



Water Budget of the Upper Chehalis River Basin

August 24, 2018

Chehalis Basin Partnership
Rochester, Washington

U.S. Department of the Interior
U.S. Geological Survey



Prepared in cooperation with the City of Centralia

Water Budget of the Upper Chehalis River Basin, Southwestern Washington



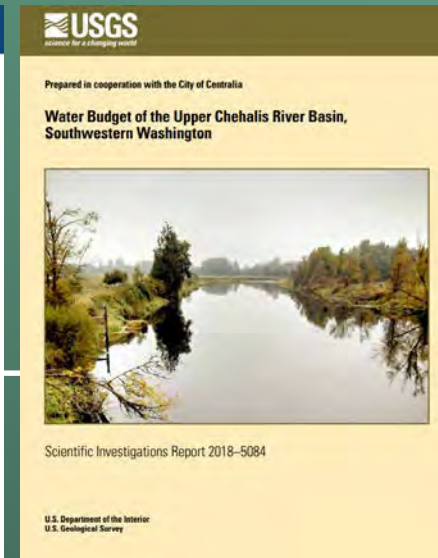
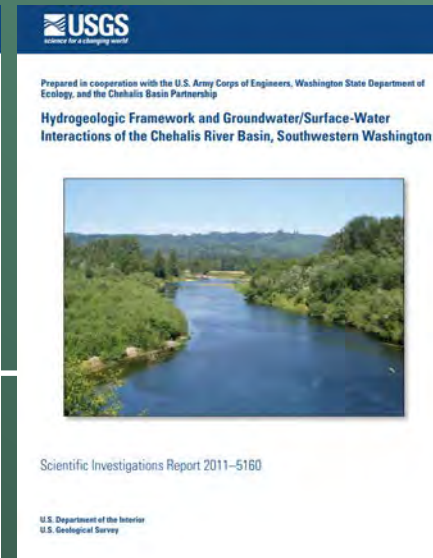
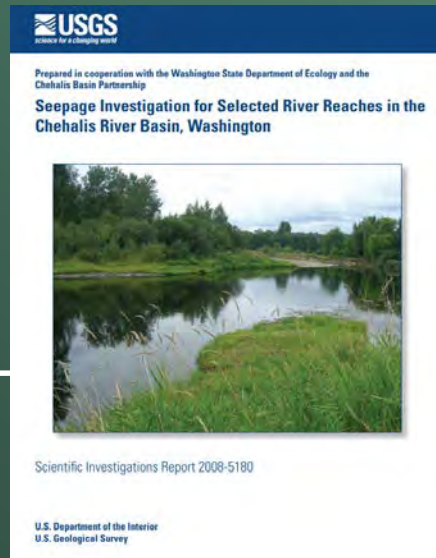
Scientific Investigations Report 2018–5084

U.S. Department of the Interior
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Andy Gendaszek
agendasz@usgs.gov
USGS – WA Water Science Center
Tacoma, Washington

Outline

- Groundwater in the Chehalis Basin - Objectives
- Previous Studies
 - Groundwater Surface/Water Interactions
 - Hydrogeologic Framework
- Recently Released Water Budget
- Next Steps



Groundwater Studies in the Chehalis Basin – Objectives and Recent Studies

- 2007 Basin-Wide Seepage Run: Groundwater/Surface-Water Interactions (Ely and others, 2008)
- Well Inventory and Hydrogeologic Framework (Gendaszek, 2011)
- Water Budget (Gendaszek and Welch, 2018)

Data Collection

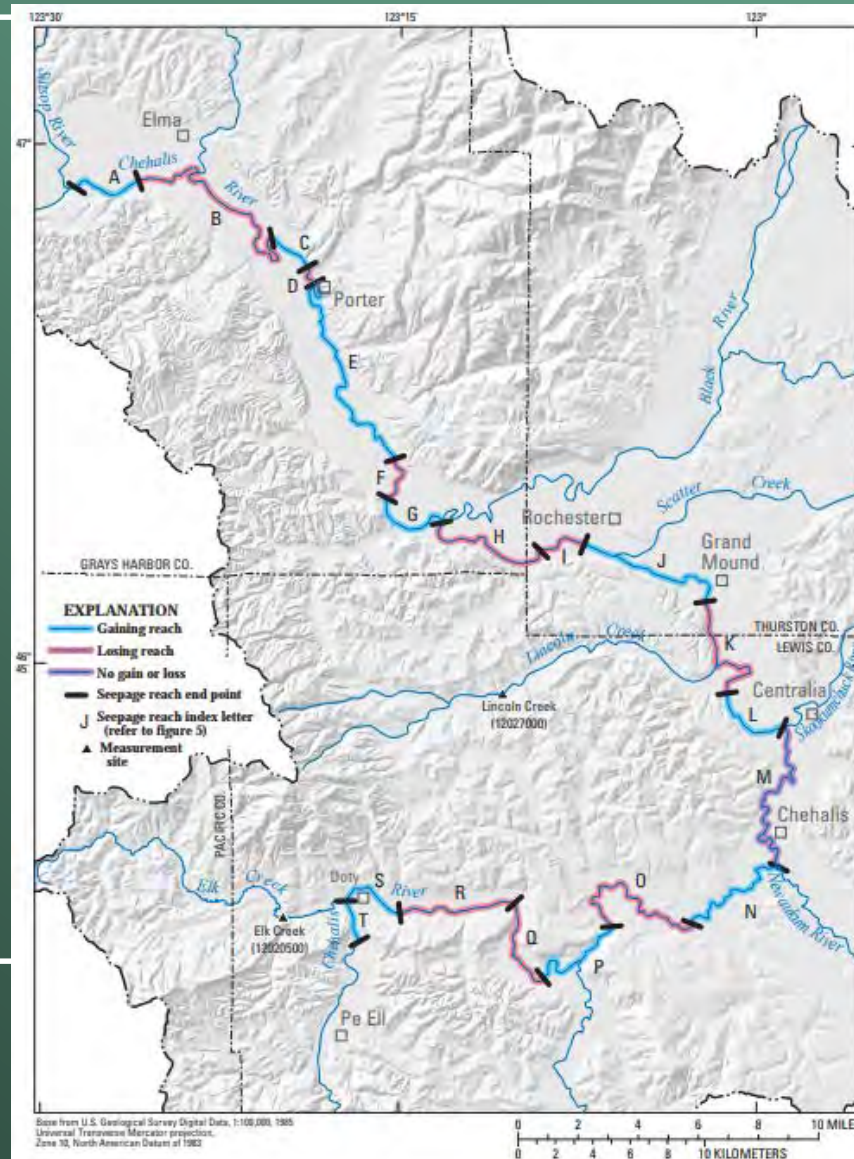


Conceptual Model



*Future
Numerical Model*

2007 Basin-Wide Seepage Run (Ely and others, 2008)



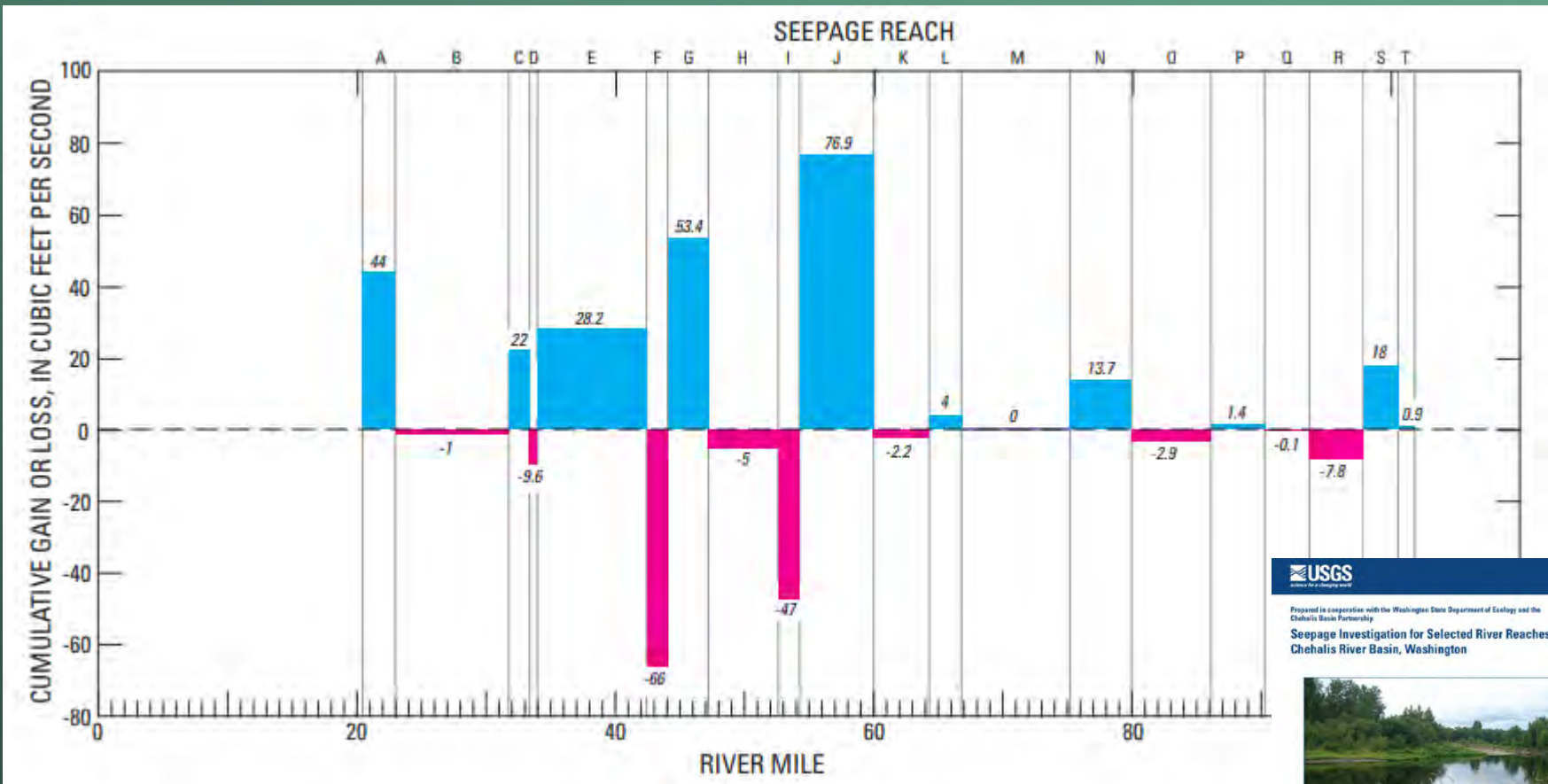
Prepared in cooperation with the Washington State Department of Ecology and the Chehalis Basin Partnership
Seepage Investigation for Selected River Reaches in the Chehalis River Basin, Washington



Scientific Investigations Report 2009-5180

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2007 Basin-Wide Seepage Run (Ely and others, 2008)



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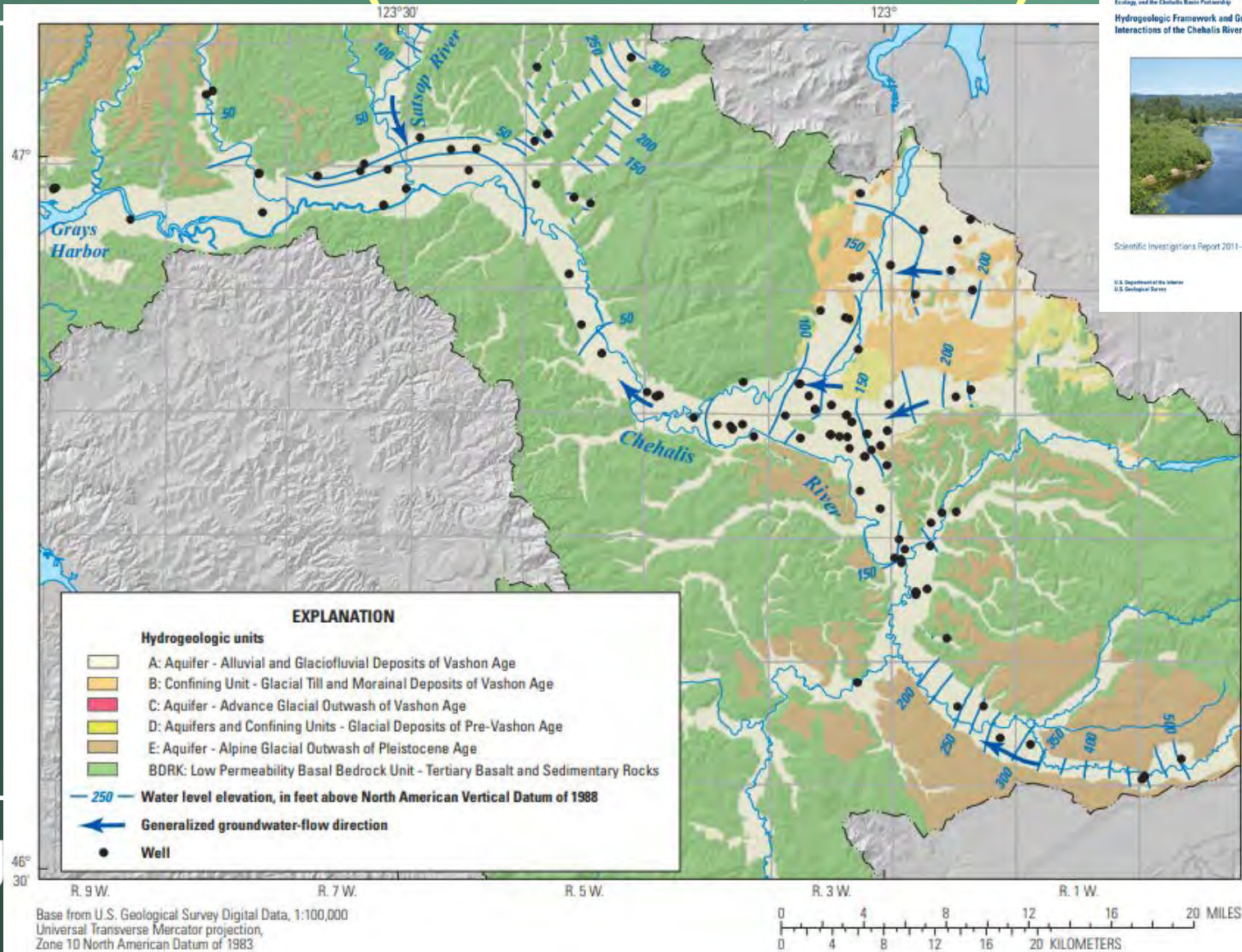


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Well Inventory and Hydrogeologic Framework (Gendaszek, 2011)



USGS
United States Geological Survey

Prepared in cooperation with the U.S. Army Corps of Engineers, Washington State Department of Ecology, and the Chehalis Basin Partnership

Hydrogeologic Framework and Groundwater/Surface-Water Interactions of the Chehalis River Basin, Southwestern Washington



Scientific Investigations Report 2011-5160

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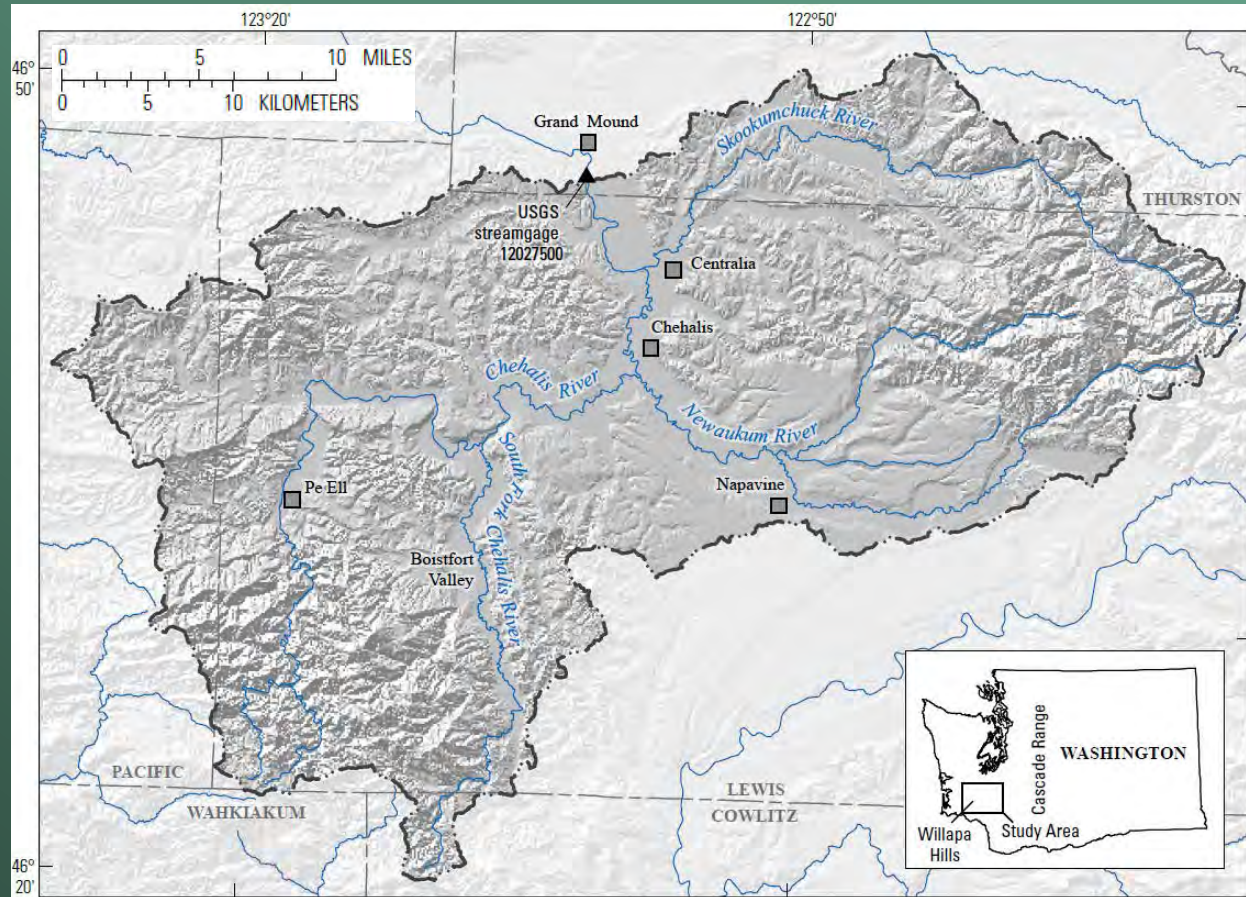
Upper Chehalis Basin Water Budget

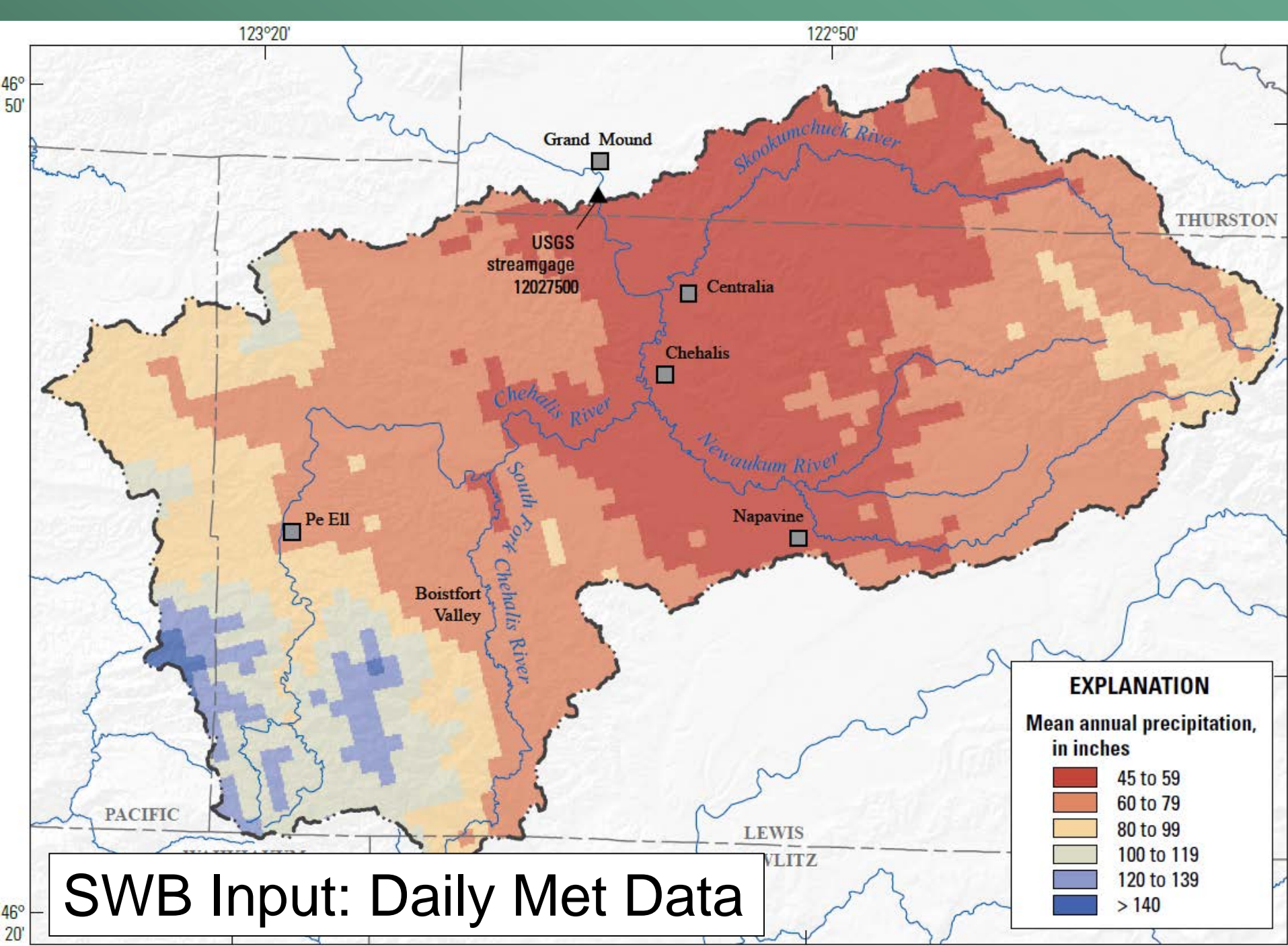
- Water Budget: $Q_{in} = Q_{out} + \Delta S$
- Estimate water budget components
 - Precipitation
 - Evapotranspiration
 - Surface Runoff
 - Groundwater Recharge
 - Water Use
- Estimate spatial distribution of groundwater recharge for future groundwater flow model

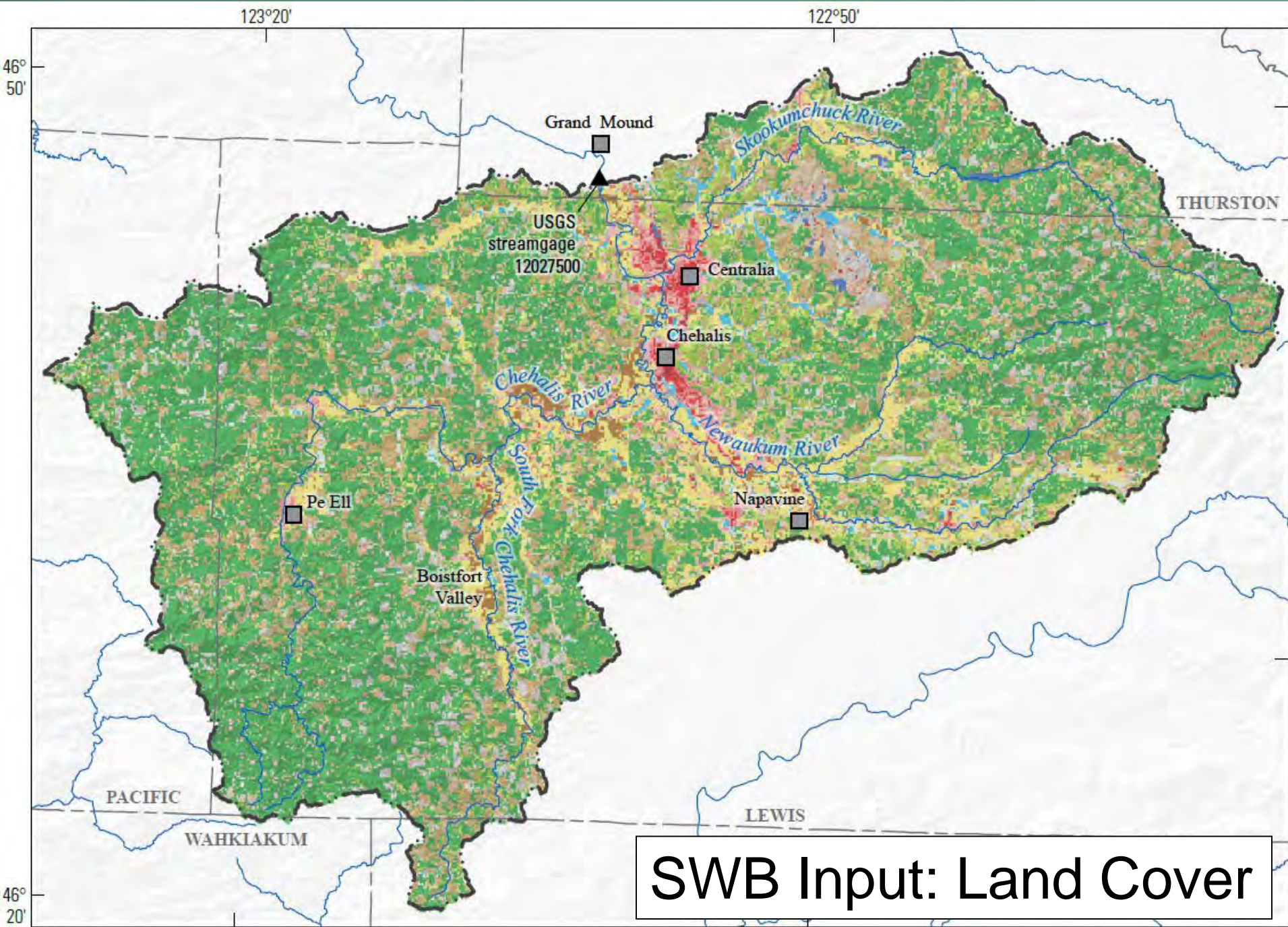
Upper Chehalis Basin Water Budget: Methods

- **USGS Soil-Water Balance (SWB) Model**
 - Accounts for spatial distribution of soil properties and land cover
 - Daily calculation of evapotranspiration, groundwater recharge, and surface runoff
 - 500-foot grid cell
 - **Hydrograph Separation**
 - USGS Gage at the Chehalis River Near Grand Mound
 - Daily calculation of surface-runoff and baseflow
 - **Groundwater and Surface-Water Use**
 - Calculated from furnished records
 - Estimated for systems without records
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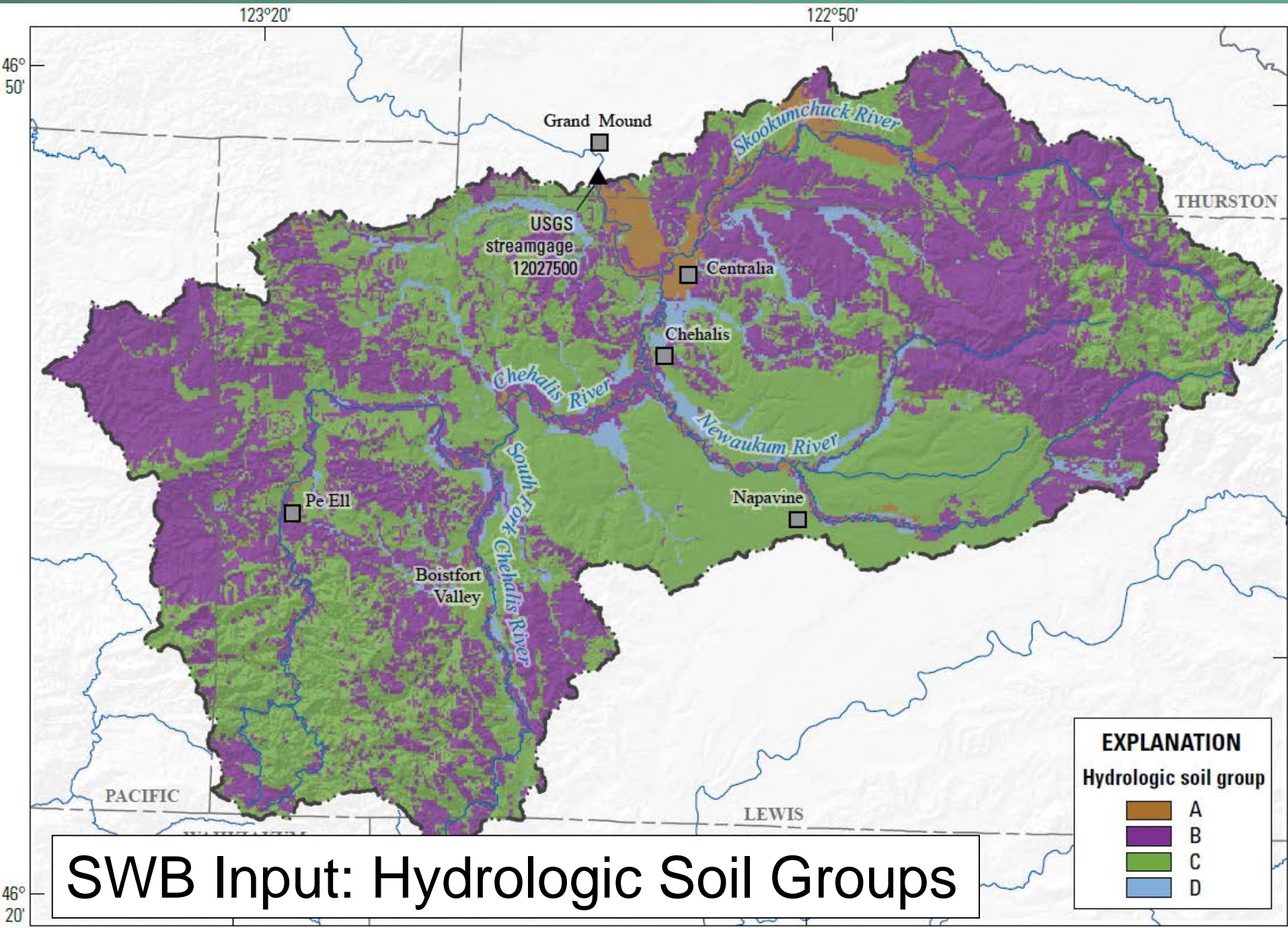
Study Area: Chehalis River Upstream of Grand Mound

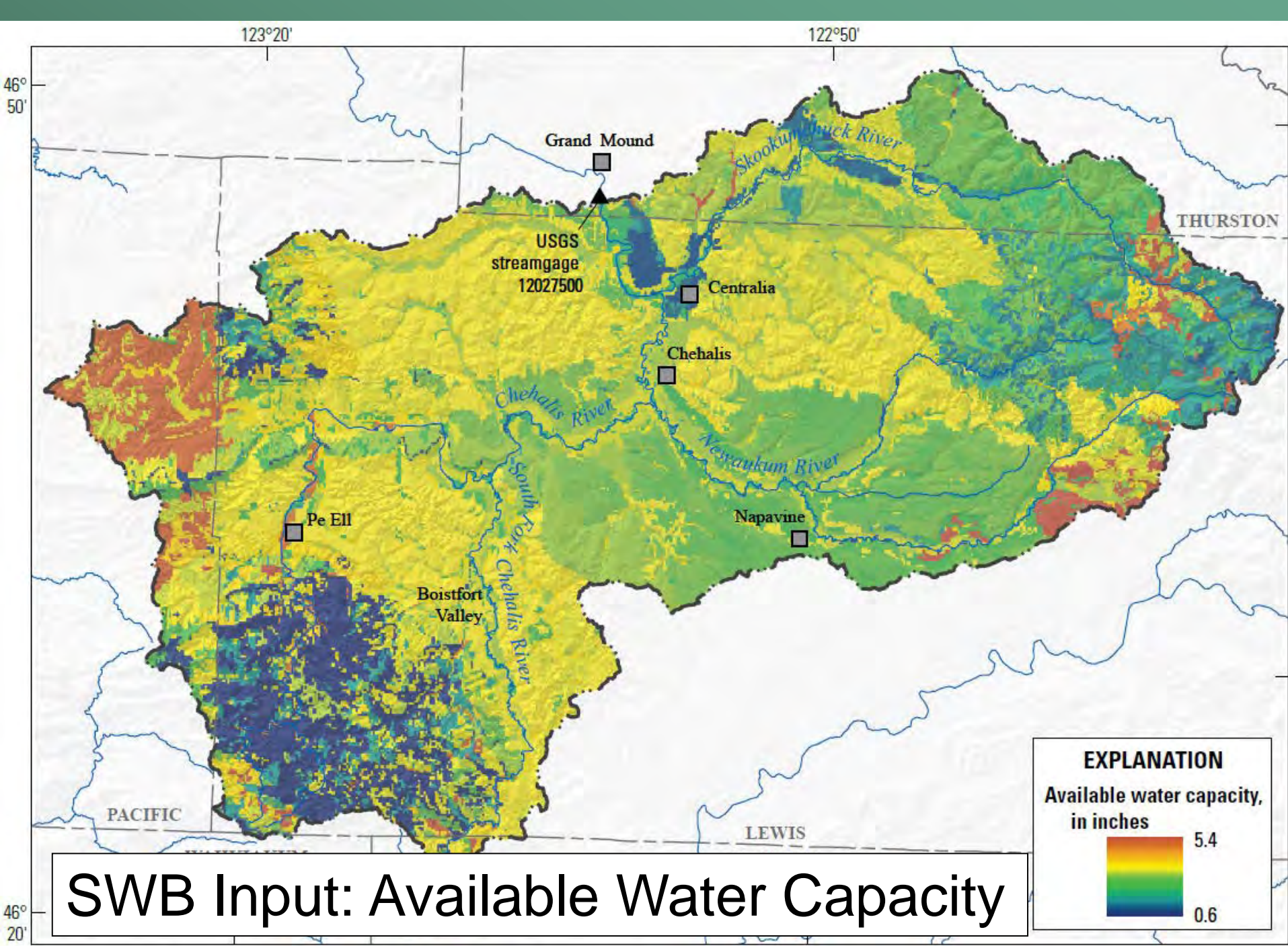


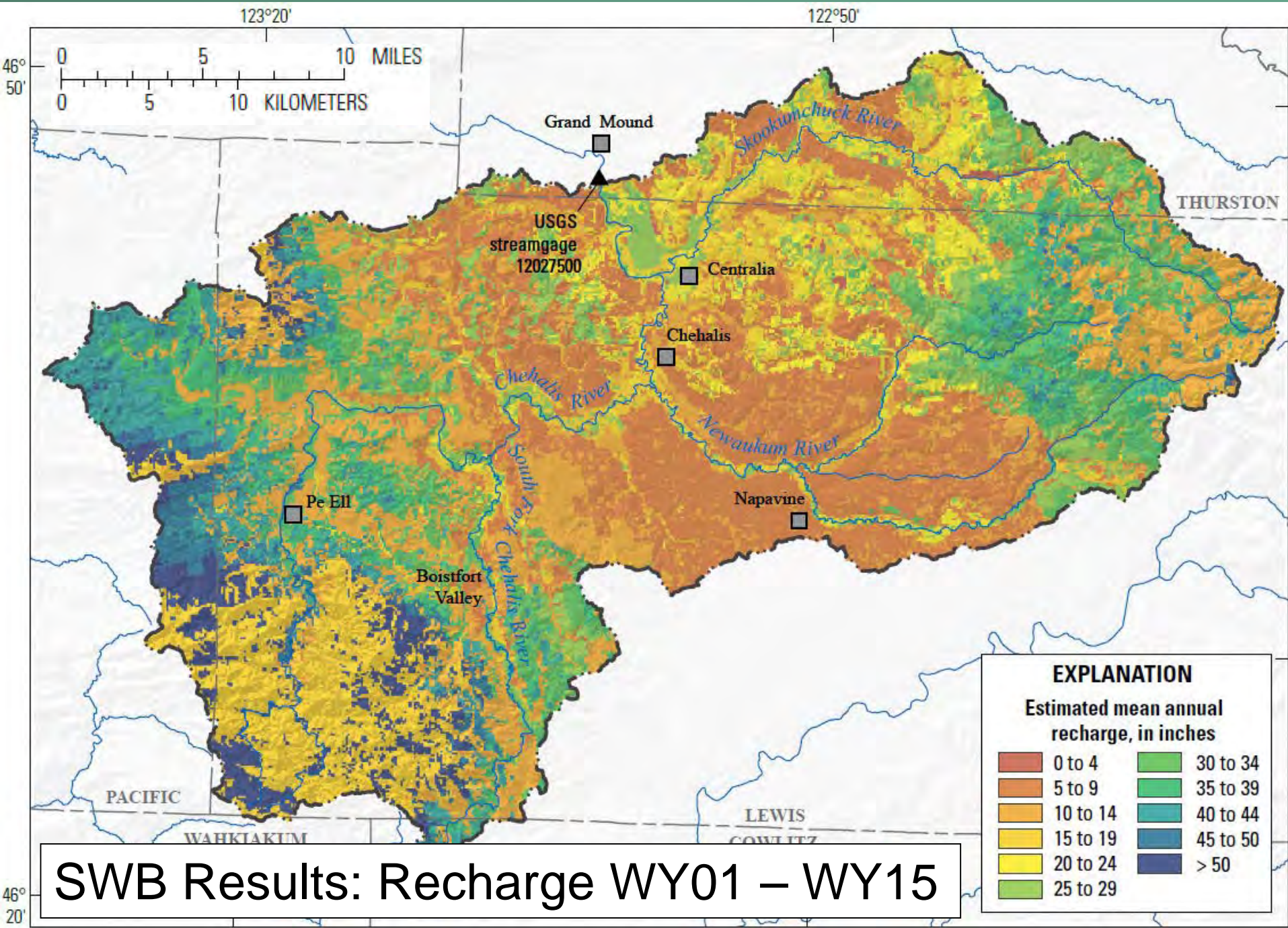




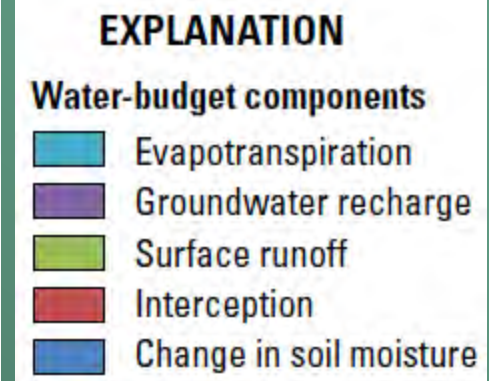
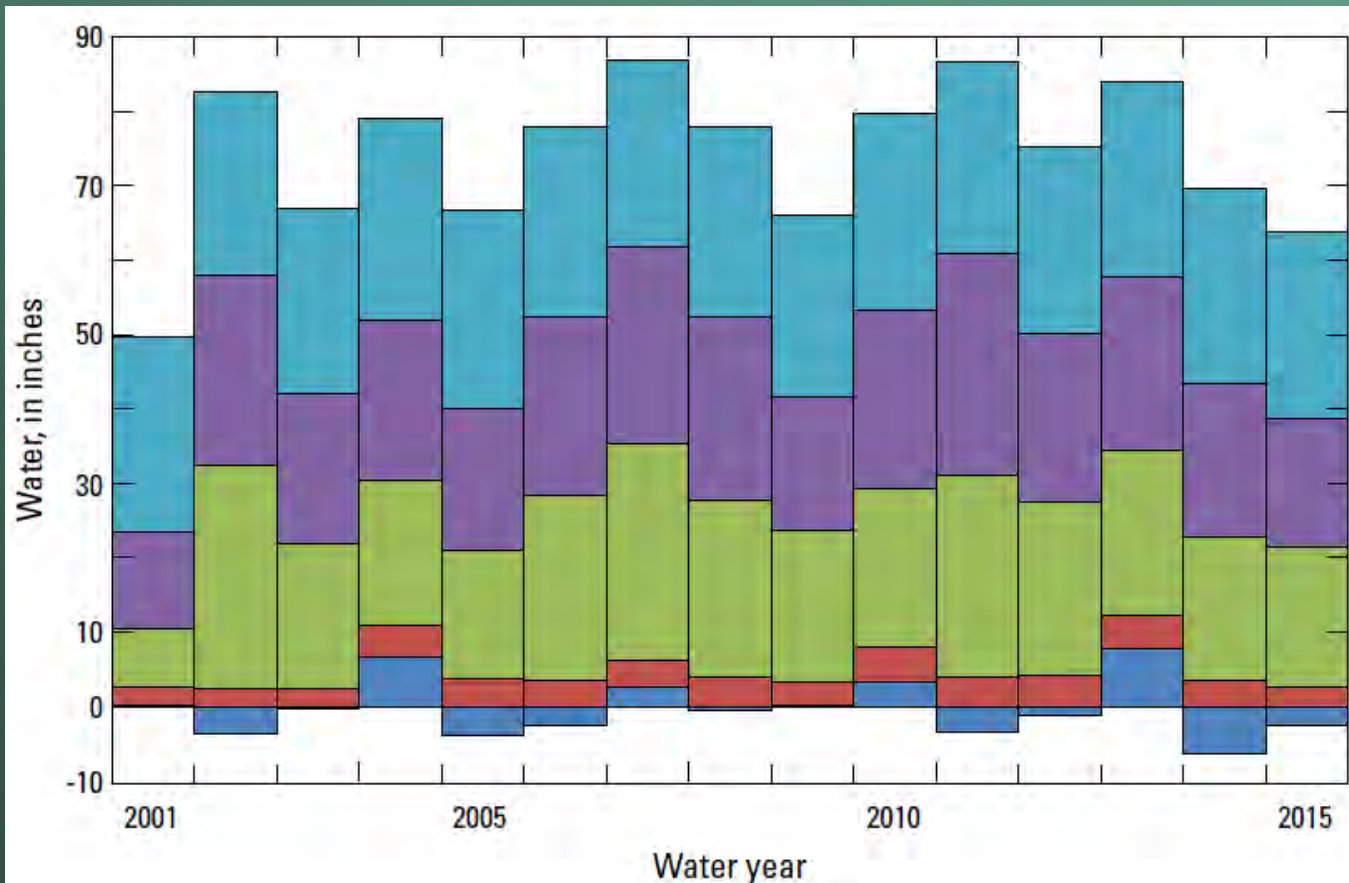
SWB Input: Land Cover







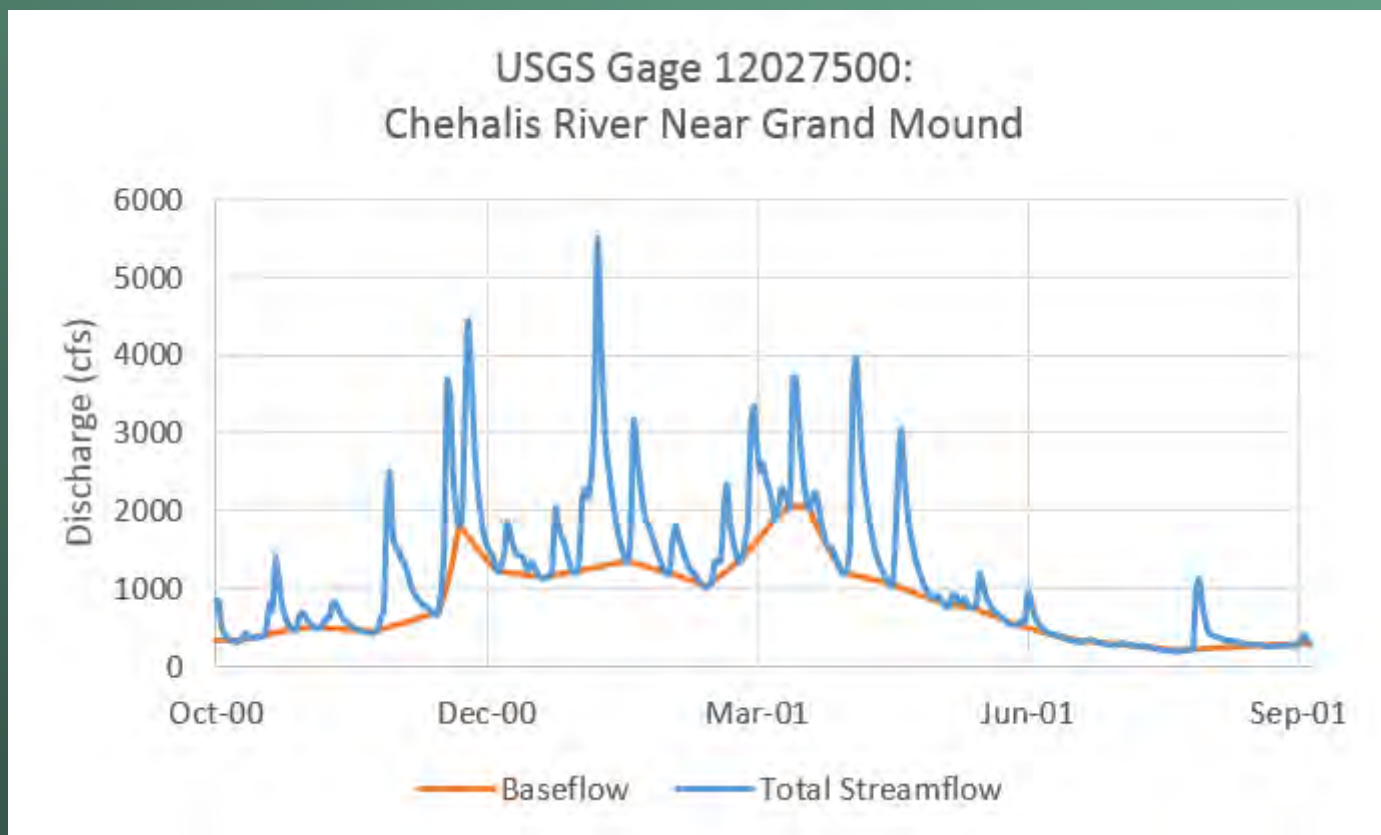
Soil Water Balance Model Results: WY01 – WY15



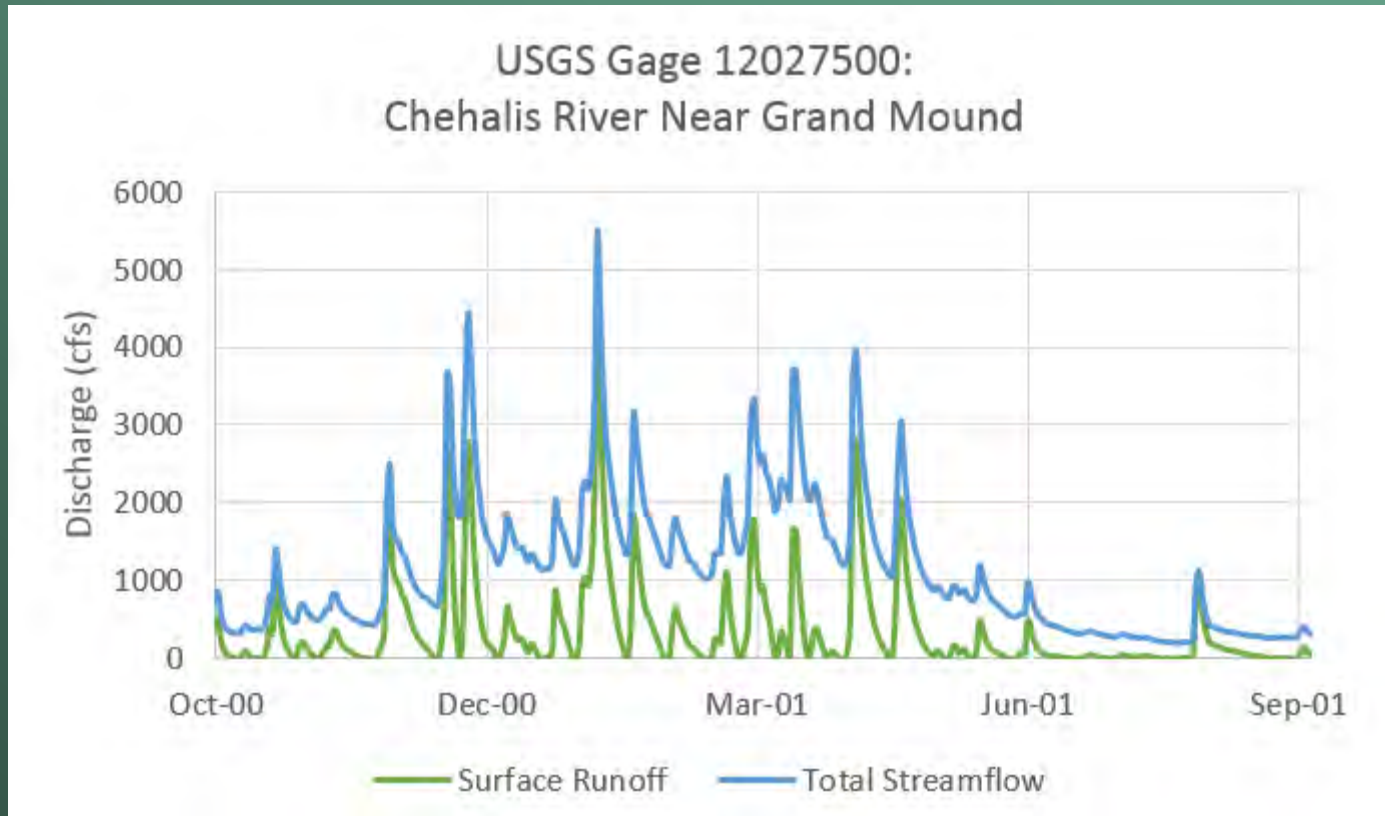
Water Budget: Fate of Precipitation

Fate of precipitation	Inches per year	Percentage of total
Surface runoff	21.6	29.8
Evapotranspiration	25.6	35.3
Groundwater recharge	22.0	30.3
Interception	3.6	5.0
Change in soil moisture	-0.2	-0.3
Total precipitation	72.6	100.0

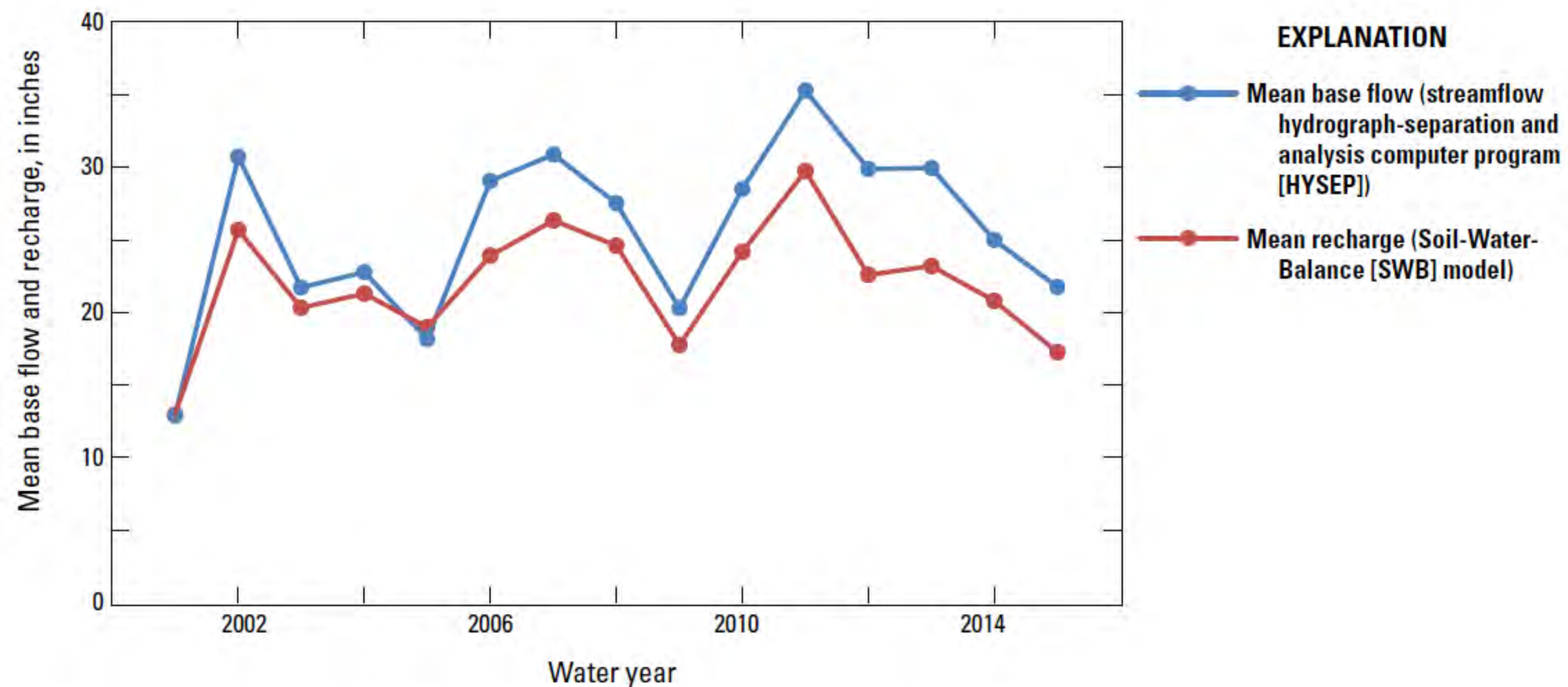
Hydrograph Separation – Baseflow

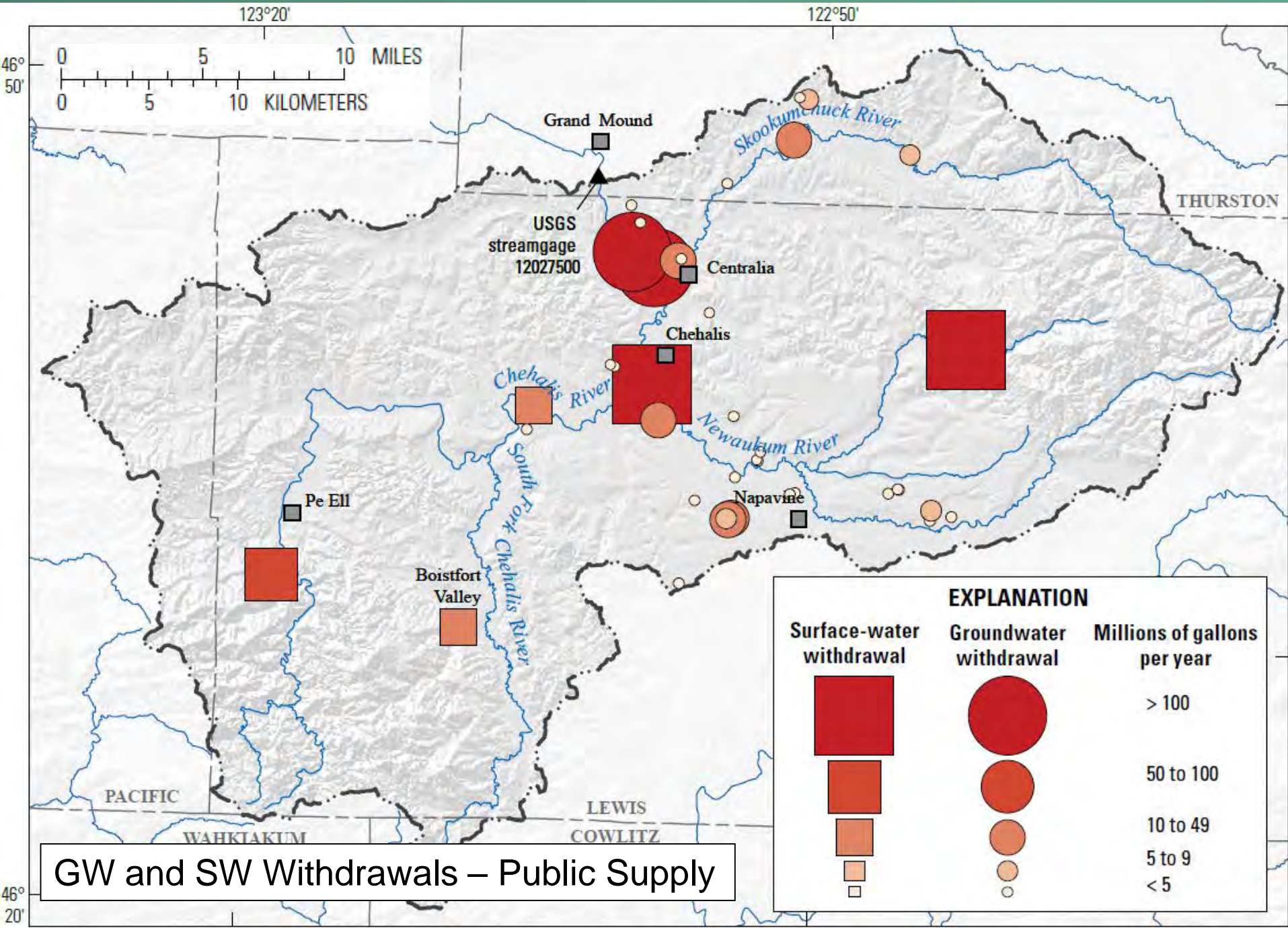


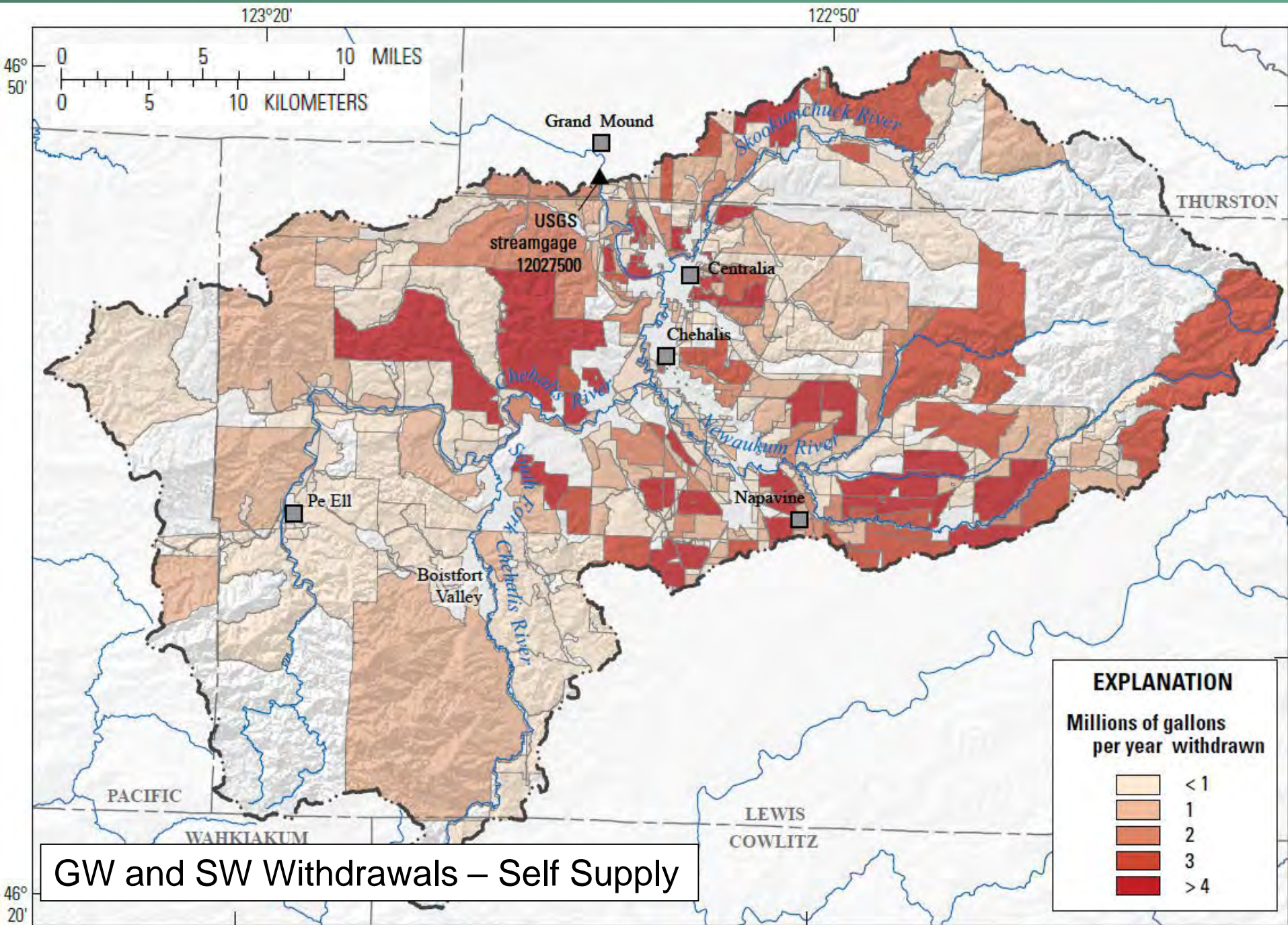
Hydrograph Separation – Surface Runoff



Comparison of SWB (Baseflow) to Hydrograph Separation (Recharge)







Water Budget: Fate of Recharge

Fate of recharge	Soil-Water-Balance model		HYSEP base-flow separation	
	Inches per year	Percentage of total	Inches per year	Percentage of total
Natural discharge	21.79	99.0	25.6	99.2
Group A well pumpage	0.06	0.3	0.06	0.2
Self-supply and Group B well pumpage	0.05	0.2	0.05	0.2
Irrigation well pumpage	0.10	0.5	0.10	0.4
Total recharge	22.0	100.0	25.81	100.0

Summary and Acknowledgements

- **Groundwater/Surface-Water Interactions and Hydrogeologic Framework (Ely and others, 2008; Gendaszek, 2011)**
 - **Water Budget of Upper Chehalis Basin**
 - Equal parts of precipitation is lost to evapotranspiration, becomes surface runoff, and recharges groundwater
 - Water use is a small fraction of groundwater recharge, but its effect on surface-water and groundwater levels is not known
 - **Groundwater flow and exchange with surface waters may be simulated with a numerical model to understand effects of groundwater use**
 - **Project was funded jointly by the City of Centralia and the U.S. Geological Survey**
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Publications

- Gendaszek, A.S., and Welch, W.B., 2018, Water budget of the upper Chehalis River Basin, southwestern Washington: U.S. Geological Survey Scientific Investigations Report 2018-5084, 17 p., <https://doi.org/10.3133/sir20185084>
 - Gendaszek, A.S., and Welch, W.B., 2018, Soil Water Balance Model of Upper Chehalis River Basin, Southwestern Washington: U.S. Geological Survey data release, <https://doi.org/10.5066/F78G8K1F>
 - Gendaszek, A.S., 2011, Hydrogeologic framework and groundwater/surface-water interactions of the Chehalis River basin, Washington: U.S. Geological Survey Scientific Investigations Report 2011-5160, 42 p.
 - Ely, D.M., Frasl, K.E., Marshall, C.A., and Reed, Fred, 2008, Seepage investigation for selected river reaches in the Chehalis River basin, Washington: U.S. Geological Survey Scientific Investigations Report 2008-5180, 12 p.
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