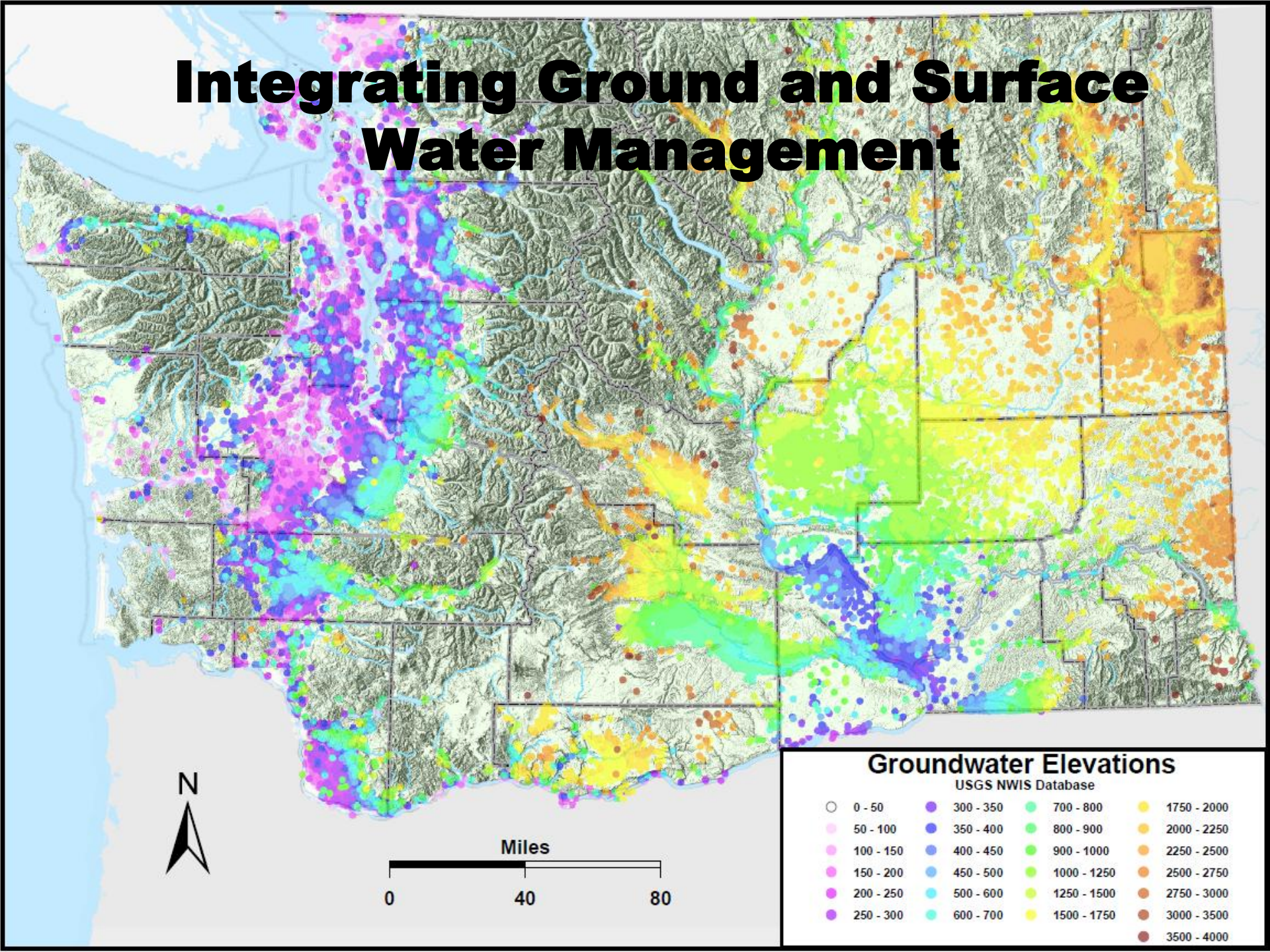
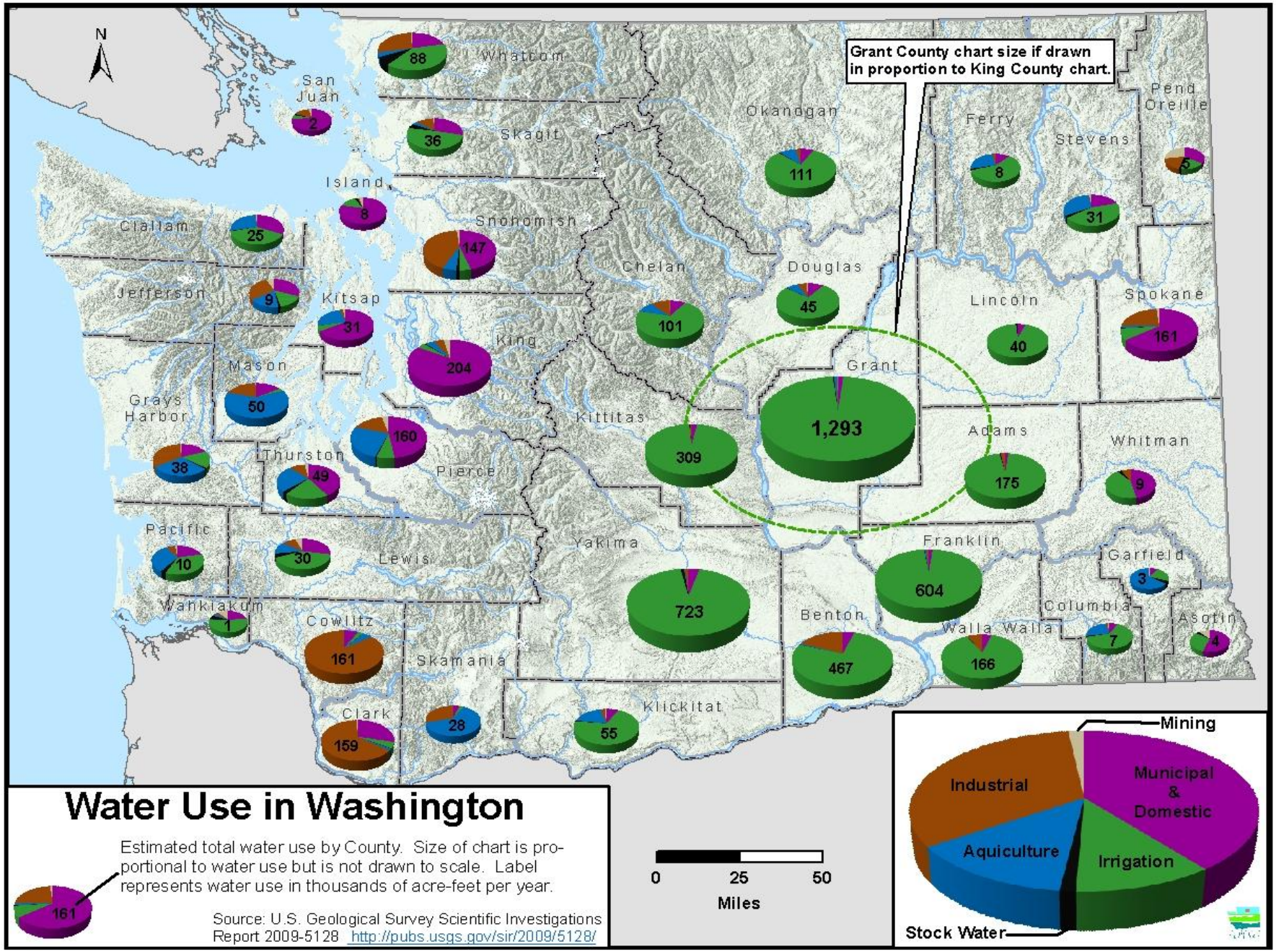
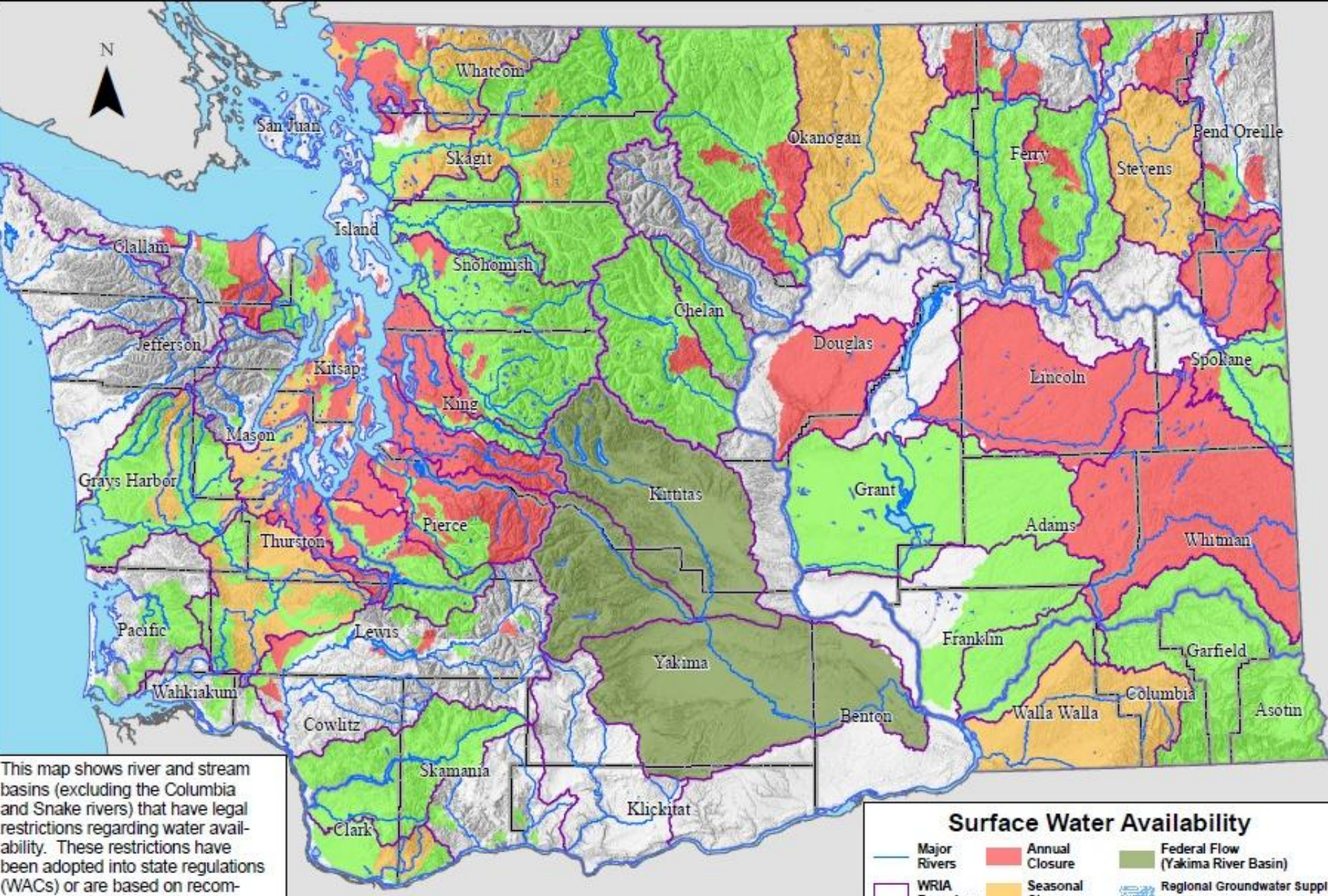
Integrating Ground and Surface Water Management



Integrating Ground and Surface Water Management in Washington

- Introduction
- Current water use and availability for new uses
- Hydrologic impacts related to a warming climate
- Future water supply – demand
- Groundwater recharge and mitigation
- Summary


N
Grant County chart size if drawn in proportion to King County chart.
Whatcom
88
San Juan
2
Skagit
36
Island
8
Snohomish
147
Clallam
25
Jefferson
9
Kitsap
31
King
204
Mason
50
Grays Harbor
Thurston
38
49
160
Pierce
Pacific
10
30
Lewis
Wahkiakum
1
Cowlitz
161
Skamania
Clark
159
28
Okanogan
111
Chelan
101
Douglas
45
Grant
1,293
309
Kittitas
Yakima
723
Klickitat
55
Benton
467
Ferry
8
Stevens
31
Pend Oreille
5
Lincoln
40
Spokane
161
Adams
175
Whitman
9
Franklin
604
166
Garfield
3
Columbia
7
Asotin
4
0
25
50
Miles
Mining
Municipal & Domestic
Industrial
Irrigation
Aquiculture
Stock Water
Water Use in Washington
Estimated total water use by County. Size of chart is proportional to water use but is not drawn to scale. Label represents water use in thousands of acre-feet per year.
161
Source: U.S. Geological Survey Scientific Investigations Report 2009-5128 http://pubs.usgs.gov/sir/2009/5128/



This map shows river and stream basins (excluding the Columbia and Snake rivers) that have legal restrictions regarding water availability. These restrictions have been adopted into state regulations (WACs) or are based on recommendations by state Fish and Wildlife officials, as required by RCW 90.03.247. For details about any particular area, please refer to the WRIA-specific Focus Sheet.

Surface Water Availability

- Major Rivers
- WRIA Boundary
- County Line
- Annual Closure
- Seasonal Closure
- Instream Flow or Low Flow
- Federal Flow (Yakima River Basin)
- Regional Groundwater Supply Area (WRIA's 27 and 28)
- Coastal Management Area (WRIA 17)

Miles
0 25 60

September 2011

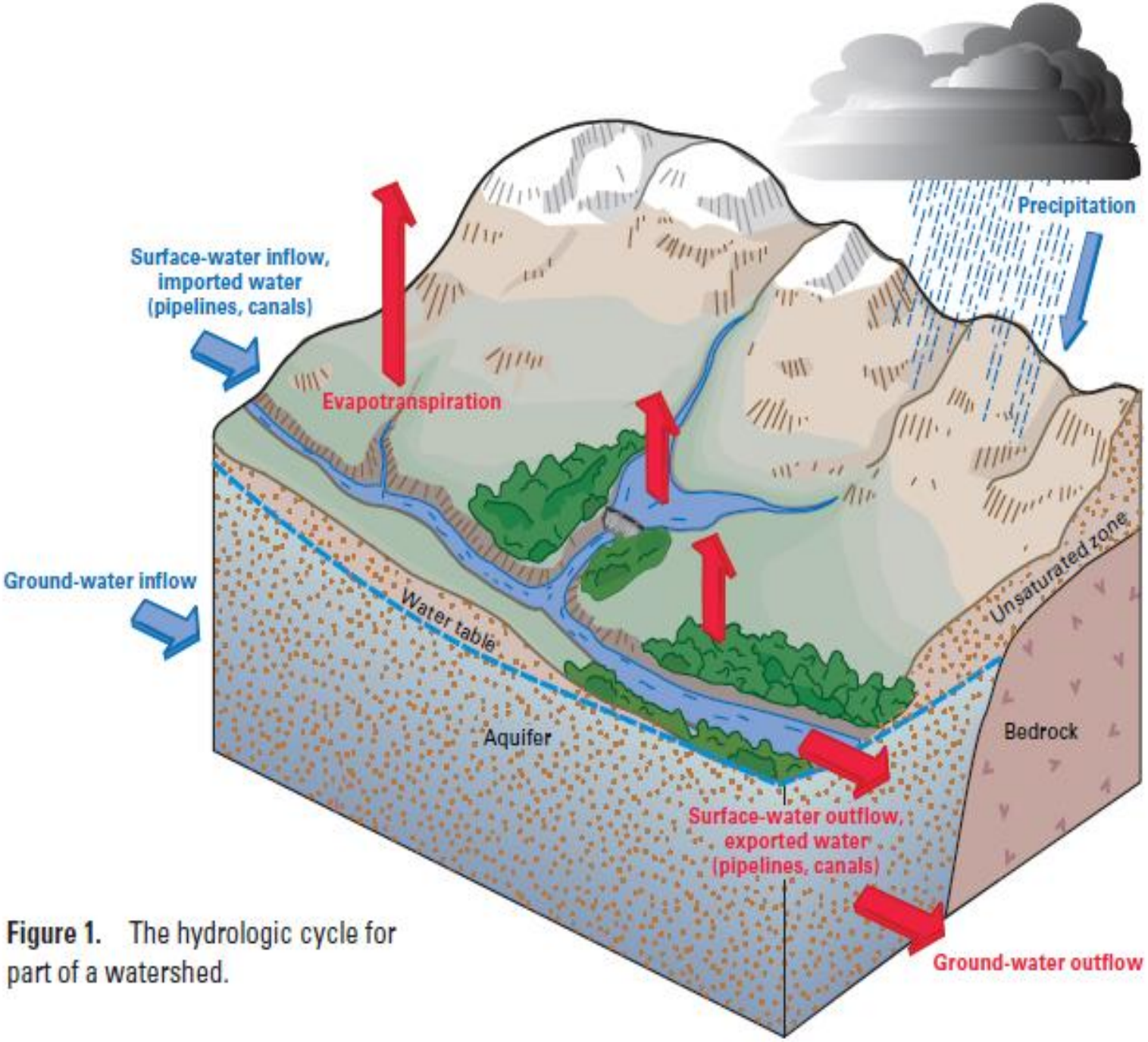
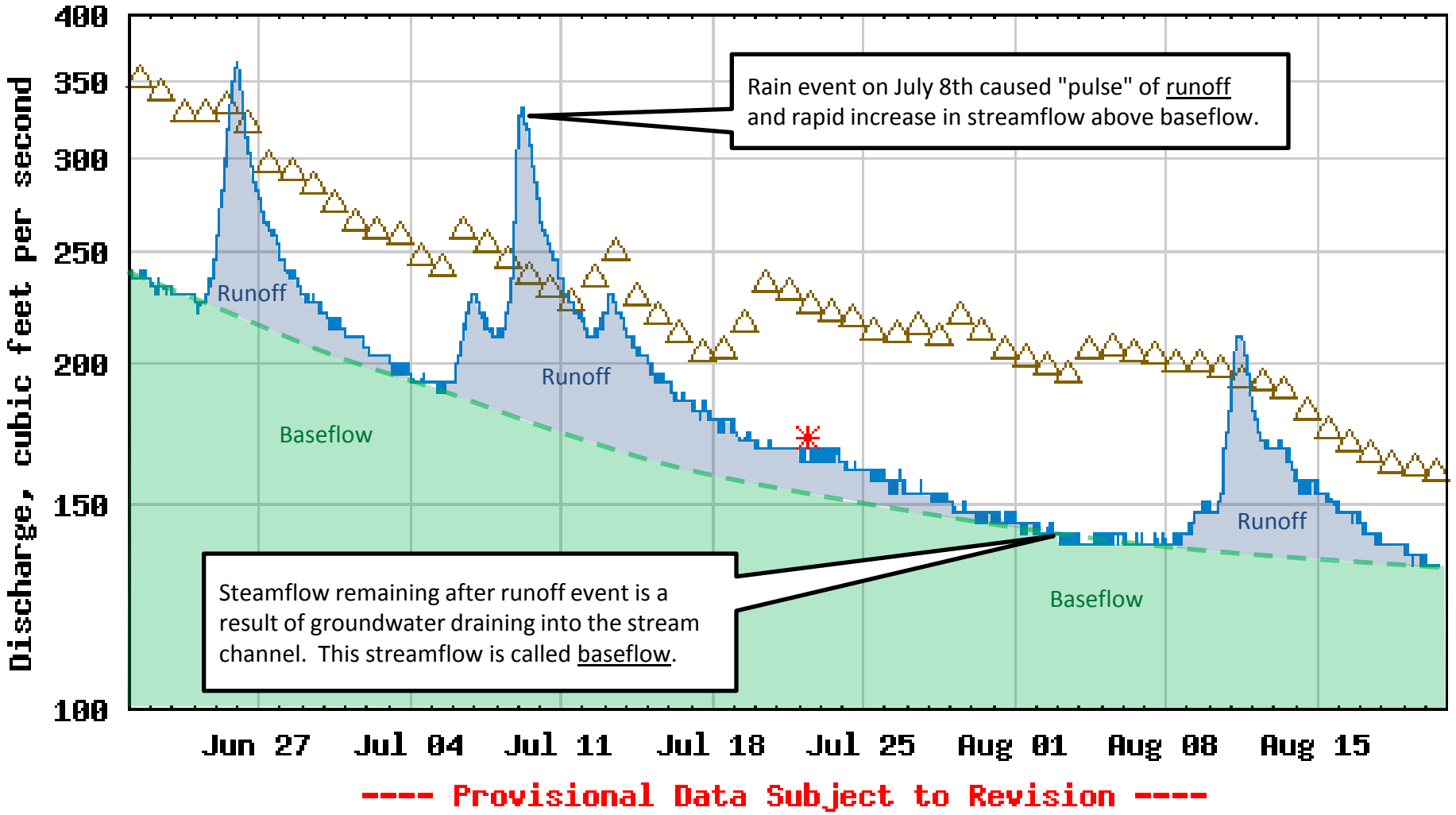


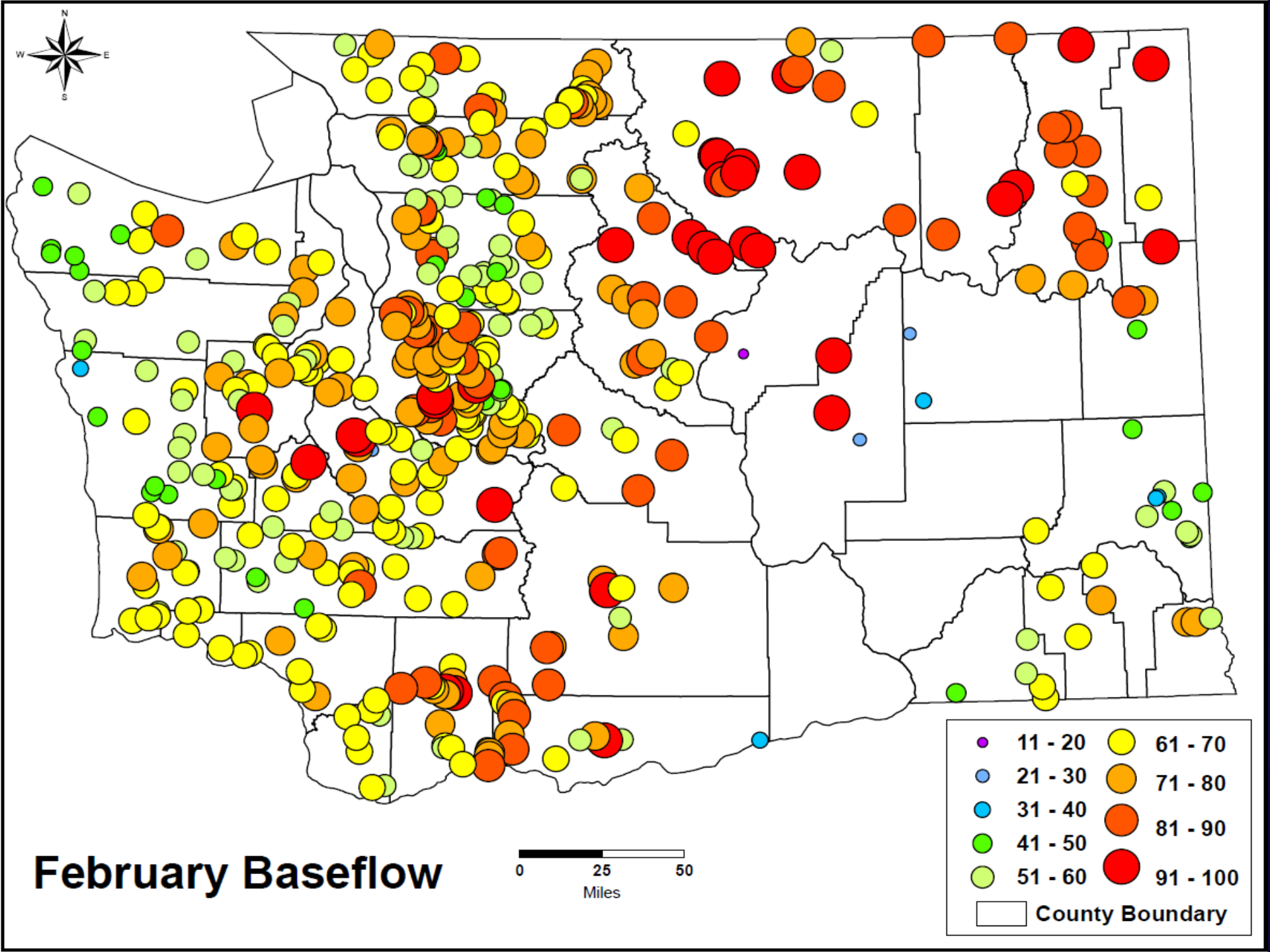
Figure 1. The hydrologic cycle for part of a watershed.

USGS

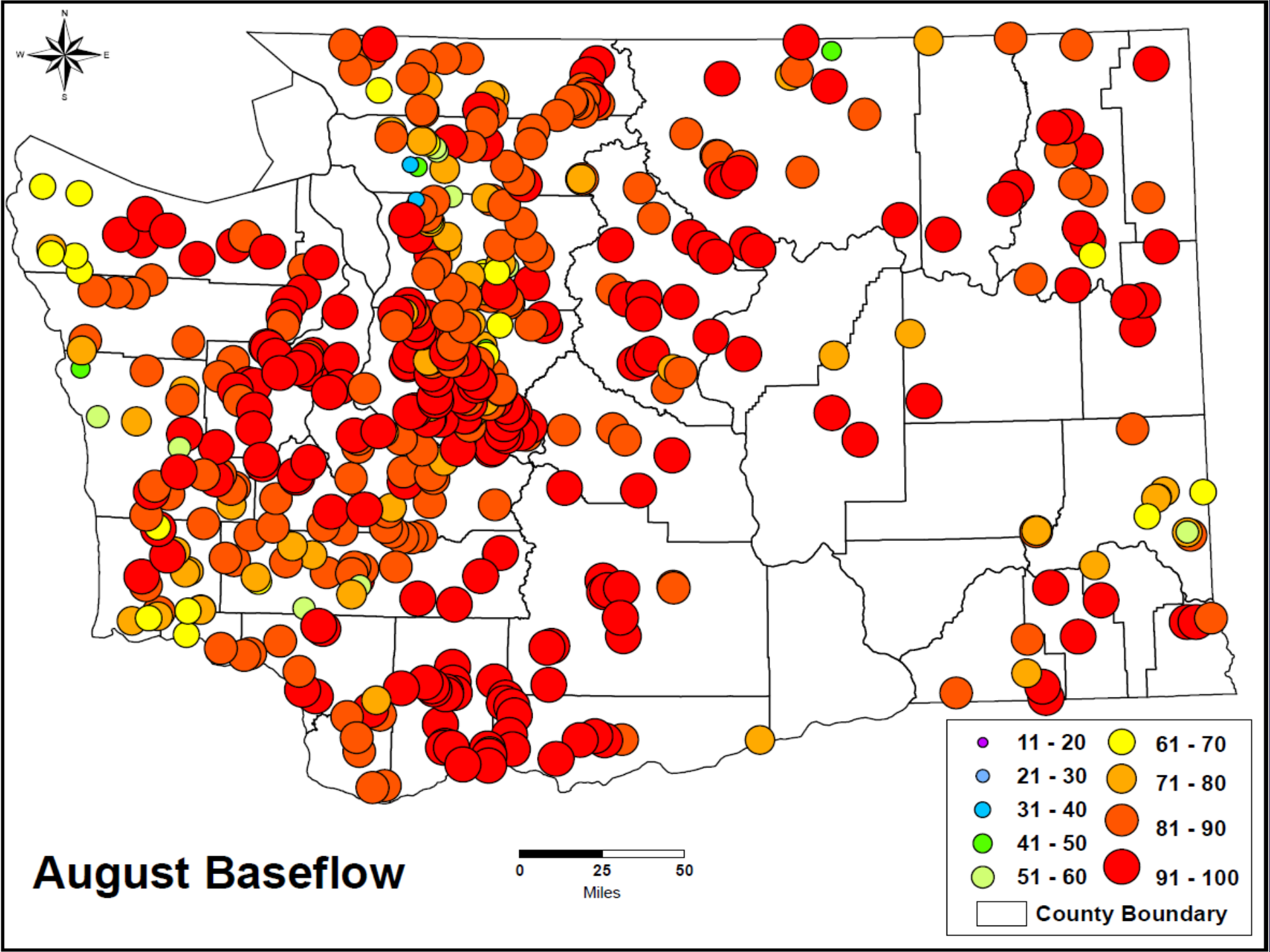
USGS 12039005 HUMPTULIPS RIVER BELOW HWY 101 NR HUMPTULIPS, WA



Data Source: http://waterdata.usgs.gov/usa/nwis/uv?12039005

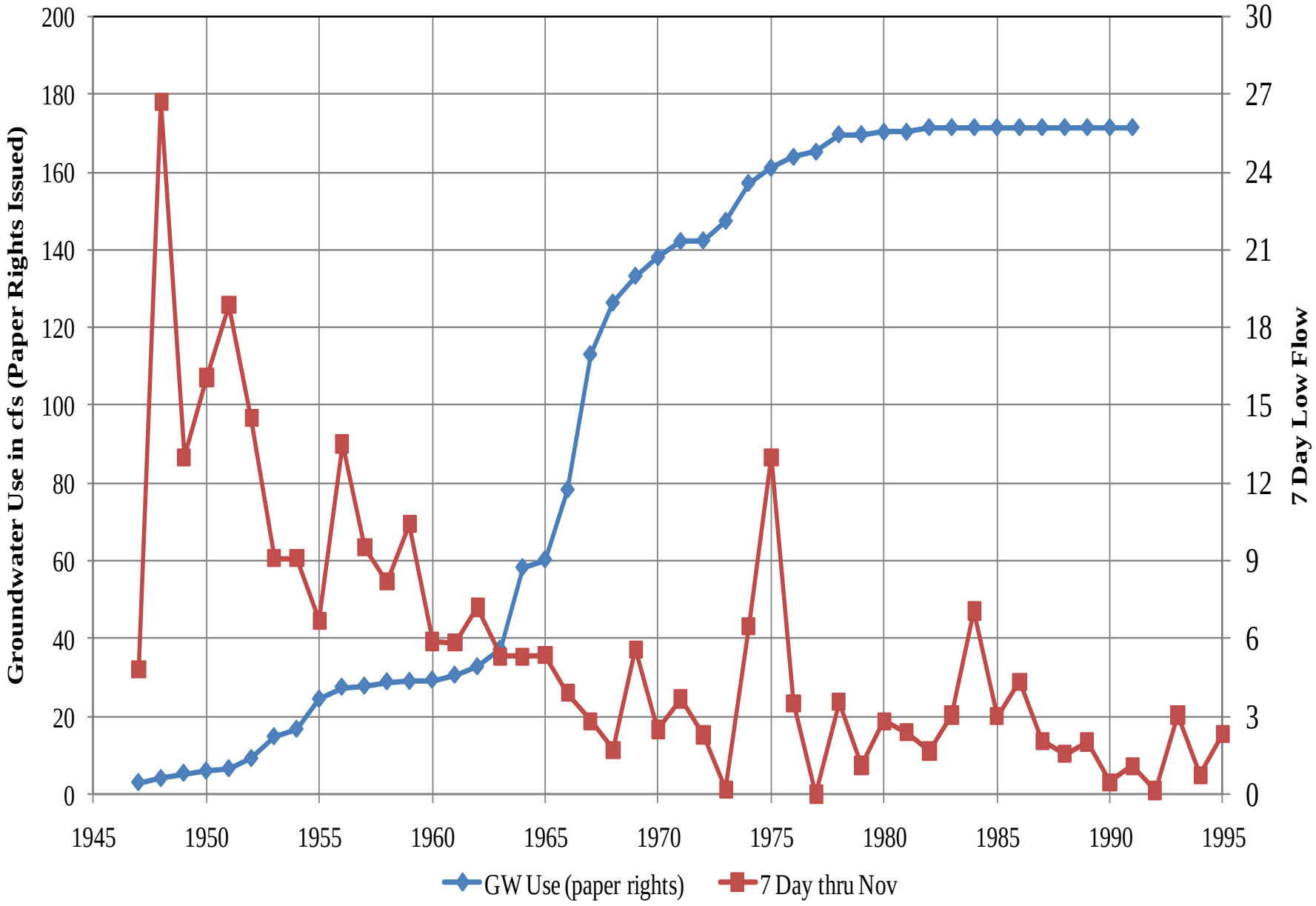


February Baseflow



August Baseflow

Groundwater Use – Annual 7-Day Low Flow
Lower Crab Creek – WRIA 41



Groundwater Pumping Impacts on Surface Water in Yakima River Basin

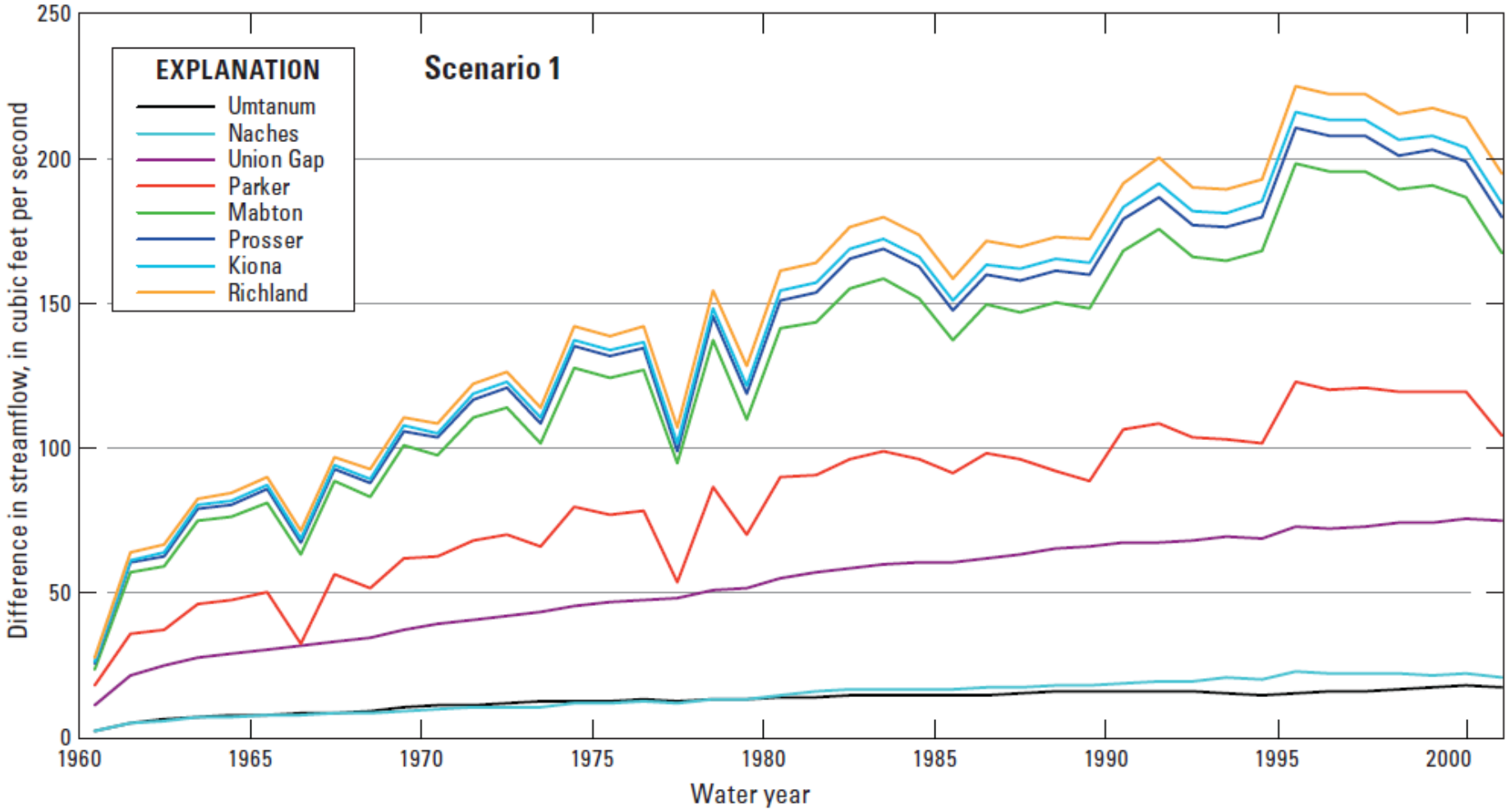
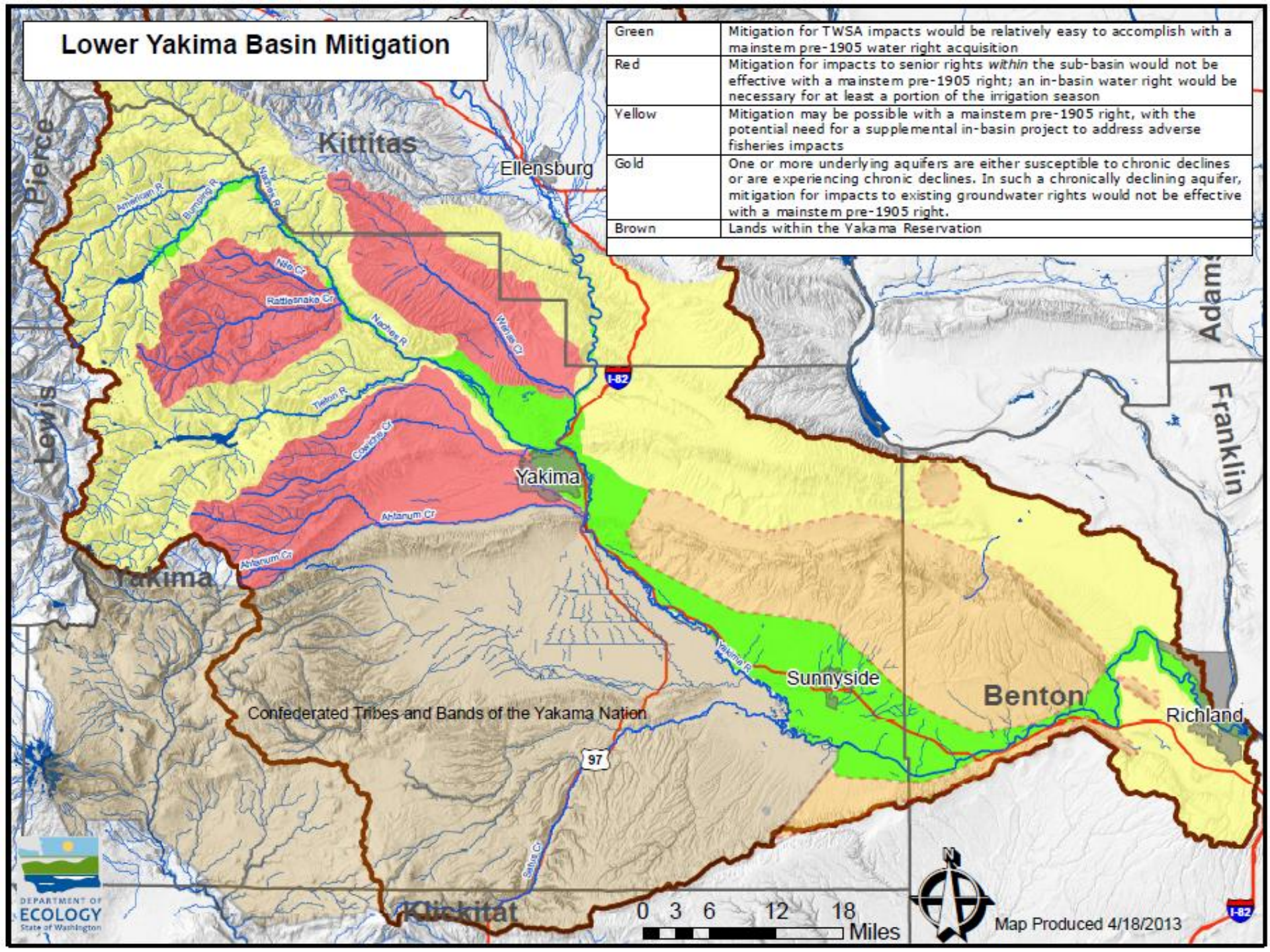


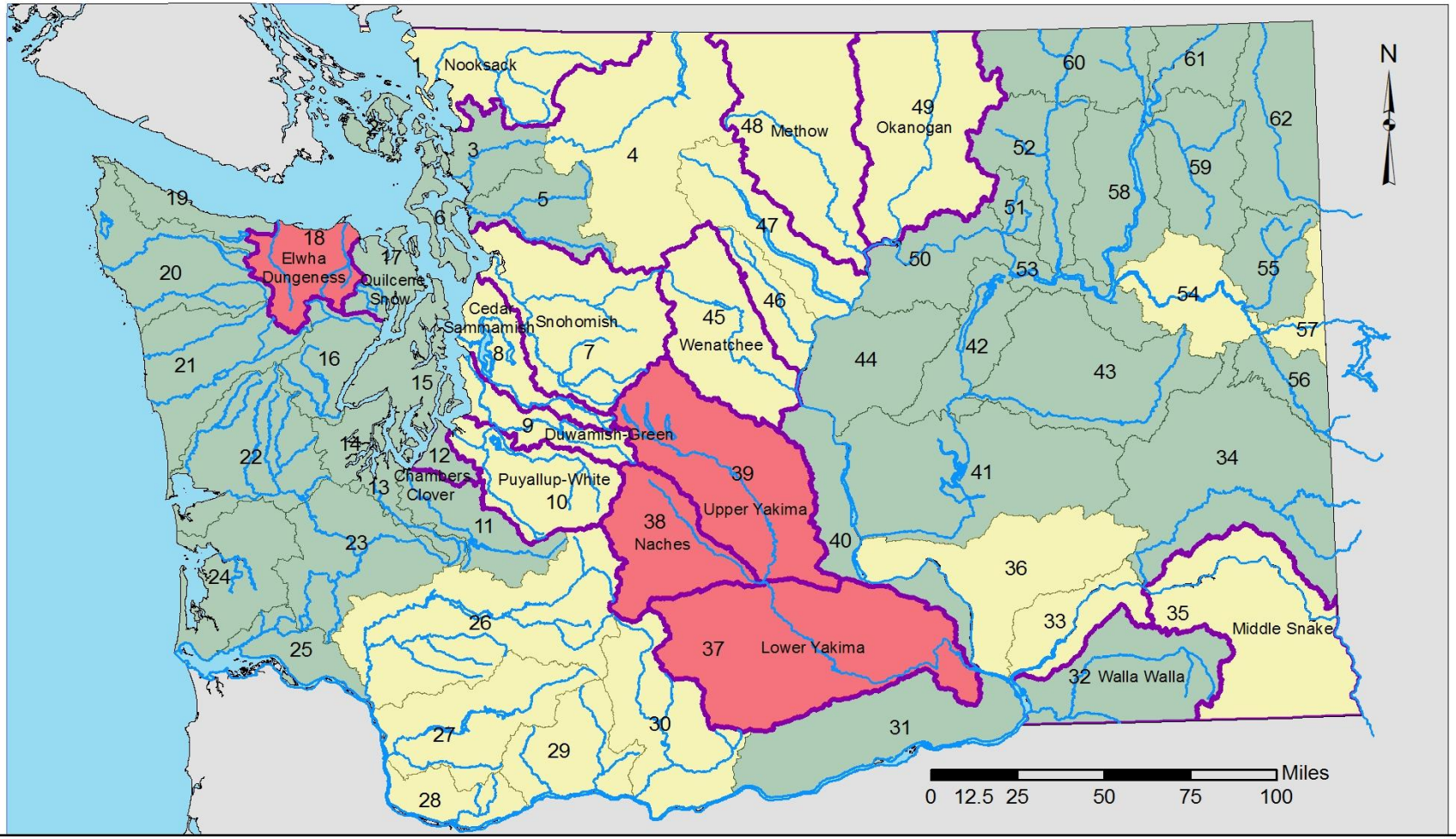
Figure 30. Difference in simulated mean annual streamflow between existing conditions and existing conditions without groundwater pumping, Yakima River basin aquifer system, Washington.

Lower Yakima Basin Mitigation

Green	Mitigation for TWSA impacts would be relatively easy to accomplish with a mainstem pre-1905 water right acquisition
Red	Mitigation for impacts to senior rights *within* the sub-basin would not be effective with a mainstem pre-1905 right; an in-basin water right would be necessary for at least a portion of the irrigation season
Yellow	Mitigation may be possible with a mainstem pre-1905 right, with the potential need for a supplemental in-basin project to address adverse fisheries impacts
Gold	One or more underlying aquifers are either susceptible to chronic declines or are experiencing chronic declines. In such a chronically declining aquifer, mitigation for impacts to existing groundwater rights would not be effective with a mainstem pre-1905 right.
Brown	Lands within the Yakama Reservation



2040 Projected Climate Change Impact by WRIA



Signifies one of the 16 critical basins (basins with shortage of water for fish)

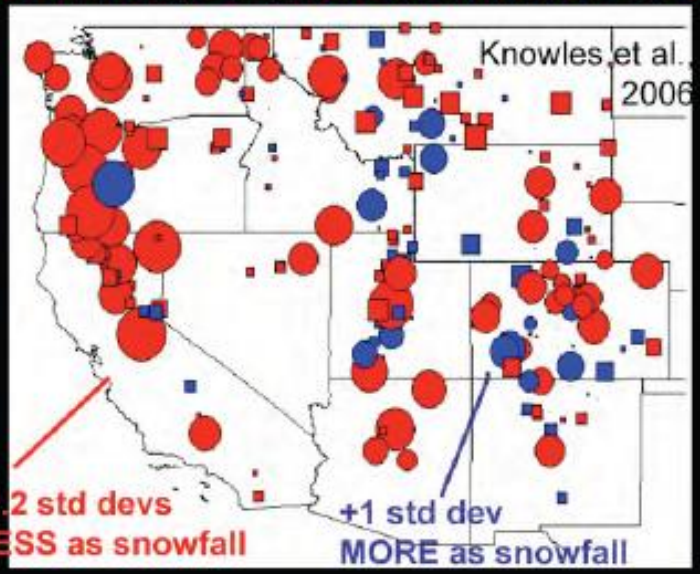
Low (rain dominant, no change or higher winter flows and similar low summer flows; also could be snowpack dominant becoming mildly transient with no effect on summer low flows or transient/rain dominant becoming more rain dominant)

Medium (Mildly transient (mostly rain dominant) to fully rain dominant with low summer flows; also could be snowpack dominant becoming significantly transient with some effect on summer low flows)

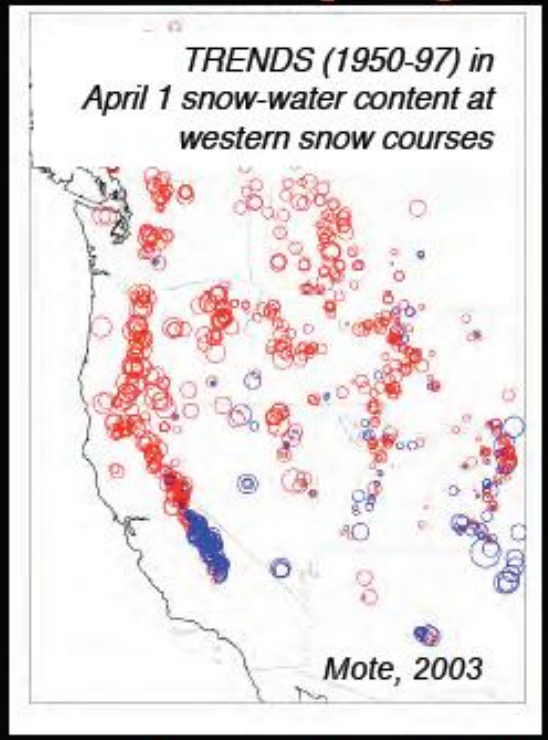
High (Transient to rain dominant or snowpack dominant to transient; also could be much earlier runoff for snowpack dominant that exacerbates summer low flows)

Warming already has driven observable hydroclimatic change

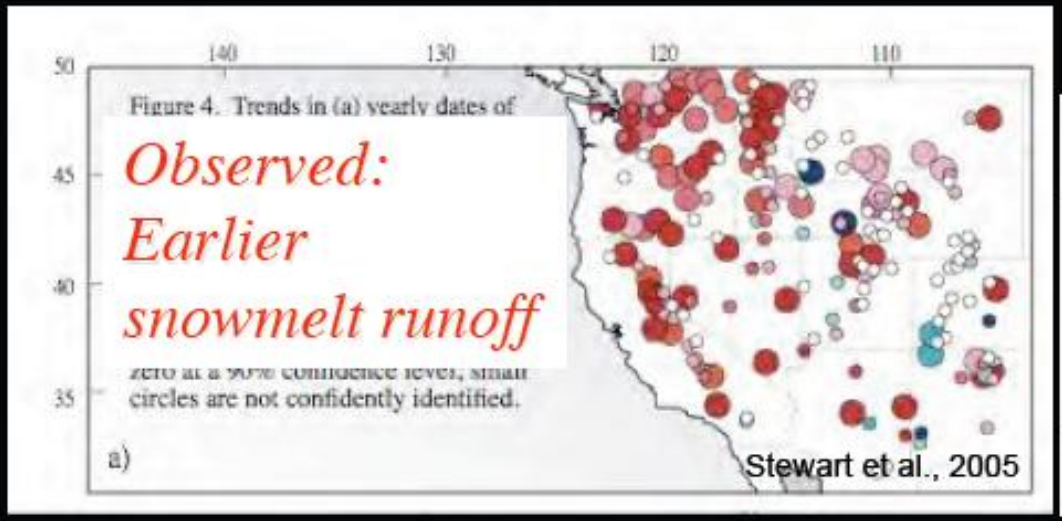
Observed: Less snow/more rain



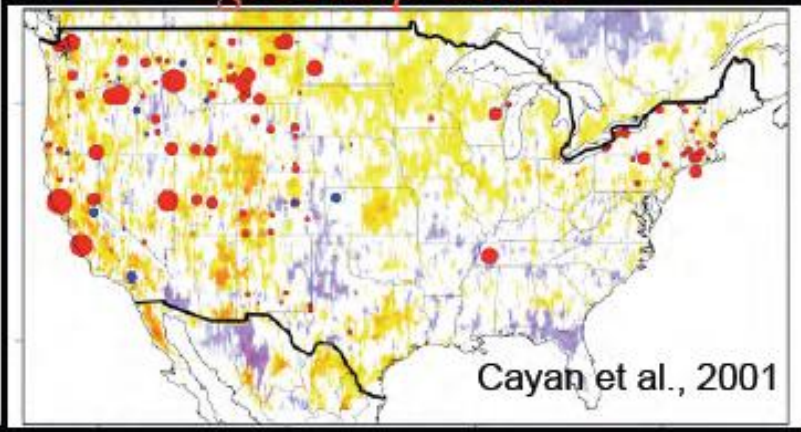
Observed: Less spring snowpack

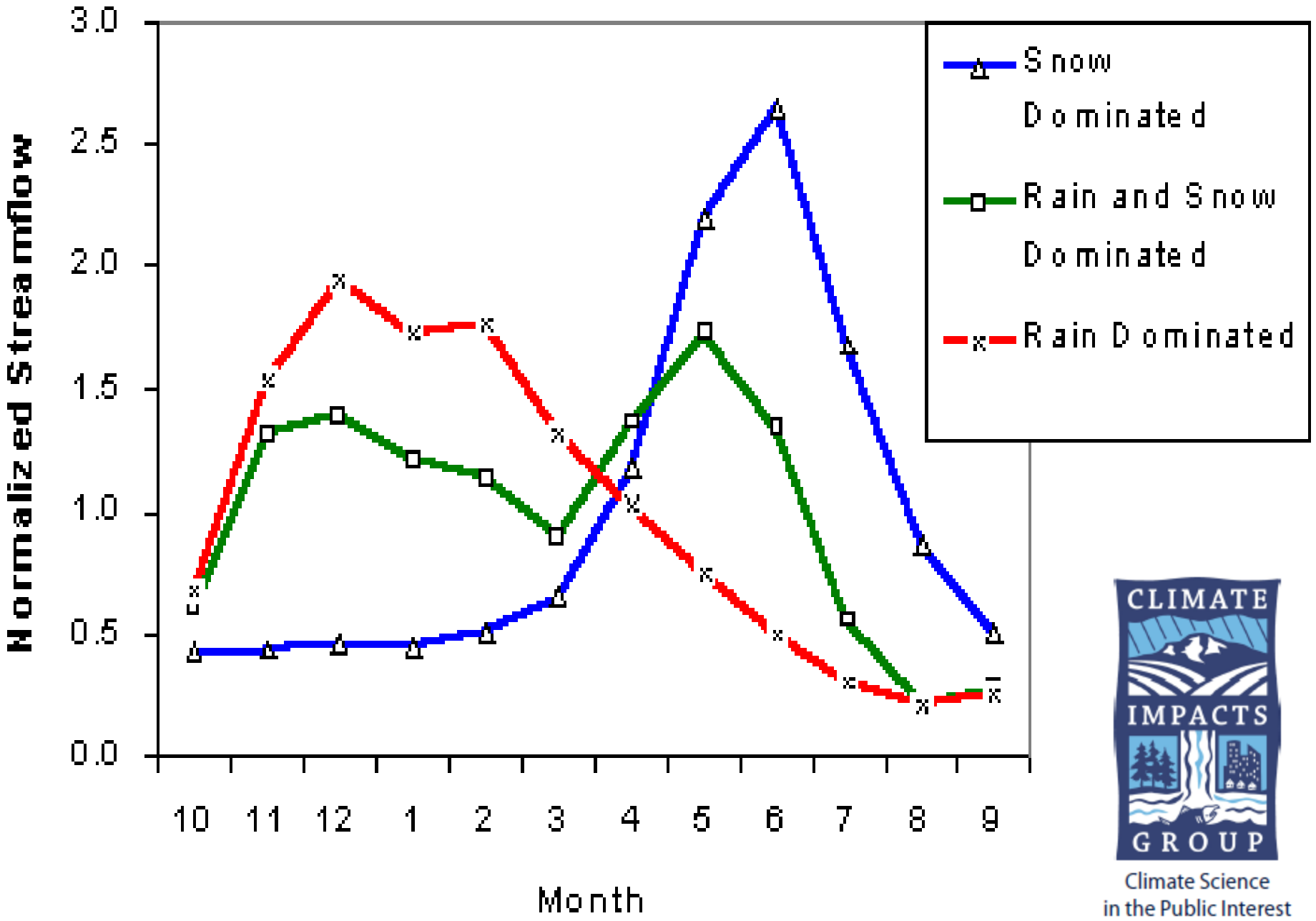


Observed: Earlier snowmelt runoff



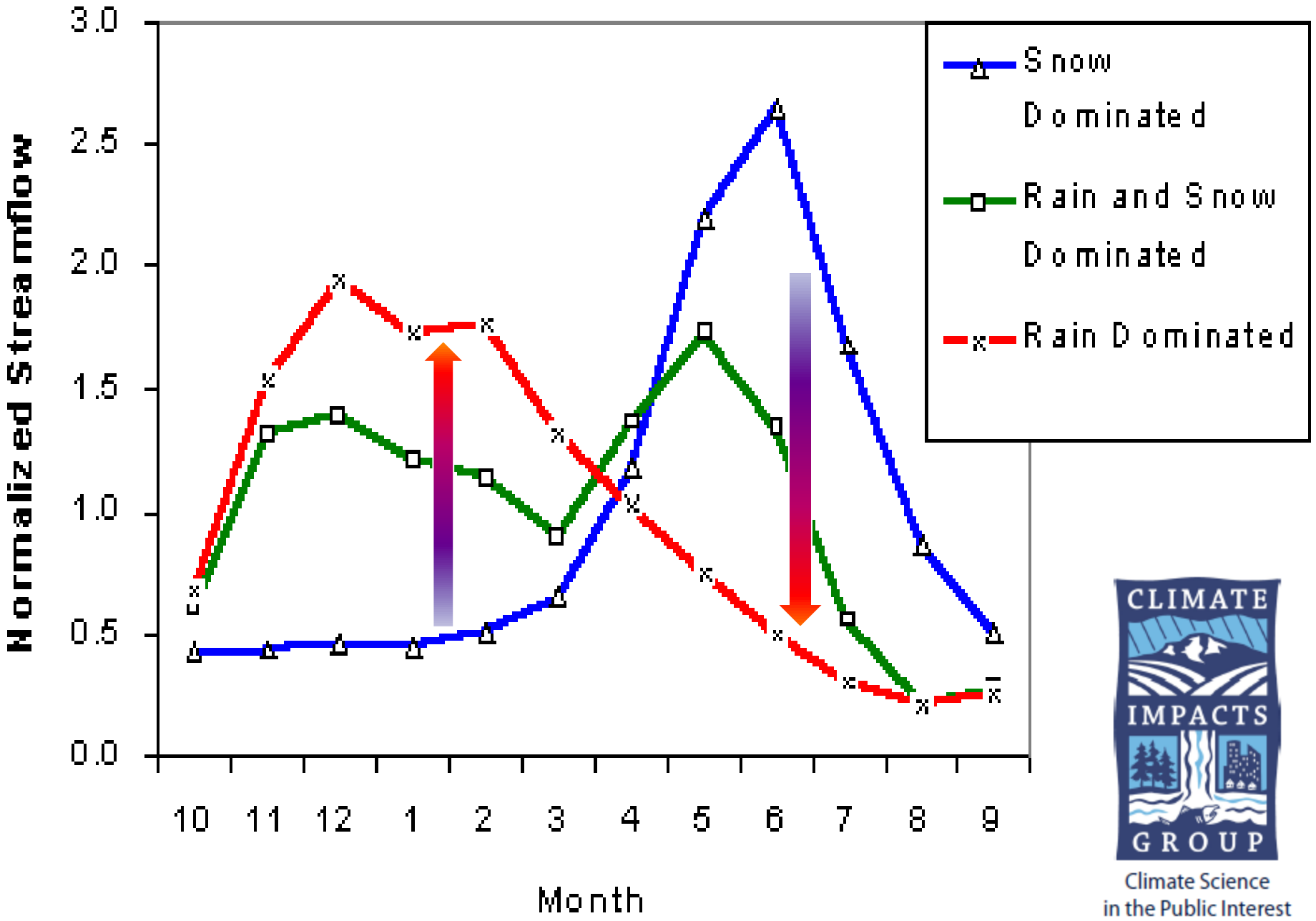
Observed: Earlier greenup dates





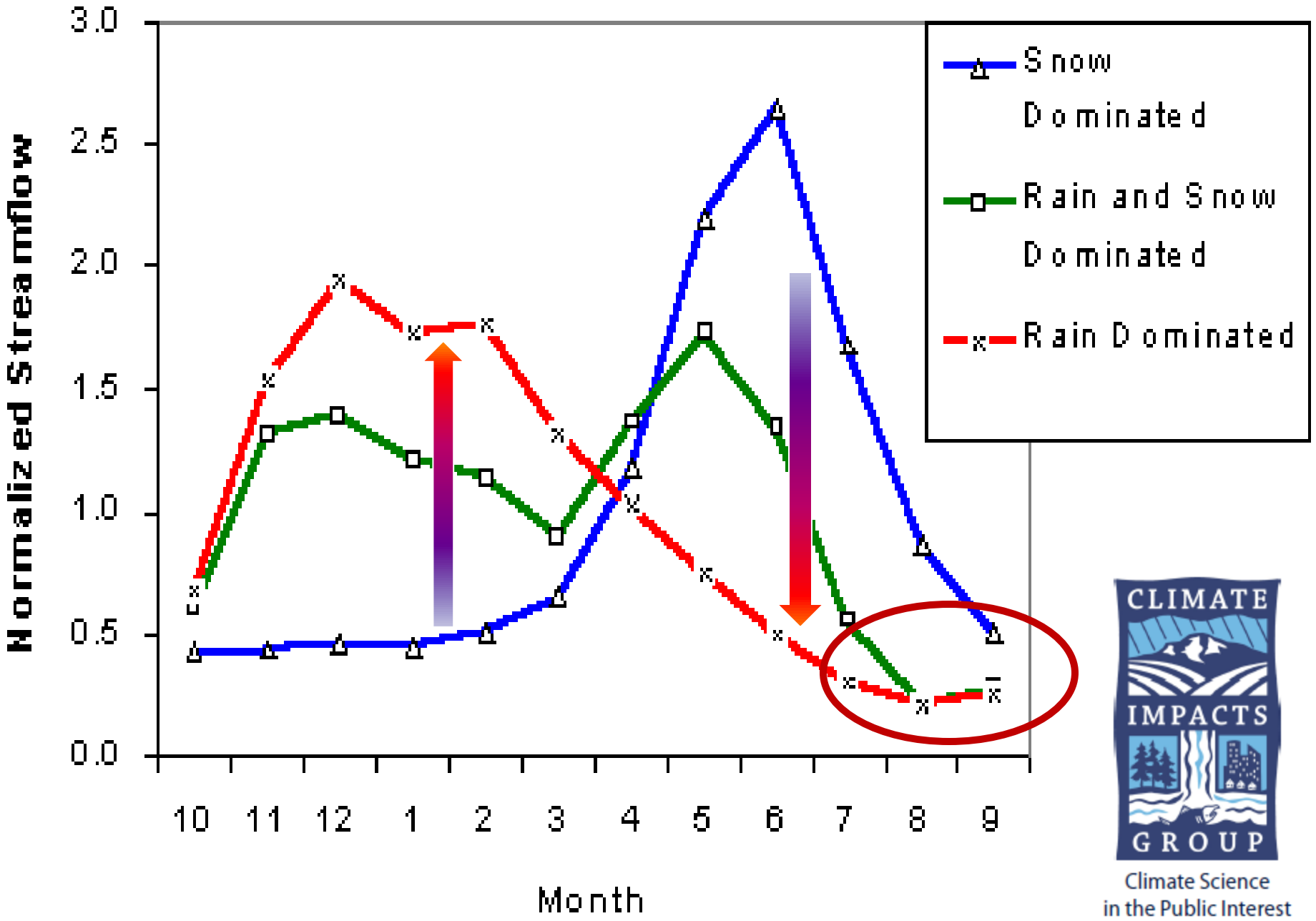
CLIMATE IMPACTS GROUP

Climate Science in the Public Interest



CLIMATE IMPACTS GROUP

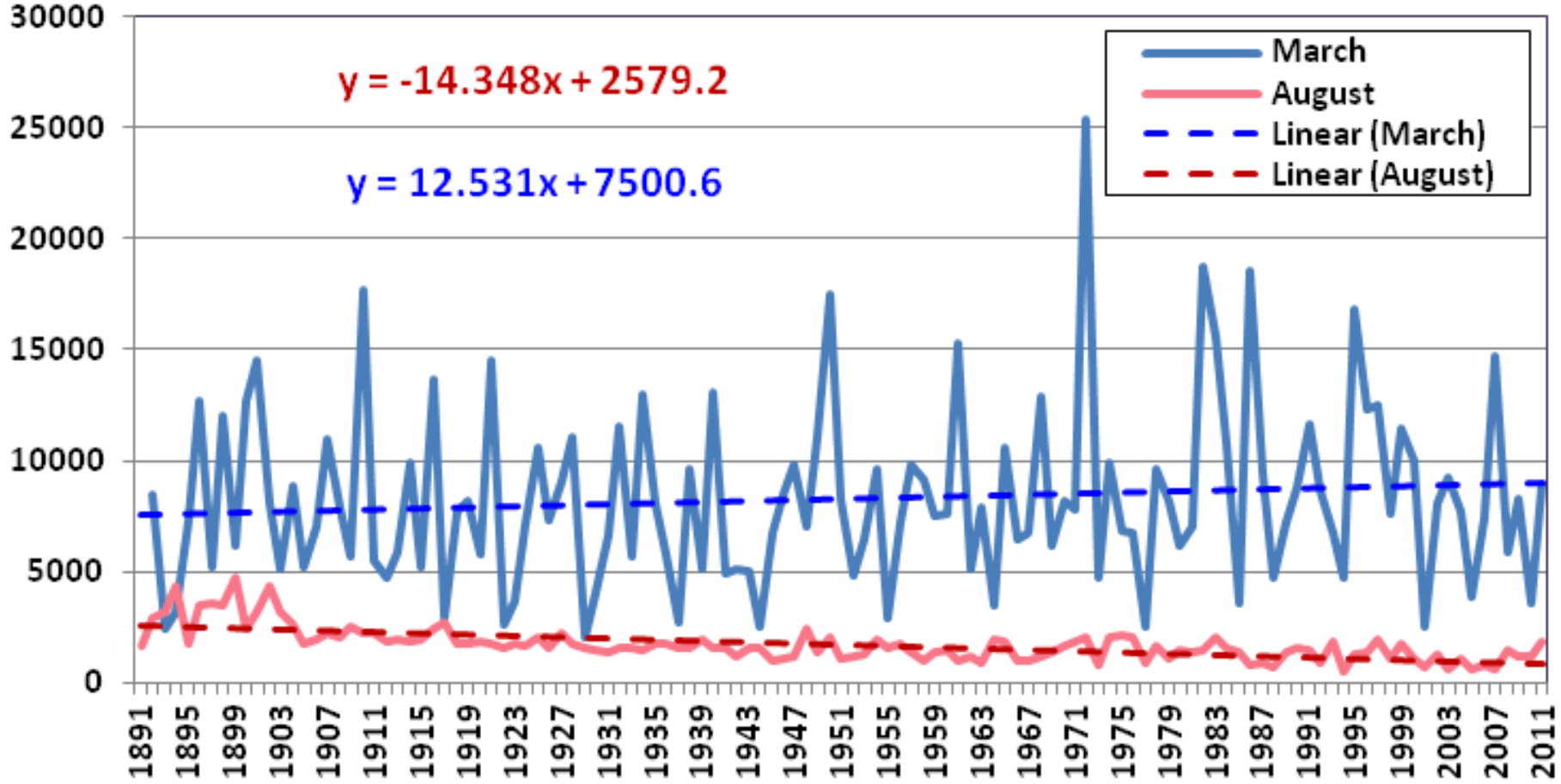
Climate Science in the Public Interest



CLIMATE IMPACTS GROUP

Climate Science in the Public Interest

USGS 12422500 SPOKANE RIVER AT SPOKANE, WA

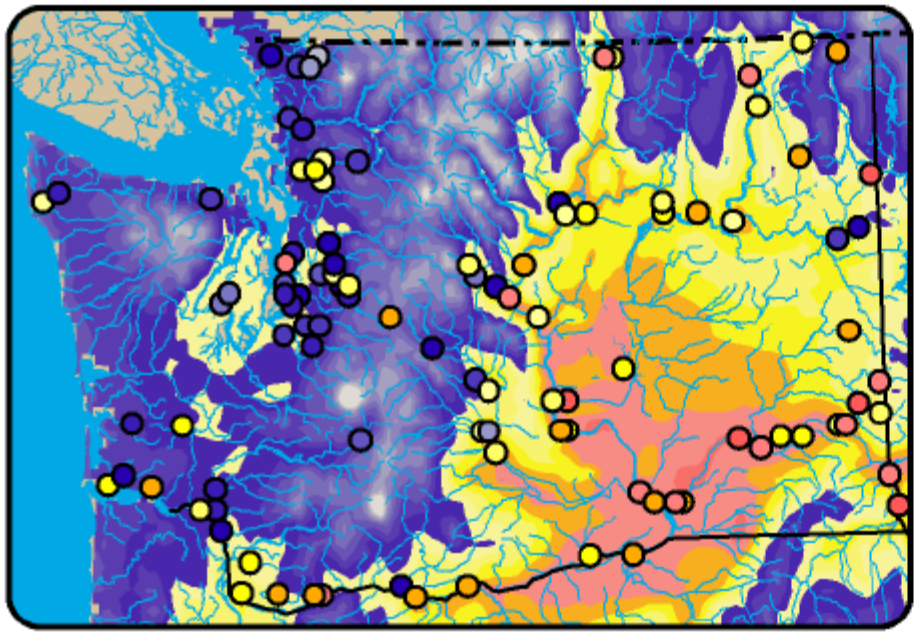


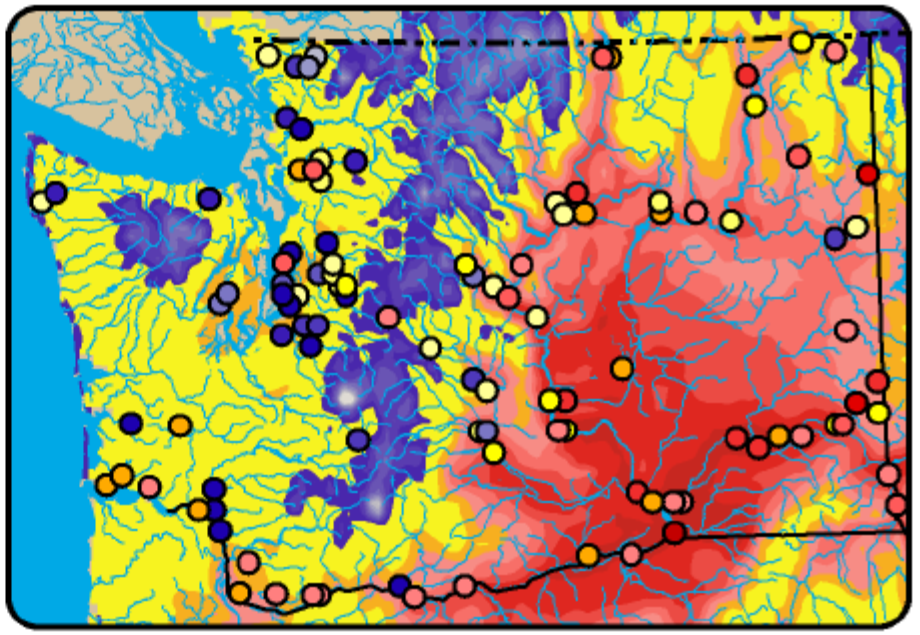
August Mean Surface Air Temperature and Maximum Stream Temperature

Climate Science in the Public Interest

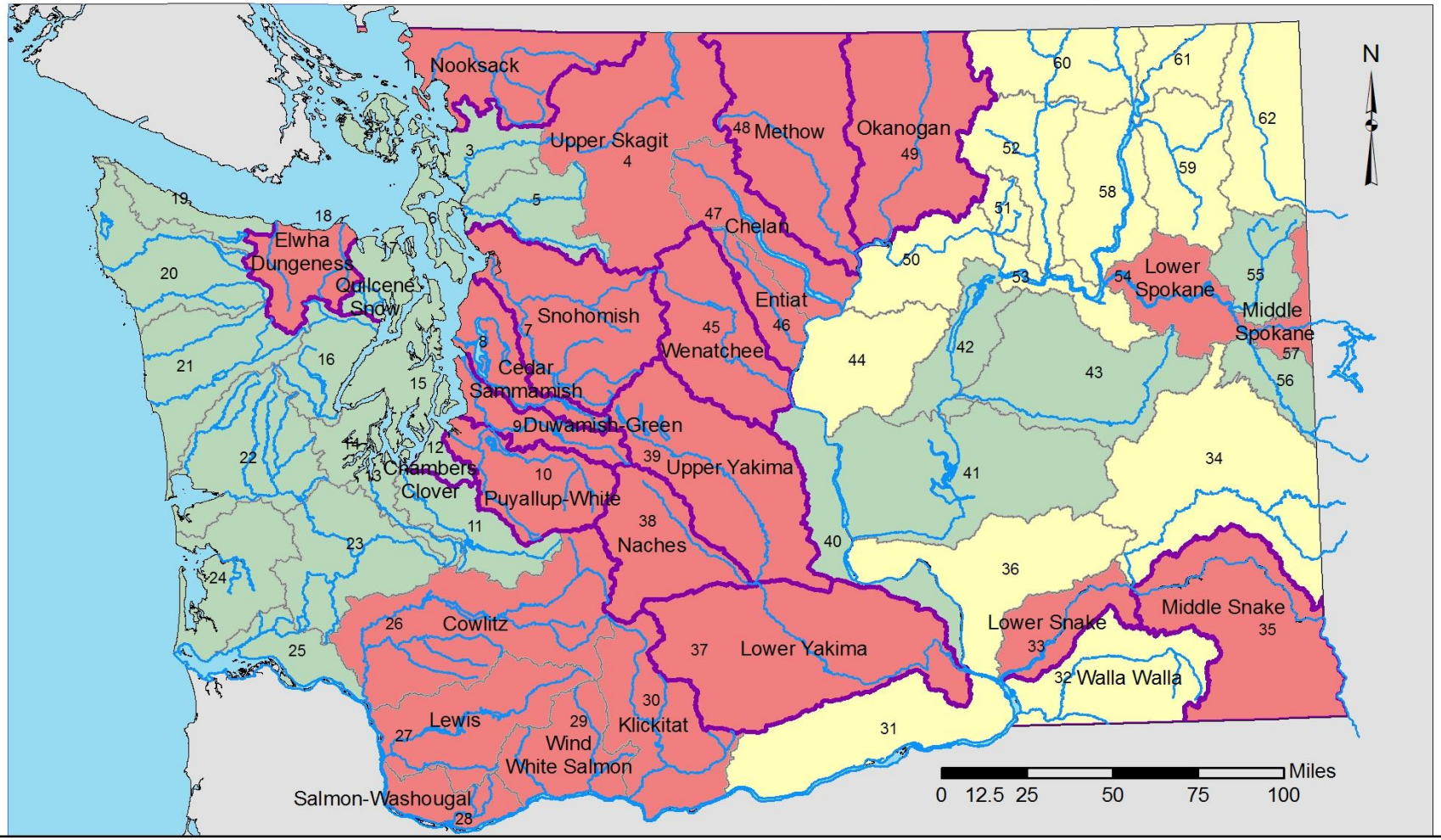
Historical (1970-1999)

2040s medium (A1B)





2080 Projected Climate Change Impact by WRIA



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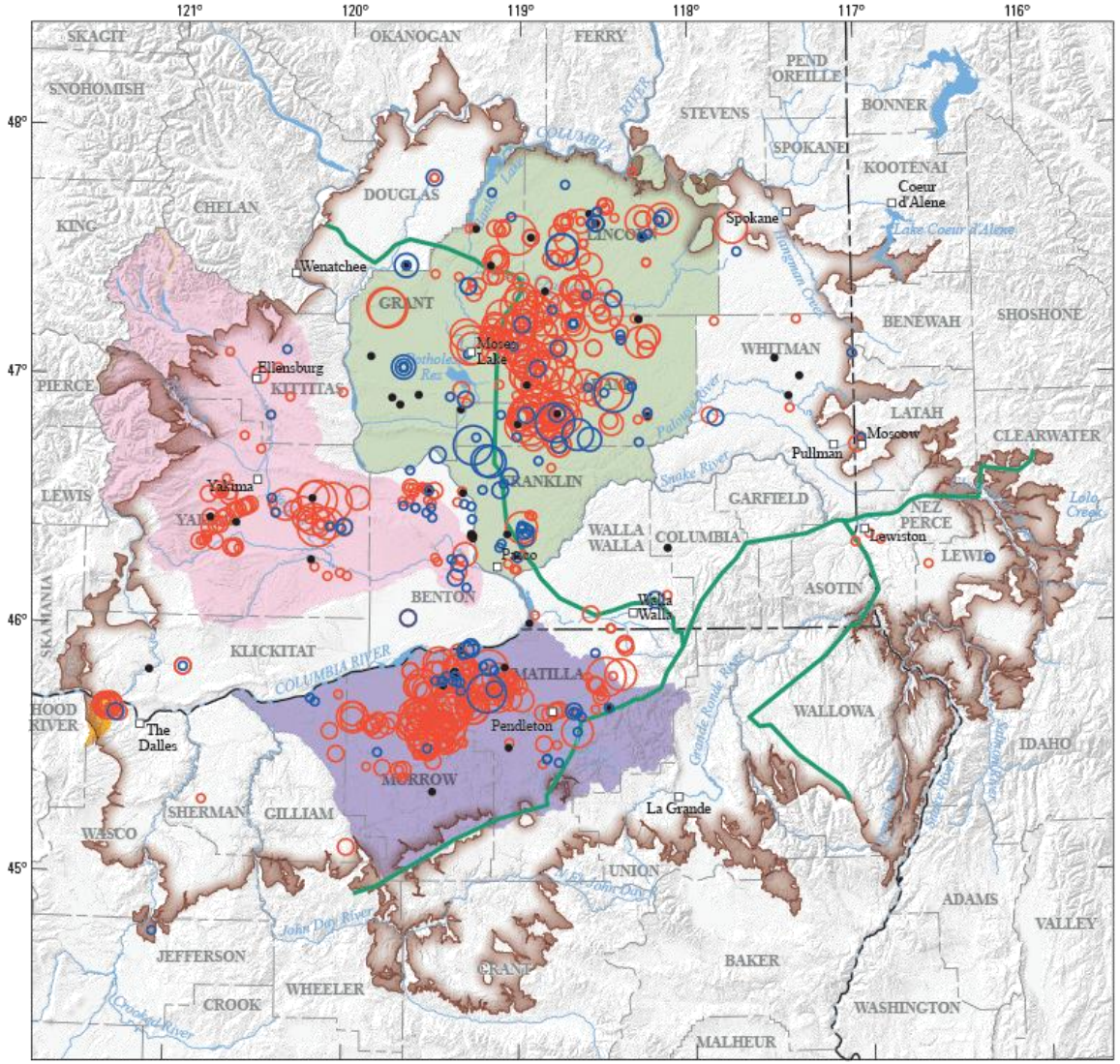


Base map modified from USGS and other digital data, various scales. Coordinate system: State Plane-Washington South FIPS 4602, Projection: Lambert Conformal Conic; North American Datum of 1983.

EXPLANATION

- Modeled extent of Columbia River Basalt Group
- Columbia Basin Ground Water Management Area
- Mosier Watershed
- Umatilla Basin
- Yakima Basin
- Structural regions of the Columbia Plateau Regional Aquifer System (see inset map)

Groundwater level trends—1968–2009

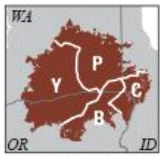
Slope increases, in feet per year

- 7.5 to 10.8
- 5.0 to 7.5
- 3.5 to 5.0
- 1.0 to 3.5
- 0.1 to 1.0

Slope declines, in feet per year

- -0.1 to -1.0
- -1.0 to -3.5
- -3.5 to -5.0
- -5.0 to -7.5
- -7.5 to -25.1

- Slope, flat -0.1 to 0.1

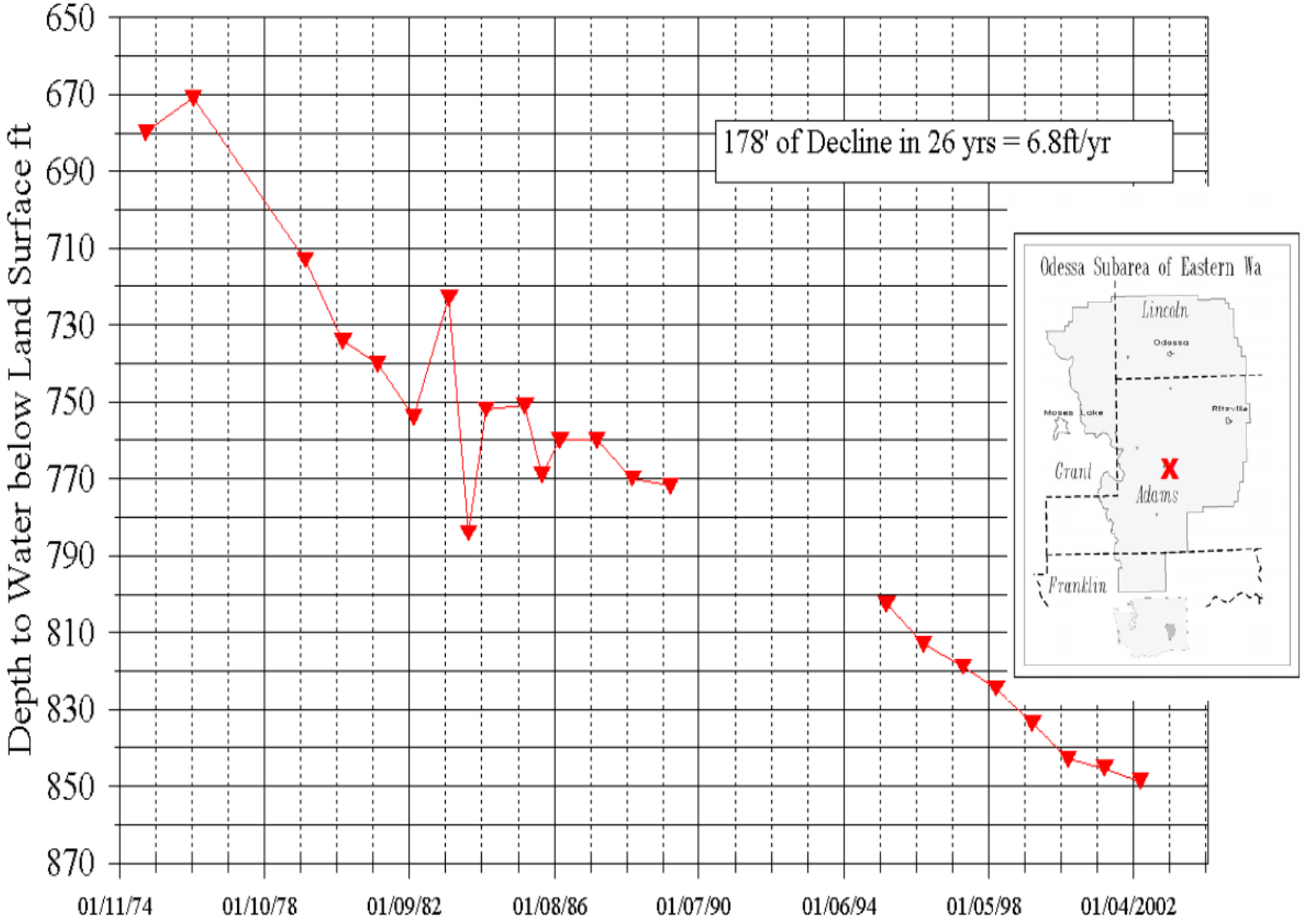


Structural regions

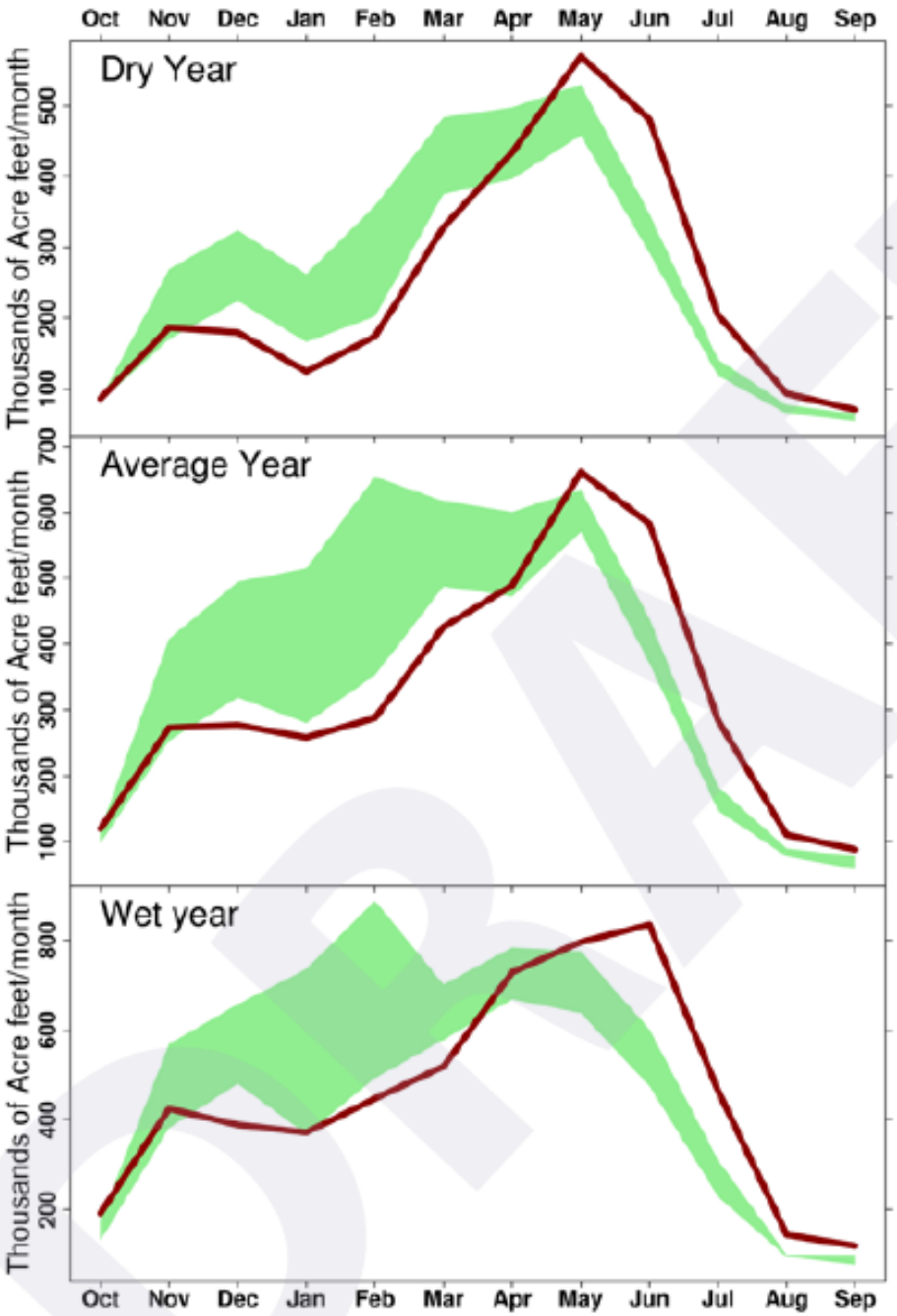
- B Blue Mountains
- C Clearwater Embayment
- P Palouse Slope
- Y Yakima Fold Belt

Water Level Measurements

17N/33E-06E01



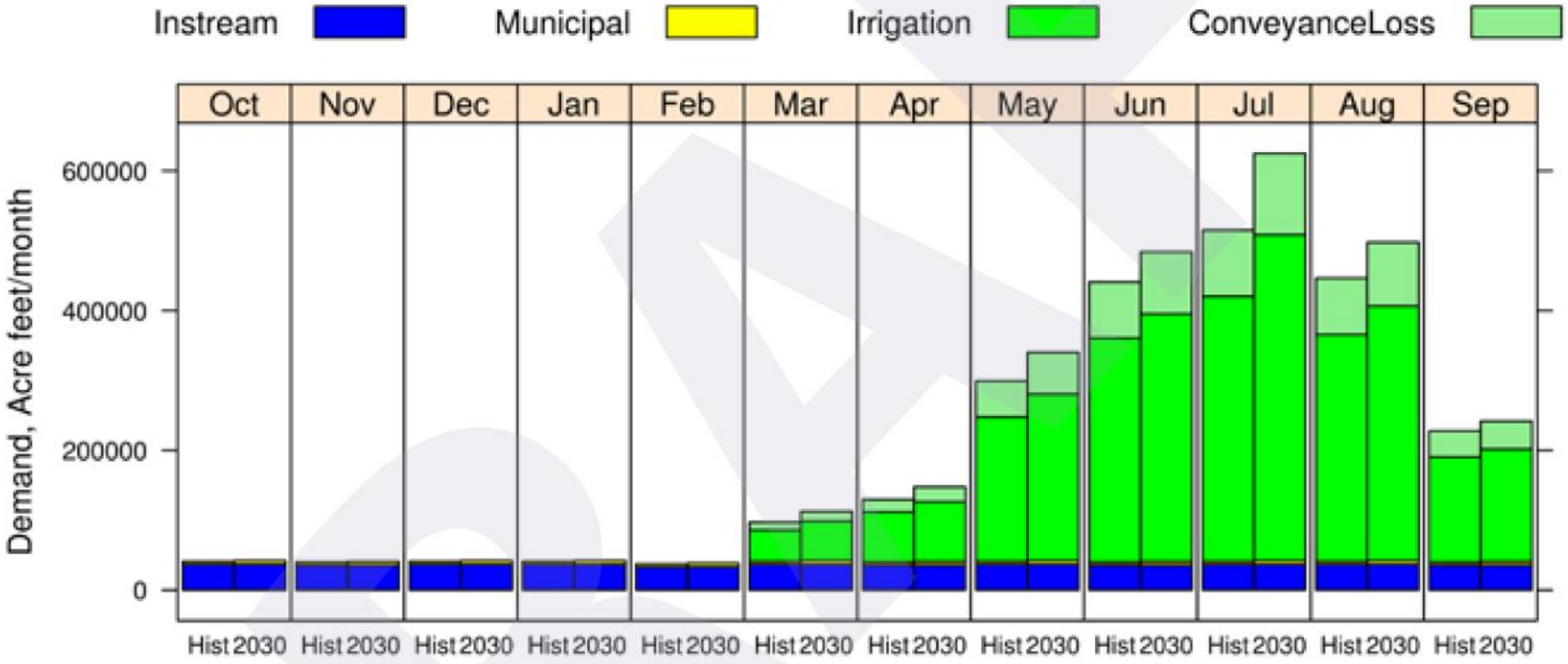
Supply



Historical
2030 Range

Lower Yakima, Naches, Upper Yakima

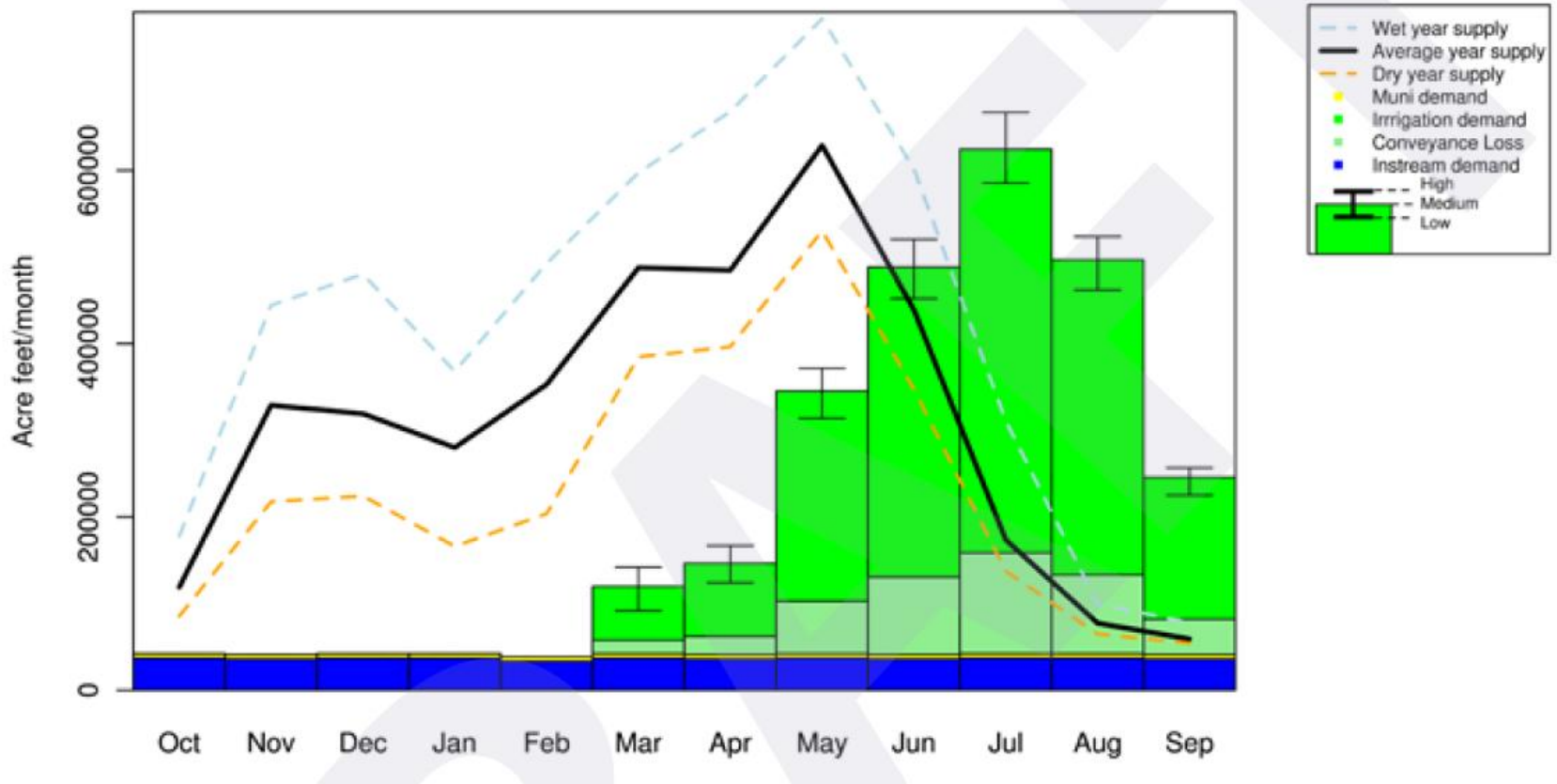
Demand


Instream
Municipal
Irrigation
ConveyanceLoss
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Demand, Acre feet/month
600000
400000
200000
0
Hist 2030

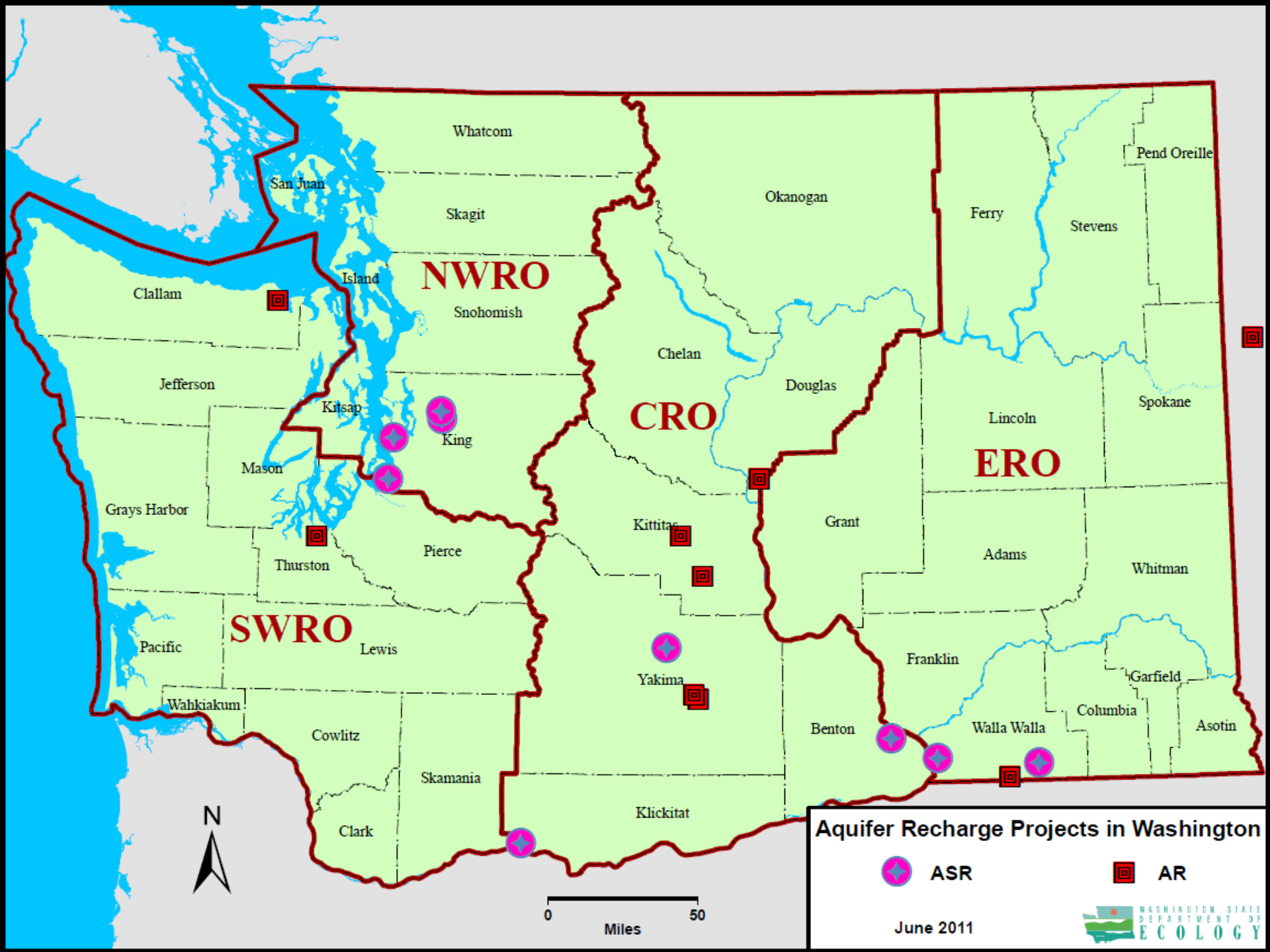
Supply & Demand

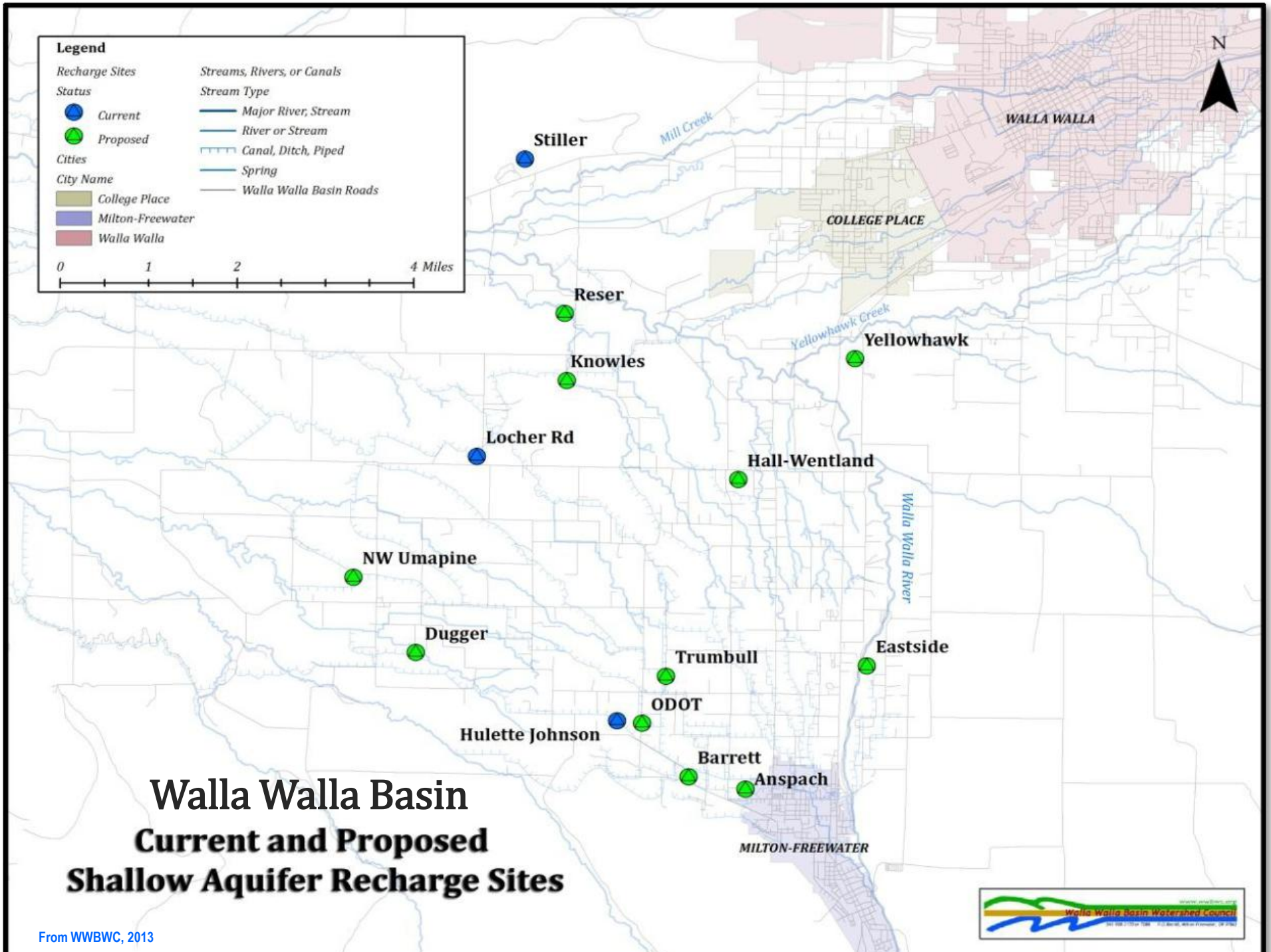
WRIA 37, 38 & 39

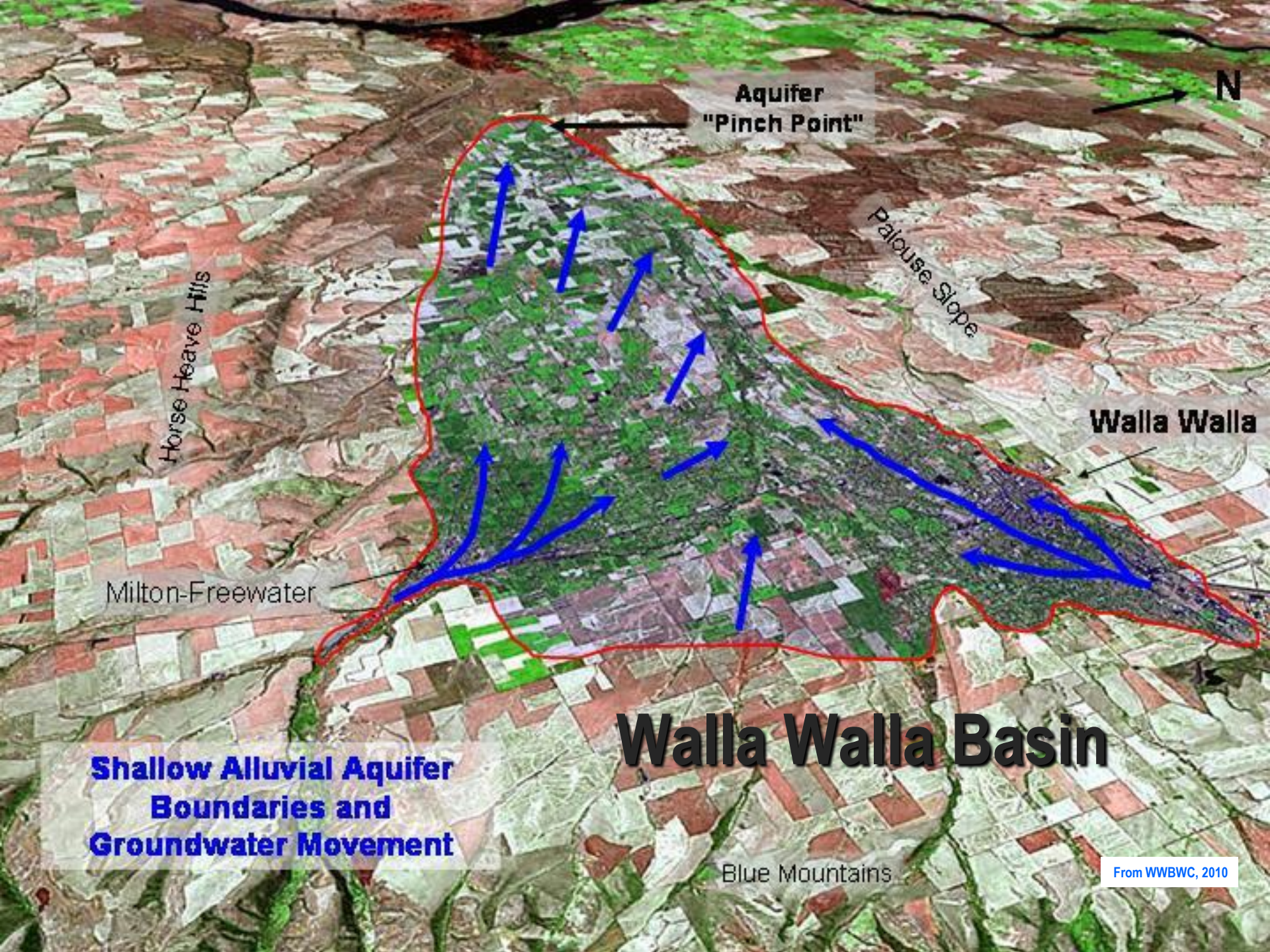
Lower Yakima, Naches & Upper Yakima



Artificial Groundwater Recharge


Whatcom
San Juan
Skagit
Okanogan
Ferry
Pend Oreille
Stevens
NWRO
Island
Clallam
Snohomish
Chelan
Douglas
CRO
Jefferson
Kitsap
King
Lincoln
Spokane
ERO
Mason
Grays Harbor
Kittitas
Grant
Pierce
Thurston
Adams
Whitman
SWRO
Pacific
Lewis
Yakima
Franklin
Garfield
Wahkiakum
Columbia
Asotin
Cowlitz
Benton
Walla Walla
Skamania
Klickitat
Clark
N
0
50
Miles
Aquifer Recharge Projects in Washington
ASR
AR
June 2011
WASHINGTON STATE DEPARTMENT OF ECOLOGY

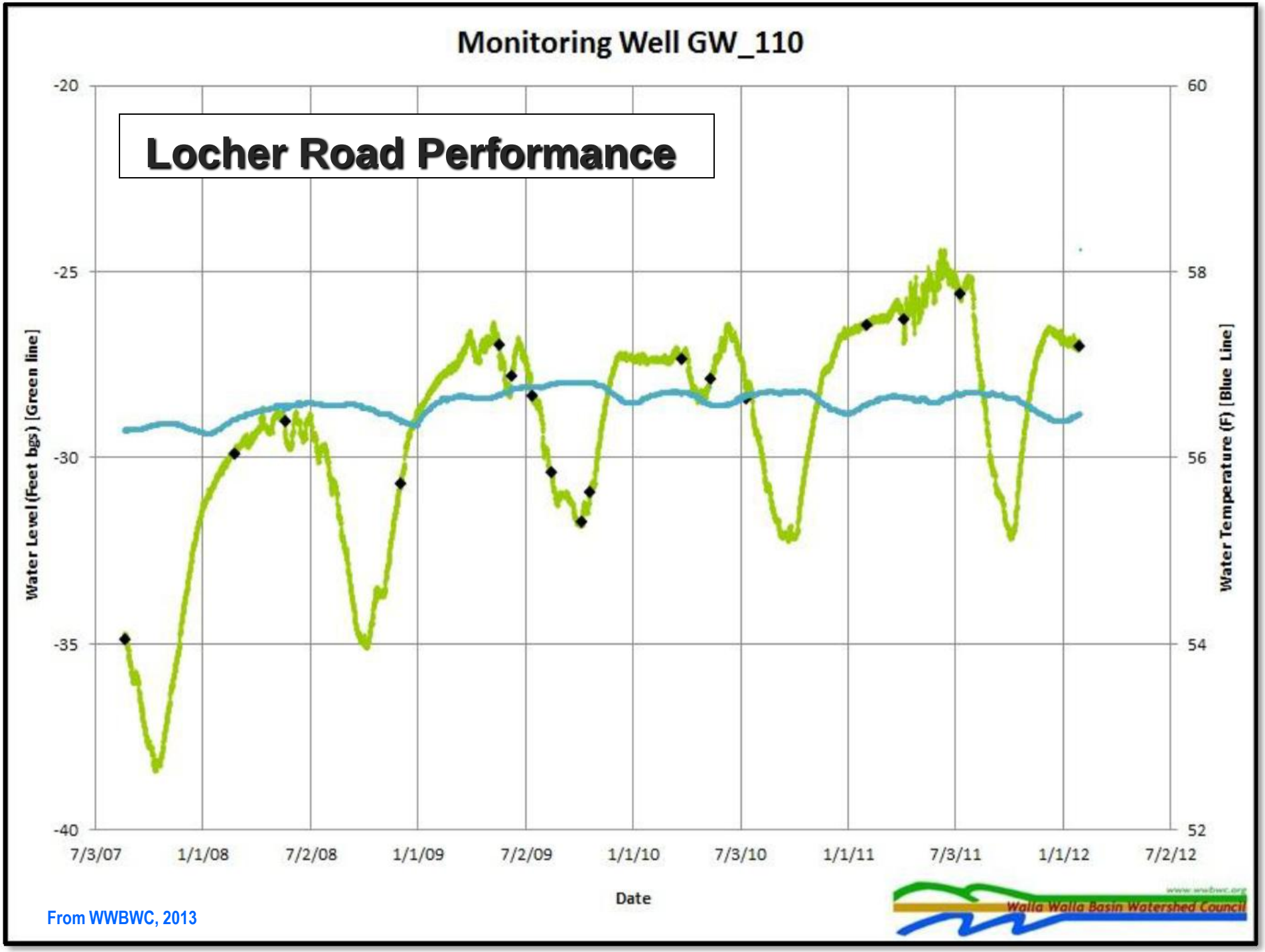

Legend
Recharge Sites
Status
Current
Proposed
Cities
City Name
College Place
Milton-Freewater
Walla Walla
Streams, Rivers, or Canals
Stream Type
Major River, Stream
River or Stream
Canal, Ditch, Piped
Spring
Walla Walla Basin Roads
0
1
2
4 Miles
N
WALLA WALLA
COLLEGE PLACE
MILTON-FREEWATER
Mill Creek
Yellowhawk Creek
Walla Walla River
Stiller
Reser
Knowles
Yellowhawk
Locher Rd
Hall-Wentland
NW Umapine
Dugger
Trumbull
Eastside
ODOT
Hulette Johnson
Barrett
Anspach
Walla Walla Basin
Current and Proposed
Shallow Aquifer Recharge Sites
From WWBWC, 2013
Walla Walla Basin Watershed Council


Aquifer
"Pinch Point"
N
Palouse Slope
Horse Heave Hills
Walla Walla
Milton-Freewater
Walla Walla Basin
Shallow Alluvial Aquifer
Boundaries and
Groundwater Movement
Blue Mountains
From WWBWC, 2010

Hudson Bay Improvement Company SAR

From WWBWC, 2013

Locher Road SAR



From WWBWC, 2013

Johnson Creek: A Success Story

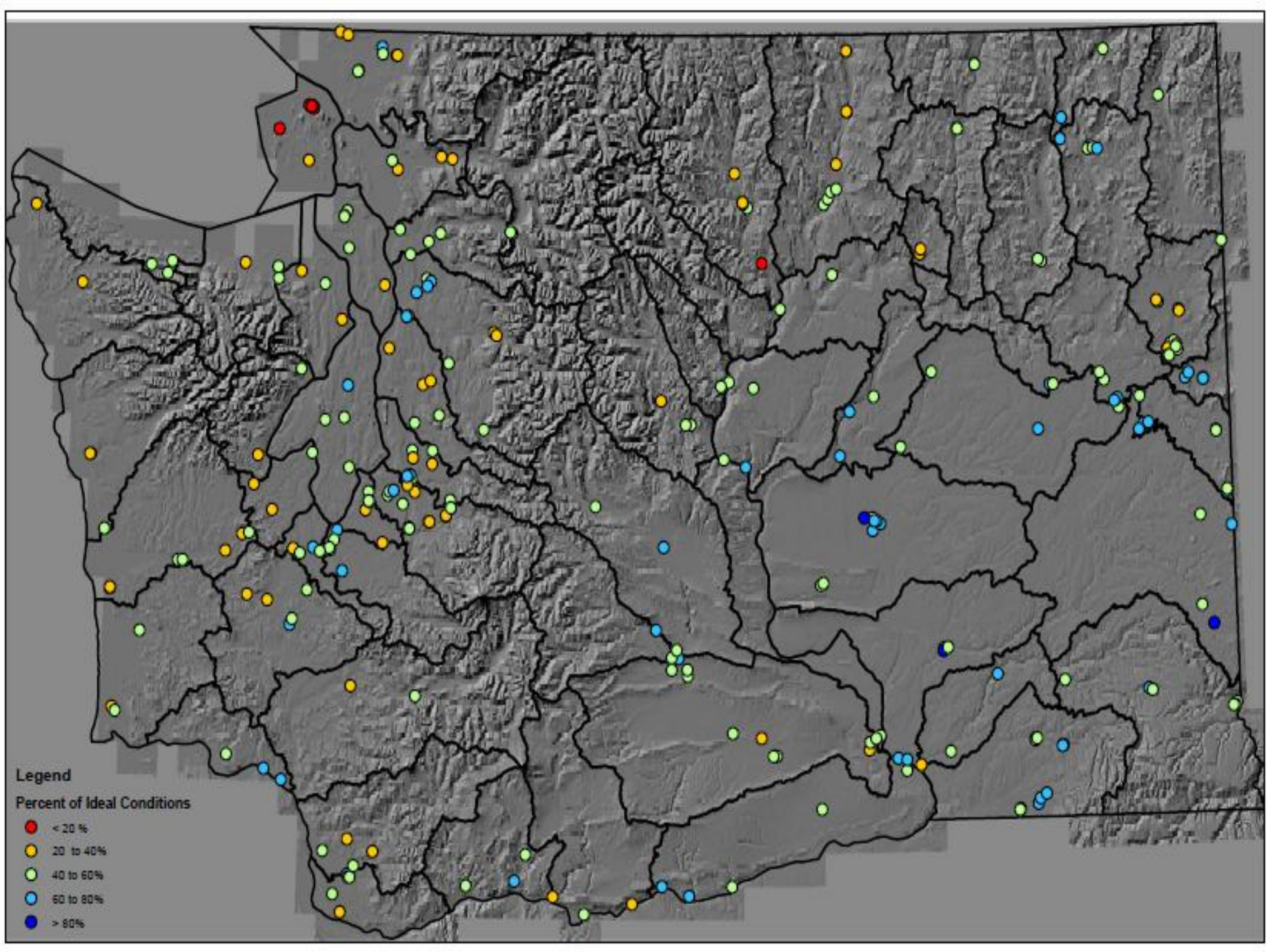
Running again after 25+ years

Modeling and hydrogeologic transect assessments demonstrate recharge-spring flow connection

Challenge: reestablishing flows to spring-creeks when significant time has passed

Reconnected to Walla Walla River 2008


GOODYEAR


Legend
Percent of Ideal Conditions
< 20 %
20 to 40%
40 to 60%
60 to 80%
> 80%

Summary

- Existing laws, regulations, water rights and hydrologic conditions already limit water availability throughout Washington.
- Washington laws and regulations (and our understanding of hydrologic systems) support managing groundwater and surface water as an integrated resource.
- Hydrologic changes resulting from climate change are already occurring and expected to continue. These include more rain and less snow, higher high flows, lower low flows, changes to the timing of runoff, and warmer streams.
- Population growth and a warming climate will increase water demand, especially for irrigation.

Summary (continued)

- A warming climate may result in a reduction of natural ground water recharge (in eastern WA), causing declines in ground water elevations, and a reduction in baseflow contribution to streams.
- There is an increasingly urgent need to implement adaption strategies in order to protect existing uses and new future uses.
- Integrated water management tools and solutions are basin-specific and must be tailored to local conditions.
- An adequate and reliable funding source is needed to support management of water now and into the future.

Thank You

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WA State Dept of Ecology
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dnaz461@ecy.wa.gov