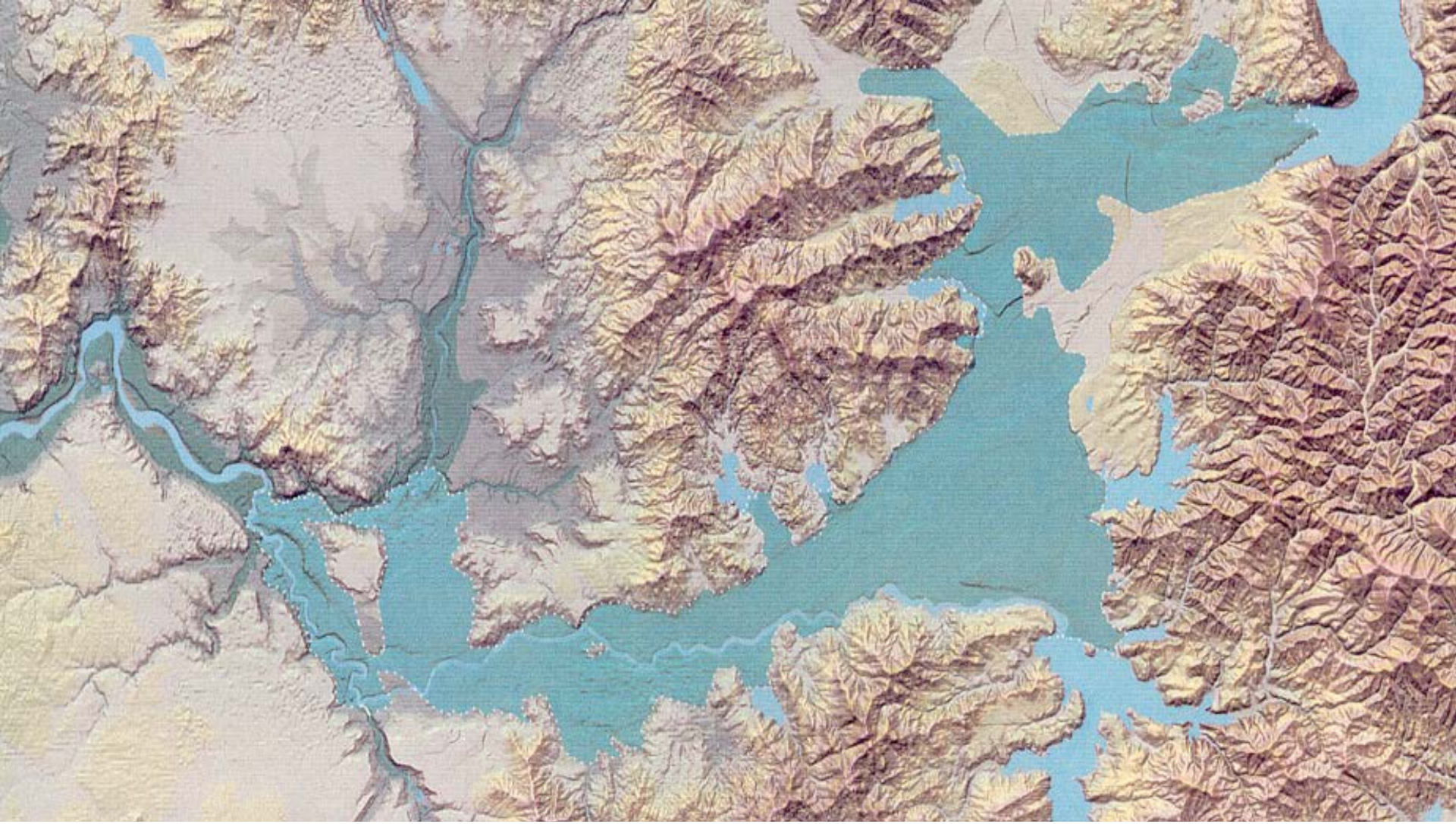


Water Management Issues and Solutions for the SVRP Aquifer and Spokane River in Washington and Idaho

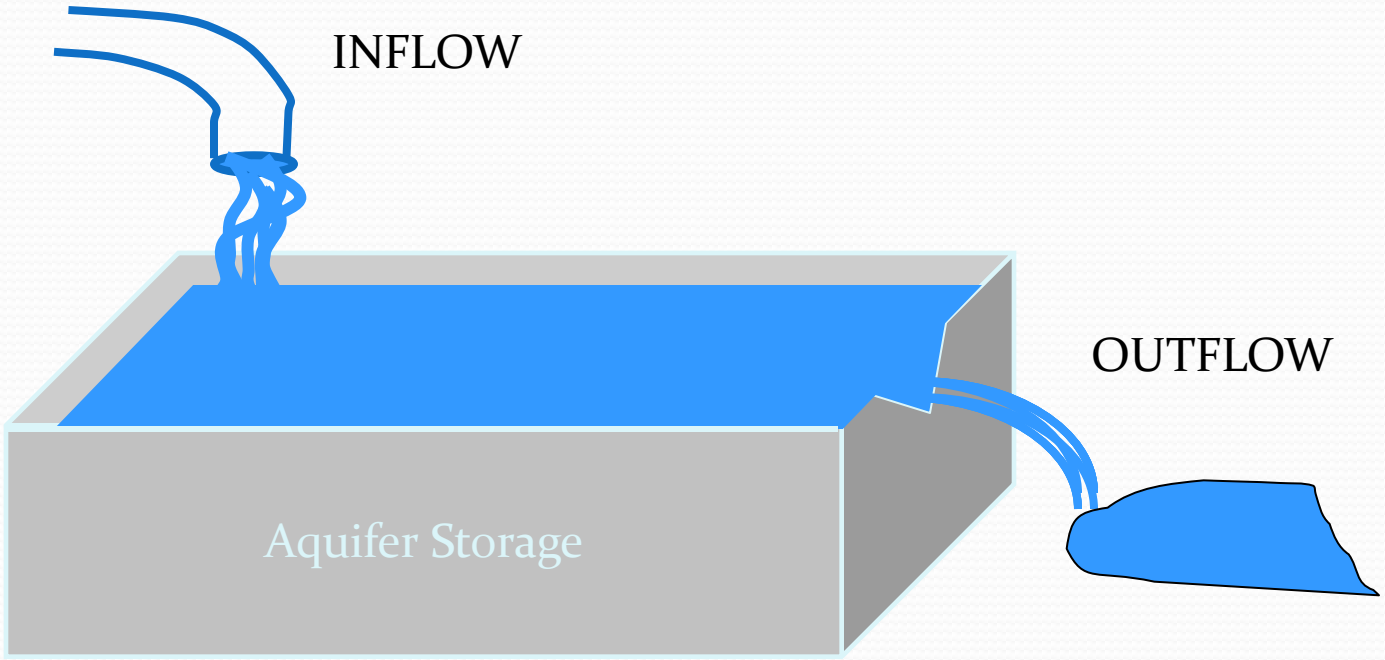
Dale Ralston, Ralston Hydrologic Services, Moscow, ID

What is the problem and what are the alternative solutions?

- The Spokane River in Washington has extremely low flow for 3 to 5 weeks each fall which results in water quality, water use and fishery problems. The low flow is caused in part by ground-water pumping in the Spokane Valley – Rathdrum Prairie (SVRP) aquifer in Washington and Idaho.
- This problem has the potential to result in a major water conflict between Washington and Idaho.
- Idaho should take steps now to understand the nature of this problem and identify and evaluate alternative solutions.
- Our proposal involves investigation of reduced ground-water pumping in the western portion of the aquifer as a way to mitigate low-flow problems in the river.

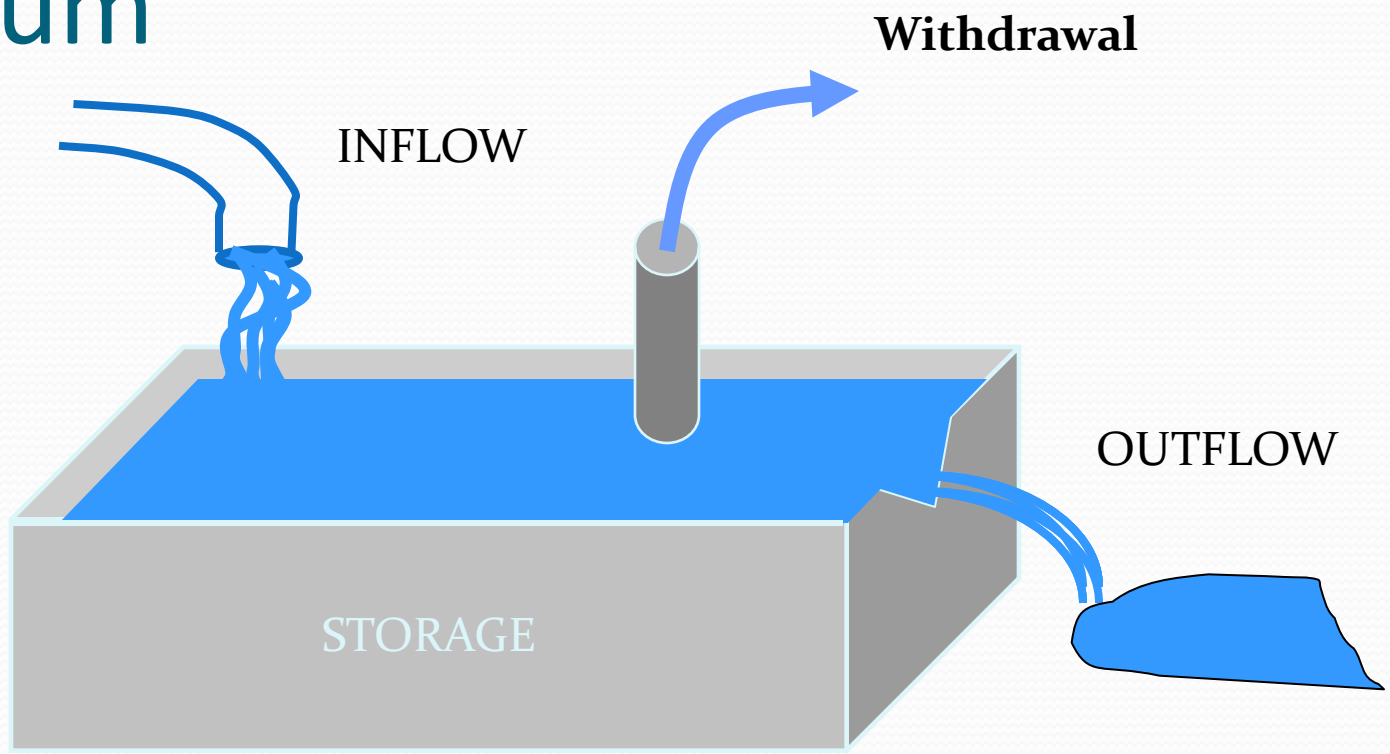
Aquifer Representation

Recharge equals discharge prior to well development



Discharge is controlled by water level
Recharge may or may not be controlled by water level

Addition of pumping results in lowered water levels and a new equilibrium



Ground water pumping always causes water-level decline and a decrease in outflow; there may also be an increase in recharge

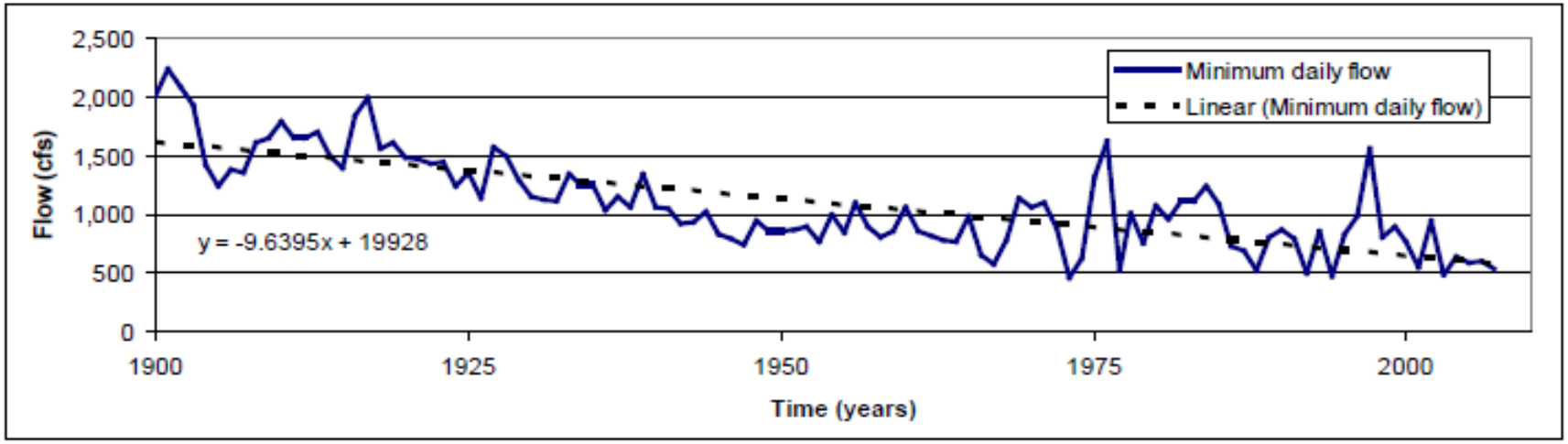
Water balance for SVRP aquifer

- Recharge is about 1,471 cfs (mostly head independent)
  - From Spokane River in the reach from CdA Lake to about Barker Road (49%); lakes and tributary basins (30%); and areal recharge (16%)
- Discharge is about 1,468 cfs (head dependent)
  - To Spokane River (59%); Little Spokane River (16%) and public supply (22%)

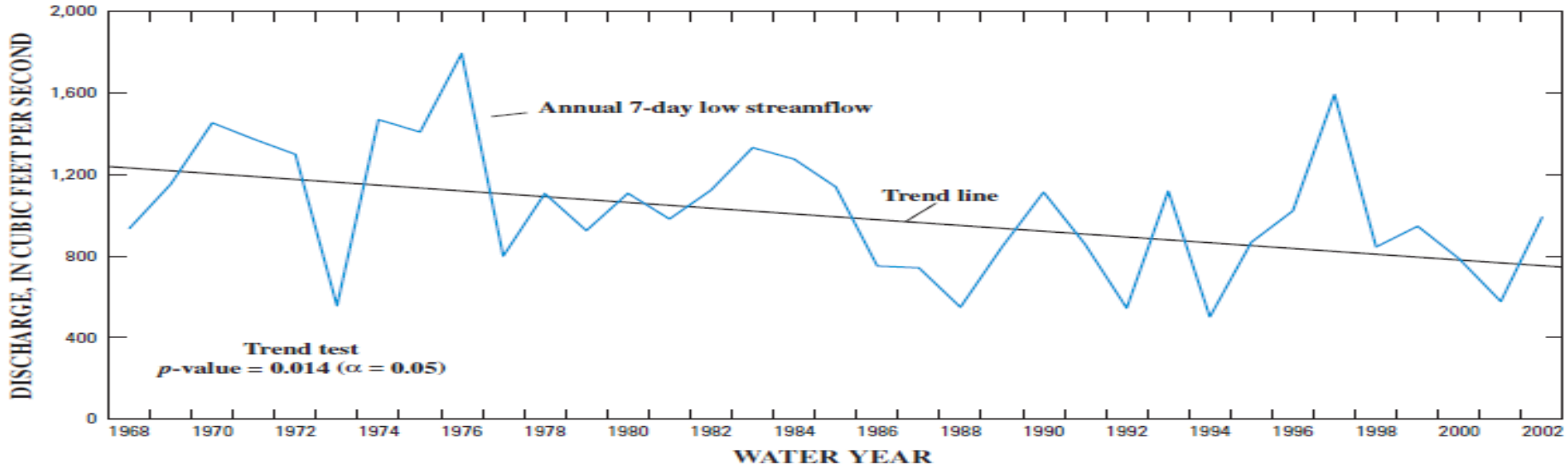
(From Kahle and Bartolino, 2007)

What is the dominant water management problem?

- The flow of the Spokane River at Spokane during the critical low-flow period in the fall and early winter has been decreasing for a number of years.
- No long-term change in river flow has been observed during average or high flow.
- Discharge from the SVRP aquifer to the Spokane and Little Spokane Rivers is an important component of river flow, particularly at low flow.



Minimum Daily Flow of the Spokane River at the Spokane Gage (Taken from Barber and others, 2011)



Annual 7-Day Low Streamflow for the Spokane River at Spokane, 1968-2002 (Taken from Hortness and Covert, 2005)

There are three identified solutions for the low flow problems in the Spokane River in the fall/winter.

- 1) Artificially recharge the aquifer at selected sites and times to increase the ground-water discharge to the river during the critical low flow time periods.
- 2) Use managed discharge from Coeur d'Alene Lake to augment the flow of the Spokane River during the critical low flow time periods.
- **3) Decrease ground-water pumping from the aquifer at selected sites and at selected times to increase aquifer discharge to the river during the critical low flow time periods (proposed project).**

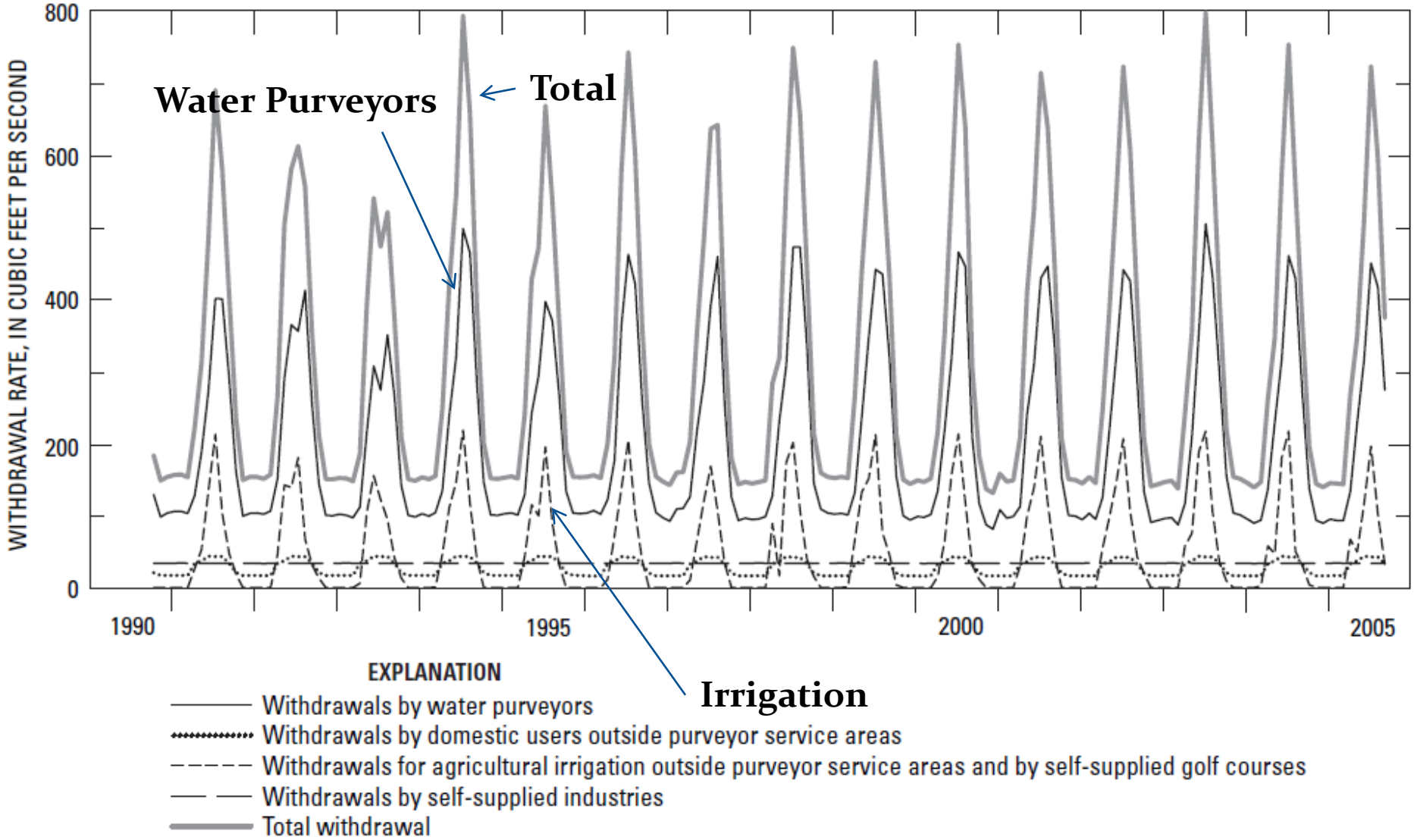
- 1) **<u>Artificially recharge the aquifer at selected sites and times to increase the ground-water discharge to the river during the critical low flow time periods.</u>**
  - This alternative has been investigated in 2011 WSU study that was funded by the Washington Department of Ecology.
  - Pump ground water in Idaho from wells near Lake Pend Oreille, pipe it to near Rathdrum and inject it back into the aquifer via wells in Idaho.
  - Aquifer recharge in the spring near Rathdrum would benefit flow in the Spokane River at the Spokane gage in the critical low flow period in the fall.

- **2) Use managed discharge from Coeur d'Alene Lake to augment the flow of the river during the critical low flow time periods.**
  - Would need to hold levels in Coeur d'Alene Lake higher in the summer season to have more water to discharge in the Spokane River in the fall.
  - Operational problems include lake front damages, channel problems in discharging the water and existing water rights in the Spokane River in Idaho.
  - The feasibility of this alternative has not been investigated.

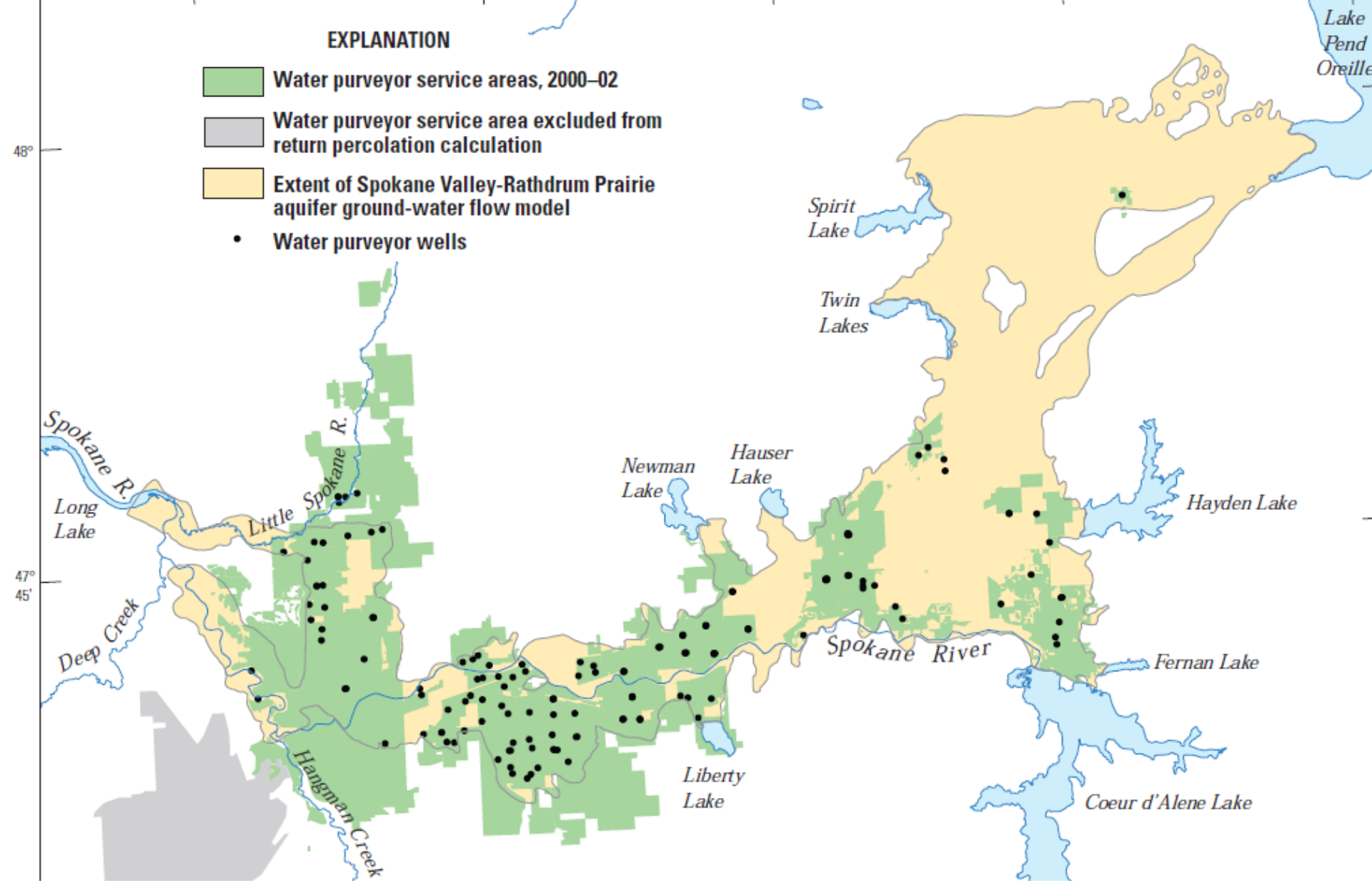
- 3) **Decrease ground-water pumping from the aquifer at selected sites and at selected times to increase aquifer discharge to the river during the critical low flow time periods.**
  - Water pumped from any well completed in the aquifer must necessarily impact the flow of the river. However, the amount and timing of the impacts are much different depending primarily on the locations of the wells.
  - The effects of well operation on the river are more immediate and greater if the well is located near the stream.
  - The focus would be on wells that cause the greatest impacts on the river during the critical low-flow period in the fall.
  - The proposed project addresses this alternative.

Questions relative to ground-water pumping and associated impacts on the flow of the Spokane River

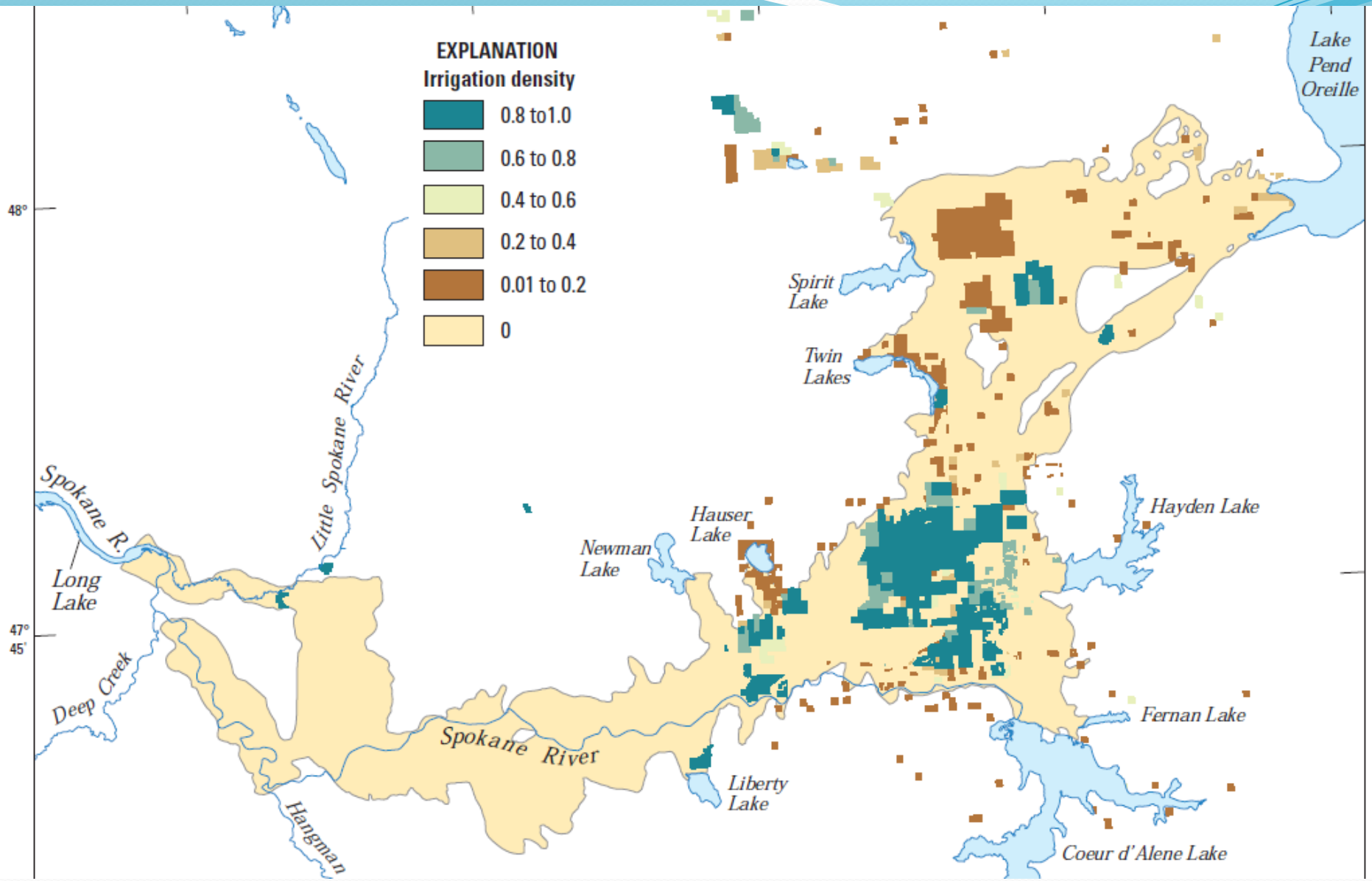
- How much ground water is currently being pumped?
- What are the uses of the ground water?
- How have ground-water levels responded to the pumping?



Withdrawal rates from wells in cubic feet per second (taken from Hsieh and others, 2007). Water purveyors pump the largest amounts followed by irrigation.



Locations of Water Purveyor Wells (taken from Hsieh and others, 2007)

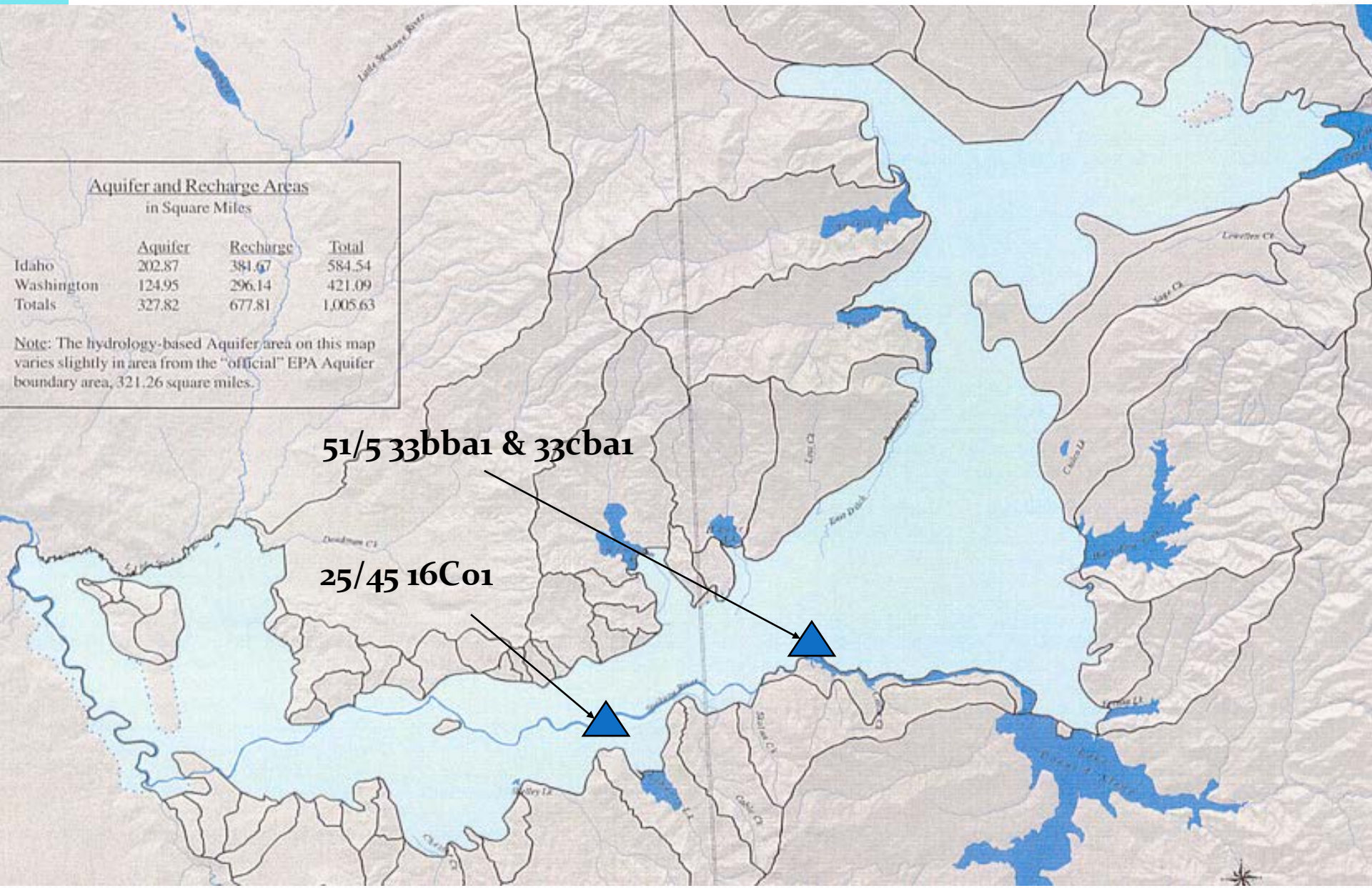


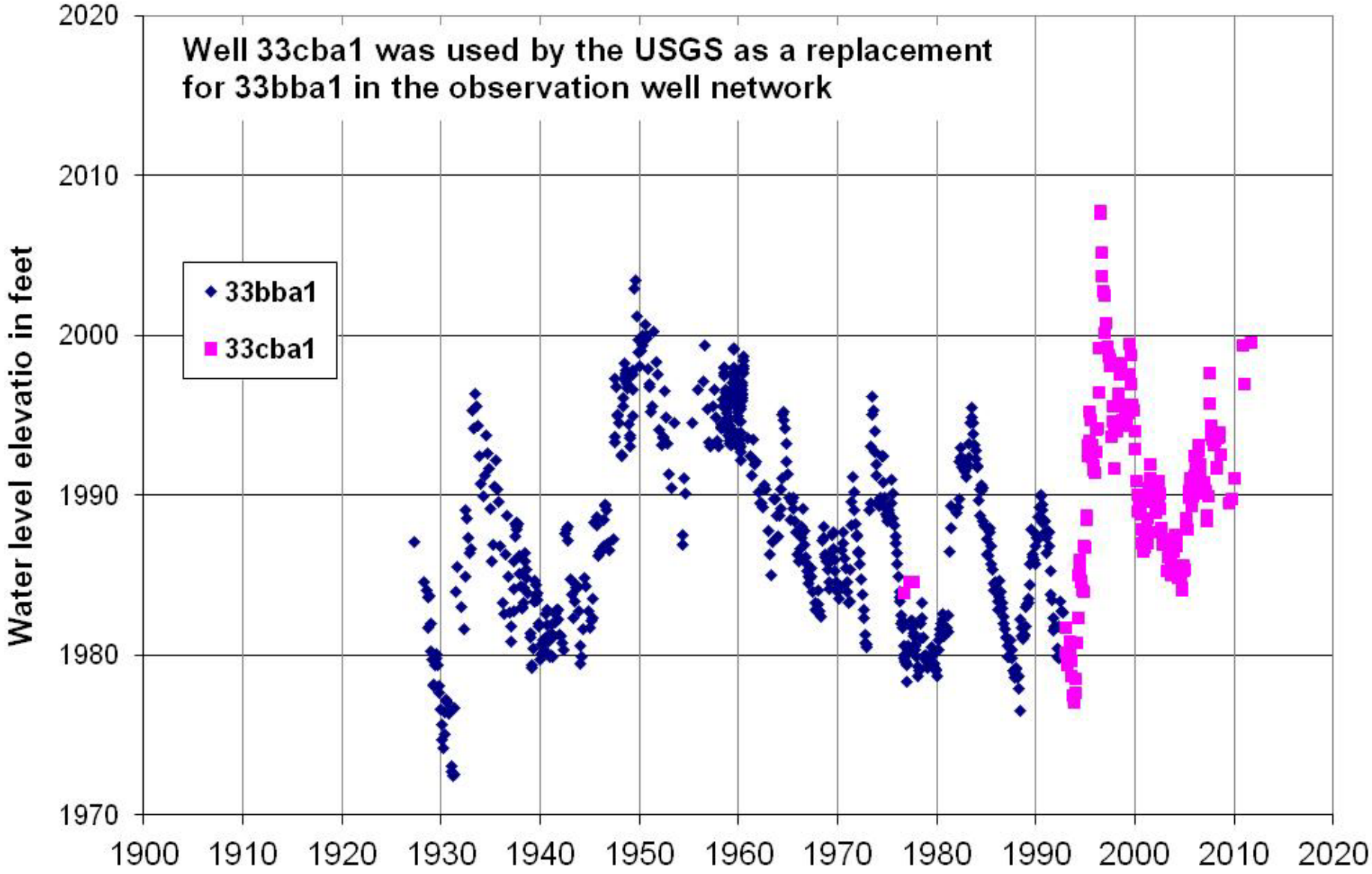
Map of Irrigation Locations and Densities (taken from Hsieh and others, 2007)

Impacts from ground-water pumping

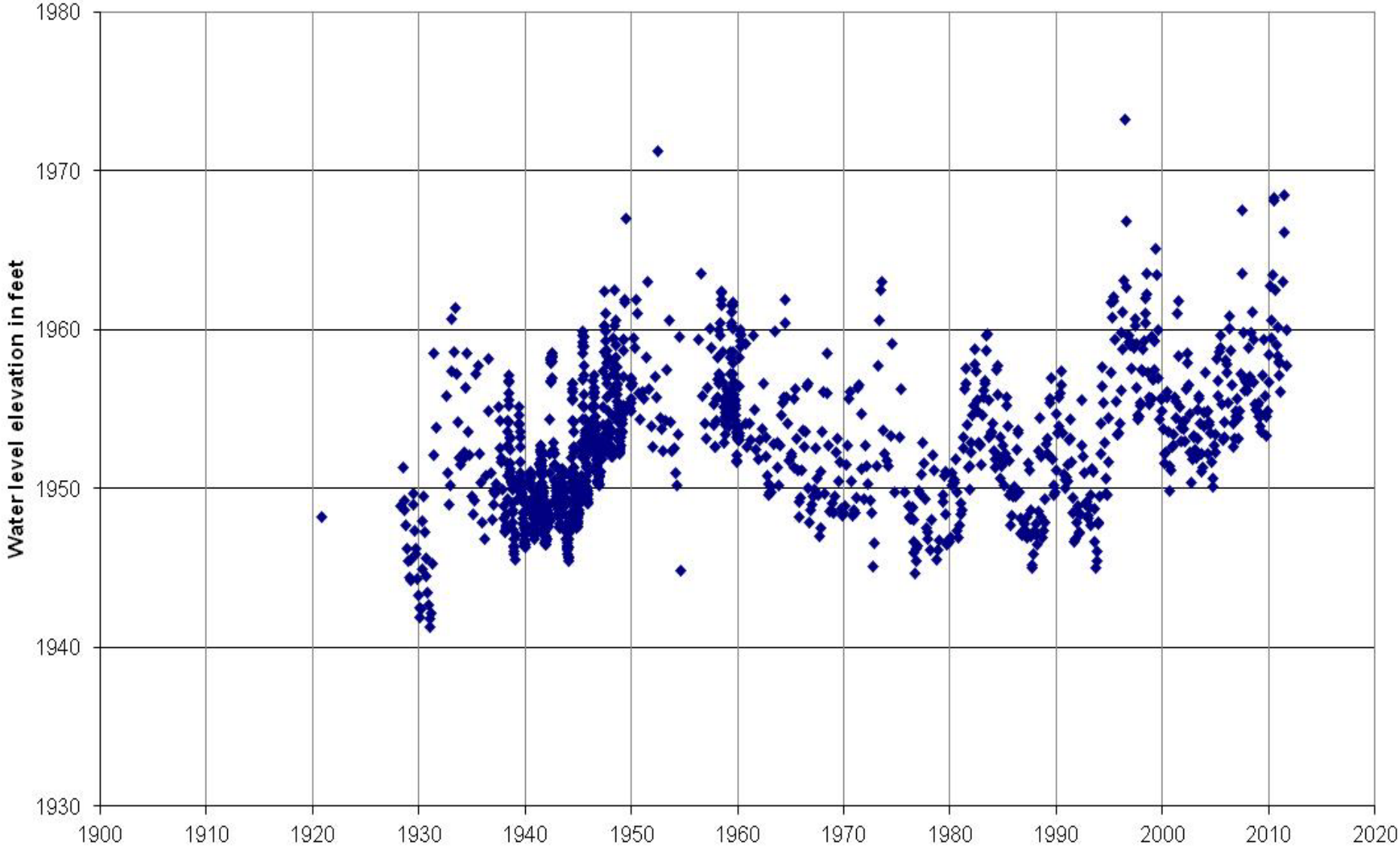
- According to the water balance model described previously, ground-water pumping causes water-level decline which in turn causes a decrease in ground-water discharge.
- Lower ground-water levels near the river can result in greater streamflow loss in losing reaches and less streamflow gain in gaining reaches.
- Analysis of long-term water-level records in Idaho and Washington is important.

Observation Wells With Long-Term Water Level Records





Hydrograph for Wells 51/5 33bba1/33cba1 Located Near Post Falls



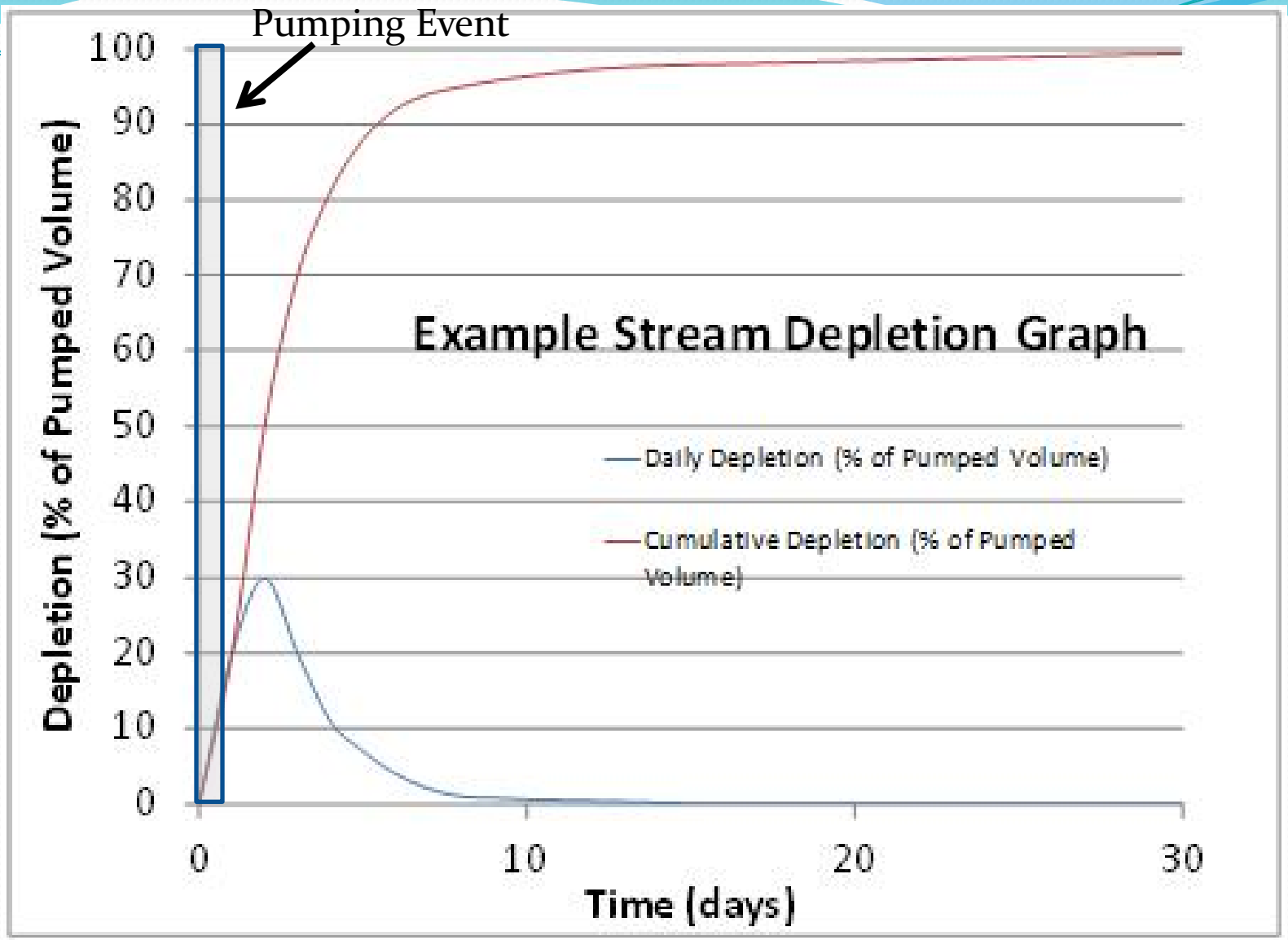
Hydrograph for Well 24N 45E 16C01Located Near Liberty Lake

Analysis of Ground-Water Levels

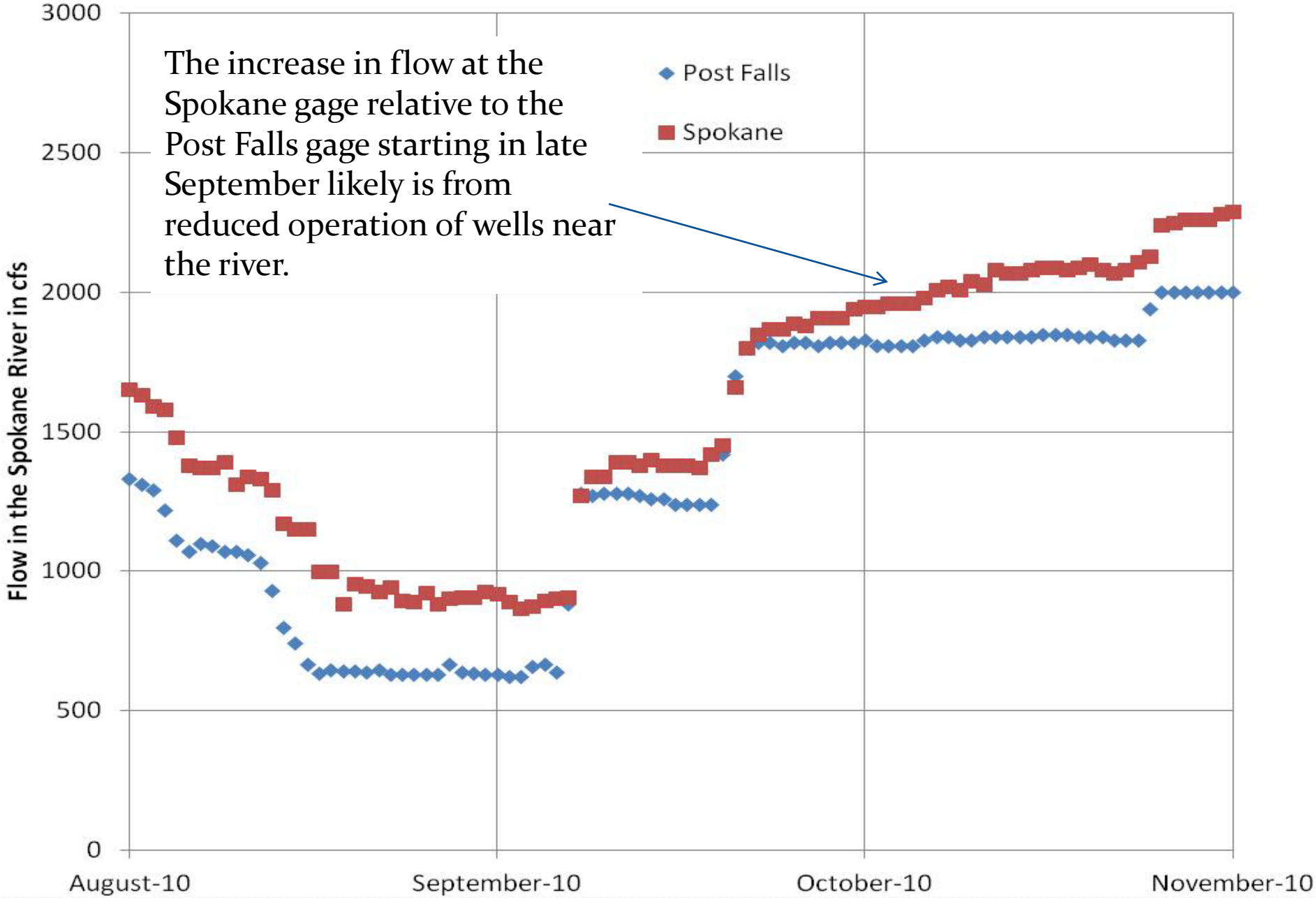
- No pattern of long-term water-level decline is evident in either of these wells. Ground-water levels in 2012 are higher than during most of the historical period of record.
- No long-term hydrograph data that extend to the present are available for wells in Washington west of Liberty Lake.
- The data suggest that reduced ground-water discharge to the Spokane River at Spokane is caused mostly by pumping wells near reaches of the river where there is direct hydraulic connection between the river and aquifer.
- The Spokane River is perched above the aquifer in Idaho; lowered ground-water levels cannot impact the river.
- Most of these wells that likely have rapid impacts on river flow are located in Washington.

Ground-Water Pumping Effects on the Spokane River

- The impact that operation of a well has on the river is dependent on four factors.
  - The pumping rate of the well.
  - The distance from the well to the river.
  - The hydraulic properties of the aquifer (transmissivity and storativity).
  - The hydraulic connection of the river and the aquifer including river bank and bed conditions.
- The effects of well operation on the river are more immediate and greater if the aquifer is highly transmissive and the well is located near the stream.



Example Stream Depletion Graph



Flow in the Spokane River at the Post Falls and Spokane gages in 2010

Proposed Project

EVALUATION OF ALTERNATIVE GROUND-WATER PUMPING SCHEMES AS AN APPROACH TO MITIGATING PROBLEMS OF CRITICAL LOW FLOW IN THE SPOKANE RIVER AT SPOKANE, WASHINGTON

Dale R. Ralston PhD PE PG
Gary S. Johnson PhD PE

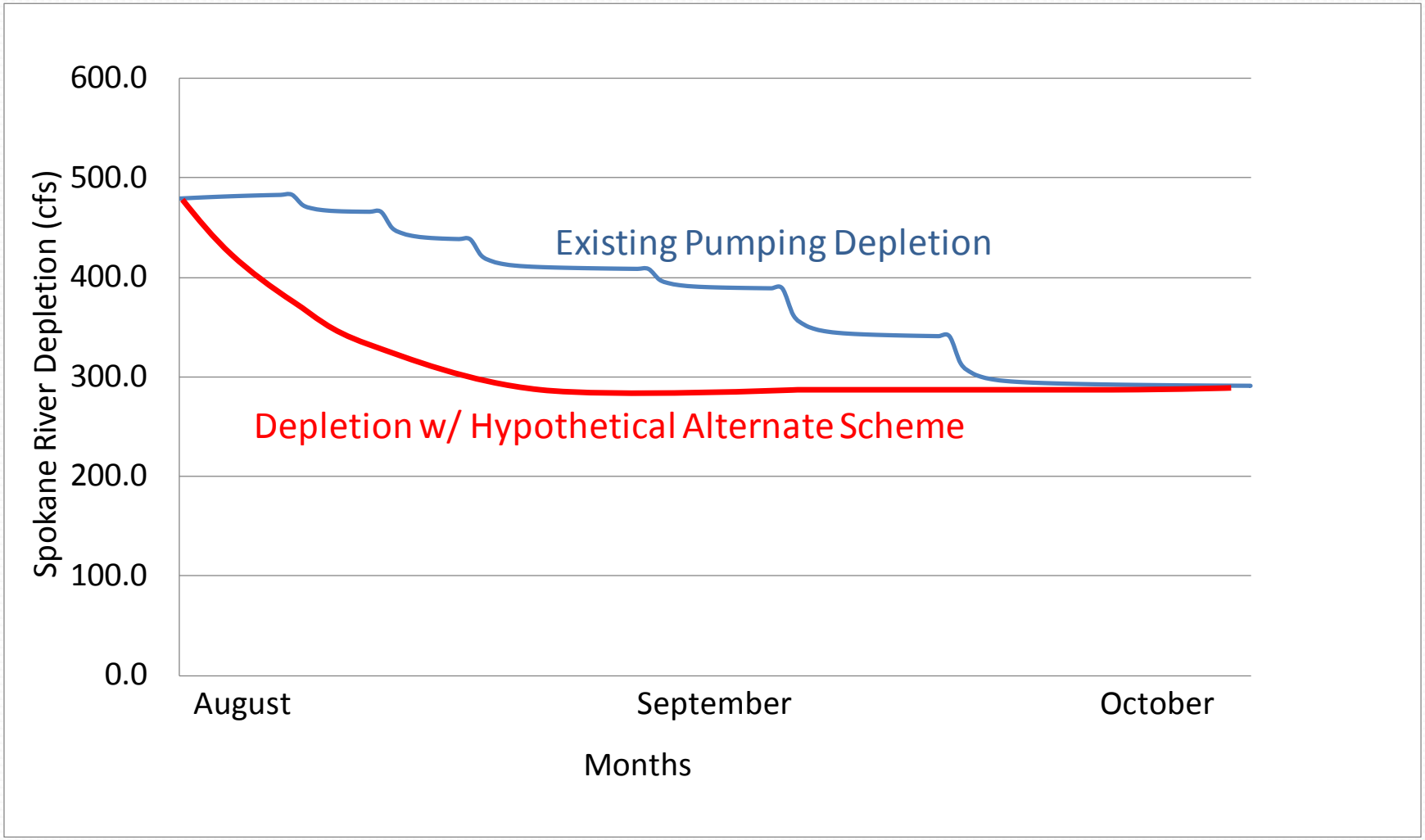
Project Description

- Develop a water management program that includes staged operation and possible relocation of production wells based on the amount and timing of impacts on the Spokane River at the Spokane gage.
- Project would be conducted using daily transient response functions in conjunction with the existing MODFLOW aquifer model (Hsieh and others, 2007).
- The timing and magnitude of impacts from groups of wells would be predicted.
- This approach is the basis for water management in the Eastern Snake Plain Aquifer in southern Idaho.

Project Questions

- At least four major questions need to be addressed relative to this water management program.
  - First, what criteria would be used to select wells to be part of the management program?
  - Second, how would the program of staged operation of production wells operate in order to meet target discharge rates within the river?
  - Third, how would impacts from decreased water supply for users of the wells included in the program be mitigated?
  - Fourth, how would the proposed management program be administered within the constraints of the water-right systems of both Washington and Idaho?

Staged reduction of pumping near the river can reduce the amount of ground-water depletion of the river



Hypothetical depletion estimates for the Spokane River for existing pumping and for an alternate scheme

Work Product A

- ***Gain an improved understanding of low-flow conditions in the Spokane River from the Post Falls gage to the Spokane gage in order to better understand the surface water/ground water system and provide a basis to evaluate the results of the transient the response function analysis.***

Work Product B

- ***Conduct a Reconnaissance Transient Response-Function Analysis of Pumping Effects on the flow of the Spokane River at the Spokane Gage.***
  - Conduct a transient response function analysis on a daily time increment to create a series of graphs that illustrate river depletion from a one day pumping event at 10 to 15 selected locations at varying distances from the Spokane River.
  - The graphs will provide the basis for developing the detailed procedure to accomplish Product C below.

Work Product C

- ***Create a River Depletion Spreadsheet***
  - Create a spreadsheet that will allow any water interest to perform independent estimates of pumping impacts on the Spokane River and evaluate alternate pumping scenarios.
  - The spreadsheet will provide the computational capability to efficiently complete the analysis of alternative pumping scenarios that is work product D.

Work Product D

- ***D) Assessment of Alternative Pumping Scenarios***
  - The first part of the assessment will include the evaluation of impacts of reported or estimated pumping rates for each significant production well or groups of wells using the spreadsheet described in Product C above.
  - The second part of the assessment results from evaluating approximately 10 different schemes (identified in collaboration with IDWR) that alter both pumping rates and locations.

Project Budget and Time Period

- Proposed project budget is $70,000.
- Proposed project time period is 1 year.

Thank You!!