

Improving Salmon Access to Inland Habitat

While reducing risk to human safety and property

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A problem that can't be ignored



Culvert Case Decision A 'Win For Salmon' In Washington



What was once a concrete apron designed to help salmon navigate this culvert has since eroded into a sharp, jagged concrete lip that creates a hazard for fish as they try to move upstream.

A big court decision could open up new habitat for salmon in Washington and end up costing the state billions of dollars. The case stemmed from poor maintenance and design of road culverts, which can block fish passage upstream.

A panel of the 9th U.S. Circuit Court of Appeals Friday denied the state request to rehear the case. A lower court had ordered the state in 2011 to fix hundreds of road culverts.

High Country News

LATEST

Latest: Washington to restore salmon habitat blocked by culverts

The state has 15 years to comply.



The Seattle Times

Local News

Environment | Local News | Northwest | Puget Sound

Washington state loses big legal battle over salmon culverts

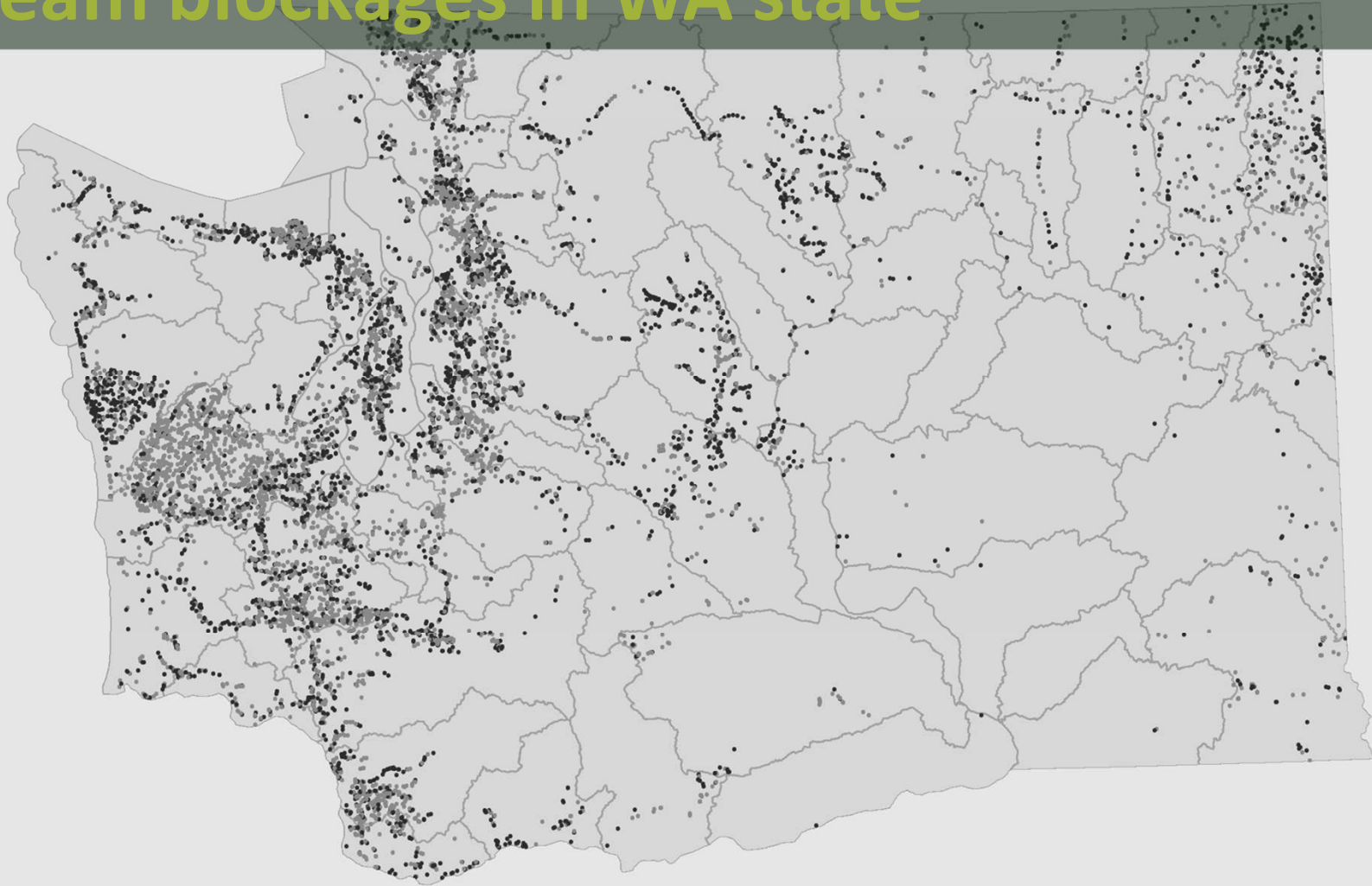


Wahkiakum tribal biologist Scott Rockwell leaves a culvert whose waters go to Mosquito Lake and can flow at rates too big for small salmon to negotiate. (Alan Berner/The Seattle Times)

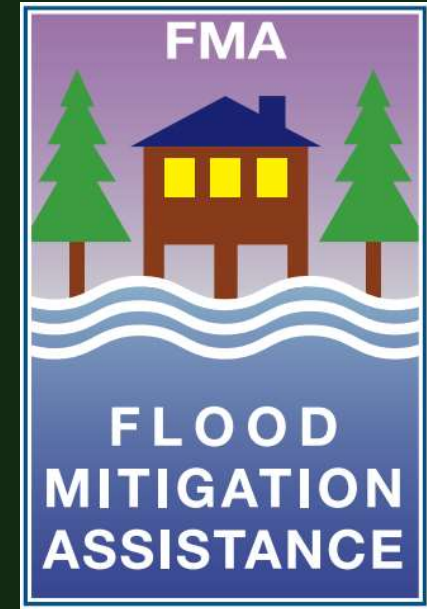
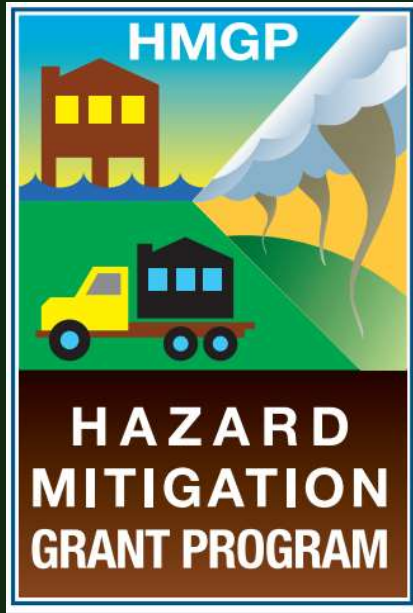
The 9th U.S. Circuit Court of Appeals decision Friday could force the state to pay \$2 billion to restore salmon habitat by removing barriers that block fish migration.



Stream blockages in WA state



FEMA Hazard Mitigation Assistance



Total FEMA funding for hazard mitigation was
\$5.1 billion in 2021



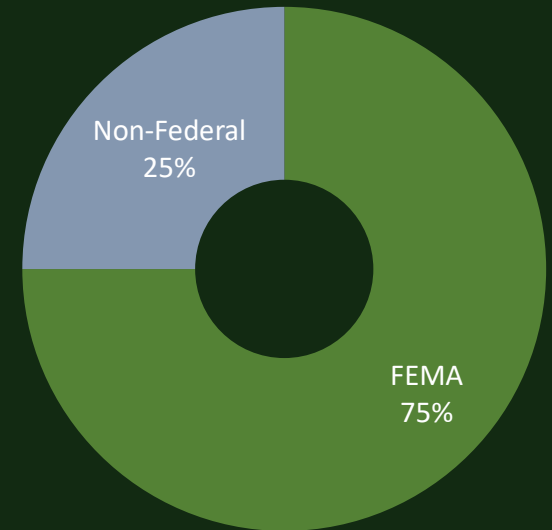
FEMA Hazard Mitigation Assistance

Goal: Reduce or eliminate **long-term risk to life or property** from natural hazard events

Projects must be cost-effective (via BCA)

Apply through state emergency management offices

Comply with Local Hazard Mitigation Plan



Cost Share Requirements



A Framework: reducing risk is a benefit

- Roads limit stream flow → localized flooding
→ *reduced* localized flooding
- Streams washout/overtop roads → transport disruptions
→ *reduced* road disruptions
- AOPs block salmon → ecosystem disruptions
→ *salmon, riparian ecosystems*

AOP = Aquatic Organism Passages (e.g., culverts)



Assessing risk

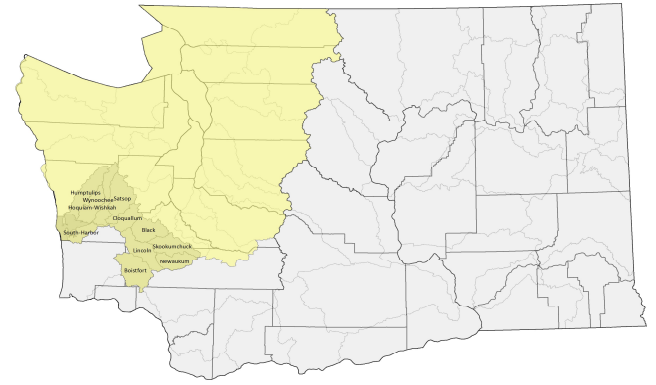
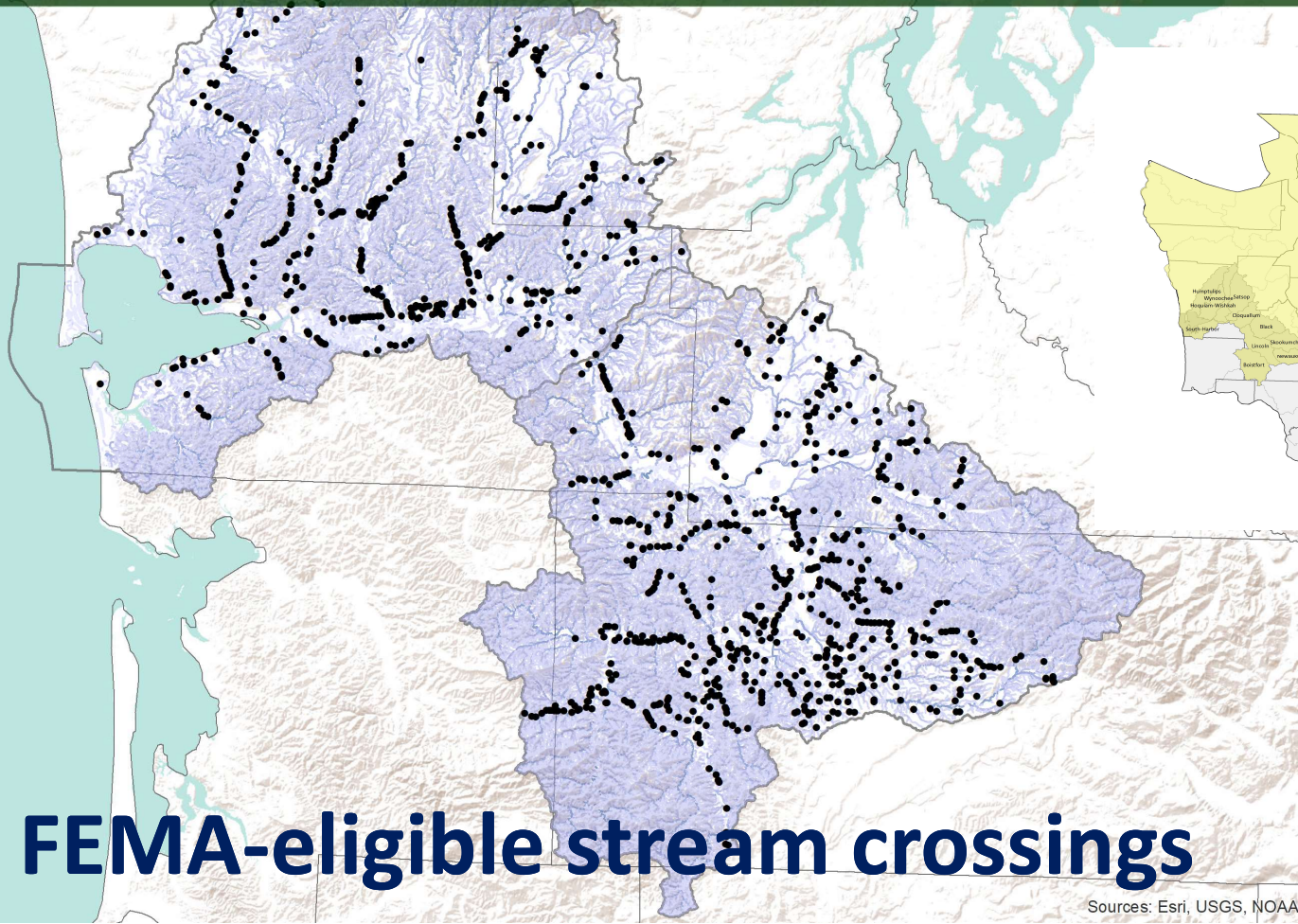
- Exposure is what is *at-risk*

$$\text{risk} = \text{exposure} \times \text{probability}$$

- Probability is a function of **observed** failure rates, **severe precipitation**, engineering (e.g., crossings and road beds), surface permeability, groundwater levels, etc.



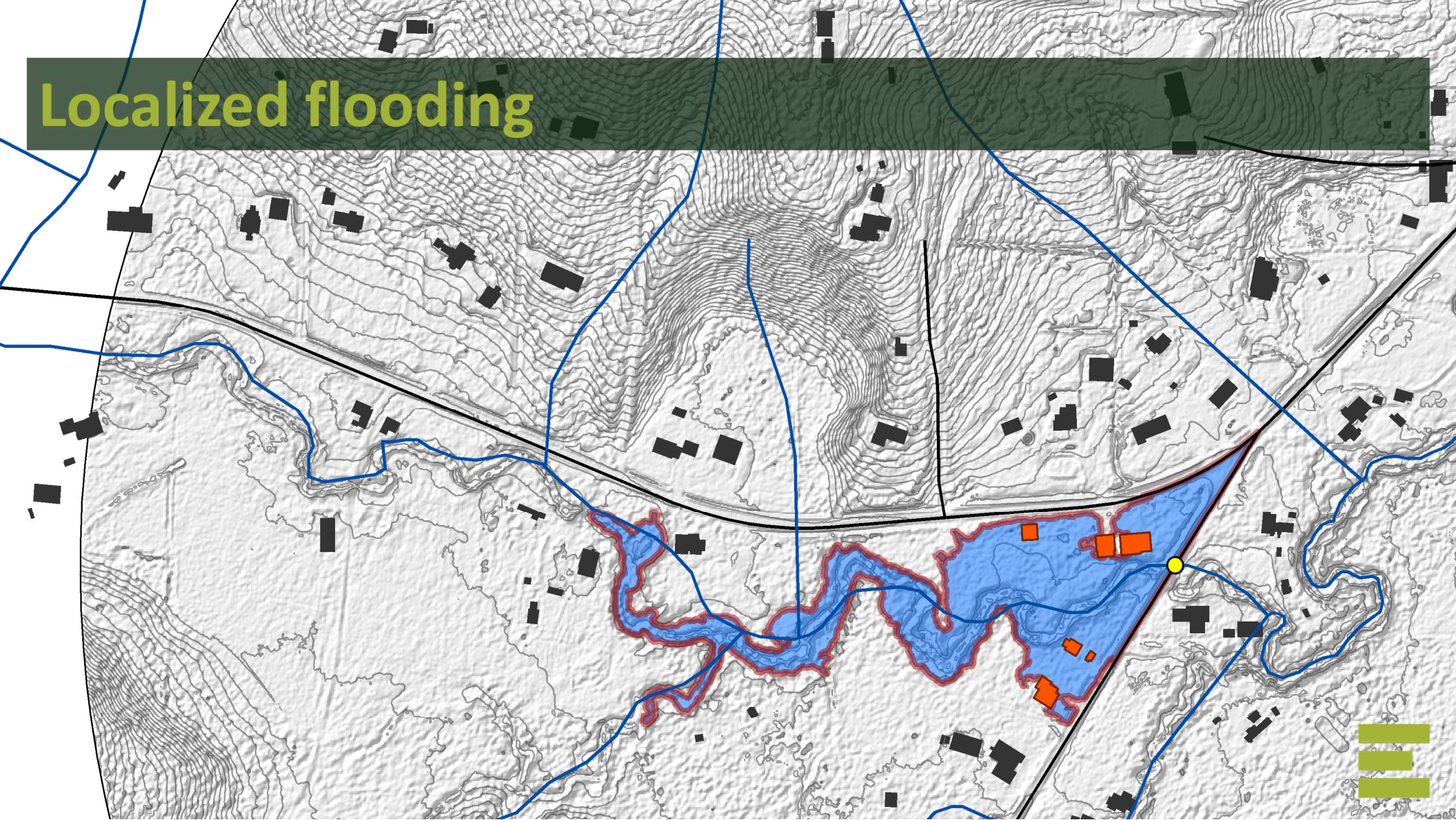
Chehalis Basin, WA state



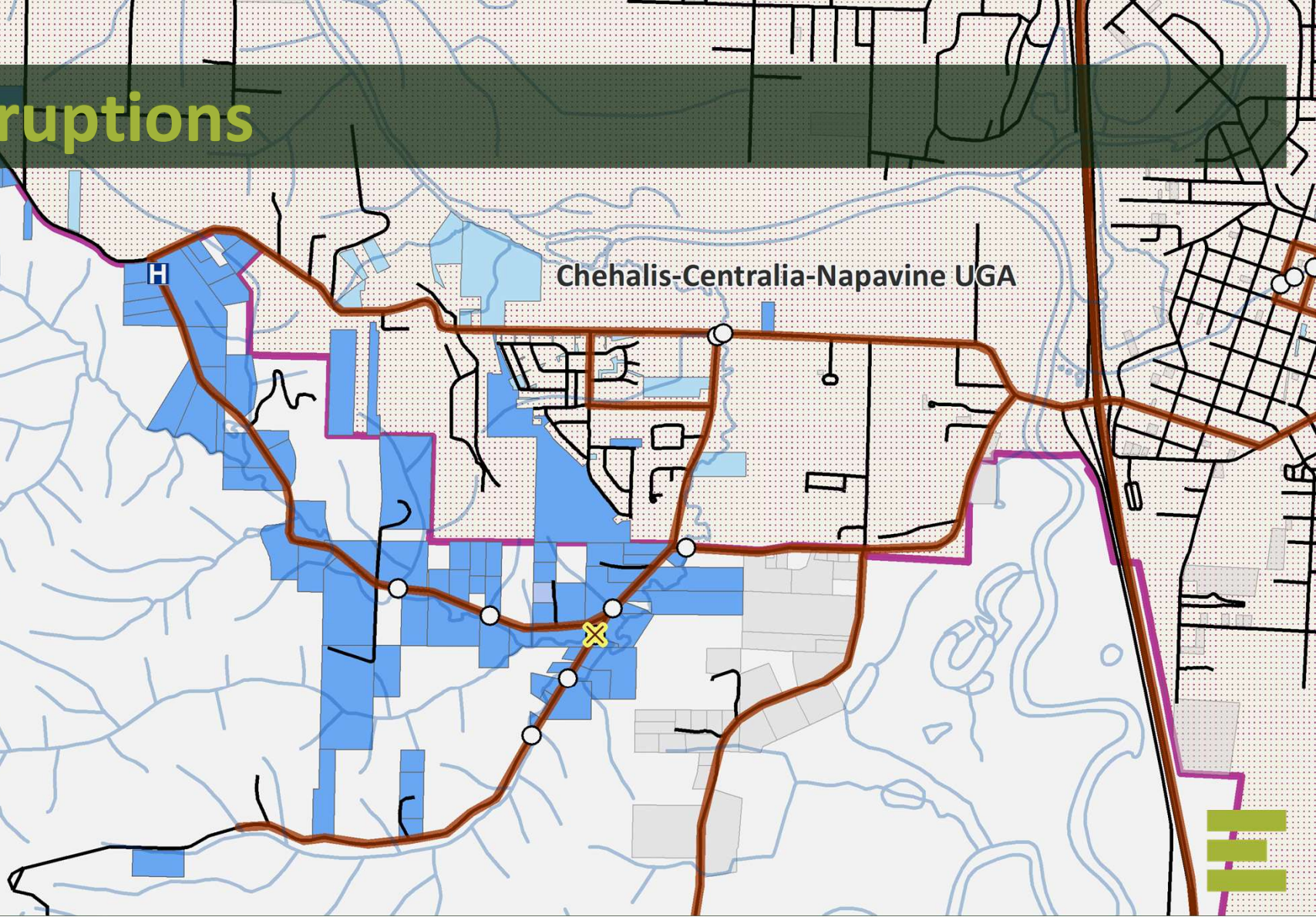
930 FEMA-eligible stream crossings



Localized flooding



Road disruptions



Flooding and transportation exposure

Owner	AOPs	Average \$/day	Highest \$/day
City of Aberdeen	2	\$15,821	\$30,481
City of Centralia	1	\$11	\$11
City of Cosmopolis	1	\$927	\$927
City of Elma	5	\$1,194	\$3,708
City of Hoquiam	2	\$32,003	\$32,708
City of Montesano	15	\$5,255	\$25,031
Grays Harbor County	163	\$4,820	\$90,987
Lewis County	388	\$27,701	\$2,693,835
Mason County	37	\$1,691	\$14,833
Thurston County	74	\$6,069	\$257,649
State agency	129	\$5,000	\$89,453
	817	\$15,755	\$294,511



FEMA application elements

- Project description
- Current level of risk (\$/year)
- How the proposed project will mitigate risk
- Project timeline
- Benefits-cost(BCA) ratio ($\geq 1:1$)
- Can include restored habitat (ecosystem services)



Environmental benefits (aka ecosystem services)

- Ecosystems can be thought of as economic assets, also known as **natural capital**.
- Ecosystem functions produce flows of benefits, known as **ecosystem goods and services**.
- Many ecosystem goods and services produce value that is not fully included in markets (i.e., **externalities**).
- These **non-market benefits** are typically reported as **\$/acre/year**.



FEMA ecosystem services values (\$/acre/year)

	Green Space	Riparian	Forest	Wetlands	Marine/estuary
Aesthetic values	\$1,707	\$612		\$3,640	
Air Quality	\$215	\$226			
Biological Control		\$173			
Climate Regulation	\$61	\$81	\$153	\$136	\$63
Erosion Control	\$68	\$12,042			
Flood Risk Reduction		\$4,215	\$321		
Food		\$641			
Habitat		\$878			\$1,214
Nutrient Cycling				\$536	\$522
Pollination	\$305				
Recreation, Tourism	\$5,644	\$15,967			
Storm Water Retention	\$308				
Water Filtration		\$4,473		\$1,406	
Water Supply		\$237	\$80	\$292	
TOTAL	\$8,308	\$39,545	\$554	\$6,010	\$1,799



Cost-effectiveness

Benefits over project life

- **Avoided damage to infrastructure**
 - Buildings, vehicles, possessions, infrastructure
- **Avoided harm to people**
 - Injury/death, lost productivity, mental stress
- **Environmental Benefits**
 - Air quality, recreation, erosion control

Costs

Costs over Project Life

- Acquisition
- Title
- Insurance
- Demolition
- Construction
- Operation
- Maintenance

**Benefit-
Cost Ratio**

Benefits



FEMA BRIC grant cost-sharing

Cost-sharing: Applicants contribute 25% of project costs

“Economically disadvantaged rural communities” (EDRCs) are eligible for reduced cost-share (10% of project costs)

“rural community of 3,000 or fewer individuals whose residents have an average annual income per capita less than 80-percent of the national per capita income.”



Culverts and FEMA: limitations

Extensive documentation: required for all aspects of risk (e.g., failure rates) and remedy (e.g., planning, materials, labor)

Two-part review: process may take *2-6 years*

Highly competitive: state-level reviews, multiple “competing” disasters



Acknowledgements

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Questions and comments:

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