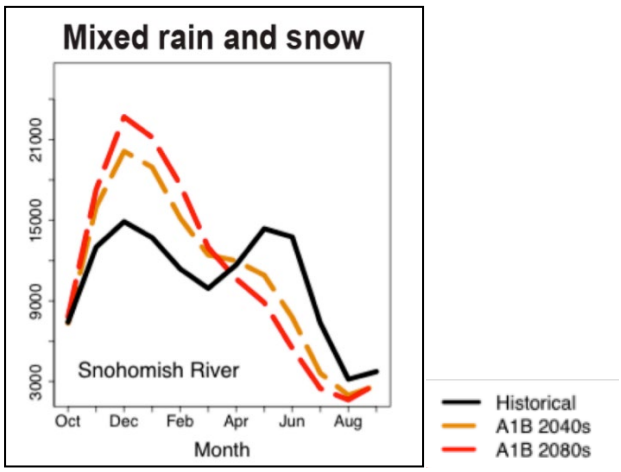
1.5.12 Climate Change Predictions, Impacts and Response

Current Condition

Figure 32. Climate Prediction for the Snohomish River into which the Snoqualmie River and Skykomish River Flow[1] (predicted flow by Cubic Feet per Second [CFS] vertical axis)



The results of extreme weather on farms in the APD have already been felt as our climate changes to a new, warmer, normal. Climate models are showing significantly increased winter flows and reduced summer flows in the next 20-60 years on the Snohomish River into which the Snoqualmie River and Skykomish River Flow (see Figure 32). And while the traditional, normal weather patterns that farmers relied upon are disrupted, farmers are on an immediate, steep learning curve to adjust planting schedules, modify varietals for annual plantings, add protections for workers, and plan for and react to a myriad of unknown weather patterns and events year-round. While many farmers are making shifts and implementing practices to accommodate the future, these weather pattern changes have had an immediate physical, mental, and economic impact on producers[2], and will continue to require substantial investment, research and educational support by agencies, universities, and other partners.

Some specialty crops are seeing earlier flowering when pollinators are less available. Summer extreme heat stress has led to scald on vegetables, leaves, tree fruit, berries, as well as lower forage production such as hay and corn, and reduced milk production. Labor & Industries (L&I) has already issued temporary emergency rules for labor when there is extreme heat and wildfire smoke and is contemplating permanent labor laws.[3] There will continue to be significant economic risk for farms with these changing weather patterns, including increased flooding and increased drought, from now on.

The Cascade snowpack has a uniquely high predominance of "warm snow" that is barely frozen, and disproportionately affected by temperature change. The Snohomish watershed, which includes the Snoqualmie and Skykomish Rivers, is considered a "mixed rain and snow basin." Such basins are predicted to experience significant increases in winter flows (November – February) and decreases in spring /summer flows from more winter precipitation falling as rain, rather than snow.[4] In addition, with more rain events and increased peak flows, modelling shows increased sediment shifts within the river which may cause flooding in new places in the APD as well as faster flows scouring flooded lands in the APD.

The year, 2015, is a tell-tale example of how our climate is expected to normalize in the next 20-40 years. A milder winter with more rain and less snow brought more winter flooding with three high flows, in January, November, and December, falling into the top eight high flows since 1995. Less snow melt led to extreme low flows in the Snoqualmie River and extensive drought in summer.

Desired Condition by 2048

Farmers have equitable and easy access to programs and funding and are implementing practices that promote agricultural resilience and mitigate climate change impacts.

Timeline

- 2024
  - Farm plans include regenerative ag practices and emergency evacuation plans
  - Workshops
    - federal disaster and crop insurance programs
  - Climate change impacts, resilience practices, and mental health education and support for farmers and farm employees
  - Develop, support, and increase farmer participation in programs that pay for carbon/capture ecosystem services and climate smart practices.
  - Support, fund, and expand Floodzilla.
- 2025
  - Conduct climate change impacts study in the APD; flood monitoring starts
  - Capital project recommendations are made based on the countywide irrigation water needs assessment.
  - Increased farmer participation in

"The ten warmest years on record have all occurred since 1998, and 2015 was the warmest year on record for Washington State since 1895. What we experienced in the Puget Sound region in 2015 was just a rehearsal of what we expect to come – warming temperatures and more extreme heat events…. These shifts will all influence the health and economic well-being of our region."[5] Western Washington is believed to be less vulnerable to climate change impacts than central and eastern Washington overall, though local agricultural adaptations will still face challenges. The Agriculture Resilience Plan for Snohomish County provided a striking context, using WSU climate modelling, that by the 2040s the area is predicted, "to have similar growing conditions to Santa Cruz County, CA, just south of San Jose."[6] Due to climate change, Puget Sound agriculture is generally projected to experience, "a lengthening of the growing season, shifts in crop production, increasing water supply challenges, changing risks from pests, increasing winter flood risk…. … [Impacts will] vary by production type but generally point to increasing suitability of some crops (e.g., grapes) and declining suitability of others (e.g., berries) ..."[7] Heat stress may also decrease livestock health and increase parasites, with drier summers impacting forage quality and quantity. For the Snoqualmie Valley APD, climate change will exacerbate many existing environmental issues for agriculture, such as increased flooding, periods of drought, and extreme heat and will likely drive changes in crop selection, livestock care, and production methods. Facing these numerous changes will require substantial investment by farmers and service providers as well as increased funding to ensure continued food production and food security.[8] While farms in the SVAPD face many challenges with climate change, they also offer many climate change solutions. USDA states, "The American agriculture sector has an incredible potential to reduce greenhouse gas emissions, sequester carbon, and deliver lasting solutions to the climate crisis. America's producers are already leading the way…thanks to their voluntary conservation efforts".[9] Many producers are already implementing "climate -smart conservation practices such as no-till, cover crops, prescribed grazing, and silvopasture. This empowers producers to both strengthen their operation's resilience to climate-related disaster events while leveraging their land's potential to sequester and store carbon, thereby delivering lasting climate solutions".[10]	○ federal disaster insurance programs and in federal crop insurance programs ○ climate resilient programs and practices • 2026 • First manure lagoon conversion for irrigation storage. • Study completed for infrastructure vulnerability especially from increased flooding. • Expand broadband service in APD • Funding plan and research underway for new practices. • Pilot for upland water storage complete. • King County emergency systems in place for continuity of farm productivity during climate change • 2035: Increased farmer participation in insurance and resilient programs and practices • 2036-2048: Remaining actions in progress and adjustments made based on research and trials.

Background	Service Providers	Priority
Predictions from modelling by UW Climate Impacts Group and WSU Center for Sustainable Agriculture and Natural Resources (CSANR) indicate a need for an area-specific study of climate change impacts on farming in the APD, including 2-D modeling and flood hazard planning, evaluation of water supplies to buffer low-flow periods, developing infrastructure, and education, information, and funding to support agricultural transitions in crop varieties and improved livestock resilience. While flooding frequency has not changed significantly in the last 30 years on the Snoqualmie River (see Figure 34 and 35), the SVWID's study on Cherry Creek tells another story (Figure 36).[11] Annual peak flows in Cherry Creek show the largest historic flows since 1945 occurring in 2019 and 2020. While there have been studies to collect information on flow changes or inundation levels on farms in the SVAPD, more information and completing recommendations from those studies is needed.	Lead ○ King County Agriculture Program Partners ○ King Conservation District ○ University of Washington ○ Washington State University	HIGH

With UW flood modeling pointing to increased winter flows of 30-40% on the Snoqualmie River[12], planning for flood safety and access to farm pads and high ground will be extremely important. 2-D modeling to highlight areas of inundation concern and potentially point to new flood storage capacity is needed. See the WSU climate change model, Map 17, showing projected inundation from flooding in the SVAPD. Many regions of the U.S. will experience worse climate change impacts than the Puget Sound, and King County farms may need to produce more food to ensure food security for the region[13] just as SVAPD farms were instrumental in supporting direct to consumer sales through the Covid-19 pandemic. Because of climate change, farmland preservation and a thriving agriculture sector in the SVAPD will become even more important.	○ SV Watershed Improvement District ○ SnoValley Tilth ○ KC Emergency Management	

Strategies

- Conduct a climate change impact assessment for agriculture in the Snoqualmie Valley APD (SCAP).
- Prepare farm plans that stress regenerative agriculture and that incorporate emergency evacuations (SCAP).
- Examine infrastructure vulnerability, especially from increased flooding (SCAP).
- Develop capital project recommendations based on the countywide irrigation water needs assessment (SCAP).
- Increase farm participation in federal disaster insurance programs (SCAP) and in federal crop insurance programs.
- Assess carbon sequestration and climate change mitigation potential of agricultural land in the SVAPD.
- Develop and support programs that reward and pay farmers for climate smart practices and ecosystem services.
- Increase farm participation in local, state, and federal programs where farms are paid for carbon capture/ecosystem services such as USDA NRCS Conservation Service Program (CSP) Climate-smart conservation activities including Soil Health , Nitrogen Management, Livestock Waste Management, and Grazing Land Management with minimum payments of $1,500 annually for compost use, cover cropping, etc.
- Increase financial support to help farmers implement environmentally sound practices that may require service providers to conduct costly studies/analyses of the property in order to meet FEMA and Surface Water Design Manual Requirements (i.e. engineers to conduct a drainage review).
- Increase climate change impacts education workshops and mental health support for farmers and farm employees.
- Support, fund, and expand Floodzilla flood monitoring system to ensure flood data collection and community-wide data remain accessible to all Floodzilla users and to ensure the community-based flood monitoring program is completely built-out, updated, and operational for the next 25 years.
- Expand broadband service to the APD in order to aid reliance and usage of technology such as Floodzilla, and precision farming practices.
- Develop funding plan and secure funding to research, design, test, trial, and implement new practices such as:
  - Dry-farming techniques to evaluate their efficacy in local climates for drought-resistant crops.
  - Seed bank resource; assess existing varietals and/or heirlooms for climate-change-resistant genes.
  - Livestock resiliency through environmental, nutritional, and breeding interventions.
  - Heat-resistant crops; begin advance cultivation of new climate-resilient crop varieties (viticulture; hemp).
  - Infrastructure for processing new crop alternatives.
- Pilot water storage and sediment removal in lakes to increase floodplain comprehensive storage for farm pads, clarify King County and FEMA regulations and examine flexibility in regulations, modify regulations as needed.
- Pilot water storage in the uplands, to increase flows in summer for irrigation and fish and to decrease flood impacts.
- Pilot manure lagoon conversion to water storage for irrigation.
- Put King County emergency systems in place such as emergency building permits, emergency water deliveries, emergency local garbage collection sites, emergency activation of Monroe Fairgrounds and Enumclaw Expo for animal holding, etc. to accommodate farming so that food production continues in the midst of changing weather norms, extreme weather events, and ultimately climate change.

Figure 33. Monthly average naturalized flows for the Snoqualmie River near Snoqualmie for the 1980s (1970-1999) and the 2080s (2070-2099). The Representative Concentration Pathways (RCPs) are a set of four new pathways developed for the climate modeling community as a basis for long-term and near-term modeling experiments.[14] RCP 4.5 Dynamical Downscaling plot shows the results for just one model (ACCESS 1.0). The other three plots show the median, minimum, and maximum for all DHSVM simulations. A separate line is included in the RCP 8.5 Dynamical Downscaling plot for the GFDL CM3 results.[15]

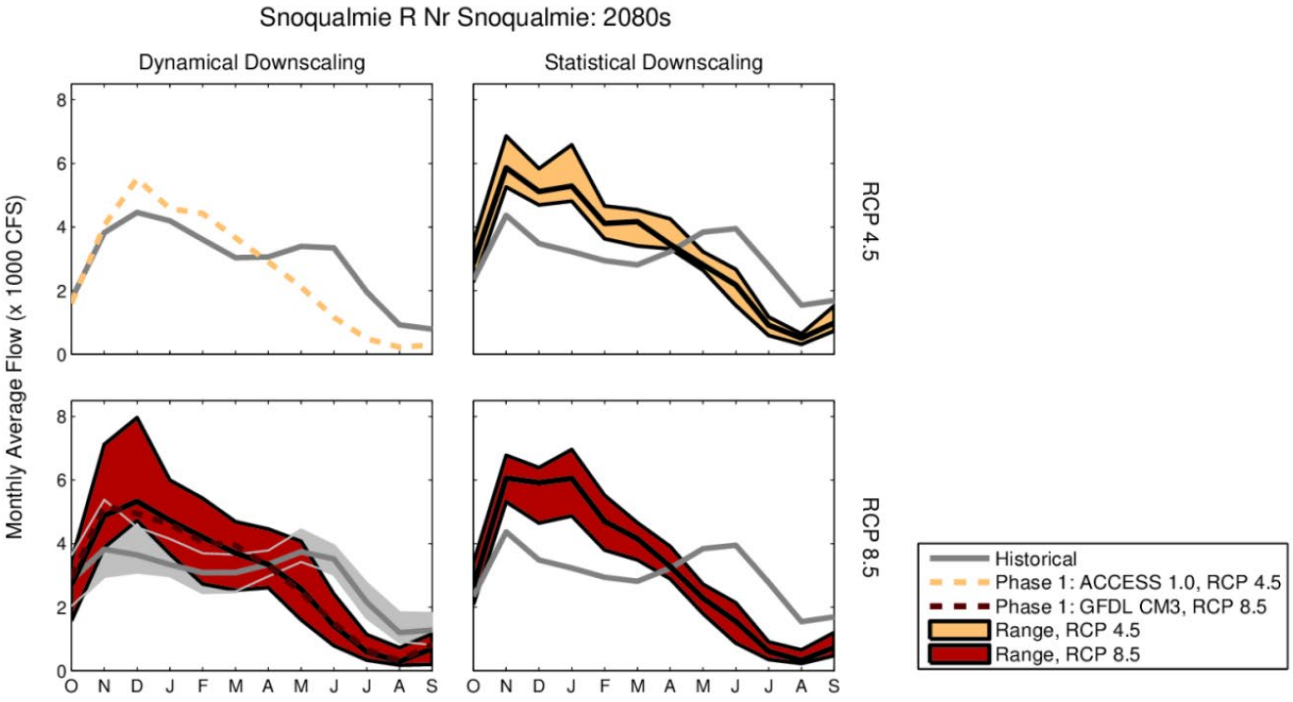


Figure 34. Recent High Flow Data (in CFS) Since 1995: Snoqualmie River near Carnation

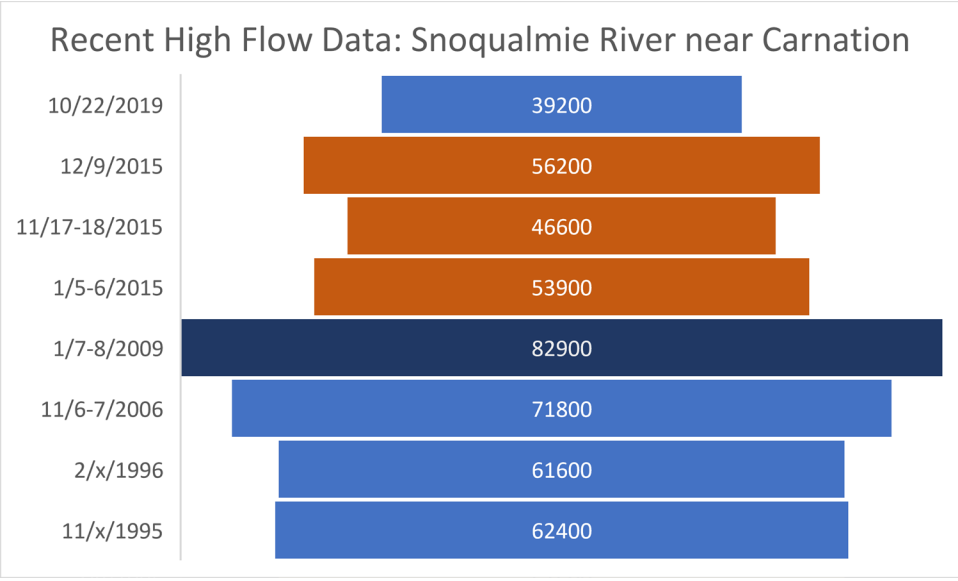


Figure 35. Number of Times Flood Levels Have Been Reached in each 3-year Period (1988-2021): Snoqualmie River near Carnation (USGS 12149000 Flow Gage)

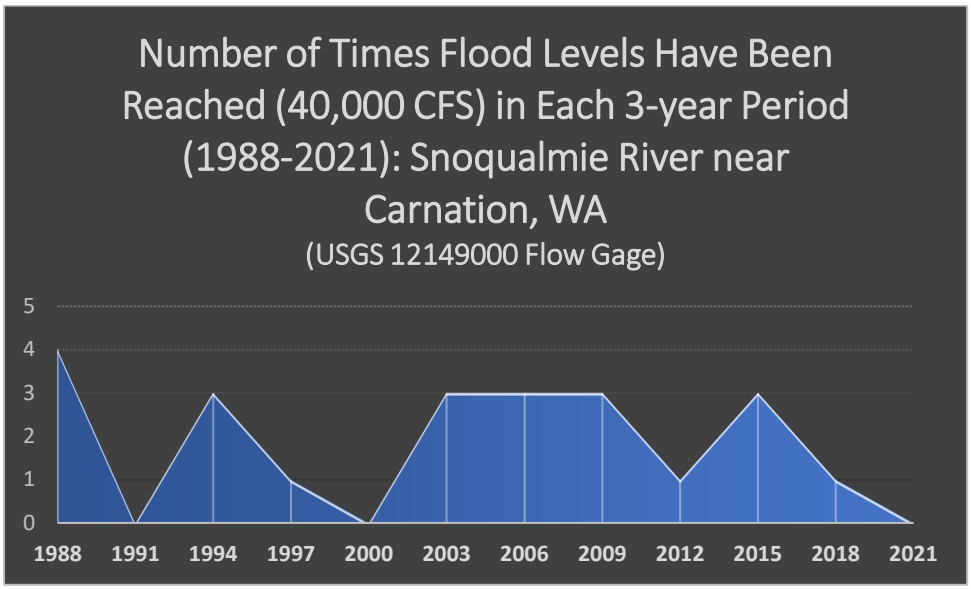
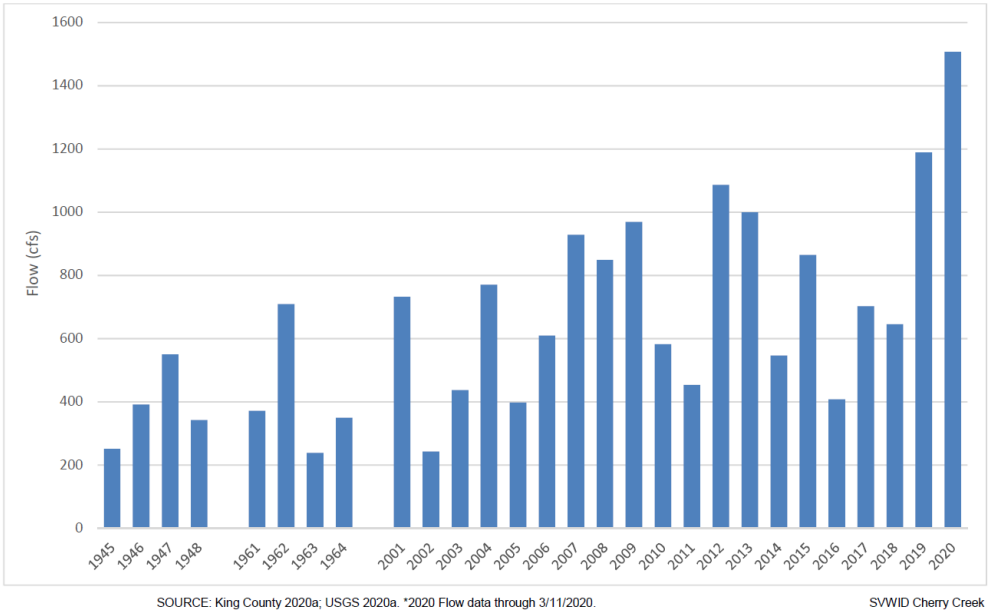
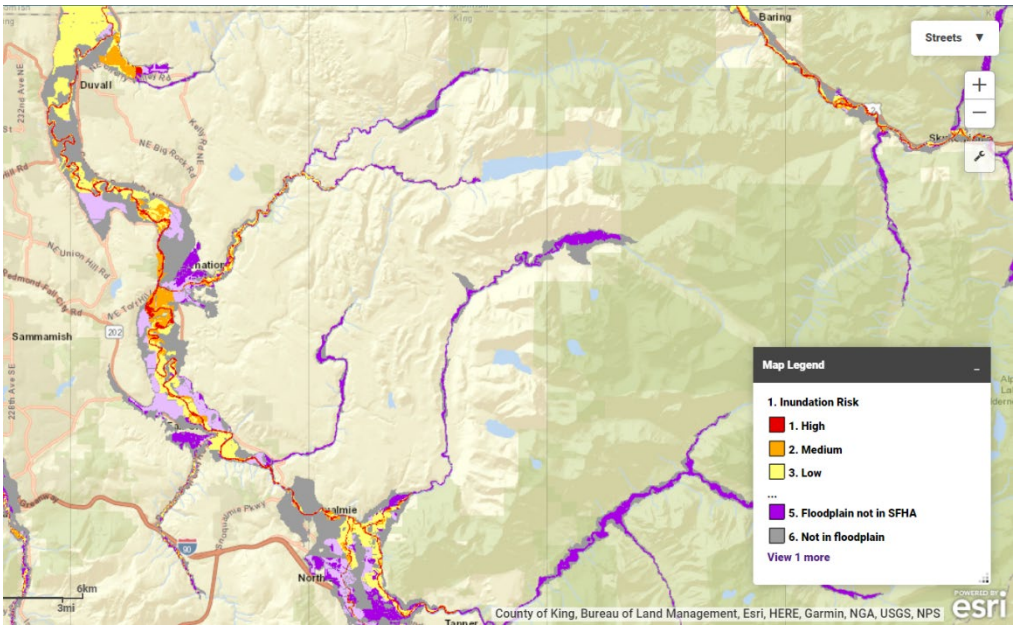


Figure 36. Annual Peak Flows from SVWID's Cherry Creek Basin Study: 19445-2020



Map 17. Inundation Risk Map: Climate Projection for Flooding[16]



[1] Mauger, G.S. et. al, "State of Knowledge: Climate Change in Puget Sound," Climate Impacts Group, University of Washington, 2015. Prepared for the Puget Sound Partnership and NOAA. doi: 10.7915/CIG93777D [LINK]. Accessed 8/27/21. Page ES-4 (14).

[2] Howard, M., Ahmed, S., Lachapelle, P., & Schure, M. B. (2020). Farmer and rancher perceptions of climate change and their relationships with mental health. Journal of Rural Mental Health, 44(2), 87–95. [LINK]. Accessed 2/22/22.

[3] Washington State Department of Labor & Industries, "Questions and Answers: Temporary Emergency Rules for Working in Extreme Heat Conditions," publication F417-292-000 [08-2021]; August 2021. [LINK]; and "Wildfire Smoke Workplace Safety & Health Rulemaking," [LINK]. Accessed 10/5/21.

[4] Mauger, G.S. et. al, "State of Knowledge: Climate Change in Puget Sound," Ibid. Page 6-4 (50).

[5]The Nature Conservancy and UW Climate Impacts Group, "Adapting to Change: Climate Impacts and Innovation in Puget Sound," April 2016. [LINK] Accessed 2/16/22. Page Preface (2).

7 Snohomish Conservation District, "Agriculture Resilience Plan for Snohomish County," December 2019. [LINK]. Page x. Accessed 9/7/2021.

[7] The Nature Conservancy and UW Climate Impacts Group, "Adapting to Change: Climate Impacts and Innovation in Puget Sound," April 2016. [LINK] Accessed 2/16/22. Page Preface (2)

[8] Mauger, G.S. et. al, "State of Knowledge: Climate Change in Puget Sound," Ibid. Page 8-6 - 8-7 (128-129)

[9] USDA, "Climate Solutions."[LINK]. Accessed 4/10/23.

[10] Ibid.

[11] Environmental Science Associates, "Memorandum: Cherry Creek Basin Study," September 2020. Prepared for the Snoqualmie Valley Watershed Improvement District. Pages 8, 9, 11, 12.

[12] Se-Yeun, L., Mauger, G., and Won, J., 2018. "Effect of Climate Change on Flooding in King County Rivers: Using New Regional Climate Model Simulations to Quantify Changes in Flood Risk," 2018. Page 46. Prepared for King County Flood Control District. University of Washington Climate Impacts Group.

[13] IPCC, 2022: *Climate Change 2022: Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press. [LINK]. Accessed 3/3/22. Page 5-134 [959].

[14] Van Veuren, D. et al, "The representative concentration pathways: an overview" August 5, 2011. [LINK]. Accessed 3.24.23.

[15] Mauger, G.S. and Won, J. "Projecting Future High Flows on King County Rivers: Phase 2," Climate Impacts Group, University of Washington, 2020. Prepared for King County Flood Control District. [LINK] Accessed 3/22/22. Page 6 (7).

[16] Snohomish Conservation District, "Inundation Risk" in "Climate Change: Impact Assessment - Results/Tools: Flooding Prediction Tool," Agriculture Resilience Plan for Snohomish County, December 2019. [LINK]. Accessed 2/15/2022.