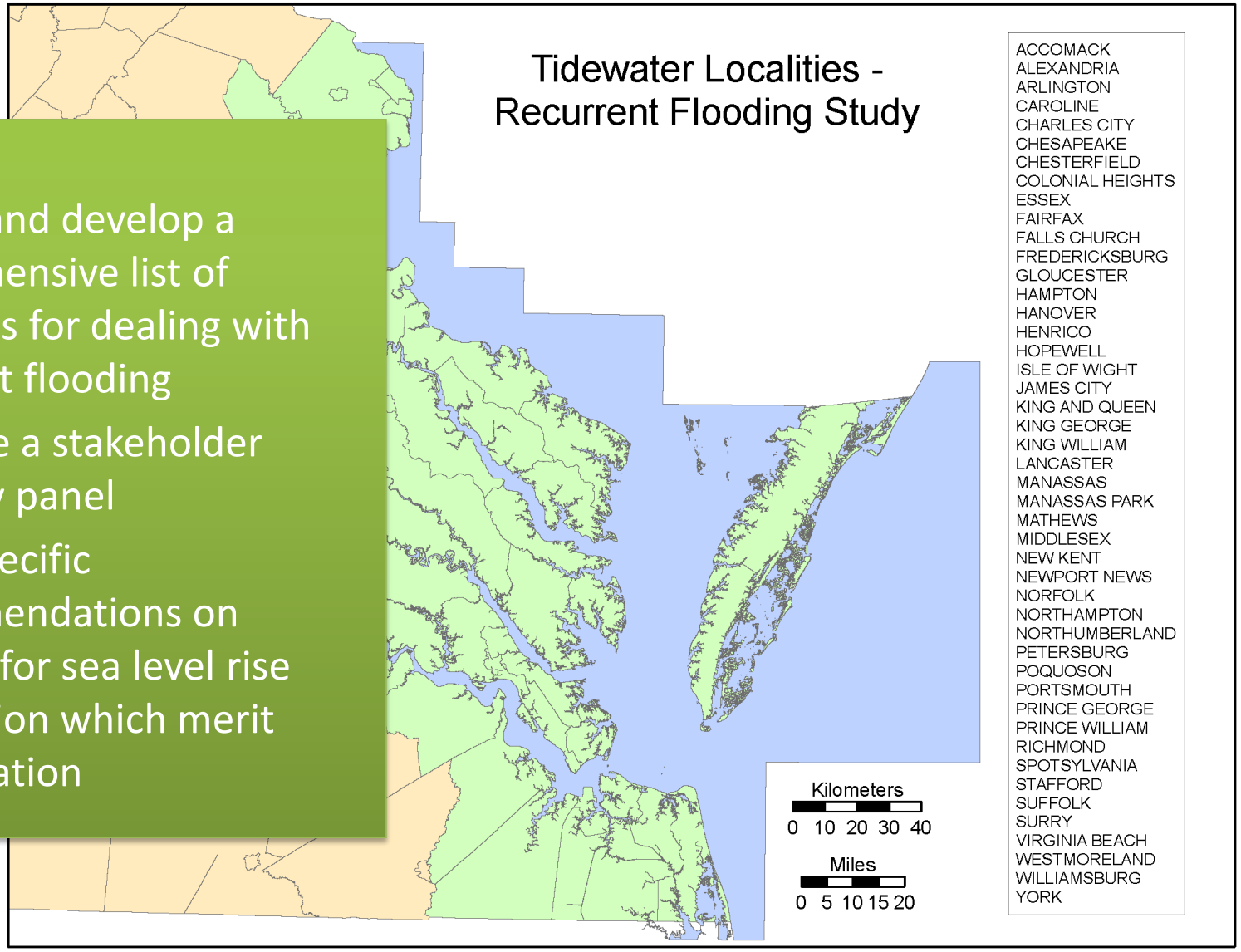
Molly Mitchell

Center for Coastal Resources Management
Virginia Institute of Marine Science

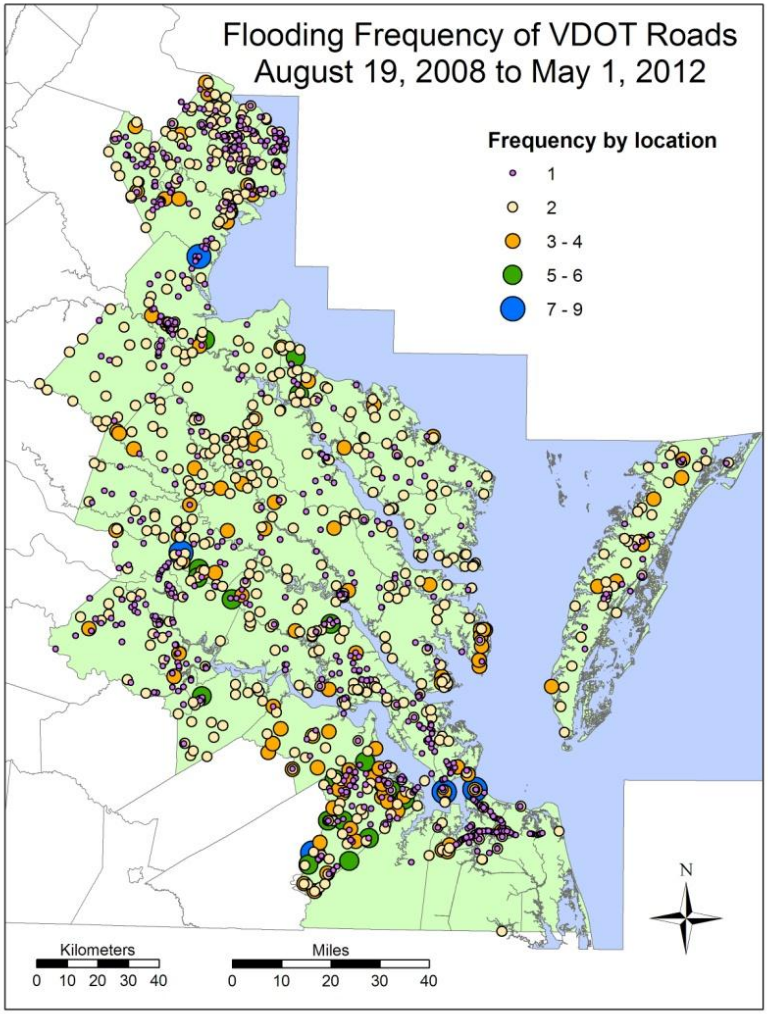
VIMS | William & Mary
Virginia Institute of Marine Science

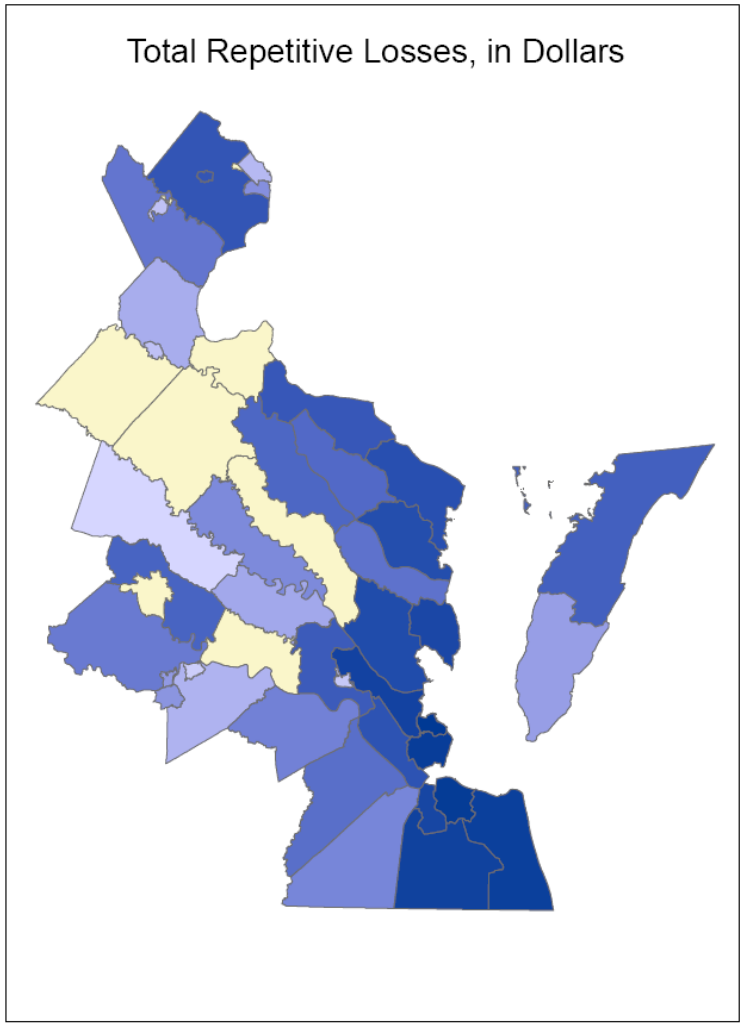
Recurrent Flooding Study

- Goals
  - Review and develop a comprehensive list of strategies for dealing with recurrent flooding
  - Convene a stakeholder advisory panel
  - Offer specific recommendations on options for sea level rise adaptation which merit investigation



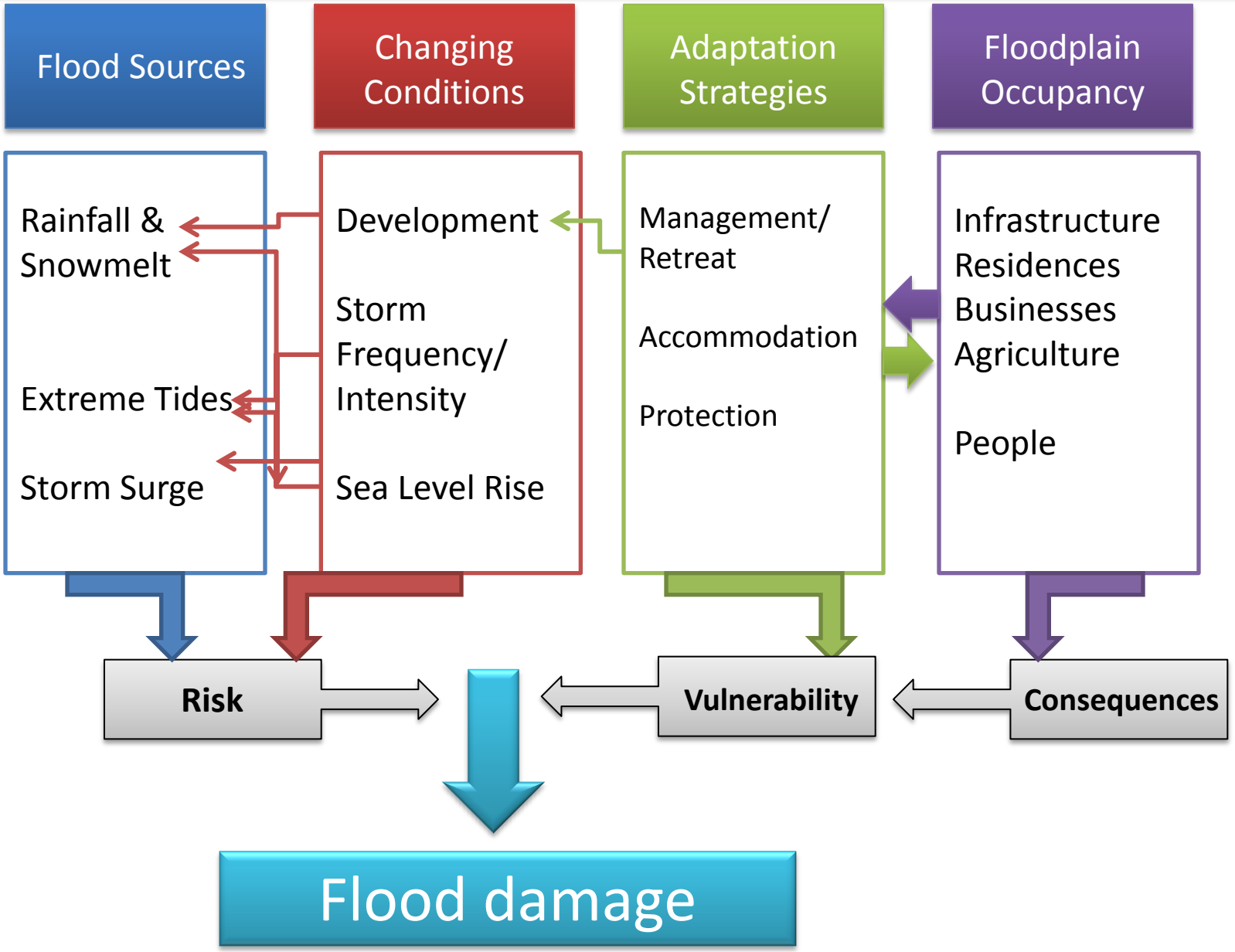
Historic Flood Data





"Floods are Acts of Nature; But Flood Losses Are Largely Acts of Man"

Dr. Gilbert White



Elevated house in Mississippi
Photo by Robert Harris/*FEMA*

Adaptation Strategies

Management/ Retreat

Accommodation

Protection

Vulnerability

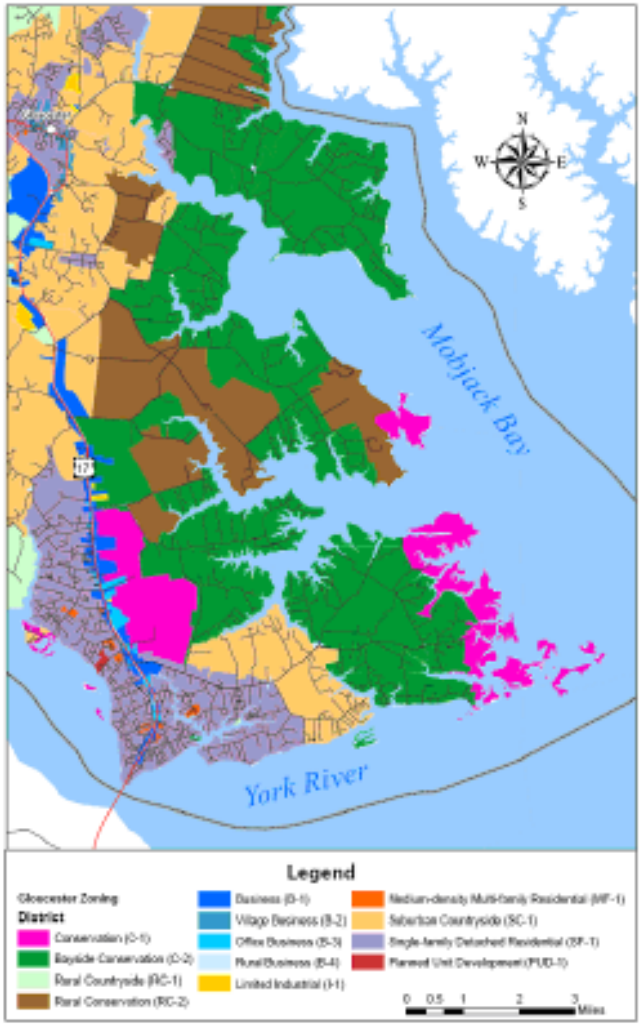

Levee in North Dakota
Photo by Andrea Booher/FEMA

Controllable: Methods to reduce vulnerability to flooding.

ADAPTATION STRATEGIES

Management

Gloucester County Zoning (Southeastern Portion Inset)

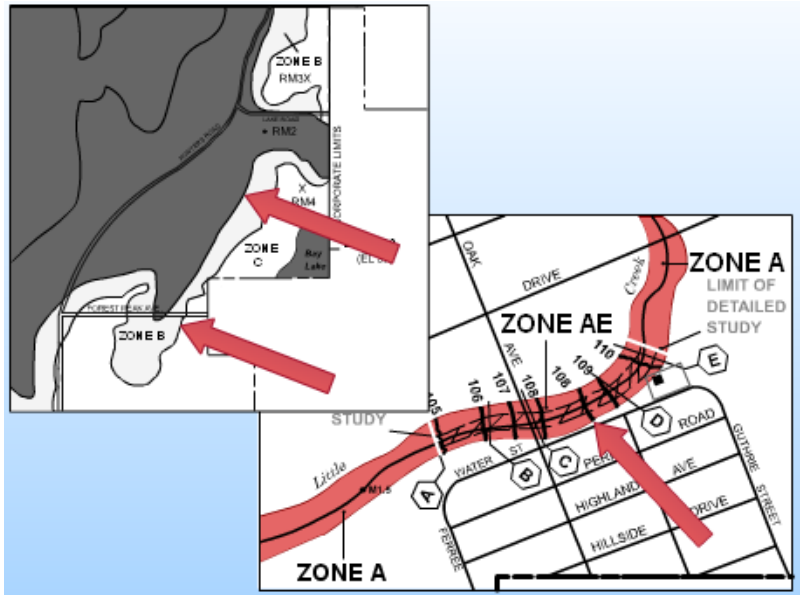


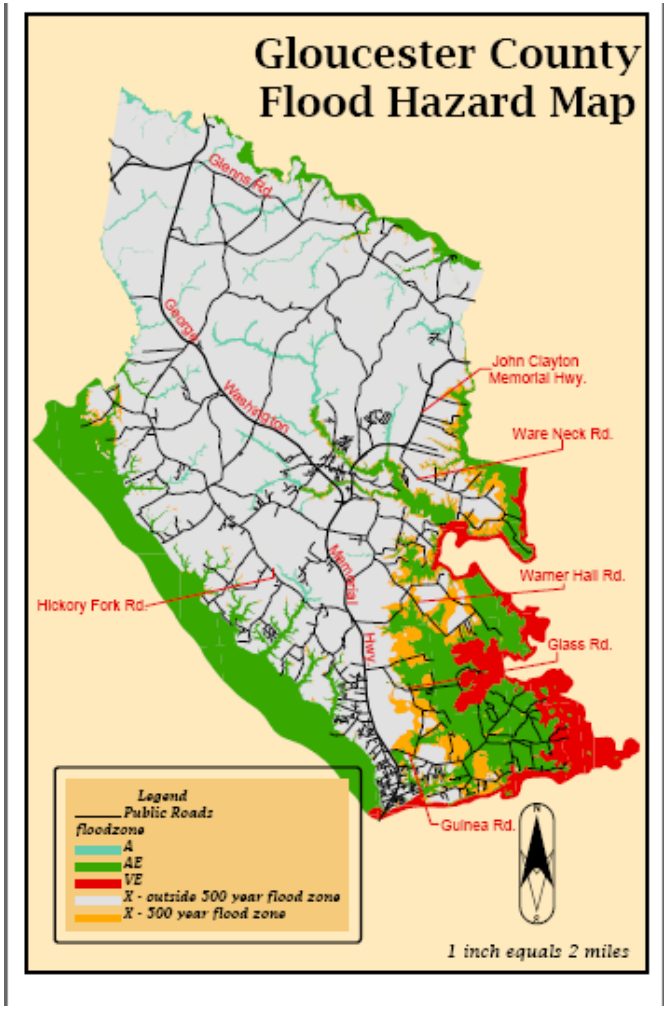
Source: County Base GIS layers were provided by United States Census Bureau and the County Zoning GIS layers were provided by Gloucester County Information Technology/ GIS Department.

Predictive Flood Data

FIRM Maps (FEMA):

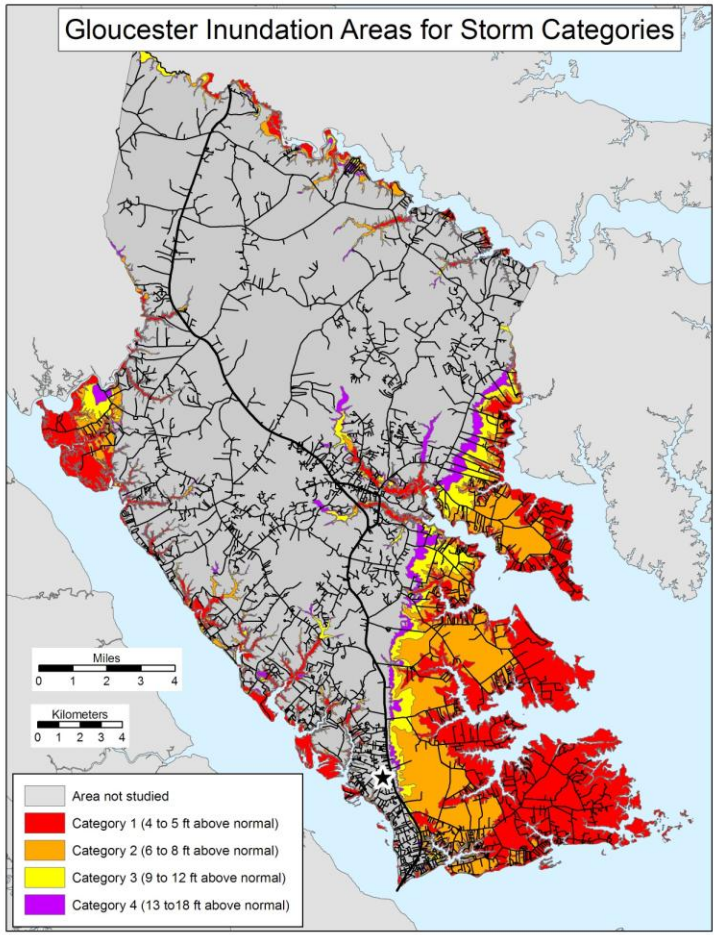
- Special Flood Hazard Areas
- Base (1 percent annual chance) flood elevations or depths
- Areas designated as regulatory floodways
- Undeveloped coastal barriers

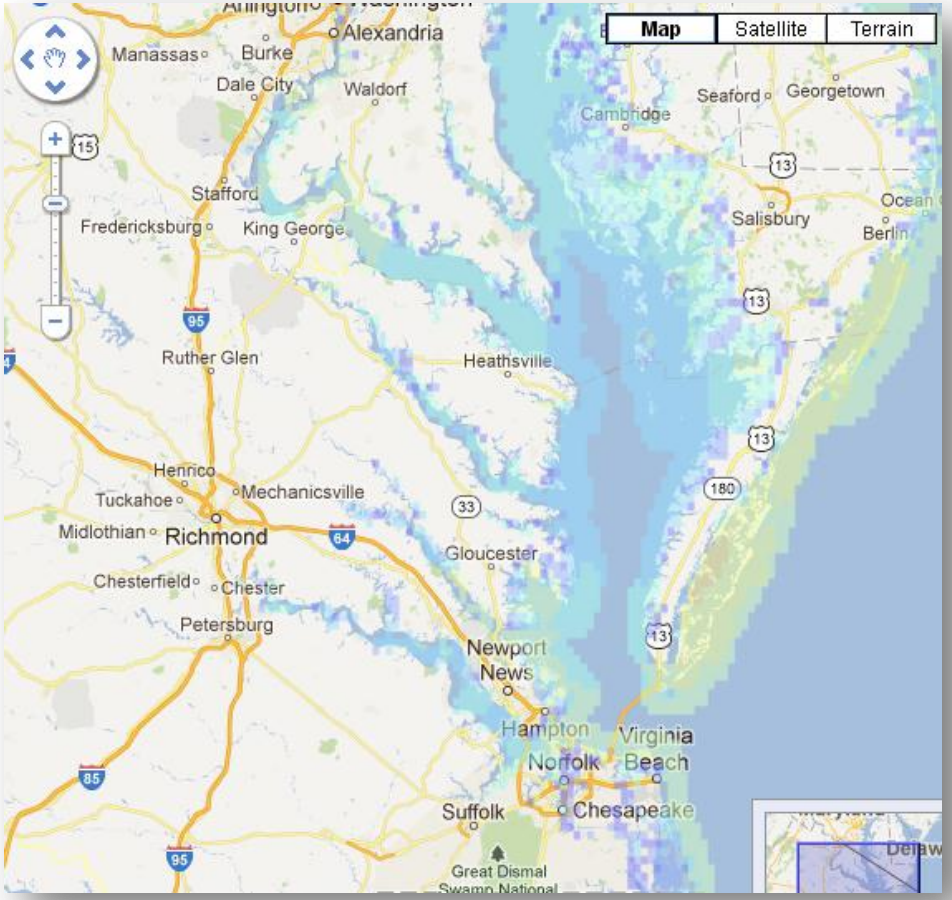




Predictive Flood Data

Storm surge maps (NOAA):
Education tool aimed at providing a national snapshot of maximum potential storm surge resulting from hurricanes (note: not for planning purposes)





Coastal Barrier Resources Act (1982)

- Restricts Federal expenditures and financial assistance which have the effect of encouraging development of coastal barriers,

- Goals: minimize the loss of human life, wasteful expenditure of Federal revenues, and damage to fish, wildlife, and other natural resources associated with coastal barriers along the Atlantic and Gulf of Mexico coasts.

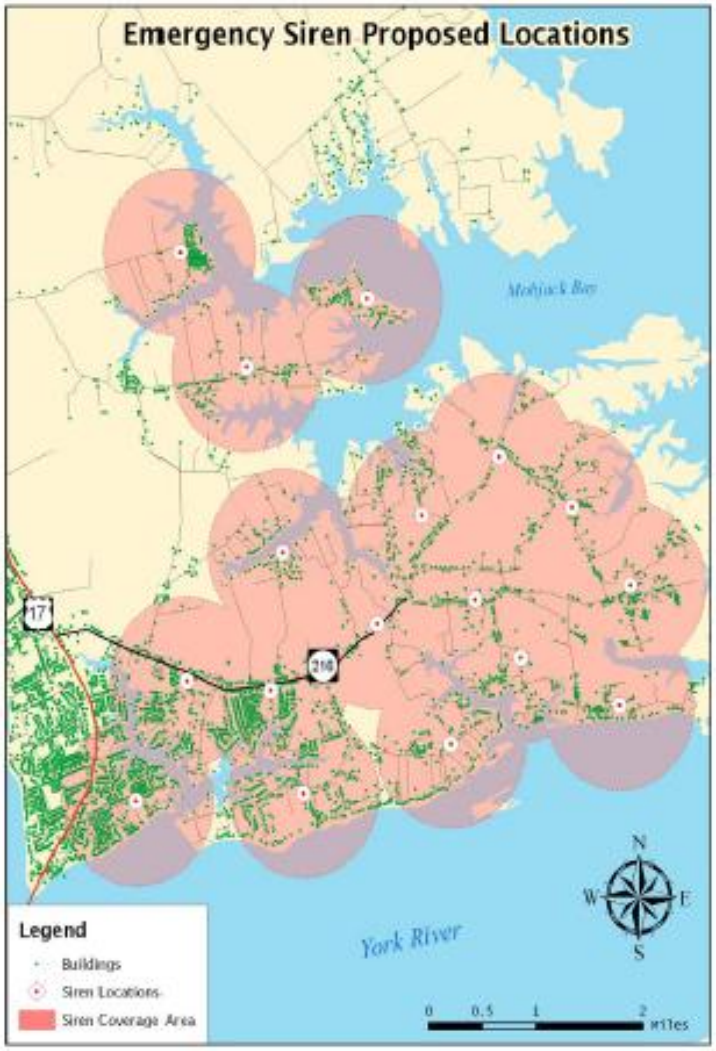
- Does not prohibit privately financed development

- Does prohibit most new Federal financial assistance, including flood insurance, within a designated Coastal Barrier Resources System (CBRS).

1990, Coastal Barrier Improvement Act CBIA

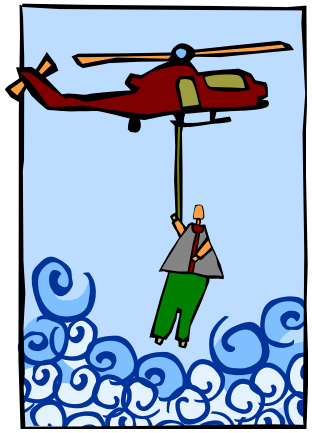
- Prohibits the issuance of new Federal flood insurance within "otherwise protected areas" on buildings constructed after November 16, 1991, unless the building is used in a manner consistent with the purpose for which the area is protected.

Accommodation

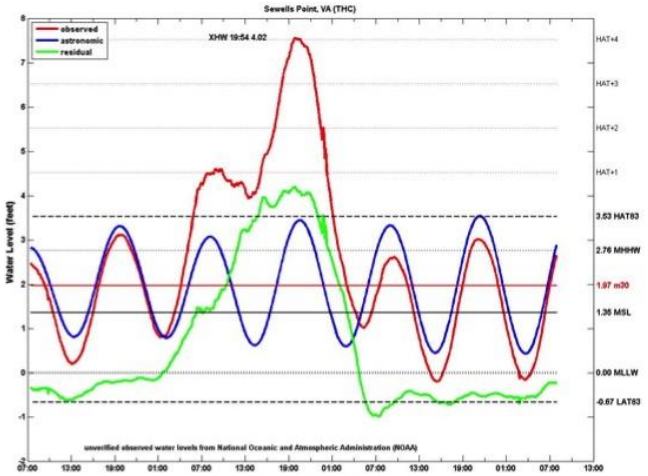


Source: County Base GIS layers were provided by United States Census Bureau and the County Addressed Building GIS layer was provided by Gloucester County Information Technology/ GIS Department.

Elevated house in Mississippi
Photo by Robert Harris*/FEMA*



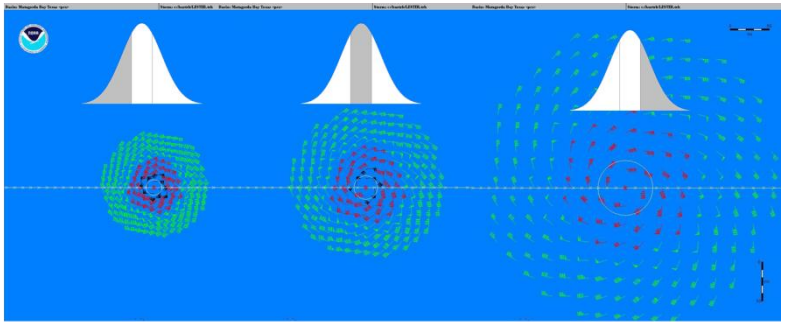
Tidewatch – Early warning



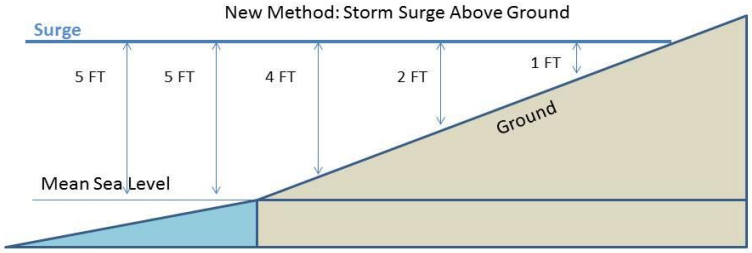
- On-line tool for gauging the <u>magnitude</u> of coastal flooding in a given location and minimizing its potential impacts

- The Tidewatch system now generates 36-hour public forecasts for 9 water-level stations within Chesapeake Bay and a single station on Virginia's seaside Eastern Shore.

Probabilistic Tropical Cyclone Inundation Guidance – Early warning

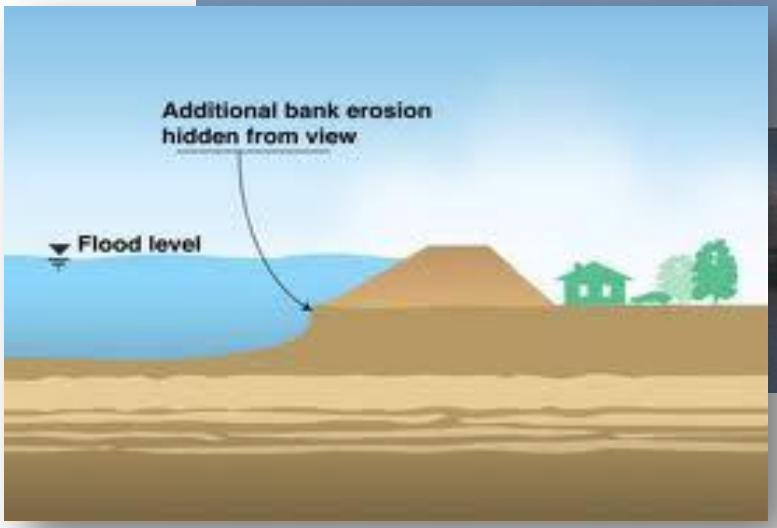


- Size: Small (30%), Medium (40%), Large (30%)
- Forward Speed: Fast (30%), Medium (40%), Slow (30%)
- Intensity: Strong (30%), Medium (40%), Weak (30%)



- Probabilities, in percent, of inundation exceeding 0 feet though 20 feet above ground level, at 1 foot intervals
- Provided out to 78 hours
- Does not account for tide, waves, and fresh water (i.e. precipitation runoff and river inflow)

Protection



Created marsh in Virginia
Photo by K. Durhing

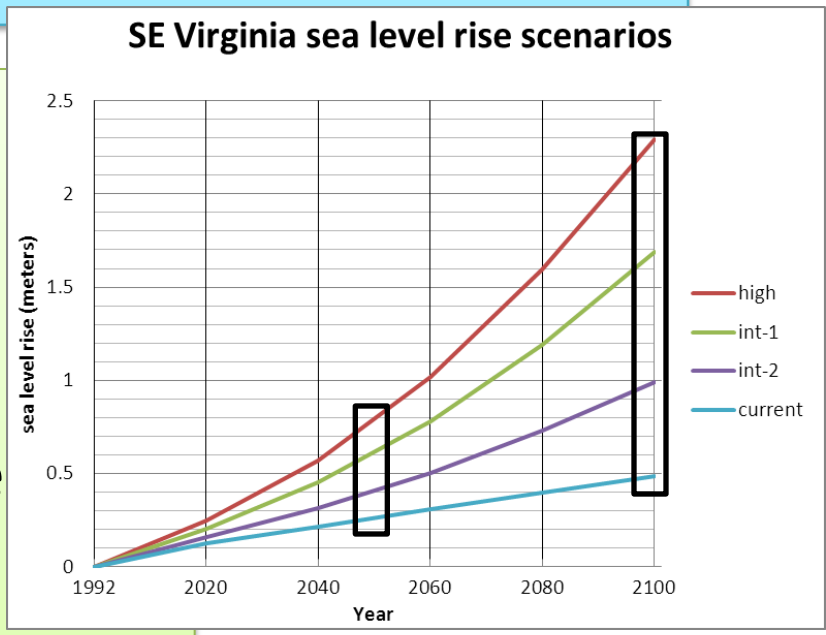
Lessons Learned:

1. PROTECTION LEVELS AND PLANNING HORIZONS

- Level of protection ∝ Amount of Risk
  - Increased levels of protection → decreased risk
- Netherlands = 1/10,000 year storm
- Red River Basin
  - Major Urban Areas = 1/500 – 700 year storm
  - Rural Residences & Farmsteads = 1/100-200 year storm
  - Transportation 1/200-250 year storm

- Planning horizons
  - Use to reduce uncertainty in projections
  - Typically 40-50 years
  - Differ for different infrastructure

Small projects or dike improvements	10-50 years
Capital works (sluices, locks)	100 years
Major works (storm surge barriers)	200 years



Based on 2012 National Climate Assessment global sea level rise scenarios + 0.27mm/yr local subsidence

Lessons Learned:

2. REGIONAL DIFFERENCES IN STRATEGIES

Fast growing urban areas

- New development increases consequences of flooding
  - As lower risk areas are built out, higher and higher risk areas are developed
- Reduction in natural areas increases extent of flooding

- Protection-type projects considered
- Master plan for development that considers current and future flood risks
- Multi-level planning to reduce consequences should protection fail

Rural or low development areas

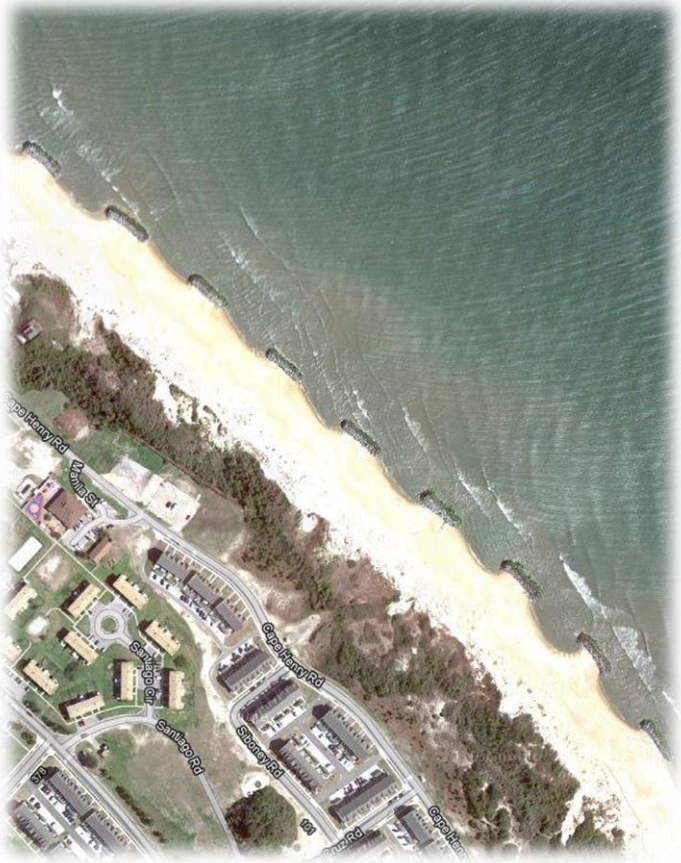
- Houses are spread out, making them difficult to protect
- Income is frequently linked to water access (makes retreat problematic)
- Saltwater intrusion in agriculture fields can destroy crops
- Ecotourism makes hard engineering unattractive

- ➢ Land management/zoning can reduce potential for future problems
- ➢ Agricultural areas may consider switching crops
- ➢ Ecotourism areas can use soft engineering

Lessons Learned:

3. NEED FOR COMPREHENSIVE PLANNING

In areas where the government takes little or no action, individuals will take action to protect their properties…



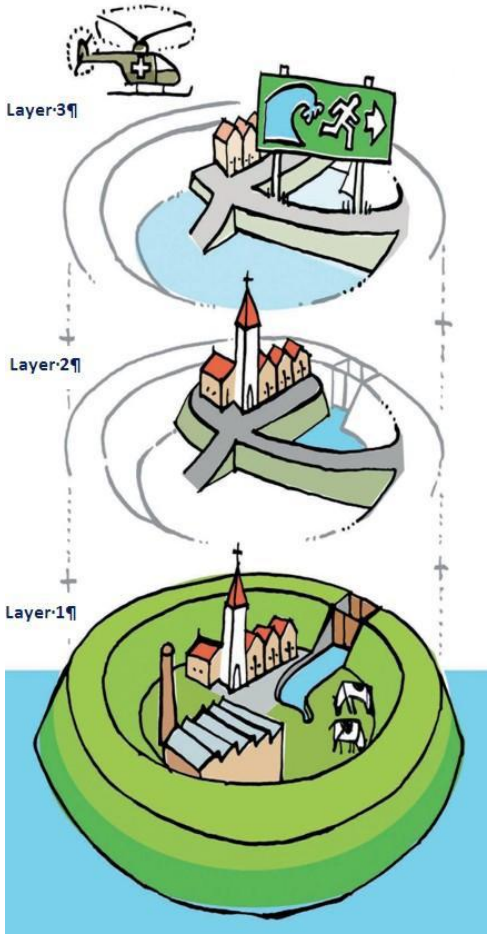
But structures can impact adjacent properties AND seawall/levee systems are only as strong as their weakest point…

Lessons Learned:

4. MULTI-LAYERED SYSTEMS

Multilayered Flood Protection

Neatherlands, National Water Plan, 2010

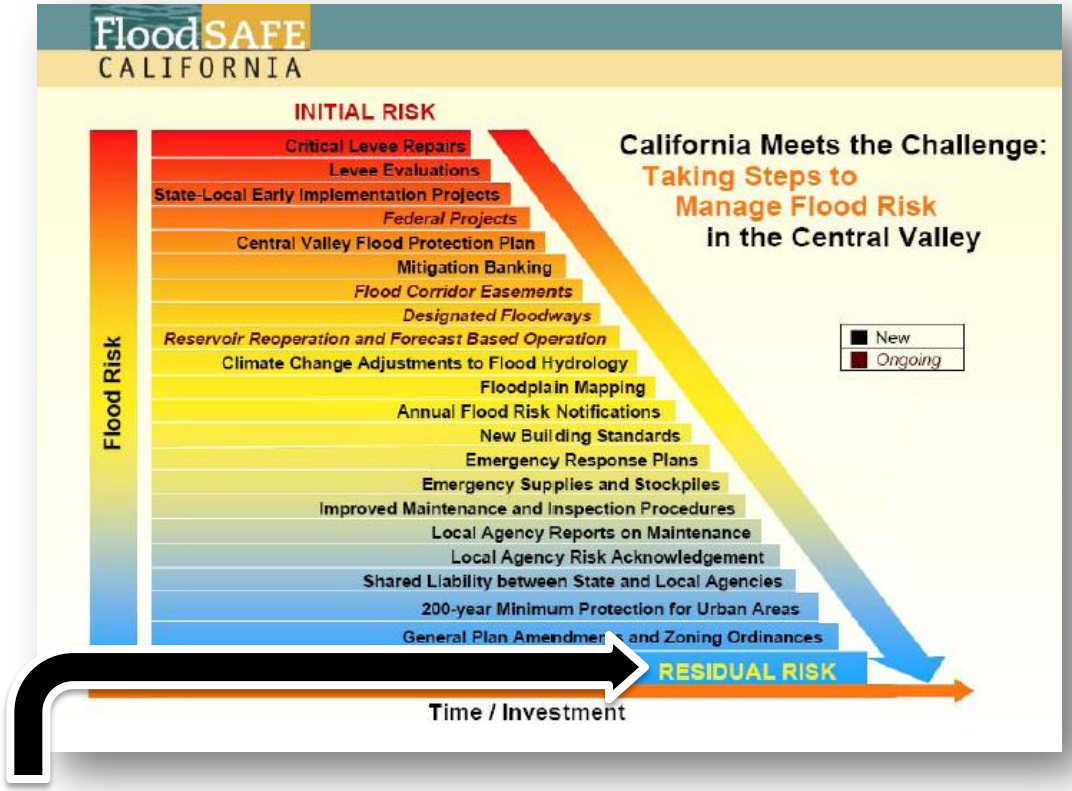


- Layer 1 = Prevention (Risk)
  - Mostly Protection measures
- Layer 2 = Spatial Development (Vulnerability and Consequences)
  - Mostly Management and some Accommodation measures
- Layer 3 = Disaster Management (Vulnerability and Consequences)
  - Subset of Accommodation measures

The Stairstep Diagram

- Based on the concept of multilayered protection plans

- The effectiveness of each additional layer of protection depends on the remaining amount of risk
- The last “step” is the base risk that cannot be mitigated



Questions?

(AP Photo/Carolyn Kaster) http://www.boston.com/bigpicture/2009/03/red_river_flooding.html