Hurricane Sandy Follow-up and Vulnerability Assessment and Adaptation Analysis

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NYMTC PFAC Meeting
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Today’s Roadmap

• Overview of FHWA’s adaptation work

• NY-NJ-CT Hurricane Sandy Follow-up and Vulnerability Assessment and Adaptation Analysis Project

Photo: Flooding of the Hugh L. Carey Tunnel in NYC due to Hurricane Sandy. Source: MTA
President’s Climate Policy

- Announced major speech and action plan on climate change June 25, 2013
- Cut Carbon Pollution
  - New and existing power plants – EPA under Clean Air Act
  - Renewable energy on federal lands
  - Heavy duty vehicle fuel economy standards, renewable fuels standard
  - Efficiency standards for appliances
- Prepare for the Impacts of Climate Change
  - Remove federal policy barriers
  - Encourage climate resilient investments through grants, technical assistance, research performance measures, etc.
  - Provide tools for climate resilience to help state and local governments
  - Rebuild and learn from Superstorm Sandy
- Lead International Efforts
- Executive Order on Climate Preparedness Nov. 1, 2013
Climate Change Adaptation at FHWA

• **Goal:** Systematic consideration of climate change vulnerability and risk in transportation decision making, at system and project level.

• **Approach:** Develop and share information on tools and methodologies that state DOTs and MPOs can use to assess risk, analyze adaptation options, and prioritize actions. FHWA funding can be used for climate adaptation.

• **Consistent with US DOT policy statement:** “DOT shall integrate consideration of climate change impacts and adaptation into the planning, operations, policies, and programs of DOT in order to ensure that taxpayer resources are invested wisely ...” June 2011.
FHWA Climate Change & Extreme Weather Vulnerability Assessment Framework

1. DEFINE SCOPE
   - IDENTIFY KEY CLIMATE VARIABLES
     - Climate impacts of concern
     - Sensitive assets & thresholds for impacts
   - ARTICULATE OBJECTIVES
     - Actions motivated by assessment
     - Target audience
     - Products needed
     - Level of detail required
   - SELECT & CHARACTERIZE RELEVANT ASSETS
     - Asset type
     - Existing vs. planned
     - Data availability
     - Further delineate

2. ASSESS VULNERABILITY
   - COLLECT & INTEGRATE DATA ON ASSETS
   - DEVELOP CLIMATE INPUTS
   - ASSESS ASSET CRITICALITY (OPTIONAL)
   - IDENTIFY & RATE VULNERABILITIES
   - INTEGRATE LIKELIHOOD & RISK (OPTIONAL)
   - DEVELOP INFORMATION ON ASSET SENSITIVITY TO CLIMATE

3. INTEGRATE INTO DECISION MAKING
   - INCORPORATE INTO ASSET MANAGEMENT
   - INTEGRATE INTO EMERGENCY & RISK MANAGEMENT
   - CONTRIBUTE TO LONG RANGE TRANSPORTATION PLAN
   - ASSIST IN PROJECT PRIORITIZATION
   - IDENTIFY OPPORTUNITIES FOR IMPROVING DATA COLLECTION, OPERATIONS OR DESIGNS
   - BUILD PUBLIC SUPPORT FOR ADAPTATION INVESTMENT
   - EDUCATE & ENGAGE STAFF & DECISION MAKERS

THE FEDERAL HIGHWAY ADMINISTRATION'S CLIMATE CHANGE & EXTREME WEATHER VULNERABILITY ASSESSMENT FRAMEWORK
DECEMBER 2012

U.S. Department of Transportation
Federal Highway Administration
2013-2014 Climate Resilience Pilot Program

Pilots using and building on FHWA’s *Climate Change & Extreme Weather Vulnerability Assessment Framework*

### 19 Pilots

- Tennessee
- Maine
- Michigan
- Arizona
- Alaska
- Oregon
- Connecticut
- New York
- Maryland
- Iowa
- Minnesota
- California
- Washington
- NCTCOG
- CAMPO (Austin)
- Hillsboro MPO
- South Florida MPOs
- MTC (San Francisco)

- Vulnerability and/or adaptation
- Broad geographic coverage and range of impacts
- Furthering the state of practice in the emerging area of resilience to climate changes
- FHWA will use lessons learned to turn the vulnerability assessment framework into an adaptation and resiliency framework
Example 2013-2014 Pilots

South Florida
- SLR, flood, storm surge maps
- Method for prioritizing impacted infrastructure
- Incorporate into decisions

CAMPO (Austin, TX)
- Extreme heat, flooding, drought, wildfire
- Regional symposium
- Incorporate into 2040 RTP

TDOT
- Statewide with MPOs
- Multimodal
- Quantitative loss and damage estimation
Example 2013-2014 Pilots

Arizona DOT
- Extreme surface temps
- Floods
- Dust storms
- Species Migration

Michigan DOT
- Lake effect and climate change
- Improve statewide, systematic approach to addressing risk

MassDOT
- Impacts to the Central Artery
- Solutions

MnDOT
- Flash Flooding
- Asset Management
Gulf Coast 2 Project (Mobile, AL)

- **Gulf Coast 2 project** is an in-depth vulnerability assessment of transportation system in Mobile, AL
- **Climate changes examined:**
  - Temperature and precipitation statistically downscaled from GCMs
  - Relative sea level rise scenarios based on range of recent global SLR scenarios plus local subsidence
  - Storm surge modeling looked at range of storm intensities and included wave modeling
- Detailed engineering analysis of select assets
- Developing tools that can be used by MPOs and DOTs around the country
- Complete Spring 2014
Gulf Coast 2 Transferable Tools Developed

- Tools include:
  - Vulnerability Assessment Scoring Tool (VAST)
  - CMIP Climate Data Processing Tool
  - Sensitivity Matrix
  - Criticality Assessment guide
Pilot & Other Project Locations for 2013-2014

- 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
Sandy Follow-Up & Adaptation Analysis Project

- **Sandy project** builds on the 2011 NJ pilot
- Purpose: Learn from experience of Sandy and identify strategies to improve the resiliency of the transportation system to extreme weather and climate change

*Source: NJTPA*
Sandy Project Major Partners

• Project Partners:
  – FHWA
  – FTA
  – NY, NJ, and CT DOTs
  – Metro area MPOs: NYMTC, NJTPA, SWRPA, and GBRC
  – MTA
  – Port Authority

• Project Consultants:
  – Cambridge Systematics (prime)
  – AECOM
  – Stratus Consulting
  – Office of Radley Horton
Sandy Project Major Tasks

• Assessment of damages from Hurricane Sandy & other recent storms, lessons learned, gaps in climate analysis
• Engineering-based analysis of adaptation options for up to 10 transportation assets
• Region-wide multimodal vulnerability assessment
Extreme Weather Impacts Assessment

- Objectives:
  - Collect and analyze historical data from recent storm-related damage and disruption to transportation infrastructure:
    - Hurricanes Sandy (2012) – *primary emphasis*
    - Irene (2011)
    - Tropical Storm Lee (2011)
    - Halloween Nor’easter (2011)
  - Collect information on climate projections used by governments and academic institutions in the tri-state region
  - Conduct gap analysis - information collected will allow us to look at modeled impacts versus observed impacts and will inform our assessment of future scenarios
## Regional Damage Assessment: Data Sources

<table>
<thead>
<tr>
<th>Surface Transportation Facilities</th>
<th>Source</th>
<th>Project info current as of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads and Bridges on Federal Aid Highways</td>
<td>FHWA ER Funding Requests submitted to FHWA Division offices (NJ-NY-CT)</td>
<td>September 2013</td>
</tr>
<tr>
<td>Self-funded bridges, tunnels, and terminals</td>
<td>MTA and PANYNJ</td>
<td>October 2013</td>
</tr>
<tr>
<td>Other roads and bridges</td>
<td>FEMA Public Assistance Public Projects Database</td>
<td>October 2013</td>
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<tr>
<td>Amtrak NE Corridor</td>
<td>Joe Boardman Testimony to U.S. Senate</td>
<td>December 2012</td>
</tr>
</tbody>
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Summary of FHWA ER Projects (DRAFT)

NJTPA
- $19 million, 139 projects*
- $234 million, 103 projects

NYMTC
- $6 million, 51 projects
- $158 million, 54 projects

SWRPC/GBRC
- $1 million, 1 project

*Projects associated with Irene and Lee were combined into a single ER funding request for NJ
FHWA Relief Projects by Asset Class (DRAFT)
FHWA Relief Projects by Climate Stressor (DRAFT)
FHWA Relief Projects by Failure Mode (DRAFT)

Legend

Failure Mode
- Debris
- Erosion/washout
- Inundation
- Mechanical and electrical damage
- Scour
- Structural failure

Note: Map includes only projects for which Emergency Relief Funding requests have been made to FHWA.

U.S. Department of Transportation
Federal Highway Administration
Review of Existing Climate Info and Gap Analysis

• Identified climate stressors of concern for region:
  – Storm surge
  – Heavy rain and inland flooding
  – High temperature events
  – High wind events

• Reviewed existing projections

• Some supplementation likely required for the purposes of the gap analysis
Engineering-Based Adaptation Analysis

• Objectives:
  – Identify up to 10 representative assets for an engineering-based analysis of adaptation options
  – Develop a process for conducting the assessments
  – Test the process on one asset and make refinements
  – Conduct assessments on remaining assets in conjunction with asset owners
Assets Selected for Engineering Analysis
Engineering-Based Adaptation Assessment Process

Divided into 4 modules:

- **Module 1**: Define Climate Impacts
- **Module 2**: Define Asset and Assess Vulnerability
- **Module 3**: Assess Risk—Likelihood and Consequence
- **Module 4**: Develop and Select Adaptation Strategies
Regional Vulnerability Assessment

• **Objective:** Assist regional transportation agencies in assessing their vulnerabilities to current and future climate conditions and support intelligent, cost-effective adaptation-based decision-making

• **Tasks:**
  – Identify future climate effects for analysis
    • Update regional climate projections
    • Develop illustrative future event scenarios for planning
  – Conduct vulnerability assessment of transportation assets in the region building on previous project work
  – Identify and map critically vulnerable sub-areas in the region
  – Conduct a planning-level assessment of adaptive capacity
  – Systems-level adaptation analysis for transportation assets in vulnerable subareas
Thank you!

www.fhwa.dot.gov/environment/climate_change/adaptation/

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Memo on Using FHWA Highway Funds for Adaptation Work

- Released September 2012
- Clarifies the use of Federal-aid and Federal Lands funding for adaptation activities to address extreme weather events and climate change impacts
- Clarifies existing eligibility for planning, design, construction, and asset management – not a new policy
- Developed jointly by three FHWA offices:
  - Planning, Environment, and Realty
  - Infrastructure
  - Federal Lands
Integrating Results into Decision-making:
Example from New York City Special Initiative for Rebuilding and Resiliency


- NYC performed risk assessment. Used data on damage from Sandy, 100yr floodplain, NYPCC climate data
- Developed 18 initiatives for transportation, in addition to coastal protection plan

Examples of initiatives

Protect assets to maintain system operations
- Reconstruct and resurface key streets damaged by Sandy to upgraded resiliency
- Elevate traffic signals & provide backup power
- Protect NYCDOT tunnels in Lower Manhattan from flooding
- Install watertight barriers to protect moveable bridge machinery

Prepare to restore service after events
- Plan temporary transit services and HOV requirements in event of subway system suspension

Increase system flexibility and redundancy
- Expand ferry services
- Expand Select Bus Service network

Credit: NYCDOT

Battery Park Underpass flooding from Hurricane Sandy

Credit: The Elizabeth River Tunnel Project

Closeable flood doors, Elizabeth River Tunnels, Portsmouth, VA