CAROLINAS
CLIMATE RESILIENCY

Presented by:

Joseph Marrone, PE | joma@ocean-coastal.com
John M. Shaffer, PE | jshaffer@shfwrs.com

April 23, 2014
LESSONS LEARNED Climate Change Adaptation Planning

Applying Lessons Learned in Europe to the Carolina Coast

Case: Copenhagen and Charleston

Copenhagen, DK

Charleston, SC
COPENHAGEN Historic Maritime City

Challenges

Vulnerable to Extreme Tides, Storm Surge and Cloudbursts

Initiated Climate Change Adaptation Plan in 2008
COPENHAGEN Historic Maritime City

Copenhagen Climate Change Adaptation Plan

Assess economic risk
Adaptation scenarios
Macroeconomics (Cost: Benefit, ROI)
Feasibility
Implementation Schedule
DTM
Digital Terrain Model
RISK ANALYSIS Floods

Where, When, Frequency, Depth, Damage Costs

- Map extent and depth of floods from
  - Sea
  - Heavy rain
  - Flowing water on surface
  - Rivers, watercourses
  - (Groundwater)
- Likelihood for floods (statistic year by year and the whole period 2010-2110)
- Damage Costs from floods
- Total Risk (e.g. economically) Likelihood x consequences
Economic development risk caused by floods from rain or sea
MACROECONOMICS,
FEASIBILITY and Implementation Schedule

PRIORITY RANKING
CHARLESTON South Carolina
CHARLESTON  Historic Maritime City

Challenges

- Vulnerable to Extreme Tides, Storm Surge and Cloudbursts
- No Comprehensive Climate Change Adaptation Plan in Place
- Costs Associated with Losses or Adaptation are Not Understood
- Approach Similar to Copenhagen is Appropriate
TYPICAL FLOODING Caused by Tide and Cloudburst

Highest astronomical time
+1 ft sea level rise
+2 ft sea level rise

Common Scenario
Manageable Impact/Losses
Major Stormwater Drainage Projects Underway

Problem Areas

Deep Shaft Tunnels

High Capacity Pumps

Effective at current, normal tide levels

Cost:Benefit?
EXTREME FLOODING Caused by Storm Surge

10 yr Storm Surge at High Tide
+1 ft sea level rise
+2 ft sea level rise

Extreme Scenario
Catastrophic Impact/Losses

What are the costs?
CHARLESTON Historic Maritime City

Management / Retreat
"Buy Back"

Accommodation
Building Codes
Zoning

Management / Retreat
Flood Barrier
Seawall Extensions
BIG Questions

What are the costs?

What has the highest ROI?

What is most feasible?

When is the right time to act?

How do we pay for it?
PRELIMINARY Climate Change Adaptation Plan for Coastal Carolina Communities

› **Basis of Design** Assumptions, Data and Codes
› **Realistic > Extreme** Evaluation Scenarios
› Understand Risks / Potential Losses
› Adaptation Scenarios and Costs
› Economics
› **Engineering, Regulatory, Societal** Feasibility
› Implementation and Funding Schedule
LESSONS LEARNED Climate Change Adaptation

› Involve Stakeholders
› Achieve consensus on Basis of Design
› Be aware of extreme conditions + probability
› Evaluate multiple Adaptation Scenarios
› Understand the costs and implementation schedule for decision making
› Build in Flexibility
Thank you

Joseph Marrone | John Schaffer