FHWA Resilience Primer

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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

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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?

23 CFR 450.200 & 23 CFR 450.300  
Take into consideration resiliency needs

23 CFR 450.206(a) & 23 CFR 450.306(b)  
Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation

23 CFR 450.316(b)  
Consult with agencies and officials responsible for natural disaster risk reduction when developing a MTP and TIP

23 CFR 450.324(f)(7)  
Assess capital investment and other strategies that reduce the vulnerability of the existing transportation infrastructure to natural disasters
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 Highway Resilience

Coming 2018

FHWA RESILIENCE PRIMER

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Resilience:

FHWA Resources and Tools—INVEST
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!

INVEST Version 1.2

www.sustainablehighways.org

Supporting the Entire Life Cycle

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

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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 Resilience**
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

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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

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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

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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

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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
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?