Big Wood River Ground Water Management Area Advisory Committee

January 5, 2021 Meeting Materials

1) Big Wood Canal Operation and Water Savings Efforts (Report from Carl Pendleton, Big Wood Canal Company)
2) Supplemental Ground Water Rights and Conditions (PowerPoint presentation from Cherie Palmer, IDWR)
3) Domestic Water Use (PowerPoint presentation from Jennifer Sukow, IDWR)
4) Return Flows and Natural Flow Determinations (PowerPoint presentation from Tim Luke, IDWR) *Note – Presentation not given at meeting due to time constraints.*

TO: Big Wood Ground Water Management Area Advisory Committee

January 5, 2021

Presentation notes and discussion from Carl Pendleton, BWCC

Big Wood Canal Operation and Water Savings Efforts

The intent of this report to the Committee is to outline the efforts of Big Wood Canal Company (BWCC), American Falls Reservoir District #2 (AFRD #2) and their stockholders to stabilize and improve the water delivery system within the boundaries of the project throughout its history.

Initial recognition should be given to those pioneers who recognized that simply diverting the river flows at the whims of mother nature and attempting to individually move water across the desert through private ditches was not an effective use of the river resources. Thus in 1910 Magic Dam was completed at a capacity of 172,600 acre feet capacity. In 1916 the dam was raised 5 feet to the 191,500 acre feet capacity of today. The next recognition and additional large-scale investment in system efficiency occurred in 1925 with the construction of a 9 mile long by-pass canal in North Shoshone removing water from the natural channel of the Big Wood River and paralleling that reach in an earthen canal at a cost of nearly $320,000. These improvements are carried on the books of BWCC in total at about $7.1 million.

Shortly thereafter in agreement with Bureau of Reclamation as part of the massive Minidoka Reclamation Project the Milner-Gooding Canal was conceived and completed in 1934. At this writing a breakdown of the of the cost of this part of the total Minidoka Project has not been located; however, it has been expressed that it was near that of the Magic Reservoir system development. Cost of the Milner-Gooding system was financed by the federal government and paid for by all the stockholders of BWCC/AFRD#2.

Incidental loss from canal systems to the aquifer across the Snake Plain averages about 50% due to the underlying basalt and alluvial nature of the region. In general terms the BWCC/AFRD#2 system experience that factor of loss. (Water Management and Conservation Plan, CH2MHILL, October 2002) Some areas of the system exhibit losses in excess of the average. To identify those high loss areas the company purchased an acoustic flow meter and over a period of time dedicated two employees to segmenting the system and locating those areas of highest loss. That data, coupled with the observation of on the ground employees has been used to address areas of concern.

Consideration was given as to the cost effectiveness of measures that the company should pursue and in general terms it was determined that the large main canals were too large to consider lining or piping at this time. Pipe of adequate size is not available and concrete lining in our freeze/thaw environment may have limited life. However, over a period of years the main canals have been shaped and the floors of the canals leveled to eliminate pooling. This allows water to be input and extracted from the system in a more efficient manor if for example a spring wet period allows withdrawals from the reservoir to be curtailed for a period of time. Areas of elevated loss has been evaluated and isolated areas excavated and sealed utilizing native clays, fabric lining or bentonite. An example of a major canal measure would be the narrowing and shaping of several miles of the previously referenced by-pass canal at a cost of nearly $100,000.

Our most cost-effective measure is the piping of the smaller laterals that service the project. In general terms the lands serviced by Magic Reservoir exhibit a gradient of about 100 feet per mile. This fact lends itself to gravity pressurization of sprinkler systems and the minimization or elimination of the need for power from electric or fossil fuel sources to pressurize irrigation systems. This economic fact realized by individual stockholders, coupled with the obvious savings to BWCC of water, maintenance and labor are key to the many projects that have been installed over the last 20 years.

The following lists of major projects and estimated costs are not a complete listing of all measures of this nature that have been accomplished. Many smaller cooperative projects have been accomplished by our maintenance and equipment personnel and stockholders as well several projects under the AFRD#2 system of similar or lessor scope. Simply removing water from a natural drain through a sprinkled field into a constructed lateral on the field border have lent to better management for the landowner and savings to BWCC.

Several projects have been installed by our stockholders with only minimal assistance from BWCC. In all cases the water savings of the systems were a benefit to all stockholders. In no case were water savings extended to the individual stockholder.

Examples of significant investment by stockholders:

Lehmann pipeline	Richfield	2005	$500,000	Partially NRCS funded
Lezamiz pipeline	Richfield	2010	$600,000	Private funds
Telford pipelines	Richfield	1990s/2000s	$500,000	Private and BWCC
Shaw/Towne	Dietrich	2006	$250,000	Private funds
Shaw/Astel/Ward	Dietrich	2014/2018	$4 million	Private funds

The general policy of the BWCC is to cooperate with a stockholder, upon request and approval of the Board of Directors, and that the stockholder(s) will purchase the pipe and pay for any needed rock excavation in the trenching process. BWCC would excavate, bed, lay, backfill pipeline and install inlet and outlet structures as required. In the case of large cooperative pipelines involving many users of varying financial resources BWCC has financed that portion of the project that would be required of those not immediately participating in pressurization. A construction cost on a per share basis is captured at completion of the project, thus in the future an unconnected stockholder could request connection to the pressurized system and pay the appropriate fees.

Examples of significant cooperative investment by stockholders and BWCC:

Marley pipeline	Richfield	2014/2016	$100,000	Cooperative
253-Bull pipeline	Richfield	2016	$250,000	Cooperative
343-Town pipeline	Richfield	2016	$300,000	Cooperative
1116-Curly pipeline	Richfield	2017	$500,000	Cooperative
1096 lateral	Richfield	2021	$500,000	Cooperative

It should be noted that the above listed 5 projects total nearly 9 miles of pipeline ranging in size from 8 inch to 27 inch in diameter.

Over the past 20 years the BWCC/AFRD#2 have invested in and maintain SCADA systems to better monitor and control lateral heads and waste drain flows. Our intention is to continue to add to that network to better control our system.

Through time there have been major maintenance projects to our system. Most significant have been the replacement of the Gooding Siphon south of Gooding, Idaho in 2012. The original pipeline was steel pipe on the surface of the ground and was replaced by a buried 78 inch diameter HDPE pipeline. Material costs exceeded $1.6 million and the project was installed by BWCC personnel. In 2015/2016 the 3 ½ mile concrete flume north of Shoshone, Idaho was lined with a product called Zypex. The flume was evaluated prior to the treatment and the concrete was considered stable with use of the compound and the addition of concrete abutments in identified reaches. Cost of the product and application was about $1 million, largely funded by the Idaho Water Resources Board in consideration of winter recharge activities through the flume. BWCC employees completed all necessary reinforcement work. There have been numerous other flume and structure replacements within the BWCC/AFRD #2 system as a normal course of operations. Many in the $50,000 to $100,000 range.

The point here is that BWCC/AFRD#2 possess and expend their resources to maintain and improve the efficiency of the delivery system. Investment in heavy equipment is in excess of $3 million, employ 35 to 40 individuals and expended over $4.5 million in 2020 for operations.

As we look to the future, we envision additional work on the system to complete piping of the Dietrich and Richfield areas serviced by Magic Reservoir. The North Shoshone area is substantially a blank slate and requires an engineered plan for future projects.

BWCC has studied opportunities to enhance storage. It is a fact that the relatively small watershed providing snow pack and resulting runoff into Magic Reservoir have produced years of excess and years of drought, often back to back. Due to this narrow geographical window, a seemingly minor alteration of the jet stream and the resulting path of a storm can have a great effect on our basin snowpack.

Raising of the dam would require starting over given current construction standards and the earthen nature of the dam. Additionally, consideration must be given to the property developments on the shoreline of East and West Magic villages. A small impoundment on Camas Creek has been studied and may have some benefit; however, the project would be expensive per acre foot and may require decades to permit. Our best alternative has been to enhance the yield of passing storms utilizing weather modification in cooperation with Idaho Power and Idaho Water Resources Board. Beginning in 2014 and through 2018 BWCC invested up to $100,000 per year in support of weather modification activities. Investment continues through cooperation with Water District 37 water users of nearly $60,000 annually.

Turning to the relative cost of water, the annual assessment per share to our stockholders today is $33.50 per share. Assuming a full season of delivery to all stockholders, the cost of water is about $5.00 per acre foot released from the reservoir. Given the average incidental loss of the delivery system at about 50%, that cost at the farmer’s headgate approaches $10 per acre foot. As a comparative, the WD 37 budget for 2020 is based on $0.61 per acre foot at the headgate. There may be additional costs associated with local canal delivery systems. I have no estimate of the comparable annual variable cost to ground water pumpers in the upper valley; however, that calculation should include annual pump and well maintenance costs and annual lift cost (**not** including irrigation system pressurization).

A few comments on the subject of basic operations of the canal companies as highlighted in the proceedings of the December 15, 2010 Advisory Committee meeting. The discussion considered the volume of tail water flows at the end of the AFRD#2 system in the months of July and August 2020. Taking a gross average of that period of time the excess spill was about 200 cfs. By simple math given an input of 1600 cfs at Milner, that would yield a tail water 'waste' of about 12%. However, note that on a small number of days the spill was recorded near 70 cfs yielding about 4.5% spill. There are several considerations that need to be noted here. The distance of the spill from the source at Milner Dam is nearly 100 miles through canals and laterals that traverse the desert landscape. Evaporation alone can be a factor in fluctuation of the system, in addition to the normal management of water being moved within the system from stockholder to stockholder in response to normal farming activities. Response time from source at Milner to near the end of the Miller-Gooding system is 4 to 5 days. There is no switch as on a ground water well to effect immediate management of the flow.

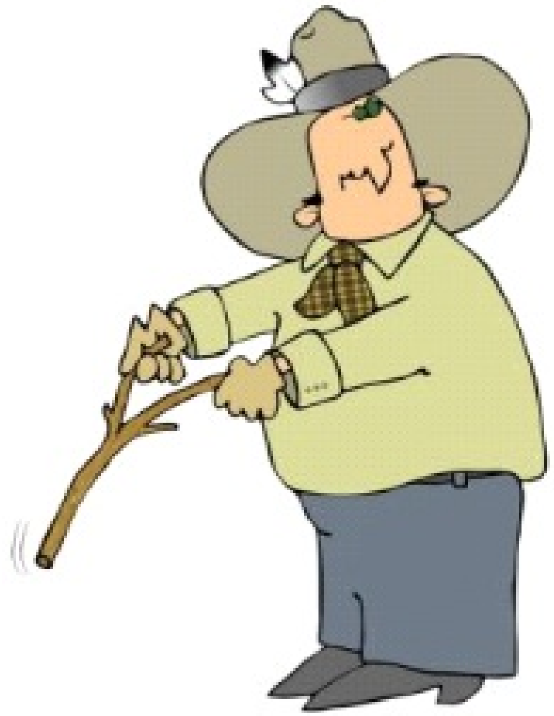
As general information the BWCC/AFRD#2 system consists of 575 miles of canals and laterals. About 105 miles under AFRD#2 and mainly in the form of the Milner-Gooding Canal and the New Lands in the Hunt (Eden) area. The remaining 470 miles of canals and laterals are under management of the BWCC with about 280 miles of that serviced exclusively by Magic Reservoir.

An additional consideration is the potential liability of running the system so close as to injure some stockholders due to a lack of water at critical times. Consider that the crop mix under the Milner-Gooding system includes several high value crops. Input to a potato or onion crop will run $2000 to $4000 per acre, a sugar beet crop in excess of $1200 per acre. In contrast a barley crop requires something under $150 per acre investment.

Turning to Magic Reservoir operations in 2020. Magic released about 195,000 acre feet and reported total spill as recorded by the WD 37 water master of 8208 acre feet for a 'waste' of 4.25% over the season. Be mindful that over ½ of this amount is returned directly to the Little Wood River between the cities of Richfield and Shoshone and the remainder to the Milner-Gooding Canal for utilization in that system.

As a final analysis of water management and water savings we will analyze the most recent 2020 irrigation season under Magic Reservoir. Todays normal irrigation season begins about May 1 and the season is deemed to end in the week prior to October 1 each season or about September 25. Documentation by delivery records and published in several past studies by third party consultants was that 275,000 acre feet was needed to deliver a full season to Magic stockholders in the not too distant past. As stated earlier, Magic Reservoir release May to September 2020 totaled about 195,000 acre feet. Accounting for an additional 25 days at an estimated 1600 acre feet per day to accomplish a normal season would have required an additional 40,000 acre feet for a total of 230,000 acre feet. The record will show that through better management, elimination of seepage loss and the actions of stockholders adopting sprinkler irrigation technologies on their own farms, demand on the water resources of Magic Reservoir has declined by about 45,000 acre feet or something over 16%.

The operation, management and efficiency measures undertaken by Big Wood Canal Company and its stockholders to insure a more stable water supply are apparent. To summarize, those measures include significant investment in company delivery infrastructure as well as on the farm efficiencies by our stockholders. Attention to system maintenance to insure efficient delivery of a scarce and valuable resource. Investment in snow enhance strategies, recognizing that upstream opportunity to expand storage are limited. A recognition that Magic Reservoir is a finite source of irrigation water supply and even though the input may be highly variable, management of the supply by narrowing our delivery window both spring and fall, taking advantage of in season pauses of delivery when weather permits and improved delivery measurements to our stockholders can provide reservoir carryover as insurance into the following season. Comparatively, the Big Wood Basin underlying the Bellevue Triangle is a reservoir filled with gravel and attention to the utilization of the resource by the ground water pumpers should be commensurate with that of the Magic Reservoir users. Continued management and investment in the infrastructure of the BWCC is a high priority of our company.



Supplemental Water Rights

Presented by Cherie Palmer, IDWR-Water Compliance Bureau
January 5, 2021

Supp-le-mental?!?

What is a supplemental water right?

A supplemental right is a stacked water right authorizing the diversion of water for irrigation from a secondary source to provide a full supply for crops when used in combination with a primary right. Water rights are "stacked" when two or more water rights, generally of different priorities and often from different sources, are used for the same use and overlie the same place of use.

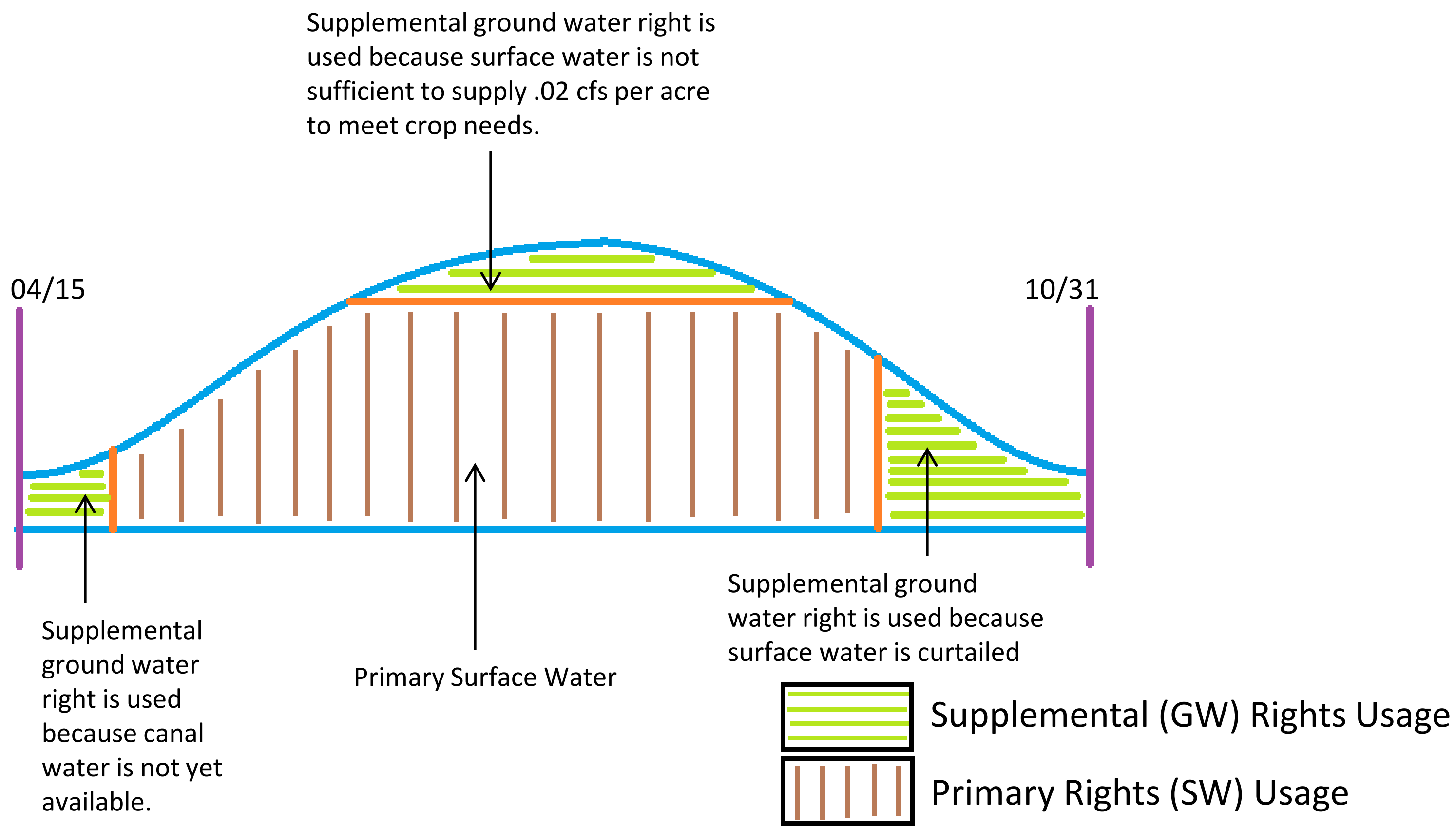
Plainly put: Supplemental rights are typically GW rights, with the same place of use as a SW right, that can be diverted when the SW is short or no longer available

Suppel-mental??

What surface water right does a supplemental water right supplement?

Ground water rights might supplement a surface water right that is held by an individual or can supplement surface water rights held by a canal co. or irrigation district.

Surface Water / Ground Water Use



Why designate a water right as supplemental?

IDWR believes it is good policy to require continued use of surface water for irrigation in order to conserve the ground water [in concurrence with Idaho Code 42-203A(5)(f) and 67-6537(1)] .

Using Surface Water Primarily..

- Conserves ground water for uses that require a cleaner supply of water
- Minimizes the number of wells, which are potential conduits for ground water contaminants
- Maintains the long term economic viability of the surface water providers
- Provides a continued supply of water to recharge our aquifers due to canal leakage

Land Use Planning Statute

(Applies to non-IDWR programs, but still a statement of public policy)

Idaho Code Section 67-6537

“The intent of this section is to <u>encourage the use of surface water for irrigation</u>. All applicants proposing to make land use changes shall be required to use surface water, where reasonably available, as the primary water source for irrigation.”

History of Supplemental Water Rights

- Long history of water users using water rights as supplemental
- Idaho Code 67-6537 added 1989
- Beginning in the early 1990’s--IDWR to condition water rights with supplemental conditions

How do Supplemental Conditions Get on a Water Right?

- SRBA, court decree
- Administrative Process
  - Transfer
  - Permit being Licensed as a Water Right

How does IDWR condition supplemental rights?

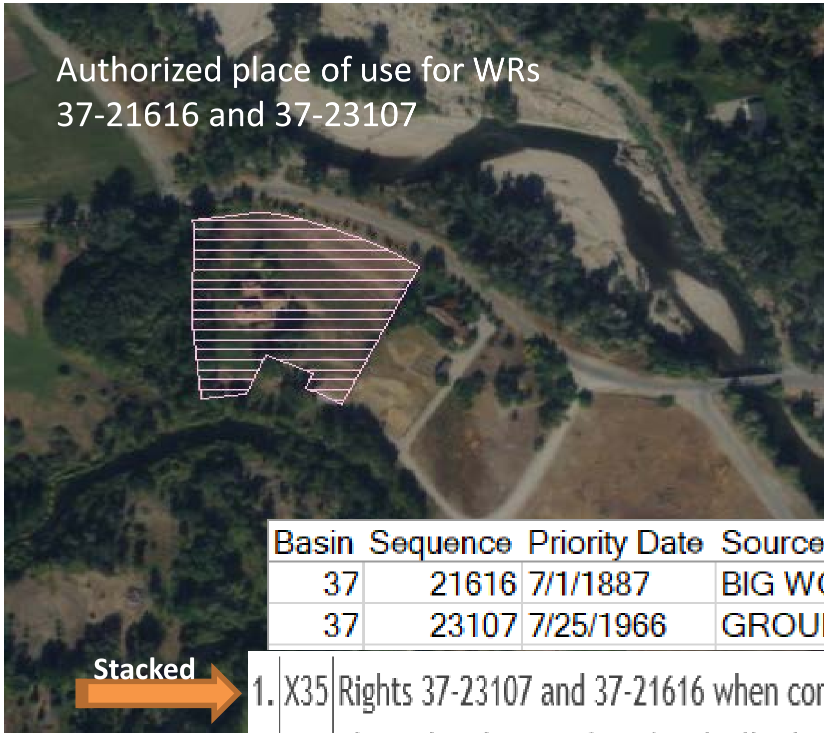
There are several iterations of “supplemental” conditions. The below is the most recent version.

Supplemental Related Condition:

The right holder shall make full beneficial use of all surface water available to the right holder for irrigation of lands within the authorized place of use for this right. The right holder may divert ground water under this right to irrigate land with appurtenant surface water rights when the surface water supply is not reasonably sufficient to irrigate the place of use for this water right or is not available due to drought, curtailment by priority, or the seasonal startup and shutoff or maintenance schedule for canal company or irrigation district deliveries. The right holder shall not divert ground water for irrigation purposes under this right if use of the surface water supply is intentionally discontinued or reduced (for example abandoned, forfeited, sold, disallowed by court decree, or leased to the Water Supply Bank), or is not deliverable due to non-payment of annual assessments, without an approved transfer pursuant to Idaho Code § 42-222 or other Department approval.

Plainly put: You must use your surface water first and primarily. If the surface water right goes away, you may not use your ground water right until your water rights are evaluated by IDWR—where your groundwater right will most likely be reduced to avoid enlargement of GW.

Ground Water Supplemental to Privately Owned Surface Water Rights



Basin	Sequence	Priority Date	Source List	Water Use List	Total Acres	Volume	Diversion Rate
37	21616	7/1/1887	BIG WOOD RIVER	IRRIG.,Stock	3.3		0.160
37	23107	7/25/1966	GROUND WATER	IRR.	3.3	11.5	0.130

Stacked

1. X35 Rights 37-23107 and 37-21616 when combined shall not exceed the irrigation of 3.3 acres.
2. R59 This right when combined with all other rights shall provide no more than 3.5 afa per acre at the field headgate for irrigation of the place of use.

Supplemental

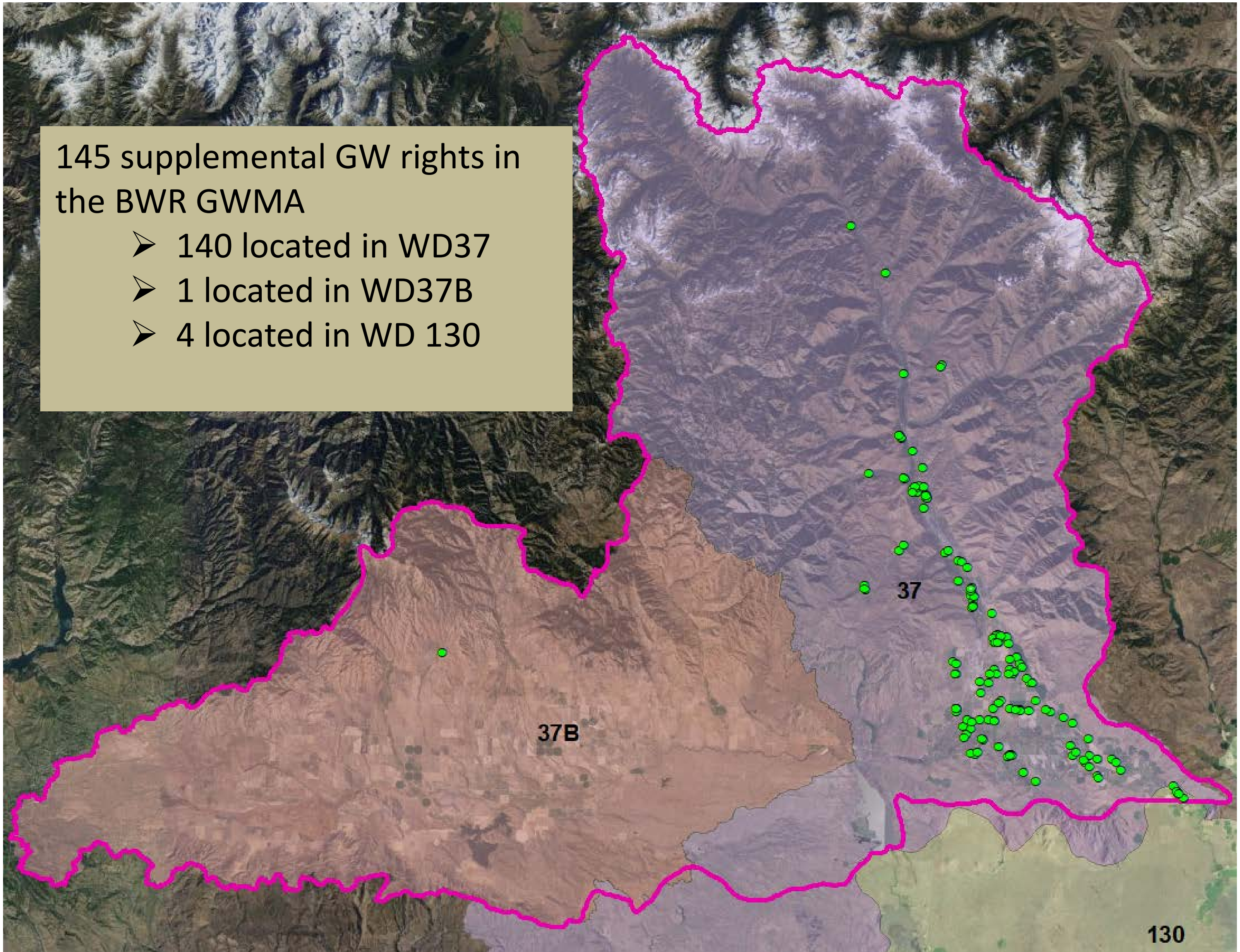
3. 943 The right holder shall make full beneficial use of all surface water available to the right holder for irrigation of lands within the authorized place of use for this right. The right holder may divert ground water under this right to irrigate land with appurtenant surface water rights when the surface water supply is not reasonably sufficient to irrigate the place of use for this water right or is not available due to drought, curtailment by priority, or the seasonal startup and cutoff or maintenance schedule for canal company deliveries. The right holder shall not divert ground water for irrigation purposes under this right if use of the surface water supply is intentionally discontinued or reduced (for example abandoned, forfeited, sold, disallowed by court decree, or leased to the Water Supply Bank), or is not deliverable due to non-payment of annual assessments, without an approved transfer pursuant to Section 42-222, Idaho Code, or other Department approval.

Ground Water Right Conditions

How Many Supplemental Rights are in the BWR GWMA?

145 supplemental GW rights in the BWR GWMA

- 140 located in WD37
- 1 located in WD37B
- 4 located in WD 130



Is a supplemental right subject to forfeiture?

- Supplemental rights are generally not subject to forfeiture.
  - If surface water is sufficient to meet the needs of a crop year after year, and the ground water is unnecessary, forfeiture wouldn’t apply.

Some Other Ground Water Rights Explained

- Not all GW rights are supplemental
  - Some are mitigated by a SW right (GW withdrawals are offset by a SW right)
    - WR conditions will explain the mitigation
  - SW is diverted from a well
    - Well withdrawals must have direct & immediate connection to SW
    - Maintains the SW priority date
    - Diversion curtailed as usual

Recap

- Supplemental Rights
  - GW right that shares a place of use with a senior SW right
  - SW used first and primarily, GW secondarily
  - Typically not subject to forfeiture
  - Found statewide where there is a supply of surface water
- "Mitigation" and "Supplemental" water rights are not related
- There are many unique water right scenarios where water is diverted from a well
- Encourage you to ask IDWR with any questions!!

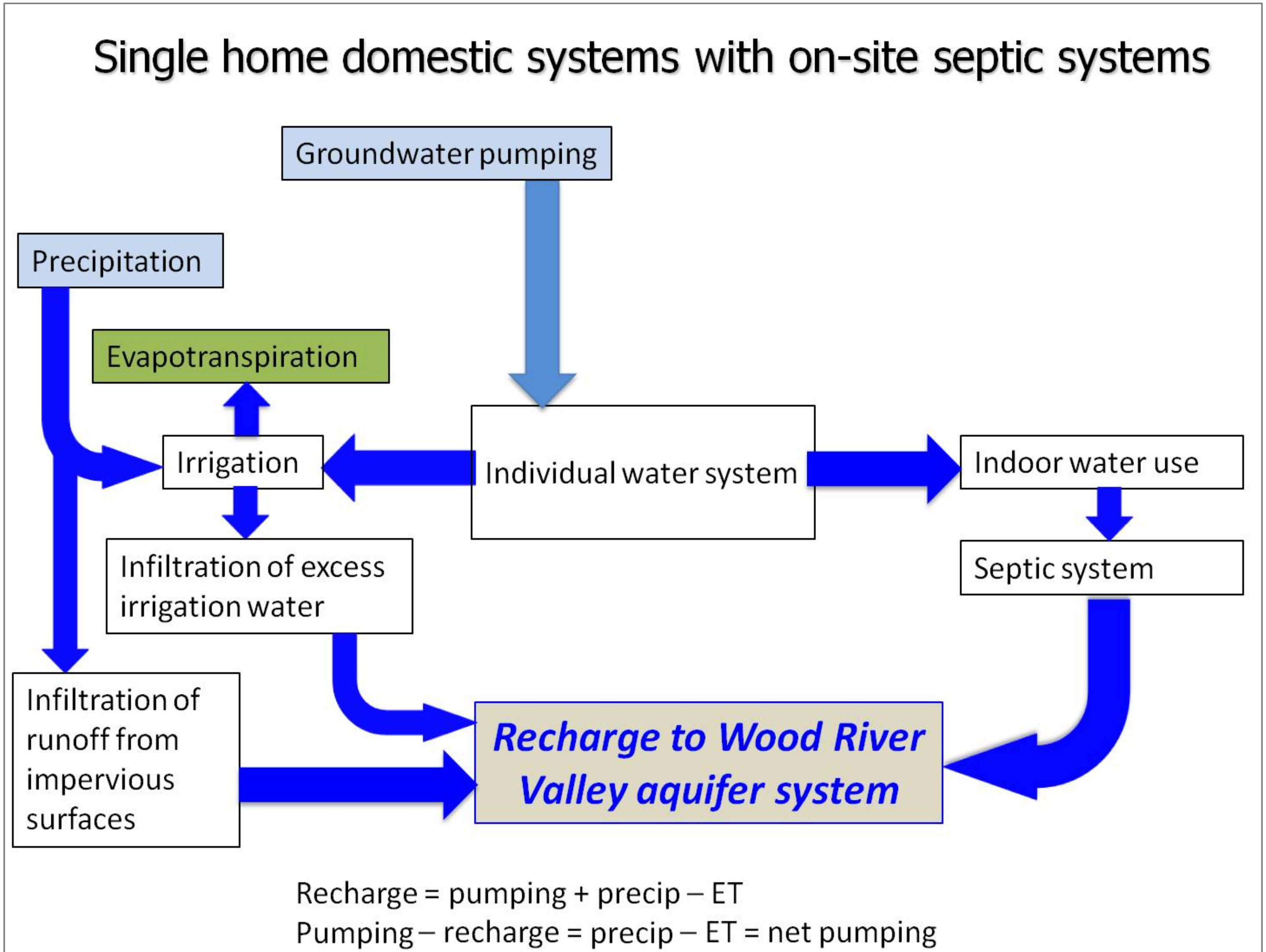
Thank You
for attending this presentation

"Yes, this is an emergency—
I'm being held at PowerPoint."

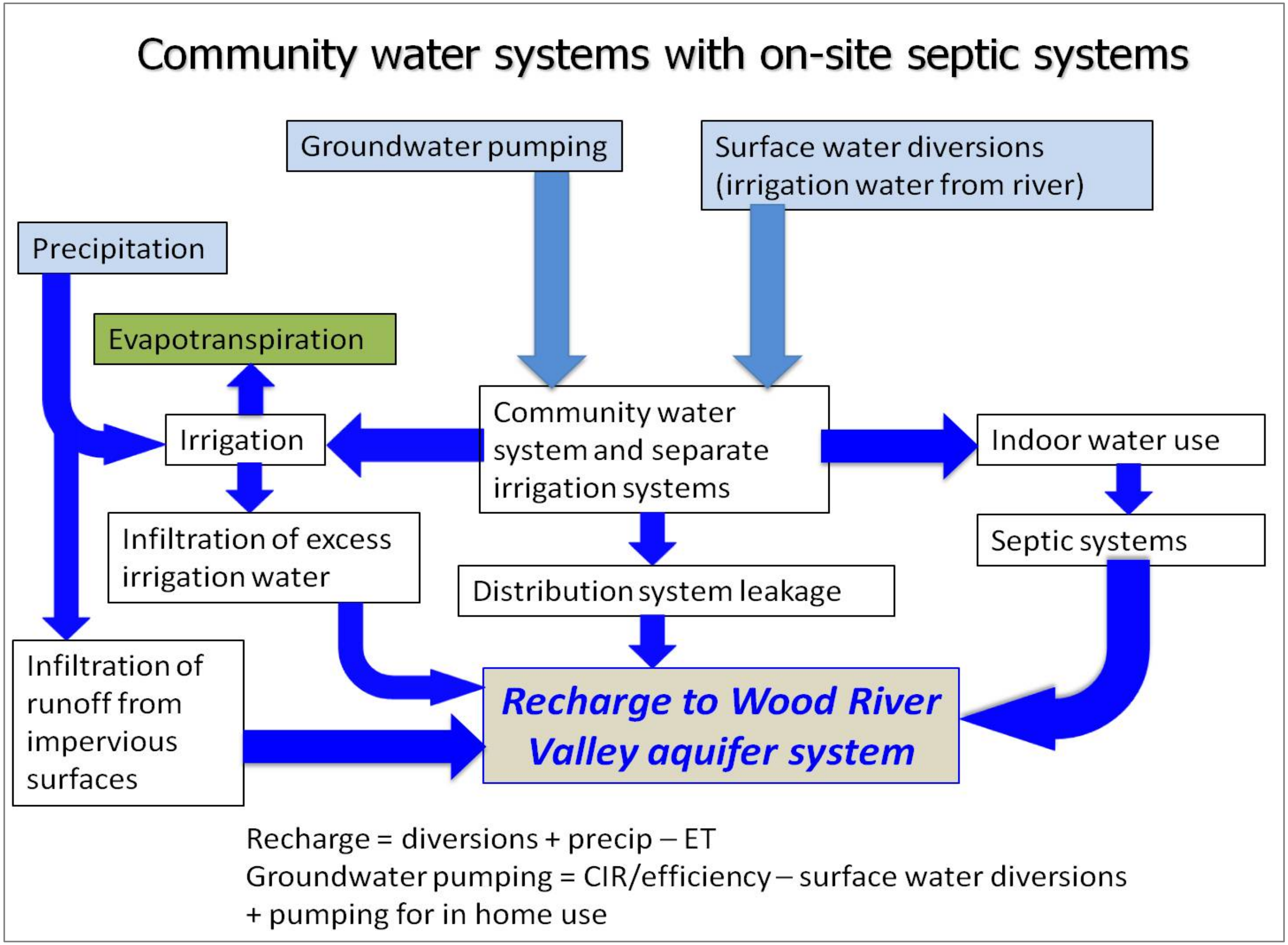
QUANTIFYING DOMESTIC AND SUBDIVISION WATER USE IN THE BWRGWMA

- How do recent estimates and measured diversions compare to Bartolino (2009) water budget?

- Wood River Valley Groundwater Flow Model V1.1
  - uses METRIC and NDVI ET data not available during Bartolino's study
- Water District 37 diversion records
  - measurement and recording began after 2011 and 2013 orders for users with > 1/2-acre of irrigation
- IDWR records of small domestic users
  - Thank you to Clinton Barnes and Corey Skinner, IDWR Southern Region



From Sukow(2014), *Calculating Incidental Recharge and Groundwater Pumping Demand on Irrigated and SemiIrrigated Lands,* Design Document for the Wood River Valley Groundwater Flow Model



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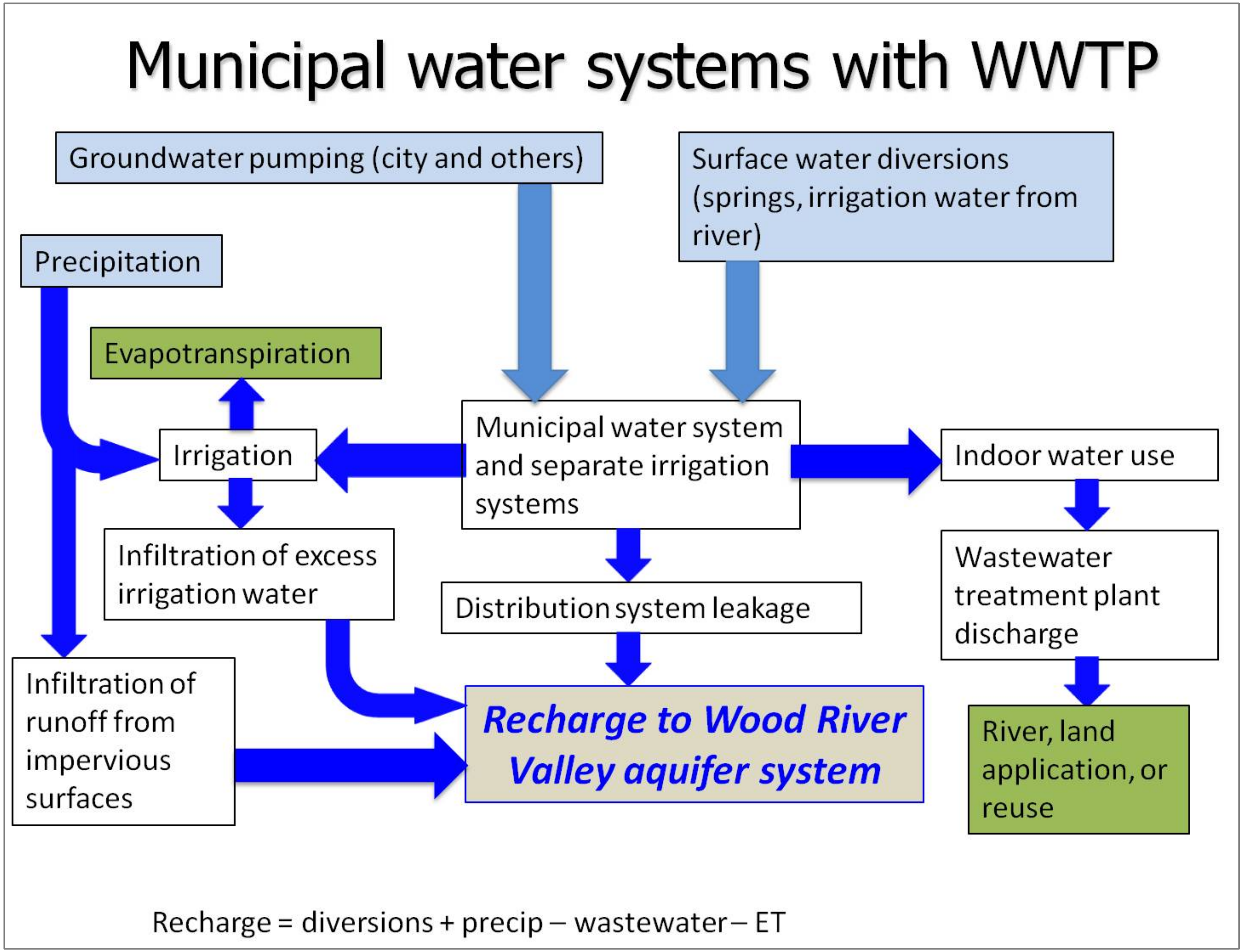

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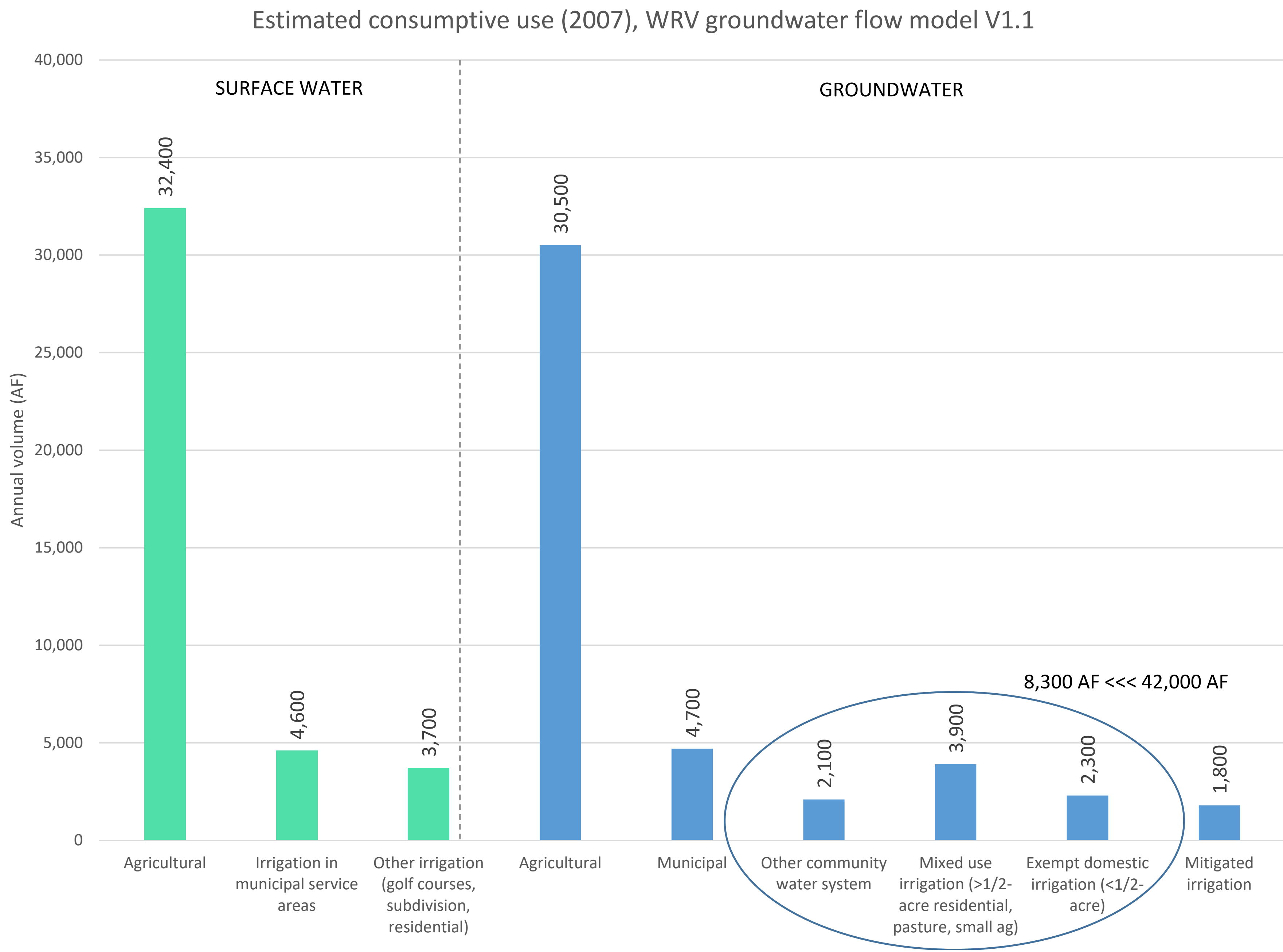
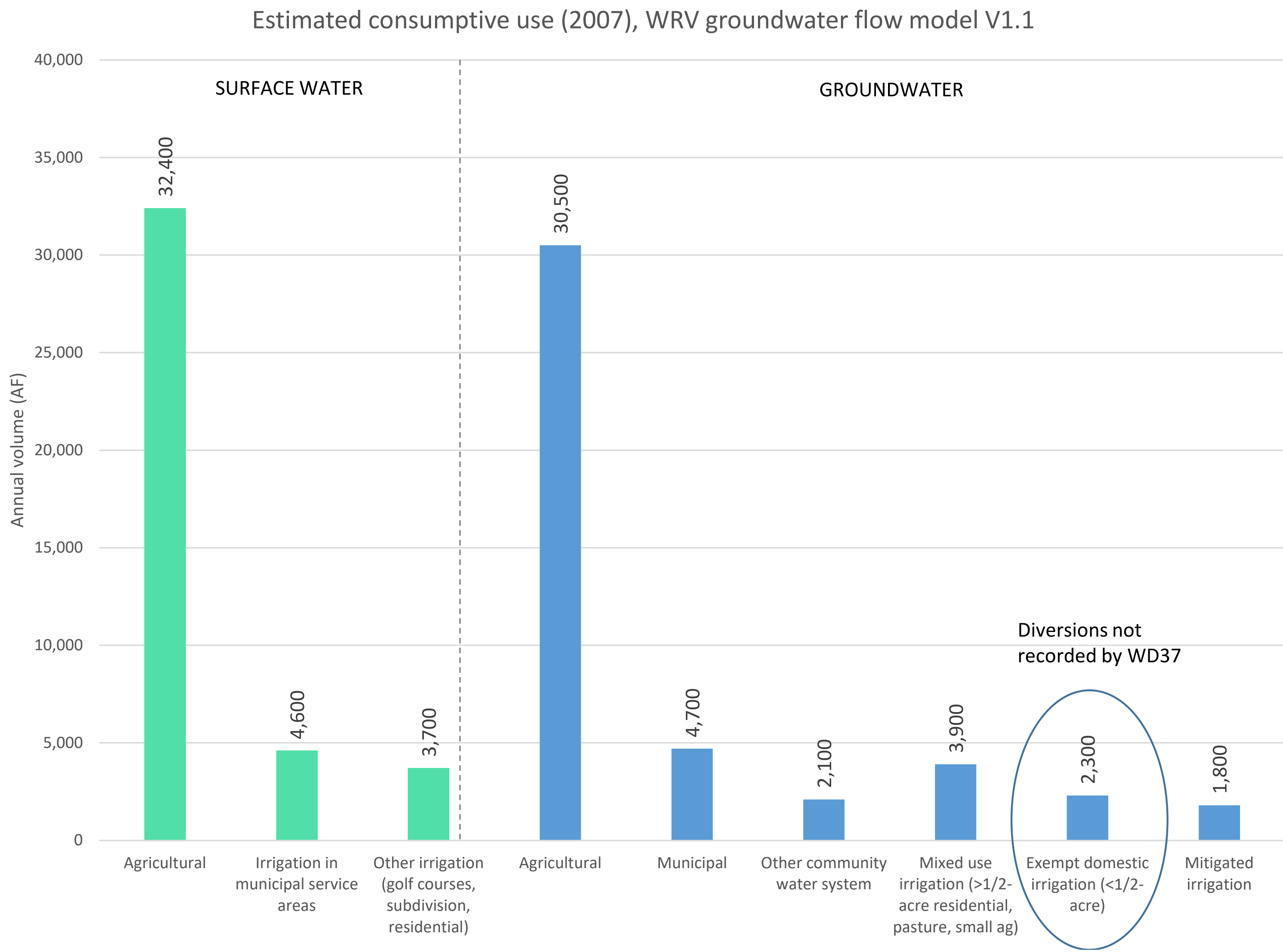

Estimated consumptive use (2007), WRV groundwater flow model V1.1
Annual volume (AF)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
SURFACE WATER
GROUNDWATER
32,400
4,600
3,700
30,500
4,700
2,100
3,900
2,300
1,800
8,300 AF <<< 42,000 AF
Agricultural
Irrigation in municipal service areas
Other irrigation (golf courses, subdivision, residential)
Agricultural
Municipal
Other community water system
Mixed use irrigation (>1/2-acre residential, pasture, small ag)
Exempt domestic irrigation (<1/2-acre)
Mitigated irrigation



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SURFACE WATER
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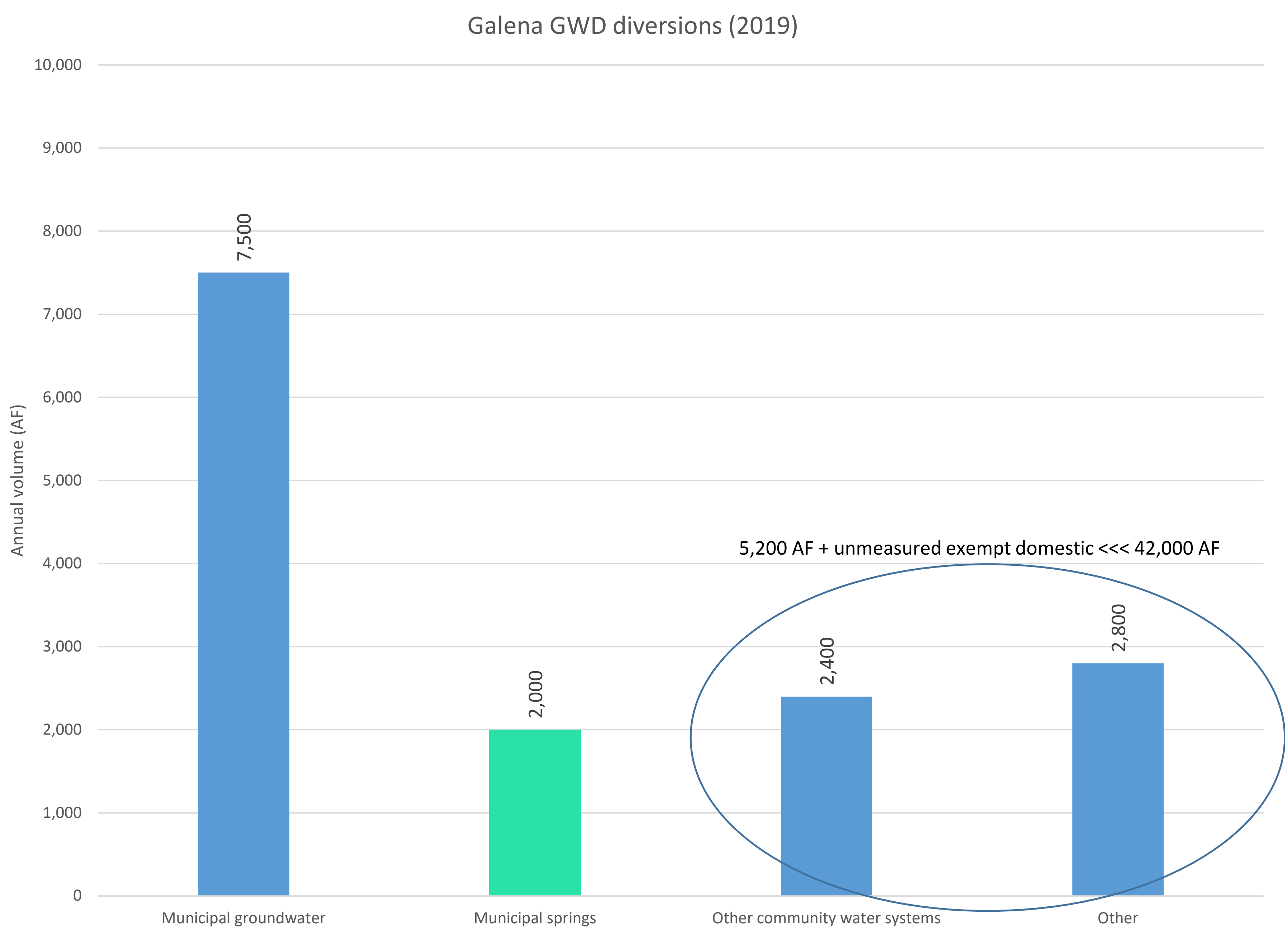
4,600
3,700
30,500
4,700
2,100
3,900
2,300
1,800
Diversions not recorded by WD37
Agricultural
Irrigation in municipal service areas
Other irrigation (golf courses, subdivision, residential)
Agricultural
Municipal
Other community water system
Mixed use irrigation (>1/2-acre residential, pasture, small ag)
Exempt domestic irrigation (<1/2-acre)
Mitigated irrigation



Galena GWD diversions (2019)
Annual volume (AF)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
7,500
2,000
2,400
2,800
5,200 AF + unmeasured exempt domestic <<< 42,000 AF
Municipal groundwater
Municipal springs
Other community water systems
Other

- **Idaho Code §42-229 states in part:**

  "The right to the use of groundwater of this state may be acquired only by appropriation."

- **However, Idaho Code §42-227 expressly exempts domestic groundwater uses from the water right filing requirement of Idaho Code §42-229.**

- **Idaho Code §42-111 defines domestic water use:**

  Part A: "*The use of water for homes, organization camps, public campgrounds, livestock and for any other purpose in connection therewith, including irrigation of up to ½ acre of land, if the total use is not in excess of thirteen thousand (13,000) gallons per day, or"*

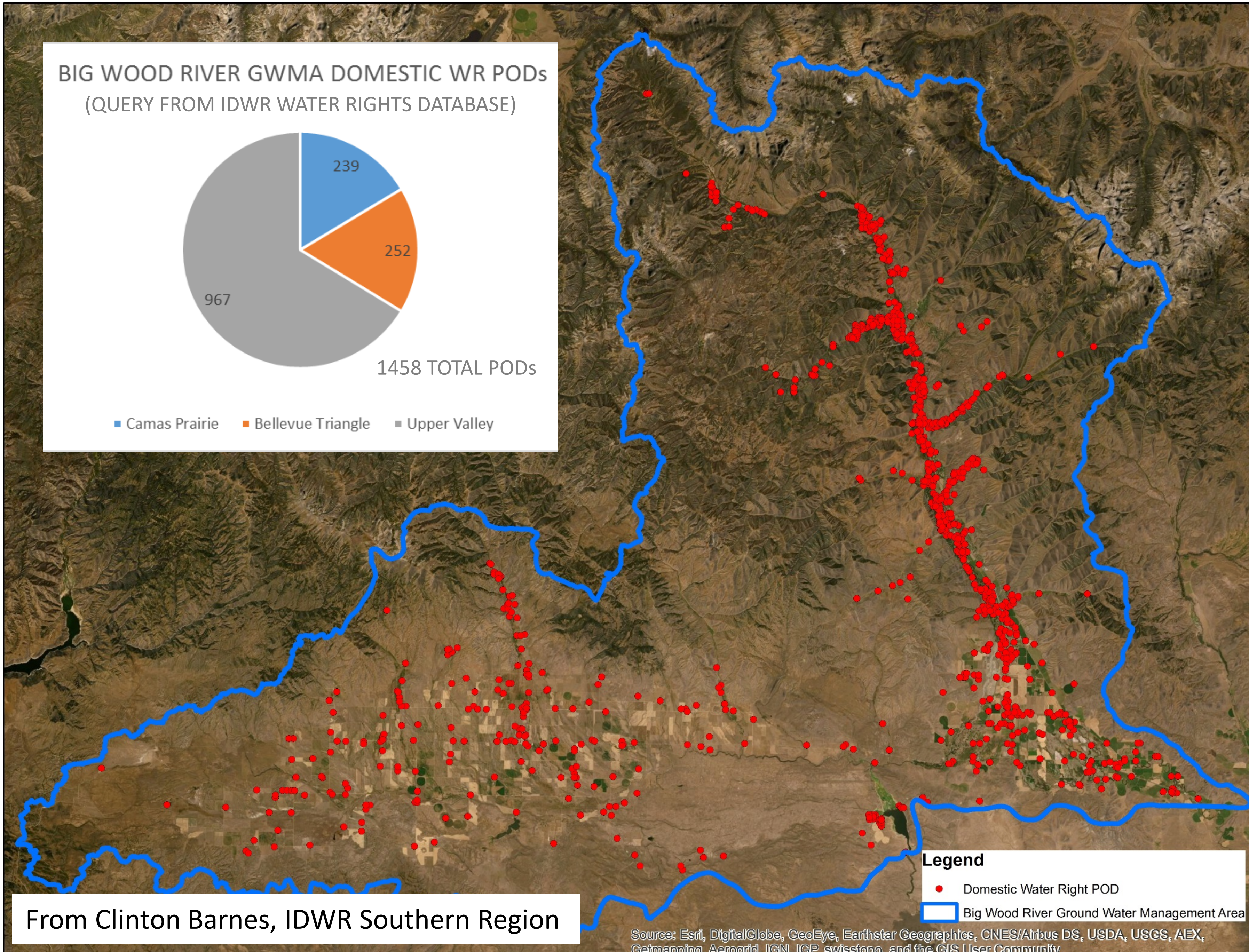
  Part B: "*Any other uses, if the total use does not exceed a diversion rate of four one-hundredths (0.04) cubic feet per second and a diversion volume of twenty-five hundred (2,500) gallons per day."*

From Clinton Barnes, IDWR Southern Region

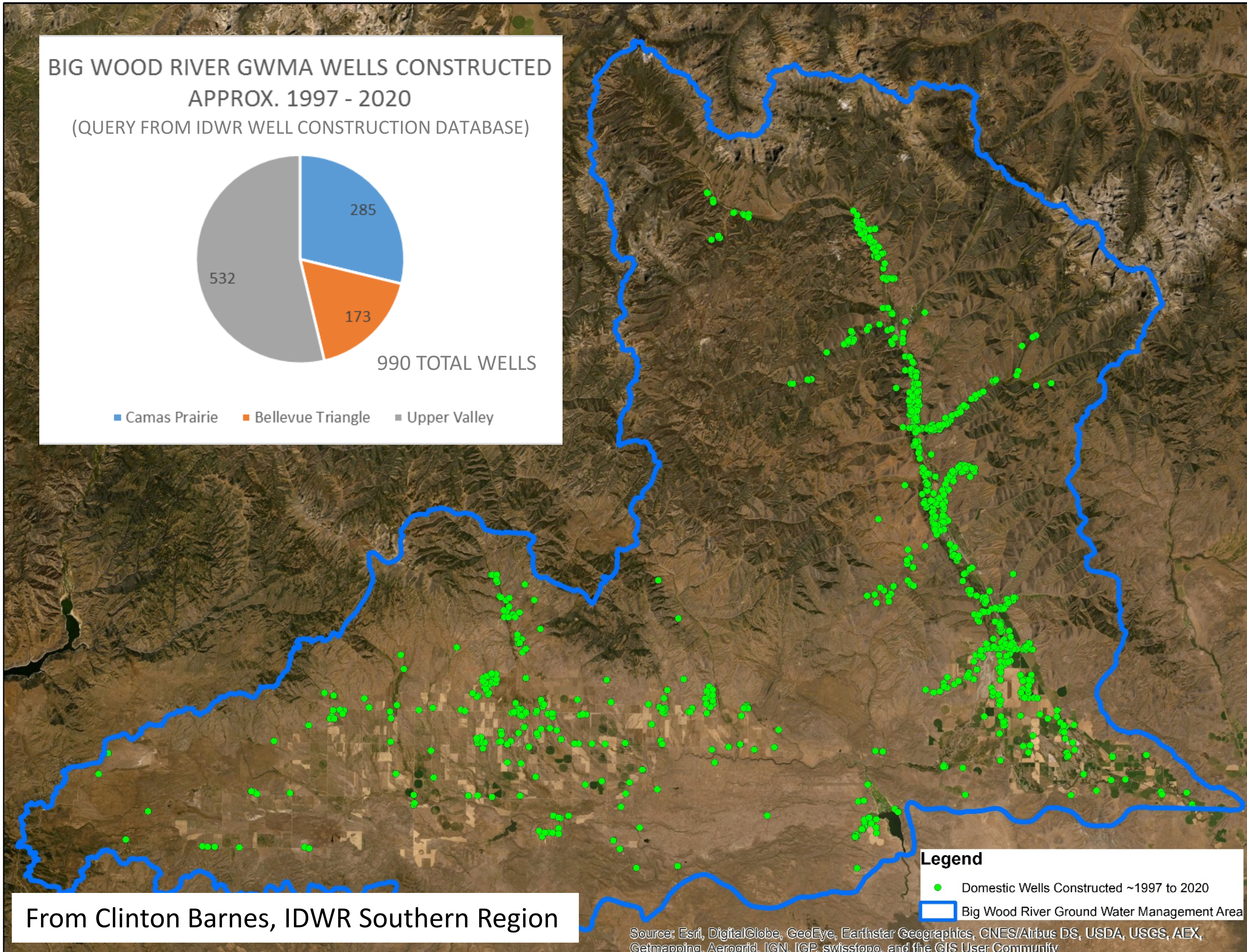
How many domestic users are in the BWRGWMA?

- **Records of domestic use**
  - **Snake River Basin Adjudication decrees**
  - **Licensed water rights**
  - **Well drilling records - many domestic users operate under a "domestic exemption", but there is often a well drilling record associated with the construction of their well (confident in accuracy of location of nearly all wells constructed since 1997 or so).**
- **Domestic users operating under a "domestic exemption" with a well drilled prior to 1997 may not be counted in IDWR records**
- **Only 3% of decreed and licensed domestic water rights in BWRGWMA have priority dates of 1997 or later**
  - **very little overlap between water right and well drilling records**

From Clinton Barnes, IDWR Southern Region



From Clinton Barnes, IDWR Southern Region


BIG WOOD RIVER GWMA WELLS CONSTRUCTED
APPROX. 1997 - 2020
(QUERY FROM IDWR WELL CONSTRUCTION DATABASE)
285
173
532
990 TOTAL WELLS
Camas Prairie
Bellevue Triangle
Upper Valley
Legend
Domestic Wells Constructed ~1997 to 2020
Big Wood River Ground Water Management Area
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
From Clinton Barnes, IDWR Southern Region

How much does a domestic use actually use?

- Varies with occupancy, water use habits, and irrigated area

IDWR "rule of thumb" often used 0.6 acre-feet per year for in house use

University of Idaho's ET Idaho website indicates the following annual precipitation deficit (irrigation requirement) values for a half acre of irrigated grass/turf (lawns) at the following locations…

Ketchum Area: **0.80 acre-feet per year**

Hailey Area: **0.94 acre-feet per year**

Picabo Area: **1.12 acre-feet per year**

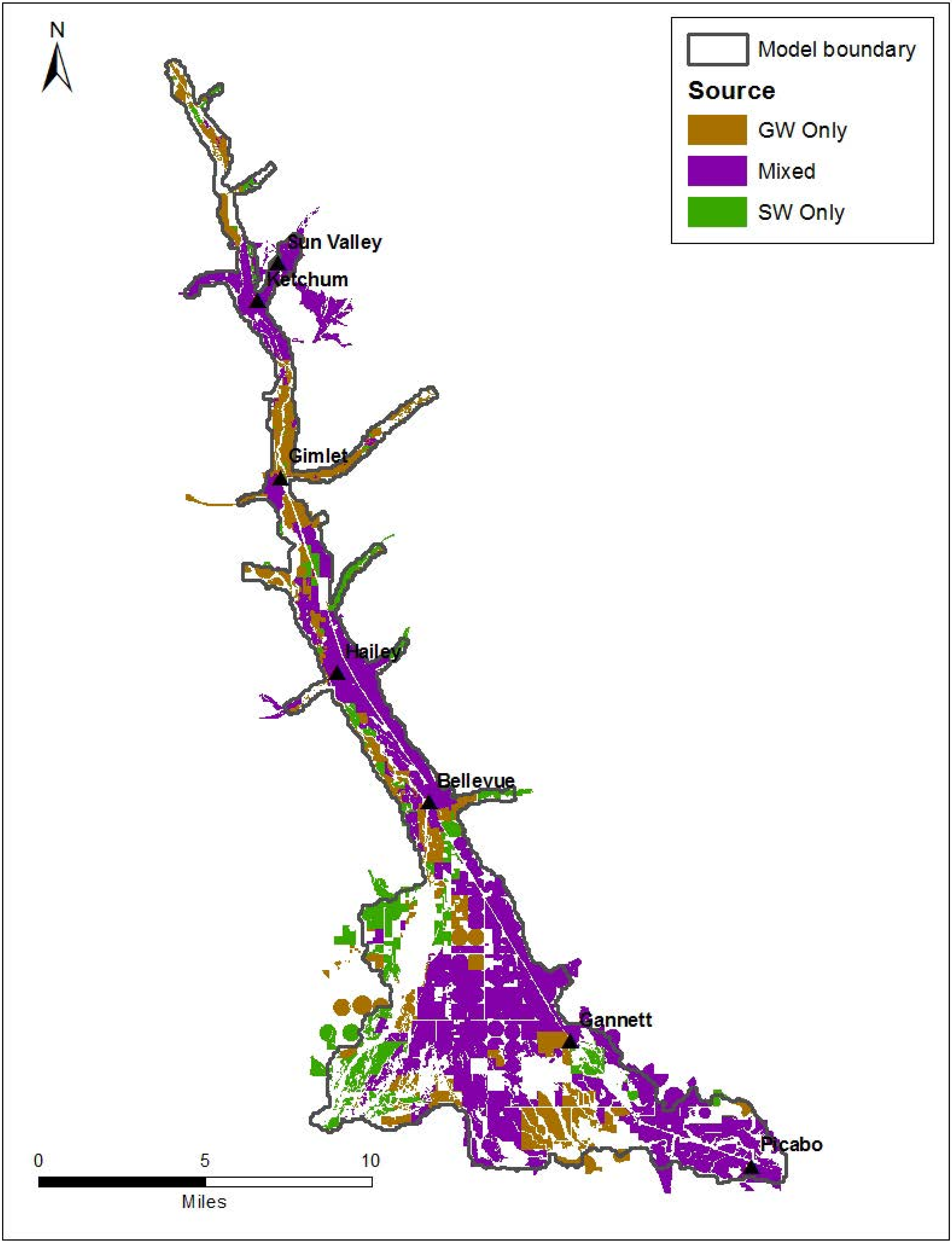
Fairfield Area: **1.18 acre-feet per year**

- Diversion might range from 0.1 to 2.0 acre-feet per year, with consumptive use of 0 to 1.2 acre-feet per year

Estimate of Domestic Water Use in BWGWMA

Area	Domestic users	Diversion volume at 1.6 AF/yr per home	Consumptive use volume at 1.0 AF/yr per home
Upper Valley	1,499	2,398	1,499
Bellevue Triangle	425	680	425
Camas Prairie	524	838	524
Total	2,448	3,917	2,448

*Domestic user estimates include decreed and licensed water rights and domestic well drilling reports, likely underestimated
*Diversion and consumptive use volume per home includes approximately ½-acre of irrigation use and is likely overestimated for some users



N
Model boundary
Source
GW Only
Mixed
SW Only
Sun Valley
Ketchum
Gimlet
Hailey
Bellevue
Gannett
Picabo
0
5
10
Miles

Big Wood River Ground Water Management Area

Advisory Committee Meeting

IDWR Presentation – Return Flows and Reach Gains

1/5/2021

Presentation Narrative – Tim Luke, IDWR

This presentation was prepared for the Big Wood River GWMA Advisory Committee that met on January 5, 2021. The presentation was not given due to lack of time. IDWR does not plan to present this information at the next meeting but will place the slides in the January 5, 2021 meeting materials.

The presentation is more of an old business item and a follow-up to Kevin Lakey's presentation on system spills from the December 15, 2020 meeting. The purpose of the presentation was to take a deeper dive on system spills and river reach gains in several lower river system reaches, introduce some concepts about river reach gain computations and water right accounting, and determine possible impact of gains on river right priority cuts. Questions have been posed to IDWR in the past about how, or if, lower system return flows could be used to offset shortages in delivery of decreed river rights. With that thought in mind, some limited data are plotted for river reach gains on the Little Wood River between Milner Gooding Canal and Gooding (July – August 2012 only), and on the Big Wood River between Gooding (Station 9 above NSCC X Canal) and the USGS gage (Station 21) on the Malad River (July – August 2020 only). The following slides introduce the meaning of reach gains and how they are used to determine available natural flow for delivery of decreed priority rights from the river. Several slides follow that plot reach gains for the reaches and periods described above. Several observations regarding those plots are summarized towards the end of the slide show.

Definitions

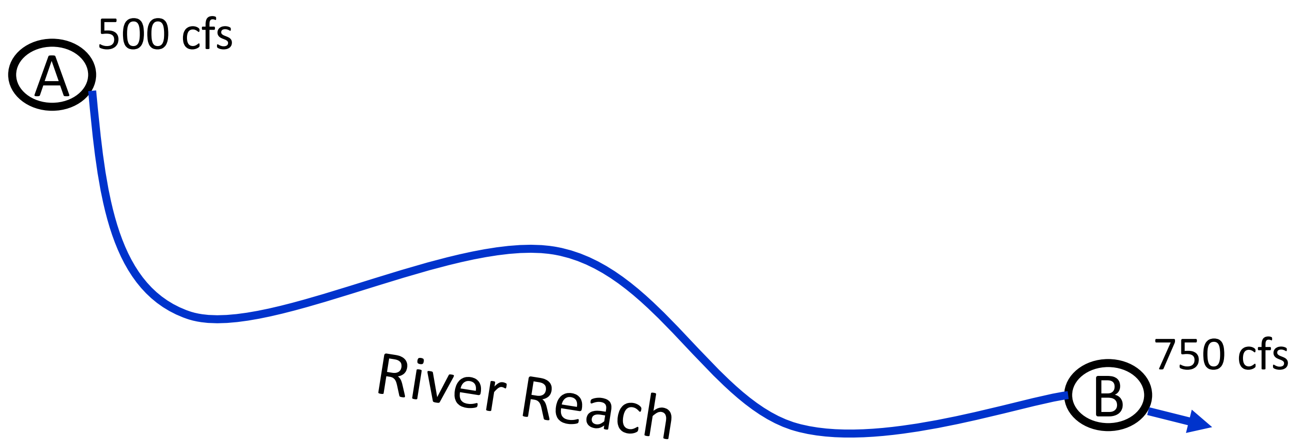
- **REACH GAIN** is the gains or losses of water within a river reach. Reach-gain computations in water right accounting are adjusted to remove the effects of diversions and changes due to reservoirs within a reach.

- **NATURAL FLOW** is equal to the computed reach gain, or cumulative upstream reach gains, in the river system.

Definitions

- **Water Right Accounting Program** is a computer program that quickly computes the available natural flow and storage water available to diversions using addition and subtraction equations to allow for regulation during the irrigation season.

River Reach without Diversions or Reservoirs

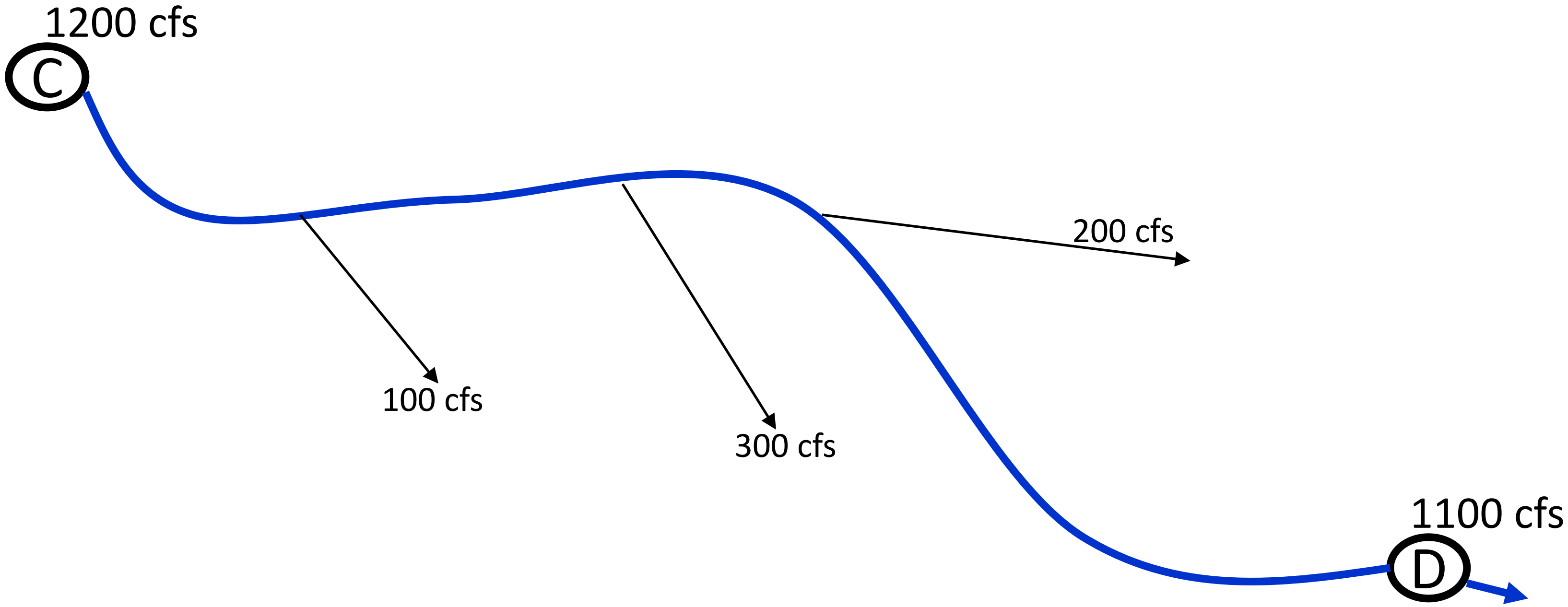


Reach Gain = Outflow minus Inflow

= 750 cfs – 500 cfs

= 250 cfs

River Reach with Diversions



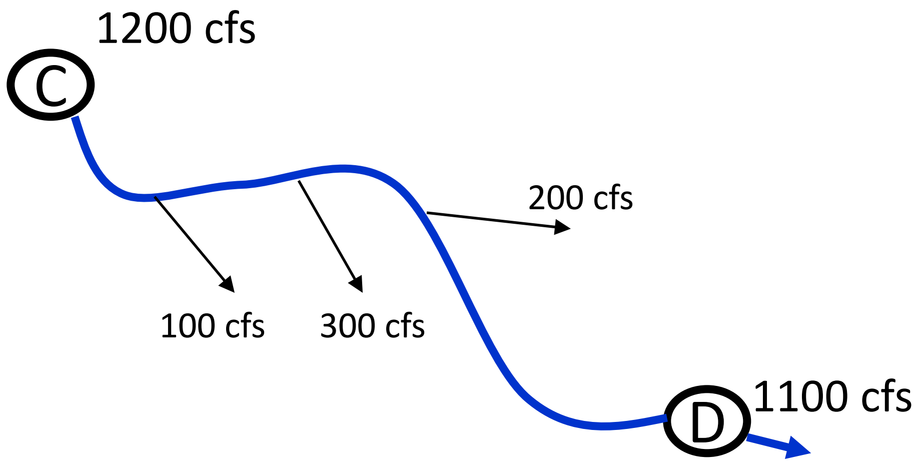
Reach Gain = Outflow – Inflow + Diversions

= 1100 cfs – 1200 cfs + 600 cfs

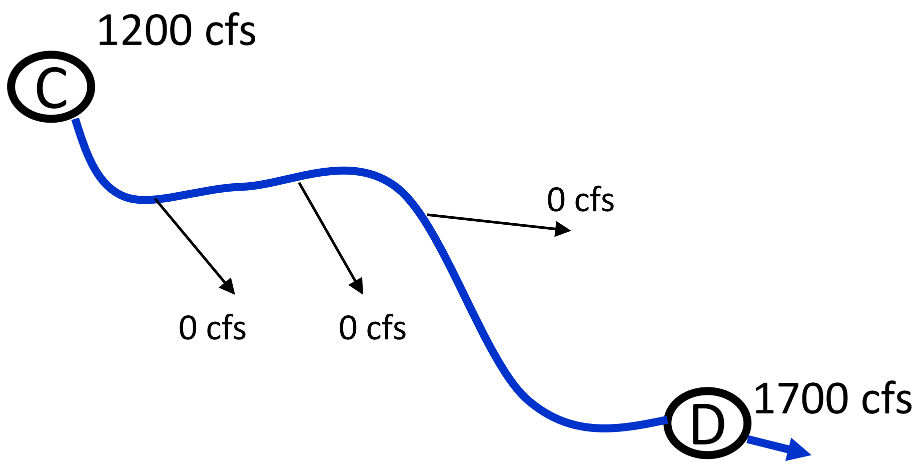
= 500 cfs

REACH GAIN = 500 CFS

<u>With Diversions</u>

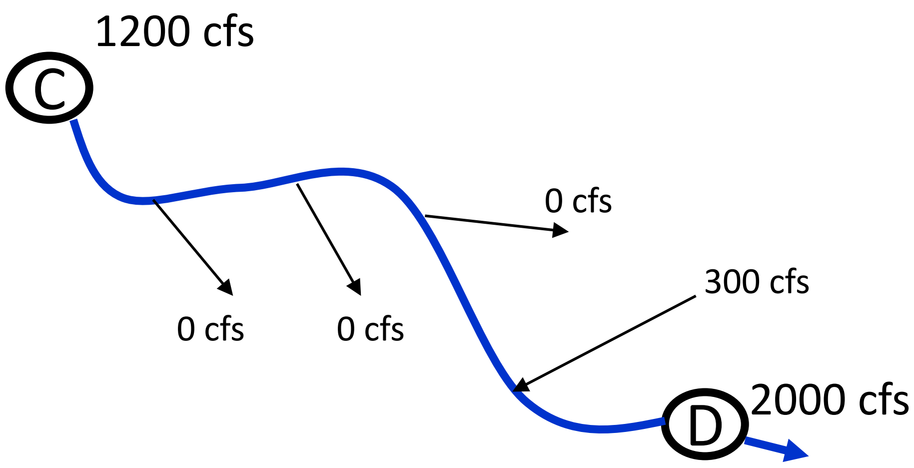


<u>Without Diversions</u>



REACH GAIN = 500 CFS

With Injection

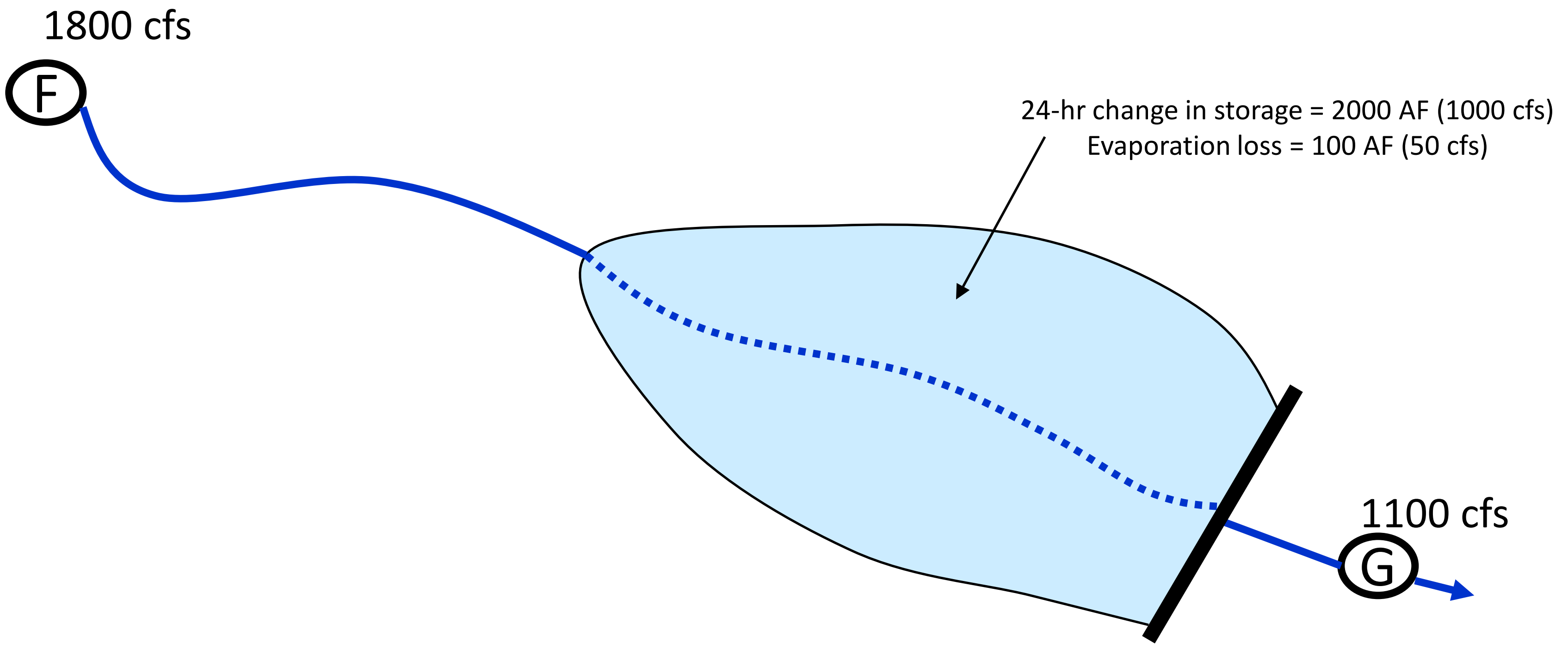


Reach Gain = Outflow – Inflow - Injection

= 2000 cfs – 1200 cfs - 300 cfs

= 500 cfs

River Reach with a Reservoir



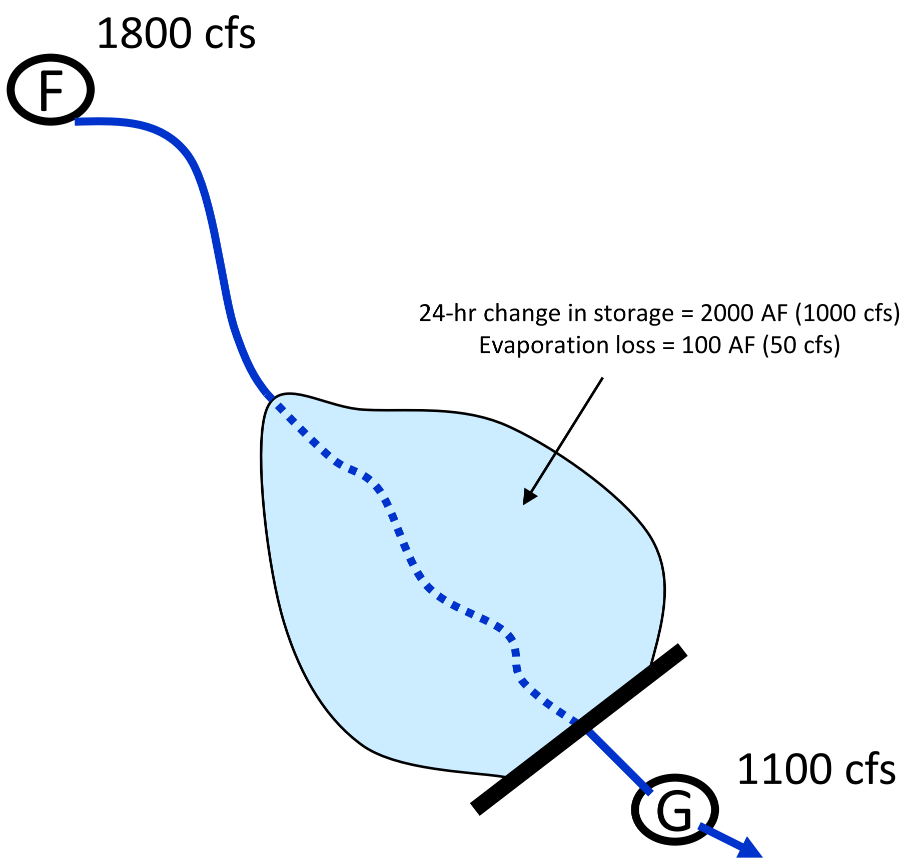
Reach Gain = Outflow – Inflow + Evaporation ± Change in Storage

= 1100 cfs – 1800 cfs + 50 cfs + 1000 cfs

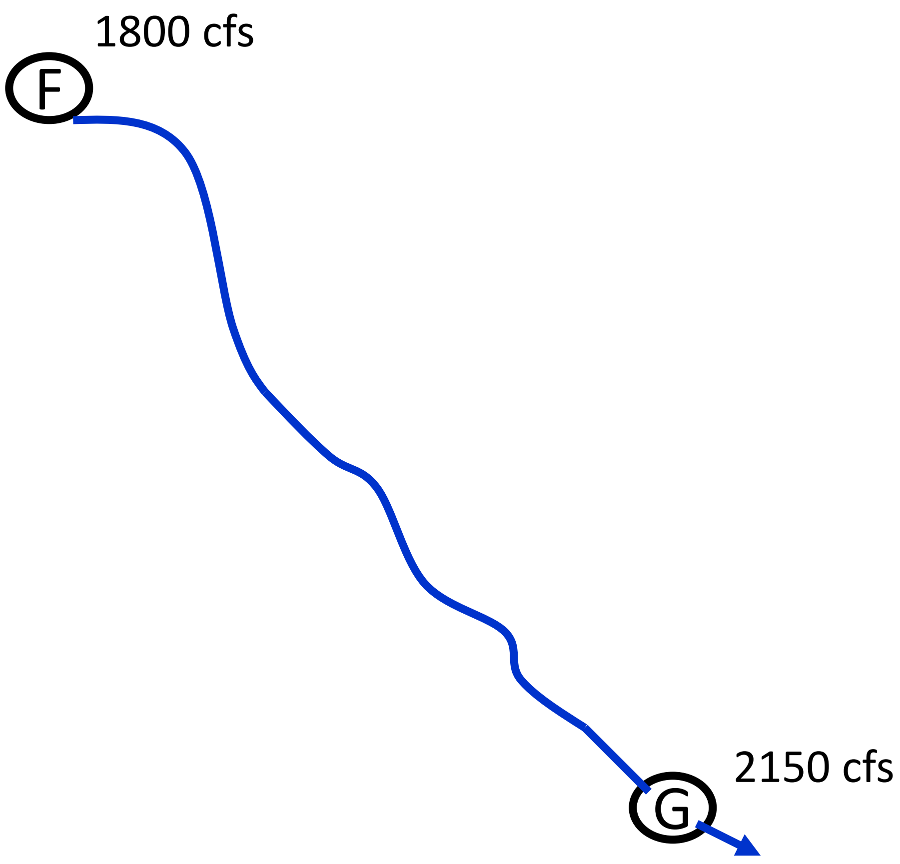
= 350 cfs

REACH GAIN = 350 CFS

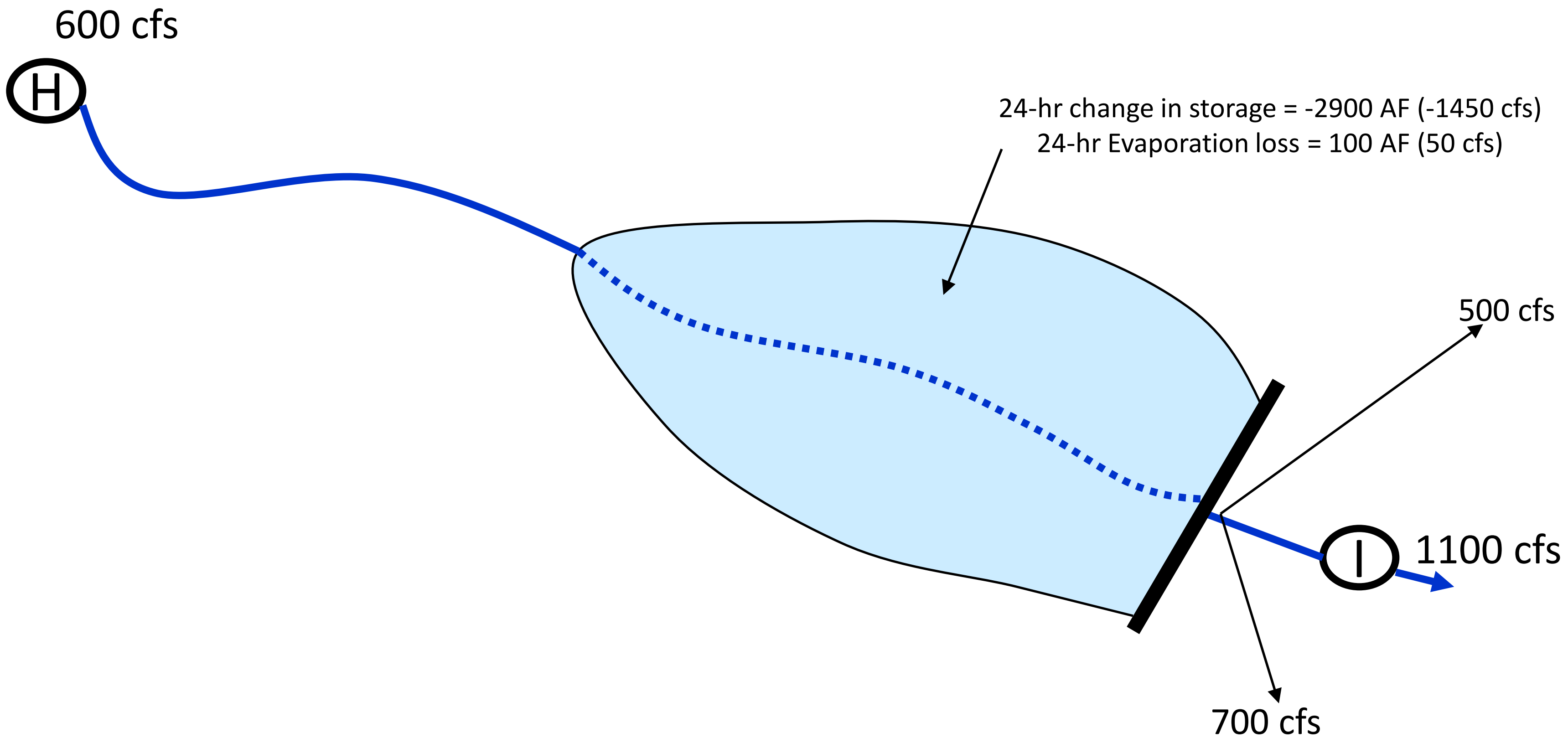
With Reservoir



Without Reservoir



River Reach with Reservoir and Diversions



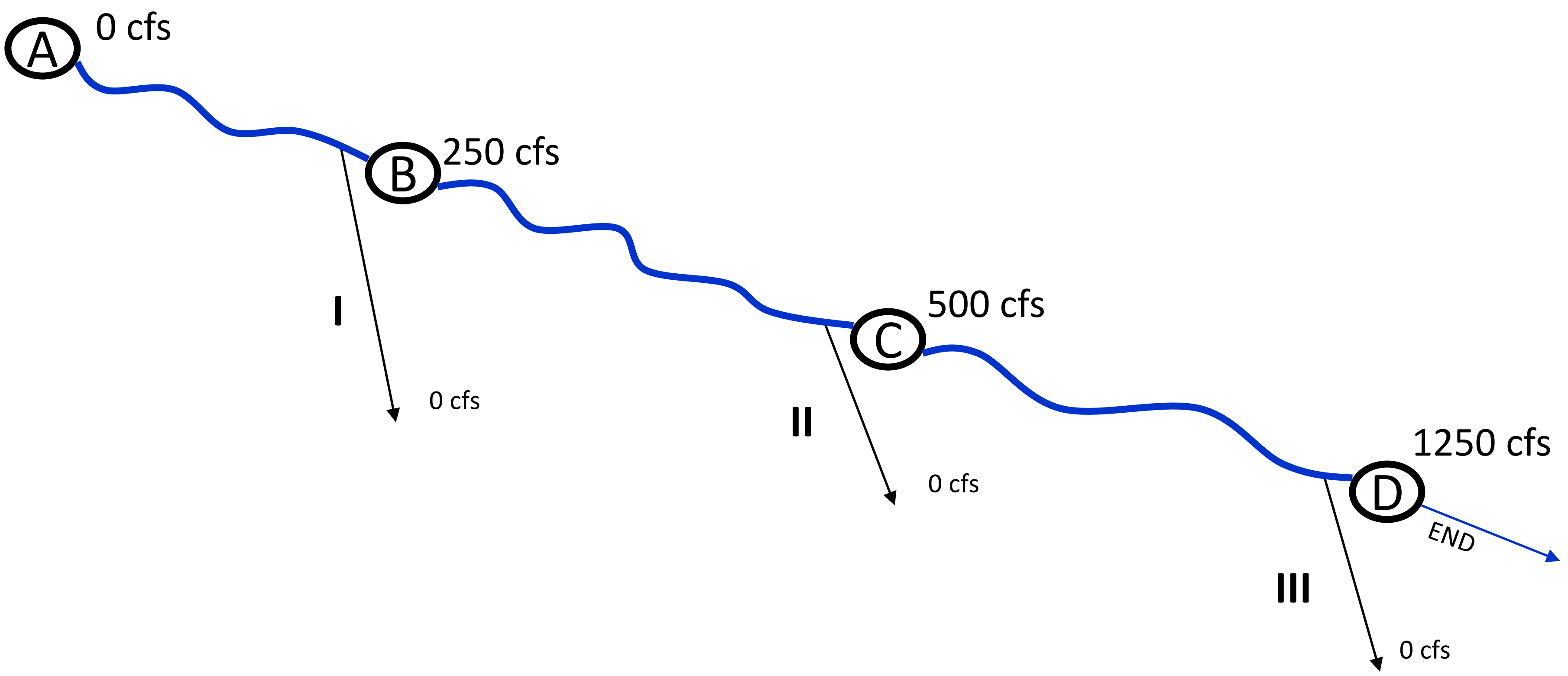
Reach Gain = Outflow – Inflow + Diversions + Evaporation ± Change in Storage

= 1100 cfs – 600 cfs + 1200 cfs + 50 cfs - 1450 cfs

= 300 cfs

TOTAL NATURAL FLOW

Sum of Reach Gains



TOTAL NATURAL FLOW

REACH	REACH GAIN
A – B	250 cfs
B – C	250 cfs
C – D	750 cfs
	=======
	1250 cfs Natural Flow

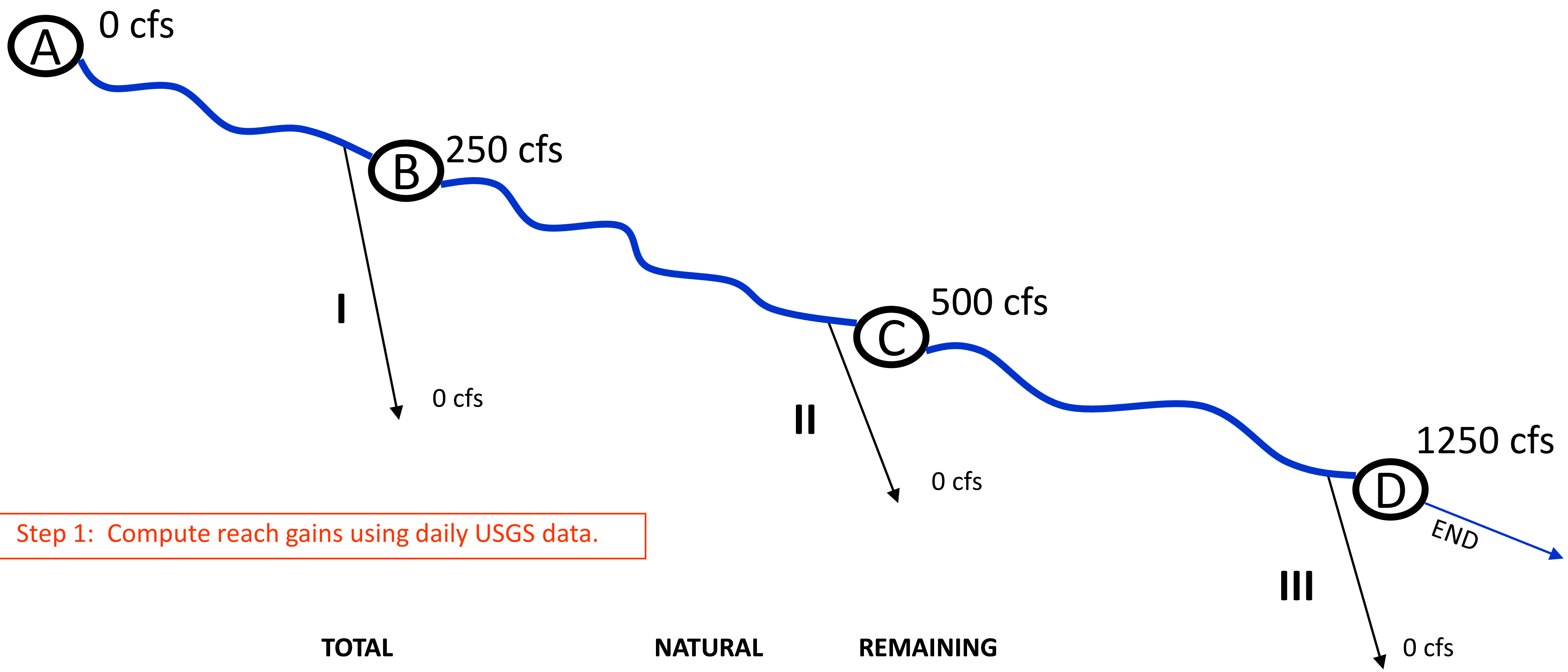
Natural Flow Delivery

1. Compute daily reach gains using daily USGS river data, reservoir, and diversion data for each reach.

2. Inventory water rights (priorities, flow rates, and volume limitations) for diversions currently diverting water.

3. Distribute natural flow according to water right requirements and natural flow available to each diversion in each reach.

Example 1: Distribution of Natural Flow

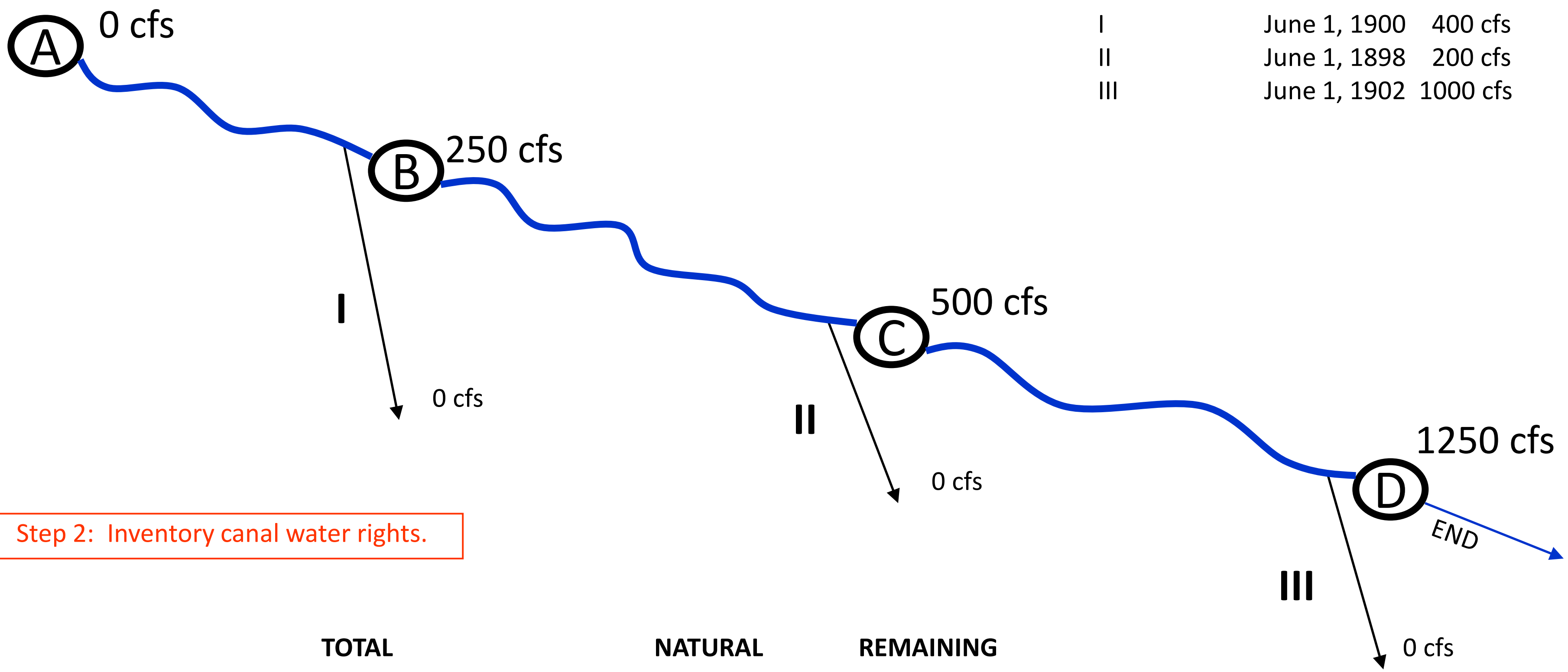


Step 1: Compute reach gains using daily USGS data.

REACH	REACH GAINS	TOTAL NATURAL FLOW	ACTUAL FLOW	NATURAL FLOW DIVERSION	REMAINING NATURAL FLOW	LAST RIGHT FILLED
A-B	250	250	250	0	250	
B-C	250	500	500	0	500	
C-D	750	1250	1250	0	1250	

Example 1: Inventory water rights.

CANAL	WATER RIGHT	
I	June 1, 1900	400 cfs
II	June 1, 1898	200 cfs
III	June 1, 1902	1000 cfs

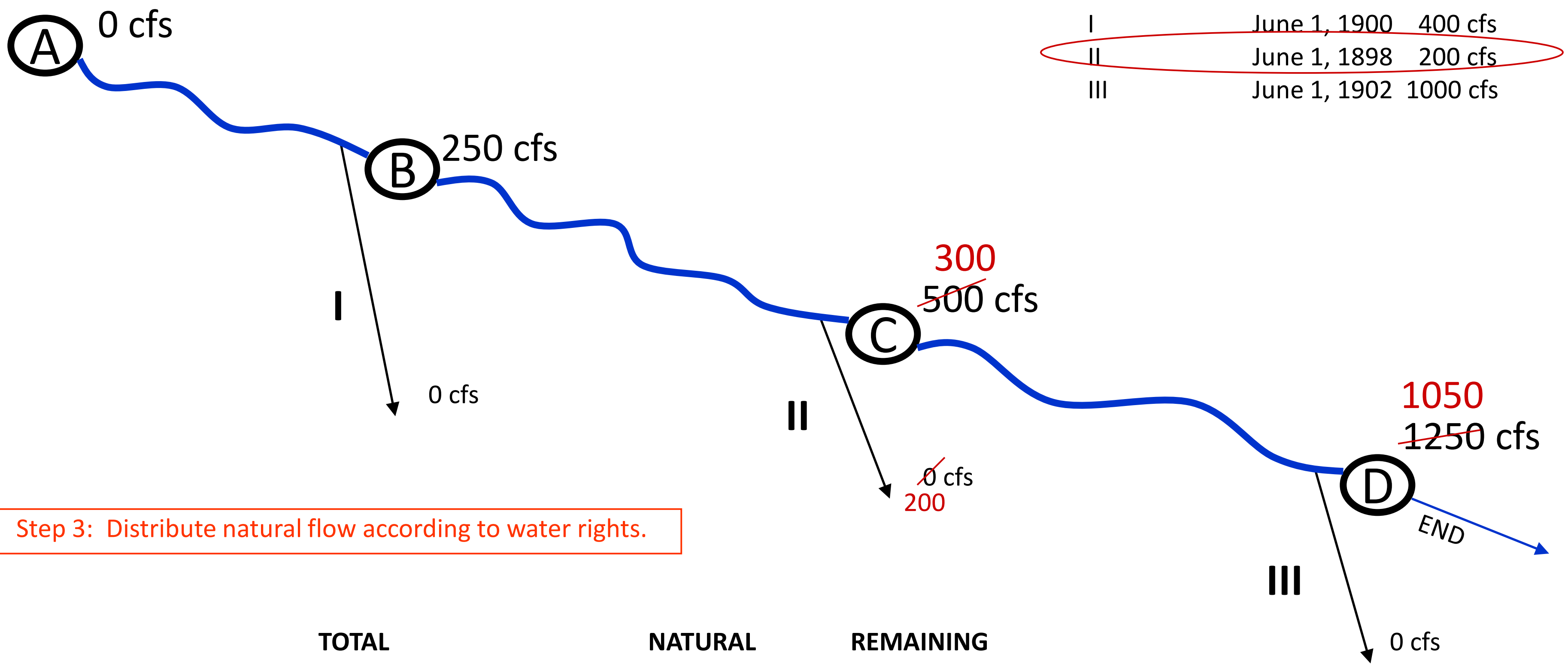


Step 2: Inventory canal water rights.

REACH	REACH GAINS	TOTAL NATURAL FLOW	ACTUAL FLOW	NATURAL FLOW DIVERSION	REMAINING NATURAL FLOW	LAST RIGHT FILLED
A-B	250	250	250	0	250	
B-C	250	500	500	0	500	
C-D	750	1250	1250	0	1250	

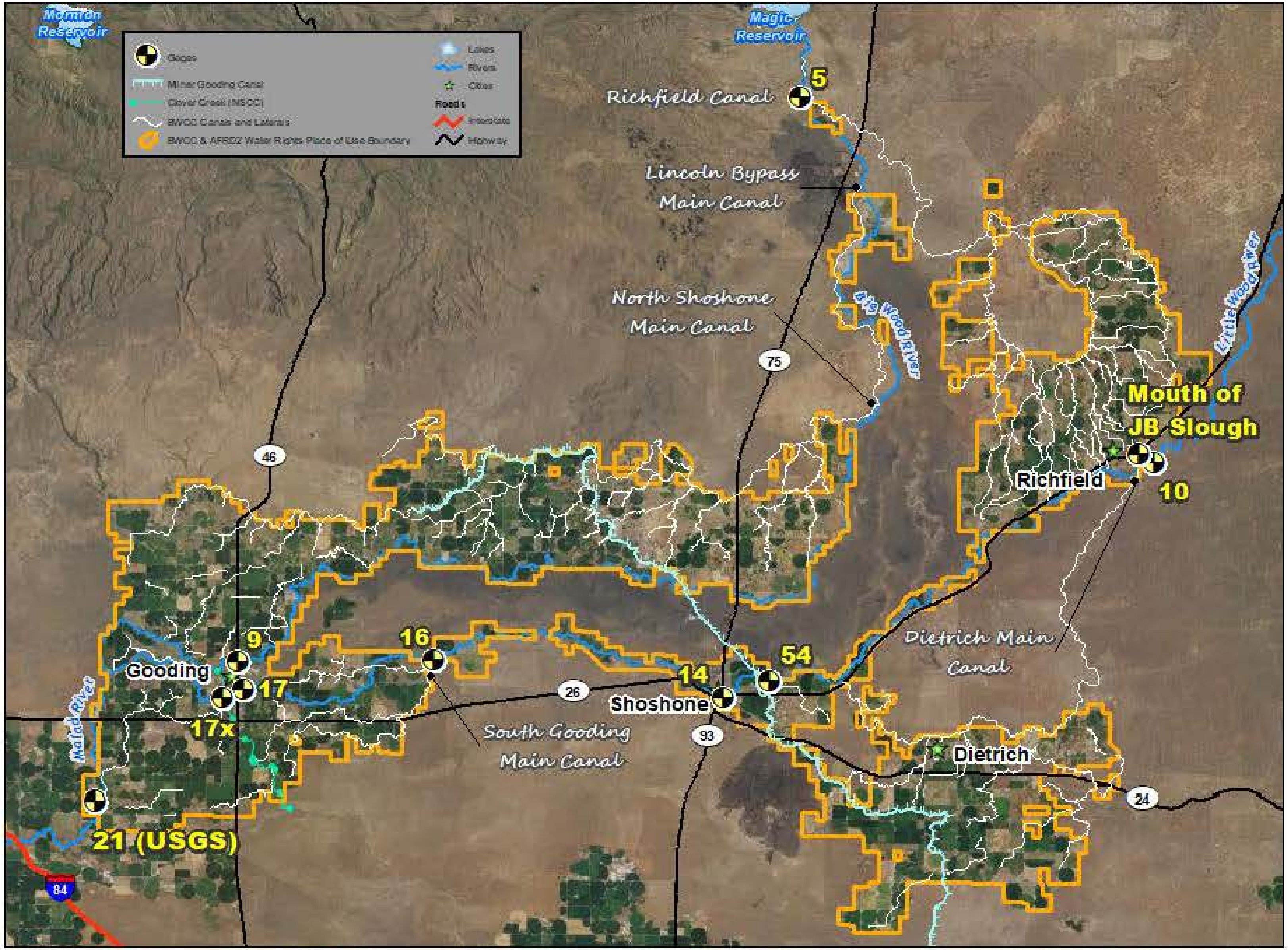
Example 1: Distribute natural flow.

CANAL	WATER RIGHT	
I	June 1, 1900	400 cfs
II	June 1, 1898	200 cfs
III	June 1, 1902	1000 cfs



Step 3: Distribute natural flow according to water rights.

REACH	REACH GAINS	TOTAL NATURAL FLOW	ACTUAL FLOW	NATURAL FLOW DIVERSION	REMAINING NATURAL FLOW	LAST RIGHT FILLED
A-B	250	250	250	0	250	
B-C	250	500	~~500~~ 300	~~0~~ 200	~~500~~ 300	
C-D	750	1250	~~1250~~ 1050	0	~~1250~~ 1050	



Service Layer Credits: USDA-FSA Aerial Photography Field office: aerial-imagery/ortho_2019_idaho

0 1 2 4 6 8 10 Miles

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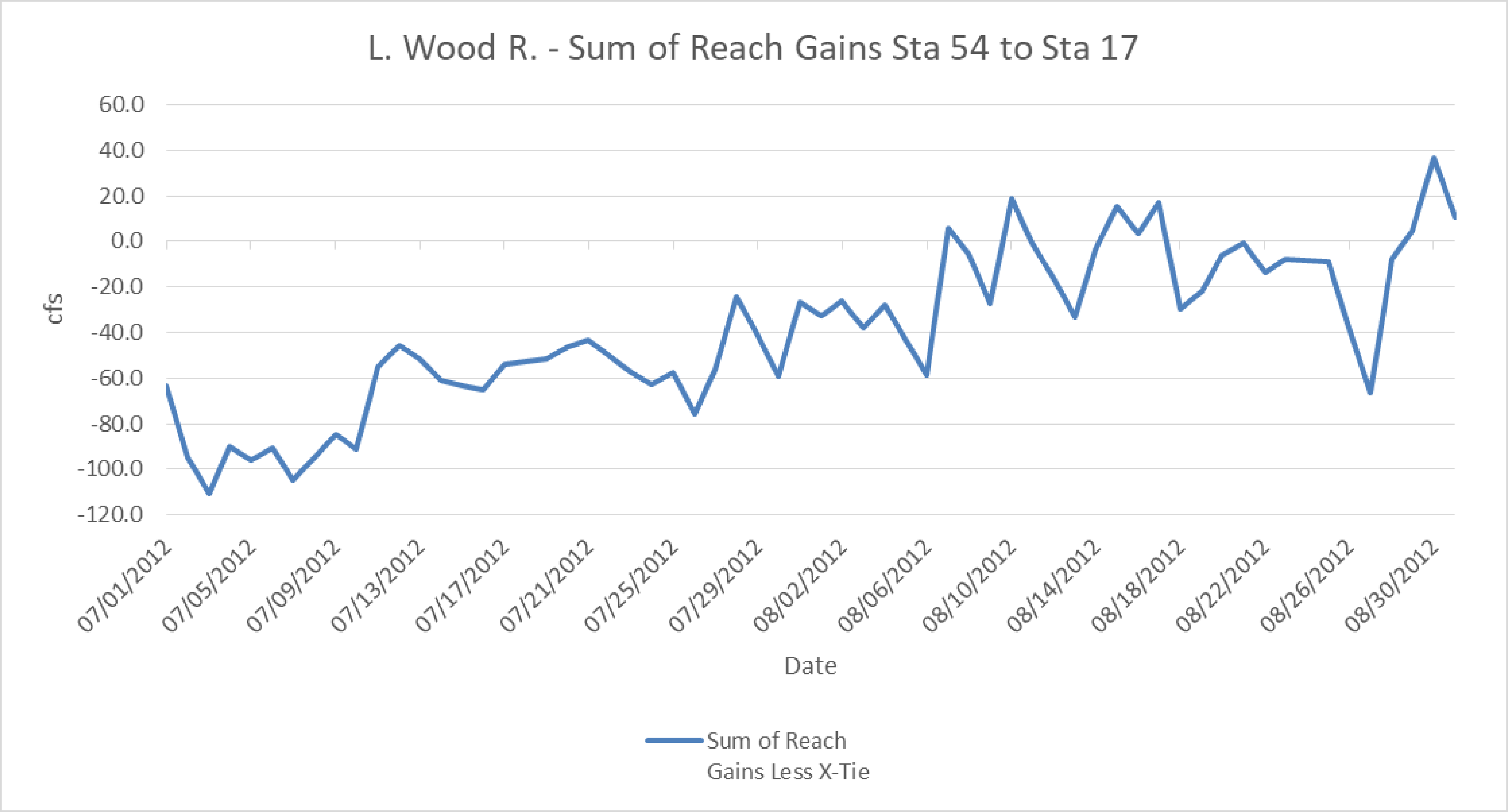
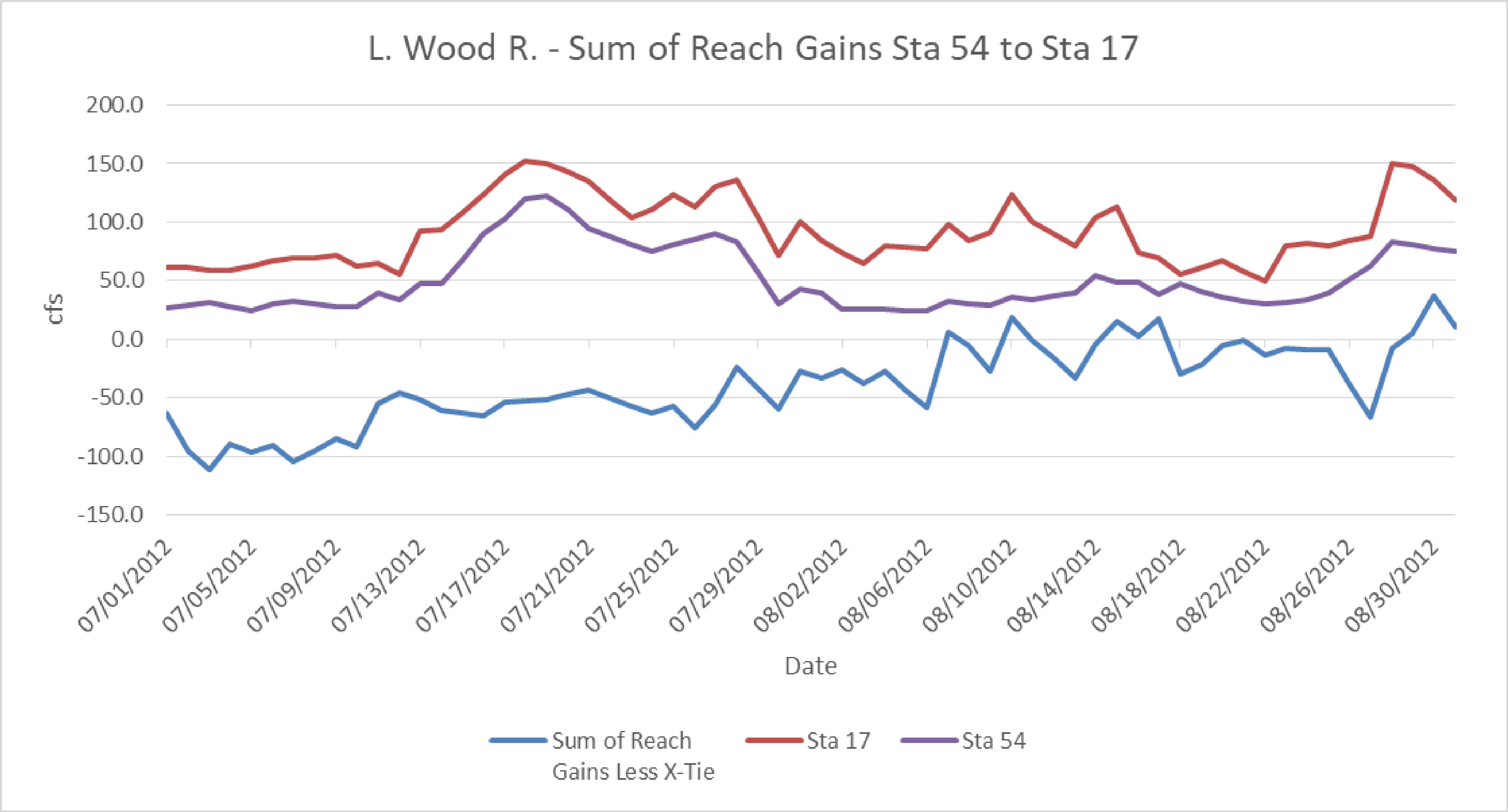
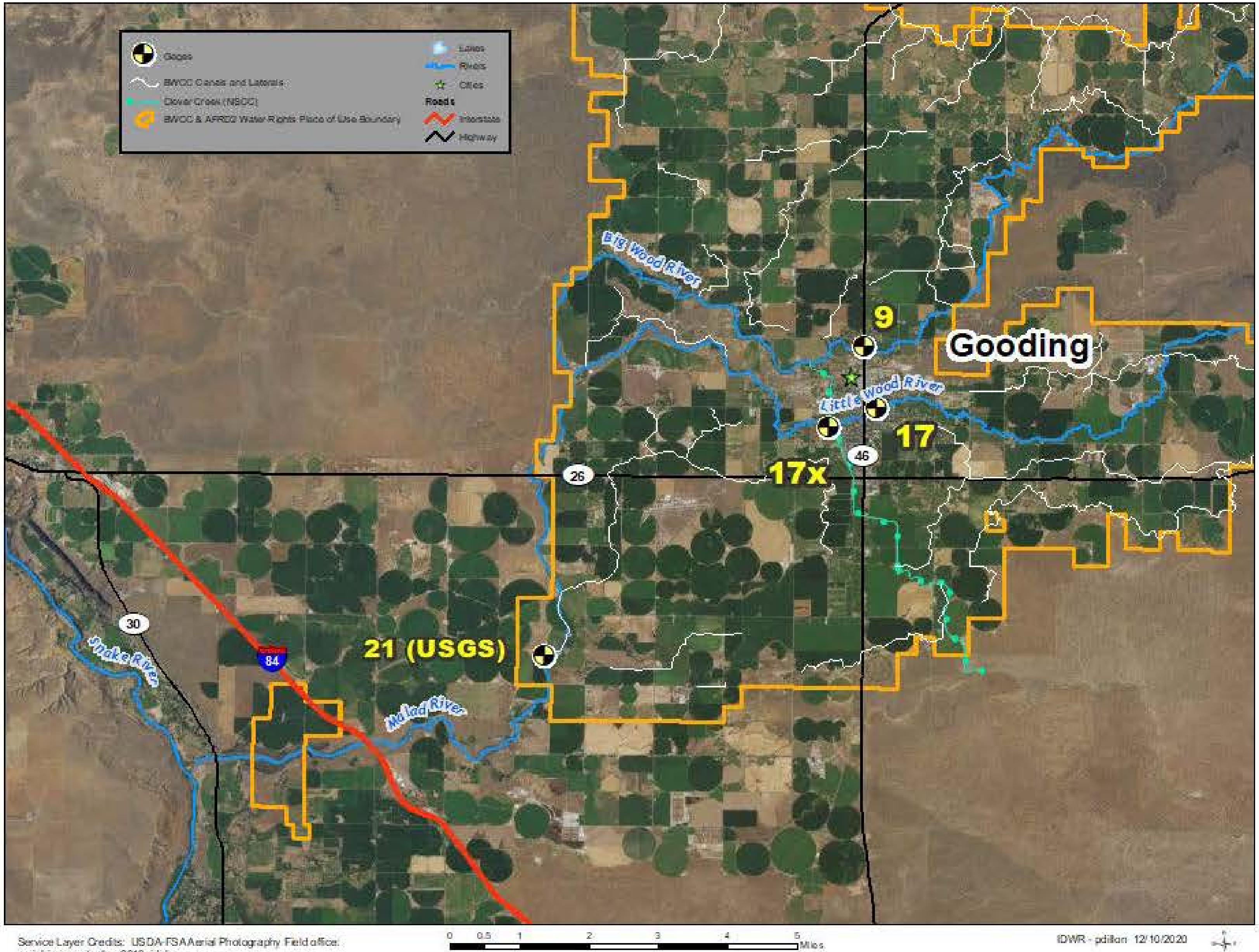
Gage Locations



Note consistent reach losses during period. Gains do not include returns from the X-Tie Ditch, a ditch off the South Gooding Main Canal that returns water to the Little Wood above the Slough Ditch. Nearly all the water diverted to South Gooding Main & Slough Ditch is from Snake River/Milner-Gooding Canal. There is a total of about 60 cfs of natural flow priority rights in the Reach from Stations 54 to 17, not including BWCC natural flow rights that are typically diverted above Station 54.



Plot of reach gain from previous slide plus flows at Station 54 and 17. Flow at Station 17 includes some water from Milner-Gooding Canal (Snake River) that is undiverted plus any remaining natural flow. During the period, 20 to 60 cfs of flow at Station 17 continued downstream on Little Wood River between Station 17 X and confluence with Big Wood River to satisfy additional diversions in that lower reach. Station 17X is located just below the X Canal (aka Clover Creek Canal managed by NSCC).



Service Layer Credits: USDA-FSA Aerial Photography Field office: aerial-imagery/ortho_2019_idaho

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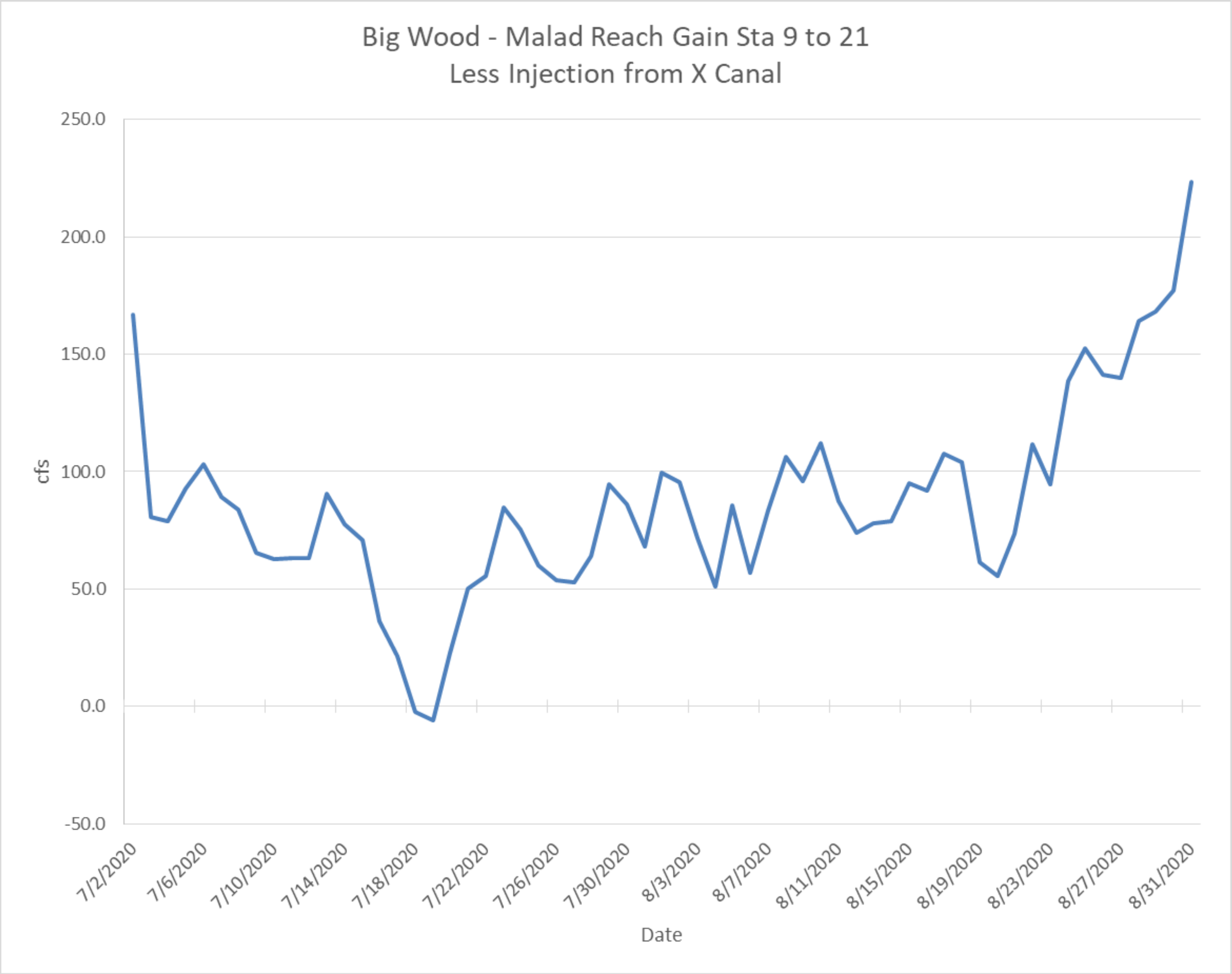
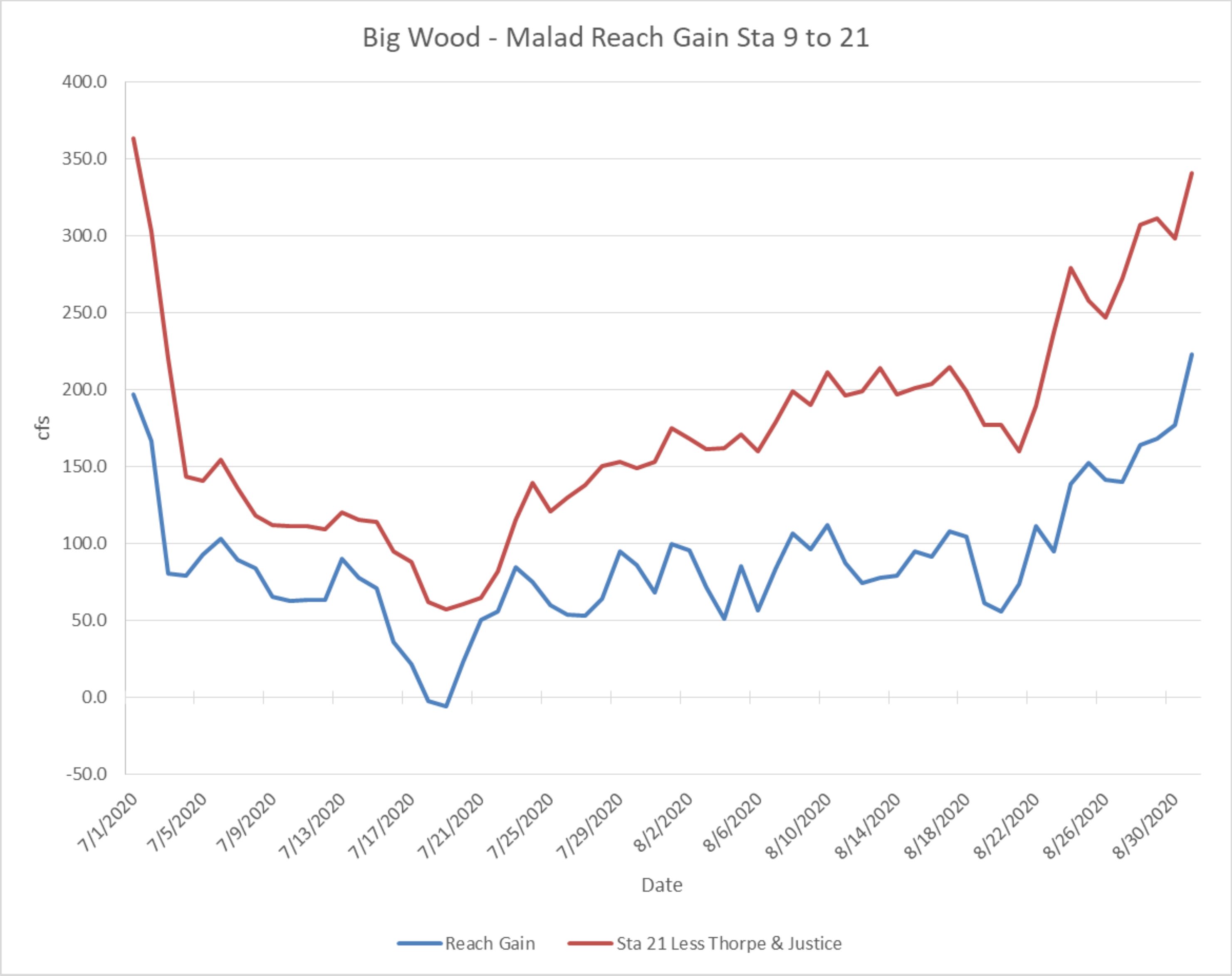
Gage Locations



Note reach gain at 50 cfs or more during the period except for several days around July 20 due to low recorded flow at Station 21.
Gain does not include water injected to river from X Canal. Much of the injected water is re-diverted at the Y and Z Canals.



Plot of reach gain from previous slide, plus flow at Station 21 minus sum of diversions at two ditches located below Station 21. Sum of all natural flow priority rights in reach is about 40 cfs, plus 20 to 25 cfs for two downstream ditches that typically divert up to 15 cfs. Flow at Station 21 may include some unused water from NSCC X Canal.

Observations

- Little Wood River between Stations 54 & 17 is a losing reach. Snake River water injected to river from Milner-Gooding Canal “absorbs” losses in this reach & reach from Station 17X to Big Wood River. Little excess water available in these reaches to affect delivery of Little Wood River priority rights.

- Big Wood – Malad River between Stations 9 and 21 is typically a gaining reach due to return flows. Gains plus unused flow injected to river from X Canal (NSCC) should be sufficient to satisfy decreed priority rights in this reach and two ditches below Station 21.

- Review of additional data and periods for these and other river reaches is recommended.

Observations

- Consider use of a Water Right Accounting program for Big Wood below Magic & Little Wood-Silver Creek systems. Benefits include:

  a. Allocate available natural flow
     - Compute losses/gains
     - Priority right delivery determinations (priority cuts)
       - "after the fact" & projections
       - Priority cuts can be adjusted based on actual demand rather than comprehensive list of rights
       - Potential for delivery of more priority rights in other reaches?
         - Further review needed

  b. Track natural flow and storage delivery (Magic Res & Snake River) by diversion
     - Who diverts natural flow vs storage, and where

IDWR Hydrology staff will gather 2020 data & water rights, develop a spreadsheet model and show concept over 2021

Example of Water Right Accounting Output – Boise River

WATER DISTRICT 63 - BOISE RIVER FLOW ACCOUNTING (VER 2.1.2.111) - Aug 2, 2020 20201222

	REACH FLOWS IN CFS		ACTUAL DATE	NATURAL FLOW	ACTUAL FLOW	RMAINING NAT FLOW	OPERATN FLOW	STORED FLOW	RESRVOIR EVAP	NATURAL FLOW DIV	TOTAL RCH DIV	REACH GAIN	LAST RIGHT
1	TWIN SPRINGS		Aug 2	522.	522.	522.	0.	0.	0.	0.	0.	522.	18841017
2	FEATHERVILLE		Aug 2	229.	229.	229.	0.	0.	0.	0.	0.	229.	18841017
3	FTHRVL TO ANDERSN RANCH		Aug 2	331.	1220.	331.	0.	889.	19.	0.	0.	102.	18841017
4	ANDSN RANCH TO ARROWROCK		Aug 2	845.	3674.	845.	0.	2829.	10.	0.	0.	-7.	18841017
5	MORES CREEK		Aug 2	35.	34.	35.	0.	-1.	0.	0.	1.	35.	18841017
6	ARROWROCK TO LUCKY PEAK		Aug 2	901.	3686.	901.	0.	2785.	14.	0.	0.	21.	18841017
7	LUCKY PEAK TO DIVSN DAM	*	Aug 2	902.	1667.	870.	0.	798.	0.	32.	2019.	1.	18841017
8	DIVSN DAM TO BOISE	*	Aug 2	902.	1210.	729.	0.	482.	0.	141.	457.	0.	18841017
9	BOISE TO GLENWOOD BR		Aug 2	778.	784.	451.	0.	333.	0.	154.	302.	-124.	18841017
10	GLENWOOD BR TO MIDDLTN		Aug 2	920.	229.	0.	229.	0.	0.	364.	697.	142.	18841017
11	MIDDLETON TO CALDWELL	*	Aug 2	1573.	395.	345.	50.	0.	0.	487.	487.	654.	20190222
12	CALDWELL TO NOTUS	*	Aug 2	1801.	323.	278.	50.	-6.	0.	295.	301.	228.	20190222
13	NOTUS TO PARMA		Aug 2	2176.	530.	601.	0.	-71.	0.	103.	167.	375.	20190222
	* - INDICATES FLOW ESTIMATED, NOT MEASURED								TOTALS:	1575.	4431.	2176.	

Note increase in reach gain between reaches 10 and 11, and resulting change in last right filled (priority delivery). May be analogous to Big Wood – Malad River Station 9 to 21 reach.

Water Right Accounting Output Example

Note bottom section tracking total daily diversion and storage used, plus cumulative storage used at each diversion

WATER DISTRICT 63 - BOISE RIVER FLOW ACCOUNTING (VER 2.1.2.111) - Aug 2, 2020 20201222

	REACH FLOWS IN CFS		ACTUAL DATE	NATURAL FLOW	ACTUAL FLOW	RMAINING NAT FLOW	OPERATN FLOW	STORED FLOW	RESRVOIR EVAP	NATURAL FLOW DIV	TOTAL RCH DIV	REACH GAIN	LAST RIGHT
1	TWIN SPRINGS		Aug 2	522.	522.	522.	0.	0.	0.	0.	0.	522.	18841017
2	FEATHERVILLE		Aug 2	229.	229.	229.	0.	0.	0.	0.	0.	229.	18841017
3	FTHRVL TO ANDERSN RANCH		Aug 2	331.	1220.	331.	0.	889.	19.	0.	0.	102.	18841017
4	ANDSN RANCH TO ARROWROCK		Aug 2	845.	3674.	845.	0.	2829.	10.	0.	0.	-7.	18841017
5	MORES CREEK		Aug 2	35.	34.	35.	0.	-1.	0.	0.	1.	35.	18841017
6	ARROWROCK TO LUCKY PEAK		Aug 2	901.	3686.	901.	0.	2785.	14.	0.	0.	21.	18841017
7	LUCKY PEAK TO DIVSN DAM	*	Aug 2	902.	1667.	870.	0.	798.	0.	32.	2019.	1.	18841017
8	DIVSN DAM TO BOISE	*	Aug 2	902.	1210.	729.	0.	482.	0.	141.	457.	0.	18841017
9	BOISE TO GLENWOOD BR		Aug 2	778.	784.	451.	0.	333.	0.	154.	302.	-124.	18841017
10	GLENWOOD BR TO MIDDLTN		Aug 2	920.	229.	0.	229.	0.	0.	364.	697.	142.	18841017
11	MIDDLETON TO CALDWELL	*	Aug 2	1573.	395.	345.	50.	0.	0.	487.	487.	654.	20190222
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13	NOTUS TO PARMA		Aug 2	2176.	530.	601.	0.	-71.	0.	103.	167.	375.	20190222

* - INDICATES FLOW ESTIMATED, NOT MEASURED TOTALS: 1575. 4431. 2176.

	RESERVOIR	PREV CONT (AF)	CURR CONT (AF)	CHNG CONT (CFS)	ACCR STOR (CFS)	TOTL STOR (AF)	TOTL EV (AF)
1	ANDERSON RANCH	303938.0	302223.0	-864.6	0.0	448700.0	4196.6
2	ARROWROCK	138573.0	134687.0	-1959.2	0.0	271224.0	2764.7
3	LUCKY PEAK	263550.0	263605.0	27.7	0.0	198173.4	3315.5
4	DIVERSION DAM	814.0	816.0	1.0	0.0	0.0	0.0
	TOTAL	706875.0	701331.0	-2795.1	0.0	918097.4	10276.8

PRIORITY	RESERVOIR	RIGHT (AF)	STORED (AF)
1	ARROWROCK	260624.0	260624.0
2	ARROWROCK	10600.0	10600.0
3	ANDERSON RANCH	448700.0	448700.0
4	LUCKY PEAK	203068.0	198173.4
5	ARROWROCK LTF	1000.0	0.0
6	ANDERSON RANCH LTF	1330.0	0.0
7	LUCKY PEAK LTF	61182.0	0.0
8	ANDERSON RANCH LLTF	0.0	0.0
	TOTAL:	986504.0	918097.4

TOTAL EARLY SEASON FILL: 0.0

	CHANGE IN CONTENT	STORAGE USED	MIDDLETON STORED	TOTAL STORED	UNACCT STORED
YEAR-TO-DATE AF	43189.0	157767.1	8857.2	220859.5	0.0

STEWART DECREE: 60% BRYAN DECREE: 0%

AVERAGING ERROR: 2941.4

	DIVERSION	CFS DIVN	CFS STOR	AF USED	AF RMNG		DIVERSION	CFS DIVN	CFS STOR	AF USED	AF RMNG		DIVERSION	CFS DIVN	CFS STOR	AF USED	AF RMNG
1	TRINITY SPRINGS	0	0	2	774	31	FARMERS UNION	119	79	3014	12330	61	SEBREE	274	0	0	148
2	SPRING SHORES	0	0	2	4	32	BOISE VALLEY	46	6	295	1608	62	CAMPBELL	12	0	0	0
3	GREEN RANCH	0	0	0	0	33	CAPITOL VIEW	7	0	0	128	63	SIEBENBERG	3	0	0	0
4	OSPREY	1	1	15	273	34	RIVERSIDE VIL	0	0	0	0	64	SHIPLEY	0	0	0	0
5	WILDERNESS RANCH	0	0	7	185	35	NEW DRY CREEK	38	6	12	3508	65	WAGNER	0	0	0	0
6	RANCH HOA	0	0	31	84	36	NEW UNION	3	0	0	205	66	NOTUS CANAL	123	0	35	-35
7	USFS NURSERY	0	0	20	159	37	WOODS	0	0	2	-2	67	CALDWELL LOWLINE	32	0	0	0
8	FLOOD CONTROL	0	0	0	0	38	LEMP	2	0	0	0	68	GOLDEN GATE	3	0	0	0
9	SANDY POINT	0	0	3	2	39	WARM SPRINGS	2	0	0	162	69	SIMPLOT	1	0	0	0
10	FISH AND GAME FL	0	0	0	48715	40	GRAHAM-GILBERT	2	0	3	1	70	EUREKA #2	106	0	0	0
11	USBR FLOW	0	0	0	100368	41	BALLENTYNE	9	4	7	1215	71	UPPER CENTER POI	14	0	0	0
12	DISCOVERY PARK	0	0	5	7	42	CONWAY-HAMMING	2	0	0	118	72	MCMANUS AND TEAT	7	6	64	-64
13	PENITENTIARY	4	3	332	0	43	EAGLE ISLAND PAR	0	0	19	15	73	ATWELL	6	0	0	0
14	NEW YORK	2015	1984	130445	415045	44	THOMAS AIKEN	2	0	7	65	74	VALE PUMP	0	0	4	-4
15	SURPRIS VY/MICRN	10	1	5	2905	45	MACE-CATLIN	8	1	33	320	75	LOWER CENTER POI	10	0	0	0
16	SHAKESPEARE	0	0	0	0	46	MACE-MACE	0	0	21	0	76	BOWMAN AND SWISH	10	0	0	0
17	RIDENBAUGH	399	297	7669	36995	47	NAGY	0	0	0	0	77	BAXTER	7	0	92	-92
18	WILLIAMS PARK	0	0	9	33	48	HART-DAVIS	9	3	111	187	78	OBENDORF	3	0	603	-603
19	BUBB	3	0	0	385	49	MIDDLETON	124	0	0	4086	79	ANDREWS	18	7	1311	-1311
20	HERRICK	0	0	0	0	50	BARBER	0	0	0	0	80	BECKLY	0	0	5	-5
21	ROSSI MILL	5	0	0	384	51	SEVEN SUCKERS	1	1	21	123	81	BID No 1	3	0	0	0
22	BOISE CITY	22	0	0	560	52	PHYLLIS	366	312	12426	42824	82	TREATMENT PL TOT	0	0	0	0
23	SUEZ WATER	18	17	1279	3698	53	EUREKA #1	25	5	219	810	83	MCCURRY PUMP	0	0	0	0
24	K ALBERTSON	0	0	0	0	54	LITTLE PIONEER	18	0	18	1126	84	MAMMON	31	28	3174	-3174
25	SETTLERS	102	51	1097	12964	55	CANYON COUNTY	61	0	1	1518	85	HAAS	12	0	0	0
26	FAIRVIEW ACRES	6	6	12	984	56	Clayton Lat (1)	3	0	0	0	86	PARMA	12	1	420	-420
27	QUINNS POND	6	6	627	668	57	CALDWELL HIGHLIN	23	0	0	0	87	ISLAND HIGHLINE	33	13	3735	-3735