



U.S. Department of Transportation
Federal Highway Administration

FHWA Approaches to Resilience & Sustainability

2019 Nevada Transportation
Conference
May 7, 2019

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FHWA



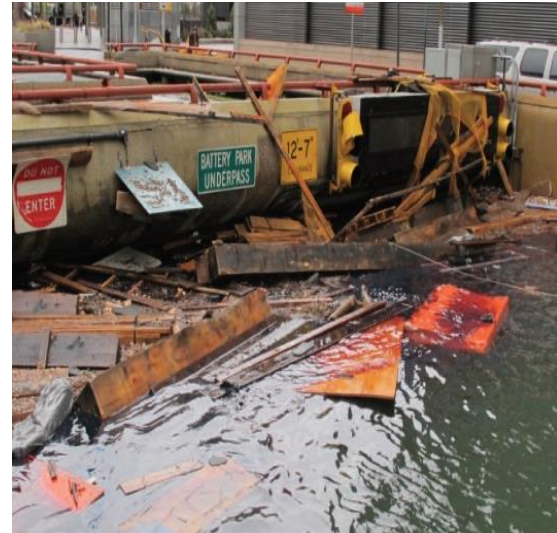
What is *Resilience*?

Resilience: the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions

Adaptation: adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects



- Waldo Canyon Fire, CO, 2012, credit: CO DOT



Battery Park Underpass in NYC following Superstorm Sandy, credit: NYC DOT.

Why Address Resilience?

- Protect public safety
- Reduce life-cycle expenditures
- Eligible for Federal-aid funding (*23 USC 119 (d)(2), etc.*)
- USDOT 2018-22 Strategic Plan:
 - “DOT will increase its effectiveness in ensuring that infrastructure is resilient enough to withstand extreme weather”

Is Resilience an Issue for my State? (Yes.)

Extreme weather leads to disruptions of transportation systems across the country...



I-680 in IA during Missouri River Flood of 2011,
credit: Iowa State Patrol



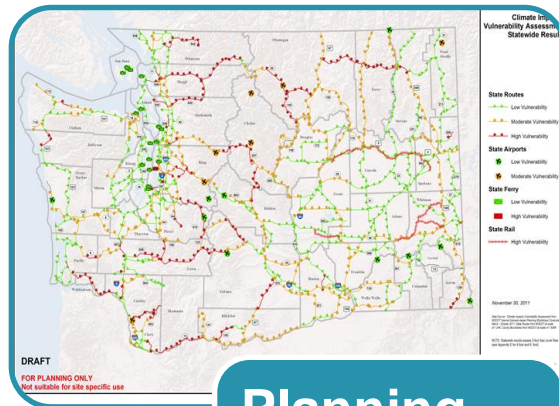
Hurricane Harvey, Beaumont, TX (photo credit: Donna
Burton for US CBP)

...and acceleration of deterioration rates.

Integrating Resilience

Goal: Integrate 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.”



Planning

- Long Range Transportation Plans
- Asset Management Plans



Project Level

- Environmental Processes
- Engineering
- Design



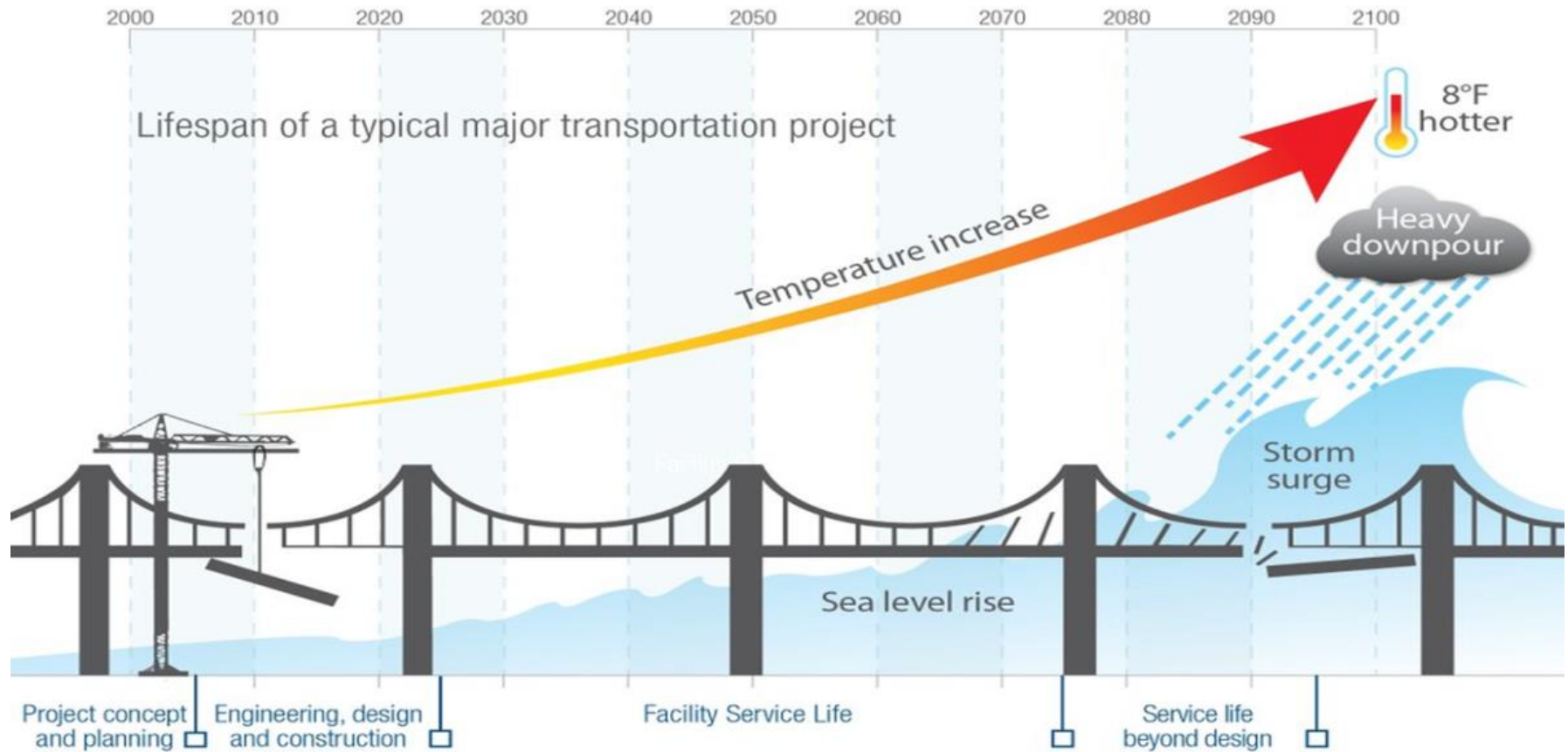
Operations and Maintenance

- Emergency Relief
- Snow Removal Programs

Extreme Weather Resilience Related Regulations

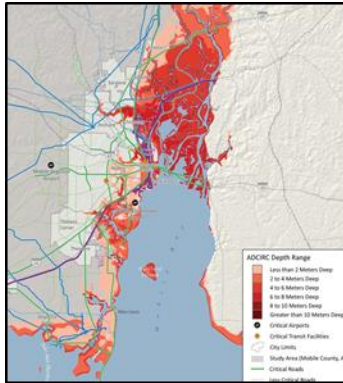
- Risk-based **asset management** plans must address risks associated with current and future environmental conditions (23 CFR 515)
- Assets requiring repeated repair require **analysis of alternatives** (23 CFR 667)
- State and metropolitan **transportation planning** should now include resilience as a planning factor (23 USC 134, 23 CFR 450)

Stationarity?

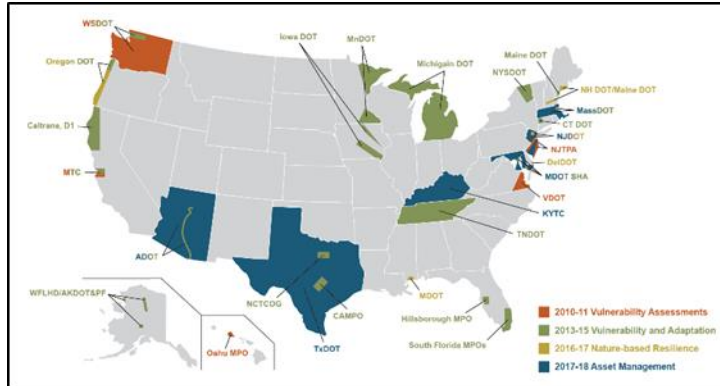


FHWA Resilience Resources

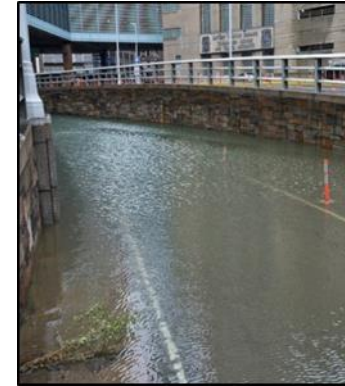
Gulf Coast 2 Study



Resilience Pilots - State DOTs, MPOs, FLMA's

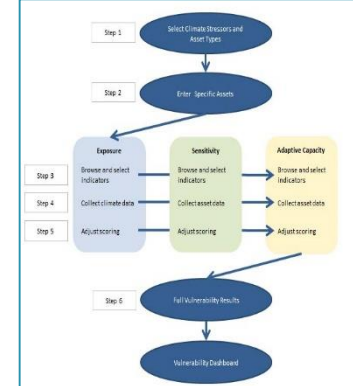


Hurricane Sandy Project



Credit: NYC DOT

Tools

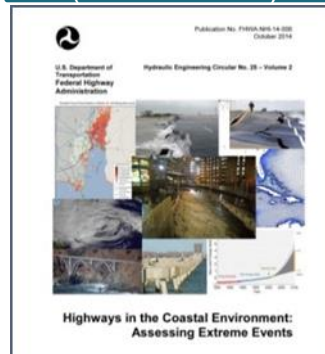


<https://www.fhwa.dot.gov/environment/sustainability/resilience/>

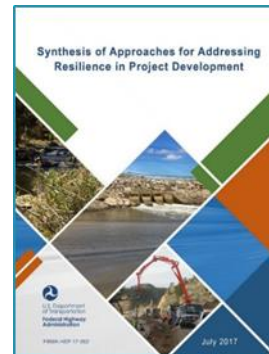
Vulnerability & Adaptation Framework



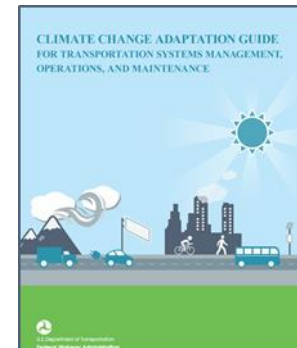
Engineering Guidance (HEC-25 & 17)



Project Development



Operations & Maintenance

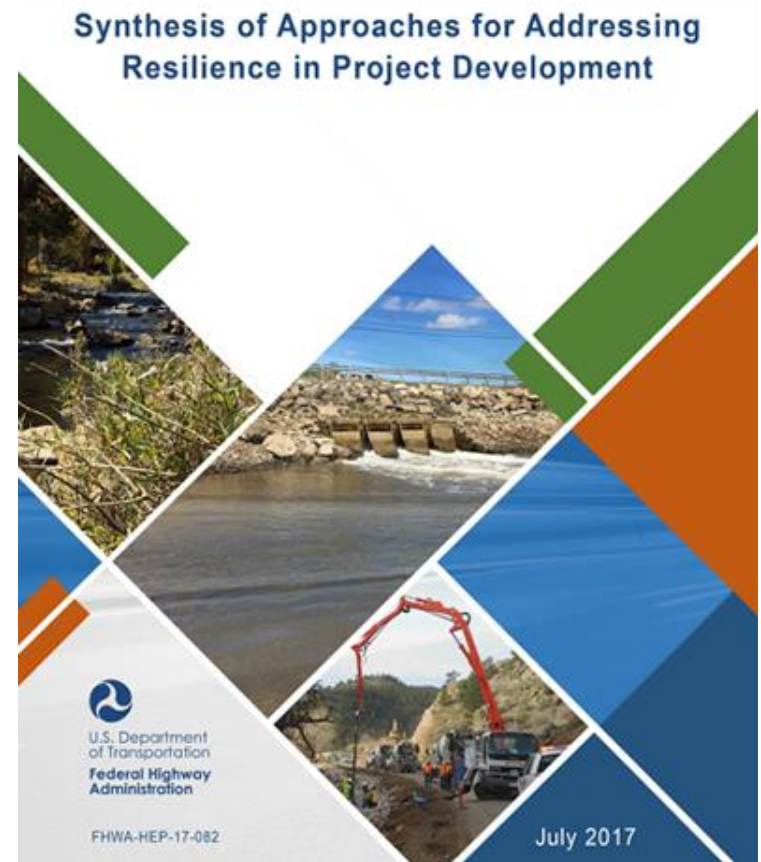


Guidebooks under development on integrating resilience in:

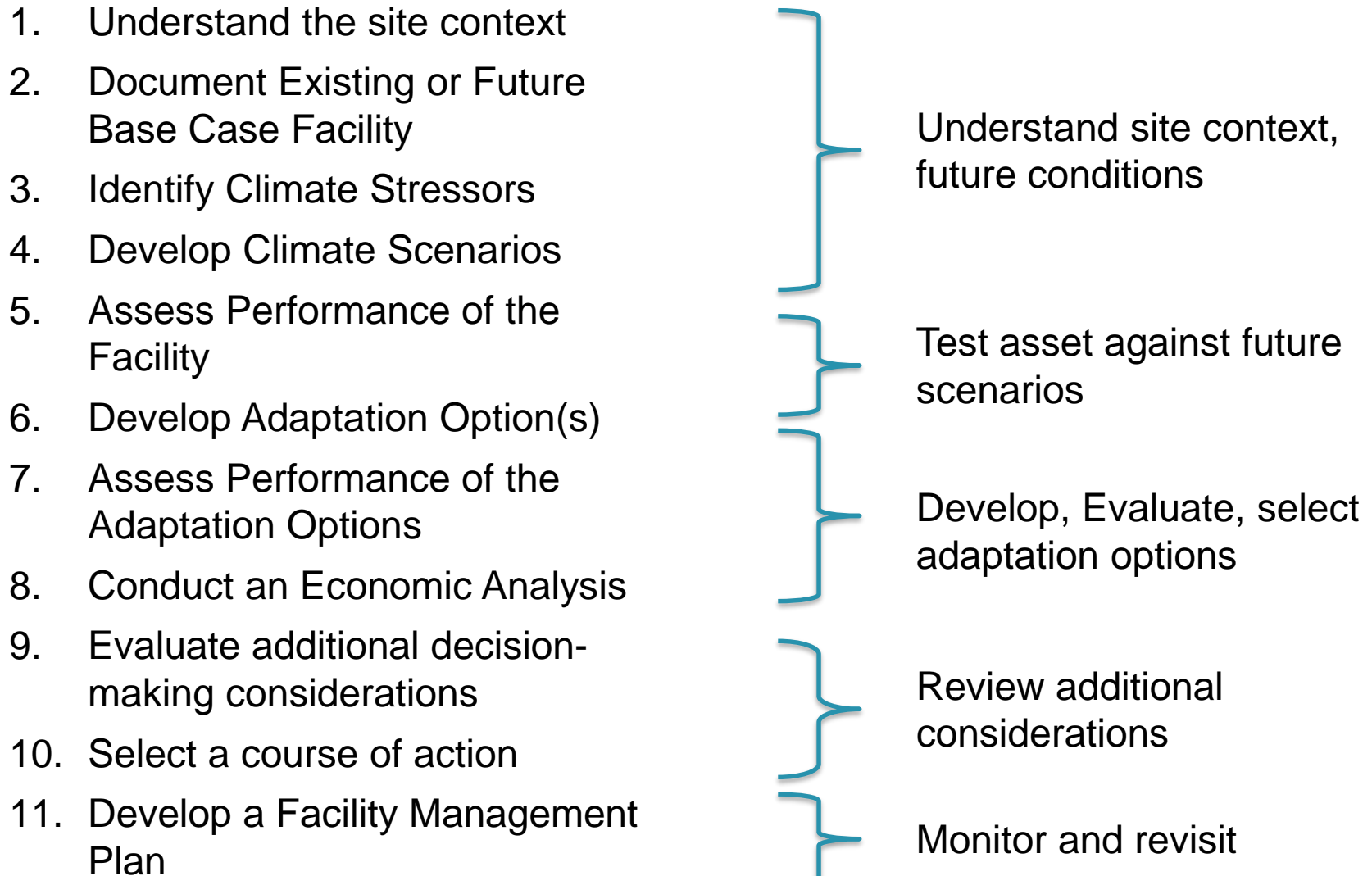
- Asset Management
- Transportation Planning
- Nature-based solutions

Synthesis of Approaches for Addressing Resilience in Project Development (2017)

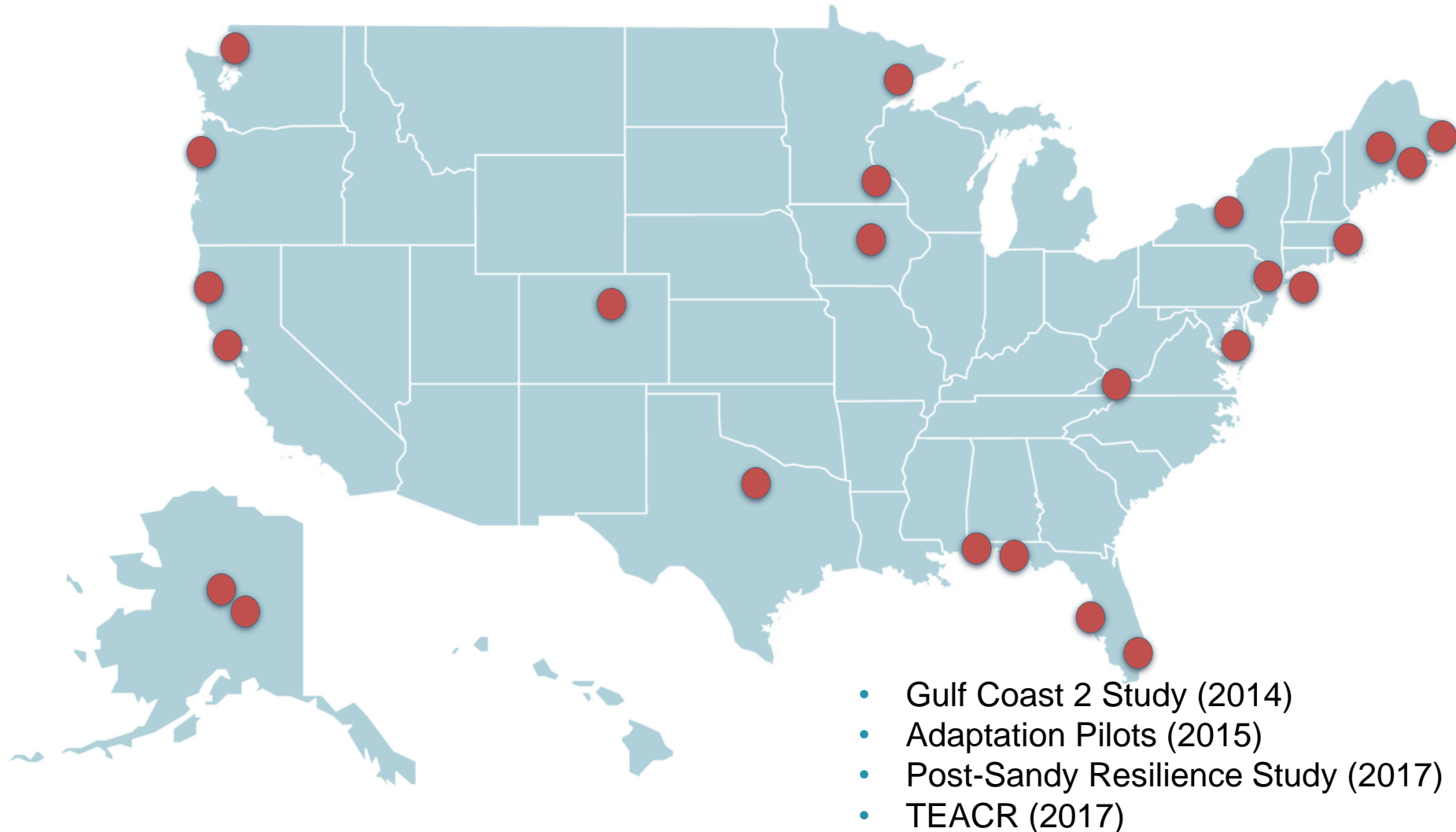
- Lessons learned, etc., for four engineering disciplines
 - Coastal Hydraulics
 - Riverine Hydraulics
 - Pavement and Soils
 - Mechanical & Electrical Systems
 - Overall Lessons learned for engineering
- Addressing resilience in the project development process
- Adaptation Decision-Making Assessment Process (ADAP)



Adaptation Decision-Making Assessment Process (ADAP)



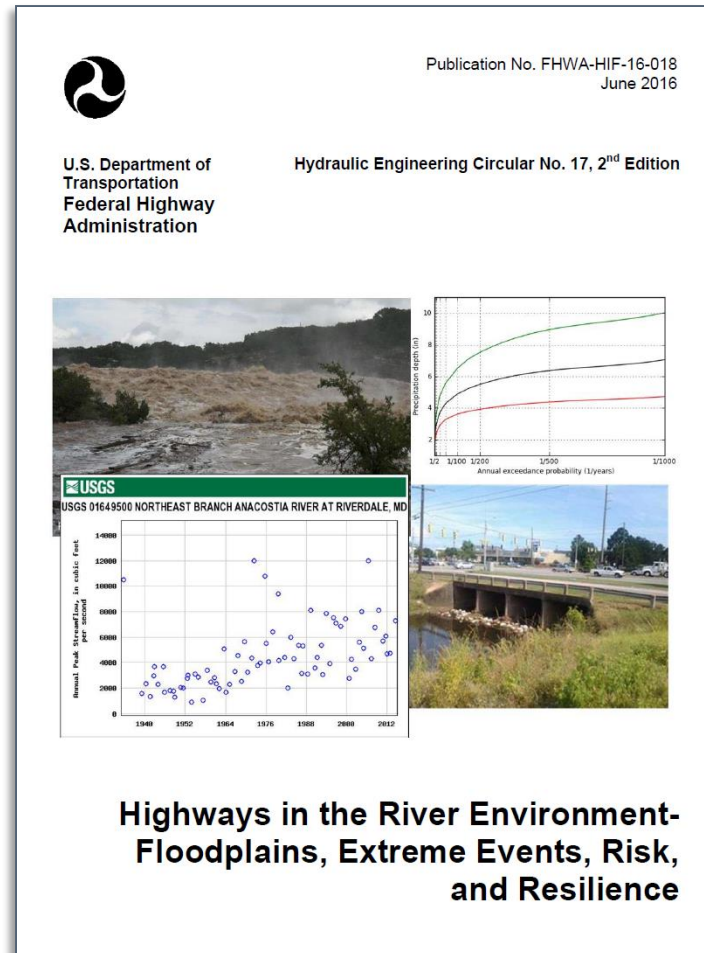
Engineering-Focused Case Studies



Riverine Hydrology

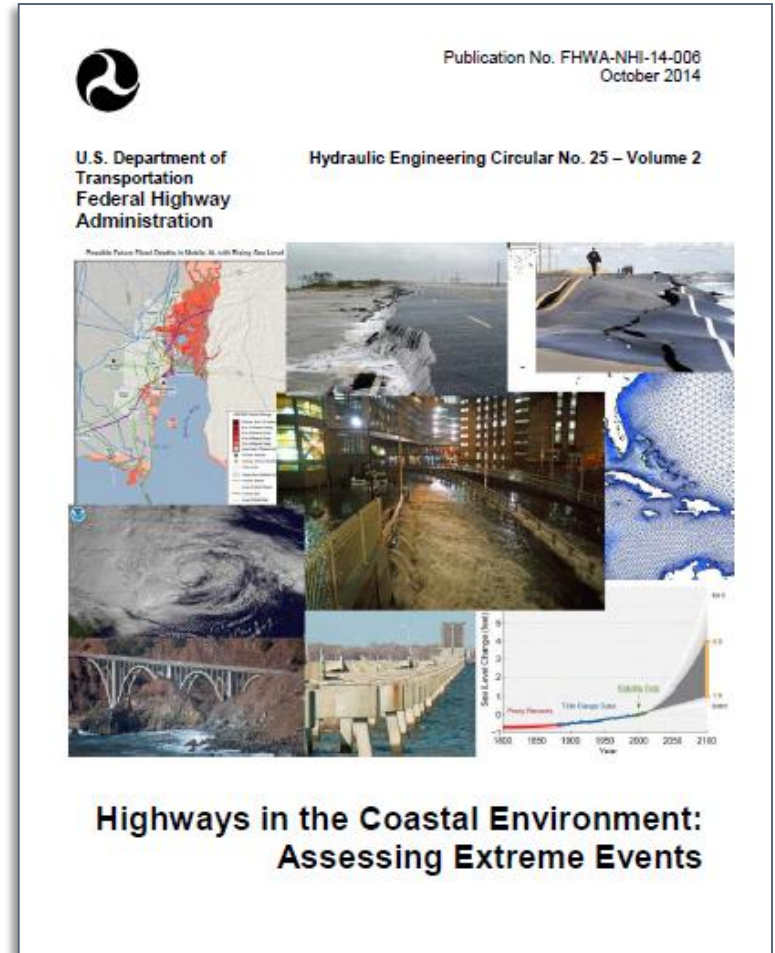
- **Hydraulics Engineering Circular 17**

Highways in the River Environment - Floodplains, Extreme Events, Risk, and Resilience (Second Edition), June 2016



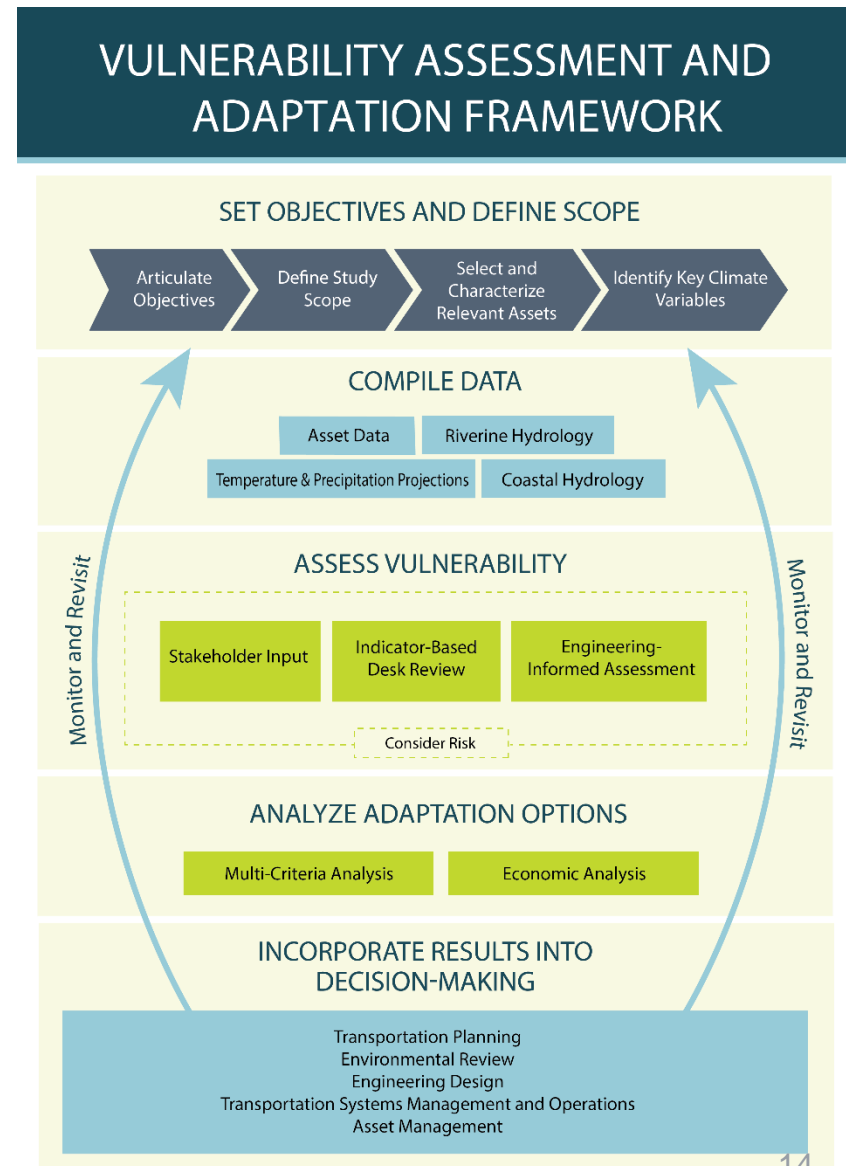
Coastal Hydrology

- **Hydraulics Engineering Circular 25, Volume 2**
Highways in the Coastal Environment: Assessing Extreme Events, October 2014.
- Currently being updated

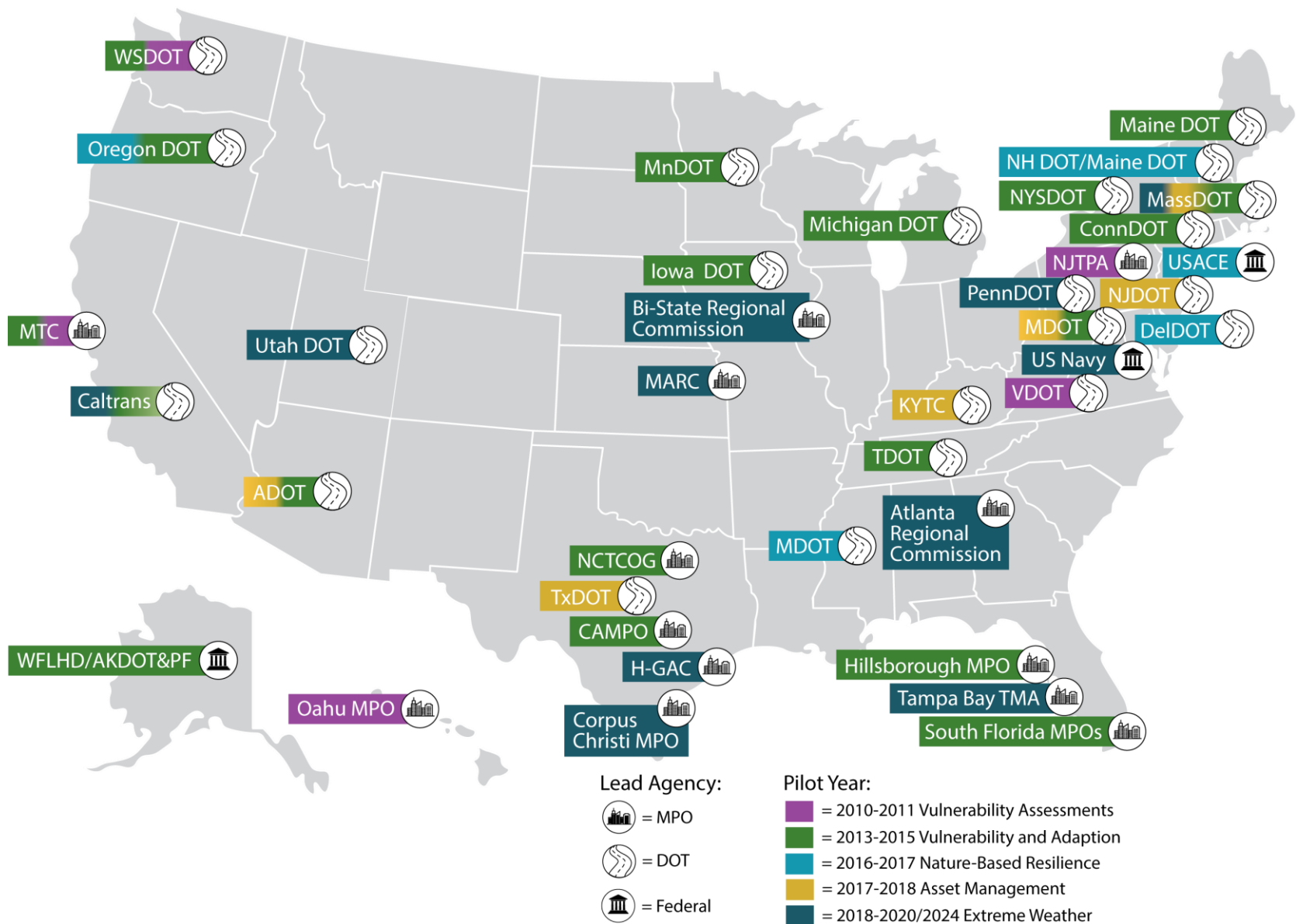


Vulnerability Assessment and Adaptation Framework, 3rd Edition

- Provides an in-depth and structured **process** for conducting a vulnerability assessment.
- Features **examples** from assessments conducted nationwide.
- Incorporates information from recent FHWA and other U.S. **partner projects**.
- Includes links to **resources and tools**.



FHWA Sponsored Resilience Pilots



Ongoing Projects

- *Incorporating Resilience into the Transportation Planning Process Case Studies and Guidebook*
 - [Integrating Resilience into the Transportation Planning Process- White Paper on Literature Review Findings](#)
- *Nature-based Resilience for Coastal Highways Guidebook*
 - [White Paper: Nature-based Solutions for Coastal Highway Resilience](#)
- Asset Management, Extreme Weather, and Proxy Indicators Pilot Projects and Guidebook
- HEC-25 Update
- CMIP Climate Data Processing Tool update





NOV 13-15 / 2019 WASHINGTON, DC TRANSPORTATION RESILIENCE 2019

A conference on natural hazards
& extreme weather events

What is Sustainability?



The Sustainability Triple Bottom Line

Key Elements

- Balance between three principles
- Stewardship for the present and future

What is INVEST?



INVEST - Infrastructure Voluntary Evaluation Sustainability Tool

- Web-based collection of voluntary best practices
- Designed to help transportation agencies assess the sustainability of their projects, plans, and programs
- Connects sustainability principles with action
- Helps stakeholders go above and beyond

INVEST is the only tool that meets all of the following:

- **Specific to transportation**
- **Covers full life-cycle**
- **Self-evaluation, no third party certification**
- **Free**

**INVEST 2.0 Coming in
Summer 2019!**

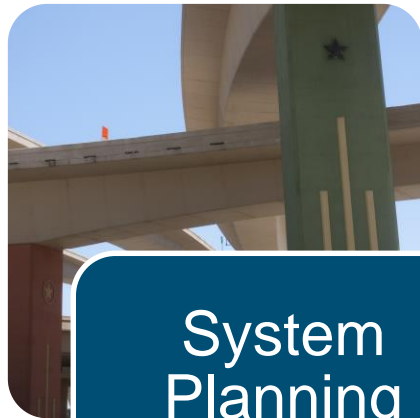
How does INVEST work?



- **Evaluate** – Using the collaborative process can provide the most important outcome
- **Score** – Provides recognition for implementing sustainability best practices and identifying gaps
- **Improve** – Using the process to improve in practice and identify cost effective measures



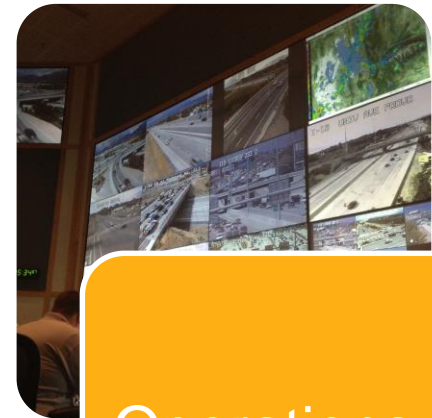
Supporting the Entire Life Cycle



System
Planning
(State or
Regional) &
Processes



Project
Development
Planning
Design
Construction



Operations &
Maintenance

INVEST Criteria



System Planning (SPR and SPS)

1. Integrated Planning: Economic Development and Land Use
2. Integrated Planning: Natural Environment
3. Integrated Planning: Social
4. Integrated Planning: Bonus
5. Access and Affordability
6. Safety Planning
7. Multimodal Transportation and Public Health
8. Freight and Goods Access & Mobility
9. Travel Demand Management
10. Air Quality & Emissions
11. Energy and Fuels
12. Financial Sustainability
13. Analysis Methods
14. Transportation Systems Management and Operations
15. Linking Asset Management and Planning
16. Infrastructure Resiliency
17. Planning and Environmental Linkages

Project Development (PD)

1. Economic Analyses
2. Lifecycle Cost Analyses
3. Context Sensitive Project Devt.
4. Highway and Traffic Safety
5. Educational Outreach
6. Tracking Enviro. Commitments
7. Habitat Restoration
8. Stormwater Quality and Flow Control
9. Ecological Connectivity
10. Pedestrian Facilities
11. Bicycle Facilities
12. Transit and HOV Facilities
13. Freight Mobility
14. ITS for System Operations
15. Historic, Arch., and Cultural Pres.
16. Scenic, Natural, and Rec. Qualities
17. Energy Efficiency
18. Site Vegetation, Maint., Irrigation
19. Reduce, Reuse, & Repurpose Materials
20. Recycle Materials
21. Earthwork Balance
22. Long-Life Pavement
23. Reduced Energy & Emissions in Pavement
24. Permeable Pavement
25. Construction Environmental Training
26. Construction Equipment Emissions
27. Construction Noise Mitigation

28. Construction Quality Control Plan
29. Construction Waste Management
30. Low Impact Development
31. Infrastructure Resiliency Planning and Design
32. Light Pollution
33. Noise Abatement

Operations & Maintenance (OM)

1. Internal Sustainability Plan
2. Electrical Energy Efficiency & Use
3. Vehicle Fuel Efficiency & Use
4. Reduce, Reuse, and Recycle
5. Safety Management
6. Environmental Commitments Tracking System
7. Pavement Mgt. System
8. Bridge Mgt. System
9. Maintenance Mgt. System
10. Highway Infrastructure Pres. & Maint.
11. Traffic Ctrl. Infrastructure Maint.
12. Road Weather Mgt. Program
13. Transportation Mgt. & Ops.
14. Work Zone Traffic Control

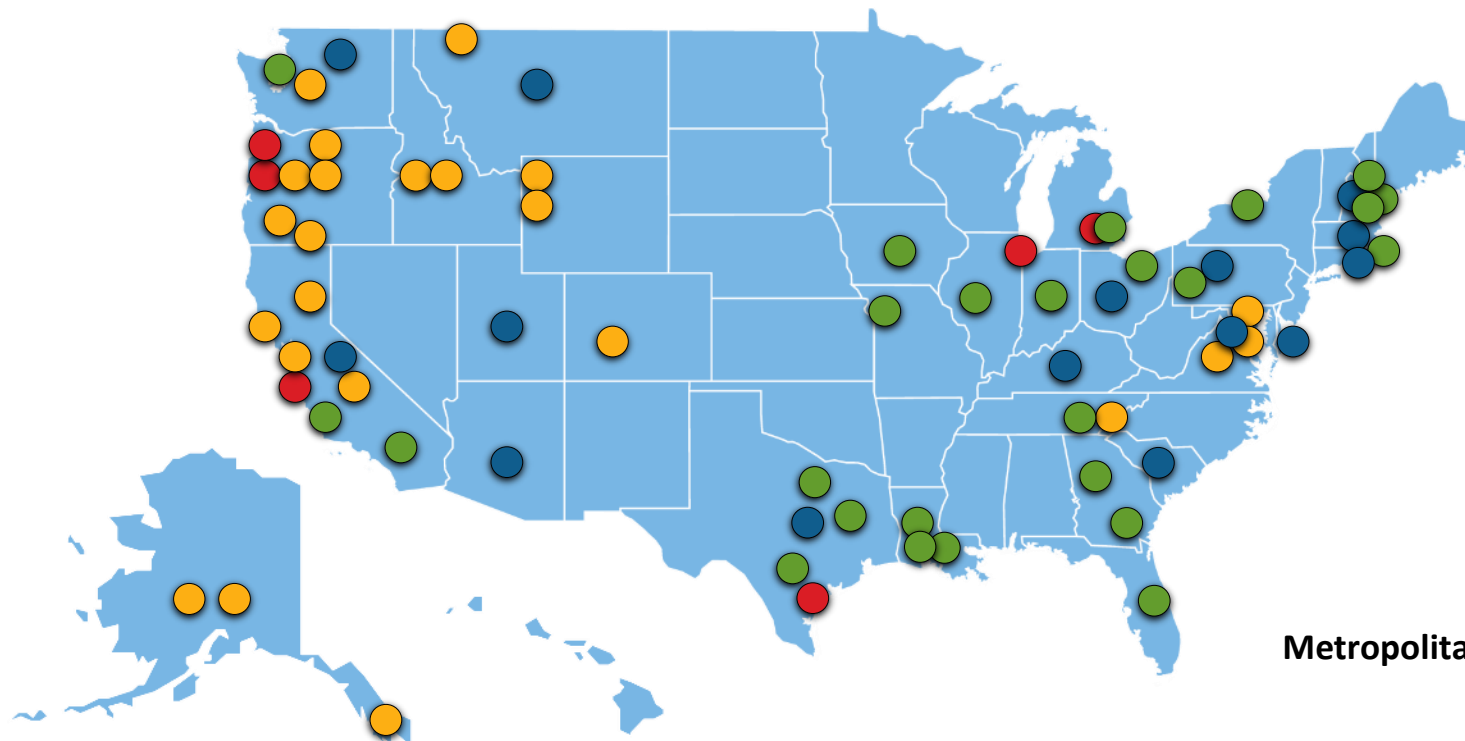
INVEST Usage



INVEST Usage By the Numbers

Entities that have informed
FHWA they are using INVEST:

- 15 State DOTs
- 25 MPOs
- 23 Federal Lands Units
- 7 other transport agencies
in US (local, transit, tollway)
- 1 foreign government

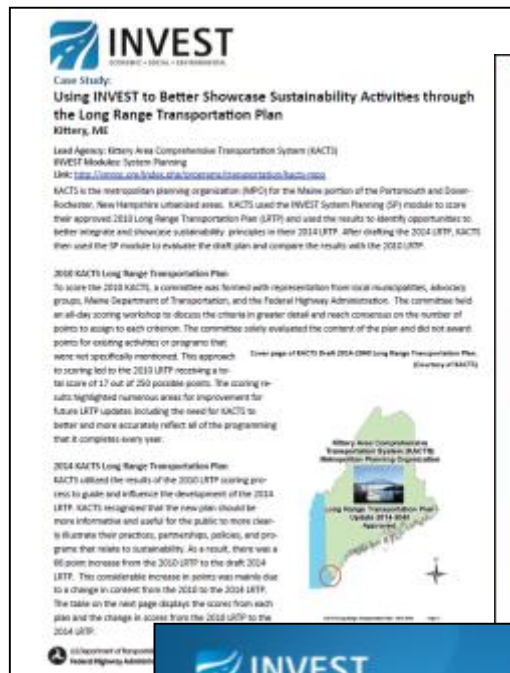


State DOT ●
Metropolitan Planning Org. (MPO) ●
Federal Lands Unit ●
Other ●

Resources Available



- Case Studies
- User Toolkit
- Cost Savings Reports
- Technical Assistance Opportunities



THANK YOU!

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