National and State Perspectives: **Considering Climate is Responsible Asset Management**

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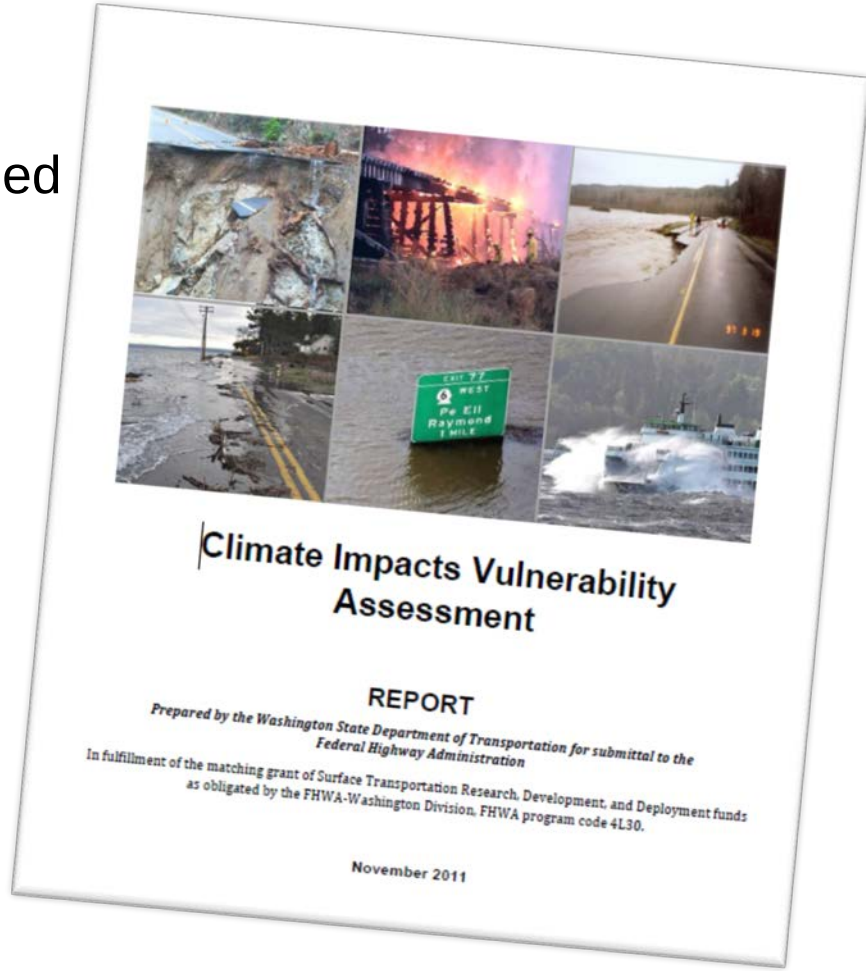
2017 Resiliency Peer Exchange on Extreme Weather and Climate Impacts
Washington, DC
November 6, 2017

Key Questions

- What resources are out there for transportation agencies?
- How have national pilot projects helped shape our path forward?
  - Examples from WA State
  - Inspiration from other states
- Is partnering important?
- What are WSDOT's next steps to integrating climate resilience into decision making?



Climate Impacts Vulnerability Assessment

REPORT

Prepared by the Washington State Department of Transportation for submittal to the Federal Highway Administration

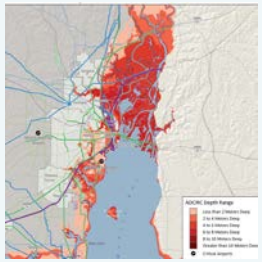
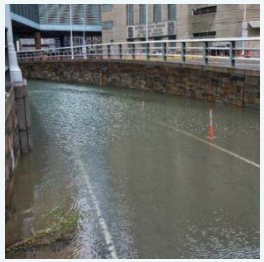
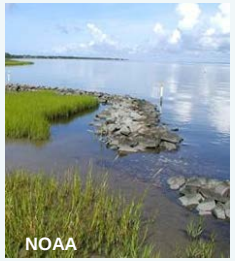
In fulfillment of the matching grant of Surface Transportation Research, Development, and Deployment funds as obligated by the FHWA-Washington Division, FHWA program code 4L30.

November 2011

FHWA Snapshot – Lots of Resources Available

WSDOT #2

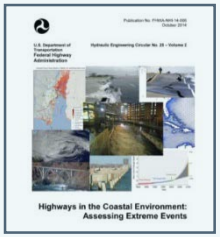
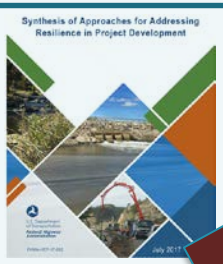
Research

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

Resources

WSDOT #1

WSDOT #3

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

2017 Synthesis is a must read!

Fall 2017: FHWA's Resilience Webinar Series

1. Addressing Resilience in Project Development (Sept 28)
2. Lessons Learned in Transportation Engineering Related to Coastal and Riverine Flooding (Oct 5)
3. Lessons Learned in Transportation Engineering Related to Pavement/Soils & Mechanical/Electrical Vulnerabilities (Oct 12)
4. Post-Hurricane Sandy Transportation Resilience Study in NY, NJ, and CT (Oct 26)
5. Green Infrastructure Pilots I (Nov 2)
6. Green Infrastructure Pilots II (Nov 9)
7. FHWA's Climate Change & Extreme Weather Vulnerability Assessment Framework (Nov 16)

Webinar signup info:
https://www.fhwa.dot.gov/environment/sustainability/resilience/webinars/

Print

Resilient and Sustainable Transportation Systems Program

Products & Programs

- State-by-State Interactive Map
- Extreme Weather 101 Briefs
- Extreme Weather Sessions
- Extreme Weather Events Symposium 2013
- Workshop on Adapting Infrastructure to Extreme Weather Events, 5/20/12
- National Climate Change Symposium (2010)
- Climate Change Adaptation Strategies Workshop, 11/17/10
- State DOT Climate Change Workshops
- Webinar Series

State-by-State Interactive Map

Overview and Resources

Steering Committee Meeting Materials

Products & Programs

Climate Change Briefing Newsletter

Climate Change Mitigation/Adaptation State-by-State Interactive Map >

Related Resources

- Federal Agencies
- State Agencies

Pacific NW Research & Resources

CLIMATE CHANGE

Observed Changes in the Climate

Global Observations

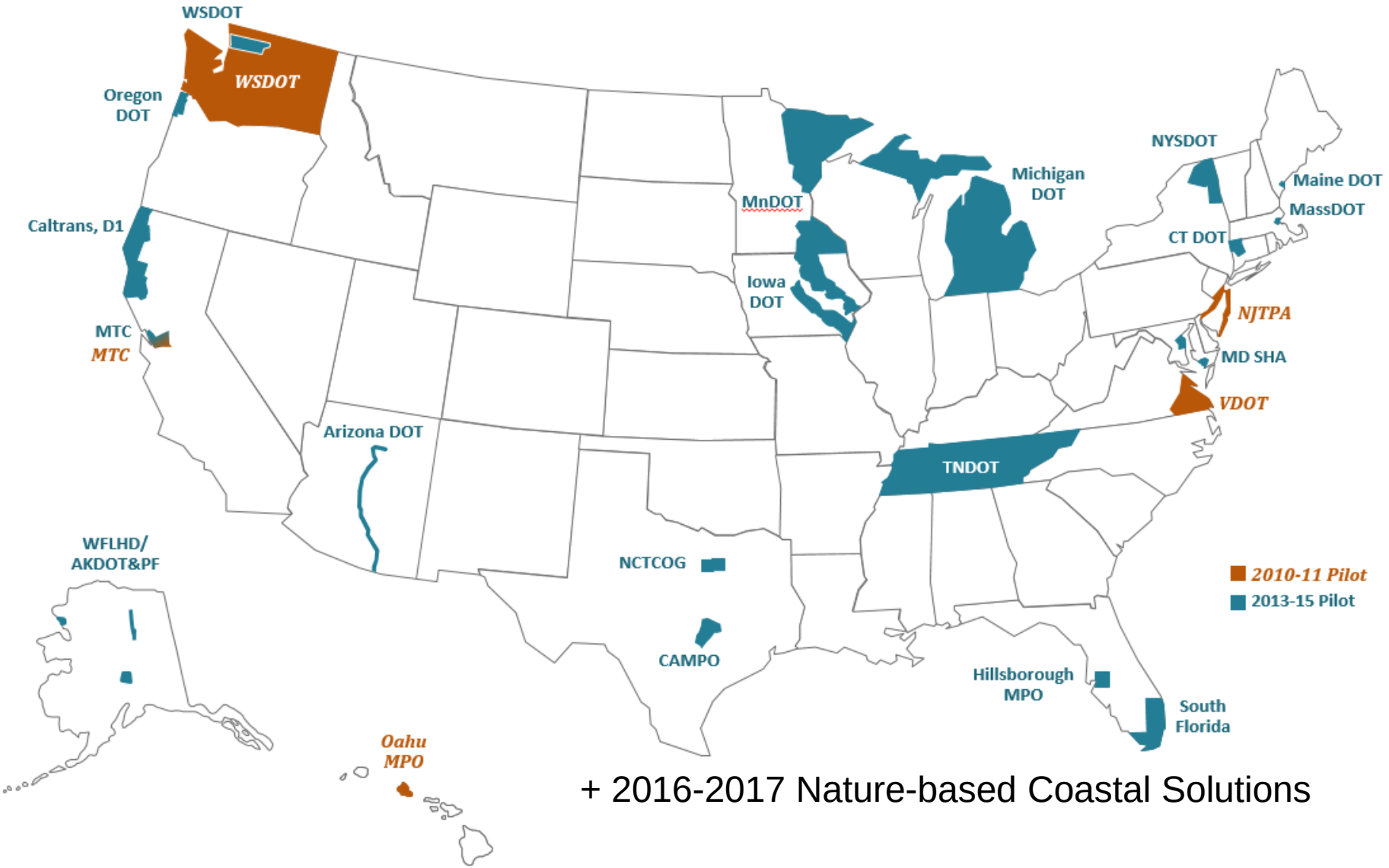
Observations of global temperatures spanning longer than a century indicate that the Earth has warmed by 1.5°F on average between 1880 and 2012 (Figure 1). Warmer temperatures are not limited to the atmosphere; ocean surface waters (top 250 ft.) warmed by +0.6 to +0.9°F from 1971 to 2009 (global

CLIMATE VARIABILITY
CLIMATE CHANGE
CLIMATE IMPACTS IN BRIEF

OUR WORK

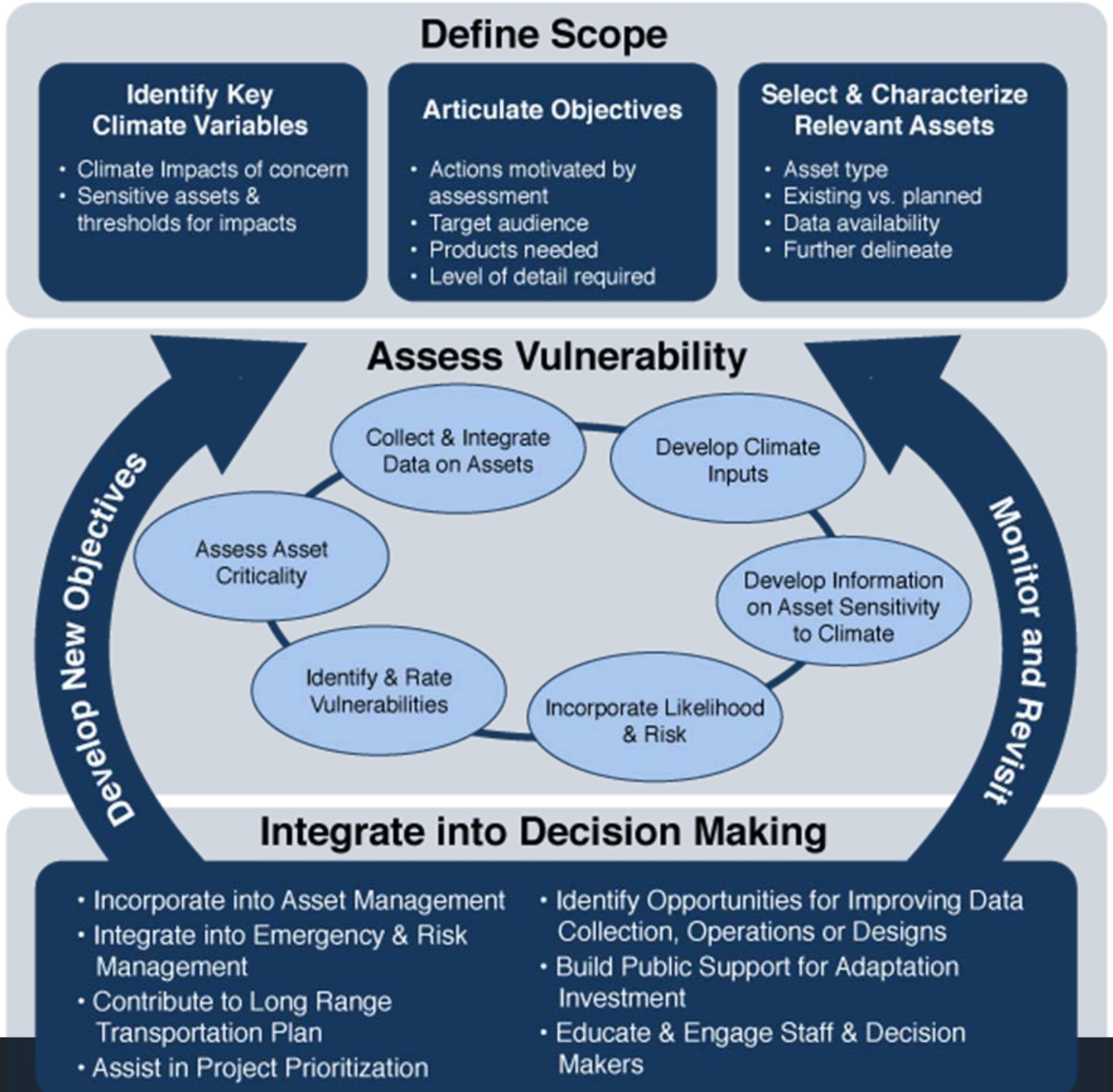
Learn more about the Climate Impacts Group's current

FEDERAL HIGHWAYS CLIMATE PILOT PROJECTS



+ 2016-2017 Nature-based Coastal Solutions

FHWA's FRAMEWORK
(updated following pilots)



WSDOT's CLIMATE VULNERABILITY ASSESSMENT: KEY FACTS

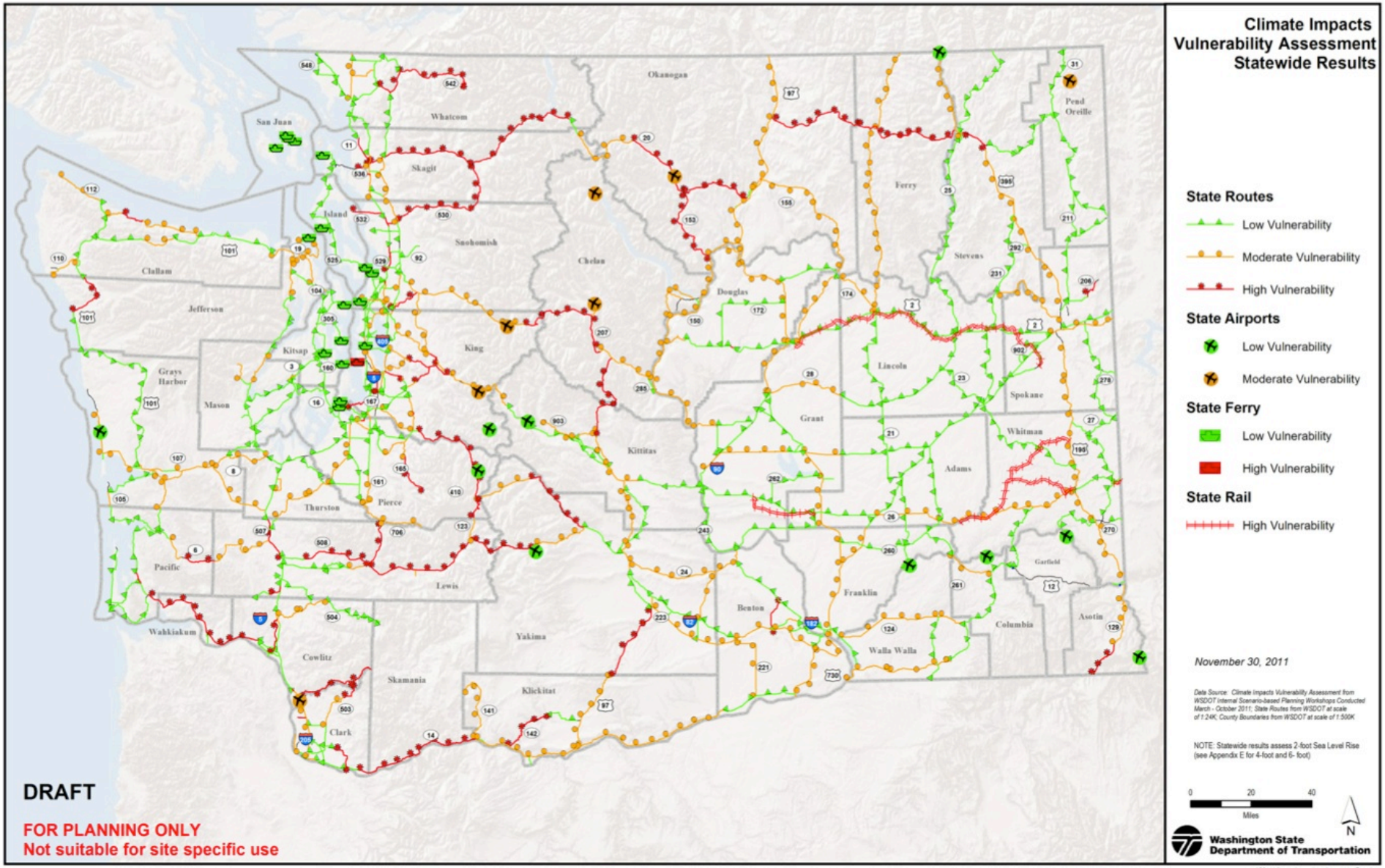
- Only statewide test of FHWA's framework
- Qualitative rankings for all state-owned assets
  - State highway & interstate routes, ferry terminals, freight rail lines, state-managed airports
- Relied on:
  - Climate change science from UW Climate Impacts Group (CIG)
  - WSDOT's Asset Management approach
  - Field personnel intimate knowledge
- 14 Workshops, 200 people were asked:
  - **What keeps you up at night?**
  - **What if it gets worse?**
  - **How resilient are your assets?**

What did we find?

- Climate change will intensify known threats to all transportation assets
- Reinforces value of our current maintenance and retrofit programs
  - Fish passage barrier corrections
  - Slope stability projects
  - Stormwater retrofits
- New awareness of combinations of climate risks / extreme events
- Considering climate ***is*** responsible asset management

STATEWIDE RESULTS

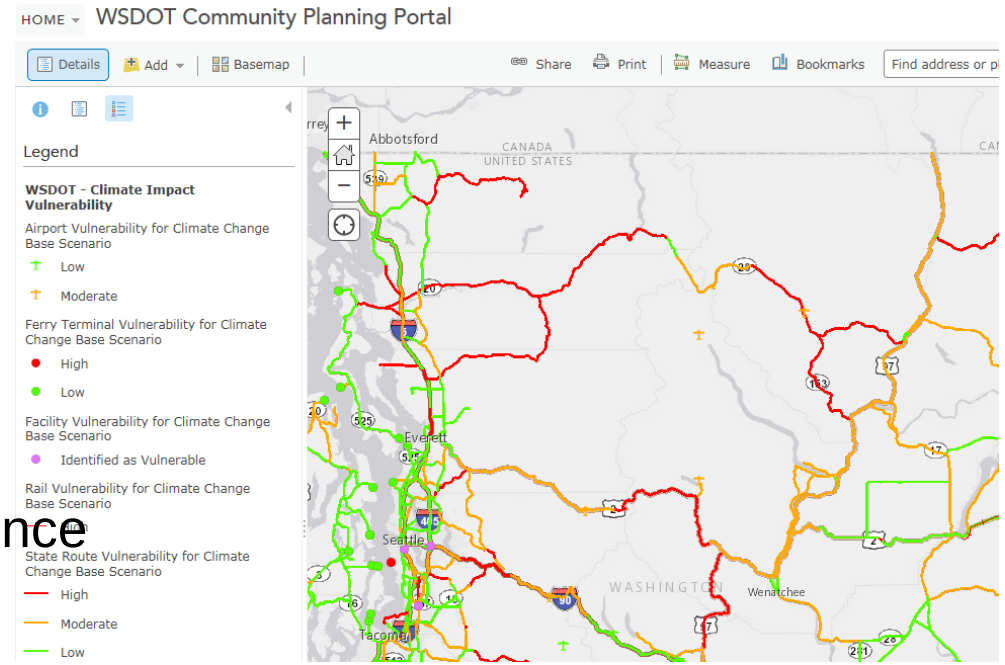
(map shows results with 2 foot sea-rise & all other threats)



Incorporating climate into WSDOT plans and projects

- Agency commitment to use the results of the vulnerability assessment
- Design and Environmental guidance for project teams
  - I-5 JBLM
  - Mukilteo Multimodal
  - SR 167 Completion

- Corridor plan guidance
- Emergency management
- Communicate & educate
- Collaborate
- Track best available climate science



http://www.wsdot.wa.gov/planning/community/WSDOTCommunityPlanningPortal.htm

Co-Benefits: Highlight current practices that are effective adaptation strategies

Before: old culverts obstruct fish passage

After: WSDOT project removes barrier and restores access to fish and wildlife habitat

Also:

- Habitat connectivity
- Slope Stabilization
- Stormwater Flow Control
- Roadside Vegetation Management

WSDOT Update




2017 – 2019 Work Plan Items

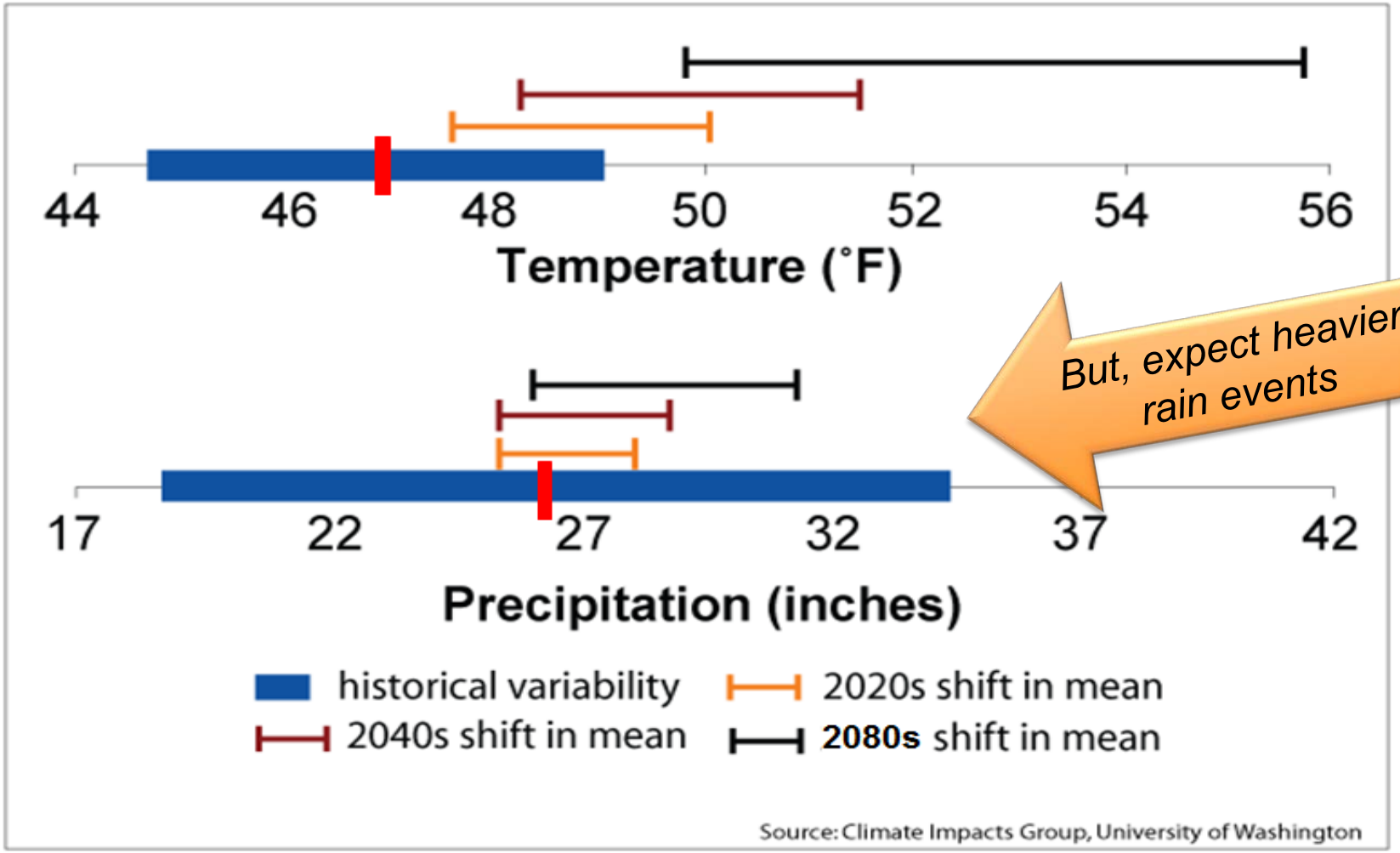
- Hydraulics & Environmental Offices guidance
  - Studied implications of WDFW 2016 research report “Incorporating Climate Change into design of Water Crossing Structures”
  - Continue to expand use of WSDOT’s statewide Climate Impacts Vulnerability Assessment (CIVA)
    - Hydraulics Office updated design approach to include a step for “highly vulnerable”
    - Issued climate guidance for WSDOT planners (***new*** for corridor sketches and plans)
    - Updated NEPA/SEPA project guidance (required for EIS and EA’s)

- Environmental Office and Olympic Region’s SR 167 Project team collaborating with FHWA and The Netherlands
  - Pilot project funded by FHWA to:
    - Test climate assessment tools and review new guidance (HEC-17)
    - Exchange info on innovations, use of nature-based solutions (SR 167’s riparian restoration)

- Asset Management Planning (23 CFR 667) & State Hazard Reduction Planning

Pacific Northwest Climate Science 2009 & 2013

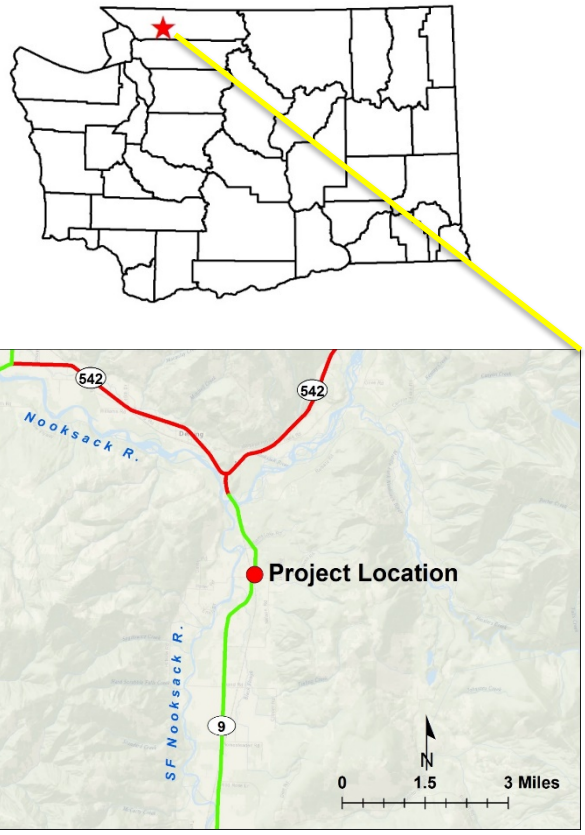
Changes Relative to the 20th Century



How resilient are our current fish passage designs?

Tributary to Tawes Creek

12 foot box culvert design using WSDOT's 5 steps compared to calculations using WDFW's approach (*)



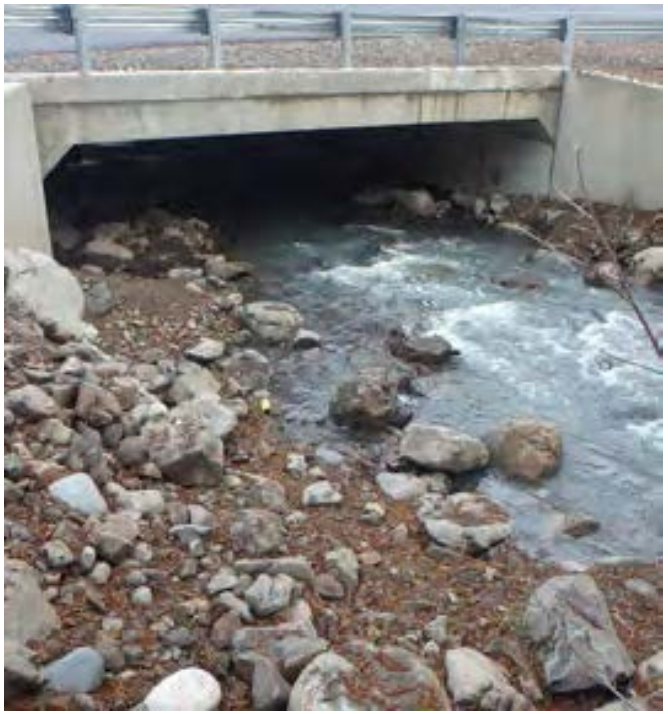
Actual BFW measured	7.1 feet
2040 predicted BFW*	7.6 feet
2080 predicted BFW*	7.8 feet
100-year flow	115 cfs
500-year flow	145 cfs
2040 predicted flow*	136 cfs
2080 predicted flow*	145 cfs
Stream-sim	12 feet
2040 Stream-sim*	11.1 feet
2080 Stream-sim *	11.4 feet
Final Structure Size	**12 ft culvert**

Results for 4 fish passage project designs

Other factors

	Trib to Tawes Creek	Grovers Creek	Olsen Creek	Gribble Creek
Measured BFW (FT)	7.1	8.8	24	11
2040 predicted BWF (FT)	7.6	9.4	26.3	11.8
2080 predicted BFW (FT)	7.8	9.6	27	12.9
100-yr flow (CFS)	115	58.9	306	130
500 -yr flow (cfs)	145	76.5	410	177
2040 predicted flow (CFS)	136	73.8	351	129
2080 predicted flow (CFS)	145	82.5	379	141
Stream-sim/bridge design (FT)	12	12.6	32	16
2040 Stream-sim/bridge design (FT)	11.1	13.3	34.7	17
2080 Stream-sim/bridge design (FT)	11.4	13.5	36	18
Final Structure Size (5 steps)	12-foot box culvert	13-foot box culvert	45-foot bridge	19-foot box culvert

Resilience of barrier corrections: **before and after**



WSDOT's new culvert (right) on State Route 129 allows fish to access habitat upstream of the old barrier (left) on Rattlesnake Creek.

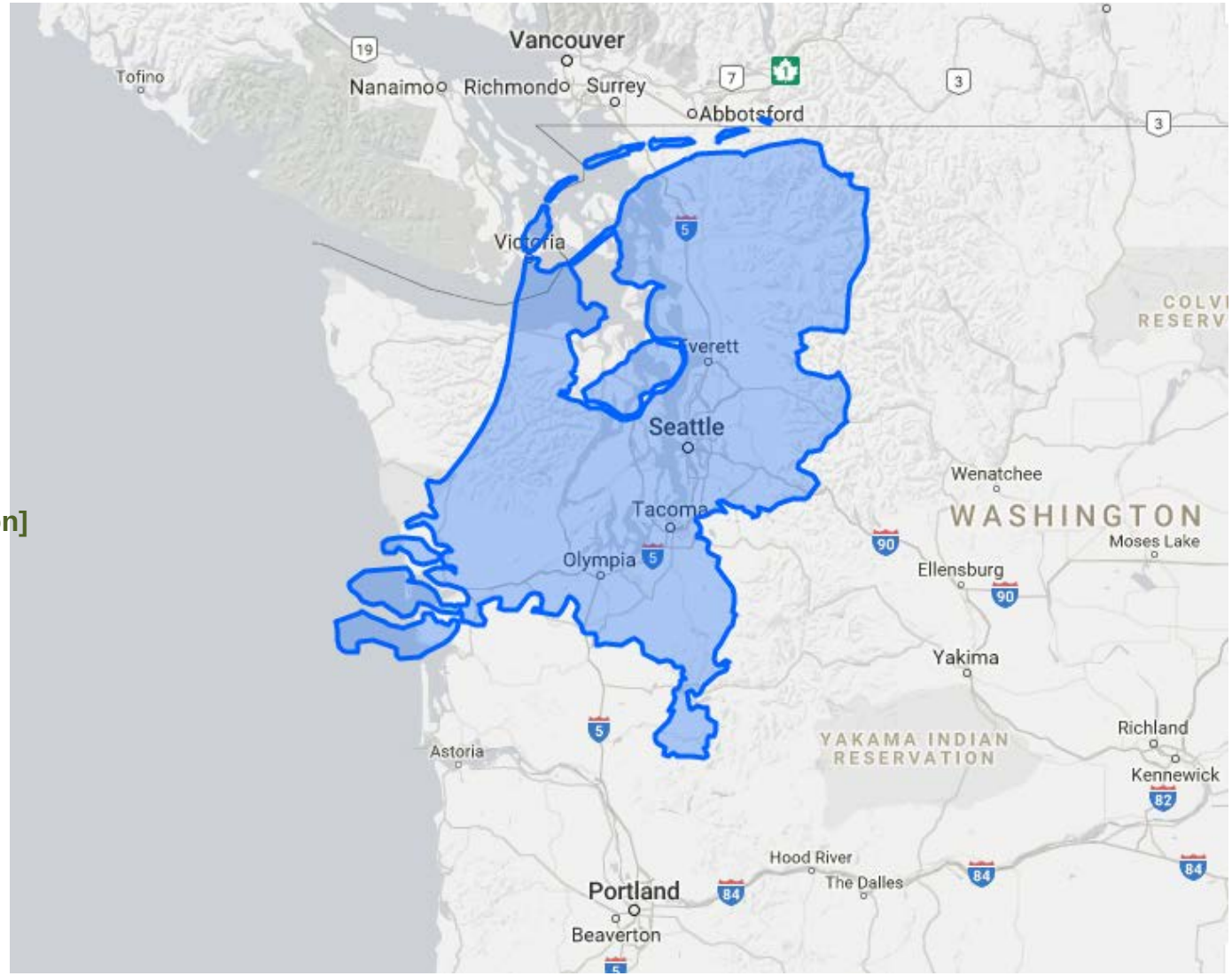
The Netherlands

Population:
17 Million
[7 Million]

Area:
16,000 sq mi
[71,000 sq mi]

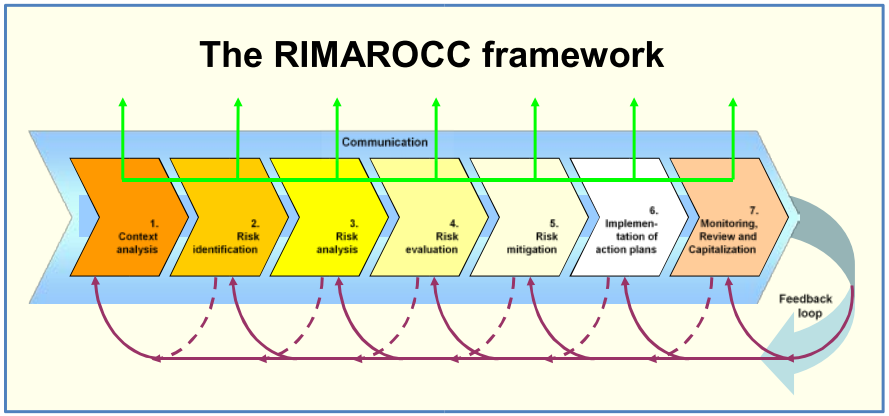
Public Roads:
86,000 miles
[82,000 miles]

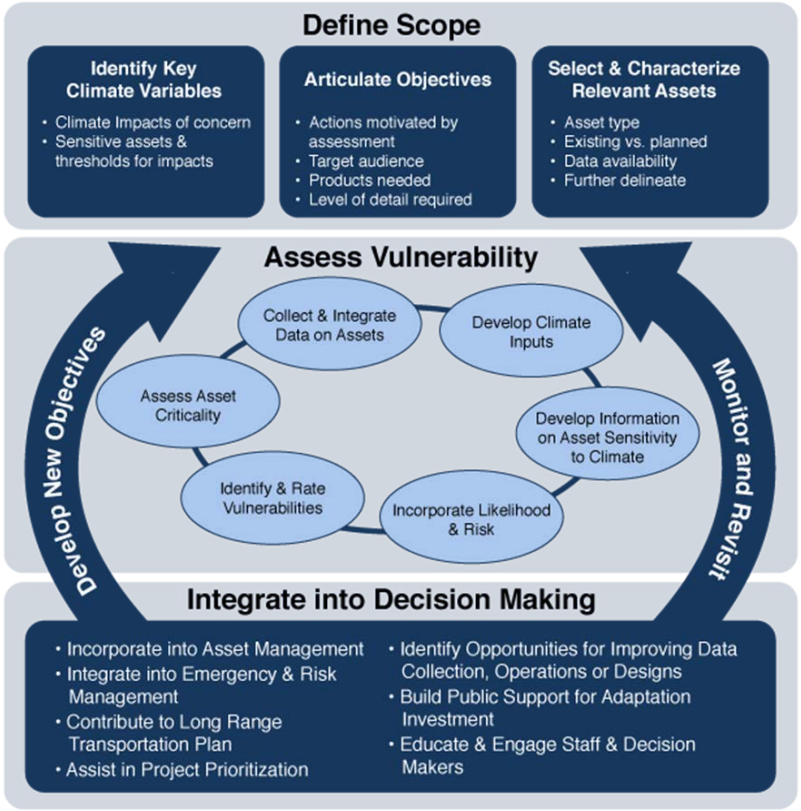
[WA State Comparison]



FHWA/RWS Pilot Project

Compare and Contrast EU's ROADAPT and FHWA's Climate Change and Extreme Weather Vulnerability Assessment Frameworks





Risk Management for Roads in a Changing Climate (above); FHWA's Framework (right)

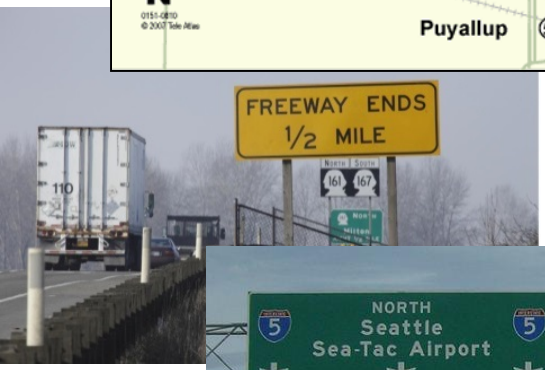
Test scalable approaches that allow analysis of transportation systems

Two highway projects:

SR 167 in Fife, WA and InnovA58, Holland

Projects on both sides

SR167 Tacoma, Washington State



InnovA58, South Netherlands

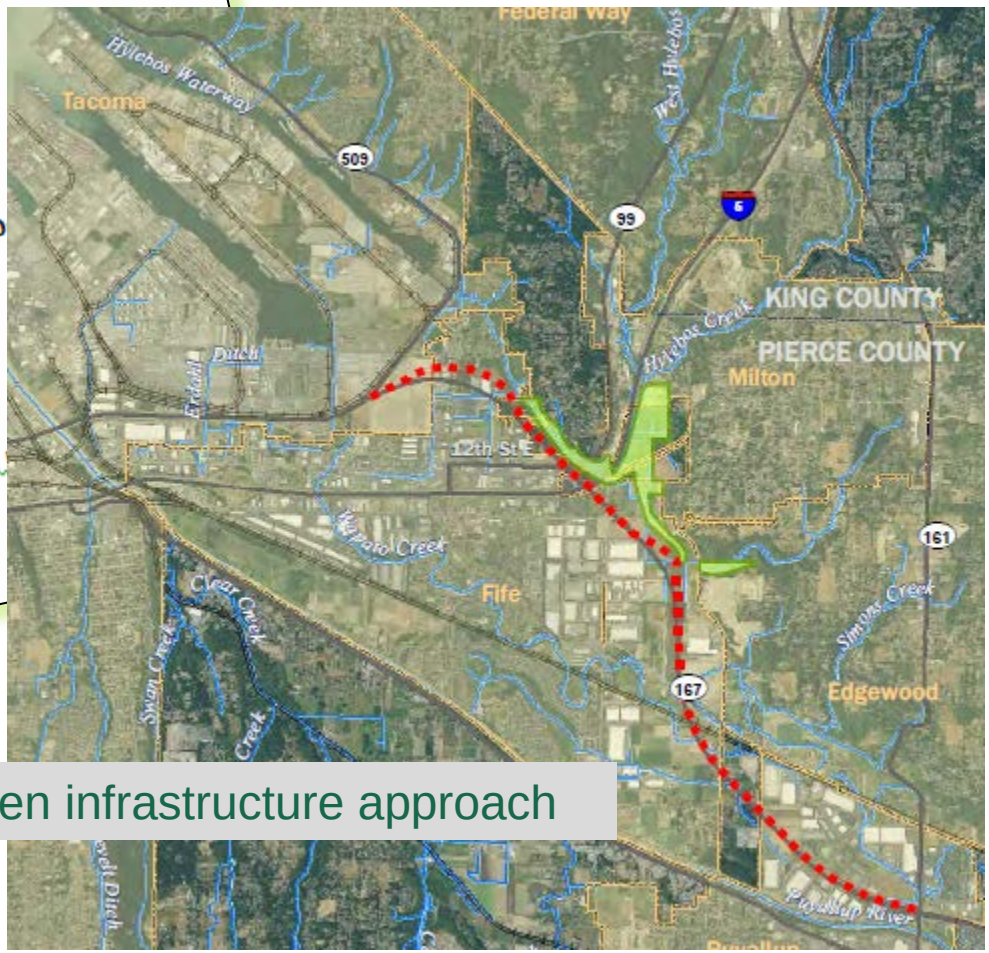
Credit: Angel Vlar, RWS

DRAFT

DISCUSSION PAPER: APPLICABILITY OF THE SR 167 COMPLETION PROJECT RIPARIAN RESTORATION PROGRAM AS AN ADAPTATION STRATEGY FOR CLIMATE RESILIENCE

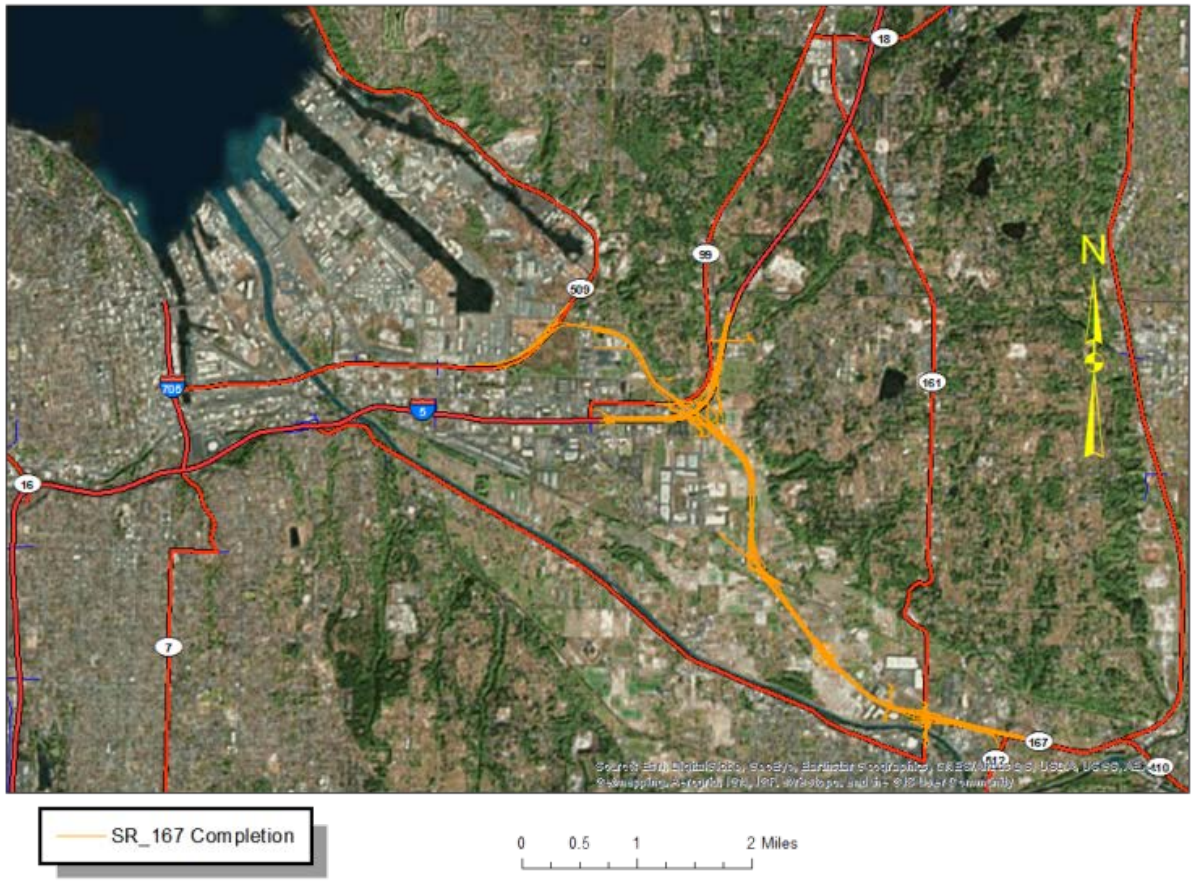
Prepared for
WSP | Parsons Brinckerhoff
and
Washington State Department of Transp

Prepared by
Herrera Environmental Consultants



Draft paper shows value of green infrastructure approach

Next Steps



- Update our manuals
- Collaborate with partners & researchers
- AASHTO & FHWA
- Pursue actionable science - like research on coastal and tidal projections

WSDOT Climate Change Contacts

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