U.S. Department of Transportation
Federal Highway Administration

FHWA Resilience Pilot Projects

Southern Transportation & Air Quality Summit 2019

Wednesday, August 21, 2019
Louisville, KY

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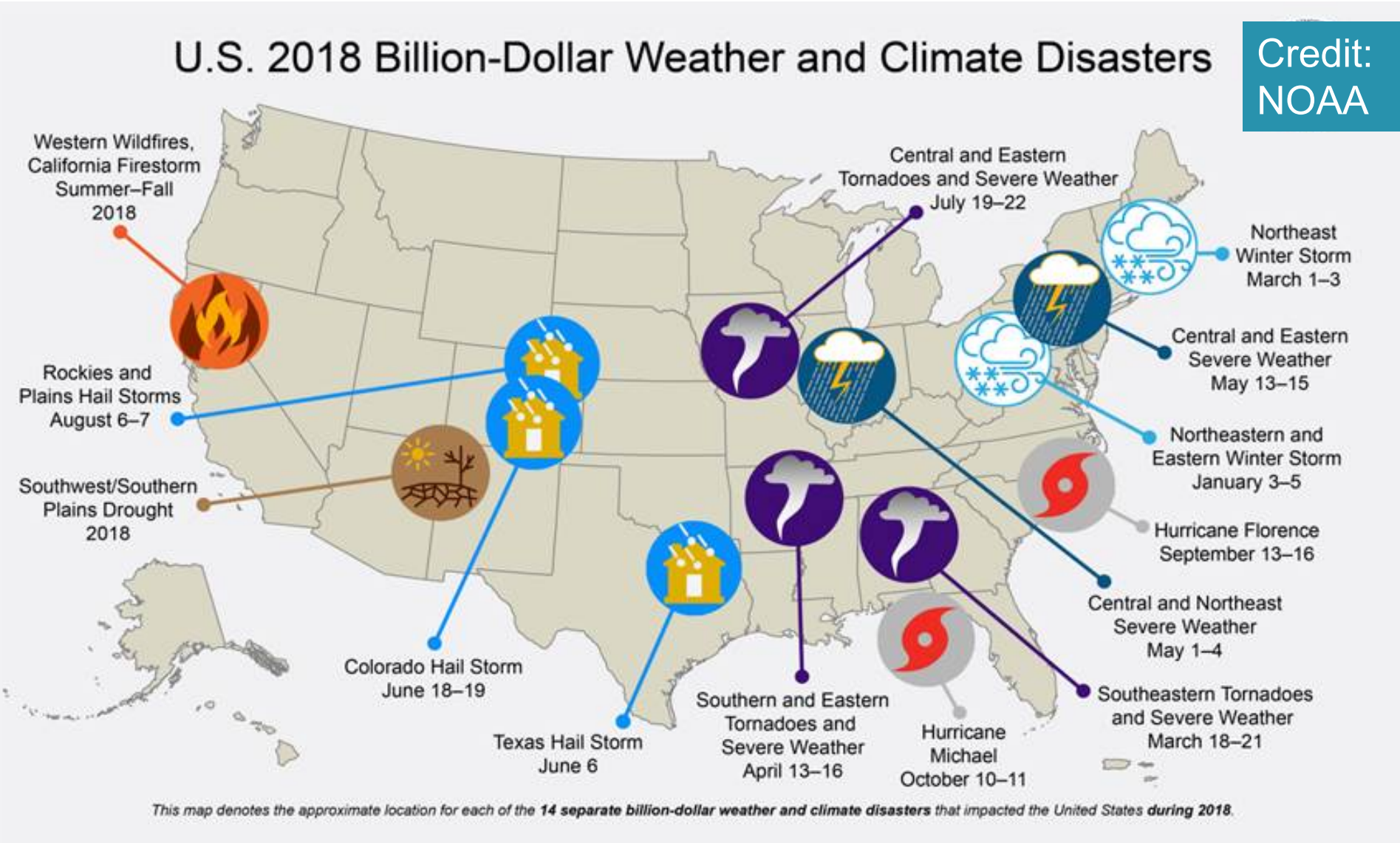
Sustainable Transportation and Resilience
Office of Natural Environment
FHWA

Fourteen Billion-Dollar Disasters in 2018



What is *Resilience*?

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

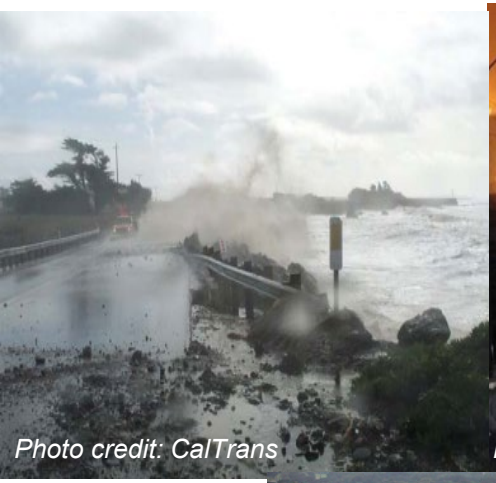


Photo credit: CalTrans


Photo credit: CO DOT


Photo credit: Iowa State Patrol

Photo credit: NYCDOT

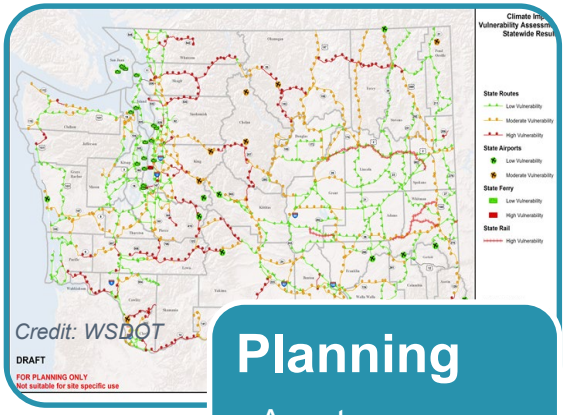

Photo credit: US CBP


Photo credit: US CBP

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

- Asset Management Plans
- Long Range Transportation Plans

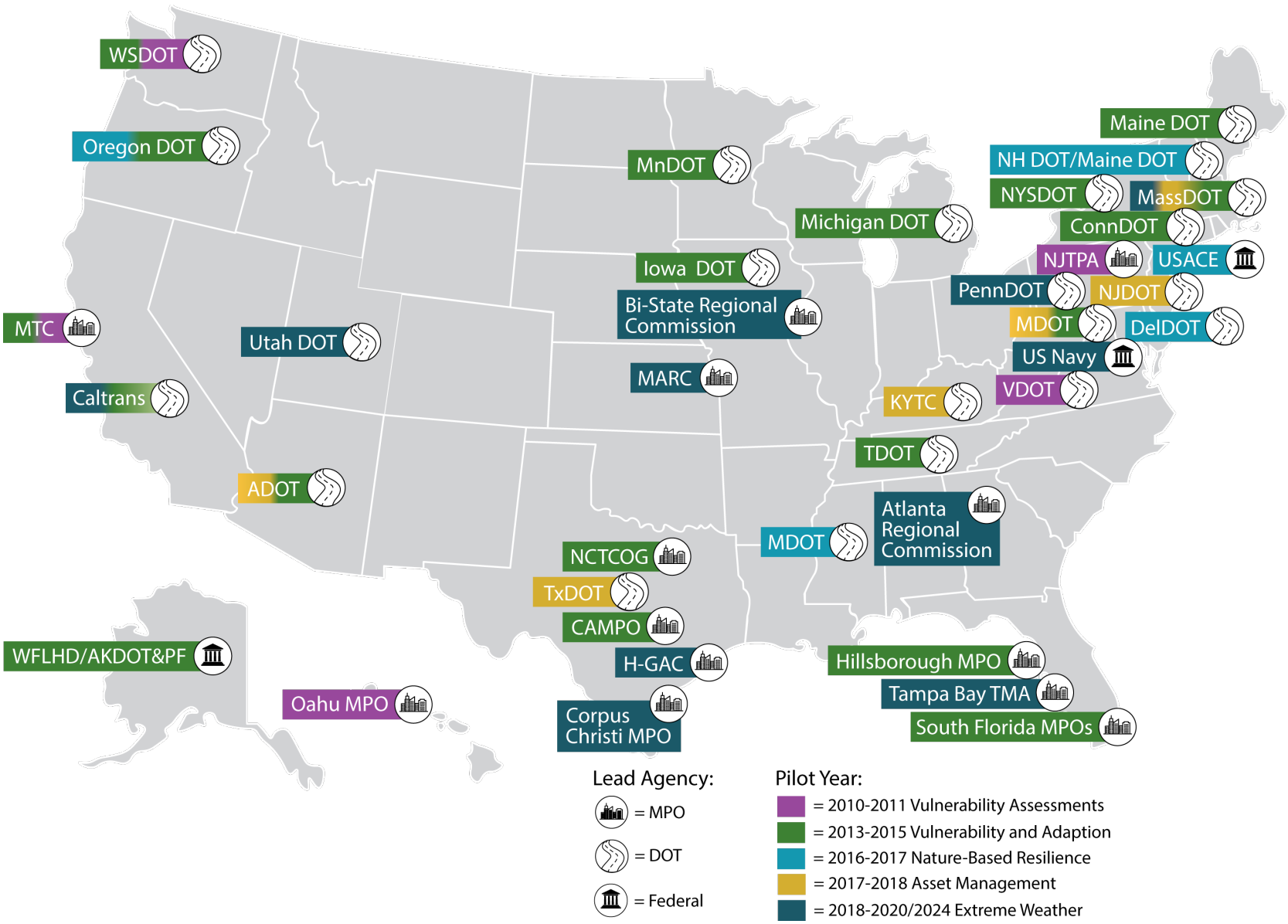
Project Level

- Environmental Processes
- Engineering
- Design

Operations and Maintenance

- Emergency Response

How Do We Integrate Resilience?



Extreme Weather Resilience Policy

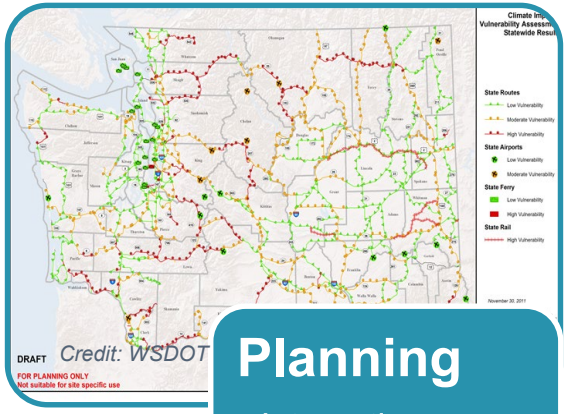
- USDOT FY 2018-22 Strategic Plan: “DOT will increase its effectiveness in ensuring that infrastructure is resilient enough to withstand extreme weather”
- FHWA Order 5520 commits FHWA to integrating extreme weather risk consideration into programs


Flooding from Harvey, Credit TTI

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 **evaluation of alternatives** (23 CFR 667)
- State and metropolitan **transportation planning** should now include resilience as a planning factor (23 USC 134, 23 CFR 450)
- **Metropolitan transportation plans** shall include an assessment of capital investment and other strategies to… reduce the vulnerability of the existing transportation infrastructure to natural disasters (23 CFR 450.324(f)(7))

Ongoing Resilience Projects

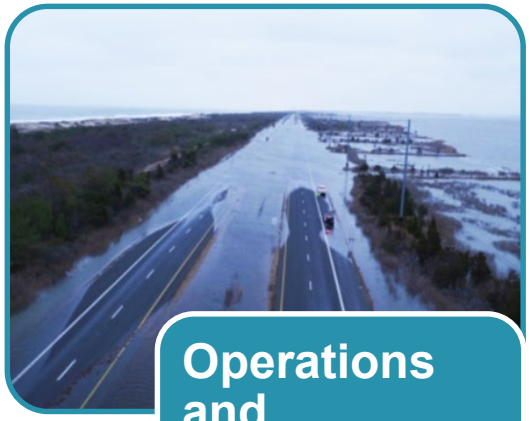


Planning

- Integrating Resilience in Asset Management
- Integrating Resilience in Transportation Planning

Project Level

- Nature Based Resilience for Coastal Highways
- Coastal Hydrology Manual



Operations and Maintenance

- Emergency Response

Integrating Resilience in Asset Management

Project: Asset Management and Resilience
https://www.fhwa.dot.gov/asset/

- Pilot projects and associated reports (Coming Summer 2019)
  - Arizona
  - Texas
  - Kentucky
  - Maryland
  - New Jersey
  - Massachusetts

Kentucky Transportation Cabinet
- Use vulnerability assessment results in risk register
- Consider effects of extreme weather events on asset deterioration rates and LCP

- Guidebook on addressing resilience in Asset Management (Coming Fall 2019)

Integrating Resilience in Transportation Planning

Project: Integrating Resilience into the Transportation Planning Process

https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/planning/

- Workshops and Peer Exchanges
- Fact Sheet (January 2017)
- White Paper (May 2018)
- 10 Case Studies (Coming 2019)
- Handbook (Coming 2019)

Nature-based Resilience for Coastal Highways

Project: Research and technical assistance to help state DOTs and MPOs implement nature-based solutions to protect coastal highways from storm surge and sea level rise.

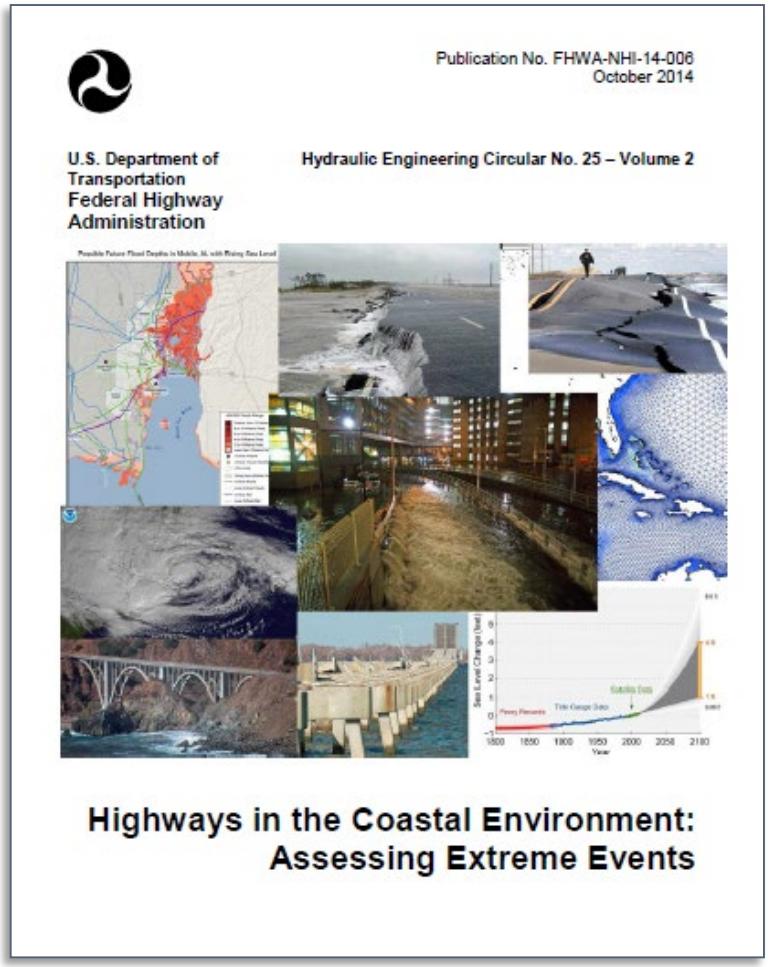
https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/index.cfm

- Build off USACE and NOAA work
- 5 pilot projects completed
  - OR DOT
  - ME & NH DOTs jointly
  - MS DOT
  - DE DOT
  - US Army Corps of Engineers in NJ
- White paper, Winter 2018
- Regional peer exchanges, Spring 2018: AL, CA, DE, NC
- Implementation guide, Coming 2019


Photo Credit: Tina Hodges

Coastal Hydrology

- **Hydraulics Engineering Circular 25, Volume 2** Highways in the Coastal Environment: Assessing Extreme Events, October 2014.
- Currently being updated (Expected Fall 2019)



Integrating Resilience into Emergency Response

FHWA Resources:

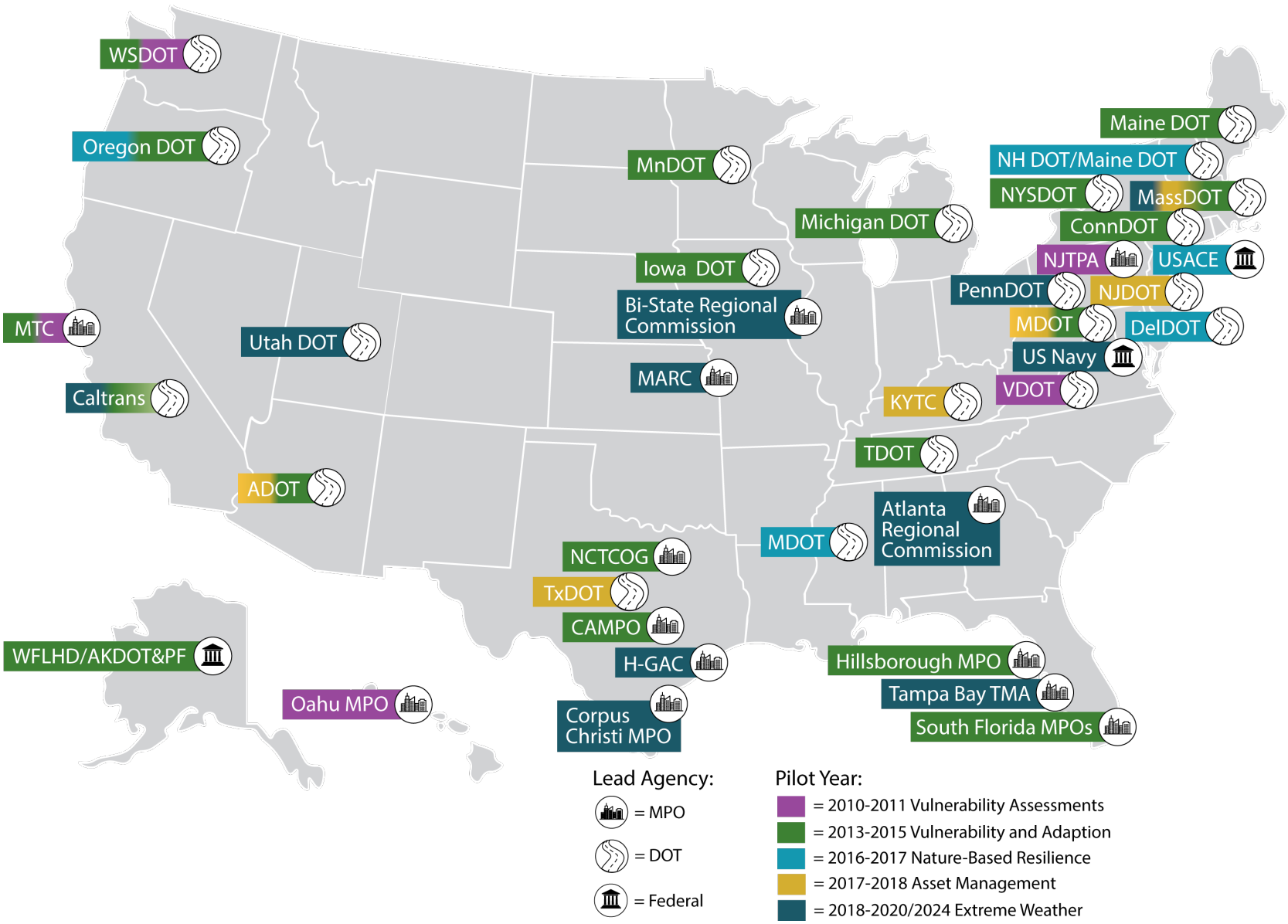
- **FHWA ER Manual (Currently being updated)**
- **ER and Resilience FAQ**
- **FHWA ER Order**

Two ways ER funds can be used to improve resilience when repairing/rebuilding damaged highway:

1. Bring up to current standards
2. Cost-effective betterment (would save FHWA ER program money over time)

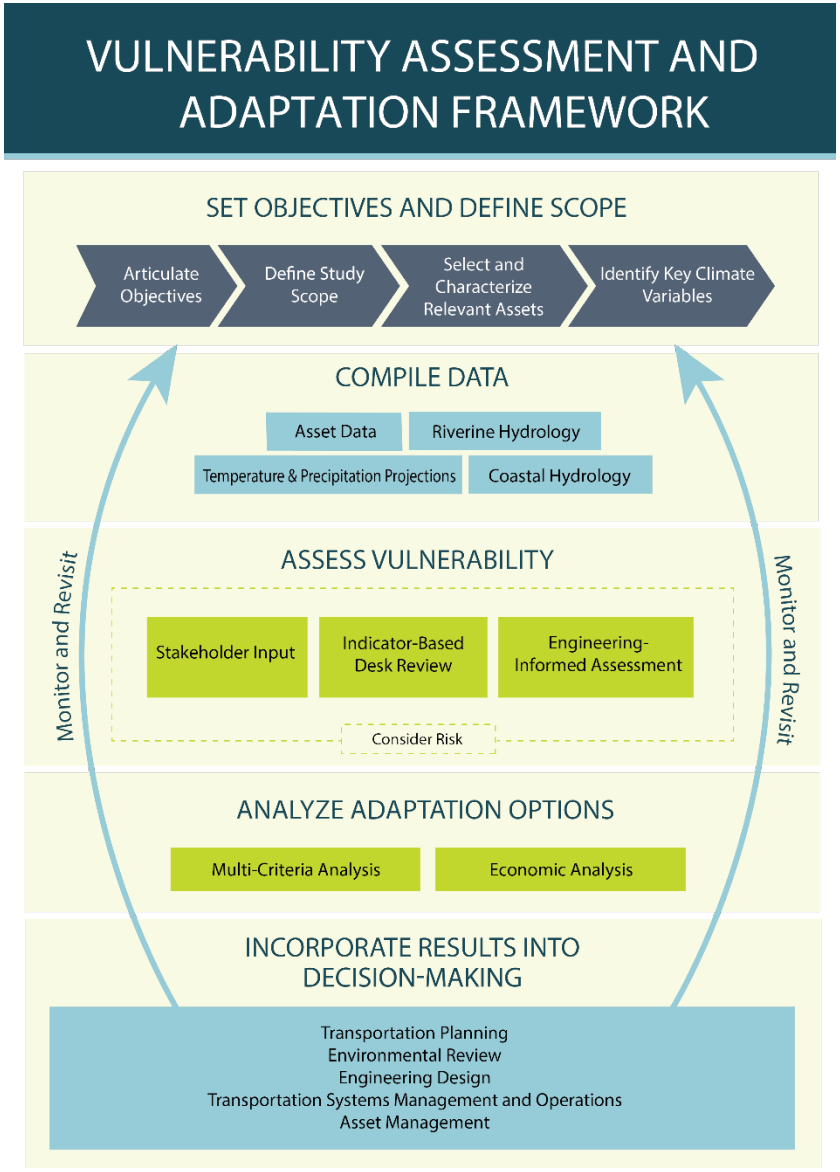
"The FHWA supports planning, designing and constructing highways to adapt to current and future climate change and extreme weather events under the Federal-aid program. Features that will improve the resilience of repaired federal aid highways should be considered and evaluated consistent with risk, cost effectiveness and regulatory conditions. The evaluation should apply the best available scientific and economic information to forecast and assess future risk factors." FHWA ER Manual, p60.

Resilience Pilots To Date

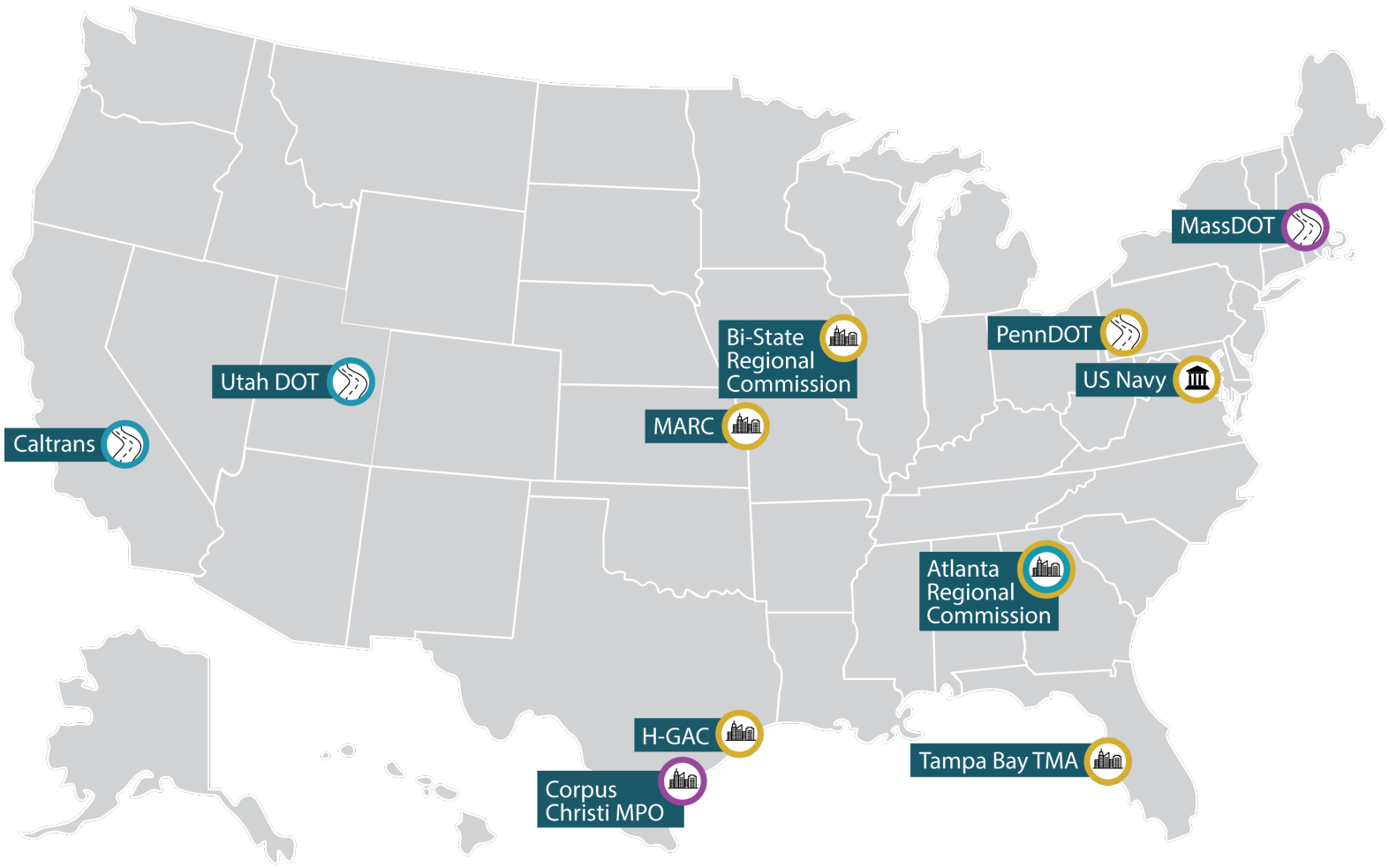


Vulnerability Assessment and Adaptation Framework, 3rd Edition

- Provides an in-depth and structured **process** for conducting a vulnerability assessment.
- Features **examples** from assessments conducted nationwide.
- Includes links and references to related **resources and tools**.



2018 Resilience and Durability Pilots



Lead Agency:

= MPO

= DOT

= Federal

Type of Project:

= Integrating resilience and durability into agency practices.

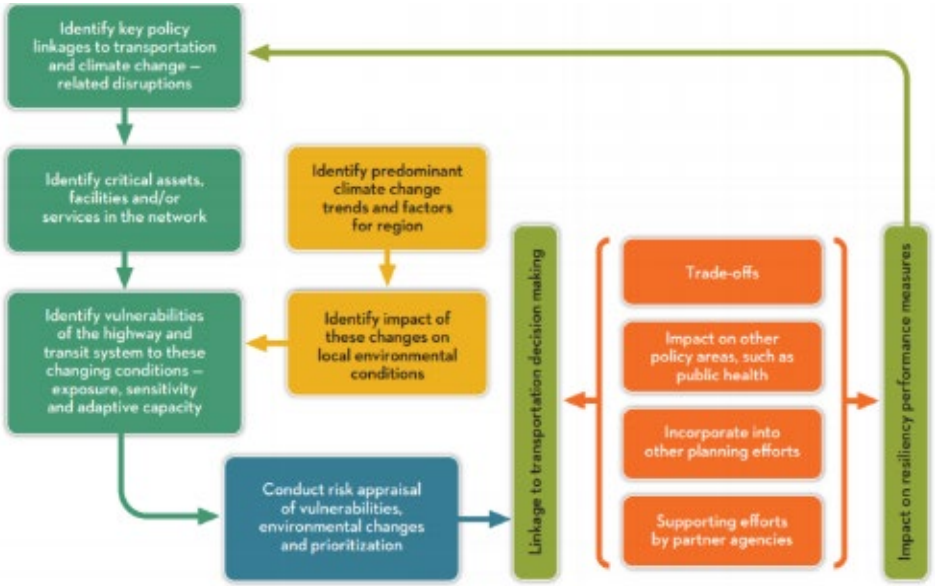
= Using available tools and resources to assess the vulnerability and risk of transportation projects or systems.

= Deploying a resilience solution and monitoring performance.

Atlanta Regional Commission

FHWA/ARC peer exchange (Fall 2016):
https://www.fhwa.dot.gov/environment/sustainability/resilience/publications/atlanta/index.cfm

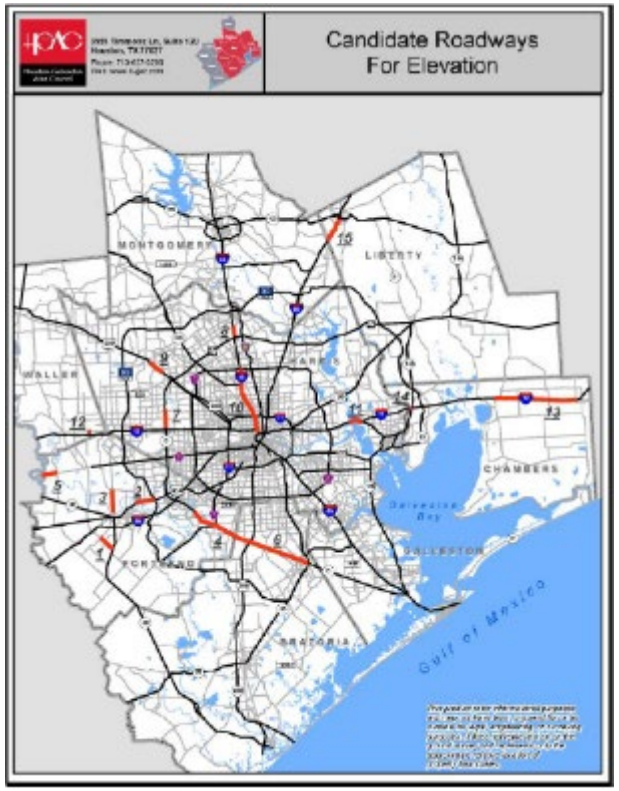
- **Project:** Integrate threats of extreme weather on transportation assets and users into the planning and engineering process using ARC's vulnerability assessment framework
- **Outcome:** Resilience integration within transportation plans, criticality and vulnerability assessments of transportation assets



ARC Vulnerability Assessment Framework

Houston-Galveston Area Council

- **Project:** Assess vulnerability and risk of transportation system to extreme weather impacts for the 8-County Metropolitan Area
- **Outcome:** Final report to be incorporated into regional planning and asset management



Possible Roadway Elevation Segments in H-GAC region

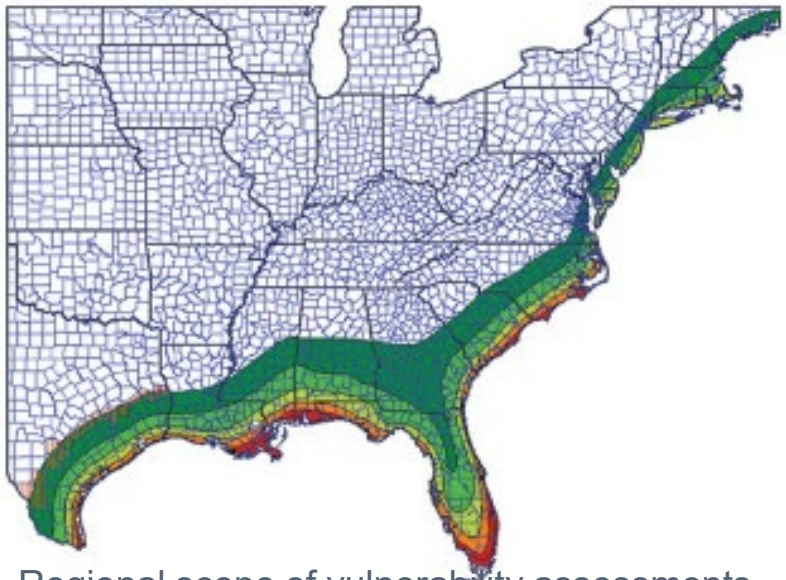
Corpus Christi Metropolitan

- **Project:** Design and deploy a nature-based shoreline protection buffer to enhance the resilience to extreme weather of Laguna Shores Road
- **Outcome:** Construction of shoreline protection project and monitoring of project effectiveness

Project location

Department of the Navy – Naval Facilities Engineering Command (NAVFAC)

- **Project:** Assess vulnerability and risk of extreme weather impacts on East and Gulf coast bridges at Navy and Marine Corps installations
- **Outcome:** Influence decision-making on new construction, rehabilitation, and maintenance of bridge assets



Regional scope of vulnerability assessments

TRB
TRANSPORTATION RESEARCH BOARD

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
AASHTO

U.S. Department of Transportation
Federal Highway Administration

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

An international conference on natural hazards & extreme weather events

For more information visit:
www.TR2019.org

THANK YOU!

Contact Information: Heather.Holsinger@dot.gov

Website: https://www.fhwa.dot.gov/environment/sustainability/resilience/

Asset Management Pilots

Arizona DOT

- Integrate extreme weather risks into Asset management practice
- Assess costs in life cycle planning
- Consider proxy indicators for identifying resilience concerns

Kentucky Transportation Cabinet

- Use vulnerability assessment results in risk register
- Consider effects of extreme weather events on asset deterioration rates and LCP

Massachusetts DOT

- Assess resilience of bridges, culverts and roads to inland flooding risks, inclusion in asset management systems.
- Culvert inspection protocols and test proxies for vulnerability

Asset Management Pilots (continued)

Maryland SHA

- Develop methods to pull coastal vulnerabilities and hazards into bridge and pavement management systems
- Update life cycle management plans to reflect future environmental risk

New Jersey DOT

- Reduce system risk by linking culvert and drainage system management to extreme weather and climate resilience

Texas DOT

- Assess vulnerability of critical assets to extreme weather events in Houston District, inform asset management practices including LCP, deterioration curves

Approaches to Nature-based Resilience Strategies

Why talk about nature-based solutions (also called **green infrastructure**)?

- May be cheaper; effective; more adaptable; co-benefits for habitat, fisheries, recreation

Integrated Approach:

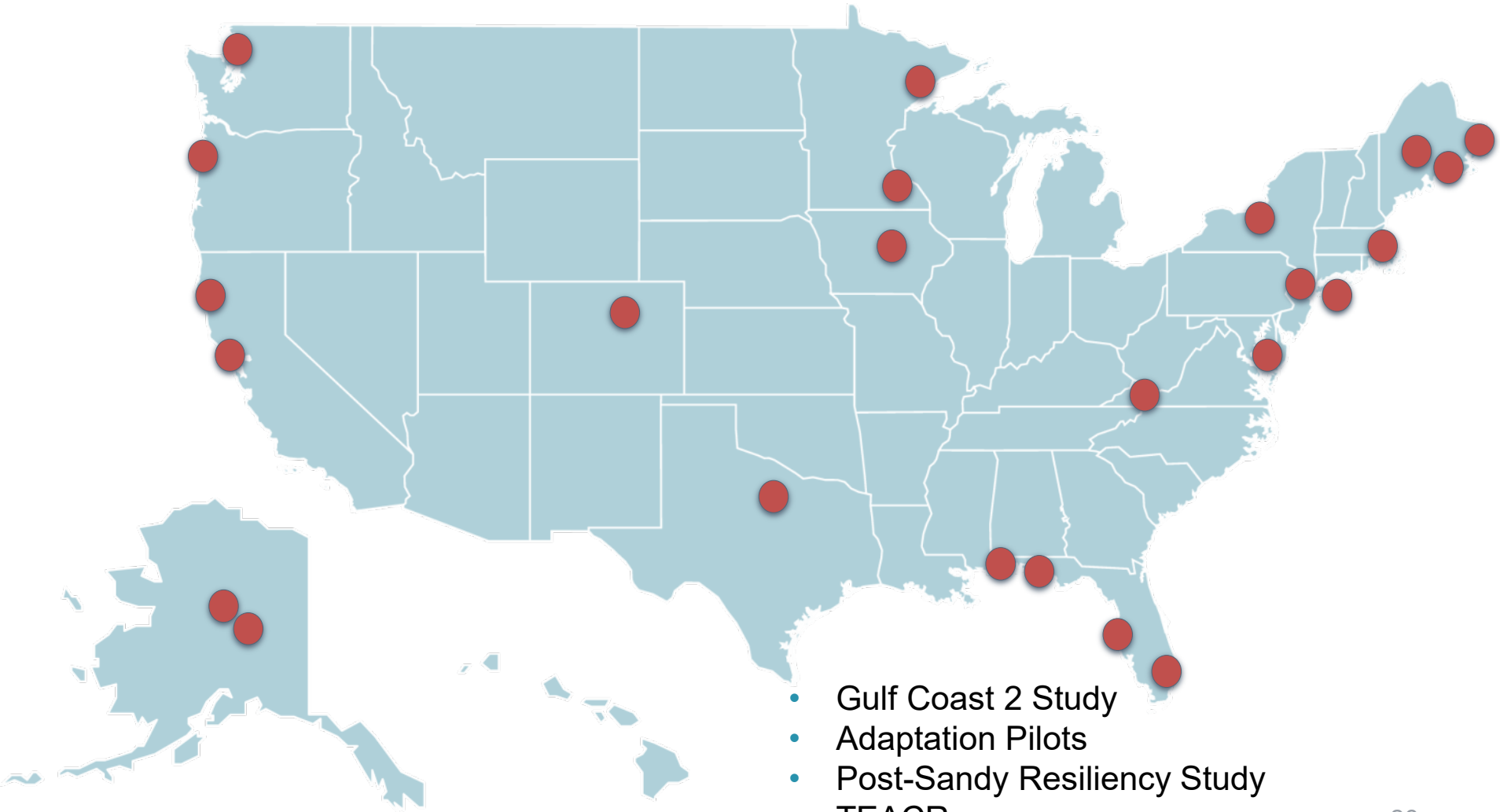
- **Structural** (e.g. armoring, raise road, widen culvert, pavement materials)
- **Natural features**: (e.g. wetlands, dunes)
- **Nature-based features**: built in coastal areas by acting in concert with natural processes (e.g. wetland restoration, artificial reefs, beach nourishment)
- **Non-structural** (e.g. land use policies, infrastructure siting, insurance policies)

Rock revetment, Photo credit: Tina Hodges

Concept for protecting Bay Bridge, Oakland, CA, Credit: MTC

Approaches to Integrating Resilience in Project Design

Engineering-Focused Case Studies



- Gulf Coast 2 Study
- Adaptation Pilots
- Post-Sandy Resiliency Study
- TEACR

TEACR Engineering Case Studies

Assessments:

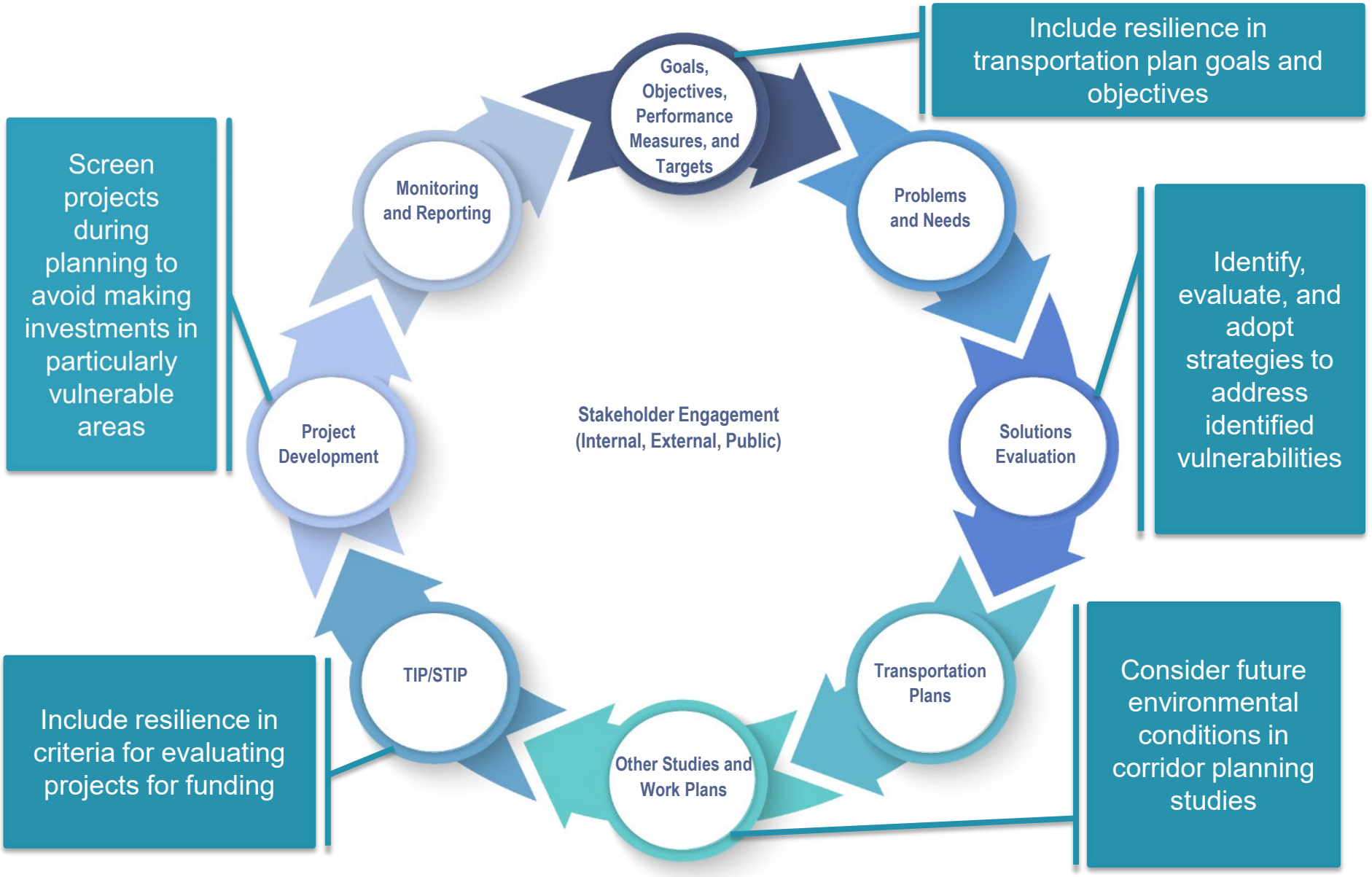
- I-10 Bridge and wave action (AL)
- Living shoreline and sea level rise (NY)
- Pavement overwashing (FL)
- Pavement and drought (TX)
- Precipitation and slope stability (VA)
- Forest fire and debris loading (CO)
- Pavement and freeze-thaw (ME)
- Pavement, permafrost thaw (AK)
- Economic Analysis (ME)

FHWA Post-Hurricane Sandy Transportation Resilience Study

- Damage/disruption assessment based on recent storms
- System-level vulnerability and risk assessment
- Subarea vulnerability and risk assessment; one each in CT, NY, and NJ
- Facility-level engineering informed assessments

For more information see: https://www.fhwa.dot.gov/environment/sustainability/resilience/publications/hurricane_sandy/fhwahep17097.pdf

Transportation Planning Process



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Rock revetment, Photo credit: Tina Hodges

Concept for protecting Bay Bridge, Oakland, CA, Credit: MTC

Approaches to Incorporating Resilience into Emergency Response

1. Prior to disasters, ensure transportation plans and asset management plans include resilience.
2. Ensure State has completed evaluation of facilities repeatedly requiring repair, as required by 23 CFR 667.
3. When developing Detailed Damage Inspection Reports (DDIR), discuss the cause of the asset failure and likelihood of recurrence. Discuss potential for resilience improvements.
4. Develop and review cost effectiveness analyses for betterments.
5. After the emergency event, ensure the DOT updates the 667 evaluation.
6. Share best practices with other States through FHWA's ongoing technical assistance and information sharing webinars, case studies, and trainings.

23 CFR 667 – Periodic Evaluations of Damaged Facilities

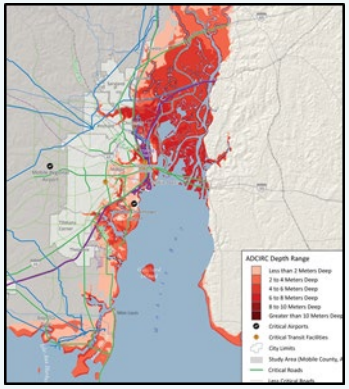
- States to evaluate alternatives to mitigate damage to roads and bridges repeatedly repaired due to emergency events
- All NHS roads, highways, and bridges (Nov 23, 2018)
- All roads, highways, and bridges (including non-NHS) evaluated prior to inclusion in a STIP (Nov 23, 2020)

April 2017 flooding in Washington State, Credit: WSDOT

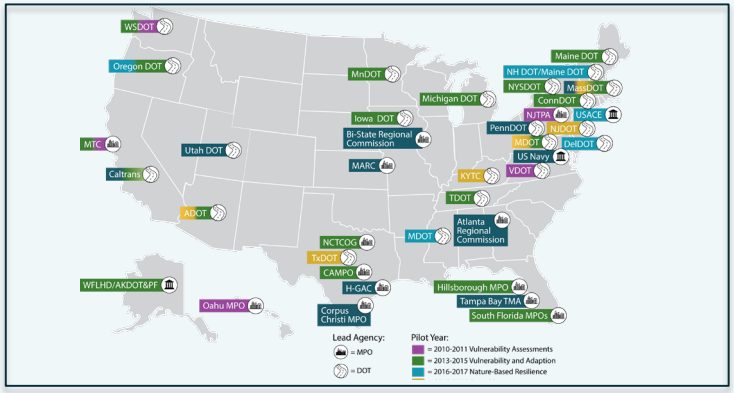
Q&A: https://www.fhwa.dot.gov/programadmin/23cfr667_qa.cfm

FHWA Resilience Resources

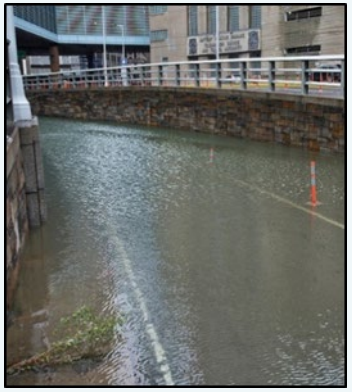
Gulf Coast 2 Study



Resilience Pilots with State DOTS & MPOs



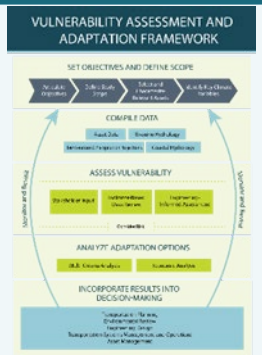
Hurricane Sandy Project



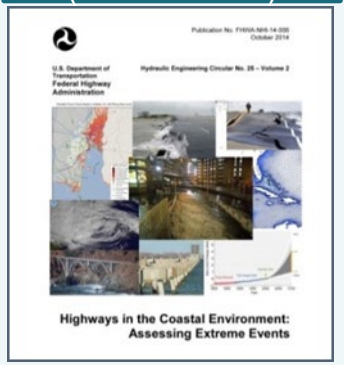
Engineering Assessments Study

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

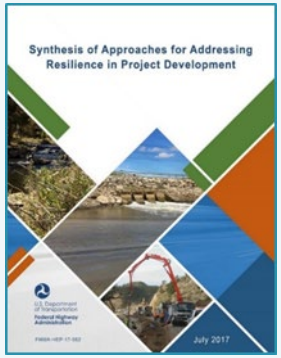
Vulnerability & Adaptation Framework



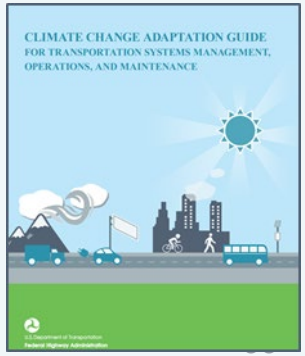
Engineering Guidance (HEC-25 & 17)



Project Development



Operations & Maintenance



Guidebooks under development on integrating resilience in:

- Asset Management
- Transportation Planning
- Nature-based solutions