

An aerial photograph of a rural landscape. In the foreground, a winding river flows through green fields. A road curves along the left side of the river. In the middle ground, there are more fields and some small clusters of buildings. In the background, a town or city is visible, surrounded by more fields and hills under a clear blue sky.

# Does Our Future Include Enough Water?

Allyson Beall King  
Washington State University  
John Porcello  
GSI Water Solutions



# Handouts

- Handouts are based on and exercise with IWAC on mental models of water resource professionals. We appreciate your feedback and will provide results!
- What you know and value -> inform outreach and education



# Integrated Water Resource Management



**Institutional  
decision  
makers**

**Individual decision makers**



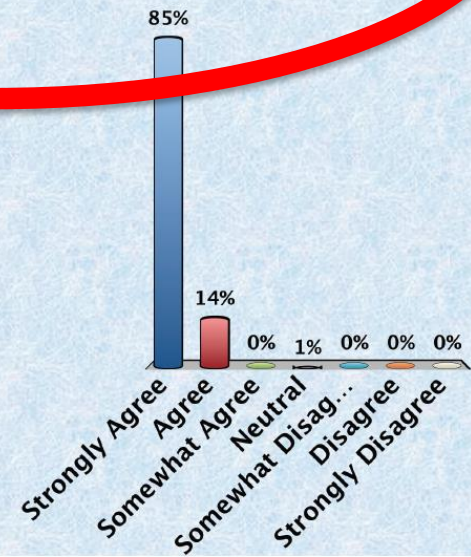
## Where do you see management of water resources in the Spokane River Basin in 2034 (20 years)?

- A. Managed as a basin through regulation
- B. Managed as a basin through collaboration
- C. Increased conflict
- D. Business-as-usual

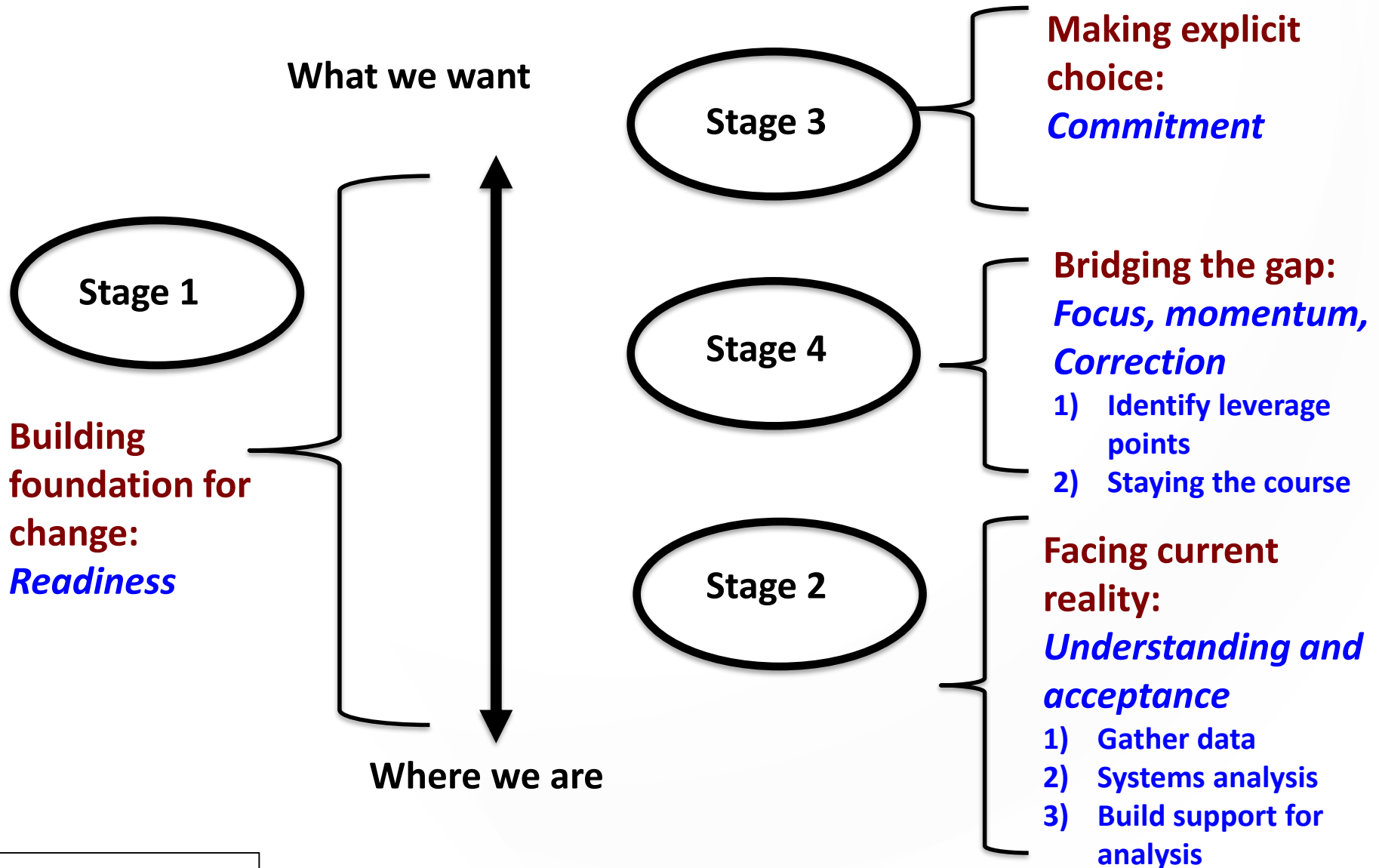


It is important to take a regional, collaborative approach among governments, agencies and stakeholders to meet water quality needs?

- A. Strongly Agree
- B. Agree
- C. Somewhat Agree
- D. Neutral
- E. Somewhat Disagree
- F. Disagree
- G. Strongly Disagree



# Four States of Facilitating Systemic Change







# Water Year 2015

## A prototype year for future climate?

Lightning Creek; tothewild.com

**University  
of Idaho**

John Abatzoglou  
Associate Professor of Climatology

 **CIRC**  
Climate Impacts Research Consortium  
A NOAA RISA TEAM



# Summary Presentation

## Spokane River Low-Flow Trends

*Historical and Present Causes*

*Prepared for*

Spokane River Forum Conference

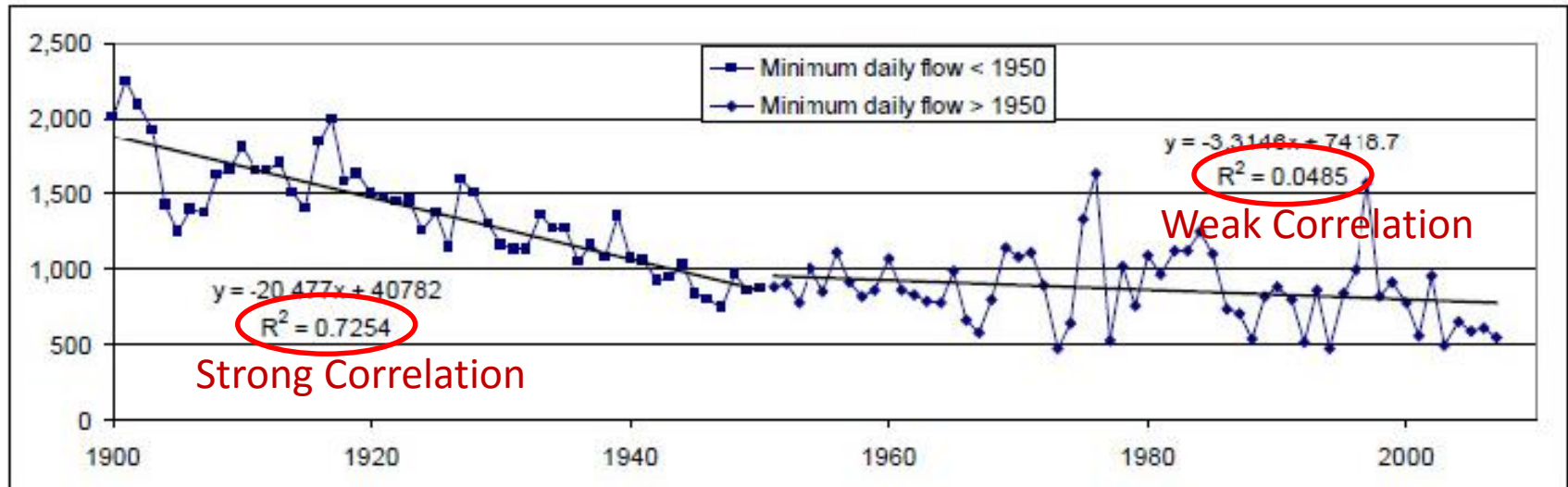
*Prepared by*

John Porcello, LHG and Jake Gorski, EIT  
GSI Water Solutions

March 23, 2016

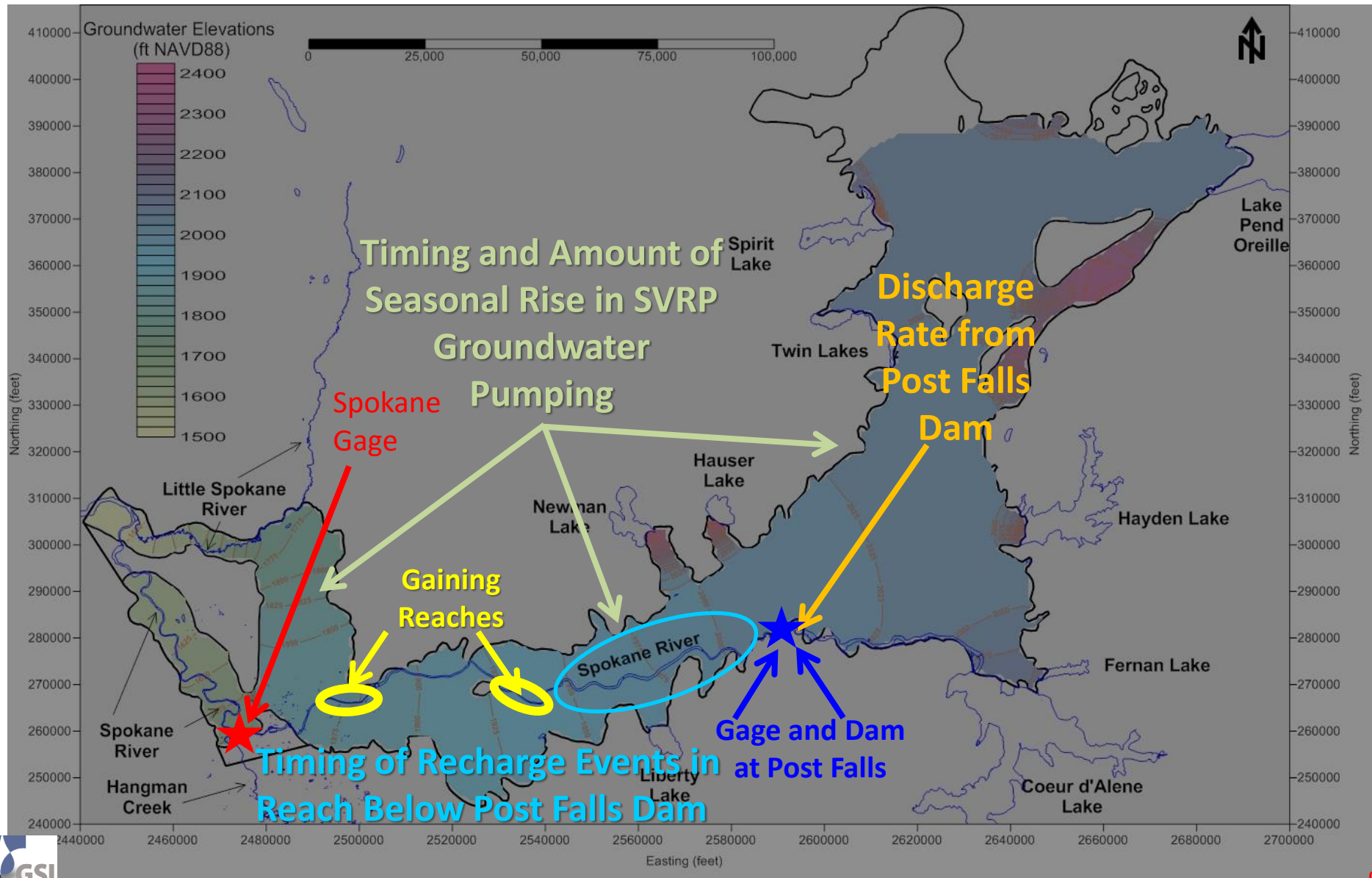
# Trends in Seasonal Low Flows at the Spokane Gage Through 2007

*(From Barber and others, 2011)*





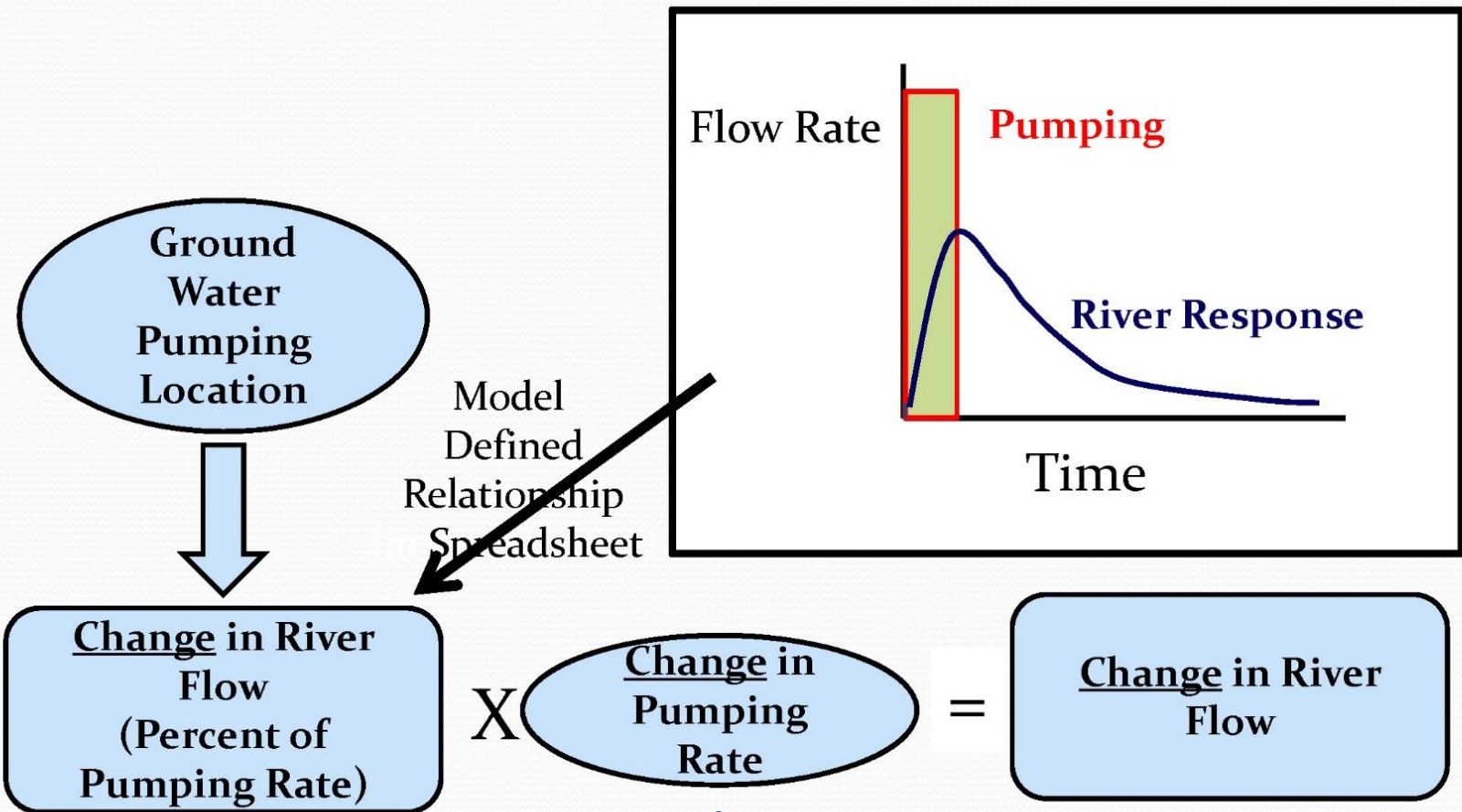
# Prior Studies: **Three** Factors Controlling August Low Flows at the Spokane Gage



# Idaho DWR Study

## *Summer Pumping Effects*

Using Response Functions Derived from the Bi-State Groundwater Model



Source

*SVRP Aquifer and the Spokane River Part 1 – How the System Works*

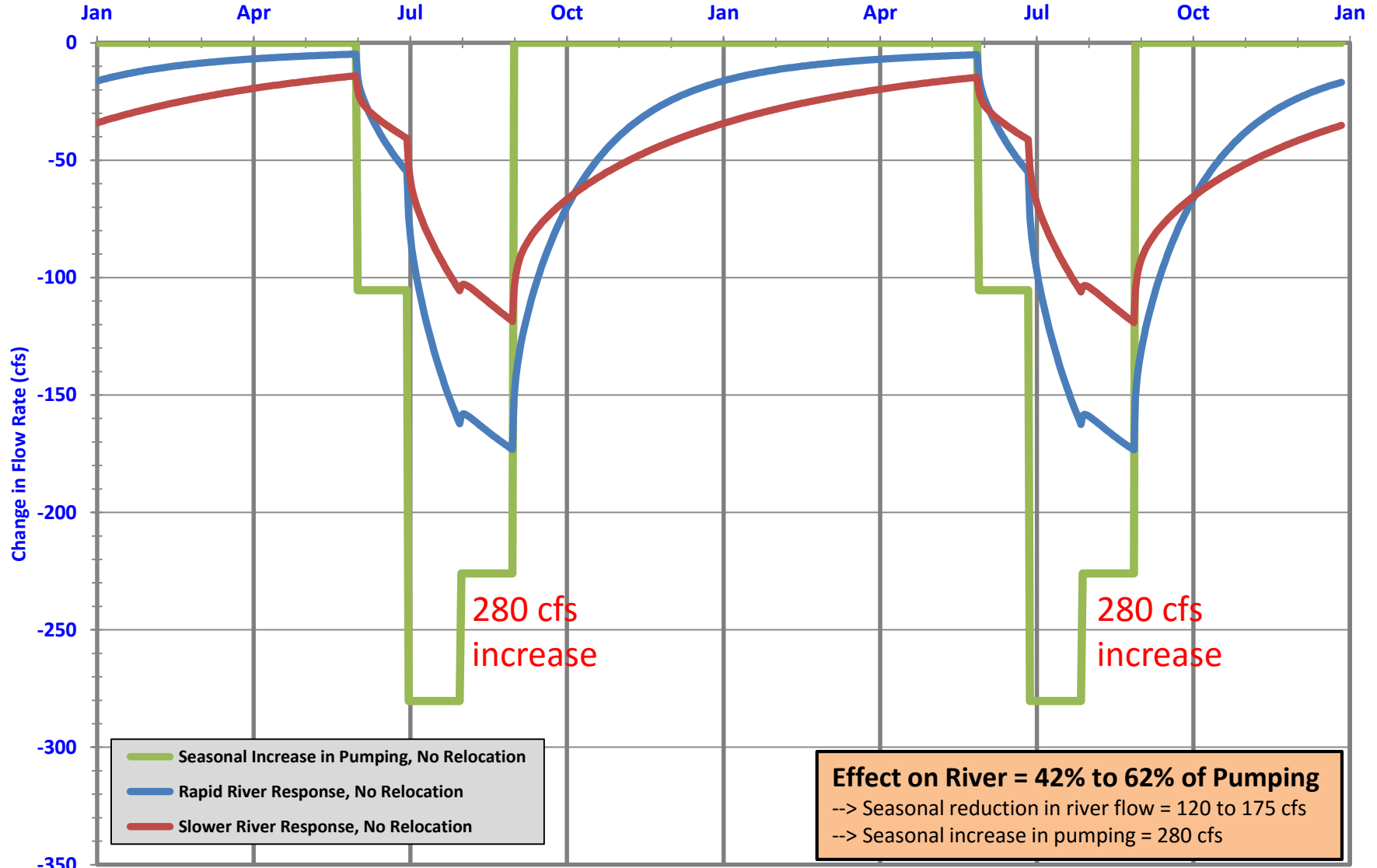
Presentation by Ralston Hydrologic Services, April 14, 2015, Washington Hydrogeology Symposium (Tacoma, WA)



# Washington Study: Spokane Aquifer Joint Board

## Summer Pumping Effects

### Modeled River Response to 2013 Seasonal Pumping (All SAJB Members)



**Effect on River = 42% to 62% of Pumping**  
--> Seasonal reduction in river flow = 120 to 175 cfs  
--> Seasonal increase in pumping = 280 cfs

# Idaho DWR and Washington SAJB Studies

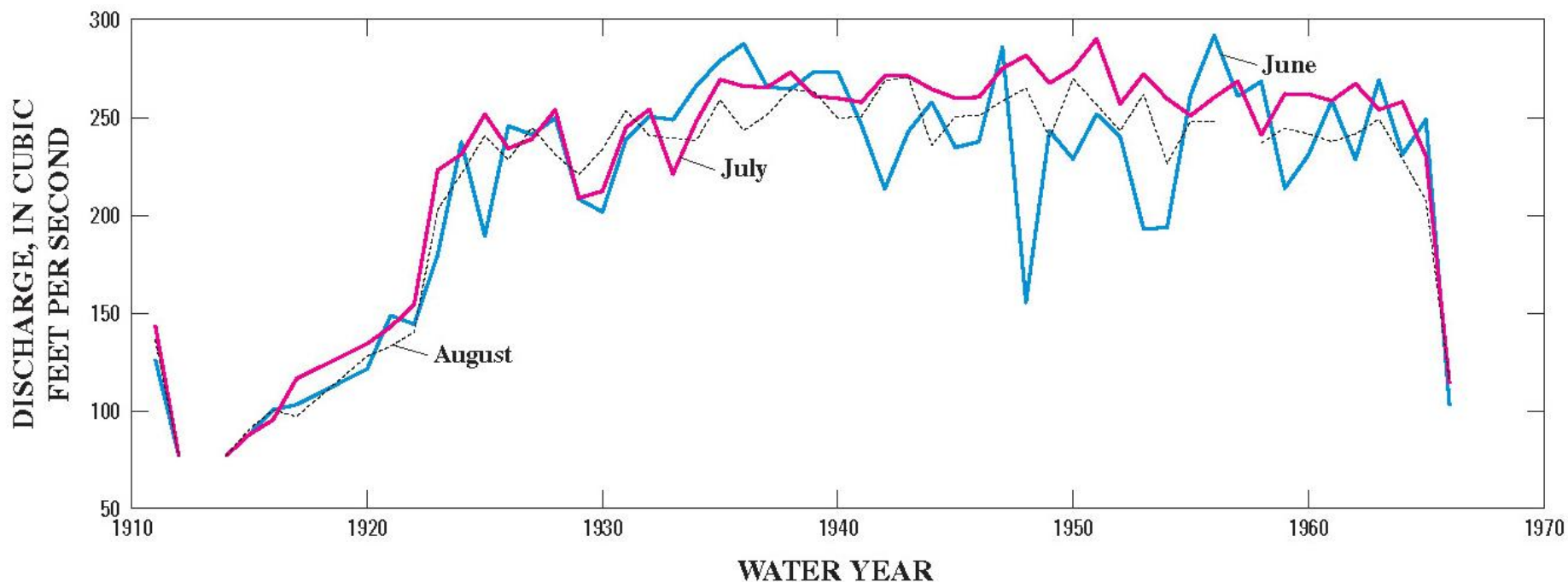
## Summer Pumping Effects

*(2014 Spokane River Forum)*

1. Groundwater pumping does influence river flows
2. But it is not a 1-for-1 relationship
  - **Indoor Use:** Essentially no effect (wastewater return flows)
  - **Outdoor Use:** For each 1 cfs of extra summer pumping (mid-June to early September), river flows decrease by 1/3 to 2/3 cfs
3. Agricultural irrigation with river water nearly 1-for-1



# Agricultural Irrigation Diversions from the Corbin Ditch, Upstream of Post Falls Dam (1910-1965)



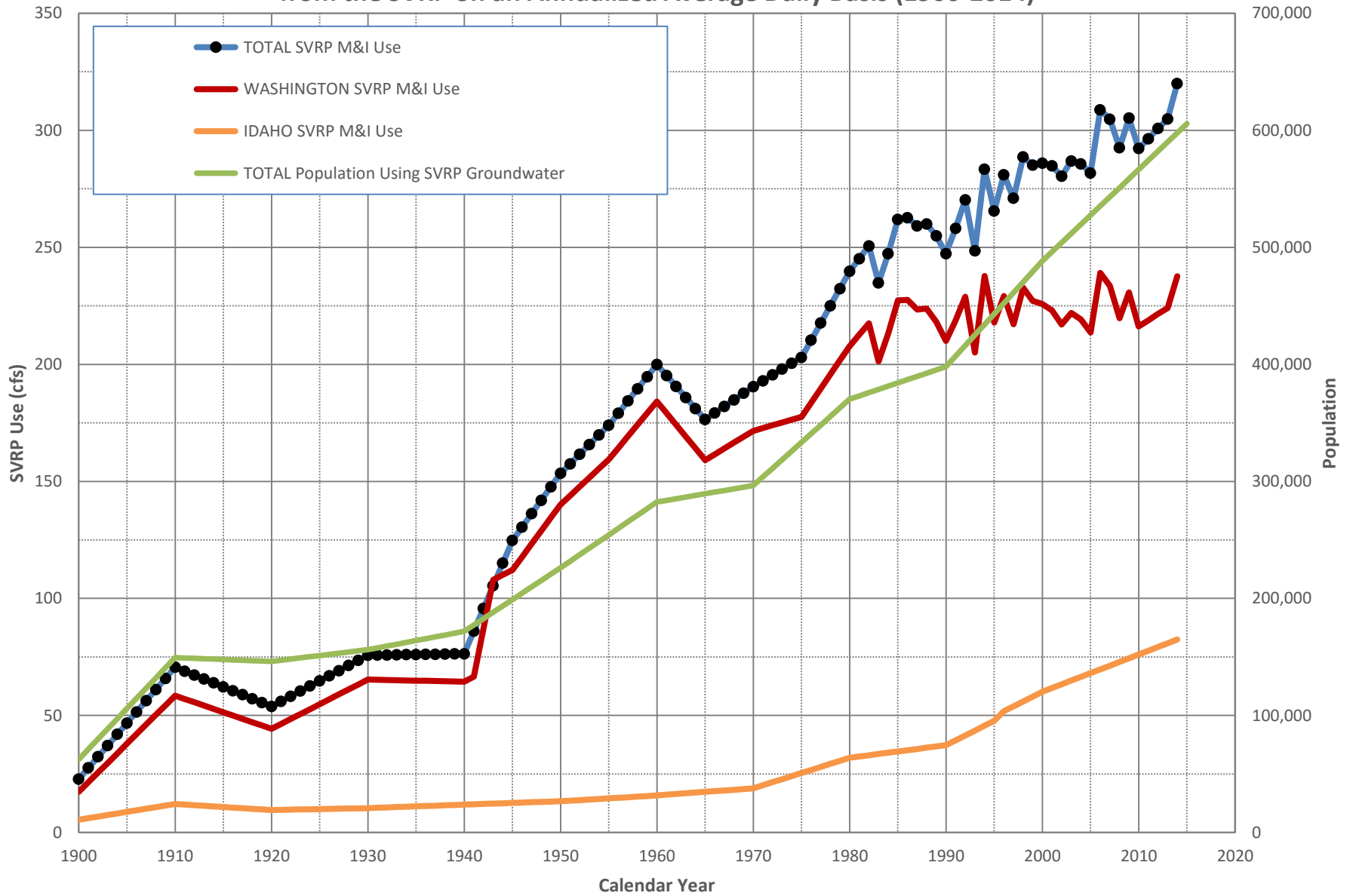
**Figure 7.** Monthly mean streamflows for the Spokane Valley Farms Canal at Post Falls, Idaho, June, July, and August, 1911–1966.

Source: Hortness, J.E. and J.J. Covert. 2005.

*Streamflow Trends in the Spokane River and Tributaries,  
Spokane Valley/Rathdrum Prairie, Idaho and Washington.*

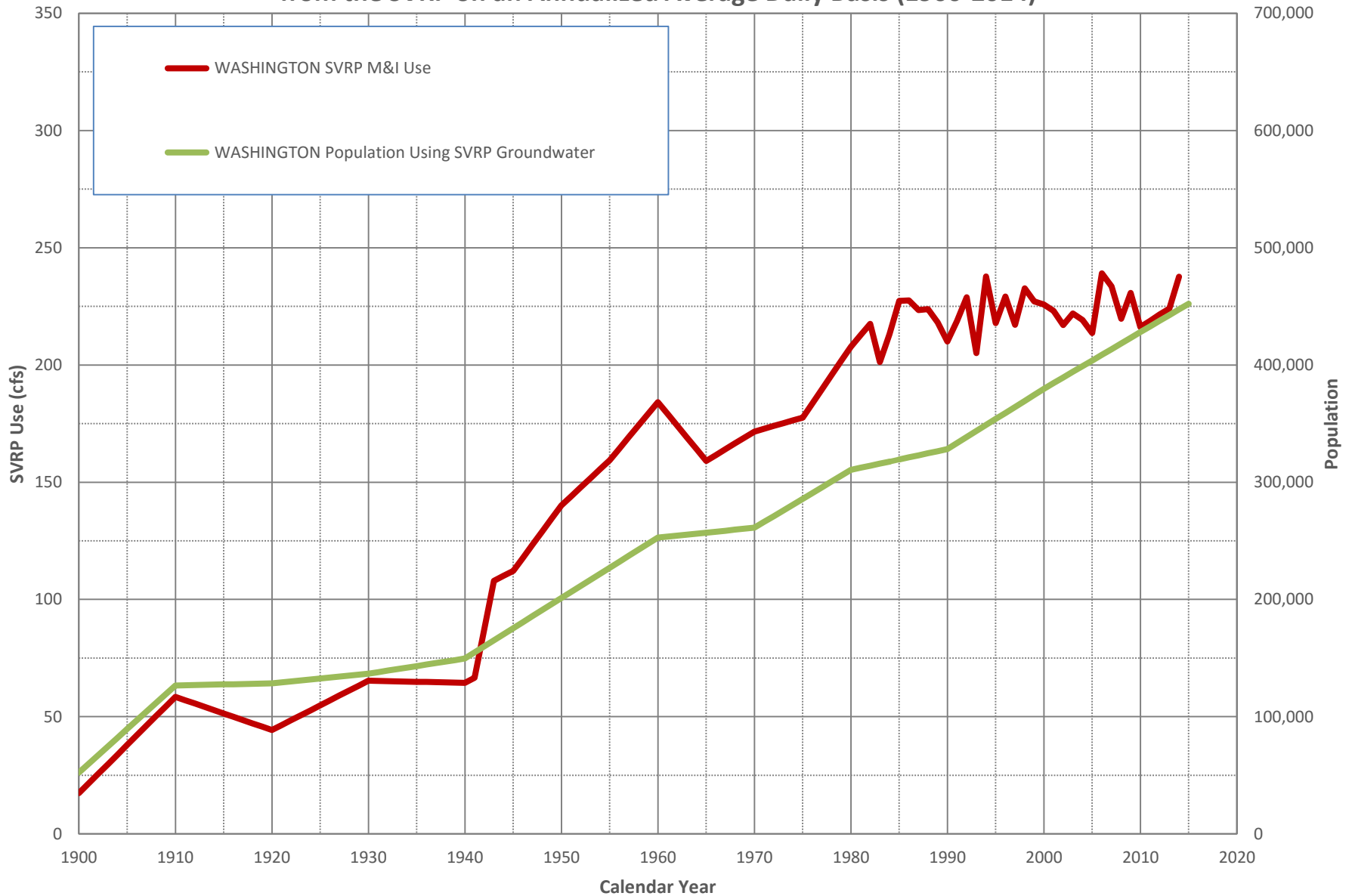
U.S. Geological Survey Investigations Report 2005-5005, 17 p.

## Estimated Use of Municipal and Industrial Water Supplies from the SVRP on an Annualized Average Daily Basis (1900-2014)

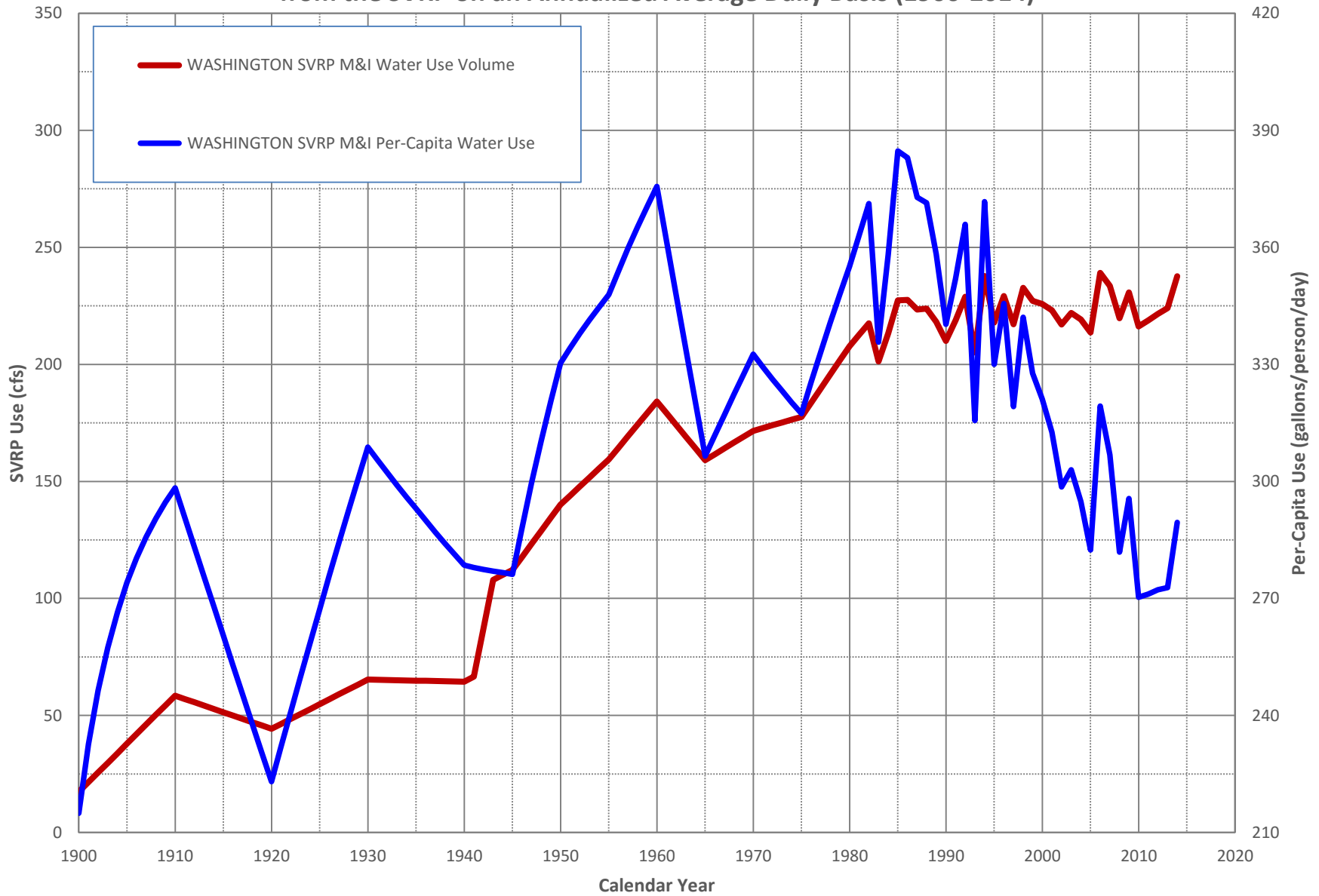




## Washington's Estimated Use of Municipal and Industrial Water Supplies from the SVRP on an Annualized Average Daily Basis (1900-2014)



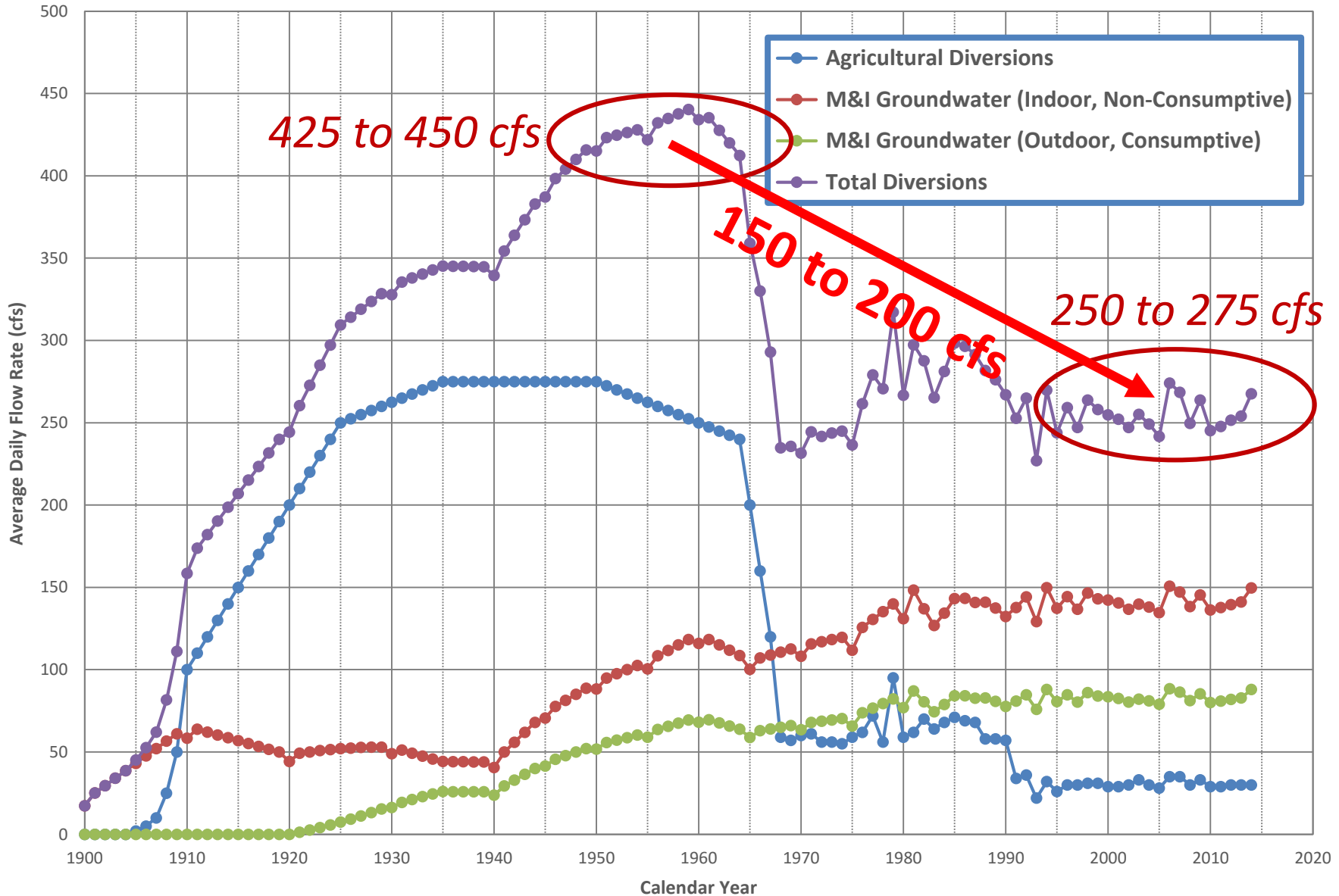
## Washington's Estimated Per-Capita Use of Municipal and Industrial Water Supplies from the SVRP on an Annualized Average Daily Basis (1900-2014)



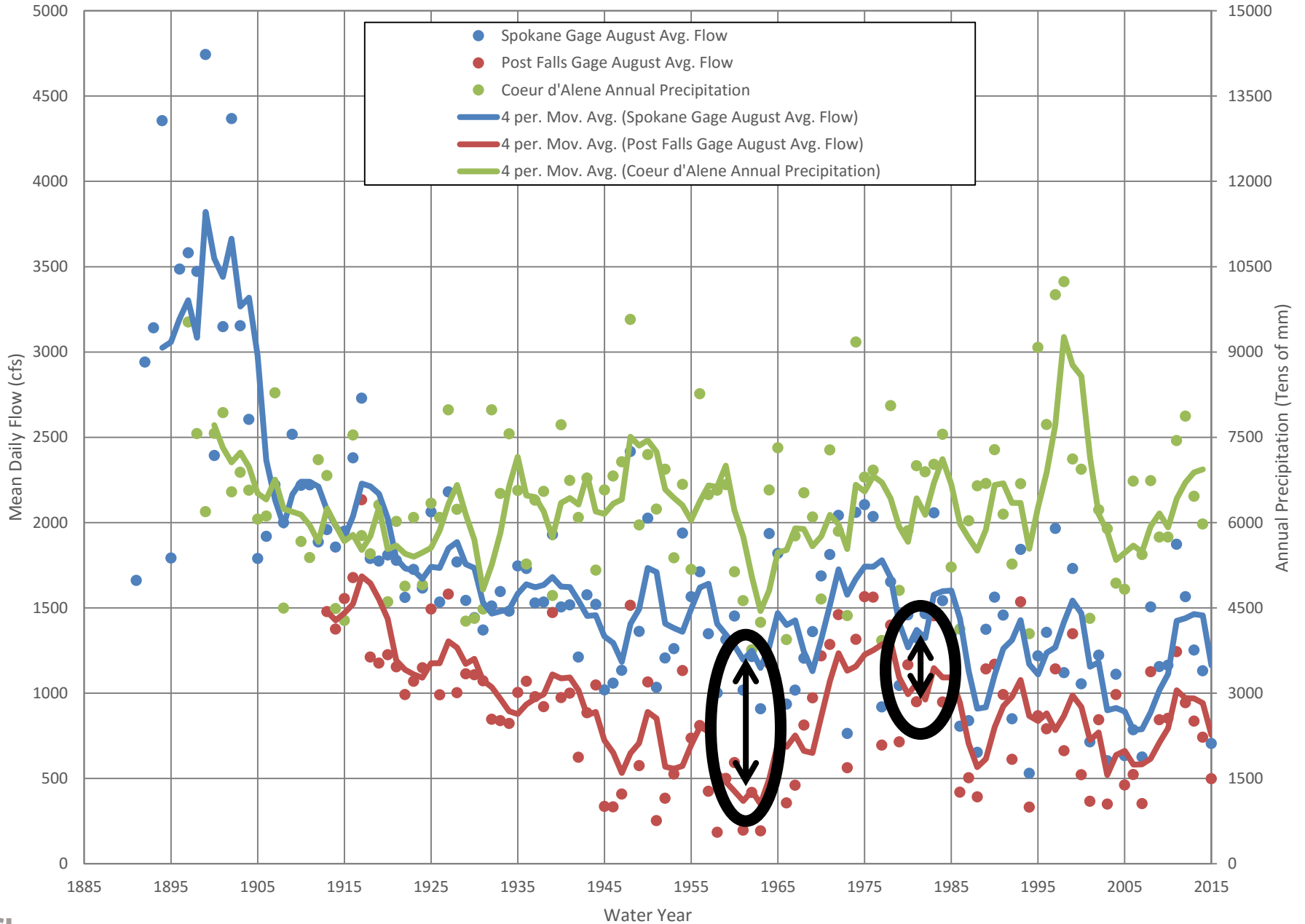


# Historical Diversions from River-Aquifer System Upstream of Spokane Gage

Average Daily Rates (cfs), Washington Only

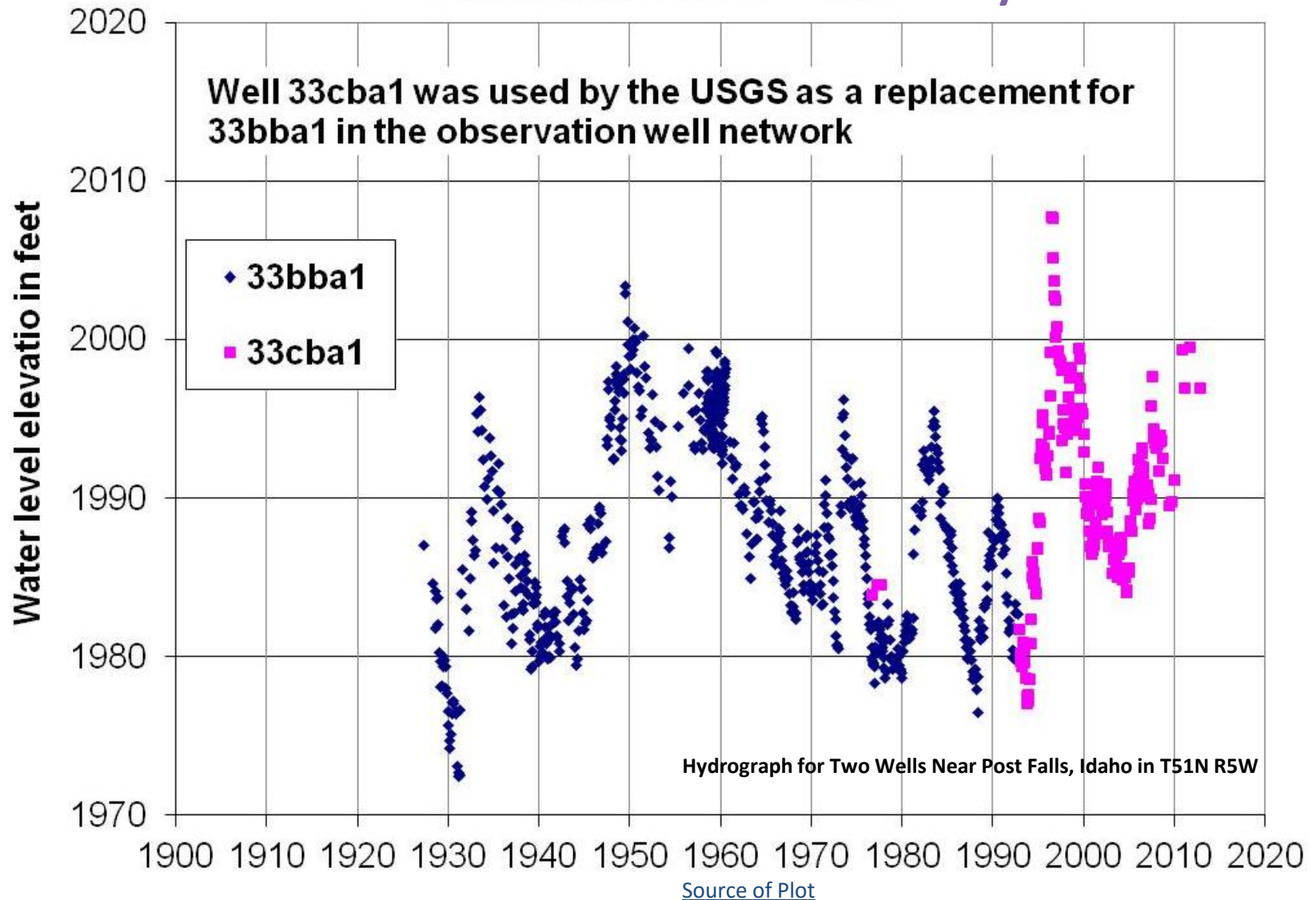


# Spokane River August Flows and Annual Coeur d'Alene Precipitation Since Late 1800s

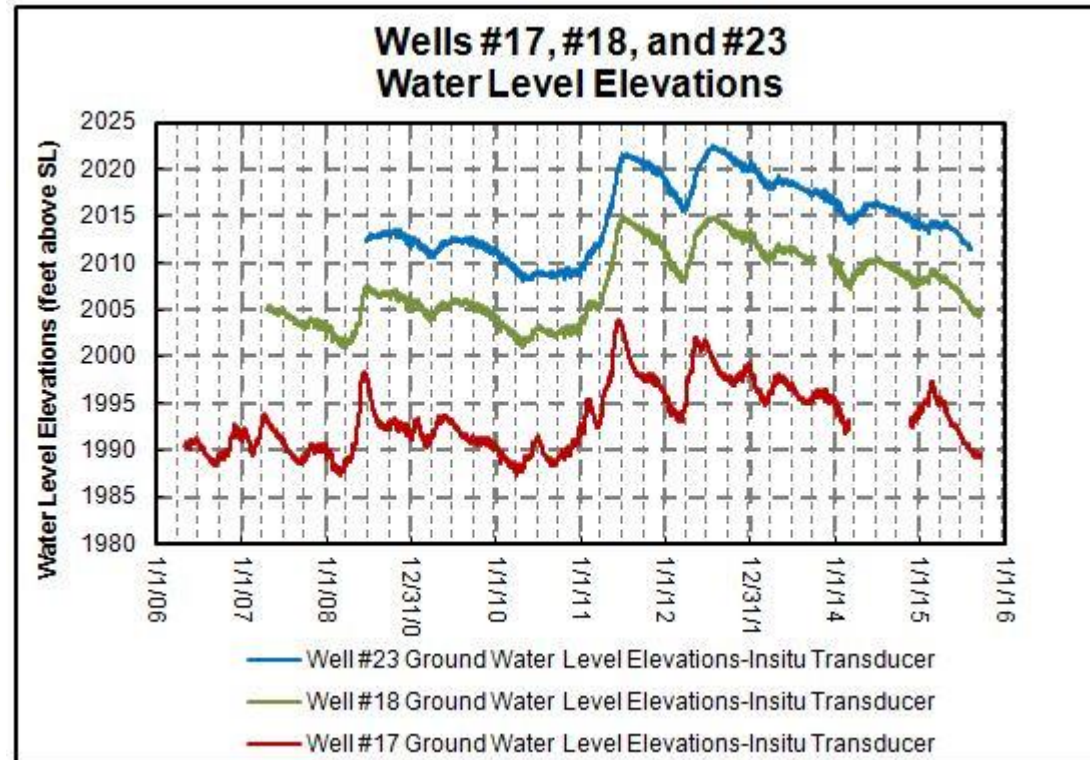
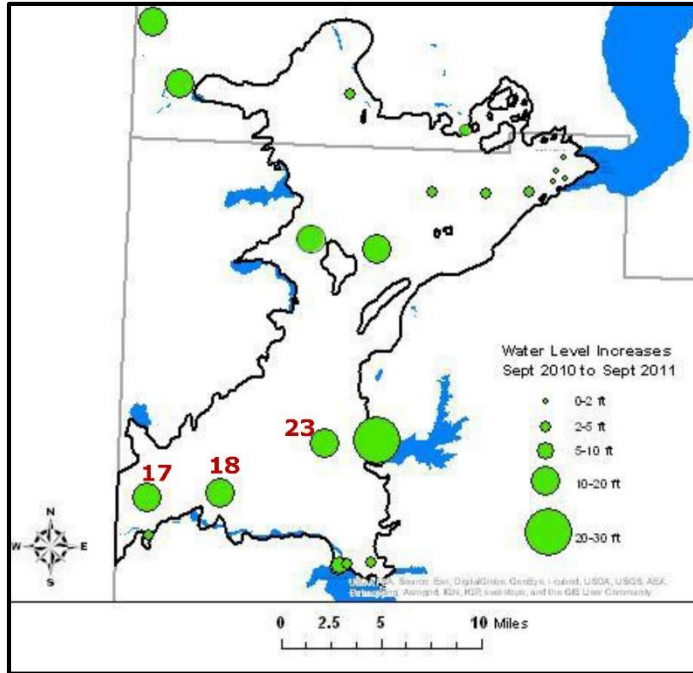




# Groundwater Elevations Appear to be Rising Near Post Falls After the Early 1990s



# Groundwater Elevations in Rathdrum Prairie (2006-2015)

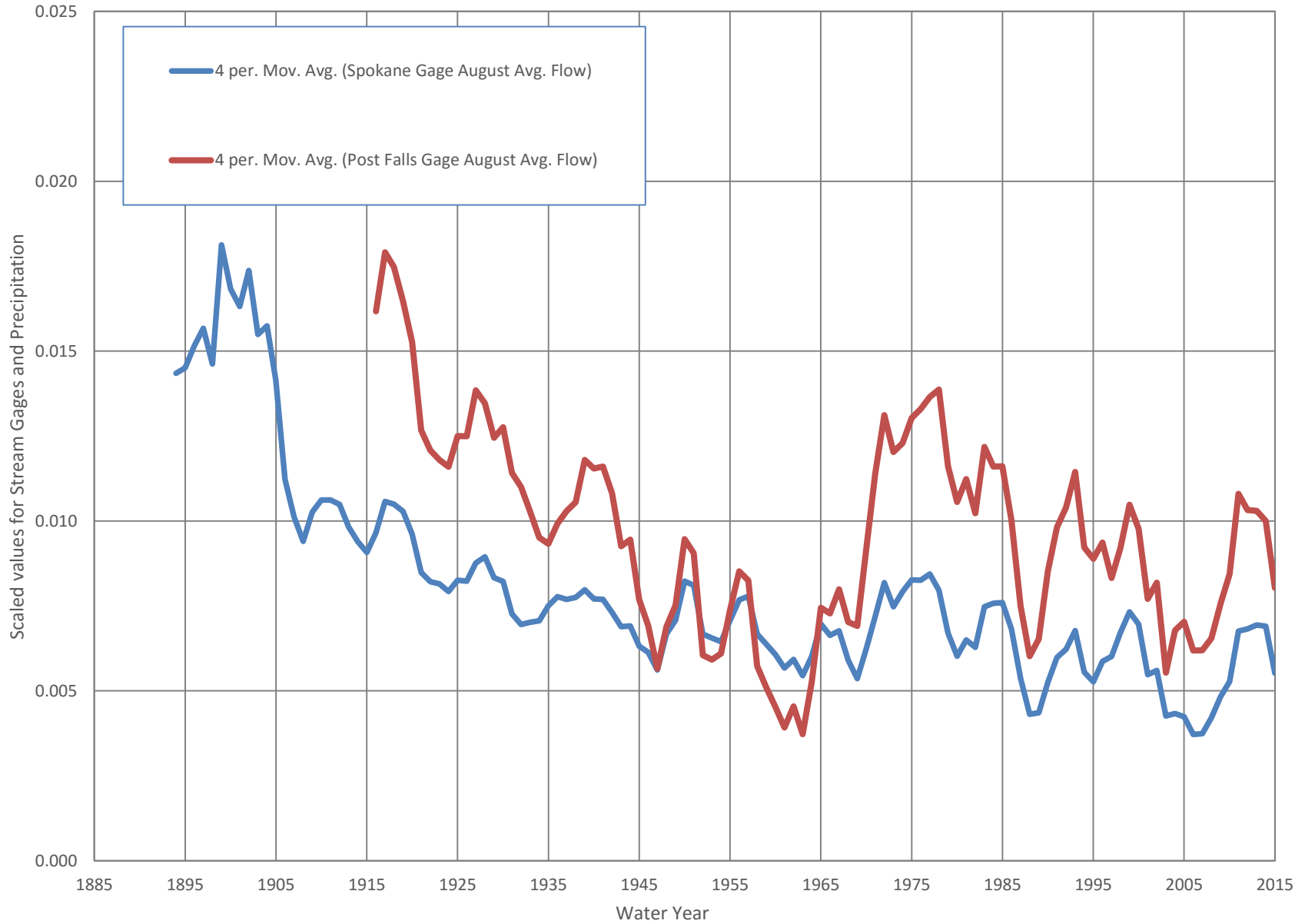


Source

Kenneth Neely, Idaho Department of Water Resources, February 2016

# River Flow and Watershed Changes Since Late 1800s

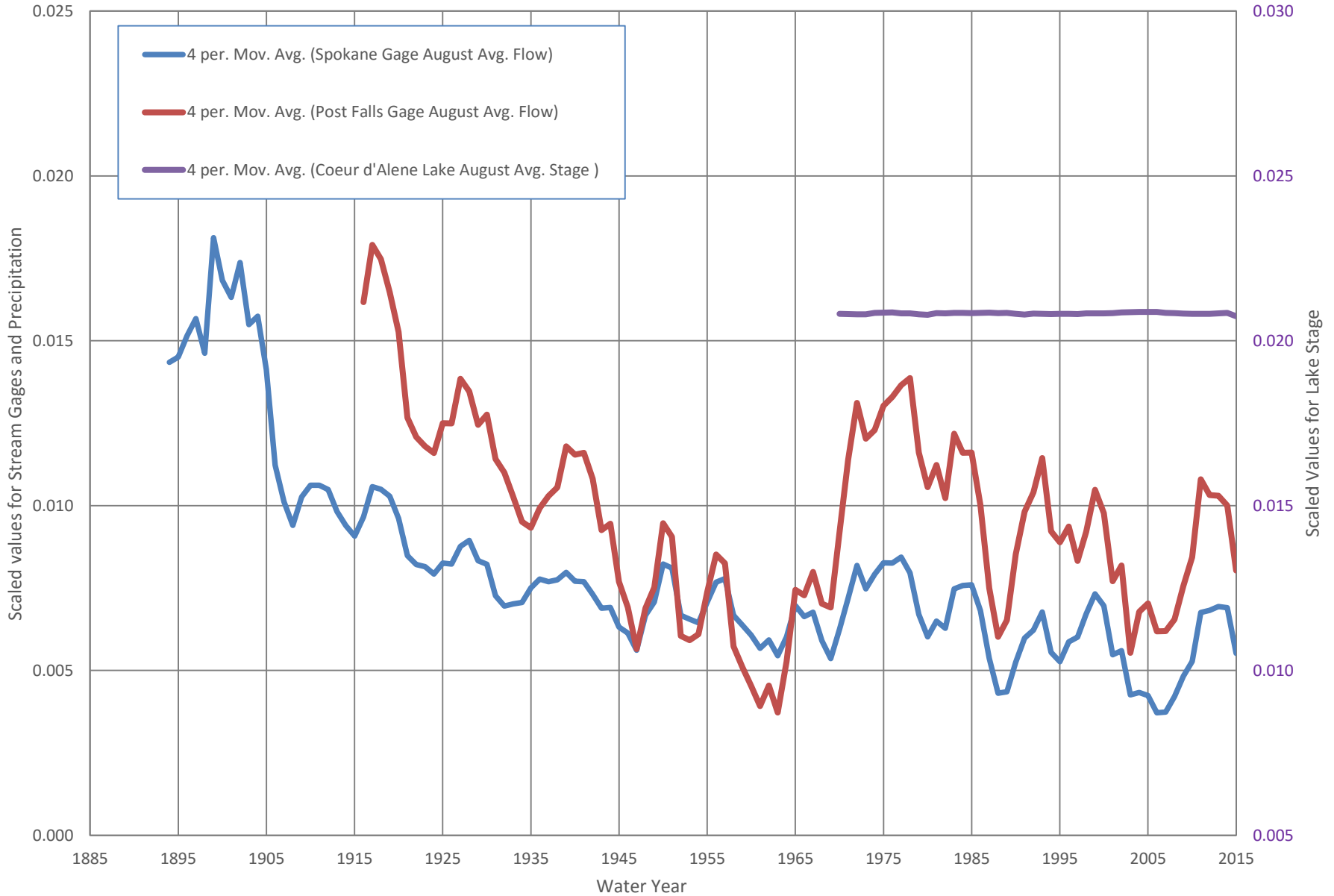
## *Stream Flows, Precipitation, Lake Stage*





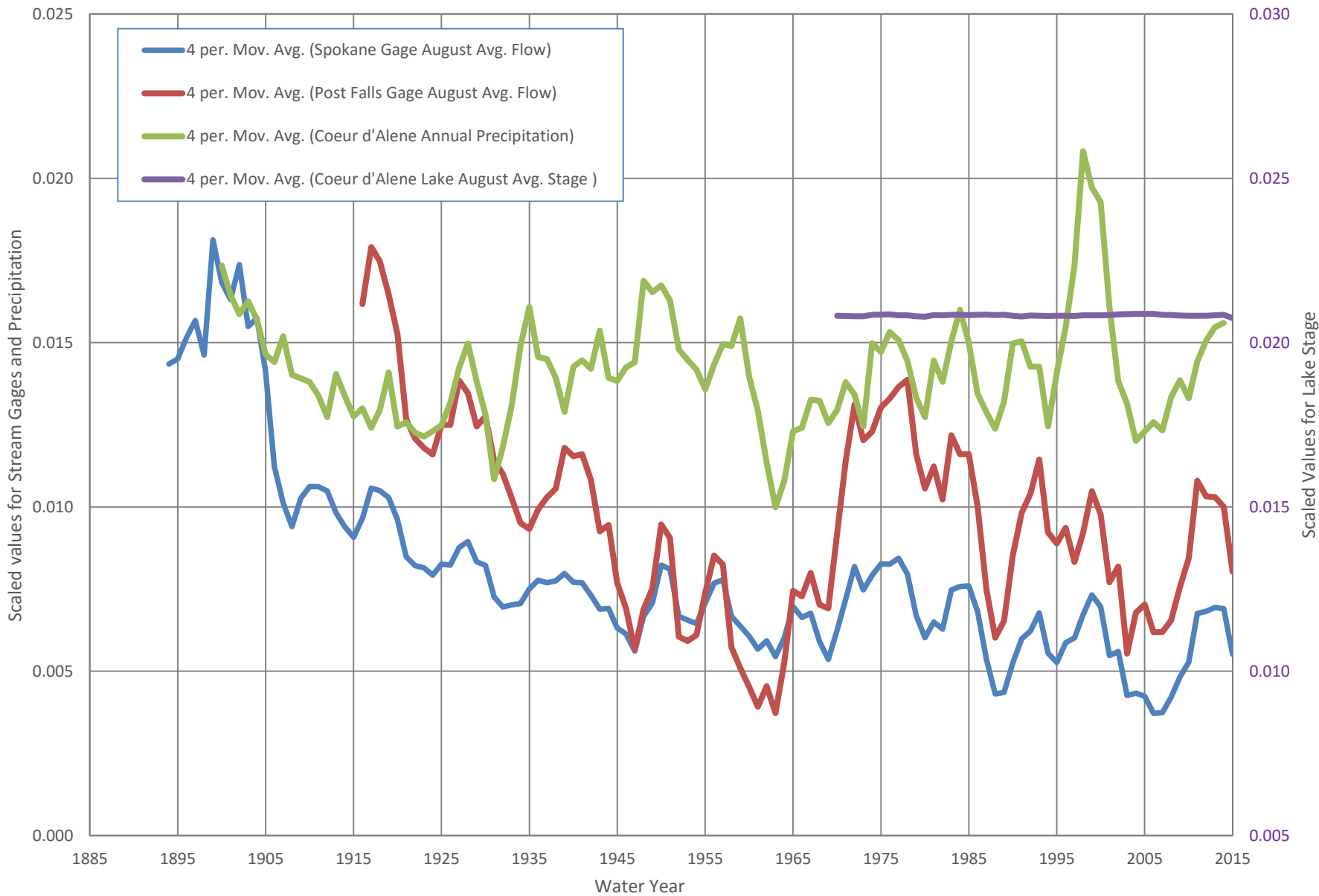
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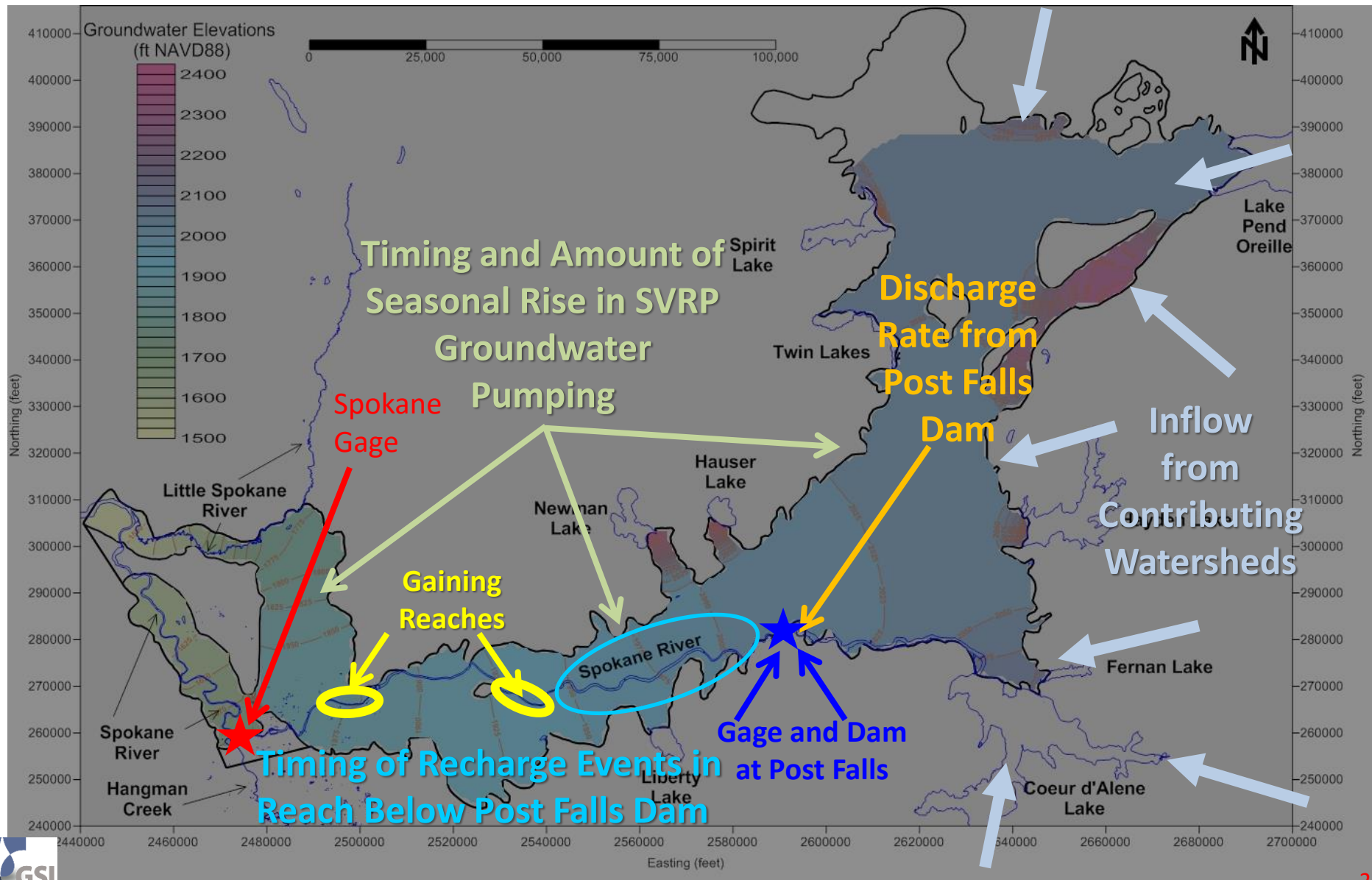


# River Flow and Watershed Changes Since Late 1800s

## Stream Flows, Precipitation, Lake Stage

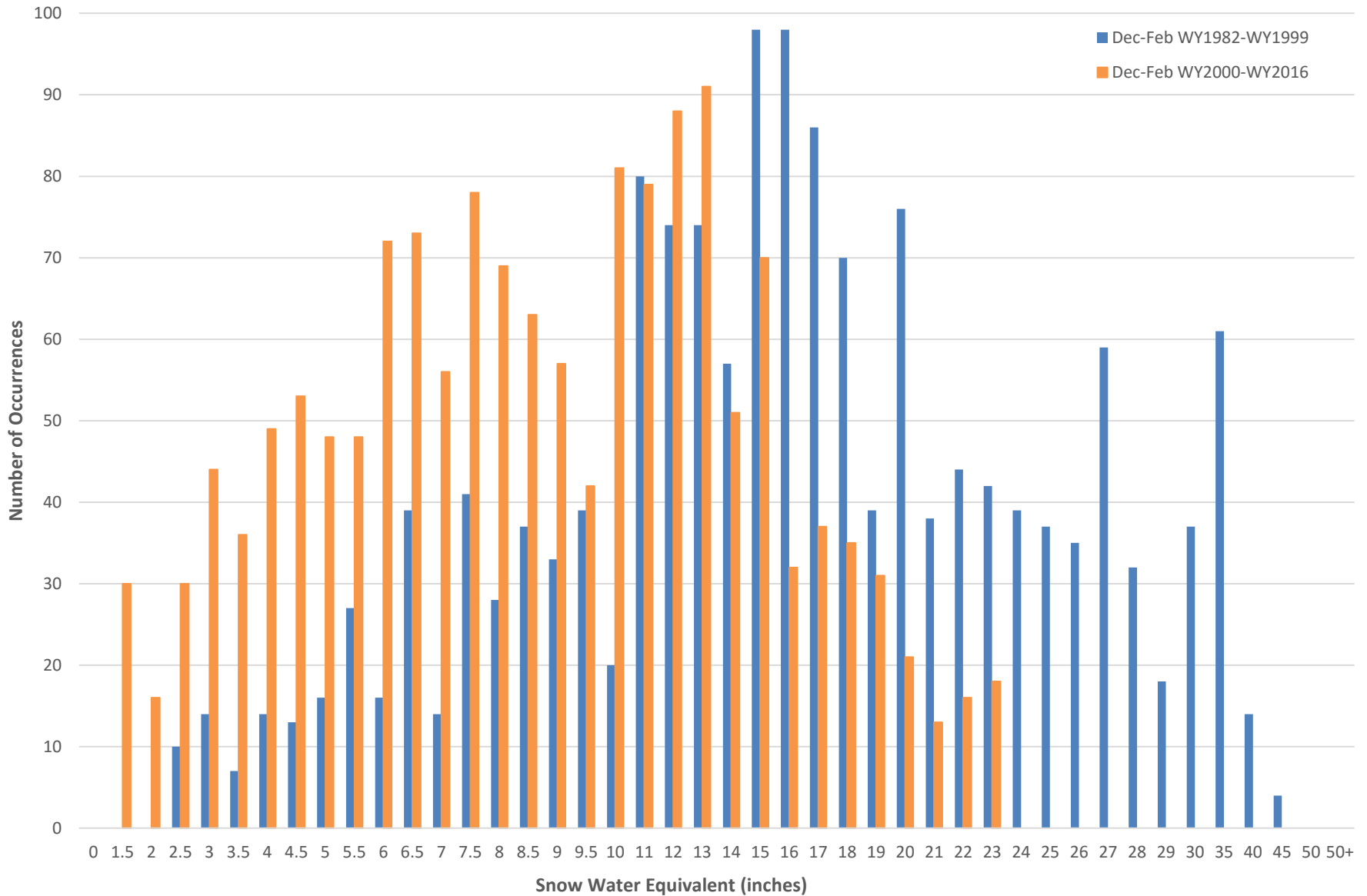


# Factors Controlling August Low Flows at the Spokane Gage

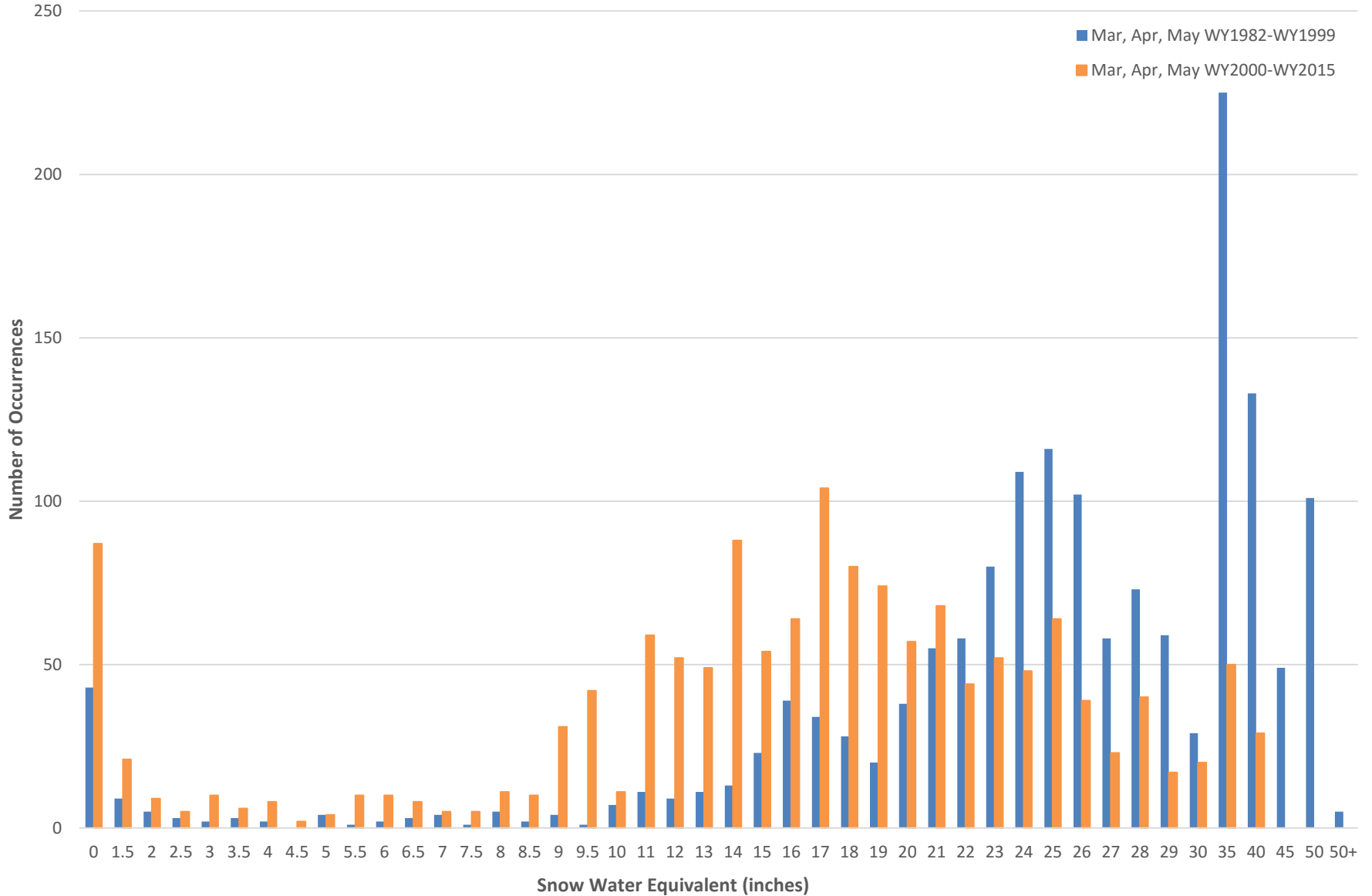




## Binned Frequency of Occurrences of Snow Water Equivalent, Sunset SNOTEL Station, December through February



## Binned Frequency of Occurrences of Snow Water Equivalent, Sunset SNOTEL Station, March through May





# GO ZAGS!







# Conclusions

## *SAJB 2014-2016 Studies*

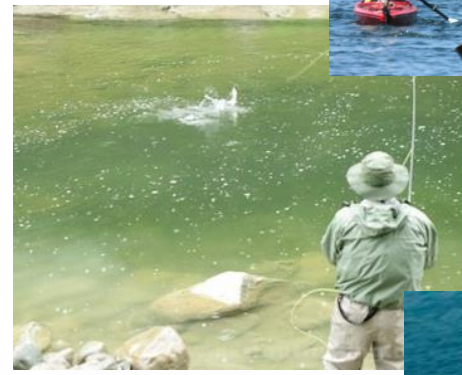
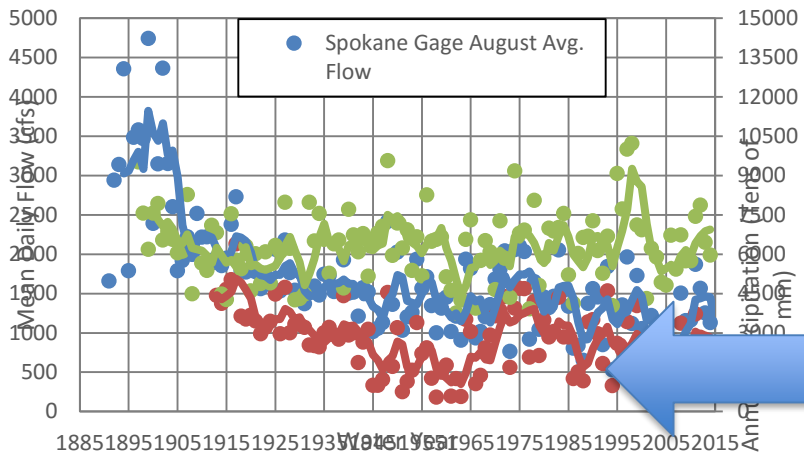
1. Summer pumping for municipal uses does not cause an equal depletion in river flows
2. Urbanization of former irrigated agricultural lands has been beneficial to the river-aquifer system
3. Changing hydrology in the contributing watershed to Coeur d'Alene Lake is the dominant cause of continued declines in Spokane River seasonal low flows

**Details Tomorrow Afternoon at 1:15 PM**

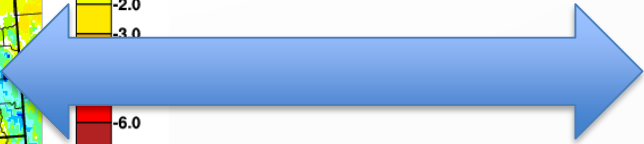
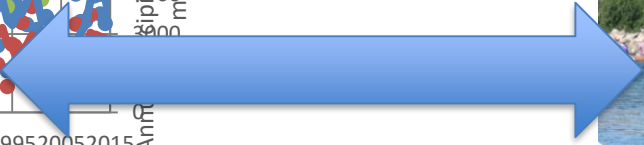
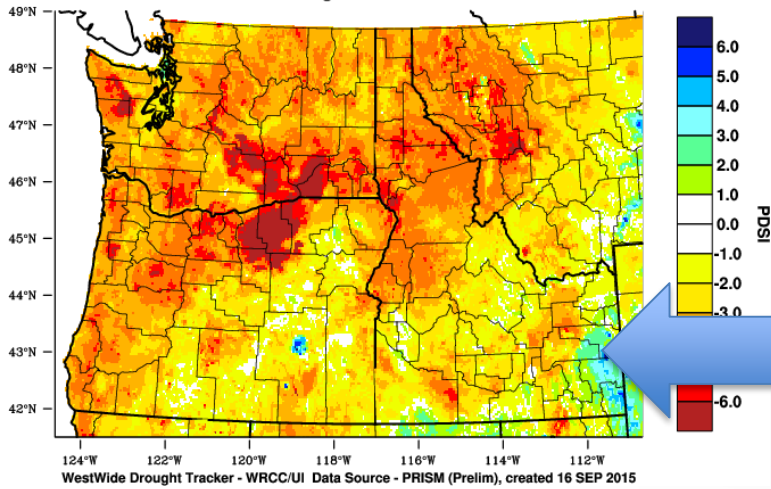
Concurrent Session Moderated by

Mark Solomon, Idaho Water Resources Research Institute

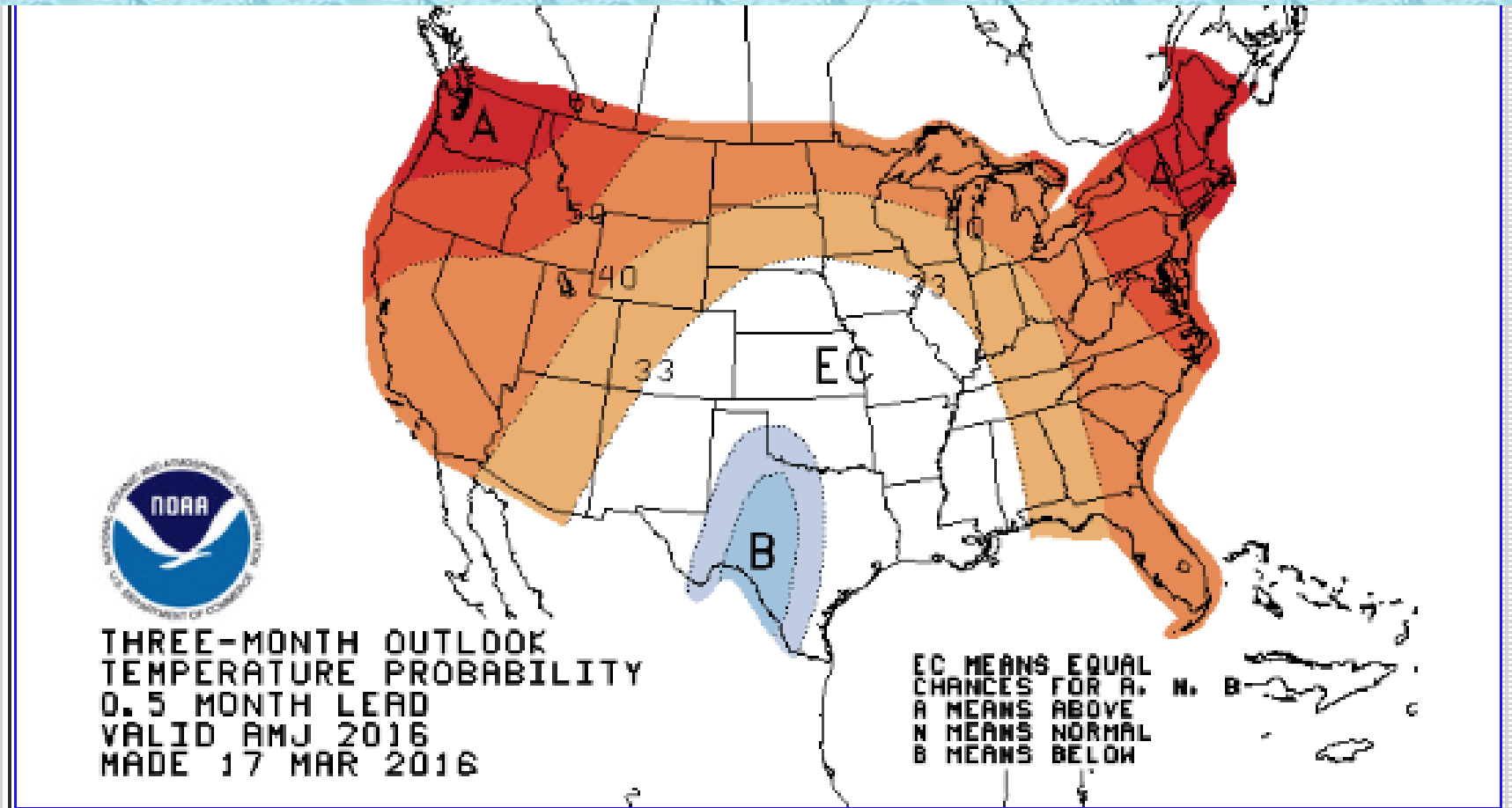
*Upstream, Downstream, and in the Middle: Integrating Water Quantity and Water Quality*



Pacific Northwest - PDSI  
August 2015

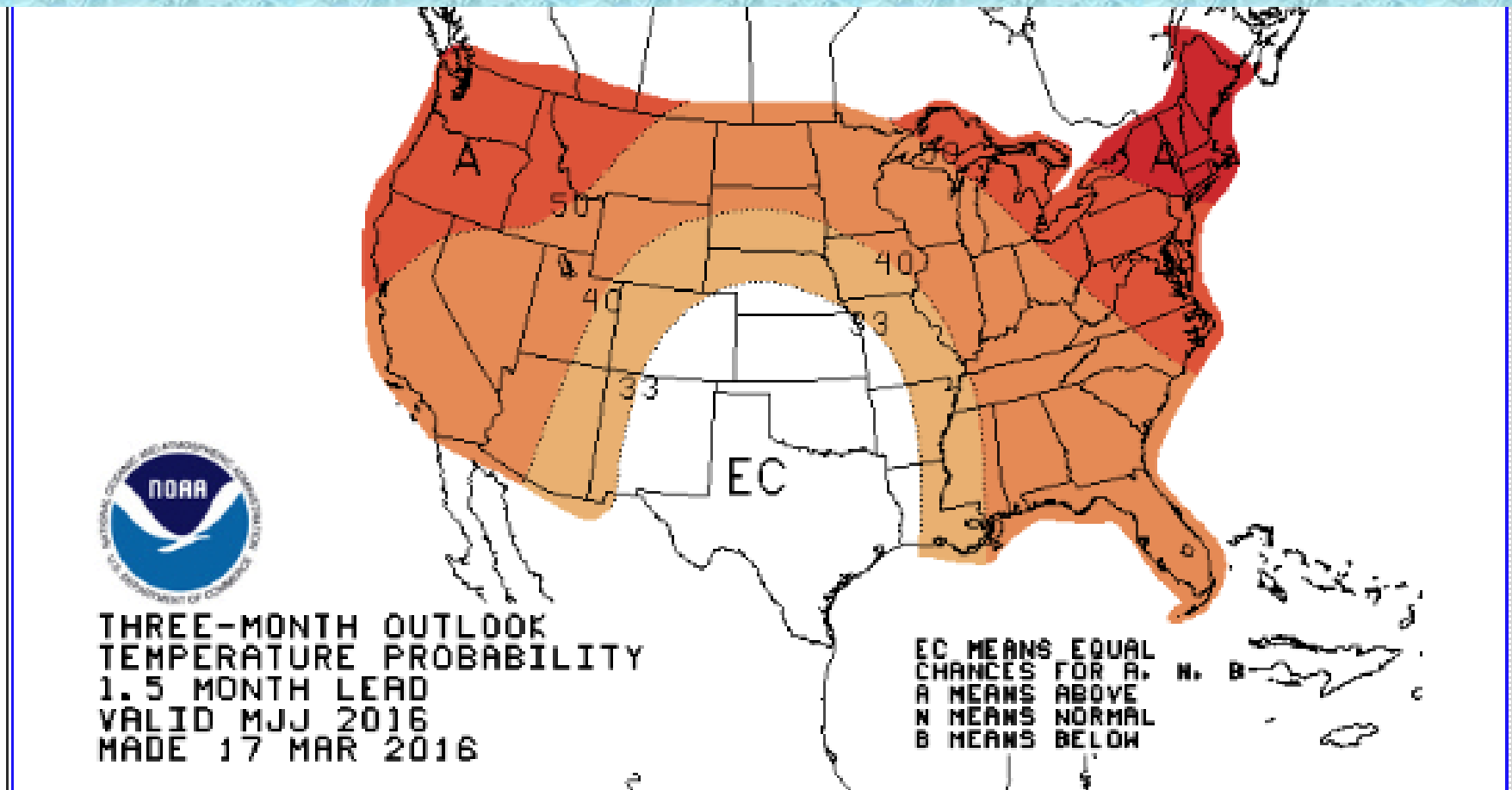


# NOAA Forecast April-May-June



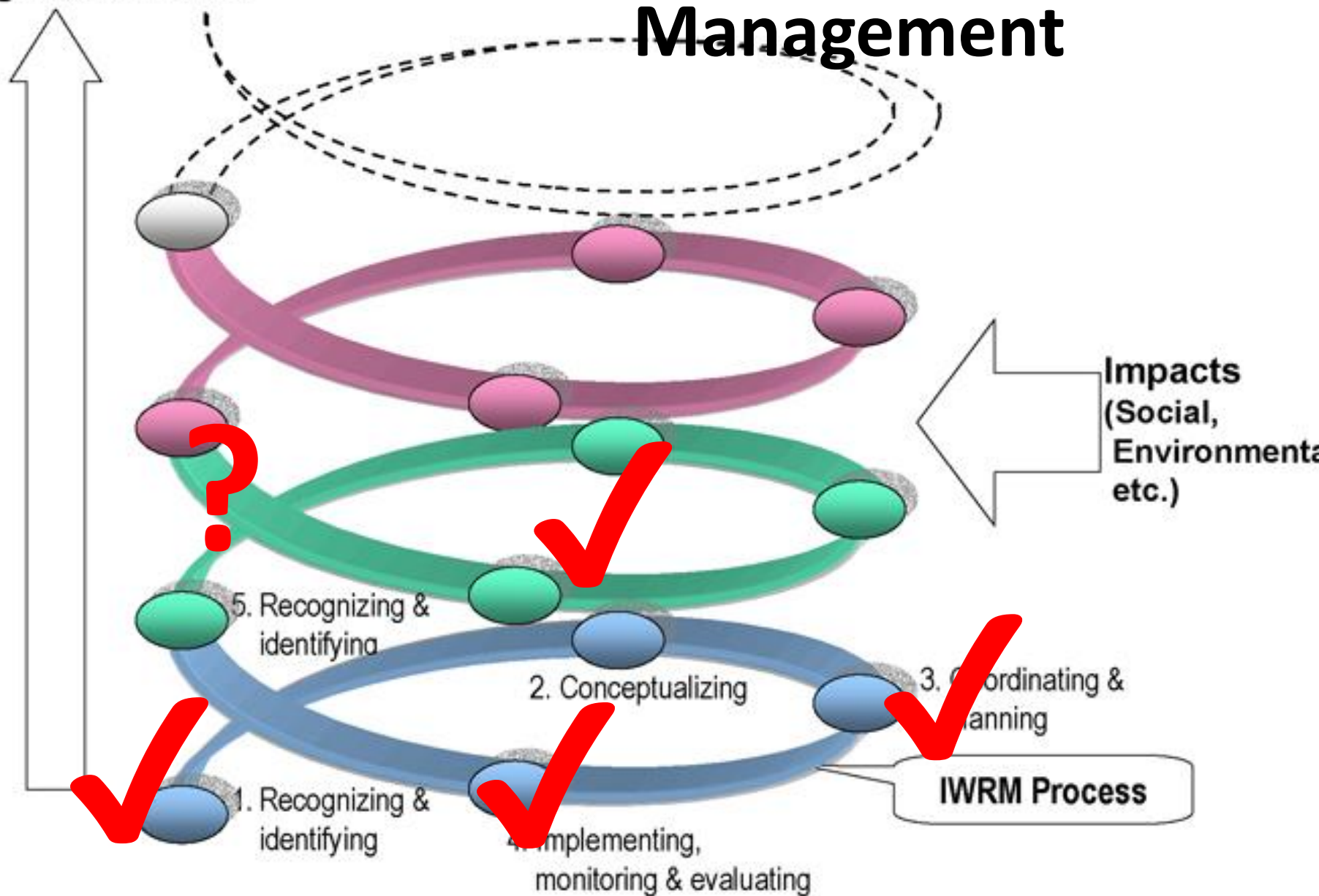


# NOAA Forecast May-June-July



# Integrated Water Resource Management

Progress of IWRM





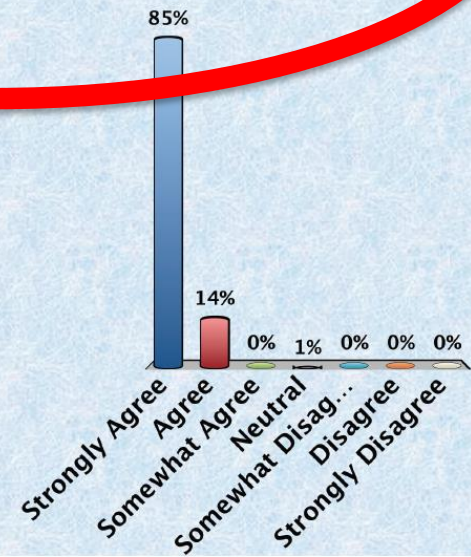
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- E. Somewhat Disagree
- F. Disagree
- G. Strongly Disagree





# Integrated Water Resource Management

An aerial photograph of a landscape featuring a river, fields, and a town. A large blue pyramid is overlaid on the image, with the text 'Institutional decision makers' at its top and 'Individual decision makers' at its base. A blue arrow points from the left towards the pyramid.

**Institutional  
decision  
makers**

**Individual decision makers**



# Integrated Water Resource Management

Institutional  
decision  
makers

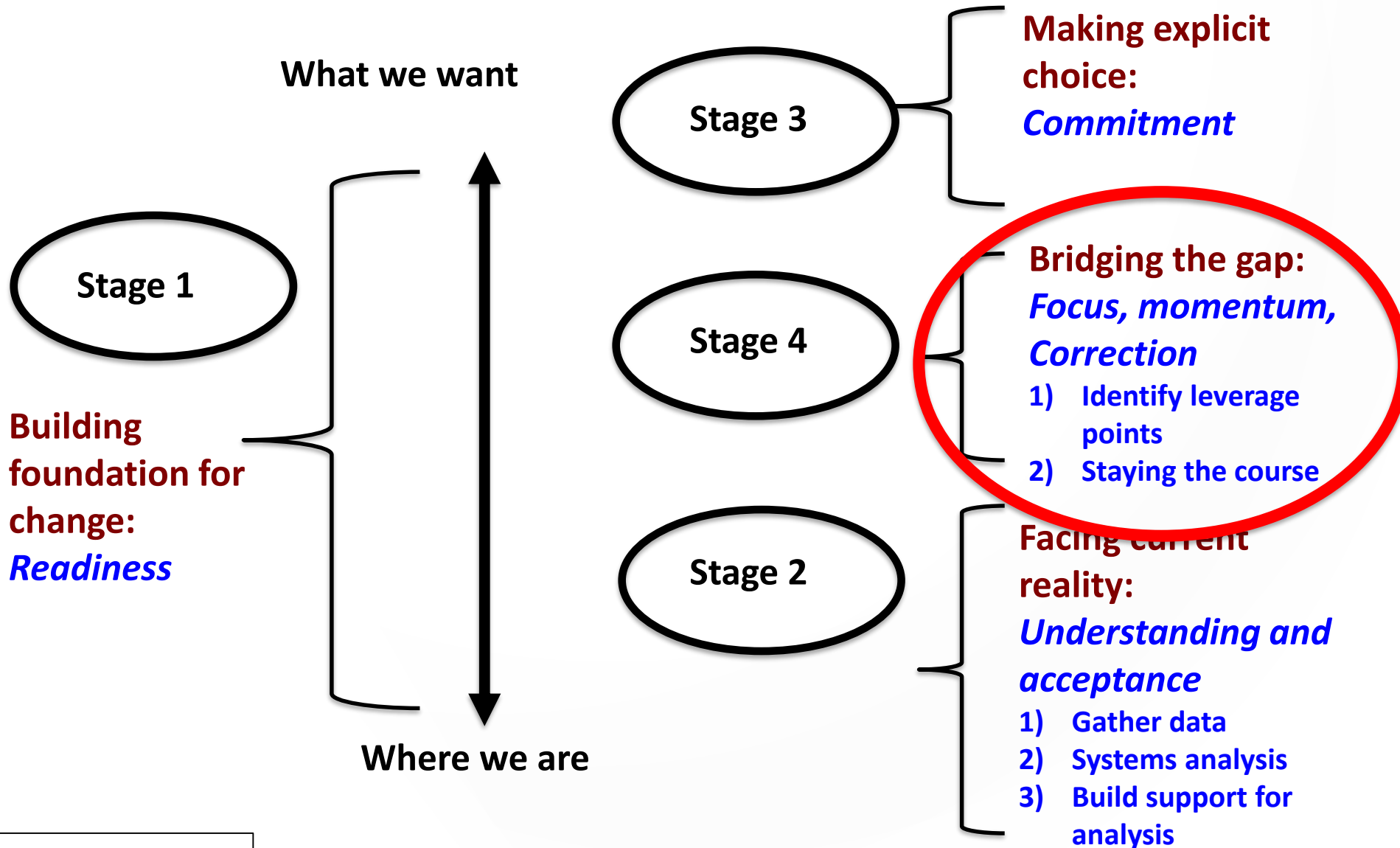
?

?

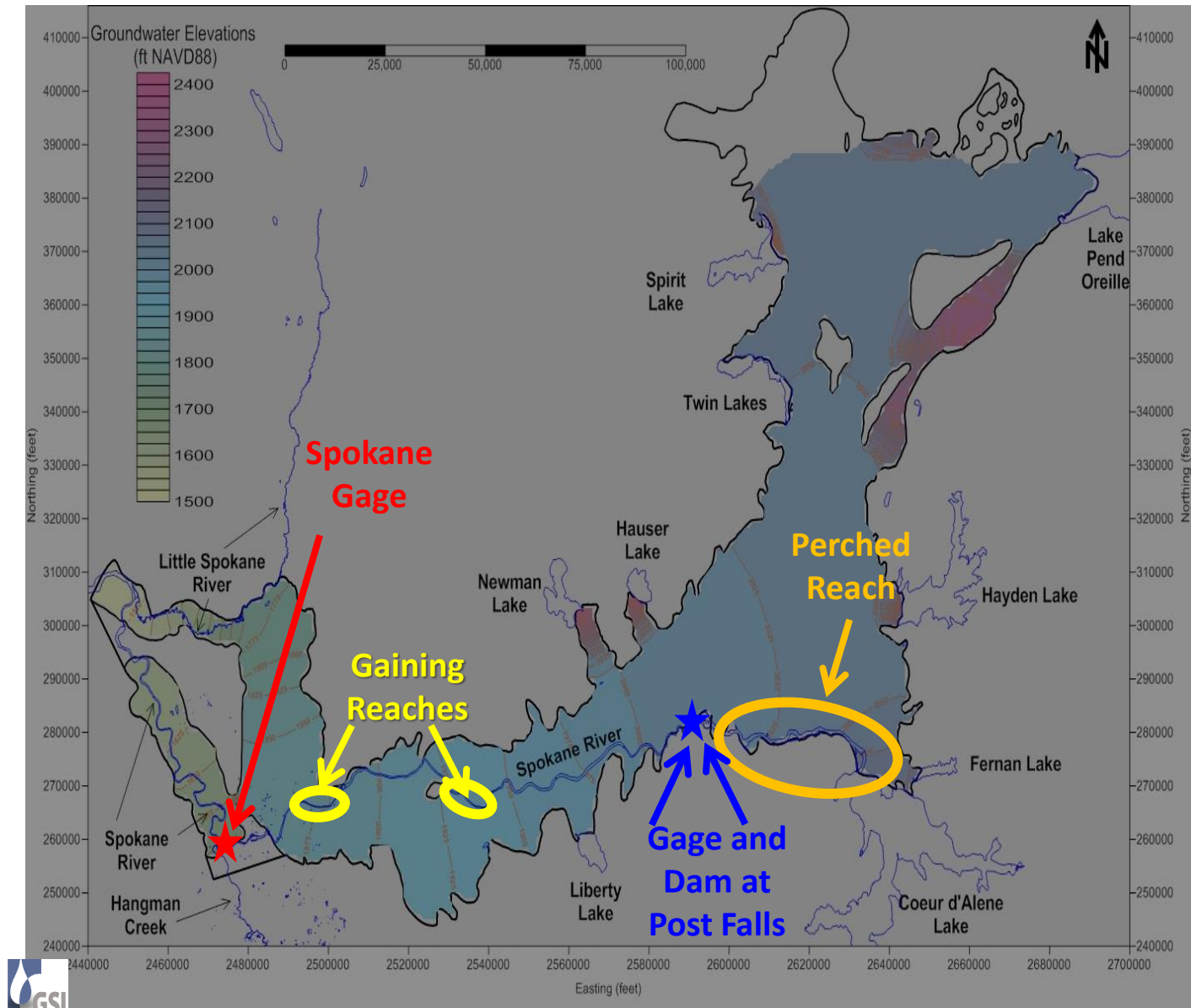
Individual decision makers

**Behavioral change that makes a difference**

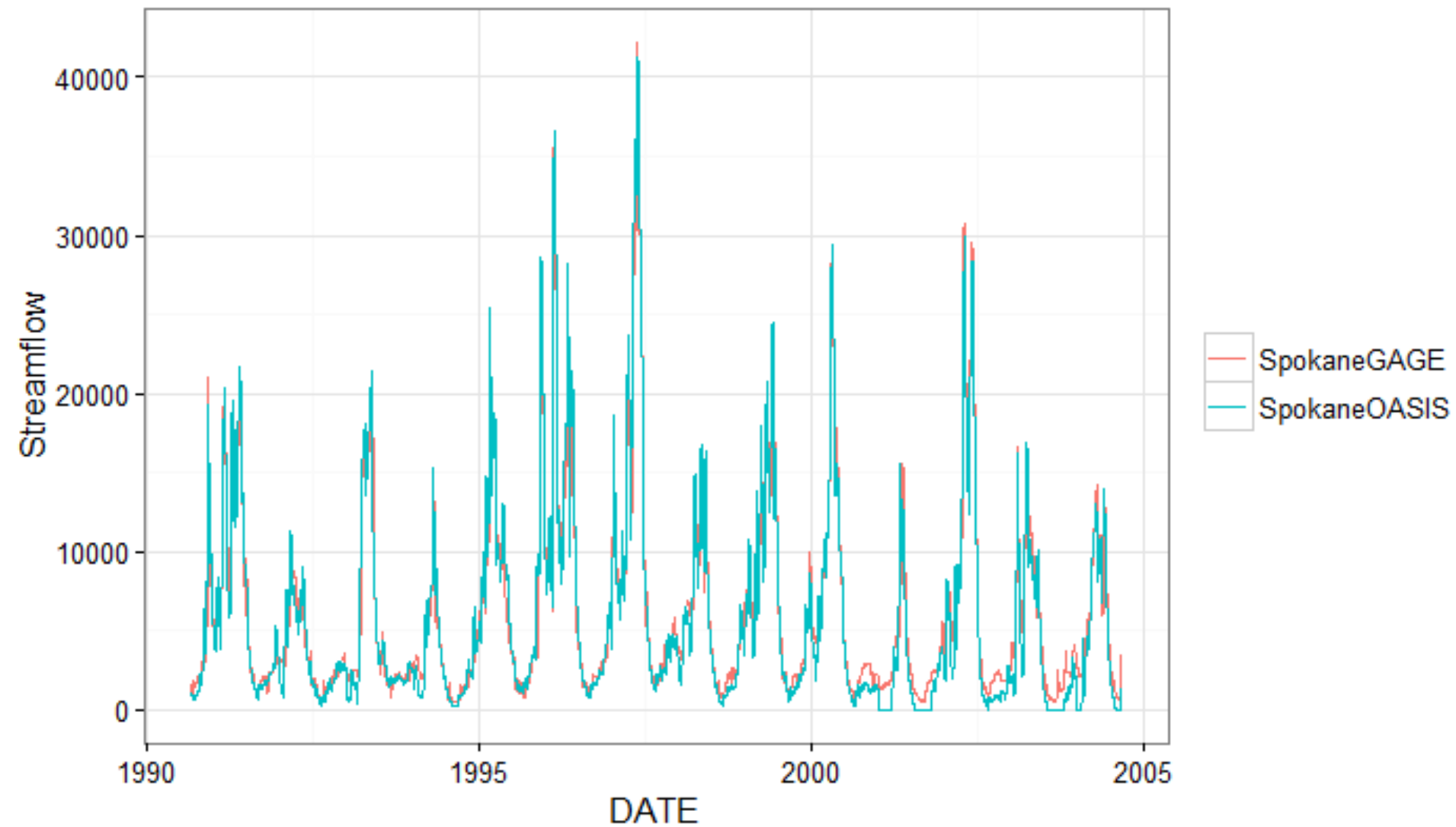
# Four States of Facilitating Systemic Change



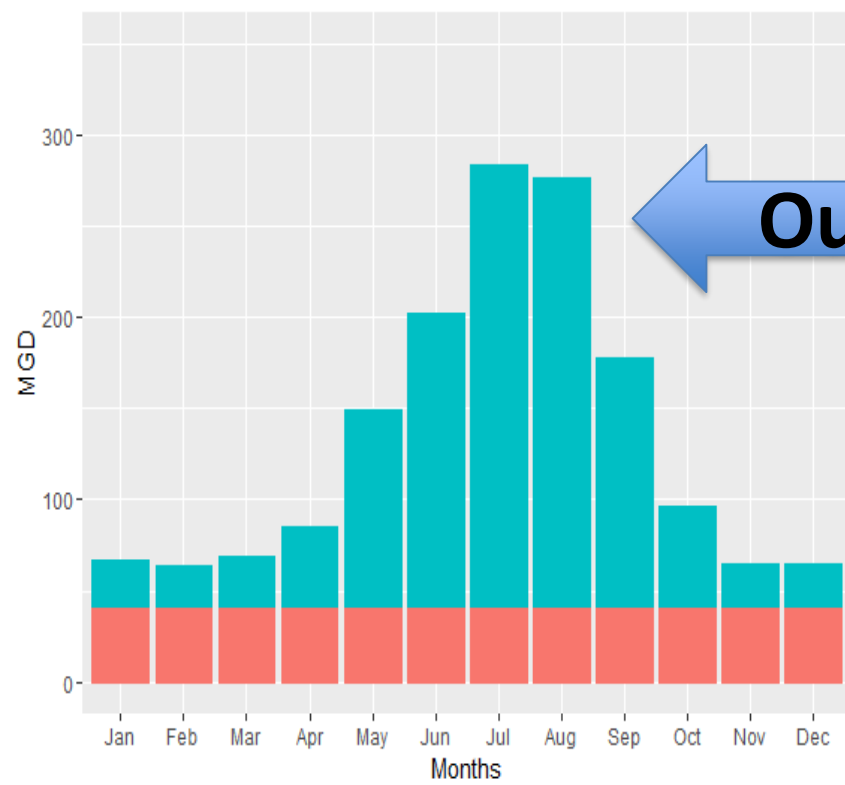
# Spokane River: gaining and losing reaches



Spokane: OASIS v. Gage (1990-2005)





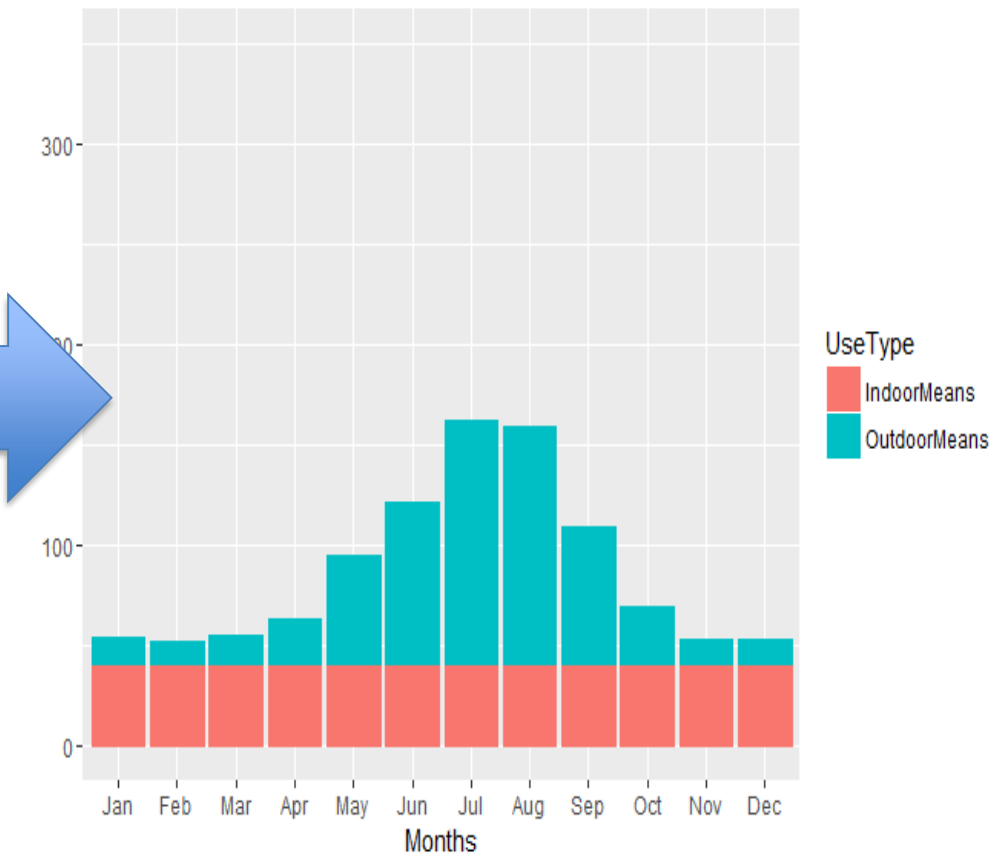


**Outdoor use**

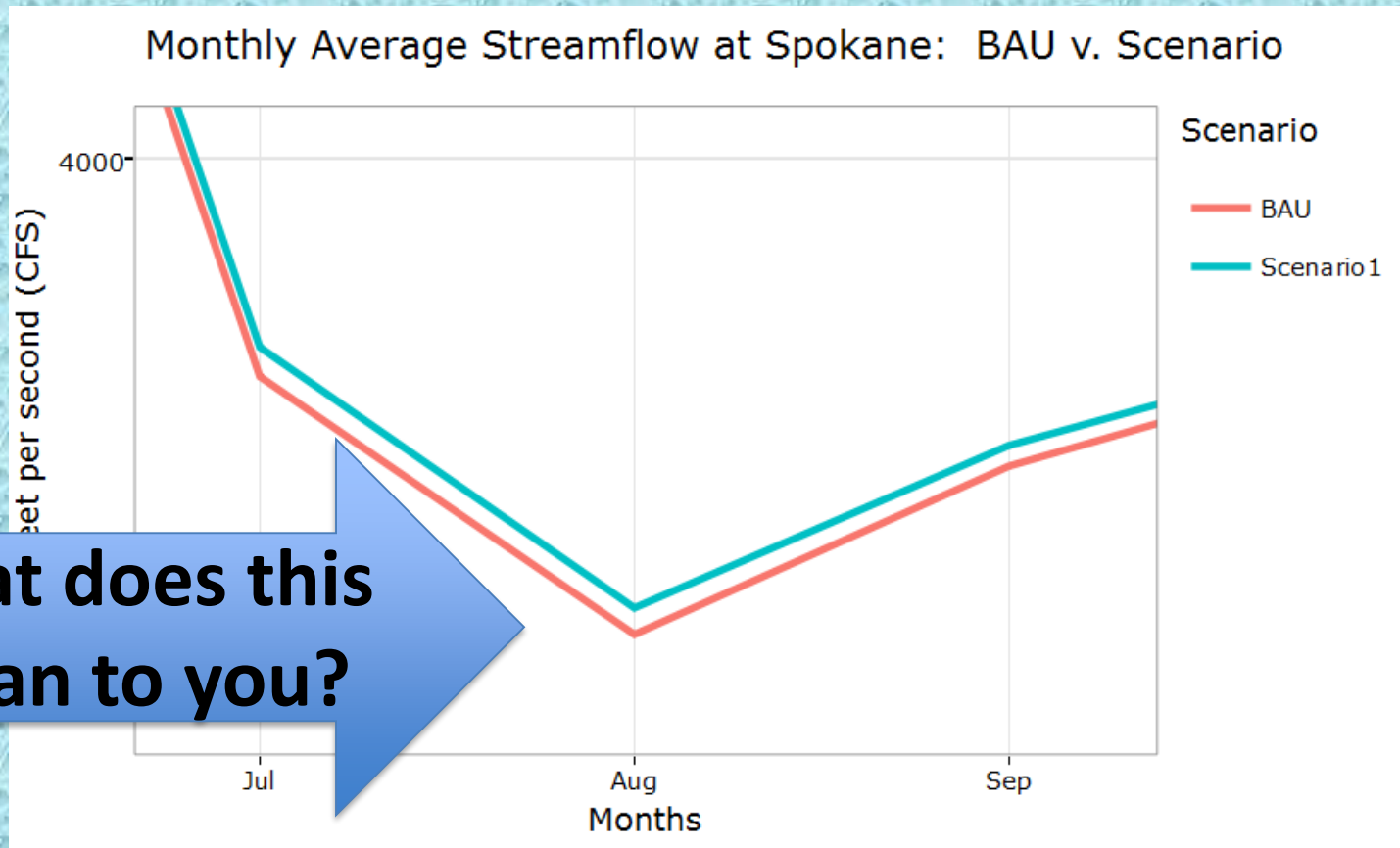
**Individual average use: ~230 gallons/per day**

**Reduced 50%?**

**Individual average use: ~150 gallons/per day**

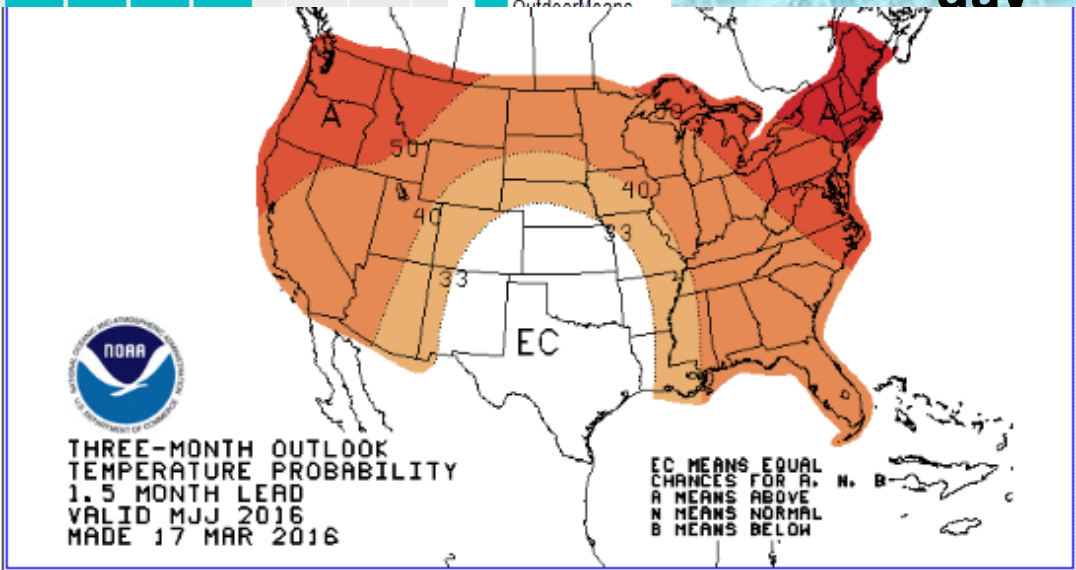
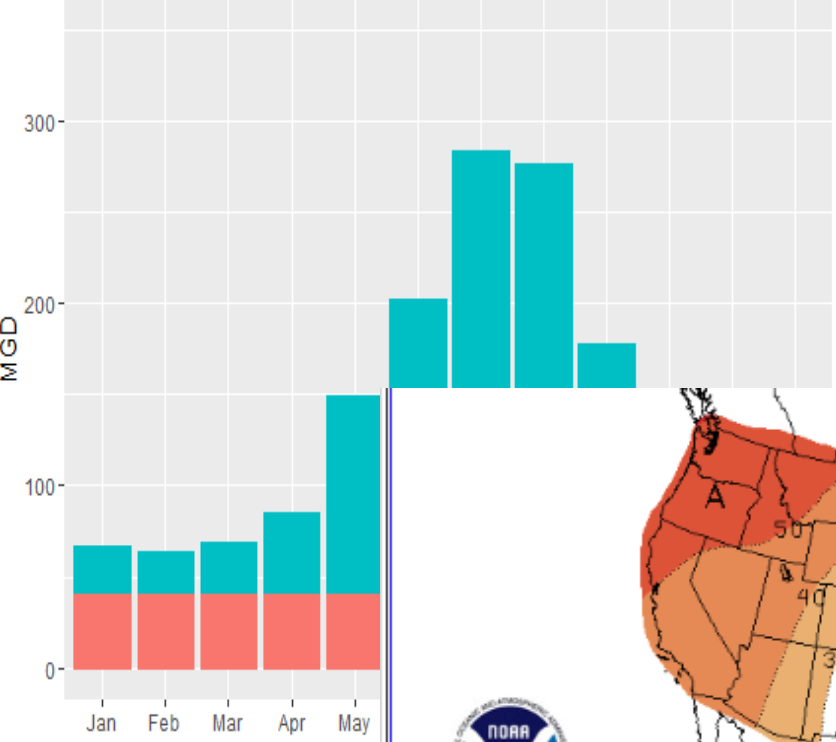


# 50% decrease in outdoor use does increase streamflow

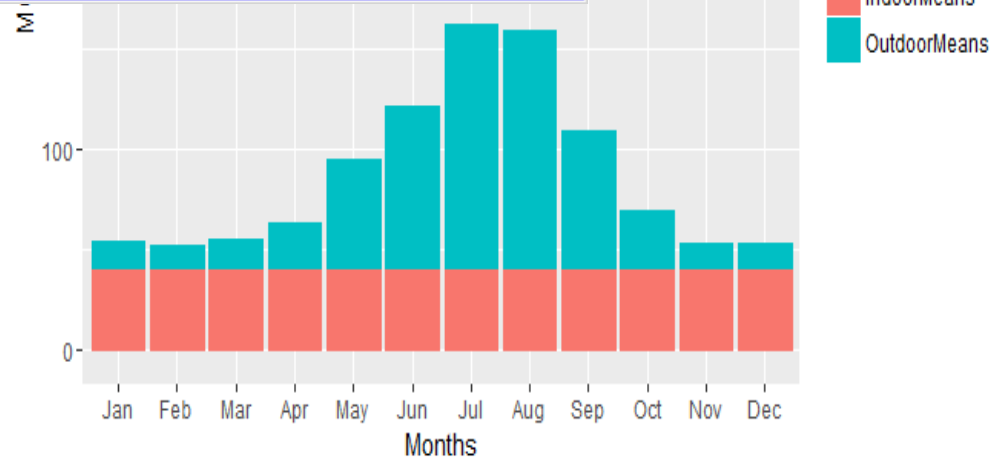


**What does this  
mean to you?**

**Individual  
average use:  
~230 gallons/per  
day**

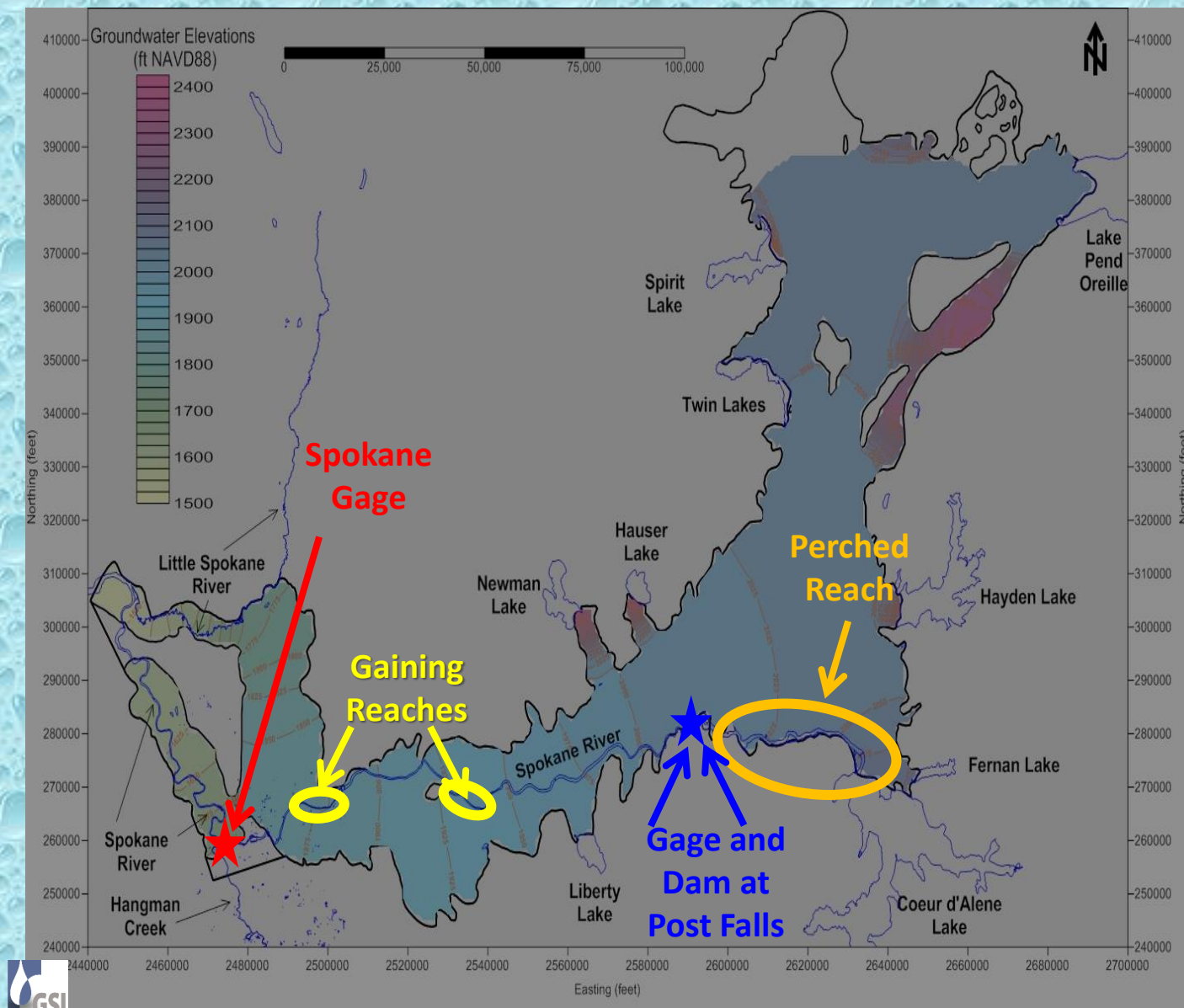


**Individual average  
use: ~150 gallons/per  
day ??????**

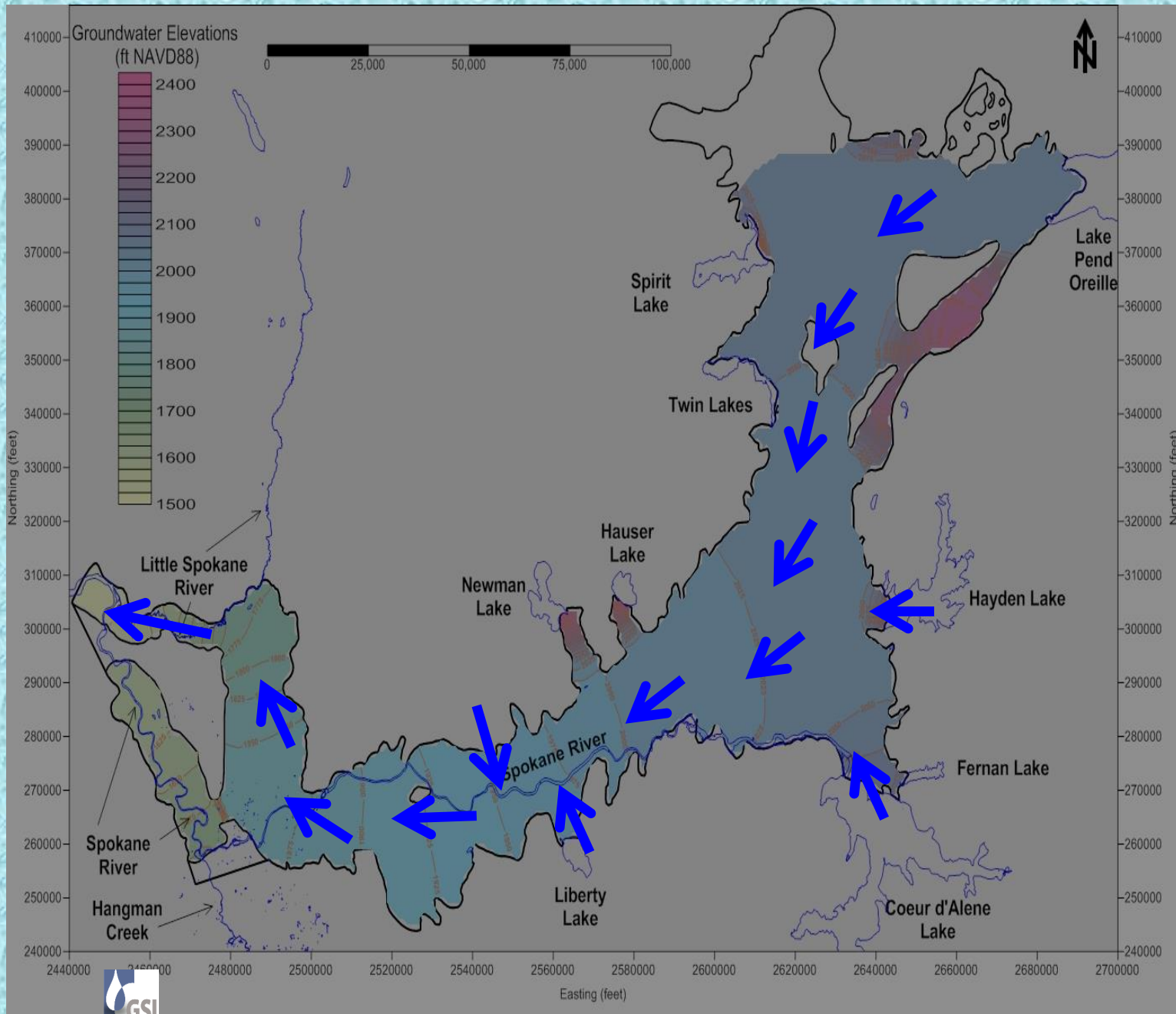




# Spokane River: gaining and losing reaches







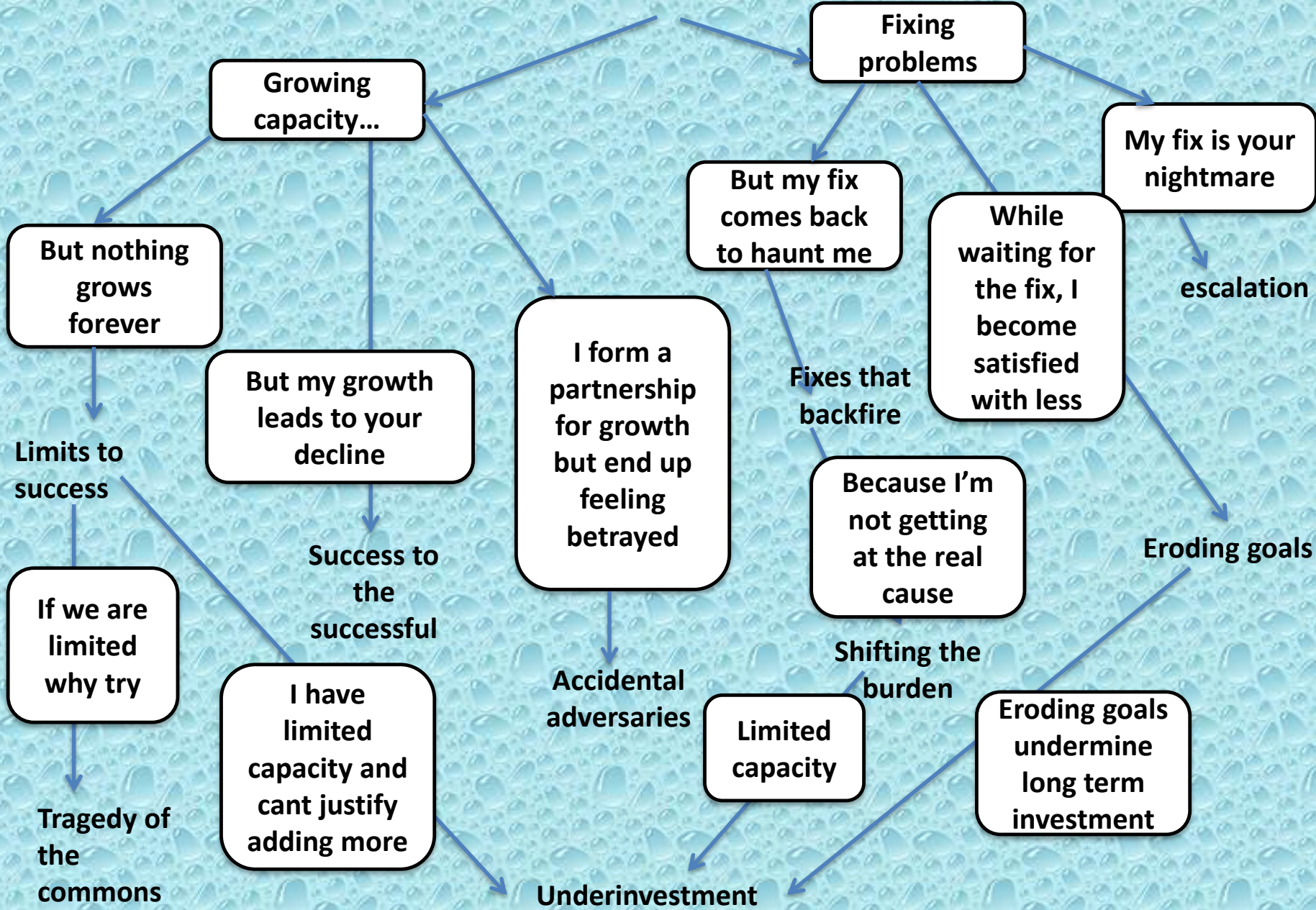
“We agree to collaborate”,  
now on to ....

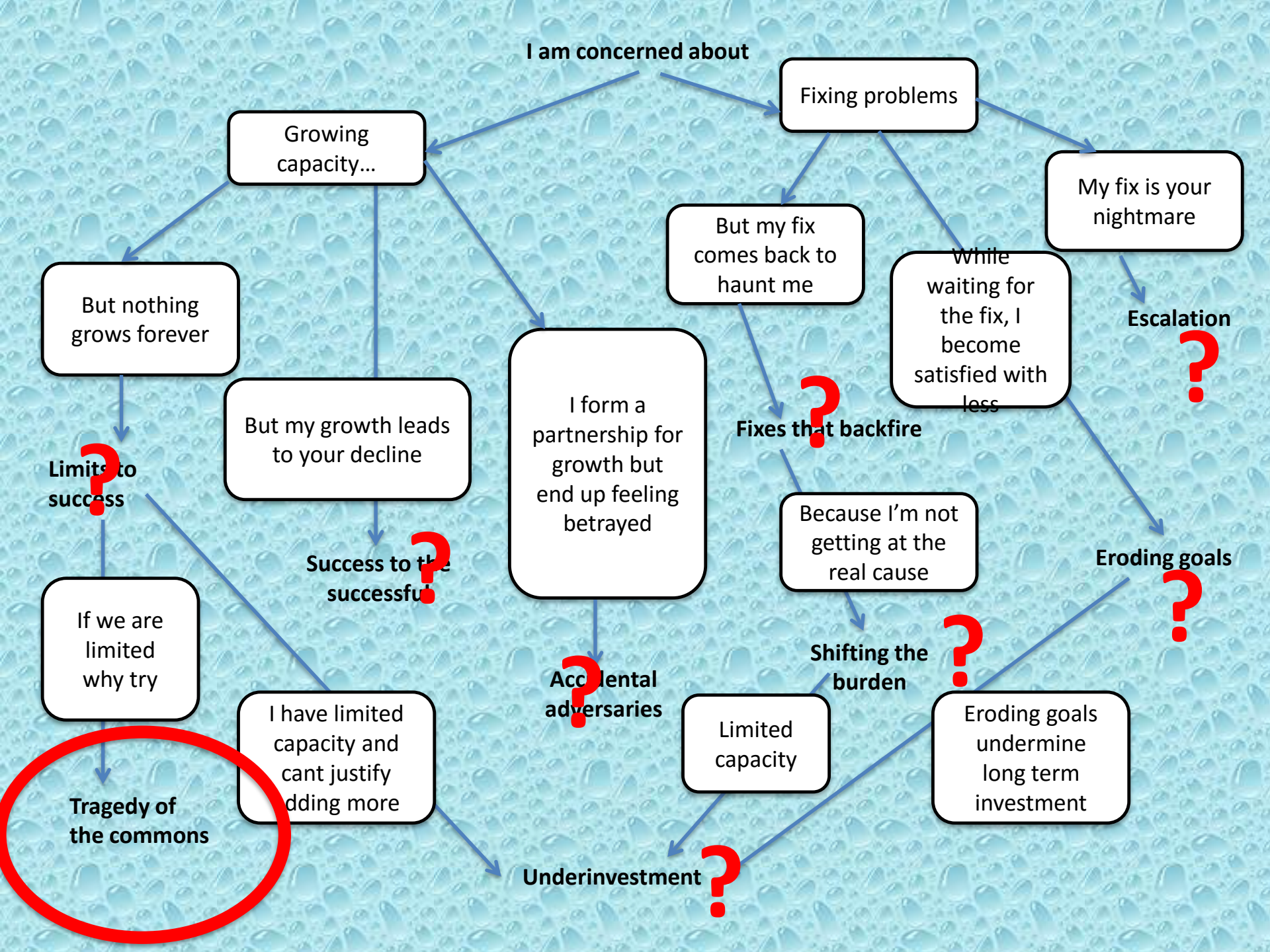
# Game of “What’s Next”





# I am concerned about





I am concerned about

Growing capacity...

Fixing problems

My fix is your nightmare

But nothing grows forever

But my fix comes back to haunt me

While waiting for the fix, I become satisfied with less

But my growth leads to your decline

I form a partnership for growth but end up feeling betrayed

Fixes that backfire

Limits to success

Success to the successful

Because I'm not getting at the real cause

Eroding goals

If we are limited why try

I have limited capacity and cant justify adding more

Accidental adversaries

Shifting the burden

Limited capacity

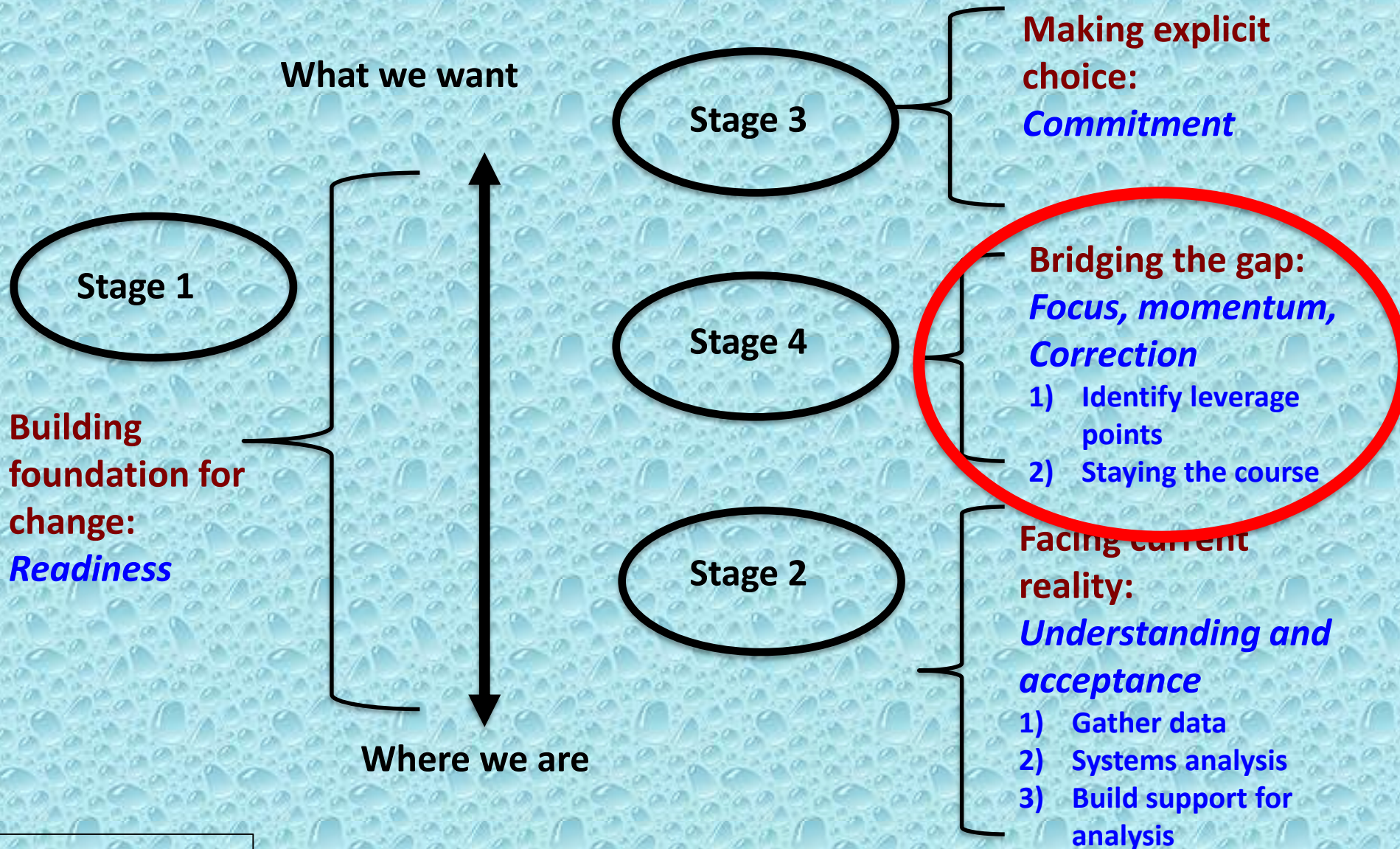
Eroding goals undermine long term investment

Tragedy of the commons

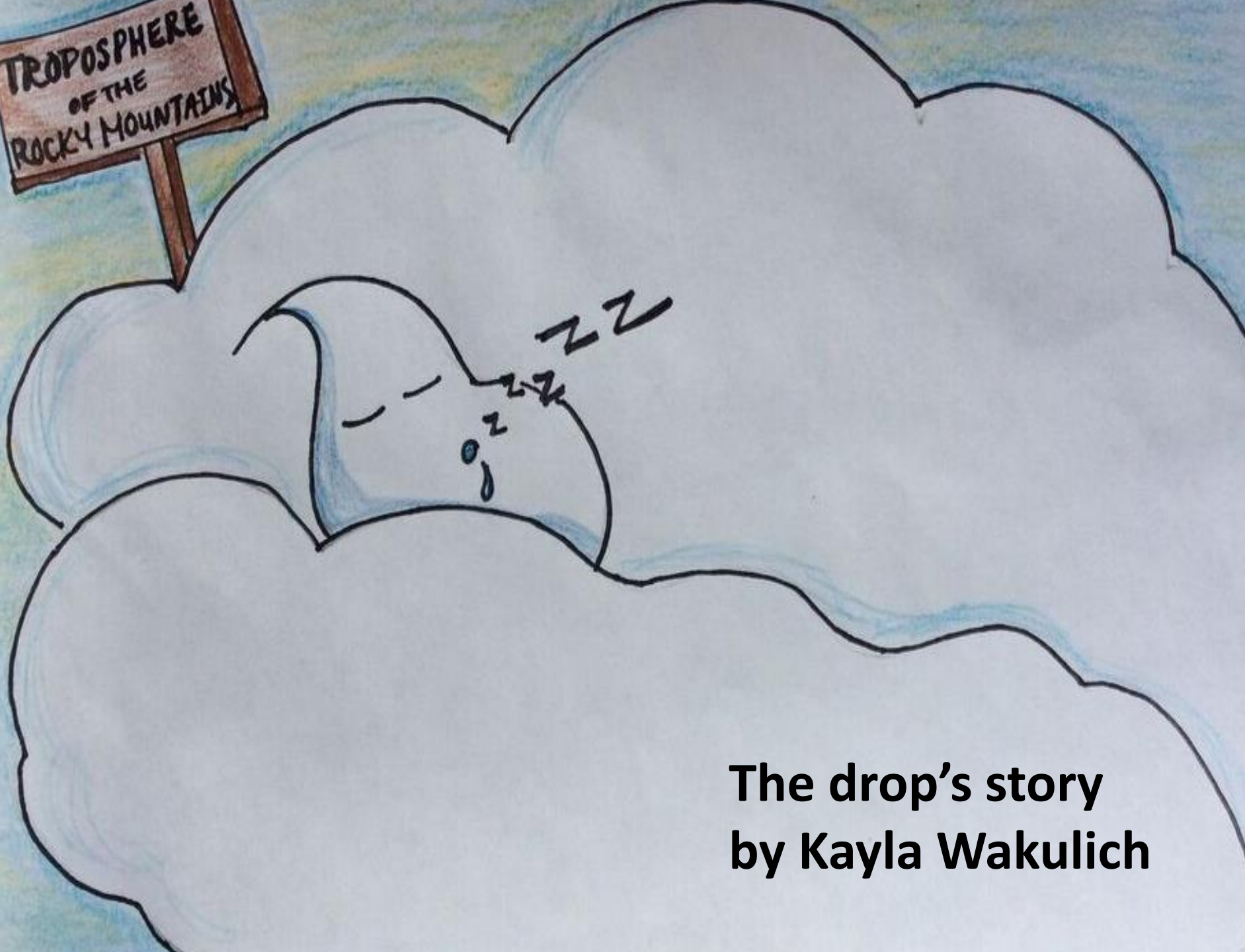
Underinvestment



# Four States of Facilitating Systemic Change



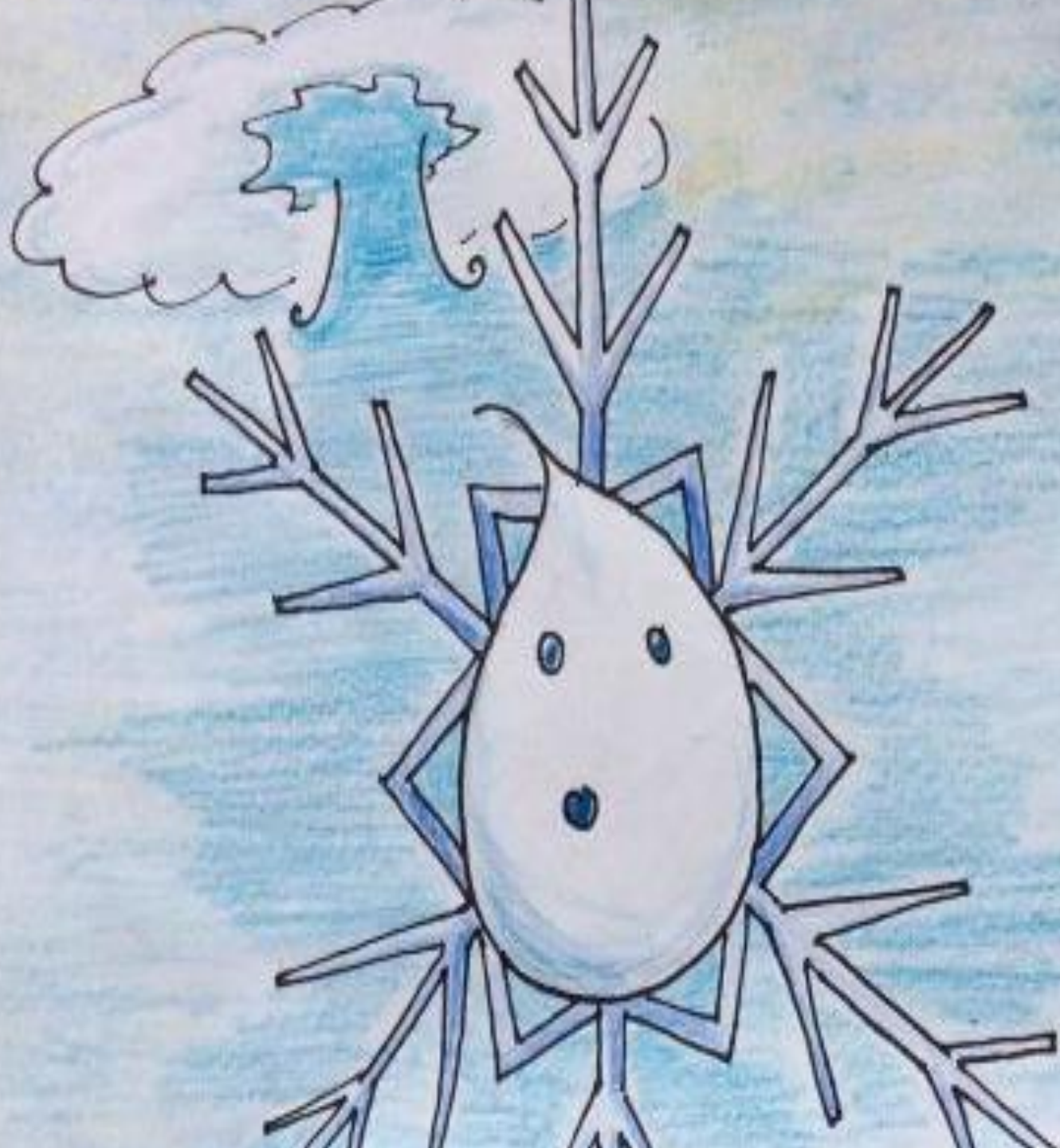
TROPOSPHERE  
OF THE  
ROCKY MOUNTAINS



**The drop's story  
by Kayla Wakulich**















ROCKY  
MOUNTAINS

























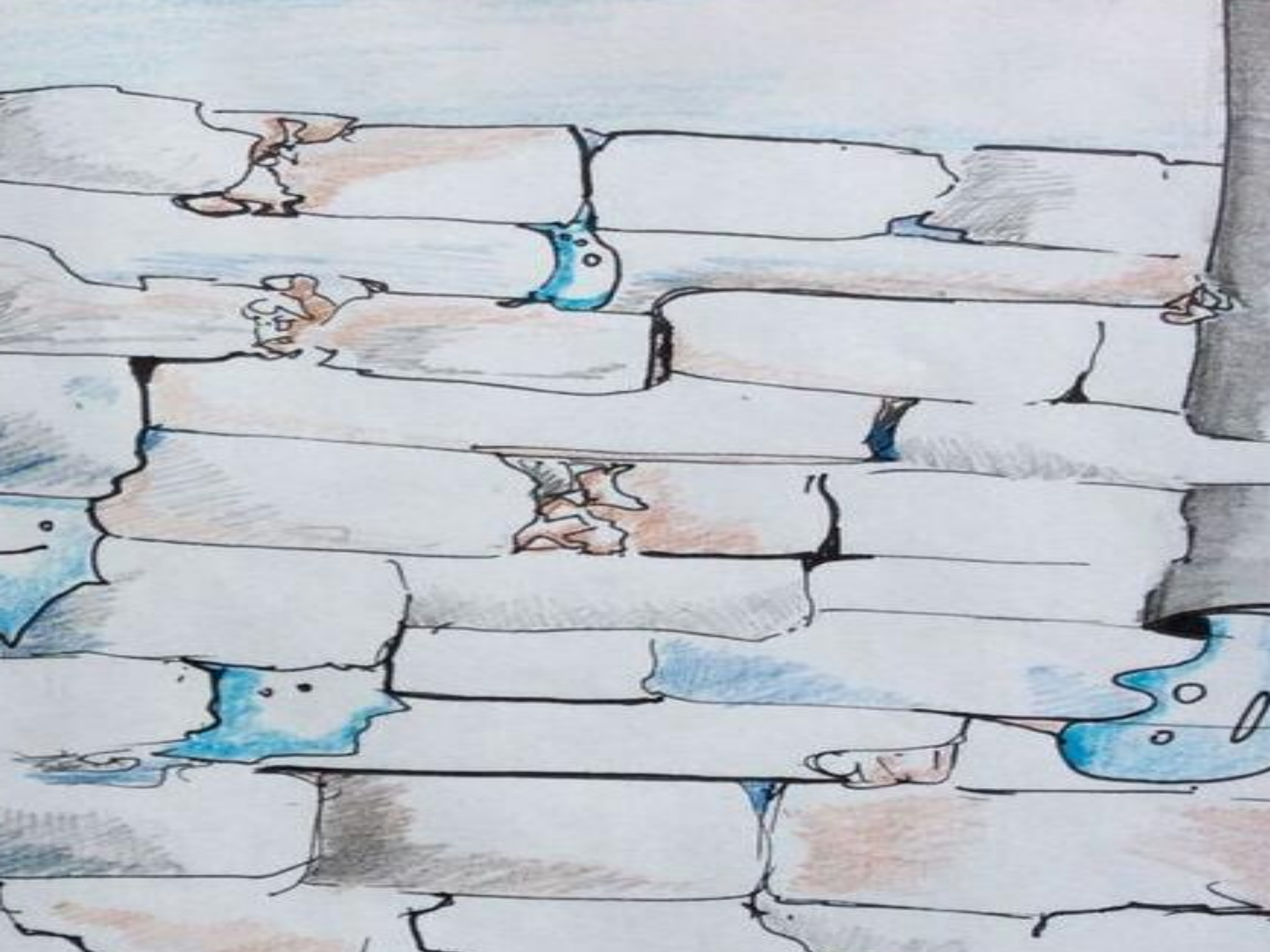




























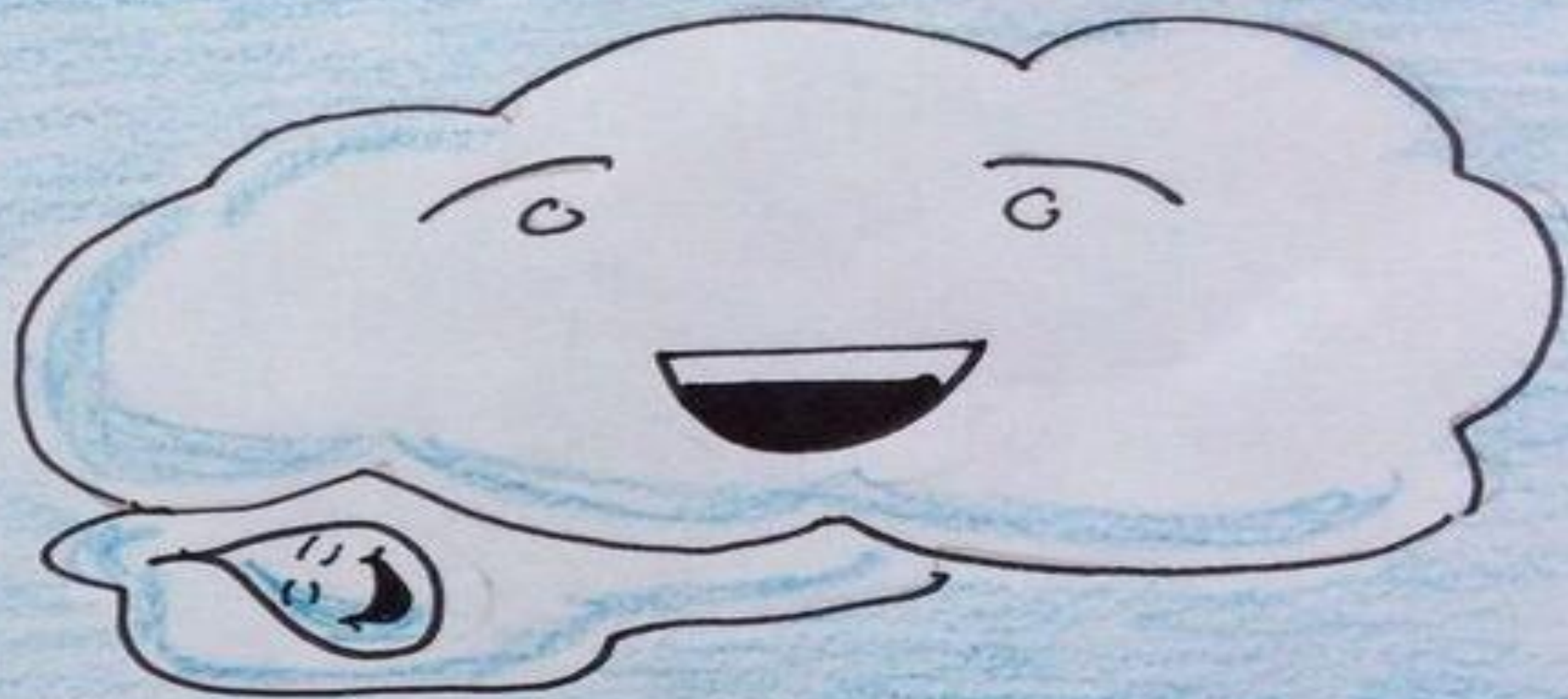












# WISDM

## Watershed Integrated System Dynamics Modeling

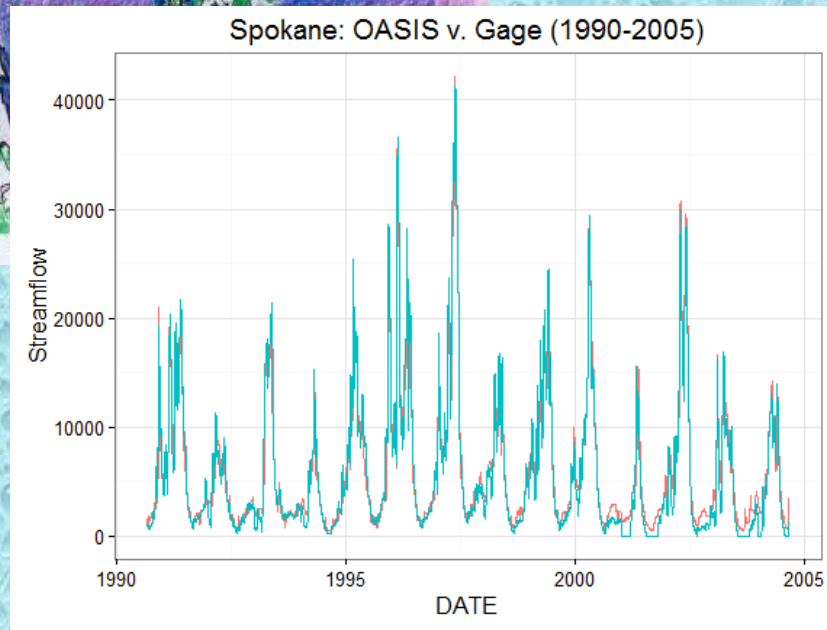


*Biosphere-relevant earth system model*





# Thank you!



— SpokaneGAGE  
— SpokaneOASIS

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