THURSTON CLIMATE ADAPTATION PLAN

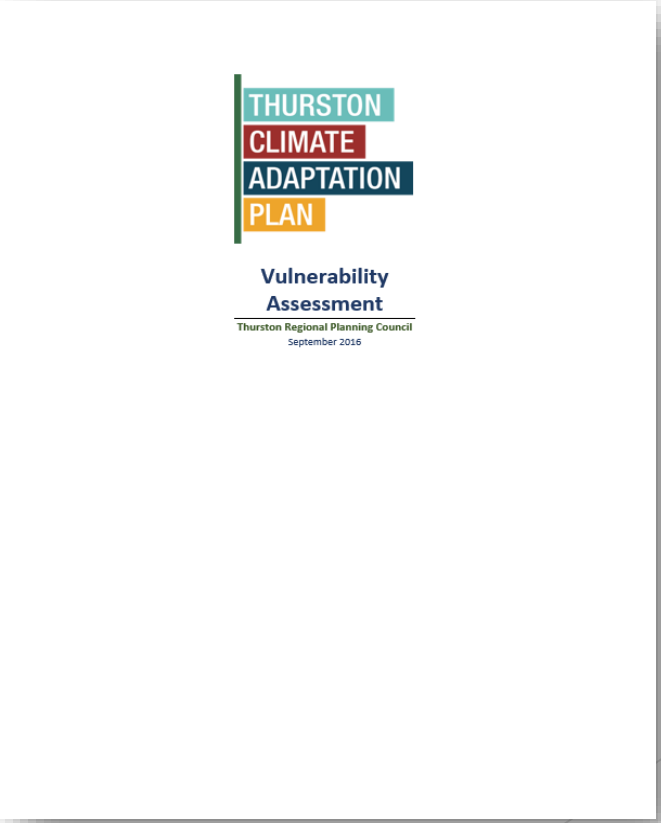
TRPC climate change vulnerability assessment

Sept. 22, 2016

thurston regional planning council

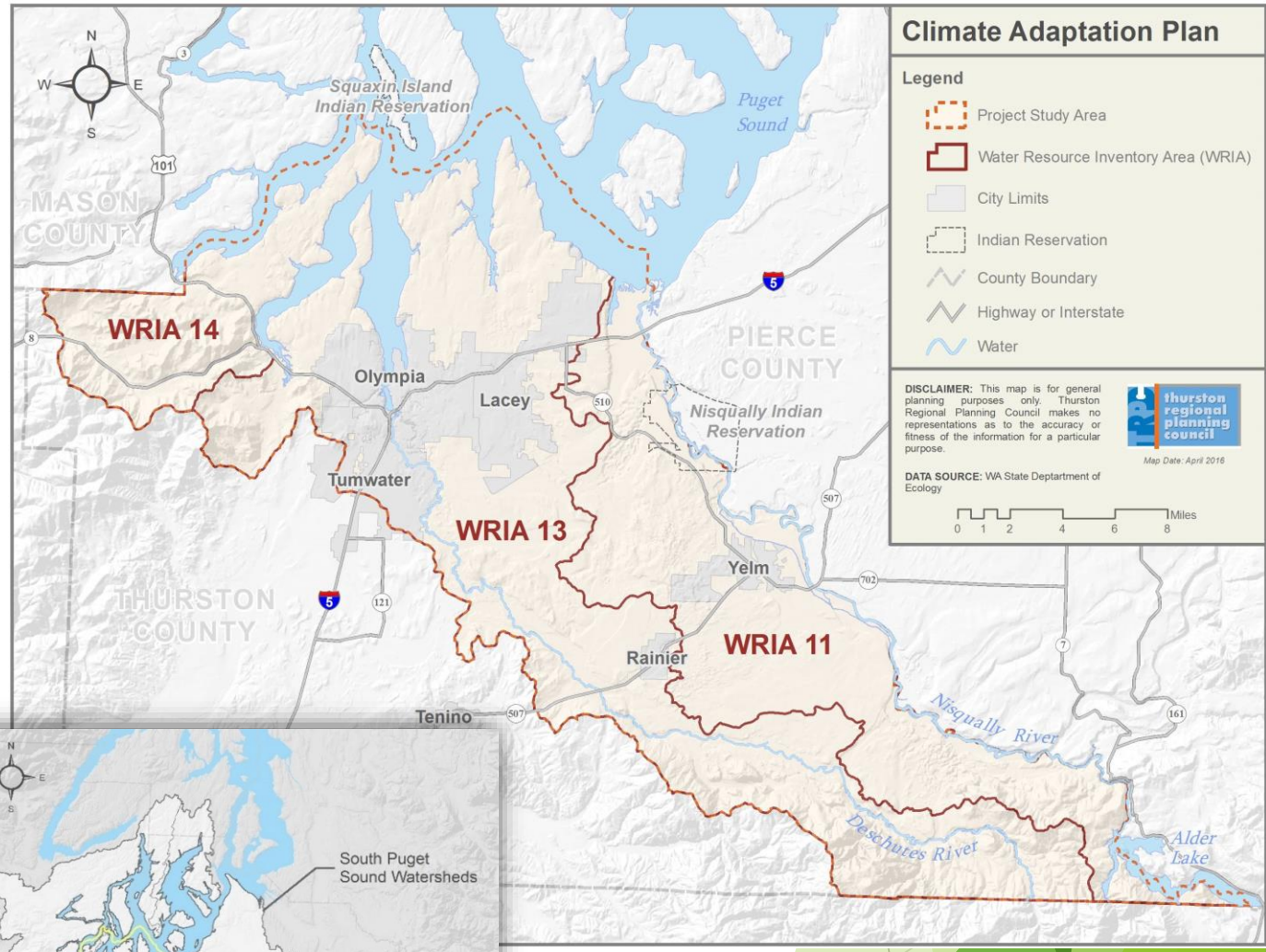
Assessment Overview

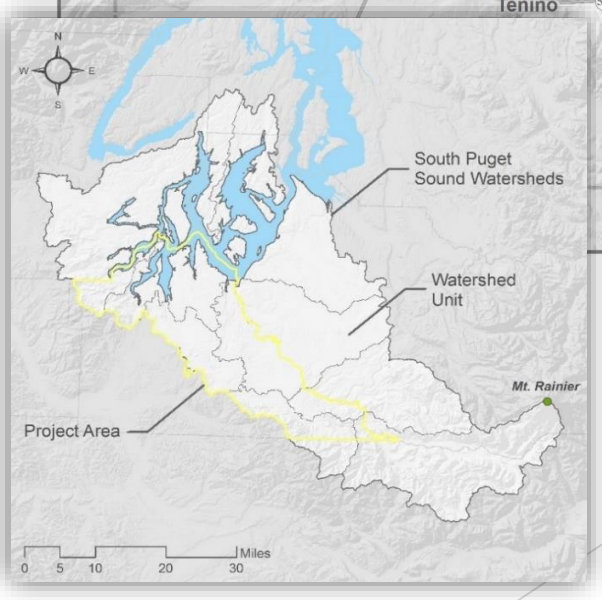
- Uses empirical data to show historical changes in South Puget Sound region's climate
- Uses emissions scenarios and climate models to show projected changes over the 21st century
- Assesses impacts on region's human and natural systems and assets
- 100-page document available online at www.trpc.org/climate



Sources & Scope

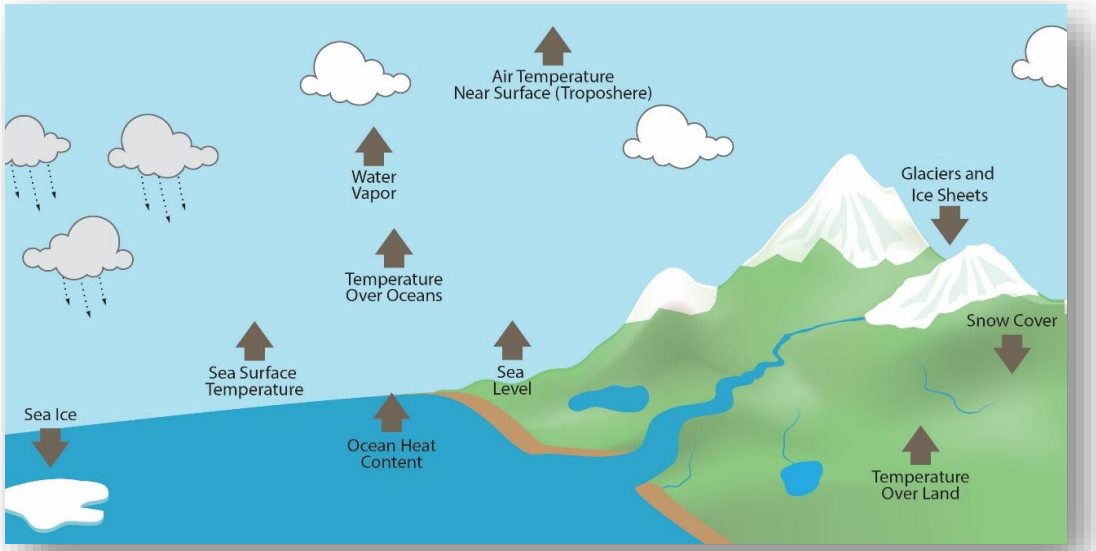
- **Purpose:** Watershed-based plan with actions to prepare for and cope with climate impacts
- **Sources:** Academic and government studies and data
- **Figures:** Generally, show “low” and “high” emissions scenarios and historical, 2050s and 2080s time intervals for project area and South Puget Sound.
- **Funding:** $250,000 National Estuary Program grant
- **Area:** Thurston County watersheds that drain into Puget Sound

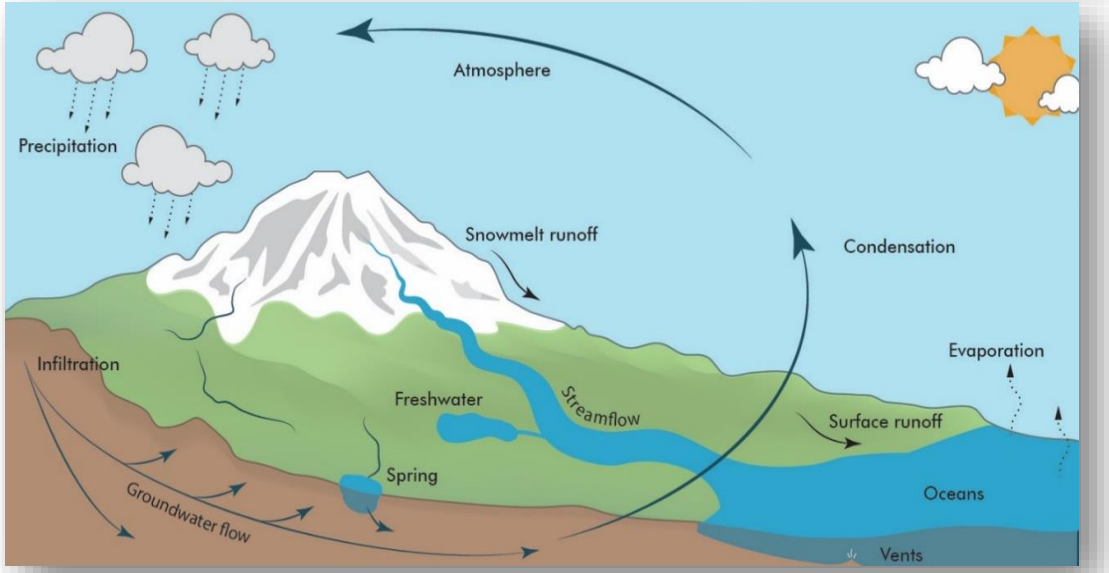




Big Picture, Small Area

- **Climate Indicators:**
  - Seeing several global changes happening locally





- **Hydrologic Cycle:**
  - Shifting seasonal precipitation, runoff, streamflow, and groundwater recharge

Air Temperature

- **20th Century:**
  - **Historical:** Annual average temperature increased by 1.3°F across Puget Sound lowlands, which include most of the project area
- **21st Century:**
  - **2050s:** +4.2°F per low scenario and +5.9°F per high scenario
  - **2080s:** +5.5°F per low scenario and +9.1°F per high scenario.
- **Impacts:**
  - Coolest nights and hottest days projected to warm
  - Fewer days with freezing temperatures and more winter rain and less snow
  - Shocks to the system for native plants and animals

Air Quality

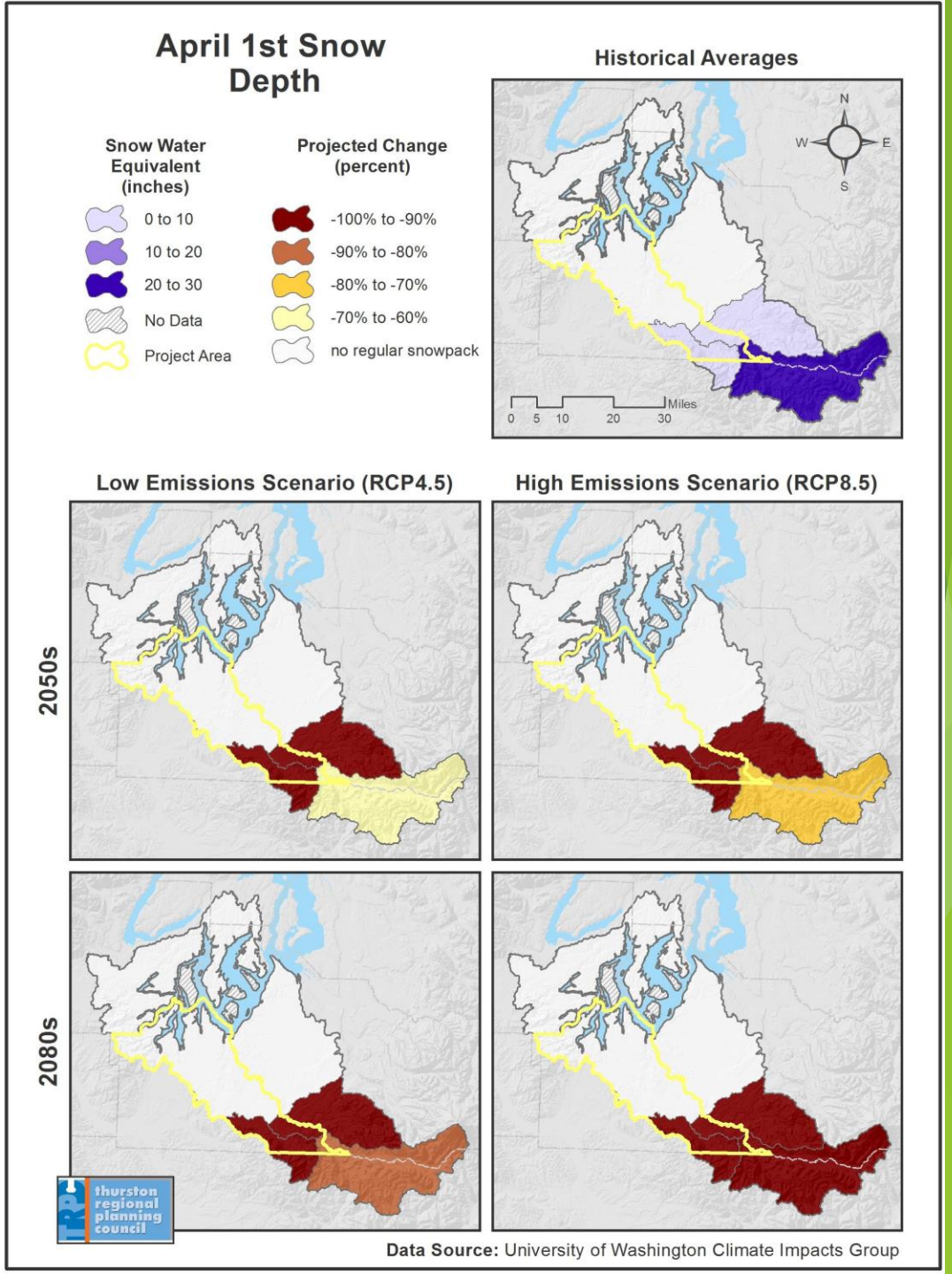
- Rising air temperature and increasing population and pollution could exacerbate:
  - Surface ozone (a main ingredient of urban smog)
  - $PM_{2.5}$ (particulate matter smaller than 2.5 micrometers in diameter)
- Primary sources of $PM_{2.5}$ in Thurston County:
  - Burning wood in stoves and outdoors
  - Combusting fossil fuels in automobile engines
- Primary sources surface ozone in Thurston County:
  - Nitrogen dioxide emissions from automobiles
  - Volatile organic compounds from industrial facilities

Precipitation

- **20th Century:**
  - **Historical:** No discernable trend in annual precipitation across Puget Sound region
- **21st Century:**
  - Small annual shift but big seasonal shifts
  - **2050s:**
    - Summers hotter and drier, with more than 20% decrease in precipitation, per low and high scenarios
    - Winters warmer and wetter, with about 10% increase in precipitation, per the scenarios
- **Impacts:**
  - Winter drizzle punctuated by more frequent and intense downpours
  - Exacerbated El Nino and La Nina cycles with longer, stronger periods of drought and rain

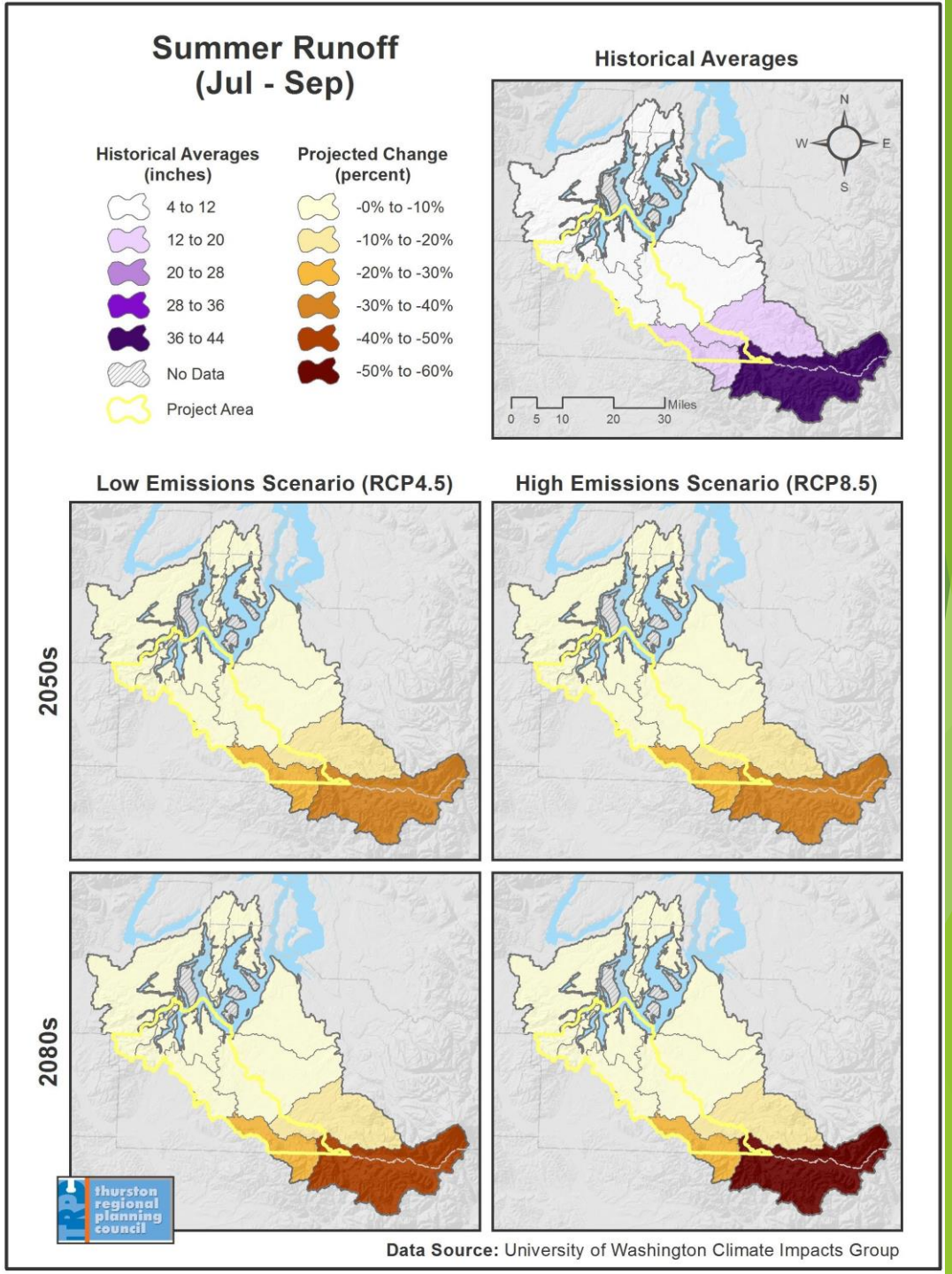
Snowfall & Snowpack

- Less snowfall and earlier melting of snowpack in South Puget Sound highlands
- Nisqually Watershed shifts to rain-dominant system, with less than 10 percent of its precipitation as snow
- Lower-elevation Deschutes and Kennedy-Goldsborough systems remain rain-dominant



Streamflow

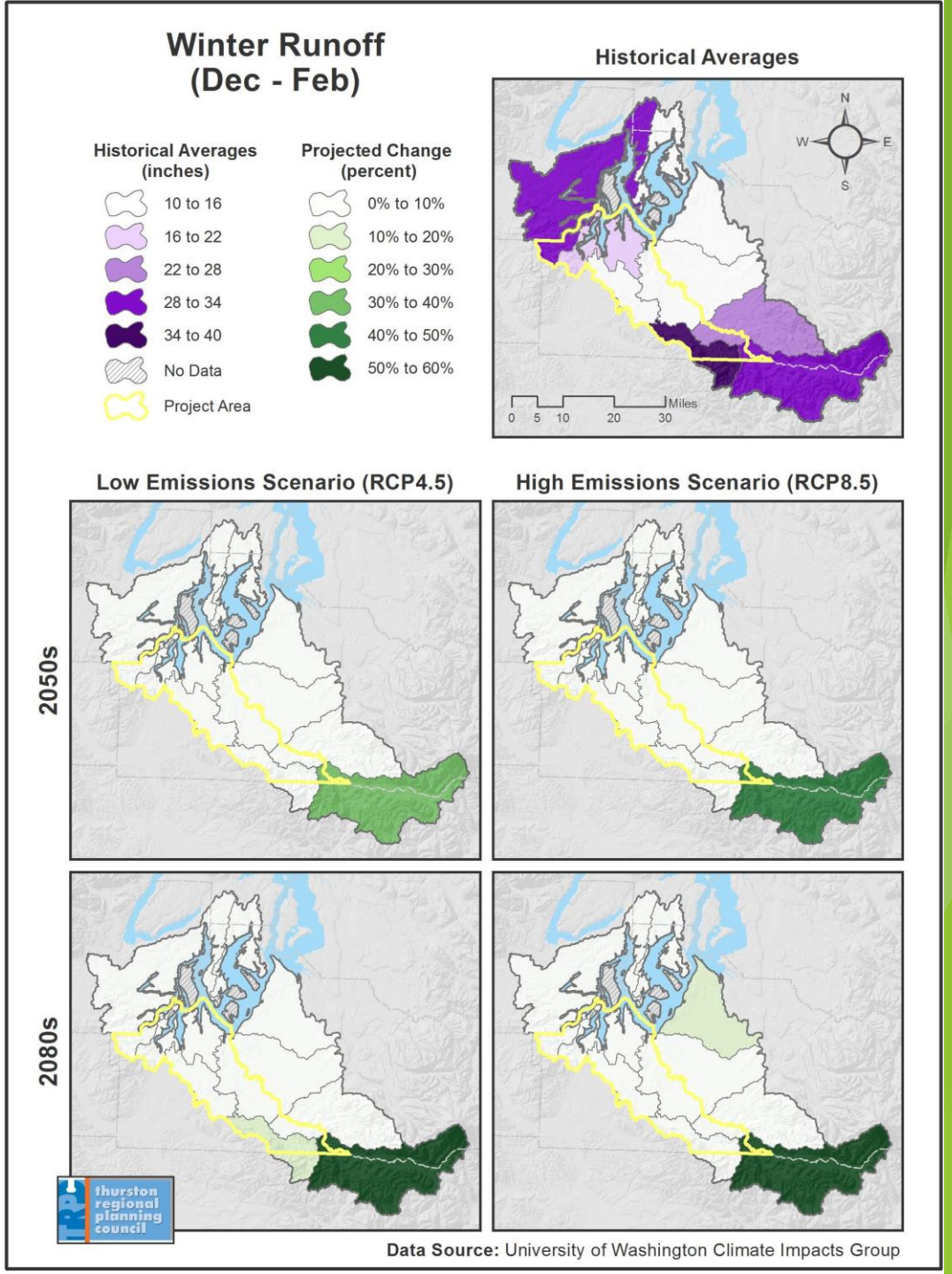
- Changes in air temperature affect the timing and type of precipitation
  - Impacts runoff and the temperature and volume of water in streams and other waterbodies
    - **Drier summers:** Lower, slow-moving flows and high temperatures stresses fish and increases competition for water among farms, utilities and other users
    - **Wetter winters:** Bigger storms scour streams, erode riparian areas and increase sediment loading — all of which degrade habitat
  - Summer streamflow projected to decrease 24-30% by the 2080s across the Puget Sound region (per avg. of low and moderate scenarios)
  - Locally, the biggest changes in summer runoff in the highland areas (due to less rain, melting snowpack/glaciers)



Streamflow (cont.)

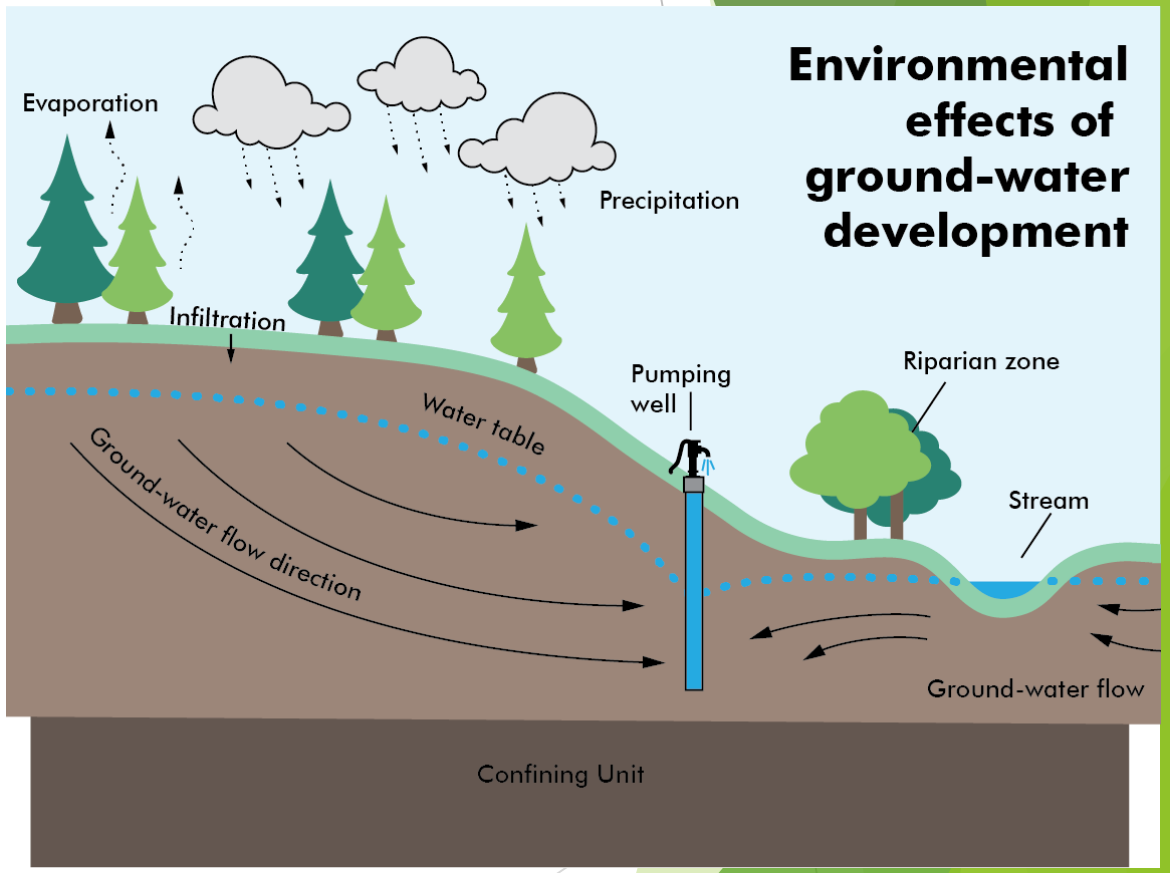
- Within South Puget Sound watersheds, winter runoff projected to *increase* the most amid highland headwaters

- Changes in seasonal precipitation, runoff and streamflow projected to affect energy supply (hydropower production) and demand across a growing region



Groundwater Quality & Quantity

- Unlikely to run out of water this century, but there are still water risks:
  - Warmer, drier summers may reduce aquifer recharge and spur more groundwater pumping when surface water is scarce.
  - Such direct and indirect climate impacts – coupled with sea-level rise – could make freshwater aquifers more vulnerable to saltwater intrusion and inundation, pathogen contamination, and overconsumption.
    - Shallow, low-producing wells most vulnerable
    - Social, economic and environmental sustainability risks



Sea-Level Rise

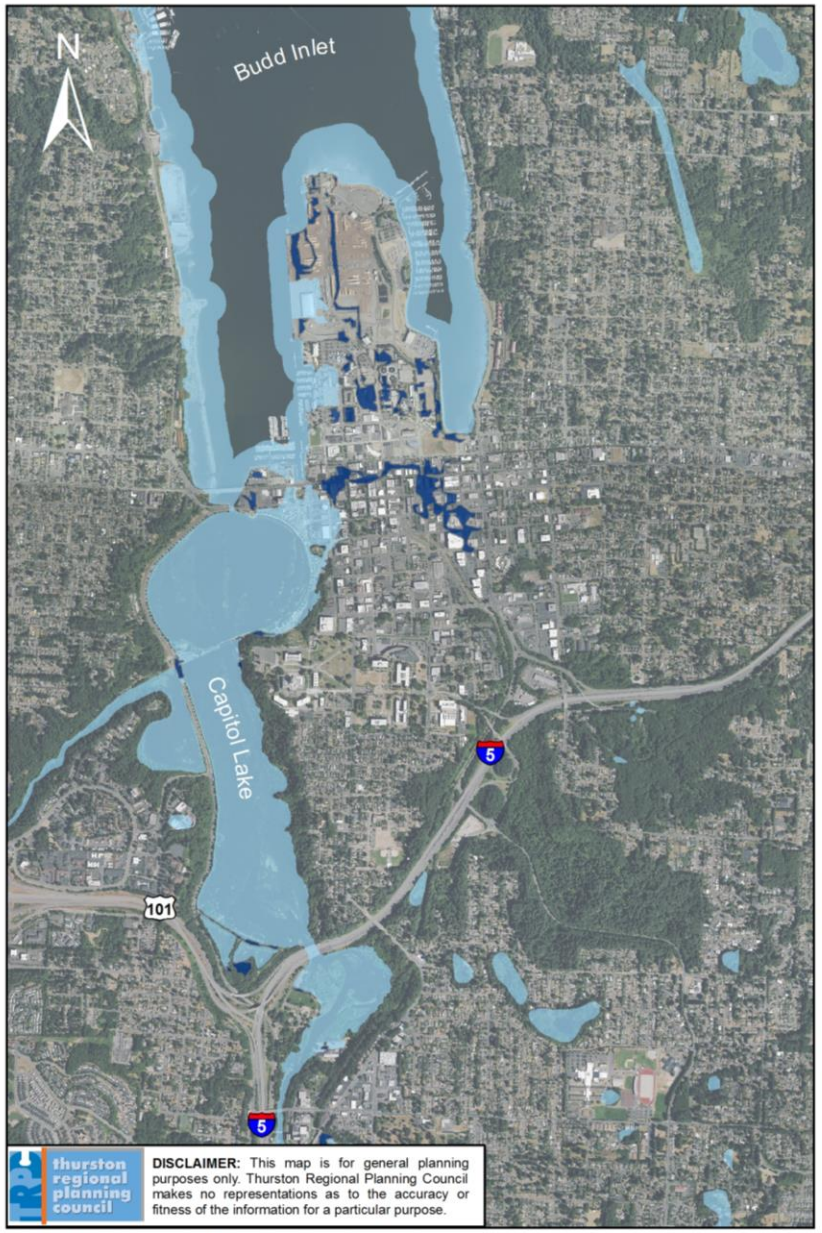
(Overview)

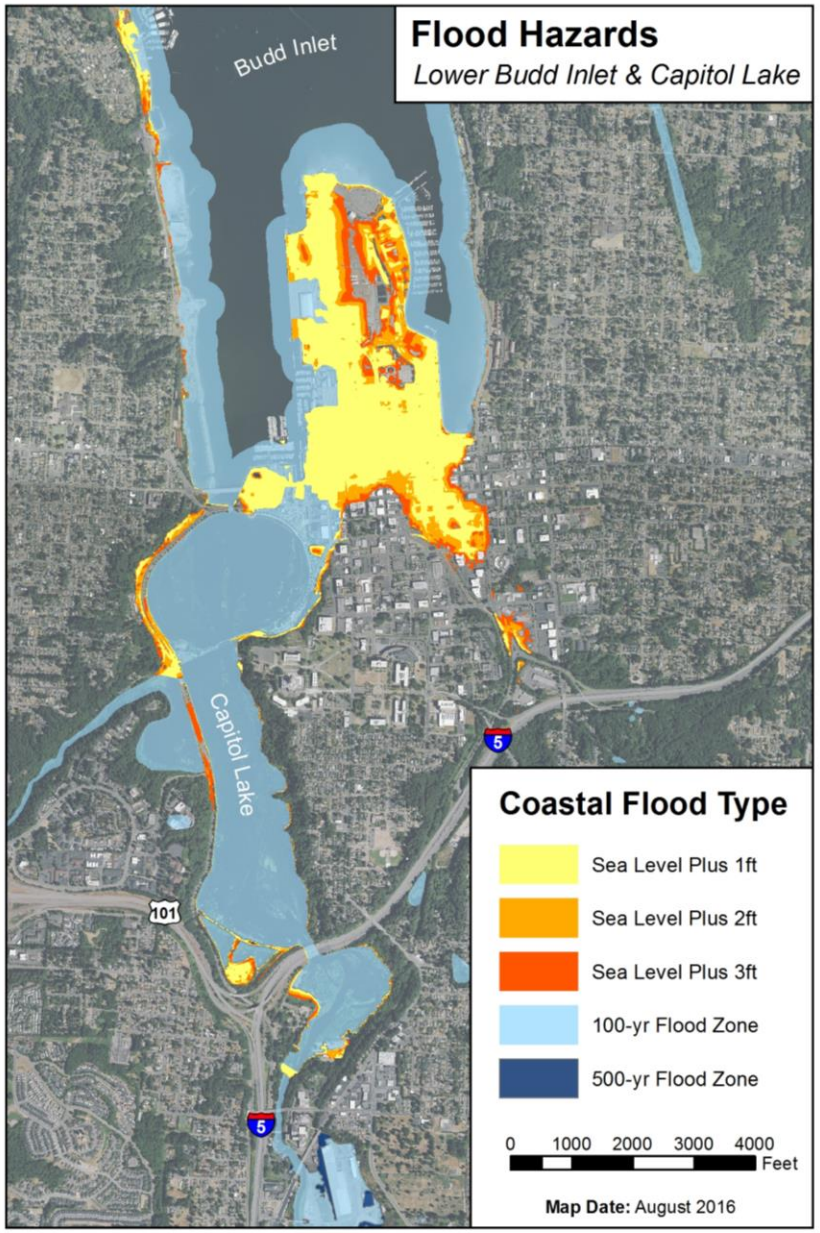
- Region faces continued SLR:
  - Projected rise of 24 inches by 2100 (range of +4” to +56”)
  - Downtown Olympia subsiding, so risk is greater than elsewhere along Thurston County coast
  - More than 65,000 acres and $1.5B in assets within Thurston County’s 100-year and 500-year floodplains (coastal and upland)

Sea-Level Rise

(Lower Budd Inlet)

- Sea-level rise expected to be worse in downtown Olympia – much of which is built on fill and subsiding
- Flooding occurs today when there is a high tide and high runoff
- Vulnerable assets include:
  - LOTT
  - Port of Olympia
  - Percival Landing
  - City Hall
  - Key east-west arterials



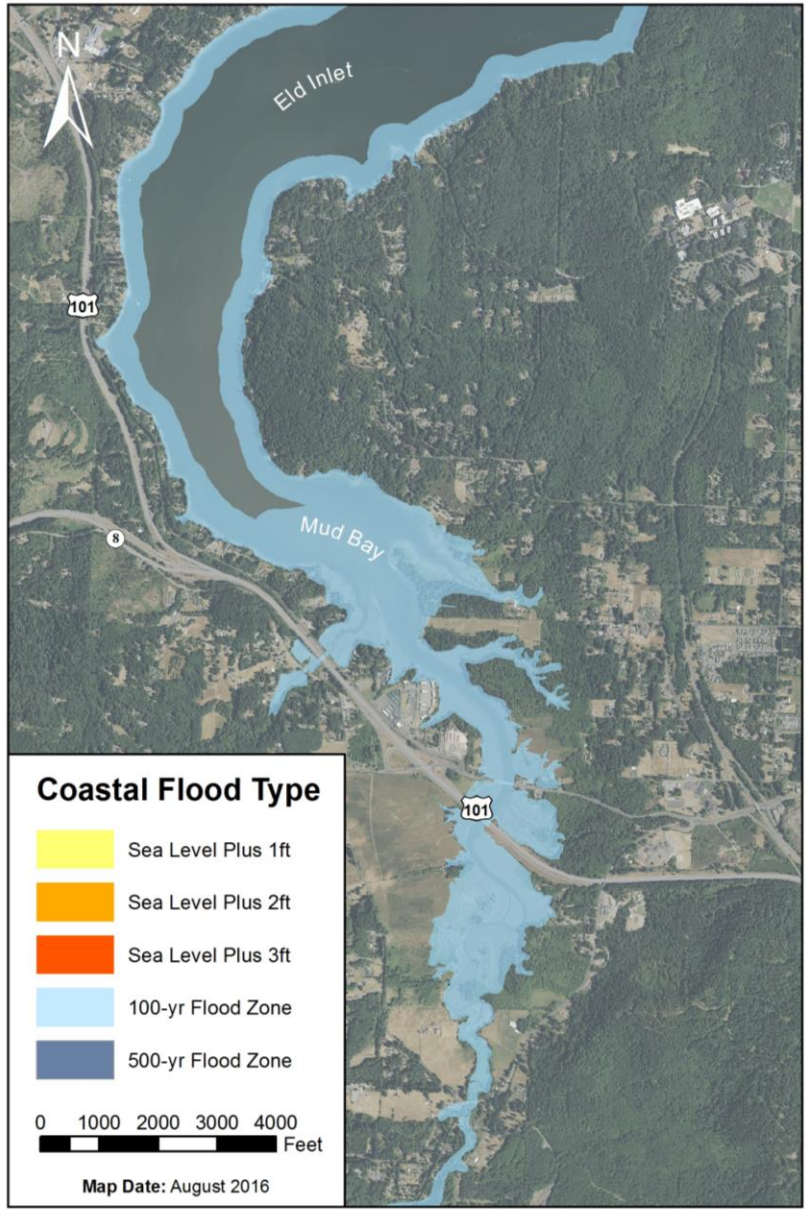


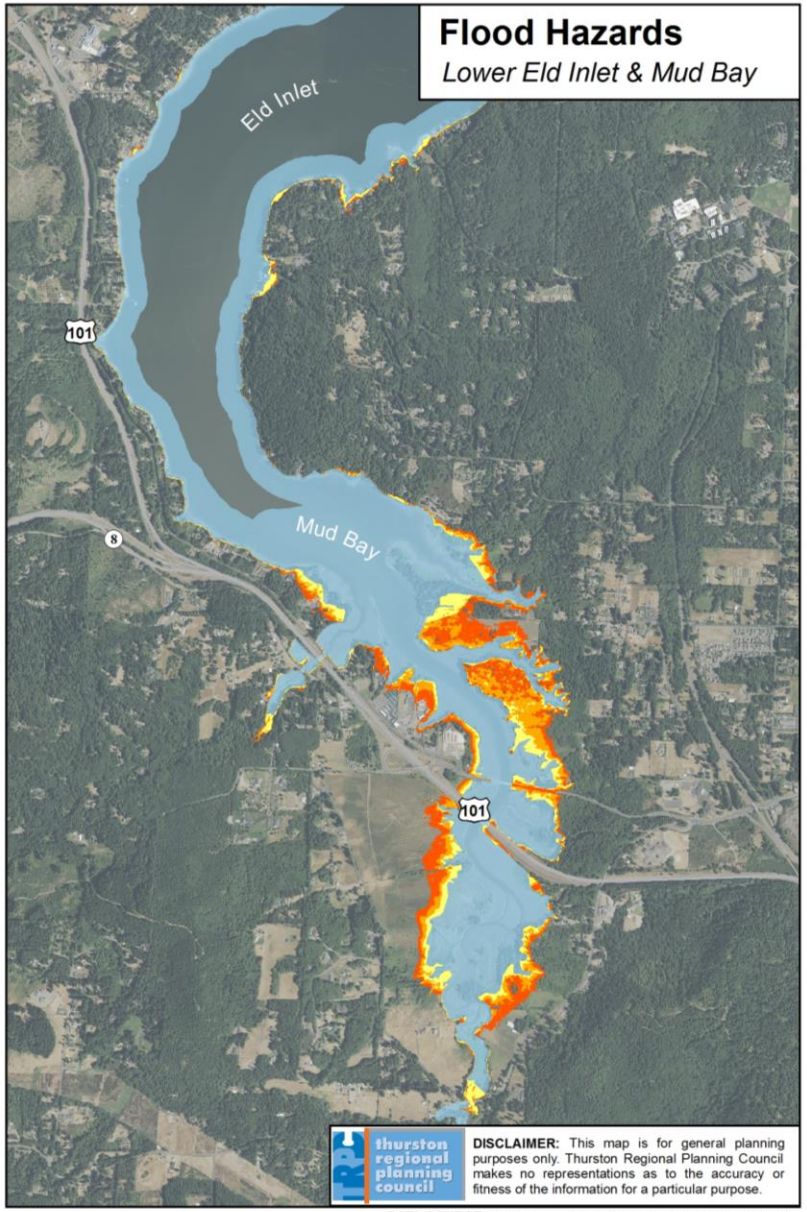
DATA SOURCE: Preliminary FEMA Flood Hazard Data, August 2016

Sea-Level Rise

(Lower Eld Inlet)

- Coastal flood risks for:
  - U.S. Highway 101's lanes and median
  - Farmland
  - Commercial and residential buildings



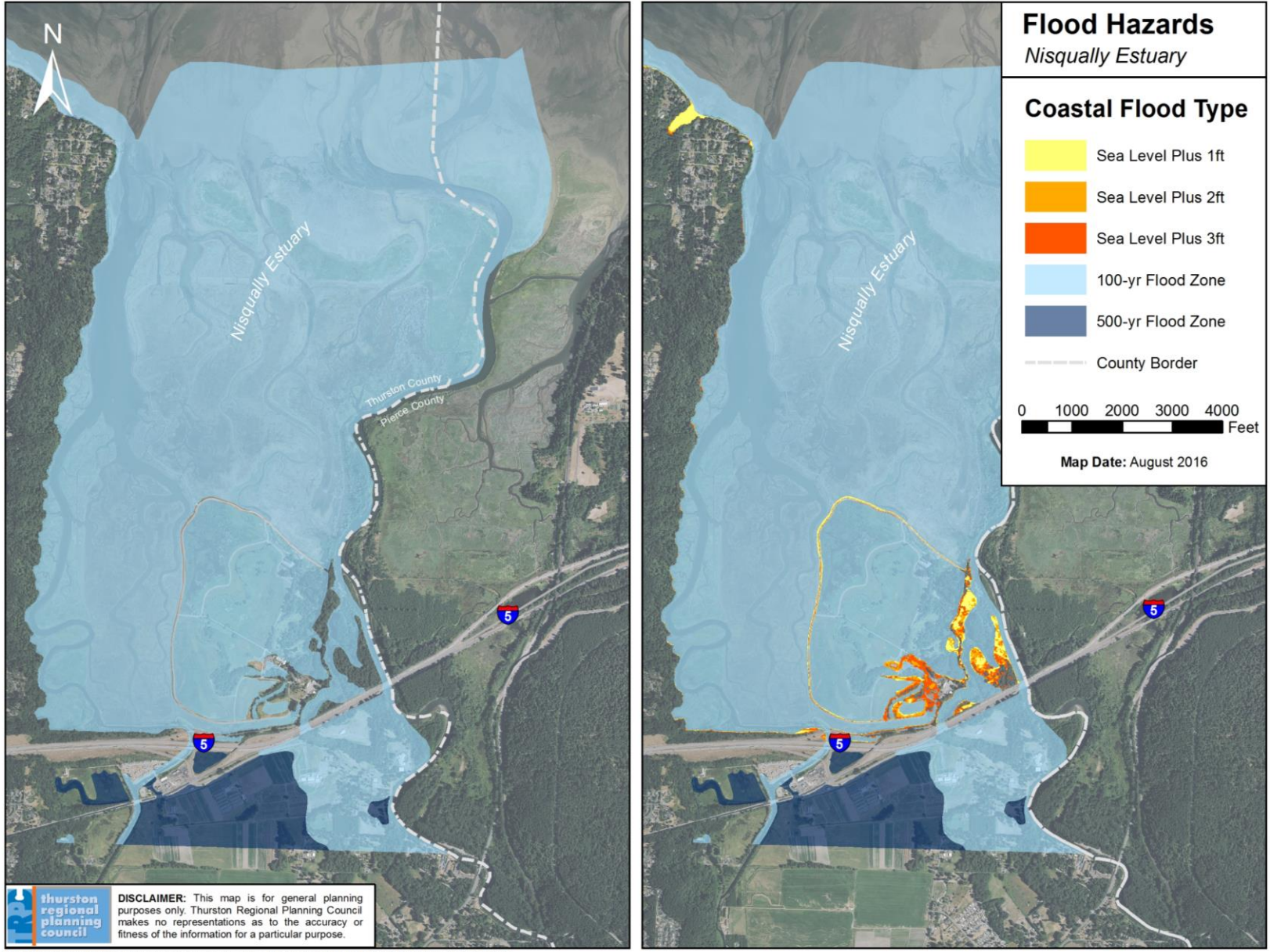


DATA SOURCE: Preliminary FEMA Flood Hazard Data, August 2016

Sea-Level Rise

(Nisqually Estuary)

- Coastal flood risks for:
  - Interstate 5 on- and off-ramps
  - Farmlands
  - Commercial and residential buildings
  - Wildlife habitat
    - Loss of wildlife refuge's marshes



DATA SOURCE: Preliminary FEMA Flood Hazard Data, August 2016. **DATA EXTENT:** Thurston County Only

Ocean Acidification & Pollution

- Ocean warming and absorbing more carbon dioxide:
  - Acidification makes it harder for calcifying organisms to make and keep shells
- Changes in ocean temperature and acidity, combined with polluted runoff, threatens region's shellfishery
  - Impacts include economic and cultural losses and health risks

Source: Wikimedia Commons

Farms & Ranches

- Region's agricultural sector expected to be relatively resilient to climate change, but there are still risks:
  - Natural hazards
  - Invasive plants and insects
  - CO2

- Changes in temperature could shape which crops farmers continue to grow and where

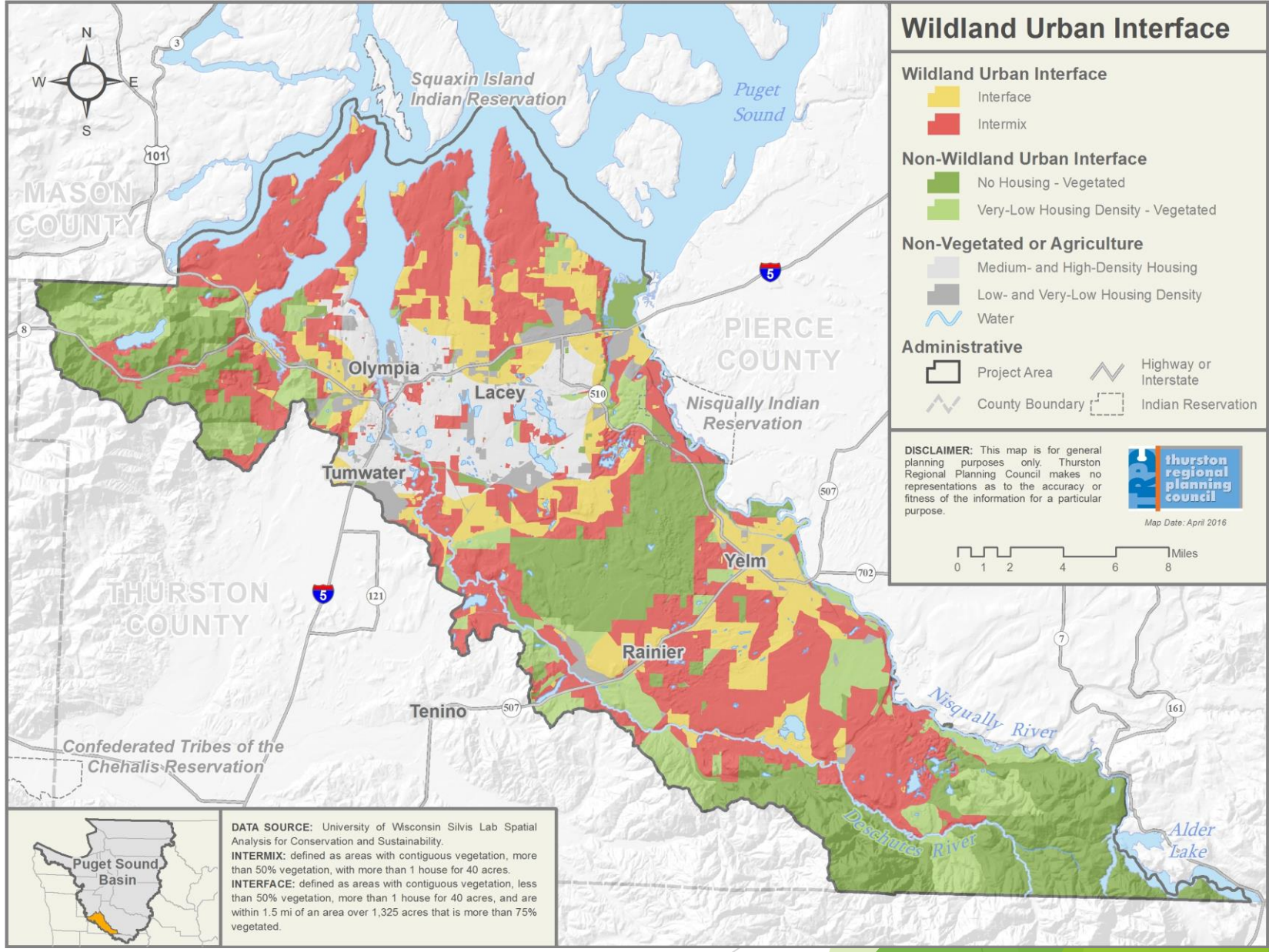
Forests & Prairies

- Changes in temperature and precipitation will affect:
  - Forest and prairie productivity and range
  - Spread of diseases and invasive insects and plants

- Vulnerable species include:
  - Prairie flowers and Garry oak
  - Douglas-fir

Wildfires

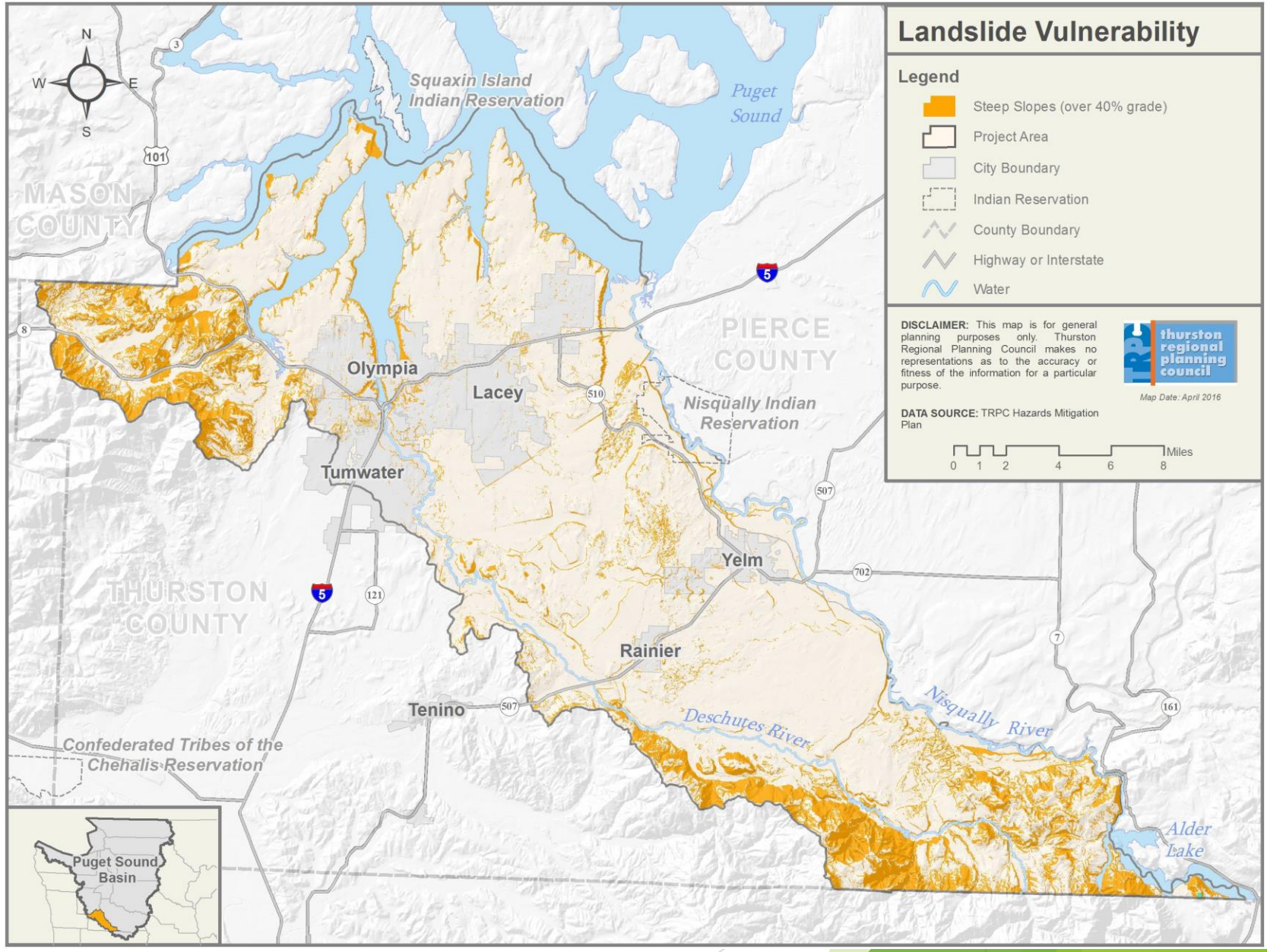
- Changes in temperature and precipitation will affect:
  - Frequency and intensity of wildfires
- Vulnerabilities:
  - Loss of life and property
  - Damage to homes and other infrastructure



Floods & Landslides

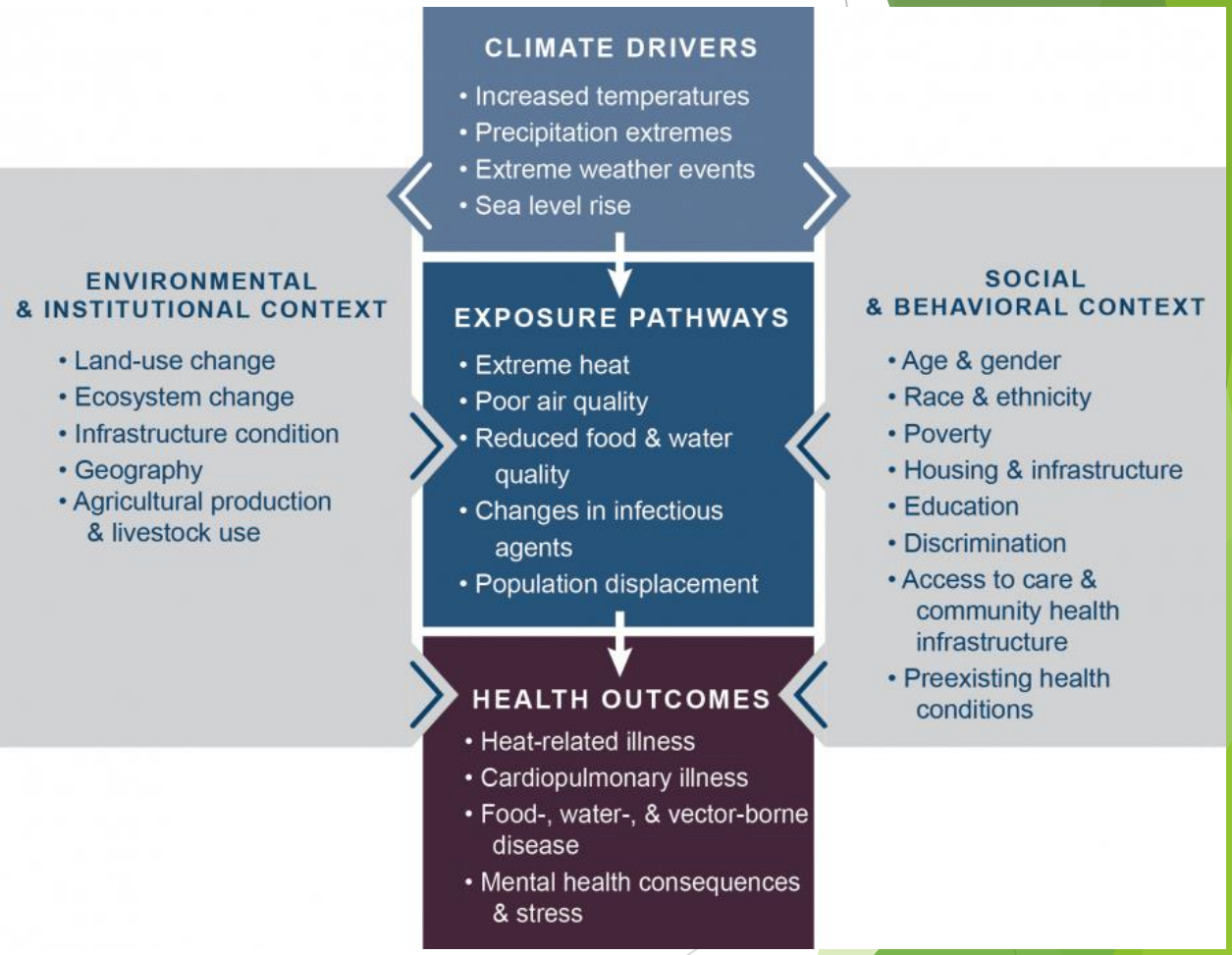
- Changes in temperature and precipitation will affect:
  - Frequency and intensity of floods and landslides

- Vulnerabilities:
  - Loss of life and property
  - Degradation of water quality
  - Spread of water-borne disease



Health & Human Welfare

- Changes in temperature and precipitation will affect:
  - Spread of existing and new diseases within region
  - Stability of vulnerable residents within and outside of the region
- Vulnerabilities:
  - Disease outbreaks
  - Population displacement



Questions?