

An aerial photograph showing a coastal town with significant flooding and debris on the beach. The town is built on a narrow strip of land, and the water has inundated many areas. A long bridge or pier extends from the town into the water. The beach is covered in sand and debris, including what appears to be a destroyed structure. The water is dark and turbulent, with waves crashing against the shore.

# Climate Risk & Transportation: Analytical Approaches

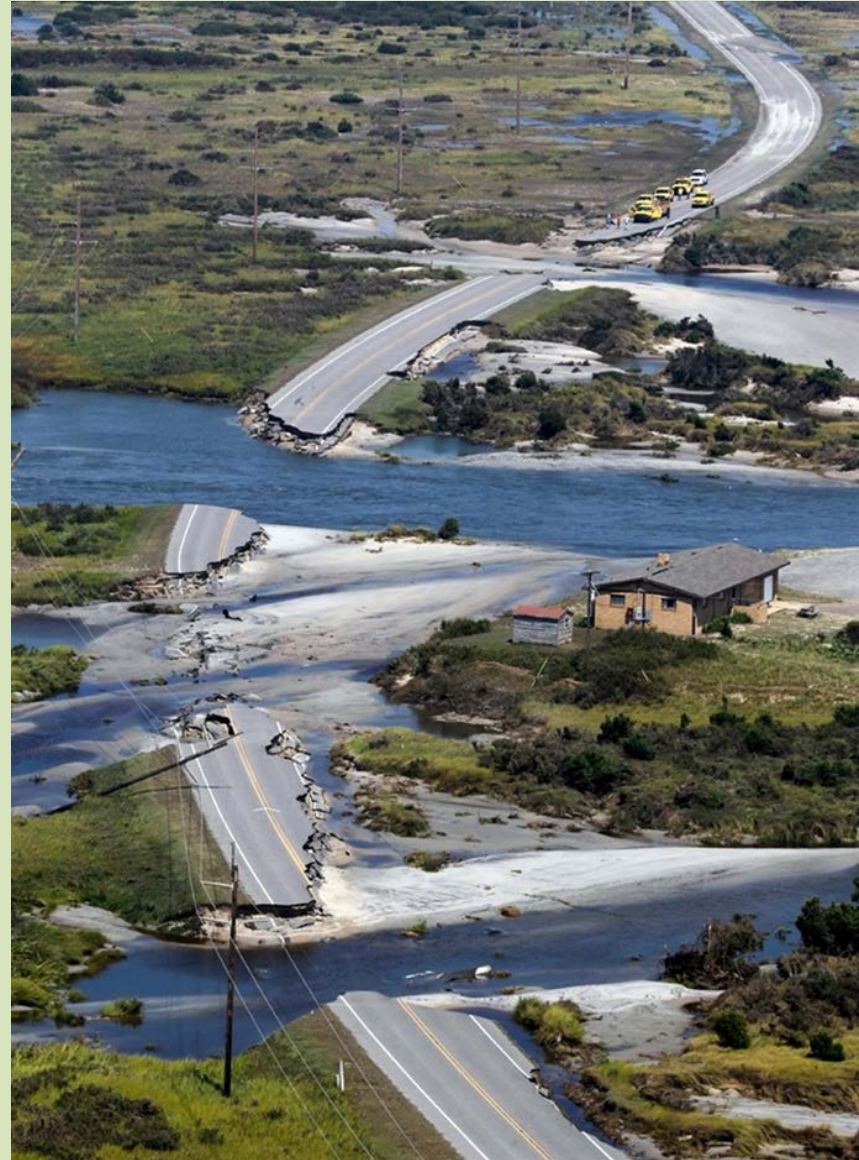
USDOT Climate Mitigation & Adaptation Workshop  
February 25-26, 2015

Arthur Rypinski  
OST/P-33

US Department of Transportation

# Okay, the future isn't going to be like the past....

- ...we get it.
- How can we make better decisions for the transportation sector and the communities we serve?
- Who decides?
- What questions do we need to decide?
- What tools would be most helpful?



# Resiliency? How? How Much?

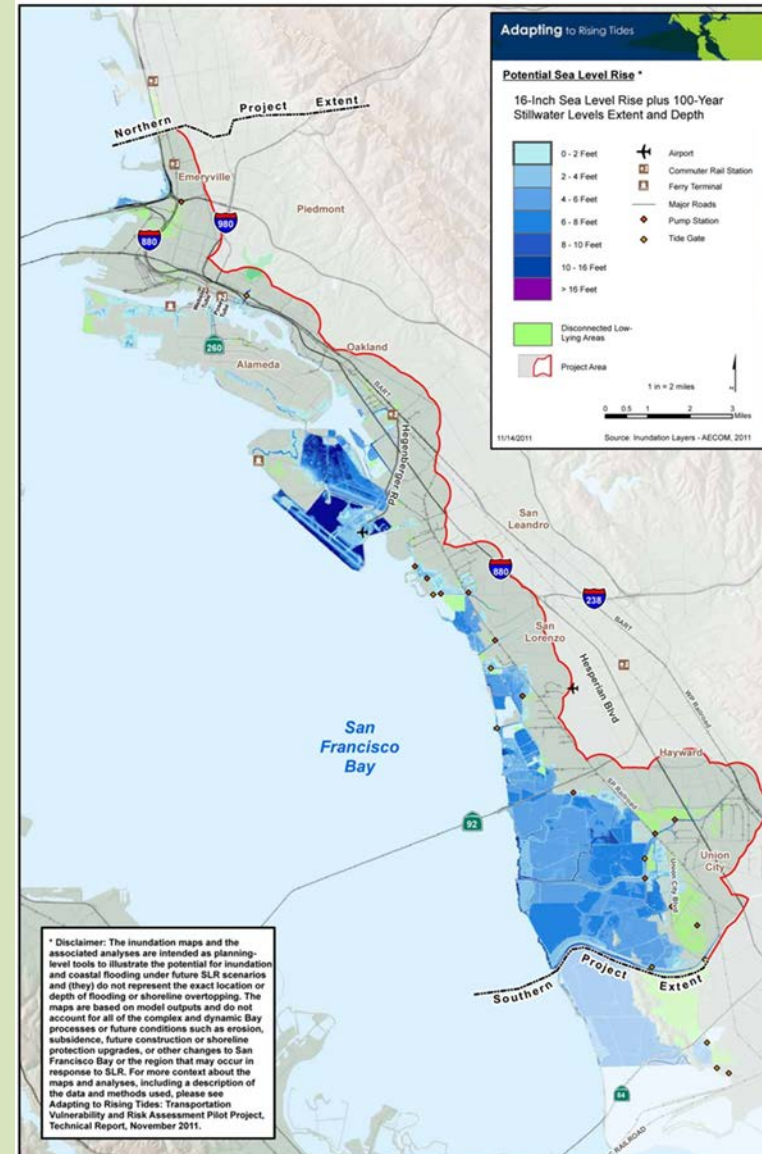
- Six Options for Resilience (For facilities or systems)
  - Hardening;
  - Redundancy (excess capacity or multiple smaller elements)
  - Relocation
  - Abandonment;
  - Rapid Recovery
  - Live with the Risk
- We Can't Possibly Harden Everything: 100% reliability is neither possible nor desirable
- Transportation facilities usually survive getting wet: the big risks are erosion, scouring, and wave action.
- Loss-of-use is more important than repair cost, but less studied.
- So, we need a set of decision-making tools and criteria that span the range of potential solutions....and....value reliability.

# Where should we be considering climate risk?

- Land Use Planning;
- Transportation System Planning
- Facility Construction;
- Asset Management;
- System Operation;
- Emergency Response

# Land Use Planning

- Largely done by public agencies.
- Fundamental adaptation decisions are often land use decisions, particularly: flood risk, ecosystem protection and services.
- Risk acceptance, relocation, abandonment, and community flood protection should normally be land use decisions.
- Transportation decisions will often follow from land use decisions.
- Basic approach probably like catastrophe modeling for insurance companies. Adding transportation elements to this approach is complex but probably feasible.



# Transportation Planning

- Done by public agencies and private companies.
- Appropriate scope for redundancy vs. relocation vs. hardening decisions.
- Main approach is transportation modeling, augmented to consider emergency evacuation and reliability considerations.
- Some scoping analysis of different new facility options (costs & risks) required to get pro-forma costs & benefits
- Benefit cost analysis to summarize results.

## Climate Impacts Vulnerability Assessment Statewide Results

### State Routes

- Low Vulnerability
- Moderate Vulnerability
- High Vulnerability

### State Airports

- Low Vulnerability
- Moderate Vulnerability

### State Ferry

- Low Vulnerability
- High Vulnerability

### State Rail

- High Vulnerability

November 30, 2011

Data Source: Climate Impacts Vulnerability Assessment from WSDOT Internal Scenario-based Planning Workshops Conducted March - October 2011; State Routes from WSDOT at scale of 1:24K; County Boundaries from WSDOT at scale of 1:500K

NOTE: Statewide results assess 2-foot Sea Level Rise (see Appendix E for 4-foot and 6-foot)



DRAFT

FOR PLANNING ONLY  
Not suitable for site specific use

# New Facility Design/Construction

- State and Local transportation agencies, infrastructure firms, architect/engineering firms. Also Federal funding agencies....
- Federally funded projects must consider:
  - CEQ EIS Greenhouse Gas Guidance
  - Federal Flood Risk Management Standard
- Many siting/scale decisions will have already been made.
- Hydrology, engineering design, engineering economics
- Key Issues:
  - Which climate scenario?
  - How much risk do we want to assume?

# Existing Facilities

- State and local agencies, private infrastructure firms.
- Focus of FHWA research and analytical work, key aspect of asset management and “State of Good Repair.”
- Key Steps
  - Identification of existing assets,
  - future climate scenarios
  - design of existing facilities
  - vulnerability assessment and ranking
  - Consideration of remedial action
- FHWA software tools, hydrology, engineering studies
- It may be desirable to measure loss-of-use as well as damage repair in vulnerability assessments.



# Systems Operation

- State and local transportation agencies, FAA, private infrastructure firms
- Weather delays in transportation, particularly when unexpected, are enormously expensive.
- May affect aggregate climate change costs, benefits of operational measures.
- Traffic flow modeling may help:
  - Estimate benefits of weather countermeasures;
  - Economic cost of climate change;
  - Loss of use analysis
  - Emergency response
- Benefit-cost analysis to summarize results.

# Emergency Response

- Fed, state and local transportation agencies, emergency management agencies
- Both infrastructure planning and operational aspects;
- Climate change will affect frequency and scale of extreme events
- From a planning/infrastructure perspective, it would be useful to consider:
  - Evacuation capacity;
  - Protection of vulnerable populations
  - Post-disaster response
- Post-disaster response requirements argues for redundancy and features to support low volume, high value mobility.
- Appropriate tool probably transportation modeling.

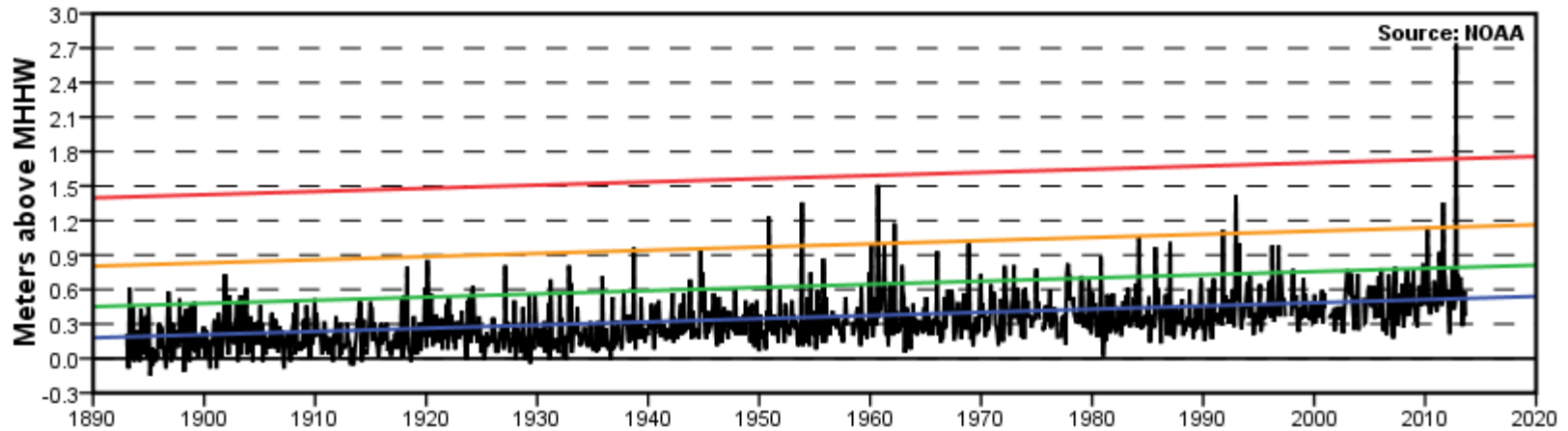
# Back-Up Slides

# Resiliency in Funding Programs

- FTA \$1.3 billion formula grant, \$3 billion resiliency competitive grant program under Sandy Relief Act
- Resilience a selection criterion and project type in TIGER
- FHWA permits adaptation studies and resilience elements under Federal-aid highway program.
- FHWA has revised emergency relief funding handbook to consider resiliency in repairs. Still limited by statute.
- Adaptation planning permitted under FHWA Federal aid highway program
- Adaptation planning and resiliency projects eligible categories for FTA planning programs
- Adaptation planning and resiliency elements permitted under FAA Airport Improvement Program.

# How Much Risk to Take?

The Battery, NY



Atlantic City, NJ

