Addressing Climate Change Vulnerabilities to Transportation Infrastructure

Lessons from Michigan and the Austin, TX region

presented to
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Transportation leadership you can trust.
Climate Change Context
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
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
Determining Asset Criticality – CAMPO

2035 POPULATION AND EMPLOYMENT DENSITY

FUTURE TRAFFIC VOLUMES (2035)

TRANSPORTATION ASSET CRITICALITY WORKSHOP

CRITICAL ASSETS

Central Austin Inset

Data Sources: APD, ODOT, CMTA

This map was developed by CAMPO for the purpose of aiding CAMPO's decision-making process and should not be used for any other purpose. No warranty is made by CAMPO regarding its accuracy or completeness.

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FHWA Vulnerability Assessment Framework

- Asset Inventory
- Criticality Determination
- Climate Modeling
- Vulnerability Assessment
Extreme weather: Precipitation (both heavy rainfall events and ice storms), temperatures, wildfire, drought

- Aftermath of wildfire - 2011
- Flooding: Tropical Storm Hermine - 2010
- Buckling roads - 2009
- Drought: Disrupted Water - 2011
# Extreme Weather Sensitivities in Central Texas

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Flooding</th>
<th>Drought</th>
<th>Extreme Heat</th>
<th>Cold/Ice</th>
<th>Wildfire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>Major impact, especially on rural roads (disruption, washout)</td>
<td>Cracking, failures on edge of pavement; soil destabilization if roadside vegetation affected</td>
<td>Some cracking and degradation, especially on edge of pavement</td>
<td>Hazardous roadway conditions; cracking on longitudinal joints</td>
<td>Disruption; Low short-term impact on pavements; destruction of guardrail and sign posts</td>
</tr>
<tr>
<td>Bridges</td>
<td>Minimal impact, except where heavy debris and sediment loads</td>
<td>Minimal impact</td>
<td>Minimal impact</td>
<td>Hazardous driving conditions, icing</td>
<td>Operational disruptions</td>
</tr>
<tr>
<td>Rail</td>
<td>Service interruptions</td>
<td>Minimal impact</td>
<td>Speed restrictions, delays during extreme heat; risk of thermal misalignment</td>
<td>Damage to switches</td>
<td>Major impact, if exposed</td>
</tr>
<tr>
<td>Transit (bus)</td>
<td>Routes disrupted, but may have ability to detour</td>
<td>Damage to routes, but may have ability to detour</td>
<td>AC issues in high heat</td>
<td>Risks to passenger health at stops</td>
<td>Operational disruptions</td>
</tr>
</tbody>
</table>

Legend:
- Major Impact
- Moderate Impact
- Lesser or long-term impact
- Minimal or no impact
CAMPO Sensitivity Example: Extreme Heat & Drought

- **Drought**: Cracking, failures on edge of pavement; soil destabilization if roadside vegetation affected

- **Extreme Heat**: Some cracking and degradation, especially on edge of pavement
Extremes Weather Sensitivity Thresholds in Central Texas – Pavement Deterioration

Thresholds in CAMPO region for pavement cracking/deterioration:

» Extended temperature > 100°F (empirical)
» Average 7-day maximum temperature > 108°F (design)
» Drought lasting longer than 14 days
» Alternating wet and dry weather patterns, cycling between a few days or weeks
» Extremely wet conditions for > 1 month
» Temperatures < 50°F
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>
</tr>
</thead>
<tbody>
<tr>
<td>Increased erosion and flooding from intense precipitation (particularly extreme</td>
<td>Extreme precipitation</td>
<td>• Change in 25, 50, and 100-year rain events</td>
</tr>
<tr>
<td>precipitation events in a 3-6 hour time period)</td>
<td></td>
<td>• Change in precipitation as snow vs. rain</td>
</tr>
</tbody>
</table>
Sample of Climate Projections: Michigan

“Worst Case” Scenario: 44 – 77% increase in Average Annual Precipitation
Michigan’s Shifting Climate
FHWA Vulnerability Assessment Framework

- Asset Inventory
- Criticality Determination
- Climate Modeling

Vulnerability Assessment
## Michigan Vulnerability Example: Flooding

<table>
<thead>
<tr>
<th></th>
<th>Major Roadways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total in County</td>
<td>383 Miles</td>
</tr>
<tr>
<td>Number in 100 Year Floodplain</td>
<td>8.5 Miles</td>
</tr>
<tr>
<td>% in 100 Year Floodplain</td>
<td>2.2%</td>
</tr>
<tr>
<td>Number in 500 Year Floodplain</td>
<td>10 Miles</td>
</tr>
<tr>
<td>% in 500 Year Floodplain</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

The map shows the distribution of major roadways within the floodplains, with a focus on the 100 and 500 year floodplains. The map legend indicates different types of floodplains and urbanized areas.
CAMPO Vulnerability Example: Extreme Heat & Drought
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!