In the Wake of Hurricane Sandy:
Creating a More Resilient Regional Transportation System in New York, New Jersey, and Connecticut

- Josh DeFlorio, Cambridge Systematics
- Jeffrey Perlman, North Jersey Transportation Planning Authority
Climate Change Adaptation at FHWA

Goal: Regular/Systematic consideration of climate change & extreme weather vulnerability and risk in transportation decision making:
- Systems level: Transportation planning, Asset Management
- Project Level: Environmental process, Preliminary Engineering, Design, Operations, Maintenance
FHWA Climate Resilience Pilots & Other Project Locations

- Hurricane Sandy Project
  - GBRC
  - SWRPC
  - NYMTC
  - NJTPA
  - NJ DOT
  - NY DOT
  - CT DOT

- Metropolitan Transportation Commission
- Mid Region COG (Scenario Planning Project)
- North Central Texas COG
- South Alabama RPC (Gulf Coast 2 Project)
- Capital Area MPO
- Hillsborough County MPO
- Broward MPO

Inset maps for Alaska and Hawaii.
Post-Hurricane Sandy Transportation Resilience Study

Project Background

» Post-Sandy project builds on a FHWA 2011 NJ pilot

» Learn from experience of Sandy

» Support FHWA goals to consider CC & EW at the system and project levels
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Project Objectives

» Enhance the resilience of the region’s transportation system to climate change and extreme weather

» Develop feasible, cost-effective strategies at the project level to reduce and manage extreme weather vulnerabilities amid the uncertainties of a changing climate

» Inform the ongoing Hurricane Sandy recovery process
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Regional Project Partners

**Lead Agency:** Federal Highway Administration

- **State DOTs**
  - Connecticut
  - New Jersey
  - New York

- **MPOs**
  - Greater Bridgeport Regional Council (CT)
  - Western Connecticut Council of Gov’ts
  - North Jersey Transportation Planning Authority
  - New York Metropolitan Transportation Council

- **Authorities/Agencies**
  - Metropolitan Transportation Authority
  - NJ Transit
  - Port Authority of New York & New Jersey

- **Consultant Team**
  - Cambridge Systematics (Lead)
  - AECOM
  - Abt Associates
  - Fitzgerald & Halliday
  - Dr. Radley Horton
  - C2E*

*Past team member*
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Major Tasks

» Conduct Transportation Damage & Disruption Assessment

» Collect and Analyze Climate Change Projections, Identify Gaps

» Engineering-Based Assessments & Adaptation Analysis for Select Transportation Assets

» Regional Climate Change Vulnerability Assessment and Adaptation Analysis
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Damage and Disruption Assessment

- Recorded transportation damage and disruption from:
  - Sandy; Irene; Lee; Alfred (Nor’easter)

- Characterized by asset class, climate stressor, failure mode, duration of disruption, etc.

- Sourced from public documentation

- Data “frozen” in late 2013
Collect and analyze existing climate output
- Extremes: precipitation, temperature, storms
- Averages: precipitation, temperature
- Sea Level Rise

Address gaps (as needed)
- Stressors, time periods, emissions, geography
- Few gaps identified in course of assessments
- Applied in Engineering-based assessments

Example: Regional SLR Projections (Ranges)
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Engineering-Based Assessments

» 10 Transportation Assets
  • A mix of bridges, highways, a port, and a railroad track

» Range of Climate Stressors Covered
  • Sea level Rise and Storm Surge (7 assessments)
  • Extreme Precipitation (2 assessments)
  • Extreme Heat (1 assessment)

» Range of Adaptation Strategies Proposed
  • Physical modifications (e.g., installation of seawalls)
  • Updating regulatory guidelines (e.g., updates to IDF Curves)
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Assessment Process

» **Pre-Assessment:** Asset Data/Description

» **Module 1:**Current and Future Climate Stressors

» **Module 2:** Vulnerability Assessment

» **Module 3:** Consequence Analysis

» **Module 4:** Develop and Select Adaptation Strategies
Engineering Assessment
NJ 7, Kearny, NJ
Engineering Assessment
NJ 7, Kearny, NJ

» Climate Stressors Considered:
  • Sea Level Rise
  • Tidal Storms

» Scenarios Chosen for Adaptation Planning
  • End-of-Century Sea Level Rise
  • 2-year Tidal Storm

» Challenges and Considerations
  • Consistency with Adjacent Projects was Critical
» Adaptation Strategies Recommended:
  • Raise 3 out of 4 stretches of the NJ Route 7 segment
  • The 4th stretch cannot be raised due to minimum vertical clearance requirements
  • Build a concrete seawall to protect this stretch
  • Install new drainage features (outfalls and pumps)
Engineering Assessment

PANYNJ Port Jersey South
Climate Stressors Considered:
- Sea Level Rise
- Tidal Storms

Scenarios Chosen for Adaptation Planning:
- Mid-century Sea Level Rise
- 100-year Tidal Storm

Observations
- Electrical infrastructure severely damaged during Hurricane Sandy (switchgear, circuit breakers)
- Peninsula likely to undergo major redevelopment
- Proposed strategies to protect infrastructure supporting future development.
**DEFINITIONS**

- **BFE**: Base Flood Elevation. 100-yr is equivalent to a 1% annual chance.
- **DFE**: Design Flood Elevation.
- **FFE**: First Floor Elevation.
- **SLR**: Sea Level Rise.

**Notes:** Elevations are referenced to the NAVD88 datum. Not drawn to scale.

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**Engineering Assessment**

**PANYNJ Port Jersey South**

- **DFE (100-year BFE + Approximate Average mid-estimate 2050 SLR + freeboard)**: 15.3’
- **14.3’**: 100-year BFE + Average mid-estimate 2050 SLR
- **13.0’**: 100-year BFE
- **FFE (varies by building)**: 15.3’ – 16.6’
- **RAISE EQUIPMENT**: 15.3’ – 16.6’
- **DFE (100-year BFE + High-estimate 2050 SLR + freeboard)**: 16.6’
- **15.6’**: 100-year BFE + High-estimate 2050 SLR
- **13.0’**: 100-year BFE

**Ground Floor Elevation**: 7.2’

**Mean Low Water Level**: -2.7’
Engineering Assessment

Thomas A. Mathis Bridge (NJ 37)
Engineering Assessment

Thomas A. Mathis Bridge (NJ 37)

» Climate Stressors Considered:
  • Sea Level Rise
  • Tidal Storms

» Scenarios Chosen for Adaptation Planning:
  • Mid-century Sea Level Rise
  • 100-year Tidal Storm

» Considerations:
  • Bridge to reach end of life by 2065
  • Electrical equipment in bascule tower experienced minimal flooding during Hurricane Sandy
  • Approach Roadways experienced significant flooding
Adaptation Options Recommended:

- Install floodwalls or earthen berms along approach roadways to prevent overtopping, and install fender systems to deflect debris

OR

- Raise vulnerable sections of the approach roadways to prevent overtopping, and install fender systems to deflect debris
Next Steps

» Disseminate Engineering-Based Assessments
  • Fall 2016

» Complete Regional Vulnerability & Adaptation Assessment
  • Expected January 2016

» Final Report/Project Documentation
  • Expected April 2016
Thank You!

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Visit the NJTPA Climate Initiative for more information  
http://www.njtpa.org/Plan/Element/Climate/ClimateChangeInitiative.aspx