HIGHWAY TO RESILIANCE

WSDOT Climate Adaptation

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Climate Change?

Fall, Winter, Spring

- Heavy rain events (more intense & more frequent)
- Increasing precipitation
- Increasing flood risk
- Increased soil saturation in winter
- Higher winter streamflows

Summer

- Decreasing summer precipitation
- Lower, warmer streamflows
- Longer summer low flow period

Annually

- Sea level rise

https://cig.uw.edu/resources/special-reports/

We Need to Act

We are designing projects that will have service lives that extend generations into the future.

> "More research uncovers a picture that is more complicated; thus, uncertainties can grow with time*…but these should not prevent those working on climate impacts, mitigation and adaptation from making decisions".*

An Isaac Cordal sculpture in Berlin: "Follow the Leaders" – politicians discussing climate change.

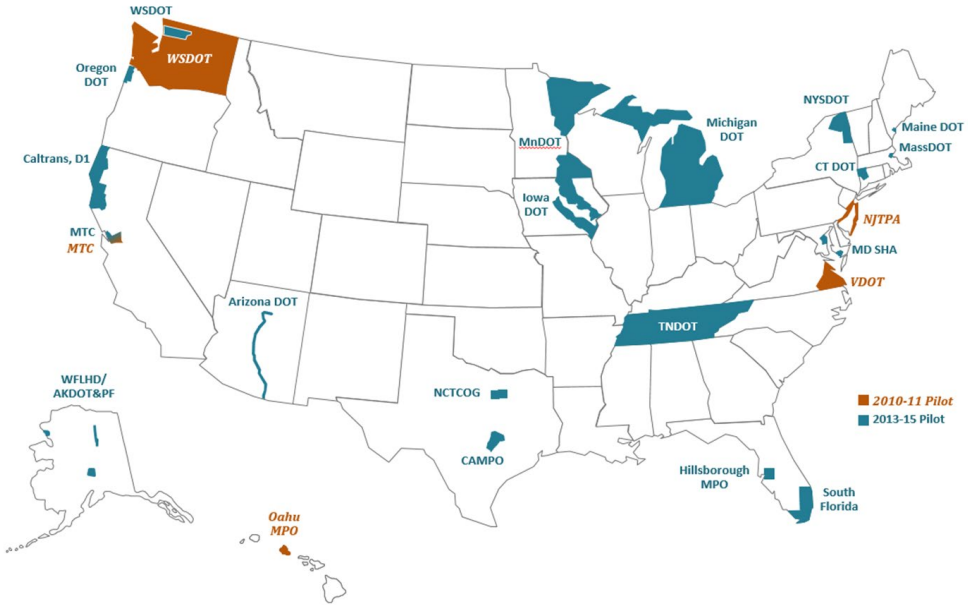
WSDOT Vulnerability Assessments

WSDOT has been leading the way, participating in three FHWA pilot programs to assess tools to identify climate vulnerability and identify adaptation strategies

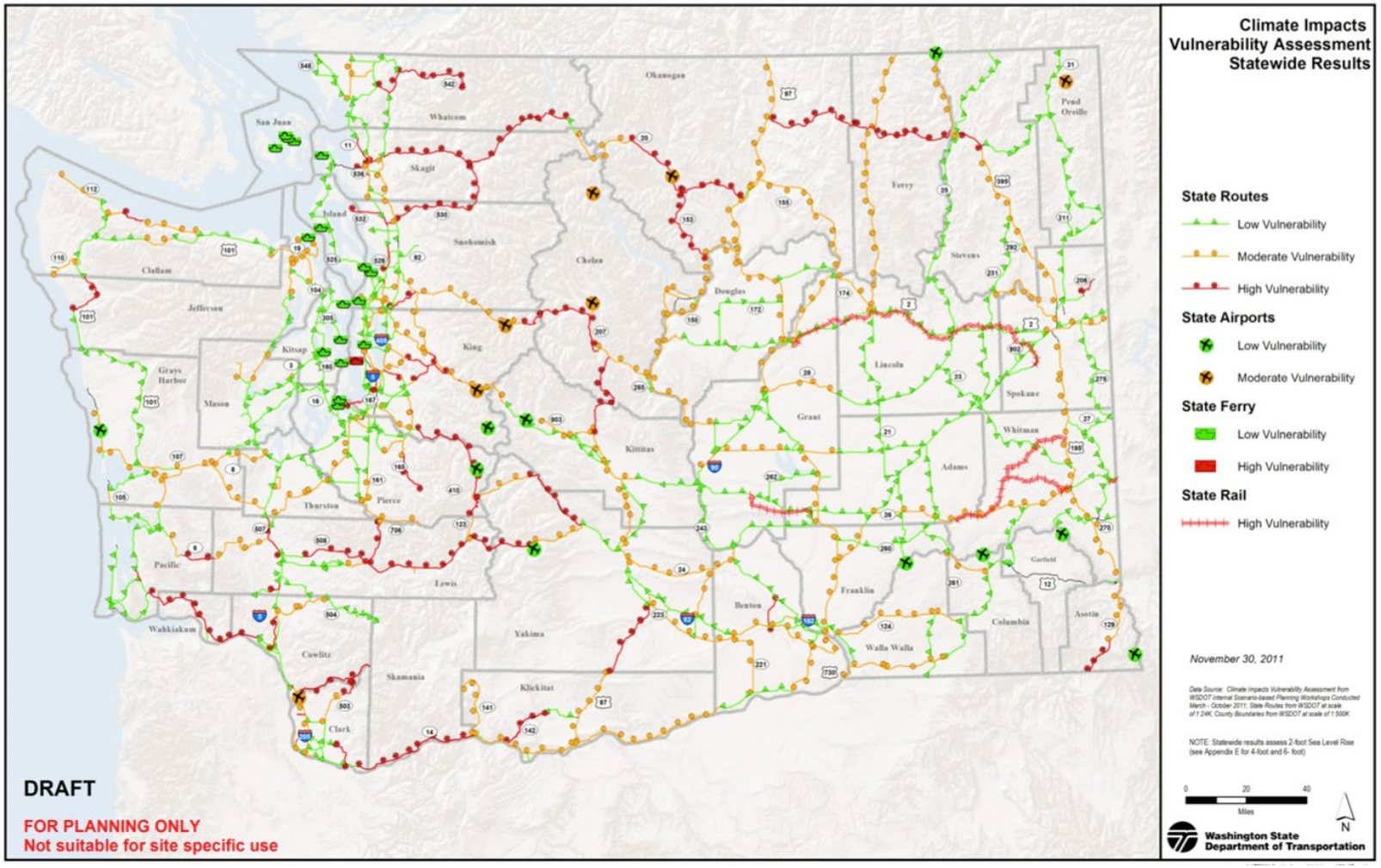
1. Statewide Climate Vulnerability Assessment

2. Skagit Basin Vulnerability Assessment

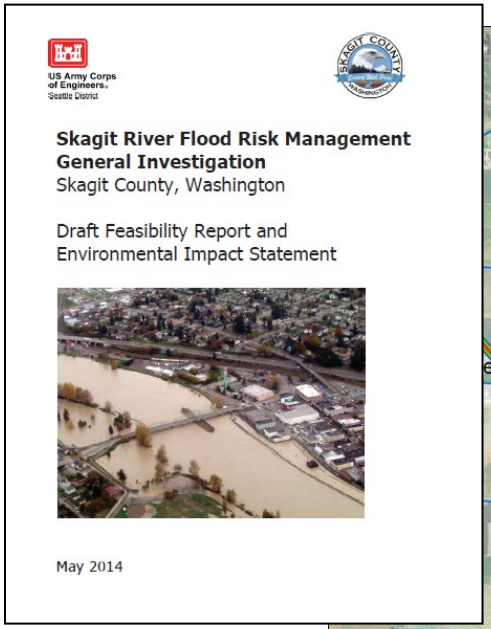
3. SR 167 Completion Project

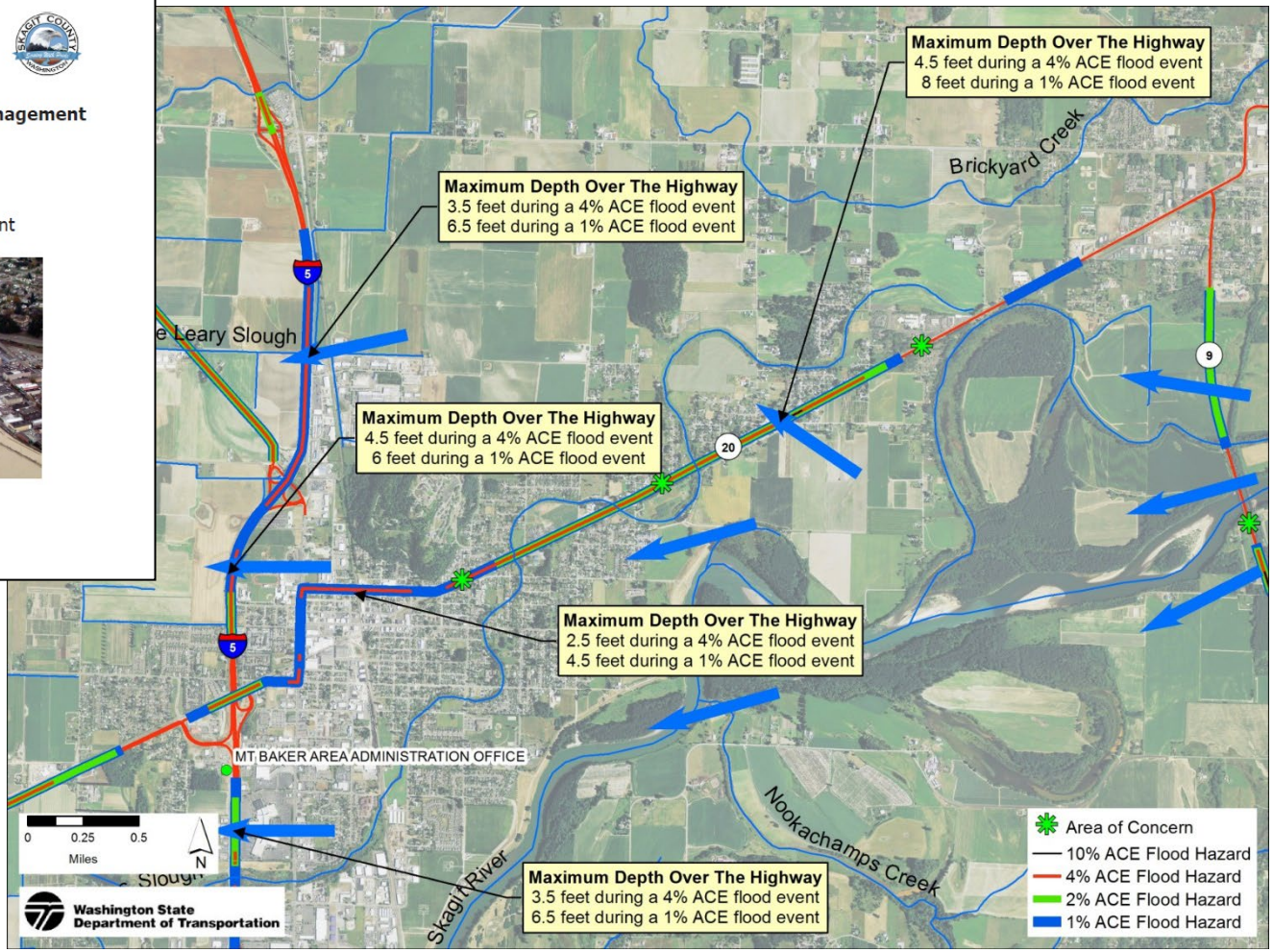


Statewide Climate Vulnerability Assessment



Skagit Basin Pilot

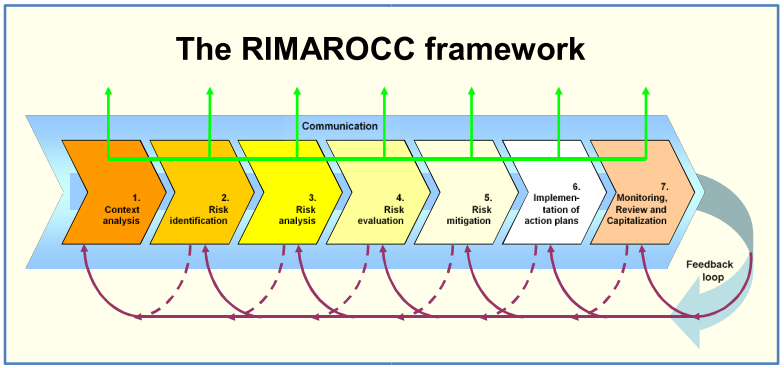


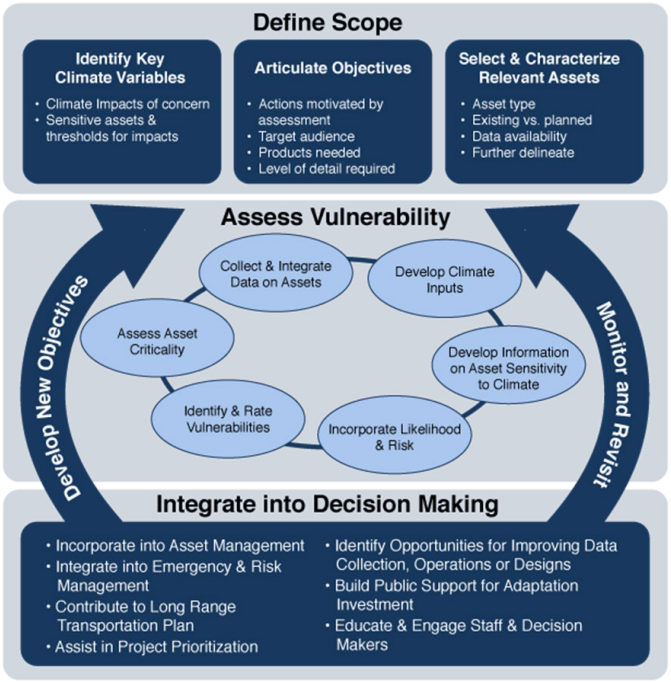


Used flood studies to inform and integrate adaptation strategies

SR 167 Completion Project Pilot

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





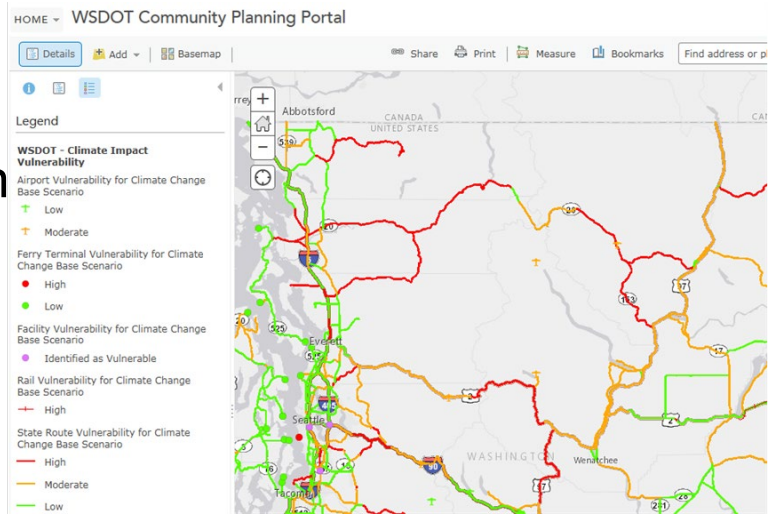
Risk Management for Roads in a Changing Climate; FHWA's Framework

- **Test scalable approaches that allow analysis of transportation systems**

- **Two highway projects: SR 167 in Fife, WA; InnovA58 in Holland**

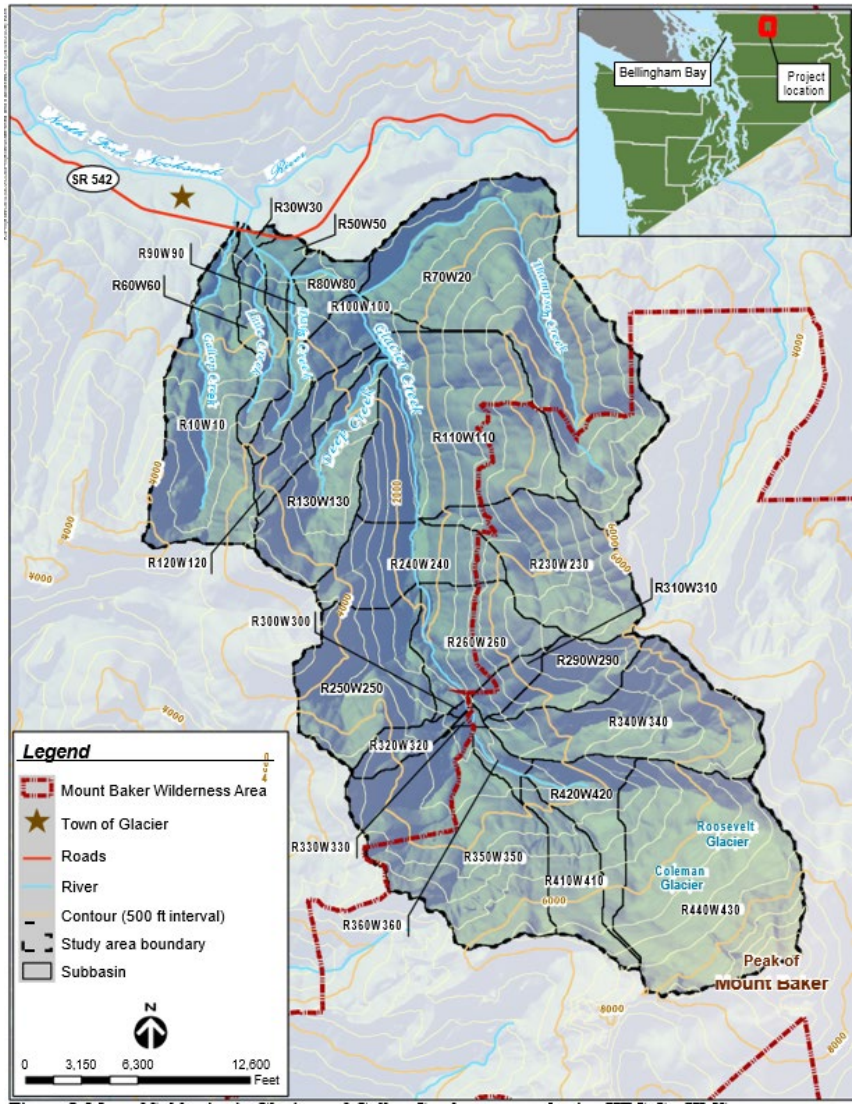
How are we incorporating climate into WSDOT plans and projects?

- Agency commitment to use the results of the vulnerability assessment (CIVA) in plans and projects
- Share with planning portal
- Asset Management Planning
- Emergency management coordination
- Use best available climate science
- Project-level NEPA & design



SR 542 Glacier Creek

- Investigate local climate change projections
- Revised HEC-HMS model to finer vertical steps for snow calculations
- Revised temperature time series to represent future conditions



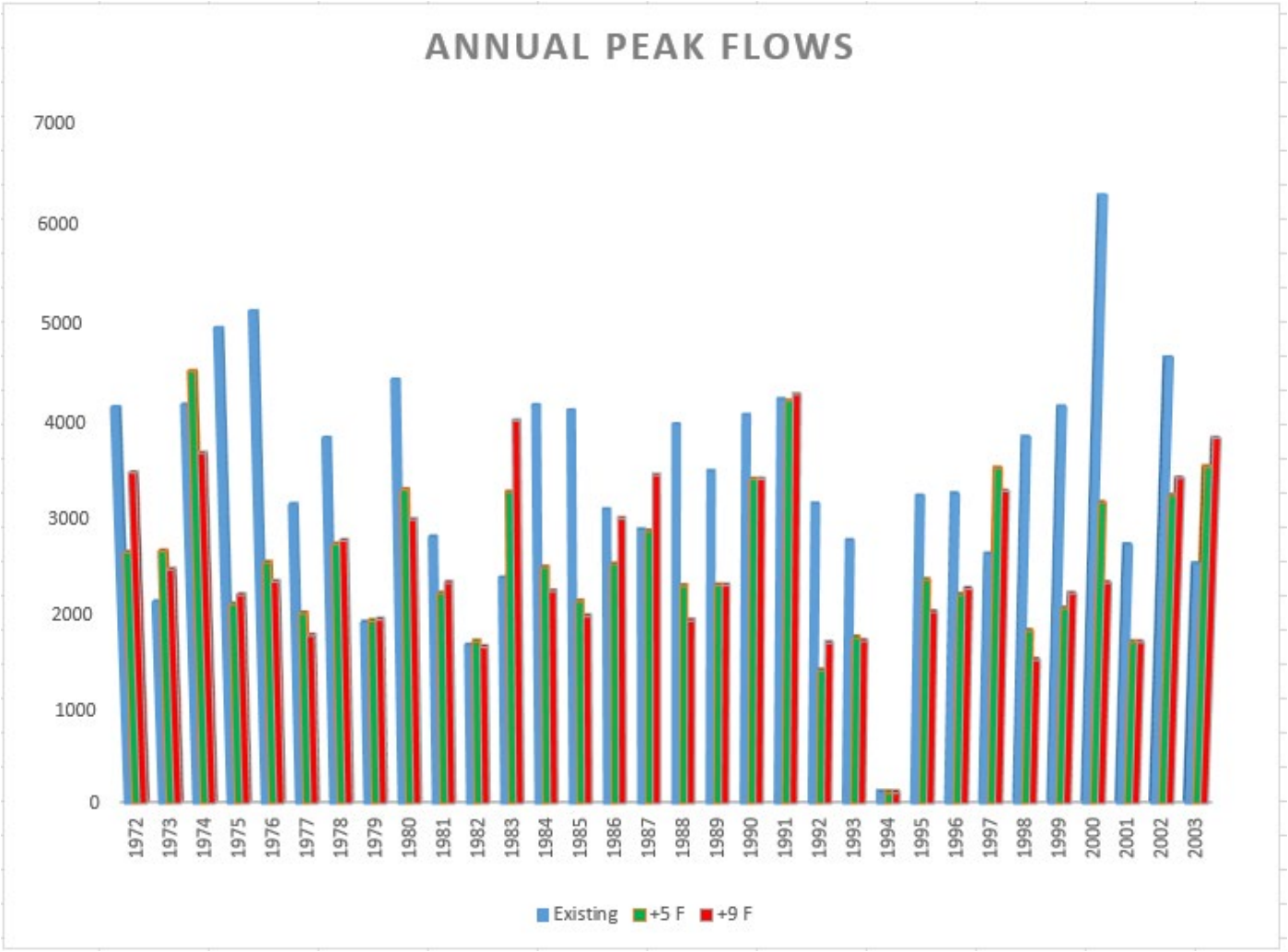
Herrera Environmental Consultants, Inc

SR 542 Glacier Creek – RI Flow

Glacier Creek Flow Statistics – USGS Regression and HEC-HMS under various temperature regimes

Statistic	Value	Unit	PII	PIu	SEp	HMS	HMS+5F	HMS+9F
2 Year Peak Flood	2620	ft^3/s	1330	5160	43.2	3431	2484	2452
5 Year Peak Flood	3910	ft^3/s	1940	7880	44.4	4385	3161	3174
10 Year Peak Flood	4770	ft^3/s	2340	9720	45.6	4959	3605	3656
25 Year Peak Flood	5850	ft^3/s	2760	12400	48.1	5634	4165	4274
50 Year Peak Flood	6620	ft^3/s	3030	16600	51.8	6105	4582	4741
100 Year Peak Flood	7460	ft^3/s	3350	16600	51.8	6553	5000	5215
200 Year Peak Flood	8270	ft^3/s	3580	19100	54.2	6984	5423	5699
500 Year Peak Flood	9370	ft^3/s	3890	22600	57.7	7533	5994	6360

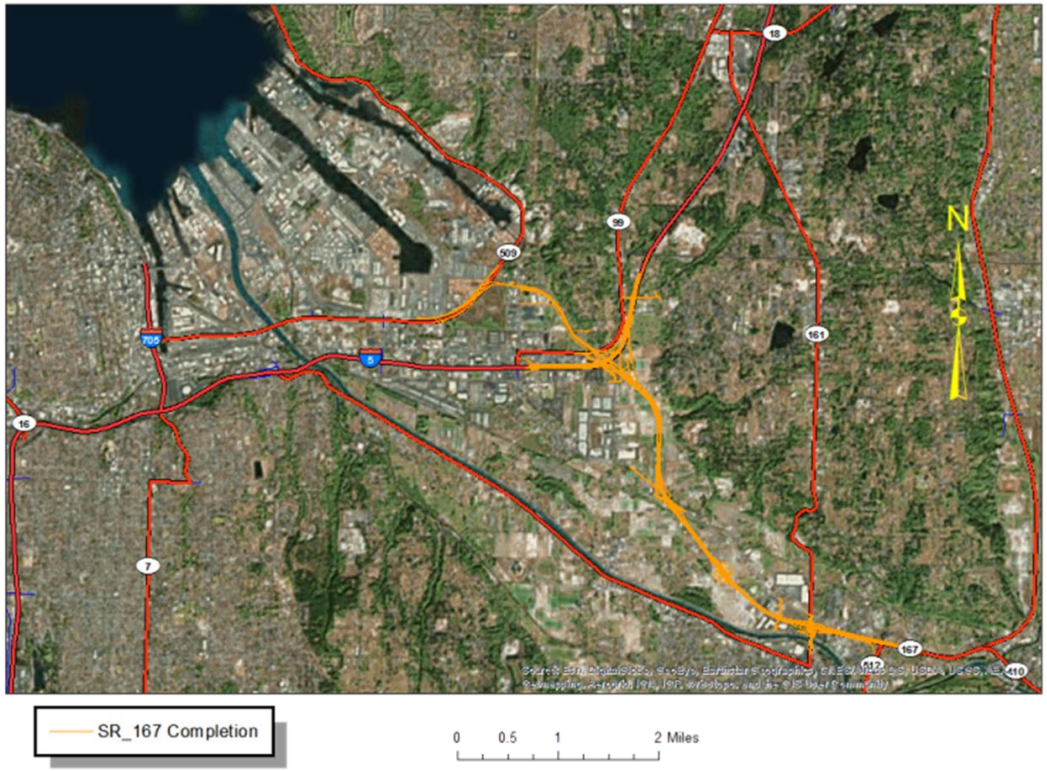
SR 542 Glacier Creek – Annual Peak Flows



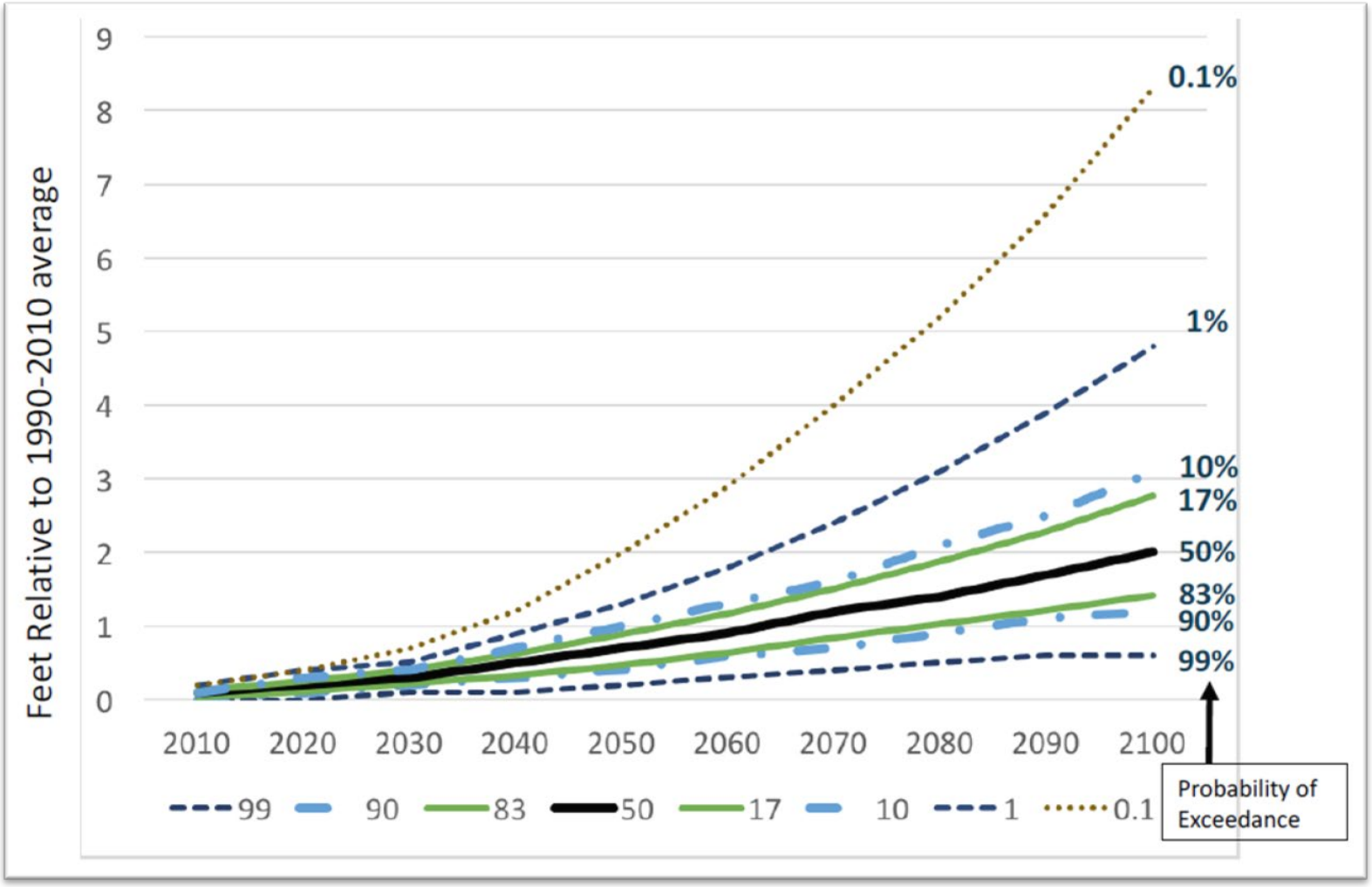
SR 167 Completion Project

Sea Level Rise – Assumed +2.2 feet

- Compared projected sea level changes
- Reviewed emerging products from academic institutions (Probabilistic relative sea level rise analysis – Washington Sea Grant/University of Washington)
- Revised hydraulic models to consider higher starting water surface elevations



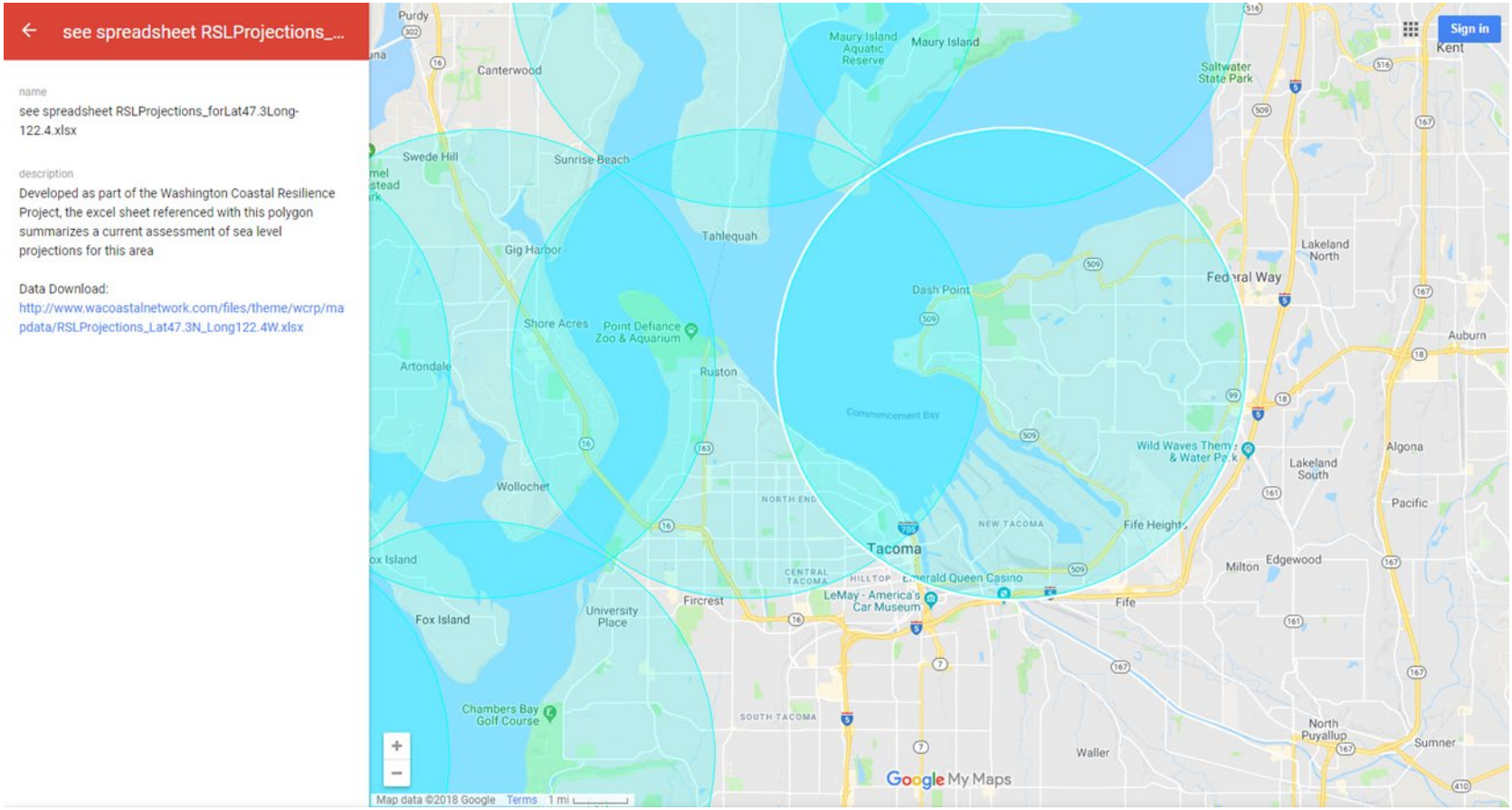
Projected Sea Level Rise - State



Mauger, G. et al 2018

Probalistic Relative Sea Level Rise - Local

Emerging tools from Washington Sea Grant



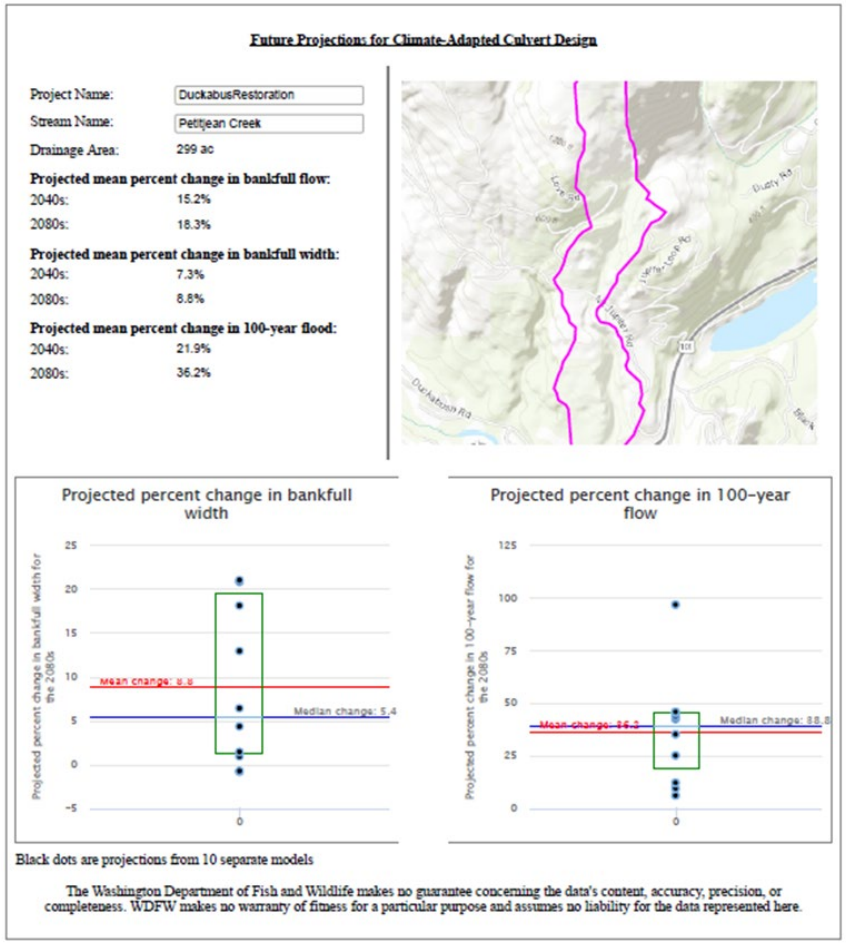
Projected Relative Sea Level Rise - Local

Table 1: Projected average sea level magnitudes, in feet, for different assessed likelihoods and time periods											
		Assessed Probability of Exceedance:									
19 year period centered on:		99	95	90	83	50	17	10	5	1	0.1
2010		0	0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3
2020		0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.5	0.5
2030		0.2	0.3	0.3	0.3	0.5	0.6	0.6	0.7	0.7	0.9
2040		0.3	0.4	0.4	0.5	0.7	0.8	0.9	1	1.1	1.5
2050		0.4	0.5	0.6	0.7	0.9	1.2	1.2	1.4	1.6	2.2
2060		0.5	0.7	0.8	0.9	1.2	1.5	1.6	1.7	2.1	3.2
2070		0.6	0.9	1	1.1	1.5	1.9	2	2.2	2.8	4.4
2080		0.8	1.1	1.2	1.4	1.8	2.3	2.5	2.8	3.5	5.7
2090		0.9	1.2	1.4	1.6	2.1	2.8	3	3.3	4.3	7.1
2100		1	1.4	1.6	1.9	2.5	3.3	3.6	4	5.3	8.8
2110		1.2	1.6	1.8	2	2.7	3.5	3.9	4.4	6	10.3
2120		1.4	1.8	2.1	2.3	3.1	4	4.5	5.1	7.1	12.5
2130		1.5	2	2.3	2.5	3.4	4.6	5.1	5.8	8.2	14.5
2140		1.6	2.1	2.5	2.8	3.8	5.1	5.7	6.5	9.3	16.7
2150		1.6	2.3	2.6	3	4.2	5.7	6.4	7.4	10.7	19.1

Fish Passage

Use WDFW Culvert Assessment Tool

- Use the 100-year 2080 projected flow change
- Reevaluate:
  - ✓ Minimum freeboad
  - ✓ Velocity ratio
  - ✓ Scour
- Make design changes if practicable
- Add additional freeboard for sea level rise if practicable



Helpful Information

WSDOT Climate Change and Transportation
https://wsdot.wa.gov/construction-planning/protecting-environment/climate-change-transportation

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

UW Climate Impacts Group
https://cig.uw.edu/

Washington Sea Grant – Coastal Hazards Resilience Network
https://wacoastalnetwork.com/