SESSION TWO

11:00 a.m. – 12:00 p.m.

Recent floods and other natural disasters have put a spotlight on resiliency. Though our first thought may be to “harden” infrastructure to resist natural events, resilient infrastructure systems may also provide multiple routes or consider multiple modes between destinations. This session will address recent flooding in Wisconsin and the response to those hazards and extreme weather events. It will also cover planning tools and approaches to consider as we integrate resiliency into our plans.

DISCUSSION QUESTIONS:

- How is your organization planning to incorporate resiliency into the planning process?
- Who are additional partners we should bring into our processes?
- Are there examples and best practices you’ve found that would be useful to the group?

RESILIENT TRANSPORTATION

Credit: weather.gov
PRESENTATIONS

WISCONSIN 2016 FLOODING AND RECOVERY
Rosie Meer, Wisconsin Department of Transportation
Professional Archaeologist and Skeletal Analyst, Taught college for 10 years and worked for the Wisconsin Historical Society for 7 years

Has worked for DOT for 20+ years as an Environmental Analysis and Review Specialist at Regions and Central Office

RESILIENCY IN THE STATE HIGHWAY PROGRAM
Jeff Gust, Wisconsin Department of Transportation
Jeff has been with WisDOT for the last 28 years, where he currently serves as the Director of the Bureau of State Highway Programs. Jeff has held other roles at WisDOT including construction, planning and design.

Jeff graduated from the University of Wisconsin, Madison with a Bachelor of Science in Civil and Environmental Engineering and is a registered Professional Engineer in the State of Wisconsin.

FHWA RESILIENCE PRIMER
Mitch Batuzich, Federal Highway Administration
Mitch has worked in the transportation field for 27 years, starting with the Texas Department of Transportation and then with FHWA Division Offices in Texas, North Carolina, and now Wisconsin. He started work in the civil rights field and subsequently worked in the local programs, environment, and transportation planning disciplines

BUILDING RESILIENT TRANSPORTATION NETWORKS IN CHICAGO
Elizabeth Irvin, Chicago Metropolitan Agency for Planning
Elizabeth Irvin is a senior planner at the Chicago Metropolitan Agency for Planning. At CMAP, Elizabeth researches and analyzes issues related to transportation, the environment, and inclusive growth. Recently, she has been working on research and strategy development for ON TO 2050, the long-range comprehensive plan for the Chicago region, particularly changing travel behaviors, emerging transportation technologies, and transportation system resilience.

Elizabeth has a Masters in City Planning from MIT and a Bachelor of Arts in English and music from Williams College. She has also worked on federal and regional transportation and environmental policy in Washington, D.C. and Massachusetts. Originally from Cleveland, Ohio, she has enjoyed returning to and working in the Great Lakes region.
WISCONSIN 2016 FLOODING AND RECOVERY

Wisconsin 2016 Flooding & Recovery

Rosie Meer
Wisconsin Department of Transportation
Pictures from: CAP Flight the afternoon of July 12, 2016

WISCONSIN 2016 FLOODING AND RECOVERY

Rosie Meer
Wisconsin Department of Transportation
Environmental Staff Involvement

- Section 106 – Cultural Resources Team & SHS
- Tribal Involvement – Heavy involvement in Northern Counties; monitoring of construction
- 404 Permitting - USACE
- 401 Water Quality Certifications – DNR
- Special Waterways in Northern Counties
- Section 7; T&E Species
- Erosion Control – during construction
- Debris Removal
- Document Writing – most after the fact
Disruptions to the transportation system due to extreme weather events have become a very real concern, threatening Wisconsin’s transportation infrastructure. Recent flood events in Northern and Western Wisconsin have demonstrated the devastating impact such weather can have and the tremendous financial consequences these events impose.
What is Resiliency?

Resilience can be defined as the ability of a system to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. As a concept, resiliency is rooted in ecological systems thinking, but has also been utilized in the field of disaster response and emergency management. Recently, the concept has been connected to asset management and risk management frameworks, where risk management helps systems prepare and plan for adverse events, and resilience management goes further by integrating the temporal capacity of a system to absorb and recover from adverse events, and then adapt.

WisDOT has focused on the reactive side of resiliency. The "withstand, respond to, and recover rapidly from disruptions".
How do we respond

- WisDOT has made great strides in ETO (Emergency Transportation Operations)
  - incident scenario matrix
  - “Chain of Command” for any incident
  - Work with other agencies
  - Many other items

Funding

- We created an overview of Emergency Highway Aid Programs in Wisconsin
- In the next portion of my presentation:
  - overview document
  - Summary of the three main categories
Disruptions to the transportation system due to increased extreme weather events have become a very real concern, threatening Wisconsin’s transportation infrastructure. Recent flood events in Northern and Western Wisconsin have demonstrated the devastating impact such weather can have and the tremendous financial consequences these events impose.

Damage to any publicly owned or private non-profit facility. This includes damage to parks, schools, buildings, utilities, and roads/structures NOT on the Federal-aid system (minor collectors and below). PA also covers debris removal and emergency protective measures on ALL roads regardless of functional classification. This includes traffic control, detour signing, police/fire protection, pumping and sandbagging.

Jeff Gust
Wisconsin Department of Transportation
Emergency Relief (ER) - FHWA

Roadway or roadway structure damage on ALL Federal-aid highways (major collectors and above) resulting from a catastrophic failure or natural disaster. Besides physical damage, ER also includes debris removal and emergency protective measures such as traffic control and detour signing.

Disaster Damage Aids (DDA) - WisDOT

Damage caused by a disaster event to any highway that is NOT on the State Trunk Highway System
Need more information on funding programs?


What about the proactive side of resiliency. The “anticipate, prepare for, and adapt to changing conditions.”

Some of the things we are doing include:

- Located and mapped low chord and low point locations along all interstate highways, also mapping floodplain locations.
- Completed flood studies of the Portage area
- Completed flood studies of the Rock and Crawfish river basins
- Updating our rainfall data in the WisDOT FDM (Facilities Development Manual)
Questions??

- Jeffrey Gust
- WisDOT Bureau of State Highway Programs - Director
- jeffrey.gust@dot.wi.gov
- (608)516-5837

Jeff Gust
Wisconsin Department of Transportation
FHWA Resilience Primer

Wisconsin Annual Planning Conference
October 30, 2017

Sustainable Transportation and Resilience

Roadmap
- Resilience
  - Definitions
  - Regulations
  - Guidance
- FHWA Resources and Tools
  - INVEST
  - Vulnerability Assessments
What is Resilience?

- **Resilience** = the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

Why is resilience important?

Extreme weather events are disrupting transportation systems across the country.

Impacts of a changing climate are being felt now, and will accelerate significantly in the future.

—National Academy of Sciences and National Climate Assessment

*Mitch Batuzich*
*Federal Highway Administration*
# FHWA Resilience Related Policy & Regulations

- **Policy** Order 5520 commits FHWA to integrating climate risk considerations into programs
- Climate adaptation activities eligible for FHWA funding
- Risk-based *asset management* plans must include climate risks
- Assets requiring repeated repair require *analysis of alternatives* to rebuild-in-kind
- State and metro *transportation plans* should now include resilience as a planning factor
- **Emergency relief** program guidance encourages cost-effective resilience strategies

# What does the planning rule say?

<table>
<thead>
<tr>
<th>Rule Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>23 CFR 450.200 &amp; 23 CFR 450.300</td>
<td>Take into consideration resiliency needs</td>
</tr>
<tr>
<td>23 CFR 450.206(a) &amp; 23 CFR 450.306(b)</td>
<td>Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation</td>
</tr>
<tr>
<td>23 CFR 450.316(b)</td>
<td>Consult with agencies and officials responsible for natural disaster risk reduction when developing a MTP and TIP</td>
</tr>
<tr>
<td>23 CFR 450.324(f)(7)</td>
<td>Assess capital investment and other strategies that reduce the vulnerability of the existing transportation infrastructure to natural disasters</td>
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Integrating Resilience

Goal: Mainstream consideration of resilience in transportation decision making

- In support of 23 U.S.C. § 503(b)(3)(B)(viii), which directs the U.S. Department of Transportation “to carry out research and development activities ... to study vulnerabilities of the transportation system to ... extreme events and methods to reduce those vulnerabilities.”

**FHWA RESILIENCE RESEARCH SNAPSHOT**

**Research**
- Gulf Coast 2 Study
- Vulnerability Pilots
- Hurricane Sandy Project
- Engineering Assessments Study
- Green Infrastructure Pilots

**Resources**
- Vulnerability Assessment Framework
- Guidance (HEC-25 & 17)
- Synthesis of Approaches for Addressing Resilience in Project Development
- Green Infrastructure Techniques for Coastal Highways Resilience

**Coming Soon**
Research projects with Partners

Resilience:

**FHWA Resources and Tools—INVEST**

*MITCH BATUZICHT
FEDERAL HIGHWAY ADMINISTRATION*
INVEST – Sustainability Assessment Tool

- Practical, web-based self-assessment tool
- Helps agencies assess and improve sustainability Triple Bottom Line
- Specific to transportation
- Voluntary, free and easy to use
- Evaluate, Score, Improve!

www.sustainablehighways.org

Supporting the Entire Life Cycle

System Planning (State or Regional) & Processes → Project Development Planning Design Construction → Operations & Maintenance

FHWA RESILIENCE PRIMER

Mitch Batuzich
Federal Highway Administration
INVEST Implementation Sites

INVEST Planning Criteria

- Integration of Transportation with Land Use, Energy and Environmental Planning
- Access and Affordability
- Safety
- Systems Management and Operations
- Multimodal
- Freight
- Travel Demand Management
- Financial
- Infrastructure Resilience
INVEST – One place to start

SPR-16: Infrastructure Resiliency
For Regions

Goal: Anticipate, assess, and plan to respond to vulnerabilities and risks associated with current and future hazards (including those associated with climate change) to ensure multi-modal transportation system reliability and resiliency.

Identify a range of vulnerability and risks to both existing and planned transportation infrastructure.

INVEST SPR-16 Infrastructure Resilience Requirements

1) Develop and adopt goals and objectives
2) Coordinate with partner agencies
3) Integrate vulnerability and risk assessment information into planning documents
4) Develop and implement adaptation and resilience strategies
5) Develop performance measures
6) Demonstrate sustainable outcomes

Mitch Batuzich
Federal Highway Administration
Adaptation Strategies

1. Planning for Redundancy
2. Build protection for existing facilities
3. Relocate vulnerable transportation facilities, whether existing or planned
4. Consider climate/weather changes in asset management planning
5. Conduct vulnerability and risk assessment to integrate climate change risk.

Vulnerability Assessments

- FHWA's Climate Change and Extreme Weather Vulnerability Assessment Framework
  Helps users implement the framework by providing tools, videos, case studies, and related resources
  www.fhwa.dot.gov/environment/adaptationframework/
Vulnerability Assessment Framework and Tools

- Articulate Objectives
- Identify Climate Stressors
- Select Assets
- Assess Vulnerabilities
- Integrate in Decision Making
- Monitor and Revisit

Sensitivity Matrix

- Criticality Guidance
- CMIP Climate Data Processing Tool
- Vulnerability Assessment Scoring Tool

Sensitivity Matrix Content

Transportation Assets
- Airports and Heliports
- Bridges
- Oil and Gas Pipelines
- Ports and Waterways
- Rail
- Roads

Climate Stressors
- High Temperatures
- Precipitation-driven Flooding
- Sea Level Rise
- Storm Surge and Waves
- Wind
- Drought
- Dust Storms
- Wildfires
- Winter Storms
- Changes in Freeze/Thaw
- Permafrost Thaw

Mitch Batuzich
Federal Highway Administration
Transportation Climate Change Sensitivity Matrix

Spreadsheet-based reference tool
Covers relationship between 6 asset types and 11 climate stressors

Answers question: *What happens when each asset type experiences each stressor?*

For each combination, provides:
- Qualitative relationship
- Thresholds
- Indicators of sensitivity
- Resources

Criticality Guidance

Guidance Document
- Describes process of identifying which transportation assets are critical
- Provides possible criticality indicators
- Includes examples of criticality assessments
Example Criticality Criteria

Socioeconomic
- Lack of redundancy
- Provides access to school, government buildings
- Serves economic centers
- Provides multimodal linkage
- Component of national and international commerce system
- Serves transit-dependent populations

Operational
- Functional classification
- Usage

Health & Safety
- Evacuation route
- Component of Disaster Relief and Recovery Plan
- Component of National Defense System
- Provides access to medical, health, and safety facilities
- Provides hazardous waste transport

CMIP Climate Data Processing Tool

What does it do?
1. Helps a user find and access downscaled climate data at the local scale (up to 56 mi²)
2. Processes the “raw” climate data into more detailed variables

Sample Temperature Outputs
- Annual averages
- Hottest temperature of the year
- 95th and 99th percentile temps
- # of days and consecutive days per year and season above 95, 100, 105, and 110°F

Sample Precipitation Outputs
- 95th and 99th percentile 24-hour precip
- Annual and seasonal precipitation
- Annual maximum 24-hour precipitation (time series)
- Largest seasonal 3-day precip

Mitch Batuzich
Federal Highway Administration
Tool Training Resources

Training Webinars
http://www.fhwa.dot.gov/environment/climate_change/adaptation/webinars/

User Guides
http://www.fhwa.dot.gov/environment/climate_change/adaptation/publications_and_tools/

Questions?
A More Resilient Chicago Region

Elizabeth Irvin
Chicago Metropolitan Agency for Planning
October 30, 2017
Three Overarching Principles:

- Resilience
- Inclusive Growth
- Prioritized Investment

Elizabeth Irvin
Chicago Metropolitan Agency for Planning
Resilience
A strong region requires communities, infrastructure, and systems that are able to thrive in the face of uncertain future economic, fiscal, and environmental shifts.
What if by 2050…
• … climate change impacts have intensified?
• … public resources are further constrained?
• … more people choose walkable, mixed-use communities?
• … technological innovations enhance transportation?
• … the economy has been transformed?
As climate change intensifies, which impact worries you most in our region?

A. Harm to life and property from storms, flooding (24%)
B. Insufficient water supply (24%)
C. Threats to regional agriculture, biodiversity
D. Effect of extreme heat on health
E. More intense impacts for vulnerable residents
F. I’m not worried
G. Other
Table 2: Heat Vulnerability

<table>
<thead>
<tr>
<th>Social Economic Characteristic</th>
<th>Regional Population</th>
<th>Top 10 Percent hottest census tracts based on land use density. Transportation</th>
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</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>8,698,768</td>
<td>511,179</td>
</tr>
<tr>
<td>Elderly Population (over 65)</td>
<td>1,952,540</td>
<td>45,568</td>
</tr>
<tr>
<td>People of Color</td>
<td>4,055,135</td>
<td>381,247</td>
</tr>
<tr>
<td>Limited English Proficiency</td>
<td>1,025,670</td>
<td>144,903</td>
</tr>
<tr>
<td>Family income below Poverty</td>
<td>4,136,941</td>
<td>813,274</td>
</tr>
<tr>
<td>No Health Insurance Coverage</td>
<td>1,146,336</td>
<td>225,787</td>
</tr>
</tbody>
</table>

Source: 2010-14 American Community Survey, 2010 Census, and CMAP analysis derived from Landsat 8.

Chicago Metropolitan Agency for Planning, 2017.
Transportation Revenues and Costs

Federal and state transportation revenue to northeastern Illinois compared to inflation and operating costs, estimates for selected sources, percent change since 2007

Elizabeth Irvin
Chicago Metropolitan Agency for Planning
Resilience Recommendations

Increase the capacity of communities to achieve local and regional goals
Address state and local tax policy
Support walkable, mixed-use communities
Plan for population shifts
Incorporate climate change considerations into planning and development
Plan for the regional transportation impacts of major land use change
Coordinate across jurisdictions to promote collaborative action

Elizabeth Irvin
Chicago Metropolitan Agency for Planning
BUILDING RESILIENT TRANSPORTATION NETWORKS IN CHICAGO

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Chicago Metropolitan Agency for Planning