FHWA Climate Change Adaptation and Resiliency Initiatives

AMPO Annual Conference
Portland, OR
October 23, 2013

Three breaches in NC12 after Hurricane Irene. Credit: Tom MacKenzie, FWS
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 and prioritize actions
President’s Climate Policy

- President delivered major speech and action plan on climate change June 25, 2013.
- Actions he can take without relying on Congress
  - 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
    - Provide tools for climate resilience to help state and local governments
    - Support climate resilient investments by removing policy barriers, ensuring federally funded projects address climate risks
    - Rebuild and learn from Superstorm Sandy
  - Lead International Efforts
“The United States Department of Transportation (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 and that transportation infrastructure, services and operations remain effective in current and future climate conditions.”
- June 2011
Memo on Using FHWA Highway Funds for Adaptation Work

• Released September 2012
• Clarifies existing eligibility
• **Activities** to plan, design, and construct highways to adapt to current and future climate change and extreme weather events are eligible for reimbursement under the Federal-aid program and for funding under the Federal Lands program.

• Eligible Activities:
  – Vulnerability and risk assessments to climate change and extreme weather events
  – Consideration of climate change and extreme weather events in project development, environmental review and design work
  – Construction of projects or features to protect existing assets from impacts and damage
  – Evaluation of potential impacts of climate change and extreme weather events on asset management cycles, life cycle costs, etc.
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
   - Identify & Rate Vulnerabilities
   - Develop Climate Inputs
   - Develop Information on Asset Sensitivity to Climate
   - Incorporate Likelihood & Risk (Optional)
   - Assess Asset Criticality (Optional)

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
Define Scope:
Example from MTC- San Francisco Pilot

**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

- Focused on sea level rise and storm surge
- Included shoreline assets (levees, floodwalls, wetlands) in analysis

Goal – foster local agency support and input. So limited study area to a portion of one county and analysis steps engaged stakeholders

- Included highways, roads, bus and rail transit, freight, rail, ferry, bike/ped
- Selected set of representative assets based on physical characteristics, function, jurisdiction
Complete Failure

Results in total loss or ruin of asset. Asset may be available for limited use after at least 60 days and would require major repair or rebuild over an extended period of time.

“Complete and/or catastrophic failure” typically involves:

- Immediate road closure
- Travel disruptions
- Vehicles forced to reroute to other roads
- Reduced commerce in affected areas
- Reduced or eliminated access to some destinations

May sever some utilities. May damage drainage conveyance or storage systems.

Temporary Operational Failure

Results in minor damage and/or disruption to asset. Asset would be available with either full or limited use within 60 days.

“Temporary operational failure” typically involves:

- Temporary road closure, hours to weeks
- Reduced access to destinations served by the asset
- Stranded vehicles

Possible temporary utility failures.

Reduced Capacity

Results in little or negligible impact to asset. Asset would be available with full use within 10 days and has immediate limited use still available.

“Reduced capacity” typically involves:

- Less convenient travel
- Occasional/brief lane closures, but roads remain open
- Some vehicles may move to alternate routes.

Used climate data from University of Washington.

Framework has suggestions on sources for climate data and interpretation.

Used a workshop-based approach to leverage knowledge of maintenance staff, engineers, etc.

Assessing Vulnerability:

Example from Washington DOT Pilot

Used climate data from University of Washington.

Framework has suggestions on sources for climate data and interpretation.

Used a workshop-based approach to leverage knowledge of maintenance staff, engineers, etc.
Assessing Vulnerability: Example from Washington DOT Pilot
Assessing Vulnerability: US DOT Gulf Coast Study Phase II

Storm Scenario: Katrina
Shifted + Pressure Reduced + 75cm SLR

Also assessed vulnerability to heat, rainfall, and wind.
Calculated net present value (NPV) of adaptation options
- **Example: Rail buckling**: Curved section of Orange Line track
- **Option 1**: Improve existing track structure (e.g. tie spacing, granite ballast, drainage)
- **Option 2**: Replace existing overpass with concrete track bed
- Accounted for construction costs, repair costs, passenger time
- Varied different factors to see impact on NPV:
  - Frequency of impacts (# of rail buckling events / year)
  - Capital costs
  - Passenger time value
- Analysis showed high return on investment for both options.
- NPV positive for both, higher for option 1. Option 2 is more expensive but would mean fewer disruptions long term.

**Integrating into asset management system**
- Flag vulnerable assets

---

Heat kink de-rails DC Metro train July 6, 2012.
55 passengers evacuated, severe delays, emergency track work performed, scheduled track work cancelled.
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
• Tested methodology for analyzing adaptation options for 2 assets based on equity, economy, ecology, governance

• San Francisco-Oakland Bay Bridge touchdown and toll plaza on Oakland side would be inundated under 100 year storm with 2050 sea level rise

<table>
<thead>
<tr>
<th>OPTIONS</th>
<th>Mid-century</th>
<th>End-of-Century</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset-specific adaptation</td>
<td>• Improve drainage</td>
<td>• Raise road surface</td>
</tr>
<tr>
<td></td>
<td>• Retrofit – waterproof</td>
<td>• Build causeway</td>
</tr>
<tr>
<td></td>
<td>• Raise touchdown &amp; toll plaza area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Partial closure</td>
<td></td>
</tr>
<tr>
<td>Regional adaptation</td>
<td>• Create berm</td>
<td>• Build levee</td>
</tr>
<tr>
<td></td>
<td>• Wetland restoration/creation</td>
<td>• Build floodwall</td>
</tr>
<tr>
<td></td>
<td>• Construct floodwall</td>
<td>• Wetland restoration/creation</td>
</tr>
<tr>
<td>Nonstructural adaptation</td>
<td>• Building &amp; design codes</td>
<td>• Continue implementation and revision of nonstructural</td>
</tr>
<tr>
<td></td>
<td>• Transportation planning guidance and policy</td>
<td>adaptation measures as needed</td>
</tr>
<tr>
<td></td>
<td>• Multi-jurisdictional partnerships</td>
<td></td>
</tr>
</tbody>
</table>

Projected inundation - 55 inch SLR + 100yr storm surge
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

MnDOT
- Flash Flooding
- Asset Management

MassDOT
- Impacts to the Central Artery
- Solutions
Sandy Follow-Up & Adaptation Analysis

- **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
- Partners: FHWA; NY, NJ, and CT DOTs; Metro area MPOs; MTA; others.

Aerial photo of Atlantic City following Hurricane Sandy. Source: Michael Reynolds/European Pressphoto Agency

*SLR 1 Meter, 2100, Coastal Study Area (Roadways).*
Source NJTPA
Hydraulic Engineering Circular (HEC) 25b

- How can engineers use already available information to design more resilient coastal infrastructure for the future?
- HEC 25b will provide technical guidance and methodologies on incorporating extreme event and climate change considerations, especially sea level rise, storm surge, and wave action.
- Completed regional peer exchanges; moving into report development

*Project performed by Kilgore Consulting and Management with South Coast Engineers*
What MPOs can do

- Assess vulnerability in the metro area to potential climate effects
  - What effects/impacts will be relevant for your area?
  - How will the transportation system be impacted or damaged
  - What alternatives might be available to address those impacts

- Consider as part of your LRTP Update
  - Consider climate vulnerability early in the process
  - Look to past work, other MPO examples in scoping effort

- Consider as part of corridor and sub-area studies as appropriate

- Coordinate with locals, State DOTs, academia, Feds to take advantage of lessons learned and other efforts underway
Thank you!

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

Michael.culp@dot.gov 202-366-9229