

Climate Change Impacts on Water in NW Washington

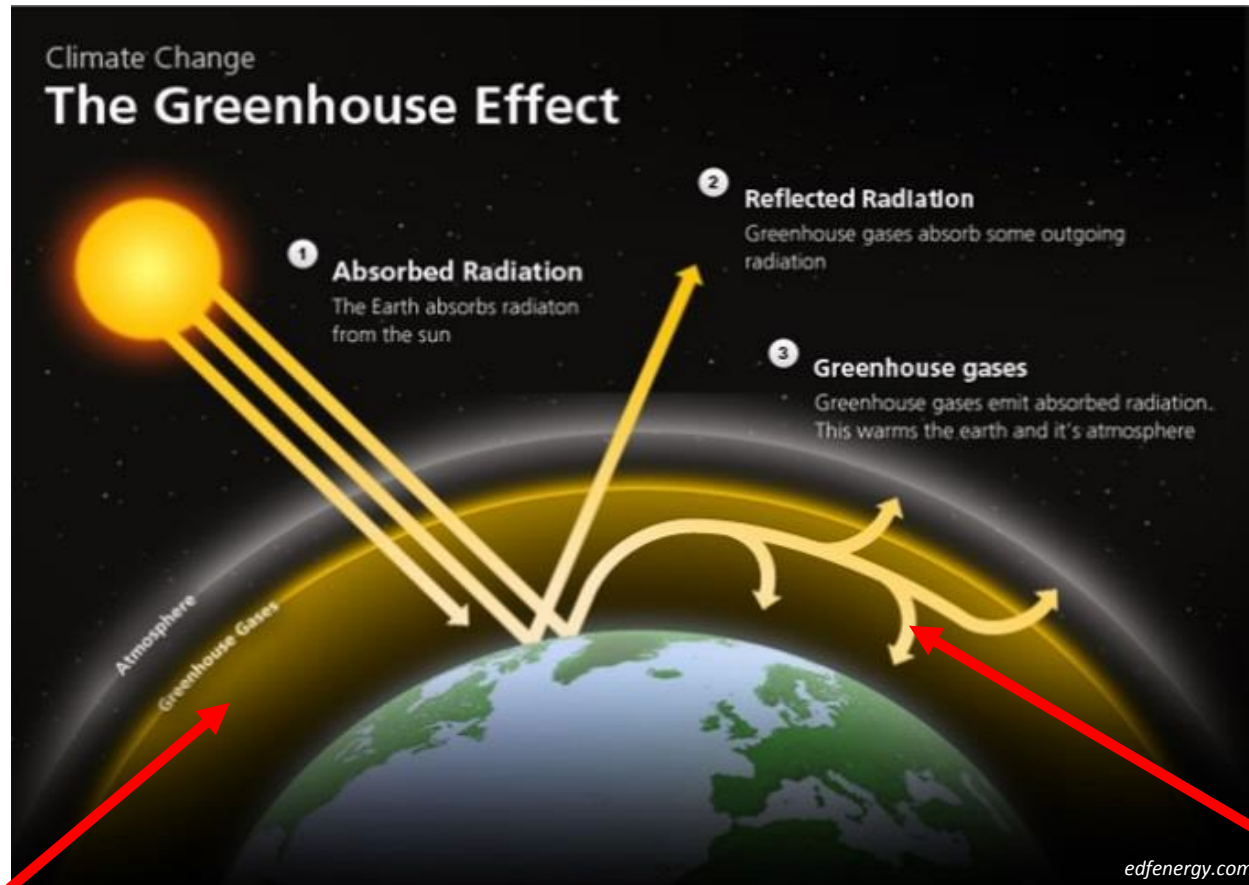
Roger Fuller
Western Washington University



www.skagitclimatescience.org



Climate Change: Quick refresher on the mechanism



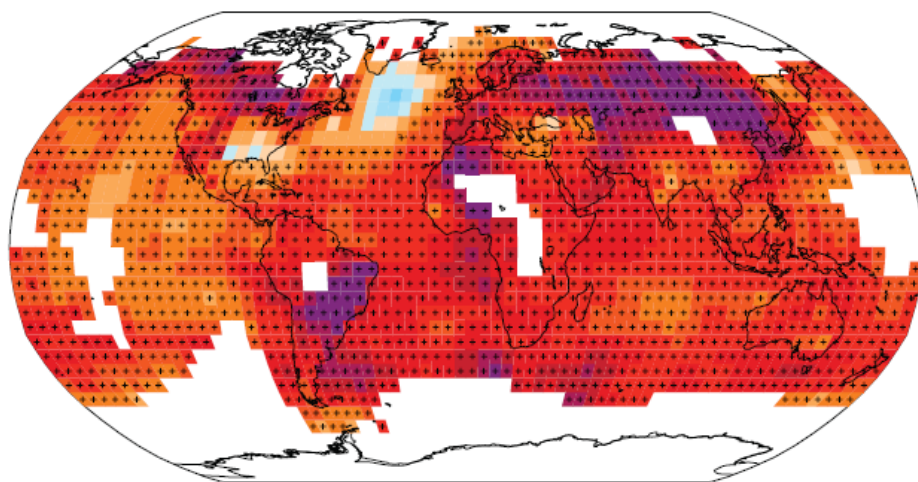
*Greenhouse gases in the atmosphere
act like a quilt on the earth*

*Trapped energy
warms the
planet*

Climate Change Impacts: Temperature and Precipitation are Key

Historical Trends across the Globe

Temperature Change, 1901-2012



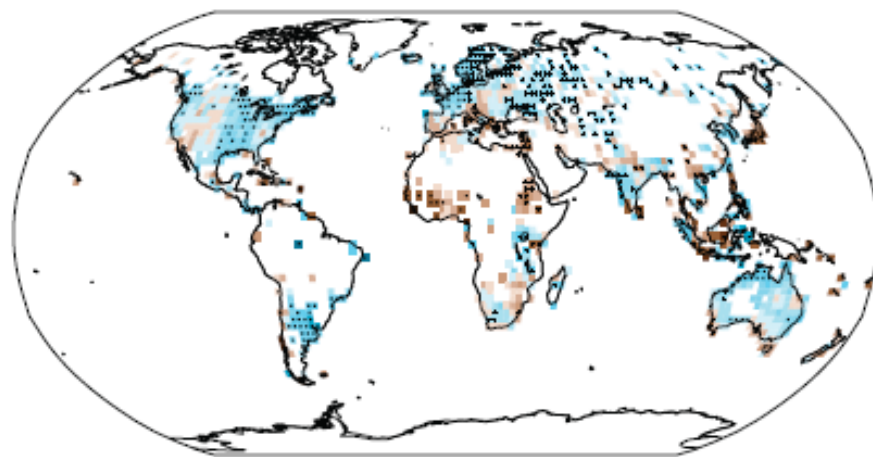
-0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 1.0 1.25 1.5 1.75 2.5

(°C)

Higher: red/purple

Lower: blue

Precipitation Change Over Land, 1901-2010



-100 -50 -25 -10 -5 -2.5 0 2.5 5 10 25 50 100

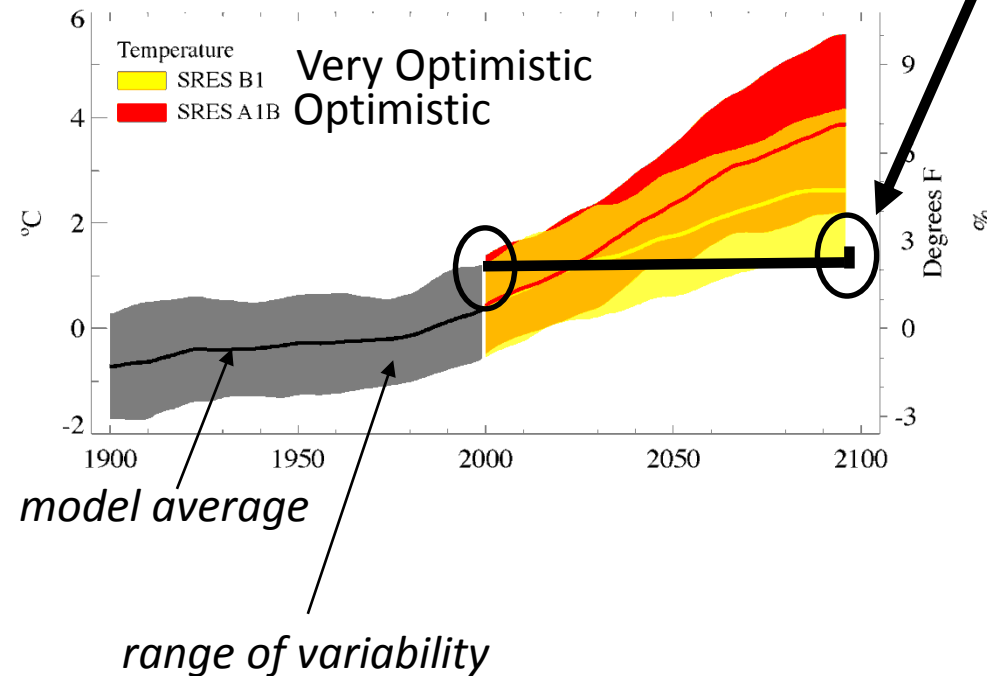
(mm yr⁻¹ per decade)

More: blue

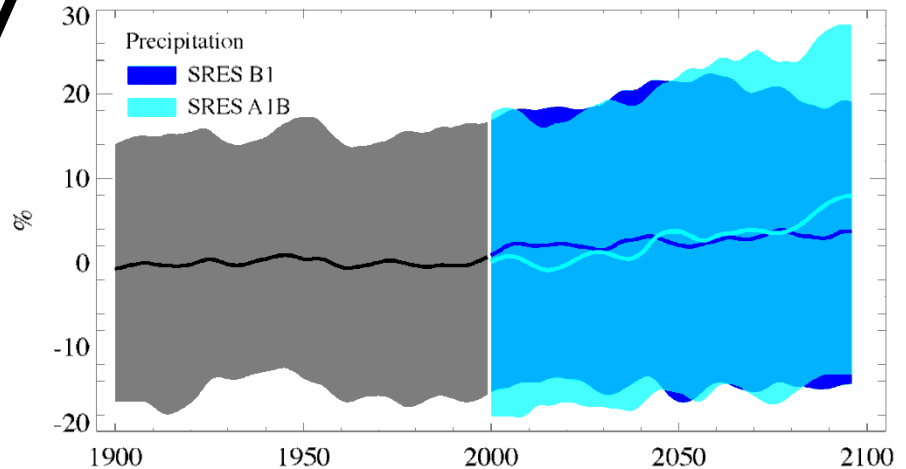
Less: brown

Temperature and Precipitation Pacific Northwest Future Projections

Temperature



Precipitation

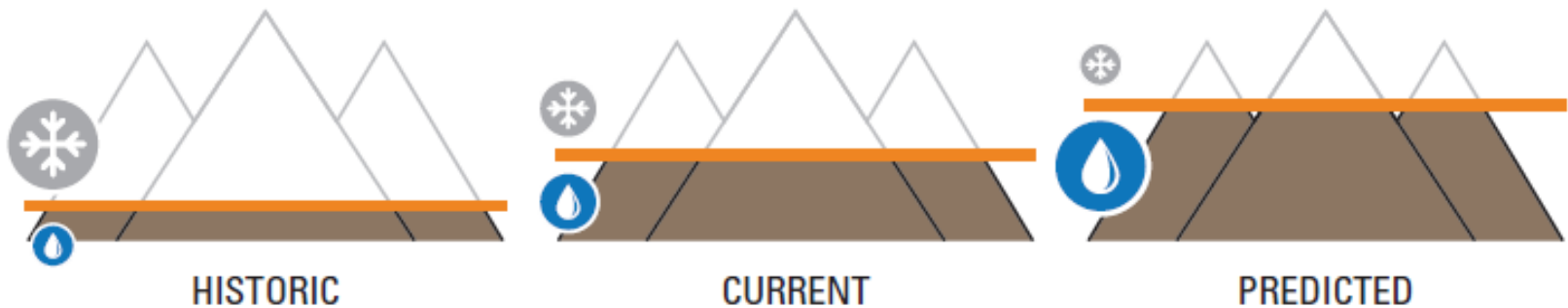


Some effects of changes in Temperature

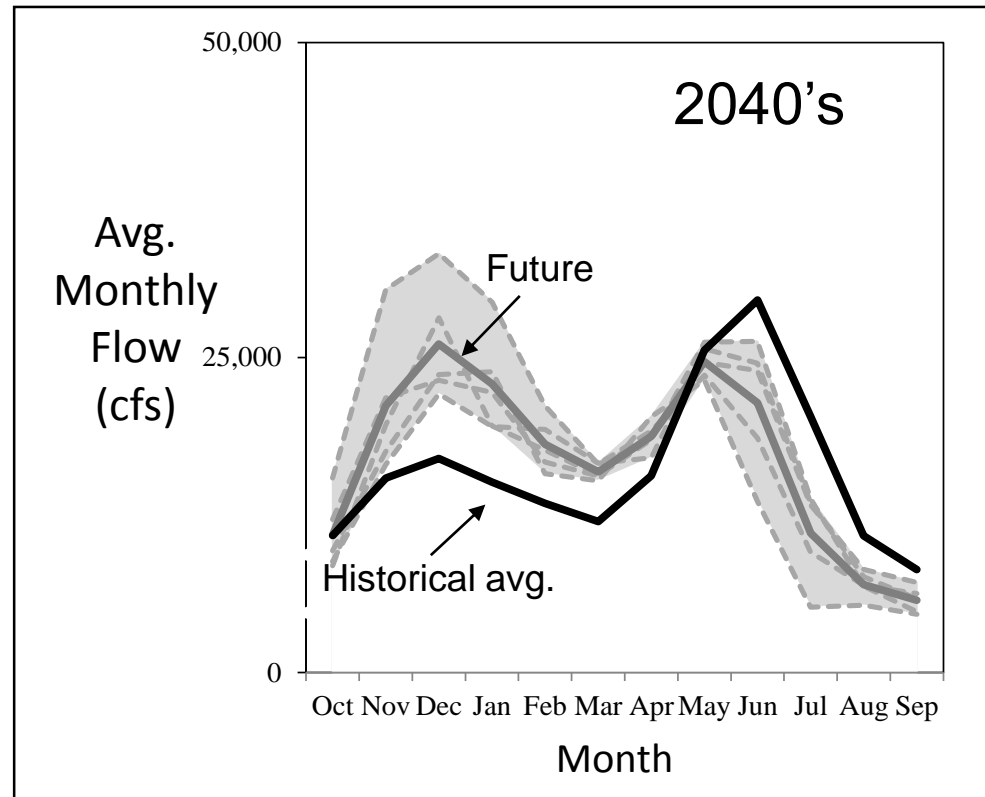
- Glaciers
- Winter freezing elevation
- Snow/rain balance
- More rain per storm
- River flow timing
- River flow extremes
- Groundwater and Soil Moisture
- Sediment
- Species – timing of natural history events
- Sea Level
- ...

The Snow-Rain Balance is shifting in Skagit County

Rising Winter Freezing Levels



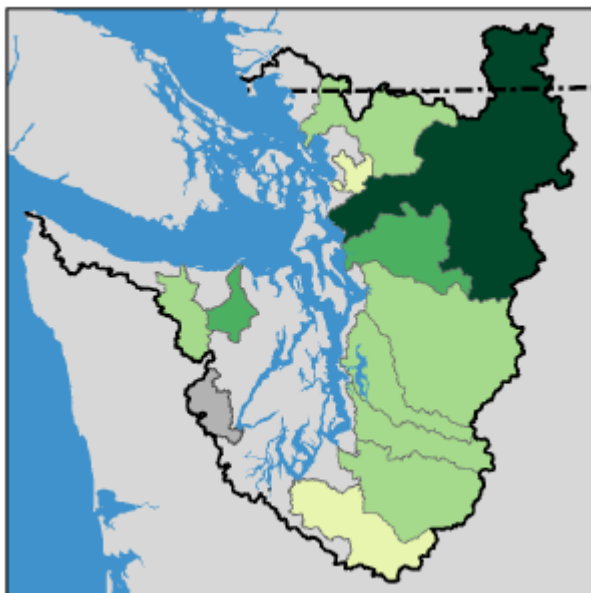
Skagit River – Average Monthly Flows in the Future



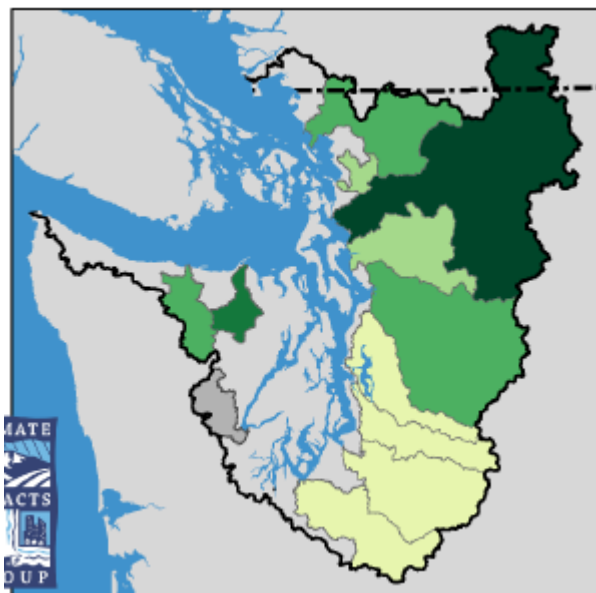
- **Higher and earlier flows in fall**
- **Lower and longer low flows in summer**

Changes in the size of the 100-year flood

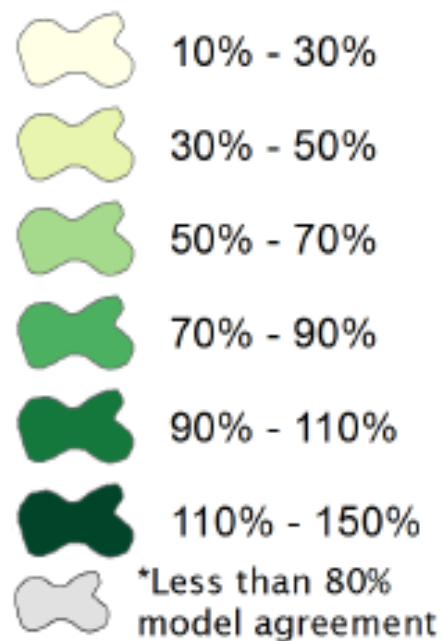
2050's



2080's

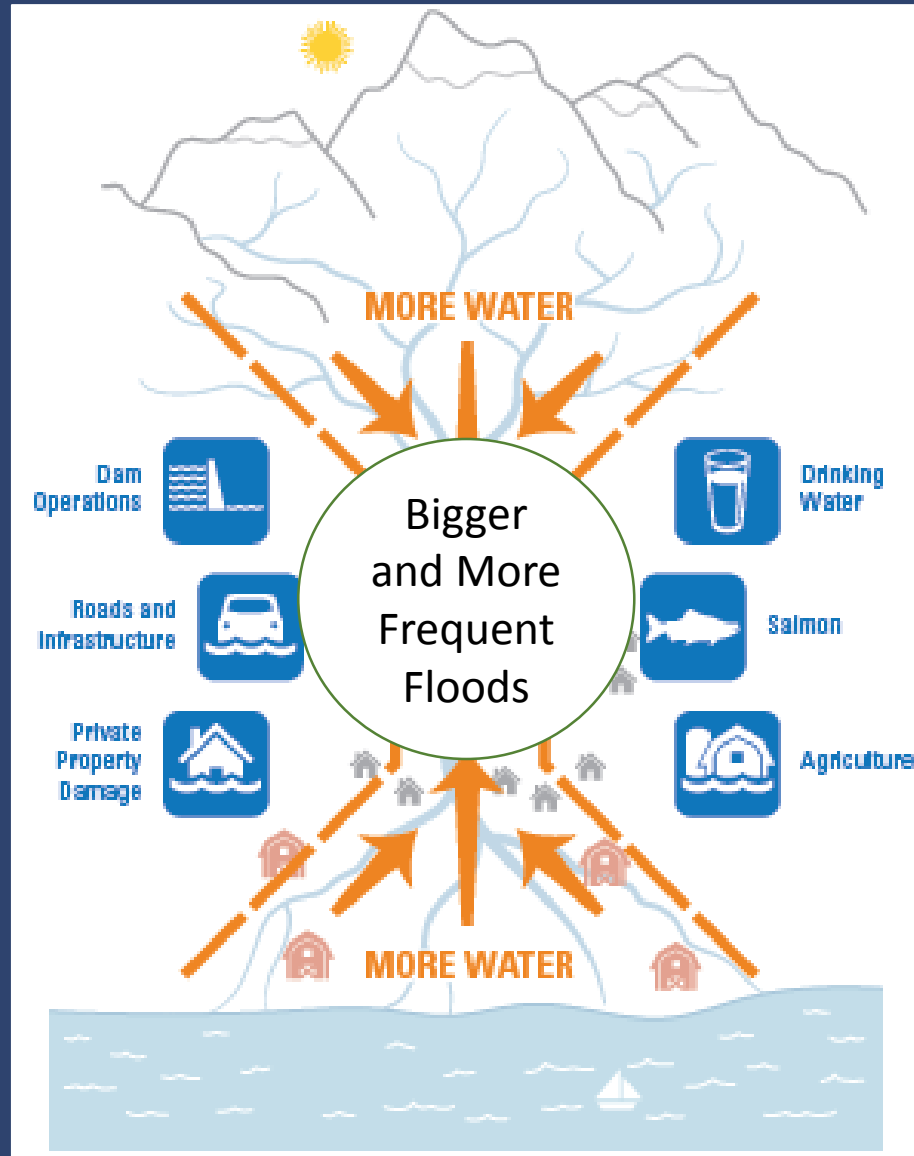


Increase

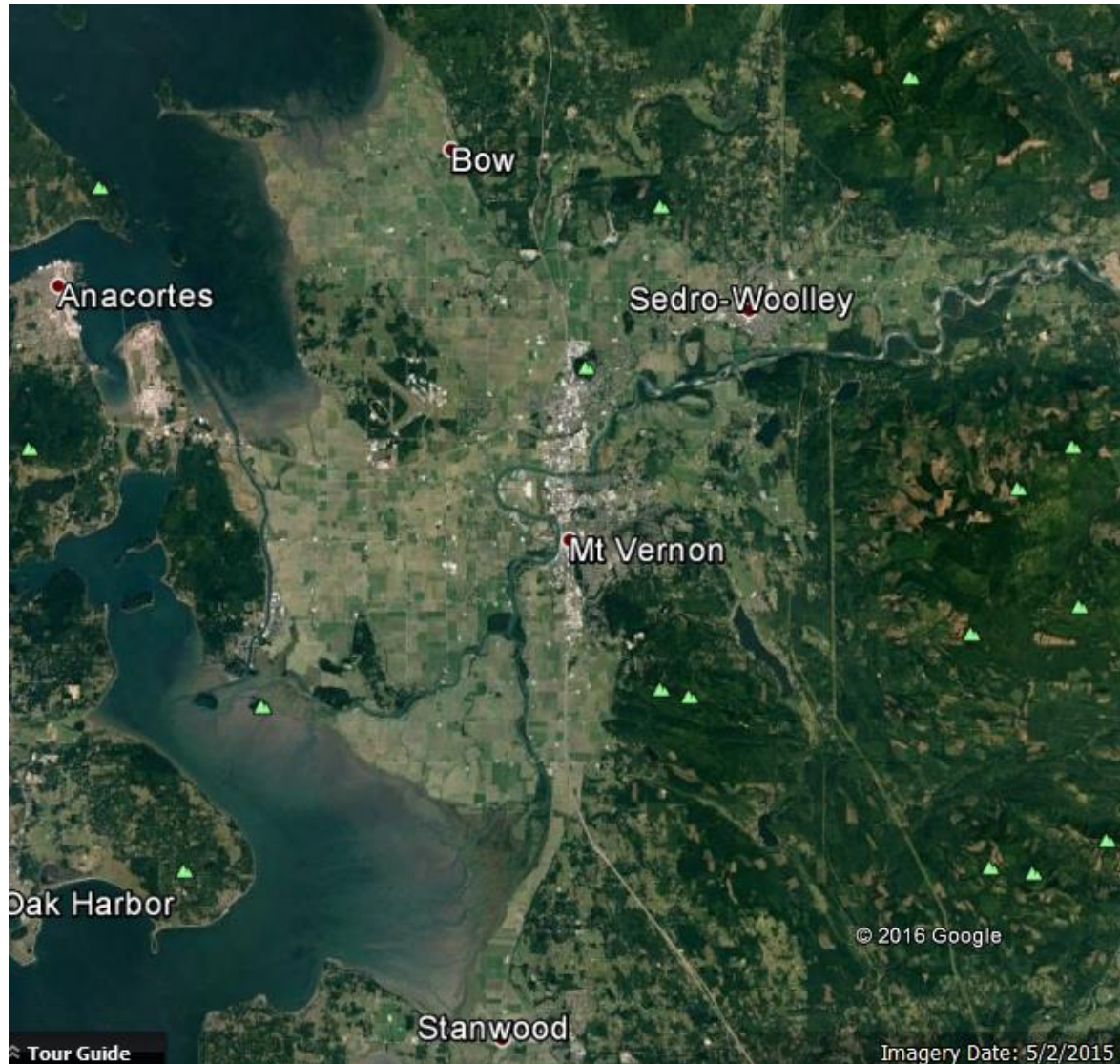


Low Carbon Emissions Scenario (RCP 4.5)
Source: UW Climate Impacts Group

Combining a river flood with sea level rise greatly increases risk on floodplains



The lower floodplain of the Skagit: where river meets tide...
...and also highways, industry, agriculture, and 30,000 people.

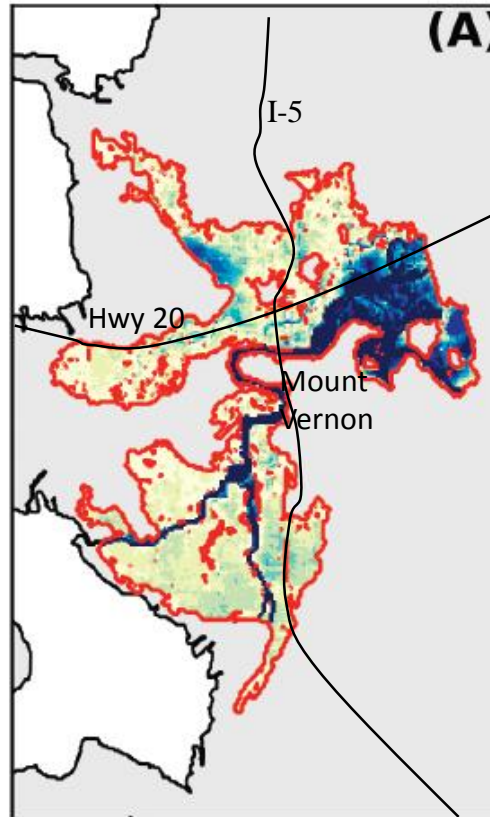


Combining a river flood with sea level rise greatly increases risk

Skagit Delta
Topography

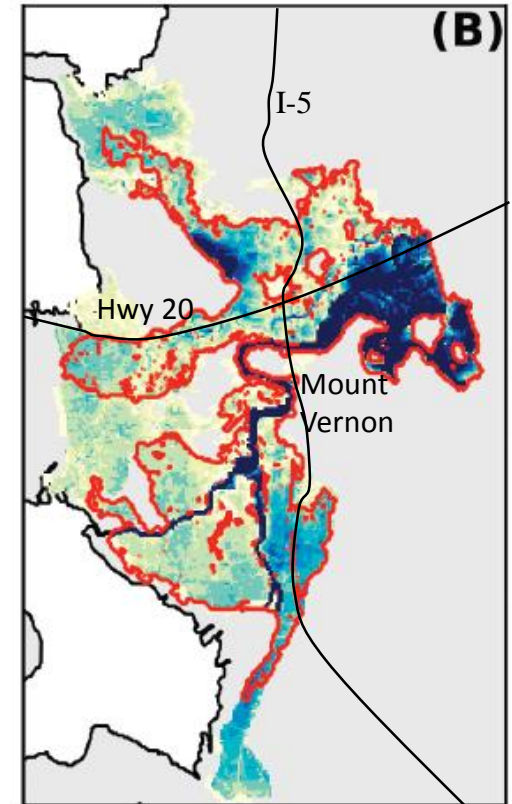


Historic
100-yr River Flood



Flooded Area:
66 mi²

2040's
100-yr Flood
+ Sea Level Rise



Flooded Area:
103 mi²
(57% increase)

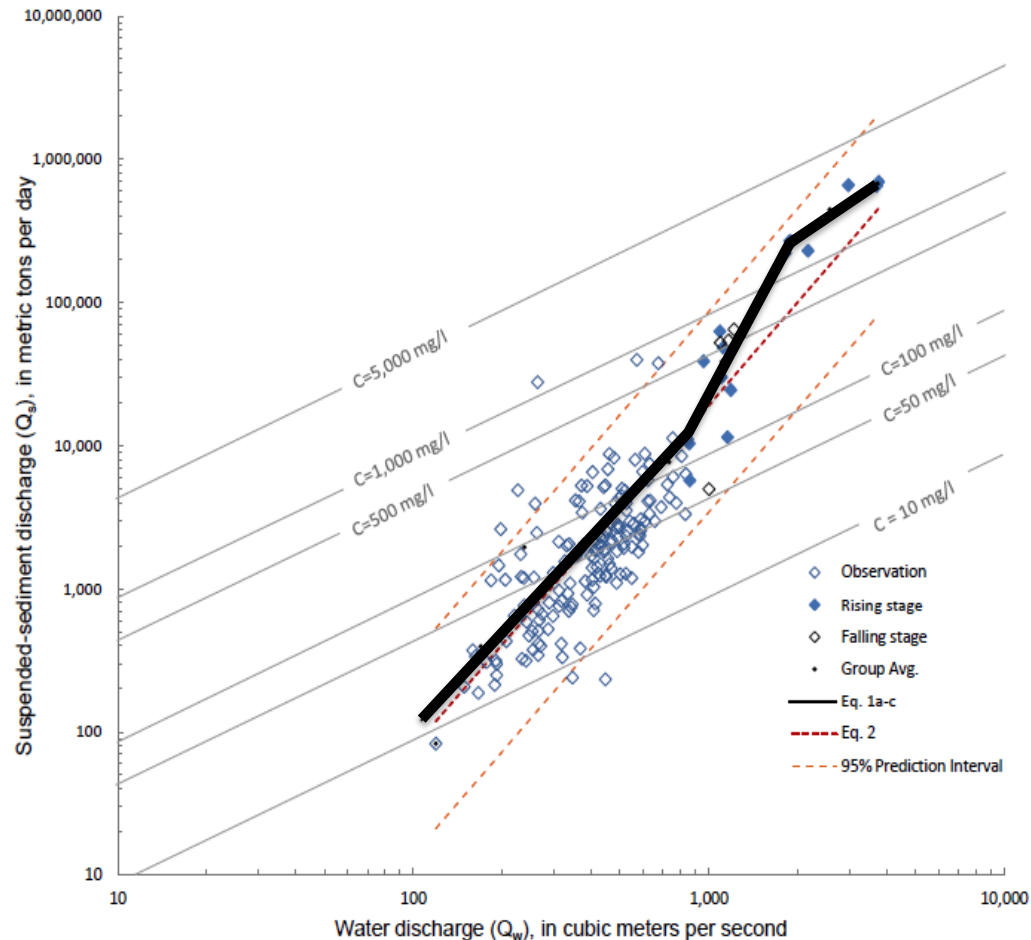
By the 2040's, this will be the 22-yr flood.



This is what a current 100-yr flood looks like
in Mount Vernon.

Floods Bring Lots of Sediment into the River

Amount of
Suspended
Sediment

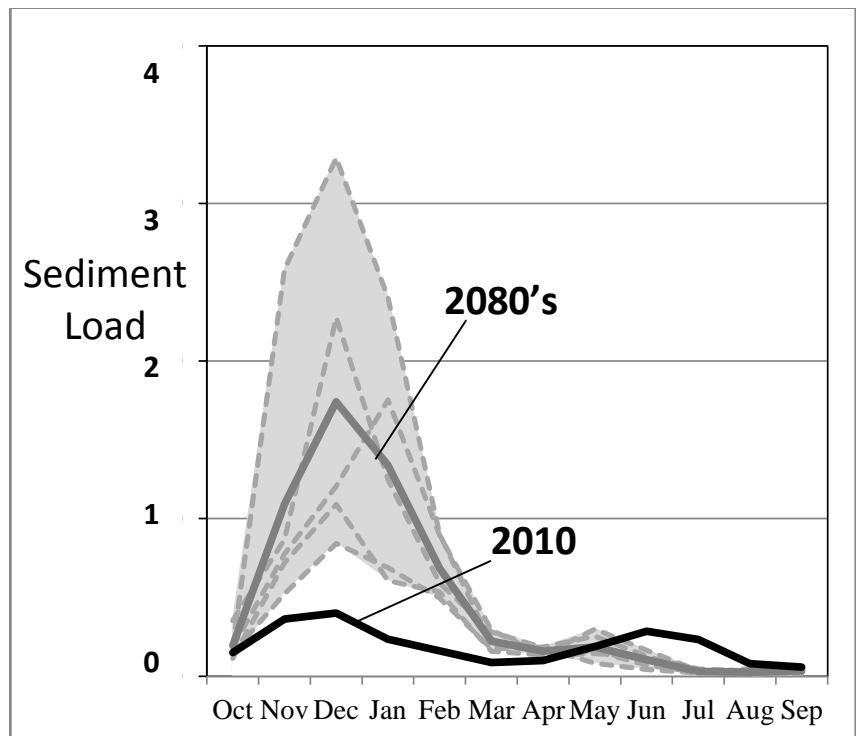
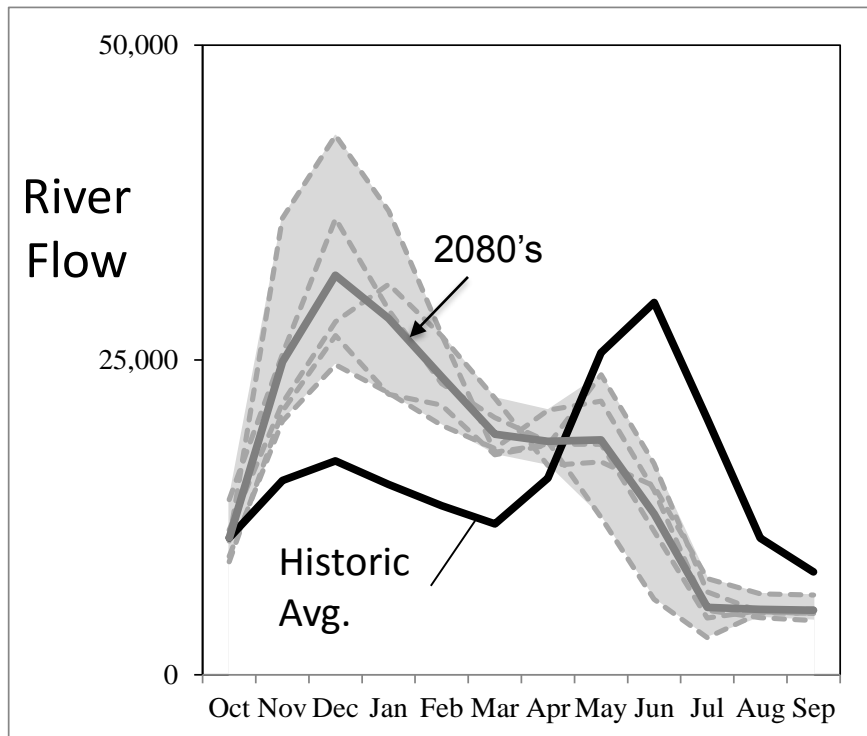


Amount of River Flow

Projected Changes in Suspended Sediment

2080s

River Flow → Sediment in River



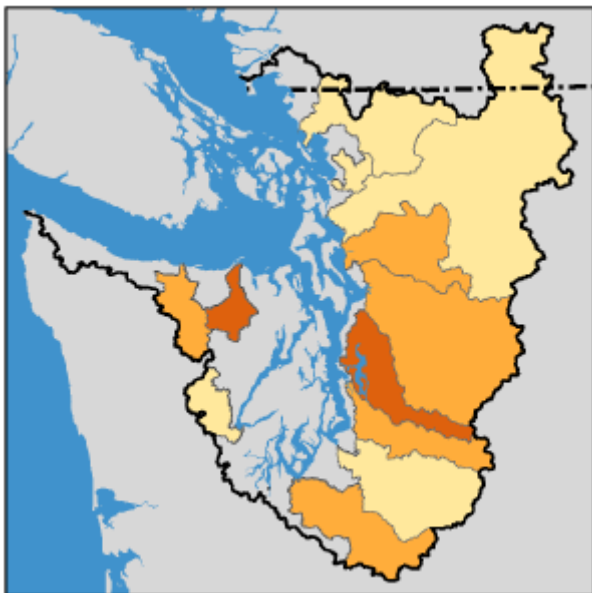
Why does more sediment matter?

Positive or Negative Effects?

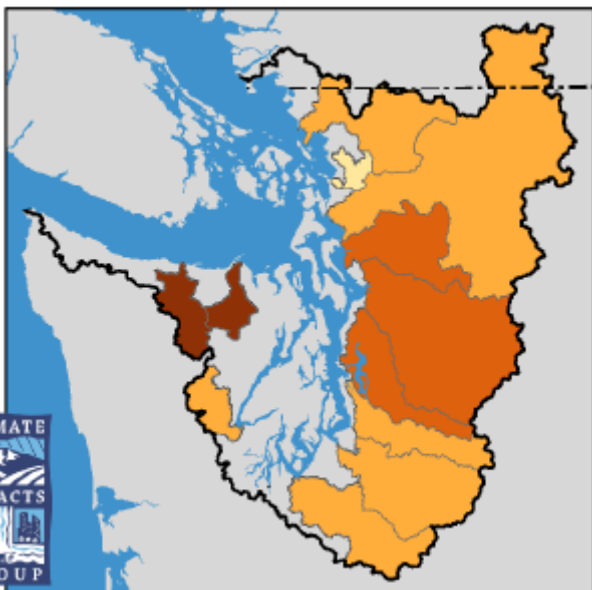
- Salmon redds (nests)
- Increased channel migration on floodplain
- Flood risk in leveed areas
- Drinking water costs
- + Tidal marshes and sea level rise
- Eelgrass beds
- Puget Sound water quality

Changes in the 2-year Summer Low Flow

2050's

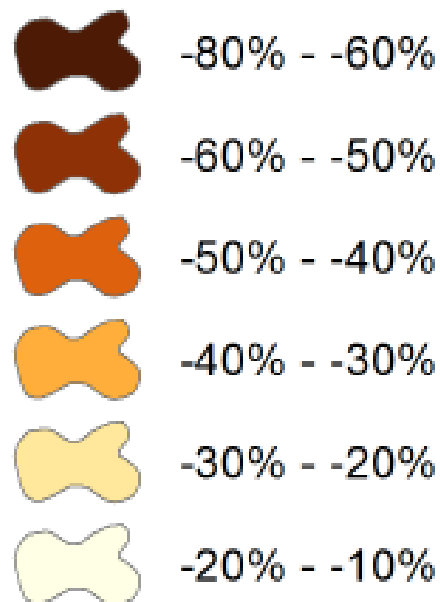


2080's



Lowest 7-day average flow

Change



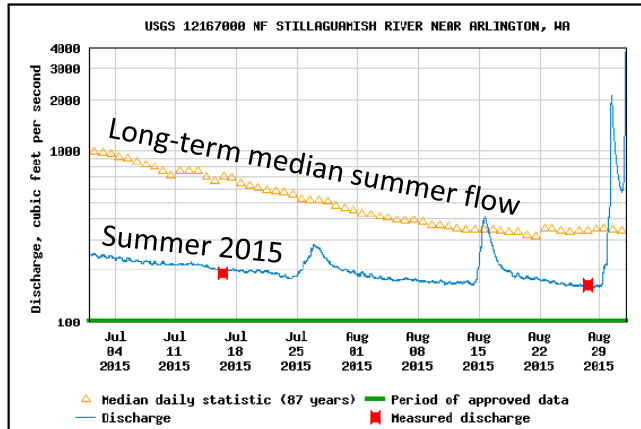
But, dams help to lessen the impact

Low Carbon Emissions Scenario (RCP 4.5)

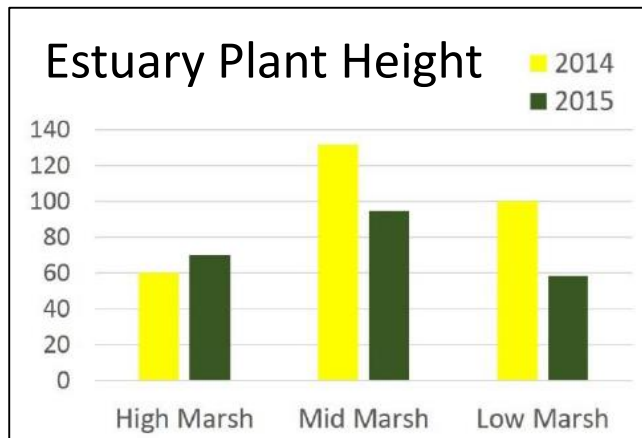
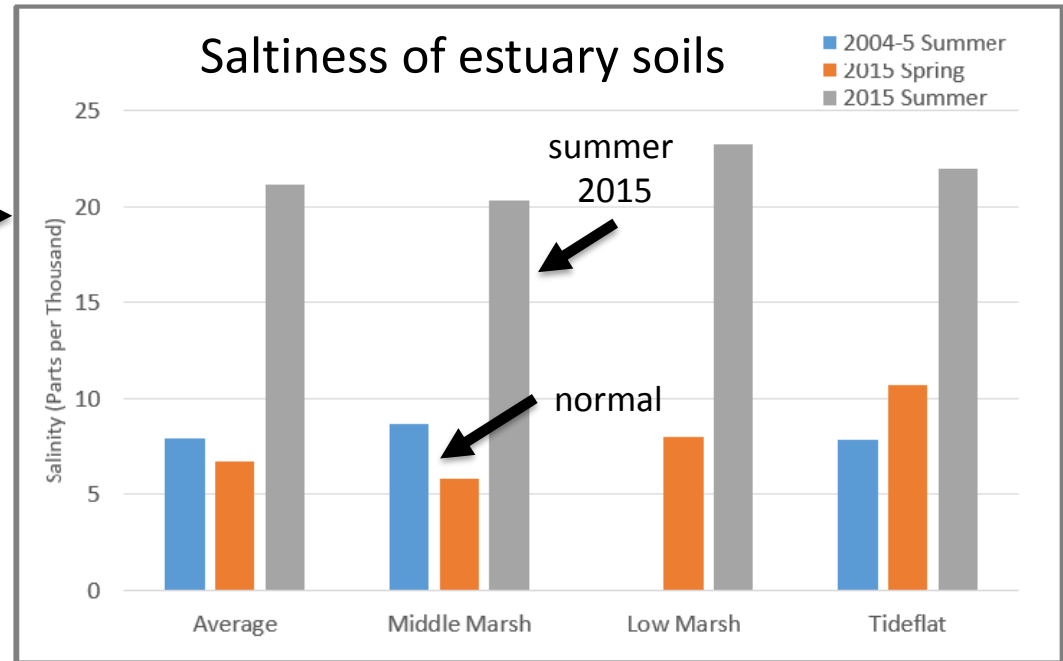
Source: UW Climate Impacts Group

Why do Low Summer Flows Matter?

Summer 2015 – what to expect as average for 2050's



Record Low River Flow



Plants were 35% shorter
and didn't produce seeds
due to salt stress

Data from the Stillaguamish River Estuary

Groundwater Flow on Floodplains

- *river flow that is underground (called “hyporheic flows”)*
- *strongly affects the wetlands and soil moisture on floodplain*



Big Hole River, [montana.gov GIS](http://montana.gov/GIS)

Groundwater Flow on Floodplains



Important for

- Floodplain wetlands
- Floodplain forests
- Farmland

Lower summer flows
impact these habitats
by reducing
groundwater flows

Water Impacts Summary

A few of the changes ahead:

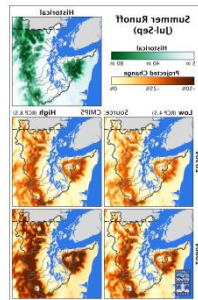
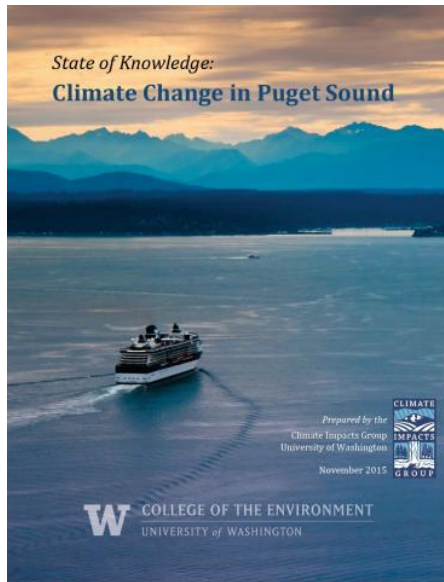
- Disappearing glaciers
- Rising winter freezing elevation
- Less snow, more rain in winter
- Higher river flows in winter
- Bigger floods in winter
- More sediment in the river, affecting people, animals, plants
- Lower river flows in summer, and lower floodplain groundwater
- Floodplain habitats and farms wetter in winter, drier in summer
- Higher soil saltiness in the estuary in summer
- On the lower delta, summer groundwater increases due to sea level rise

More Resources...



www.skagitclimatescience.org

State of the Knowledge: Climate Change in Puget Sound



University of Washington Climate Impacts Group



<https://cig.uw.edu/>

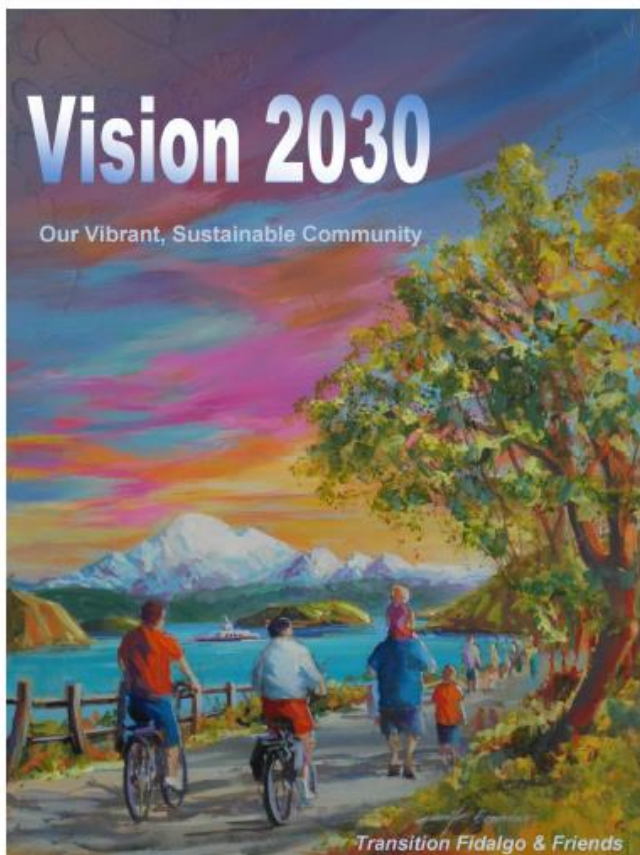
www.eopugetsound.org/articles/state-knowledge-climate-change-puget-sound

Thank you!

Roger Fuller
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Vision 2030

Our Vibrant, Sustainable Community



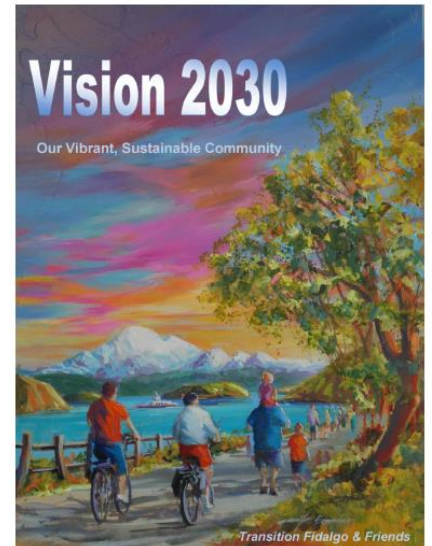
Transition Fidalgo & Friends

Eight Focus Areas

- A Thriving, Sustainable Economy
- **Emergency Preparedness**
- Clean Energy and Efficiency
- Feeding Our Community
- Physical and Emotional Health
- Affordable Homes & Vibrant Neighborhoods
- **Taking Care of our Natural Resources**
- Clean, Multi-Modal Transportation

What can we do to lessen impacts, adapt, or increase resilience?

Local governments
Emergency preparation
Education
Post-disaster response
Citizen science
....??



....What are your ideas? Apply for a TFF grant to get started!