Extreme Weather Events and Highways

Date: May 30, 2014
Committee: STEICS
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Best Practices for Extreme Weather Management

- It pays to be ready and pre-plan
- Practice, practice, practice
- Know what is out there
- Use all forms of communication media
OTHER KEY MESSAGES

• Affects operations and maintenance functions of state DOTs today and will do more so in the future

• Involves coordinated efforts on the part of numerous governmental and emergency response agencies

• Possibly changes the way one designs infrastructure

• Uses a wide range of technologies to better manage emergency response

• Relates to asset management systems
AASHTO’s Center for Environmental Excellence Initiative

Update on Federal Programs and Recent Research

SOM
SCOE
NASTO
WASHTO
SASHTO
SCOH  SCOM  STEICS  SOD  SOC

U.S. Department of Transportation
Federal Highway Administration

AASHTO
100 Years
1918-2018
Center for Environmental Excellence
How Can TSM&O Managers Prepare for Extreme Weather Events?

Although DOT experience with operations will vary by state and topic, below is a “Top 10” list of suggestions for TSM&O managers and staff to better prepare for extreme weather.

1. **Contingency Plans**: Have contingency plans for power outages, detours, debris clearance, and routing for overweight or disabled trucks - to include pre-approved contractors and funds.

2. **Evacuation & Emergency Routes**: Operate effective evacuation routes in high risk areas.

3. **Traveler Information**: Develop effective public and traveler information systems/services to inform travelers of travel options (including social media tools, mobile apps, and collecting real time conditions through vehicle technology).

4. **Drill & Test**: Use response to “routine emergencies” to test staffing, deployment, and communications. Also, coordinate in advance with partners at the local, state, and Federal level in the event response is required.

5. **Pre-Positioning Materials & Equipment**: Develop strategies for responding to transportation system disruptions due to weather-related events, including pre-positioning replacement materials (culverts, etc.) in vulnerable areas.

6. **Backup Communications**: Prepare backup communications such as satellite phones, portable highway advisory radios, truck radios, and alternative networks.

7. **Risk Reduction Strategies**: Identify facility locations vulnerable to risks (flooding, landslides etc.), and develop appropriate strategies to minimize such risk.

8. **Early Warning Indicators**: Incorporate “early warning indicators” for potential extreme weather-related risks into asset and maintenance management systems.

9. **Harden the System**: Prepare for events with backup power generators, “hardened” sign structures and traffic signal wires, pre-positioned variable message sign boards and support vehicles trucks.

10. **Workforce Protection**: Protect workers from extreme temperatures and weather during day-to-day and response activities.
National Climate Assessment (2014)

Climate Change Impacts in the United States

HIGHLIGHTS
• Changing climatic conditions and extreme weather events are affecting the reliability and capacity of the U.S. transportation system in many ways.

• Major coastal impacts, including both temporary and permanent flooding.

• Extreme weather events currently disrupt transportation networks in all areas of the country; projections indicate that such disruptions will increase.

• Impacts can be reduced through a wide range of adaptive actions.
Key Concepts

- Asset vulnerability
- System resiliency
- Adaptation
- Risk
- Flexible design
- Operations/maintenance
KEY QUESTIONS

• How Could Changes in Temperature Affect Road Assets?
• How Could Changes in Precipitation Affect Road Assets?
• How Could Sea-Level Rise Affect Road Assets?
• How Could Greater Hurricane Intensity Affect Road Assets?
• How Could Stressors Affect Ecological Systems?
• What Are the Types of Adaptation Strategies that Can Be Considered by Transportation Agencies?
<table>
<thead>
<tr>
<th>Precipitation</th>
<th>Impact to Infrastructure</th>
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| Greater changes in precipitation levels | • If more precipitation falls as rain rather than snow in winter and spring, there will be an increased risk of landslides, slope failures, and floods from the runoff, causing road washouts and closures as well as the need for road repair and reconstruction;  
• Increasing precipitation could lead to soil moisture levels becoming too high (structural integrity of roads, bridges, and tunnels could be compromised leading to accelerated deterioration);  
• Less rain available to dilute surface salt may cause steel reinforcing in concrete structures to corrode;  
• Road embankments at risk of subsidence/ heave;  
• Drought-caused shrinkage of subsurface soils |
| Increased intense precipitation, other change in storm intensity (except hurricanes) | • Heavy winter rain with accompanying mudslides can damage roads (washouts and undercutting) which could lead to permanent road closures;  
• Heavy precipitation and increased runoff can cause damage to tunnels, culverts, roads in or near flood zones, and coastal highways;  
• Bridges are more prone to extreme wind events and scouring from higher stream runoff;  
• Bridges, signs, overhead cables, tall structures at risk from increased wind speeds |
To view relevant engineering information, please tell us about your project.

1. What is your project's asset type?
   - Bridge
   - Culvert
   - Pavement
   - Slope or Wall
   - Stormwater Infrastructure

2. Is the existing asset?

3. Which climate stressors are of interest?

Based on the asset type you specified above, the following climate stressors might impact your project:

   Please choose options above to view applicable climate stressor options.

View relevant engineering information
To view relevant engineering information, please tell us about your project.

1. What is your project’s asset type?
   - Slope or Wall

2. Is your project for a new or an existing asset?
   - New asset
   - Existing asset

3. Which climate stressors are of interest?
   - Precipitation
     - More extreme rainfall events
       - Erosion and mass wasting
       - Floodplain extent and elevation
     - Higher average precipitation
       - Increased vegetation growth
       - Direct effects
     - Greater snowfall depths
       - Snow melt water amounts
   - Temperature
   - Water Level / Chemistry
   - Wind

View climate projections for your region.

Based on the asset type you specified above, the following climate stressors might impact your project:

View relevant engineering information.
POTENTIAL CONSTRUCTION-RELATED IMPACTS

- Changes to the windows available for certain weather-sensitive construction activities (e.g., paving) including, in many cases, a lengthening of the construction season
- Changes in working hours or other strategies to protect laborers from heat waves
- Different construction contracting methods for responding to quick fix projects
- Enhanced erosion, dust and sedimentation control plans for more extreme precipitation events
POTENTIAL CONSTRUCTION-RELATED IMPACTS

• Different types of materials and designs

• Greater precautions in securing loose objects on job sites or new tree plantings due to stronger winds

• Work zone traffic management plans that take into account more frequent and perhaps more intense storms; work zone recovery strategies
DISASTER RECOVERY AND LONG-TERM RESILIENCE

Guidance Document for the State of Vermont

November 2013
Climate Tools
Local Snapshot, Temperature, Snowpack, Precipitation, Sea Level Rise, Wildfire

VIDEO TOUR
This short video walks you through the different tools and data available in Cal-Adapt. See how you can explore and share information on California climate change.

LOCAL CLIMATE SNAPSHOTS
The Local Climate Snapshot tool has been developed to provide quick access to some of the most basic climate change data for a given location. Just enter an address or click on the map and you will get simple figures and statistics for your area.
Highways Agency (England)

Vulnerability of Pavement Asset

- Resurfacing
- Construction - laying surface dressing, microsurfacing, HMB and other
- Maintenance
- Foundations
- Materials specification and construction details
- Design of foundations
- Integrity of materials
- Skid resistance

http://www.highways.gov.uk/publications/climate-change-mitigation/
Priorities for Adaptation of Highways Agency Assets

Priorities for Adaptation

Early
- Culverts
- Bridges
- Retaining walls
- Tunnels
- Drainage
- Lighting columns (steel)
- Steel safety barrier
- Concrete safety barrier
- Concrete pavement
- Base & sub-base layers of pavement
- Surface layers of flexible pavement
- Signs & signals
- CCTV cameras
- Emergency roadside telephone
- Lanterns
- SOS
- Leased vehicles (TCS/ESU)
- Winter maintenance vehicles
- Lamp
- Leased office buildings

Later
- Pavements
- Geotechnics
- Property
- Technology
- Central reserve
- Structures
- Plant equipment

Yrs: 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120+
Final Report

Vulnerability of Transportation System and Evacuation Plan for Coastal Flooding in Climate Change

Performing Organization: The City College of New York, CUNY

February, 2014

University Research
AASHTO RESOURCES

• Transportation and Climate Change Resource Center (See especially State DOT Climate Change Programs)
  
  http://climatechange.transportation.org/


• Impacts of Extreme Weather on Transportation: National Symposium Summary, 2013
Transportation Research Board Efforts

- NCHRP 25-25 (94): *Integrating Extreme Weather and Adaptation into Transportation Asset Management Plans*
- ACRP SYNTHESIS 33, *Airport Climate Adaptation and Resilience A Synthesis of Airport Practice*
- *Risk-Based Adaptation Frameworks for Climate Change Planning in the Transportation Sector*, Research Circular E-C181
- *Adapting Transportation to the Impacts of Climate Change: State of the Practice 2011*
Transportation Research Board Efforts

• Synthesis of Climate Change and Transportation Research Efforts at State DOTs, State Universities, and Federal Level (2011)

• Global Change and Extreme Hydrology: Testing Conventional Wisdom (2011)

• International Conference on Transportation System Resilience to Climate Change and Extreme Weather Events, mid-2015
EXTREME WEATHER & THE TRANSPORTATION SYSTEM RESOURCES

U.S. DOT:
http://climate.dot.gov/

FHWA:
http://www.fhwa.dot.gov/environment/climate_change/index.cfm

USGS:

Georgetown Climate Center:
http://www.georgetownclimate.org/resources/transportation-and-climate-change-clearinghouse-tccc

EU:
http://ec.europa.eu/clima/policies/adaptation/index_en.htm