Title: Scenarios assessing the effects of land-use change, forest management, and climate change on Puget Sound hydrologic regimes and freshwater habitat quality.

Halama, Jonathan, US EPA, Halama.Jonathan@epa.gov, ORCiD 0000-0003-3862-7629

McKane, Bob, US EPA, Mckane.Bob@epa.gov

Allen Brookes, US EPA, Brookes.Allen@epa.gov

Chokshi, Sonali, US EPA through ORAU, Chokshi.Sonali@epa.gov

Djang, Kevin, US EPA through Inoventures LLC, Djang.Kevin@epa.gov

Bogue, Kevin, University of Washington, kbogue13@uw.edu

North, Phillip, Tulalip Tribe, pnorth@tulaliptribes-nsn.gov

Hinton, Steven, Tulalip Tribe, shinton@tulaliptribes-nsn.gov

McDermott, Jacob, Tulalip Tribe, jmcdermott@tulaliptribes-nsn.gov

Totman, Michelle, Tulalip Tribe, mtotman@tulaliptribes-nsn.gov

Murphy, Philip, InfoHarvest Inc., philip.murphy@infoharvest.com

Abstract

Across the Pacific Northwest late summer stream temperatures are increasing while stream flows are becoming extremely low. Stream nutrient and contaminant loadings from diverse sources are also on the rise. These environmental shifts have direct impacts on aquatic systems and all pose a rising threat to the health of human communities and aquatic life (e.g., populations of Coho Salmon, Chinook Salmon, and Orca listed under the Endangered Species Act (ESA)). We are applying the ecohydrology model Visualizing Ecosystem Land Management Assessments (VELMA) as an ecosystem services tool to help inform mitigation of these effects. VELMA simulations can estimate impacts from climate change, land-use change, and other increasingly frequent extreme events. Extending from existing regional Tribal and partner experience with VELMA, we are co-developing best management practices (BMPs) through watershed scale simulations that estimate the long-term impacts from changes in land-use change and climate.

A recently initiated multi-institutional modeling effort called Puget Sound Integrated Modeling Framework (PSIMF) has been launched to identify practical, proactive watershed restoration strategies that can be started now to lessen long-term extreme impacts of climate and land-use change on Puget Sound communities. This research includes coupling of the University of Washington's Land Cover Change Model (LCCM) to provide dynamic land-use change inputs to VELMA. VELMA simulations being developed under PSIMF address projected trends for years 2024 through 2100 for landscape scale disturbances including: 1) historic forest management and fires, 2) land-use change (i.e., forestry to agricultural, and agricultural to urban), 3) projected forest fires frequency and intensity and alternative forest management practices, and 4) applies representative concentration pathway (RCP) 4.5 and RCP 8.5 climate change projections out to 2100.

Presented here are Snohomish River watershed (4807 km^2) results comparing simulated to observed watershed discharge and nutrient loadings between 1990 and 2023. Also presented are alternative scenario results aim to assess aquatic systems and human health impacts. This effort aims to inform remediation, restoration, and revitalization (R2R2R) toward all Puget Sound communities but is particularly pertinent to tribal communities and the salmonid populations essential to their sustenance, health, and culture. The broader focus of this work targets 24 Salish Sea salmonid-bearing watersheds that the tribes and State of Washington co-manage for salmon recovery and habitat protection. Through the PSIMF effort we aim to mitigate the impact of these trends and extreme events on Puget Sound aquatic systems and expanding human population.