Addressing Climate Change Vulnerabilities to Transportation Infrastructure

Lessons from Michigan DOT

presented to

Adaptation in the Great Lakes Region Conference

presented by

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Transportation leadership you can trust.
Michigan’s Climate and Transportation

- Over 3,000 Miles of Shoreline – 2nd only to Alaska
- Over 100,000 Miles of Roadway
- Over 10,000 Bridges
- 98 Islands
- Over 11,000 Inland Lakes

At any point in Michigan you are never more than 85 Miles away from one of the Great Lakes
Michigan’s Climate and Transportation

- 35% of US/Canada Trade flows through Michigan
- $520 Billion in Freight is Moved each year on Michigan’s Highways, Rail and Water Ports
- Trucking Accounts for 67% of all Freight Tonnage Moved in Michigan
Climate Risks

- More Frequent and Intense Rain Events
  » Washout of Transportation Infrastructure
- Increased Frequency of Freeze Thaw Cycle
- Increased and Prolonged Summer Temperatures Extremes
  » Both will Deteriorate Roads more Rapidly
- Changes to Maintenance Needs
Climate Risks
Winter Melt/Spring Rains - More Flooding
Climate Risks
What to Do

- Continue to Develop Asset Management Databases
- Data will be used to Identify Potential Risks
- Address these Risks through Regular Transportation Program Process
Opportunity to apply for an FHWA Pilot Study to Assess Vulnerability to Climate Change

» Assess Available Climate Models,

» Compare them to Asset Management Data and

» Prepare set of Infrastructure at most Risk for Climate Change
What is Climate Change Vulnerability?

Climate change and extreme weather vulnerability in the transportation context a function of a transportation asset or system’s sensitivity to climate effects, exposure to climate effects, and adaptive capacity.
Objective of Climate Vulnerability Assessments

- Assess vulnerability of transportation infrastructure to climate change
- Develop adaptation strategies and update asset management process to address these vulnerabilities
FHWA Vulnerability Assessment Framework

1. DEFINE SCOPE
   - Identify Key
   - Articulate Objectives
   - Select & Characterize Relevant Assets

2. ASSESS VULNERABILITY
   - Develop Climate Inputs
   - Incorporate Likelihood & Risk
   - Rate Vulnerabilities

3. INVEST IN REDUCING VULNERABILITY
   - Incorporate Infrastructure Improvements for Improving Operations or Designs
   - Contribute to Transportation Plan
   - Assist in Project Prioritization
   - Educate & Engage Staff & Decision Makers

Asset Inventory
Criticality Determination
Climate Modeling
Vulnerability Assessment
Asset Inventory

- A meaningful vulnerability assessment requires robust, accurate transportation system data

- Obtaining the best available spatial and attribute data in Geographic Information System (GIS) format a critical first step
FHWA Vulnerability Assessment Framework

- Asset Inventory
- Criticality Determination
- Climate Modeling
- Vulnerability Assessment
Approaches for assessing asset criticality can range from simple to complex.

Criticality assessment attempts to define the consequence of asset unavailability.

Used to screen down number of assets for vulnerability assessment.
Determining Asset Criticality - Michigan

- Using “desk review” approach
- Incorporating some stakeholder input
- Ranking assets based on “low, medium, high” criticality
FHWA Vulnerability Assessment Framework

- Asset Inventory
- Criticality Determination
- Climate Modeling
- Vulnerability Assessment
Issues of concern:

» Increased erosion from intense precipitation, decreased snow/increased rain

» Bridge scour

» Freeze/thaw cycle

» Great Lakes ice cover and impact on lake effect snow; lake levels

» Road buckling
## Climate Stressors: Michigan

<table>
<thead>
<tr>
<th>Issue(s) of Concern</th>
<th>Climate Variable for Analysis</th>
<th>Operationalized Climate Variables</th>
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</thead>
<tbody>
<tr>
<td>Increased erosion and flooding from intense precipitation (particularly extreme precipitation events in a 3-6 hour time period)</td>
<td>Extreme precipitation</td>
<td>• Change in 25, 50, and 100-year rain events</td>
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<tr>
<td></td>
<td></td>
<td>• Change in precipitation as snow vs. rain</td>
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</tbody>
</table>
Sample of Climate Projections: Michigan

“Worst Case” Scenario: 44 – 77% increase in Average Annual Precipitation
FHWA Vulnerability Assessment Framework

- Asset Inventory
- Criticality Determination
- Climate Modeling
- Vulnerability Assessment
<table>
<thead>
<tr>
<th></th>
<th>Major Roadways</th>
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<tbody>
<tr>
<td><strong>Total in County</strong></td>
<td>383 Miles</td>
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<tr>
<td><strong>Number in 100 Year Floodplain</strong></td>
<td>8.5 Miles</td>
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<tr>
<td><strong>% in 100 Year Floodplain</strong></td>
<td>2.2%</td>
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<tr>
<td><strong>Number in 500 Year Floodplain</strong></td>
<td>10 Miles</td>
</tr>
<tr>
<td><strong>% in 500 Year Floodplain</strong></td>
<td>2.6%</td>
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</tbody>
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Final Step: Integrate Findings into Decision-making Processes

- Educate staff regarding overall climate risks to the agency’s transportation system
- Inform the development of adaptation strategies, such as updated design standards
- Site new assets in areas less vulnerable to climate change
THANK YOU!