Implementing Oregon's Statewide Strategy: Using Flow Prescriptions to Protect Instream Needs While Developing New Water Storage

Rachel LovellFord[1], Danette Faucera[2], Tim Hardin[2], Smita Mehta[3], Wade Peerman[3], and Heather Tugaw[3]

[1]Oregon Water Resources Department, Salem, OR, Rachel.M.LovellFord@state.or.us; [2]Oregon Department of Fish and Wildlife, Salem, OR; [3]Oregon Department of Environmental Quality, Portland, OR

Background: Meeting Instream and Out-of-Stream Needs

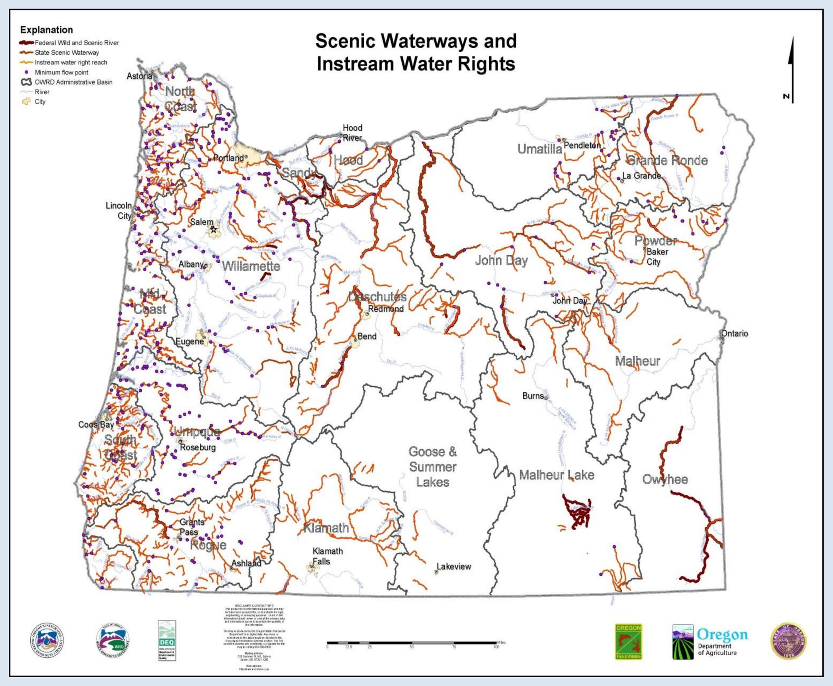

Figure 1. Oregon has protected Existing instream water rights (fish, wildlife, recreation, and pollution abatement) and Scenic Waterways as of 2010.

The Evolution of Instream Protections and Oregon's Integrated Water Resources Strategy

Although Oregon is a recognized leader in protecting instream flow (Figure 1), increasing water demand has sparked the need for a wider array of tools to bolster water supplies while continuing to protect ecological functions.

In 2012, the state of Oregon adopted the Integrated Water Resources Strategy (IWRS) in order to develop actions to meet instream and out-of-stream water needs. The IWRS also provides a blueprint to help the state better understand its water quantity, water quality, and ecological needs, while taking into account forthcoming pressures such as climate change, population growth, and land use changes.

Why New Storage in Oregon? A Mismatch in Timing of Supply and Demand

Statewide water demand is expected to increase during periods when supply is already limited (Figures 2-5). Although other activities can bolster summer water availability, storage to meet peak water demands remains a crucial component in meeting Oregon's water supply needs.

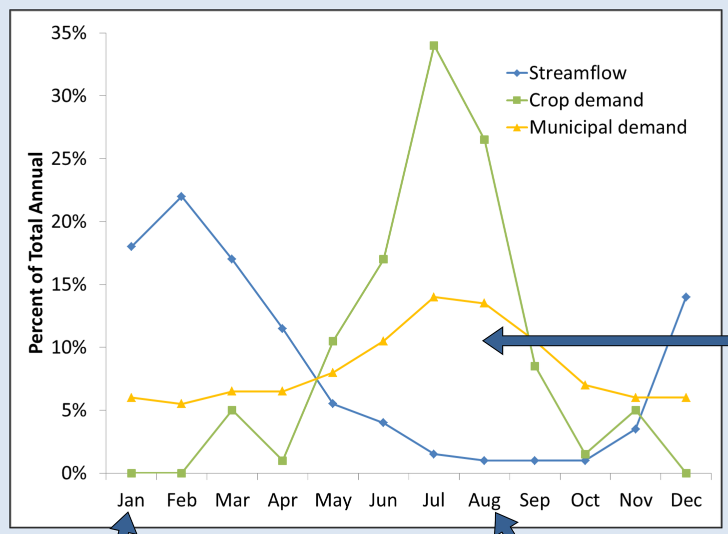

Figure 2. Typical timing of streamflow and water demand in Oregon.

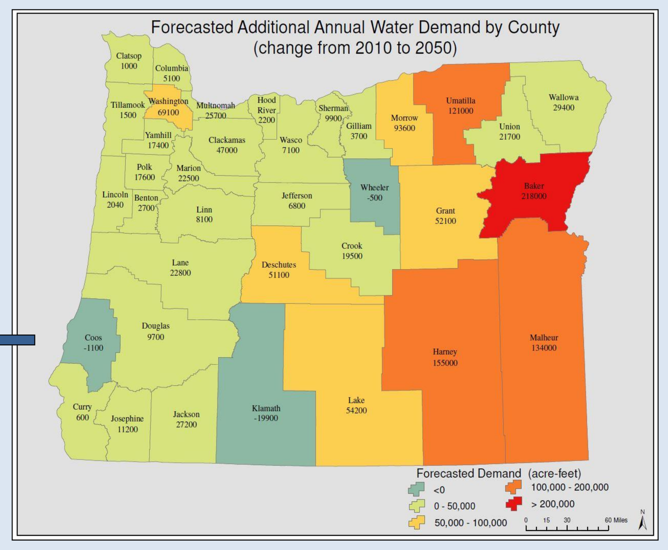

Figure 3. Forecasted change in annual statewide water demand from 2010 to 2050 for an overall increase of 1.2 million acre-feet (OWRD 2008).

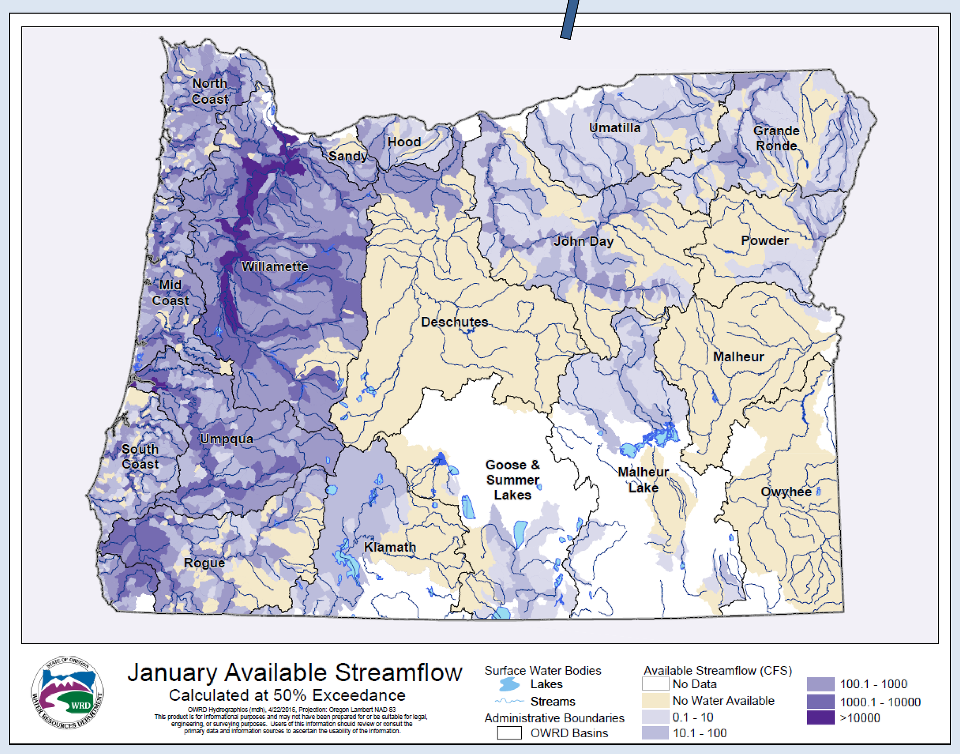

Figure 4. Water available for storage allocation in the month of January (OWRD 2015).

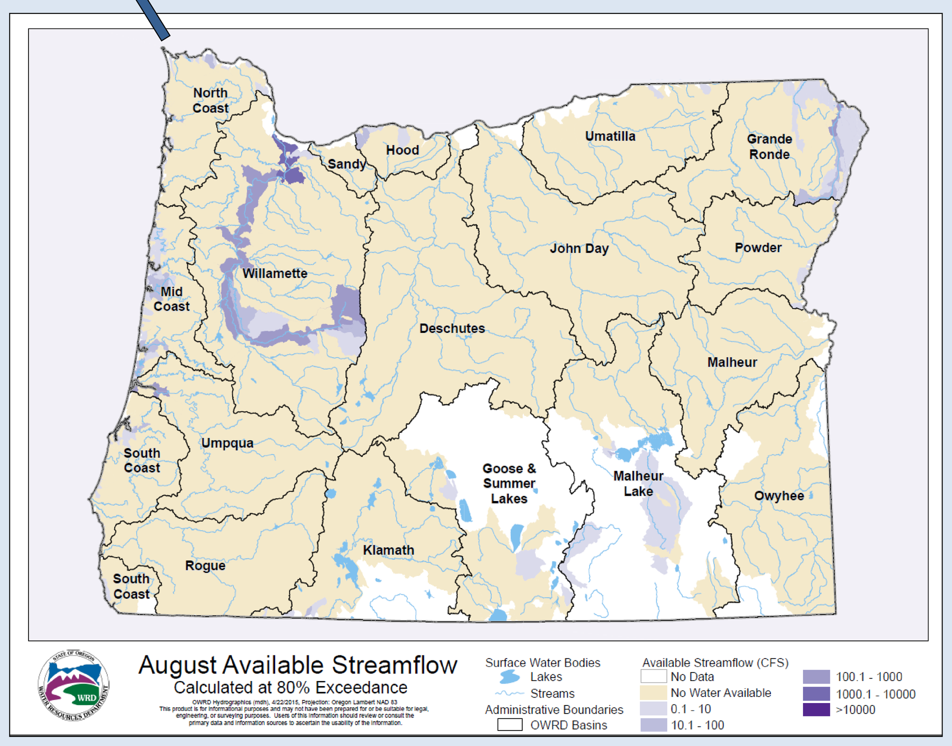

Figure 5. Water available for live flow allocation in the month of August (OWRD 2015).

Senate Bill 839 and Seasonally Varying Flows (SVF)

In the spirit of the IWRS, members of Oregon's legislature worked with a consortium of water users and conservation groups to develop a funding program for water development projects that also protect various ecologically important flows (SB 839, 2013). In 2014, a report outlining scientific approaches to the SVF method was developed by a task force of Oregon-based environmental flow experts (SVF Science Sub-Group 2014).

Water supply projects that **receive funding from the state and are on a perennial stream, divert more than 500 acre-feet, or divert water from a stream supporting a sensitive, threatened, or endangered fish species** must contain an SVF prescription.

SVFs are described as the duration, timing, frequency, and volume of flows identified for the purpose of determining conditions for a new or expanded storage project that must remain instream outside of the official irrigation season in order to protect and **maintain the biological, ecological and physical functions of the watershed** downstream of the point of diversion, with due regard given to the need for balancing these functions against the need to store and divert water for multiple purposes.

Methods: Development of Seasonally Varying Flow Prescriptions

Step 1

Describe Ecological Context and Identify Elements for Analysis

Assess qualified project applications based on:

- Geographic scope and reach location
- Geomorphic context
- Target species and habitat/water quality needs (Figures 6 and 7)
- Existing water use and allocation
- Amount of requested storage

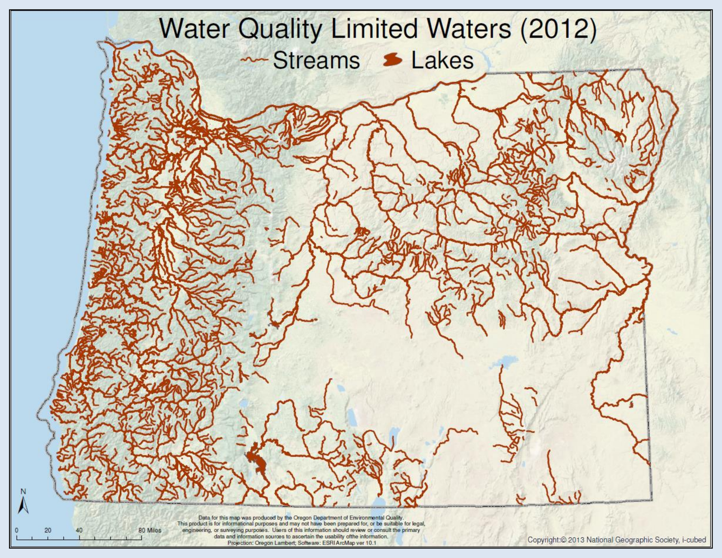

Figure 6. Preliminary 2012 water quality limited streams identified by DEQ. Streams may or may not have met regulatory requirements (DEQ 2012).

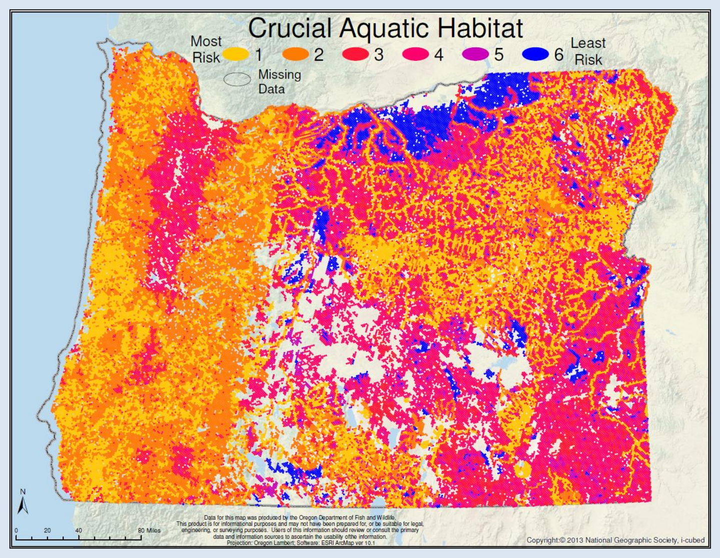

Figure 7. Mapping of aquatic crucial habitat from ODFW's component of the Western Governors' Association Crucial Habitat Assessment Tool project. (ODFW 2015).

Step 2

Compile Data and Conduct Evaluations

Assemble relevant data for the proposed project area and develop flow-function hypotheses (Figure 8) that consider:

- Hydrology
- Physical Processes
- Hydraulics
- Biology

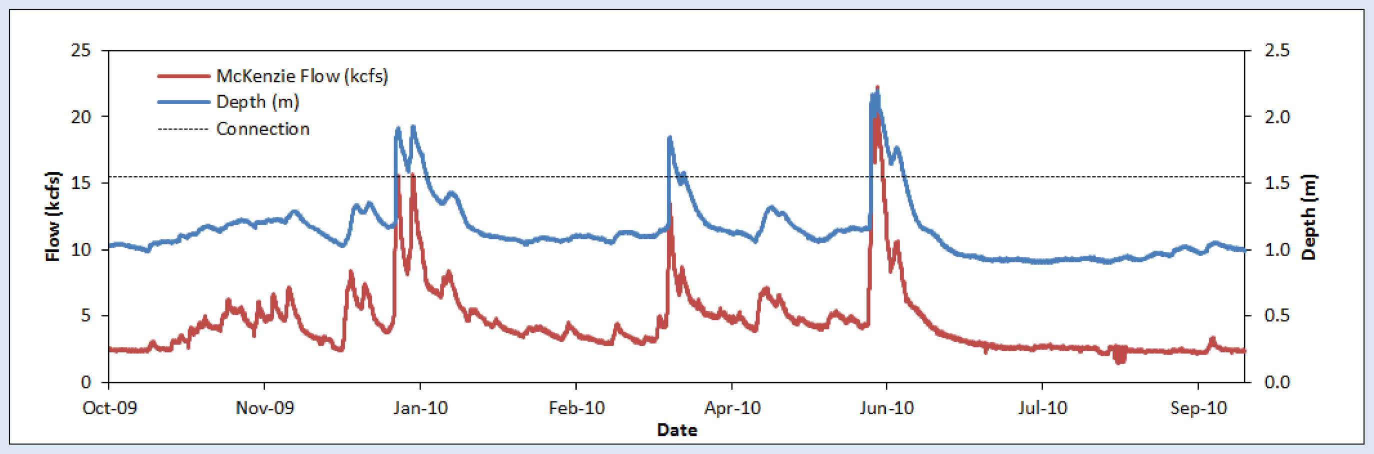

Figure 8. Relationship between McKenzie River flow and depth in off-channel rearing areas during the 2010 water year. The dashed line signifies water depth when the areas are hydraulically connected (Bangs 2014).

Step 3

Perform Quantitative Analysis, Interpretation, and Integration

- Evaluate flow-function responses (Figure 9)
- Quantify impacts of flow alteration
- Test flow-function hypothesis

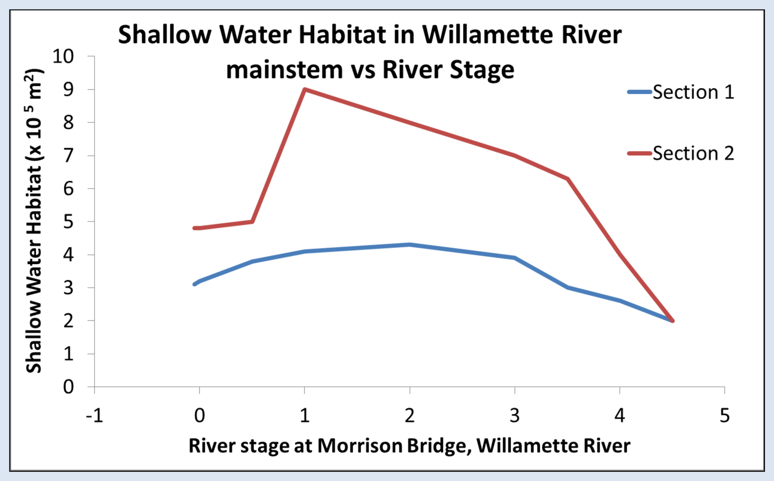

Figure 9. The relationship between available shallow-water habitat and river stage could be used to test flow-function hypothesis. Example modified from Jorgenson (2013).

Step 4

Develop Flow Prescription

Design project-specific flow prescription (Figure 10) that describes:

- Duration
- Timing
- Frequency
- Volume of flows

Project will also be prescribed by existing rules and regulations.

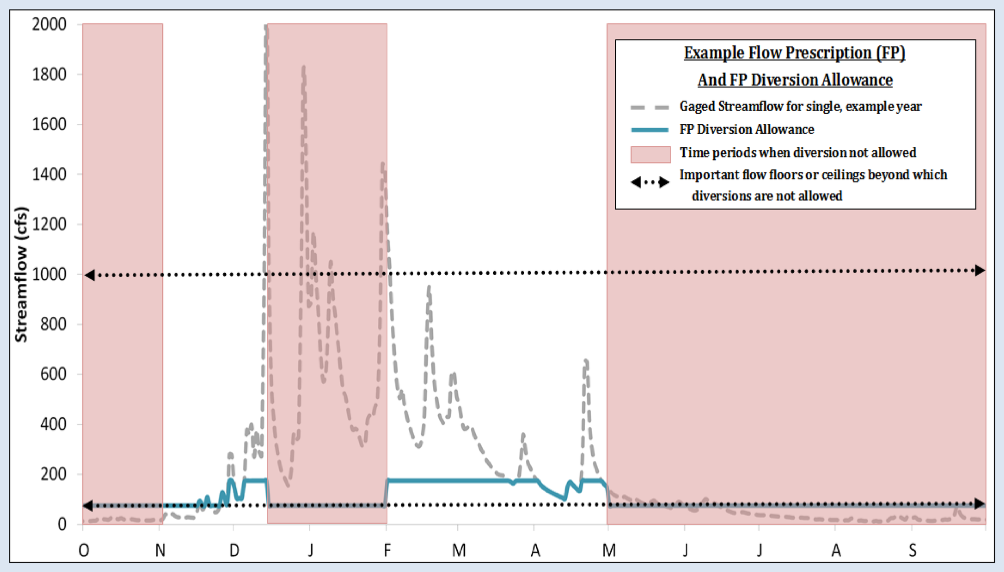

Figure 10. Example of a flow prescription that conditions a water use permit.

Protections may include:

- *Periods of salmon migration and spawning*
- *Channel forming flow ceilings*
- *Bypass flows required to maintain temperature*

Challenges: Addressing Climate Change in Flow Prescriptions

The state will consider uncertainty associated with flow regimes and species needs when quantifying impacts and benefits of a new storage project. Impact assessments will be used to determine whether projects can feasibly meet both instream and out-of-stream needs.

Non-stationarity (Figure 11)

- Determine basins/flow regimes most susceptible to major changes; identify significant shifts in variability
- Determine basins most susceptible to temperature and other water quality challenges

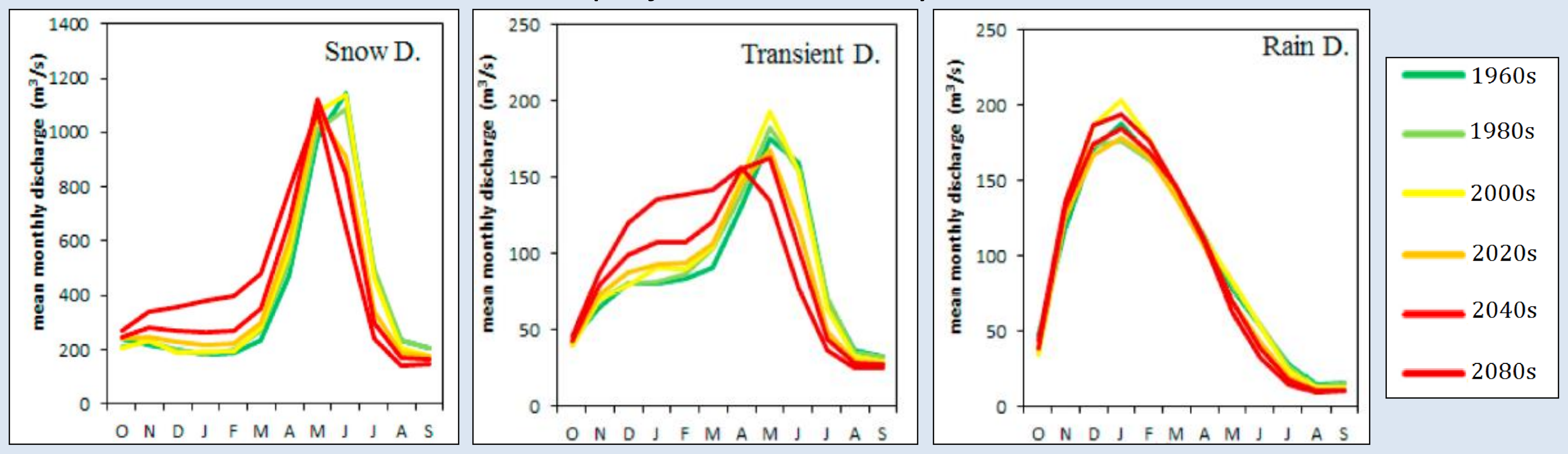

Figure 11. Monthly average simulated streamflow for past and future conditions (Wu 2012).

Shifting Aquatic Communities (Figure 12)

- Resilience/adaptive capacity of salmon and other indicator species to changing habitat availability
- Resilience of aquatic ecosystems to phenotypic mismatch

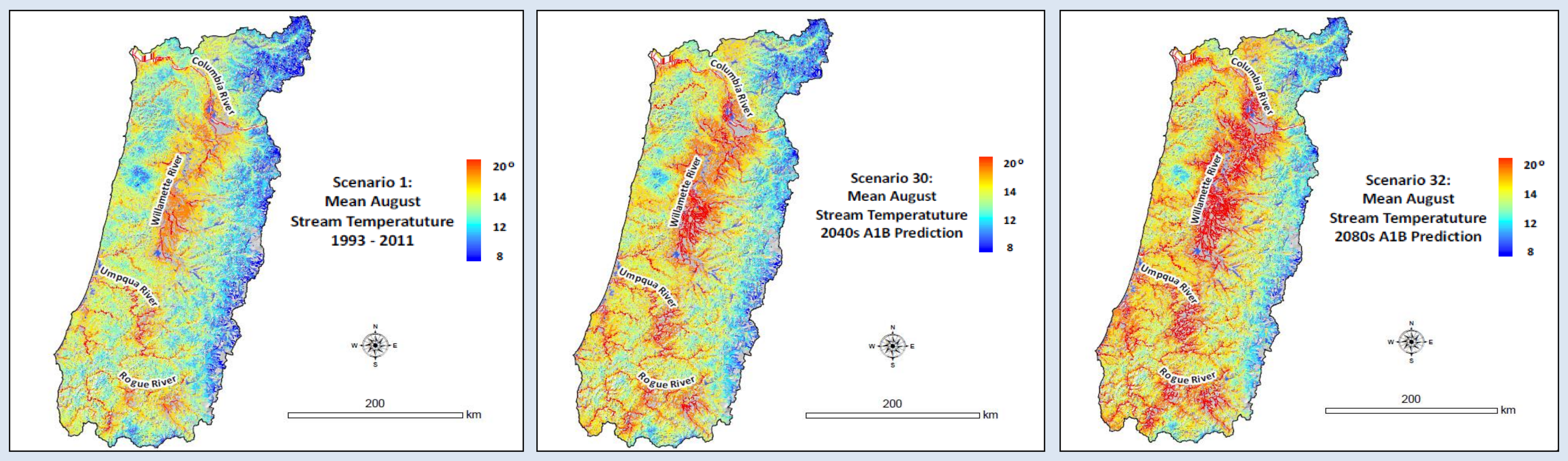

Figure 12. Stream temperature results for 1993-2011, and A1B predictions for 2040 and 2080 (NorWEST 2015).

Next Steps: Implementation, Statewide Framework, and Adaptive Prescriptions

- Implementation of SVF prescriptions for pilot project and future SB 839-funded projects
- Develop methods to include climate change adaptation approaches within flow prescriptions
- Develop statewide framework for assessing ecologically important flows

References

Bangs, B. L., Scheerer, P.D., and Clements, S. 2014. Effects of U.S. Army Corps of Engineers Willamette Project Operations on Oregon Chub and Other Floodplain Fishes. Corvallis, OR: Oregon Department of Fish and Wildlife.
Jorgensen, J., McClure, M., Sheer, M., and N. Munn. 2013. Combined Effects of Climate Change and Bank Stabilization on Shallow Water Habitats of Chinook Salmon. Conservation Biology. 27(6):1201-1211.
NorWeST. 2015. Modeled Mean August Stream Temperature for the Lower Columbia, Willamette, North and South Oregon Coasts. http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST/downloads/ModeledStreamTemperatureMaps/170800_900_171002_003OregonCoast/OregonCoast_ModeledStreamTemperature_Layered.pdf
Oregon Department of Fish and Wildlife. Crucial Habitat Data Set. ODFW Compass. Published November, 2014. Accessed April, 2015. http://www.dfw.state.or.us/maps/compass/
Oregon Department of Environmental Quality. 2014. Oregon's 2012 Integrated Report Assessment Geodatabase and 303(d) List Version 1 (Provisional) http://www.deq.state.or.us/wq/assessment/AssessGIS.htm#gis10
Oregon Water Resources Department. 2008. Statewide Water Needs Assessment-Oregon Water Supply and Conservation Initiative. Oregon Water Resources Department. http://www.oregon.gov/owrd/law/docs/owsci/owrd_demand_assessment_report_final_september_2008.pdf
Oregon Water Resources Department. 2015. Water Availability Maps. http://apps.wrd.state.or.us/apps/wars/wars_display_wa_tables/search_for_WAB.aspx
Seasonally Varying Flow Science Sub-Group. 2014. A Proposed "Percent of Flow" Approach for Water Storage Projects in Oregon.
Senate Bill 839 Enrolled. 2013. 77th Oregon Legislative Assembly.
Wu, H., J. S. Kimball, M. M. Elsner, N. Mantua, R. F. Adler, and J. Stanford (2012), Projected climate change impacts on the hydrology and temperature of Pacific Northwest rivers, Water Resources Research, 48, W11530, doi:10.1029/2012WR012082.