



# Wood River Valley Aquifer Model

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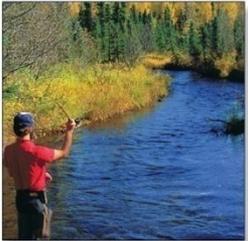
Presented by Allan Wylie, IDWR

March 17, 2015

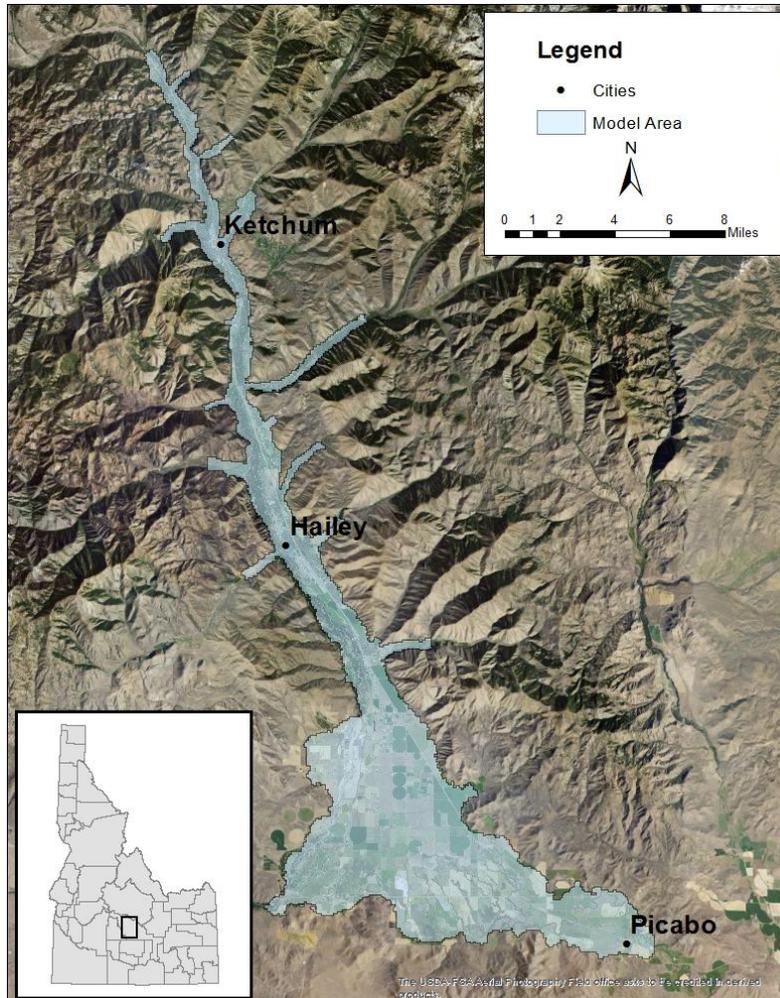


# Outline

- Recharge program
  - Tributary underflow
    - Adjusted by multiplying starting values by a factor
    - Adjust seasonal amplitude
    - Adjust averaging period
  - Surface water irrigation efficiency
  - Canal seepage currently fixed
- Physical properties adjusted by changing values in MODFLOW input files
  - Aquifer transmissivity
  - Riverbed conductance
  - Drain conductance

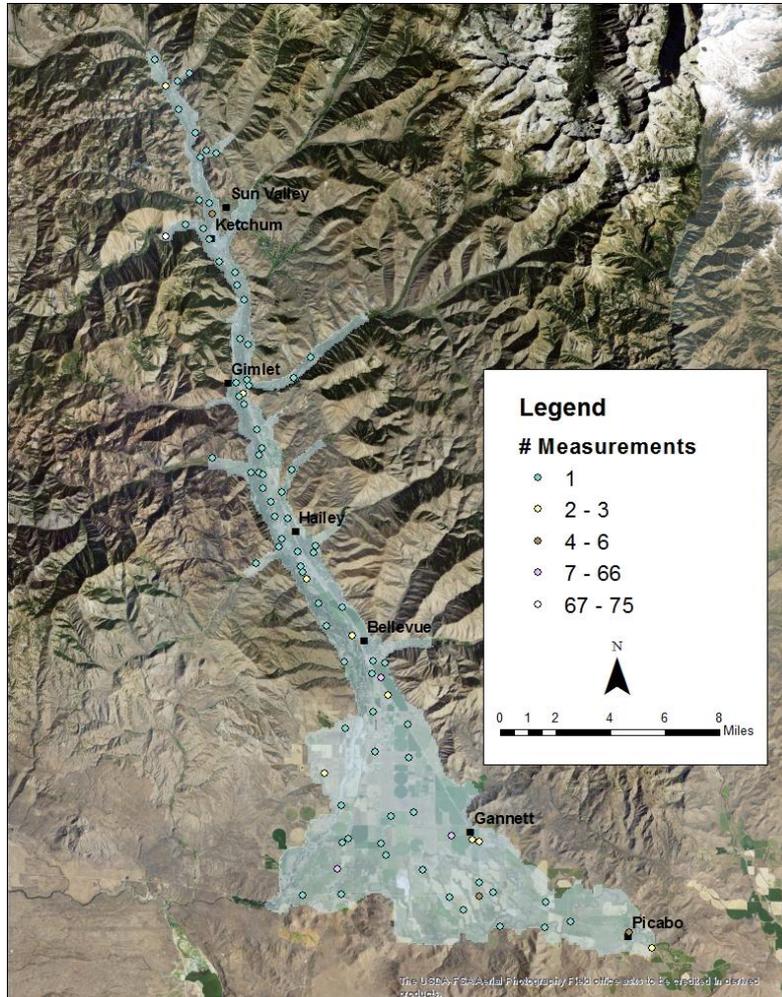


# Outline



- This is **Preliminary**
- Model period 1995-2010
  - 1995-2000 warm-up period
  - 2000-2010 calibration period
- Attempting full 3D model
- Plan to attempt unconfined

# Observation Wells

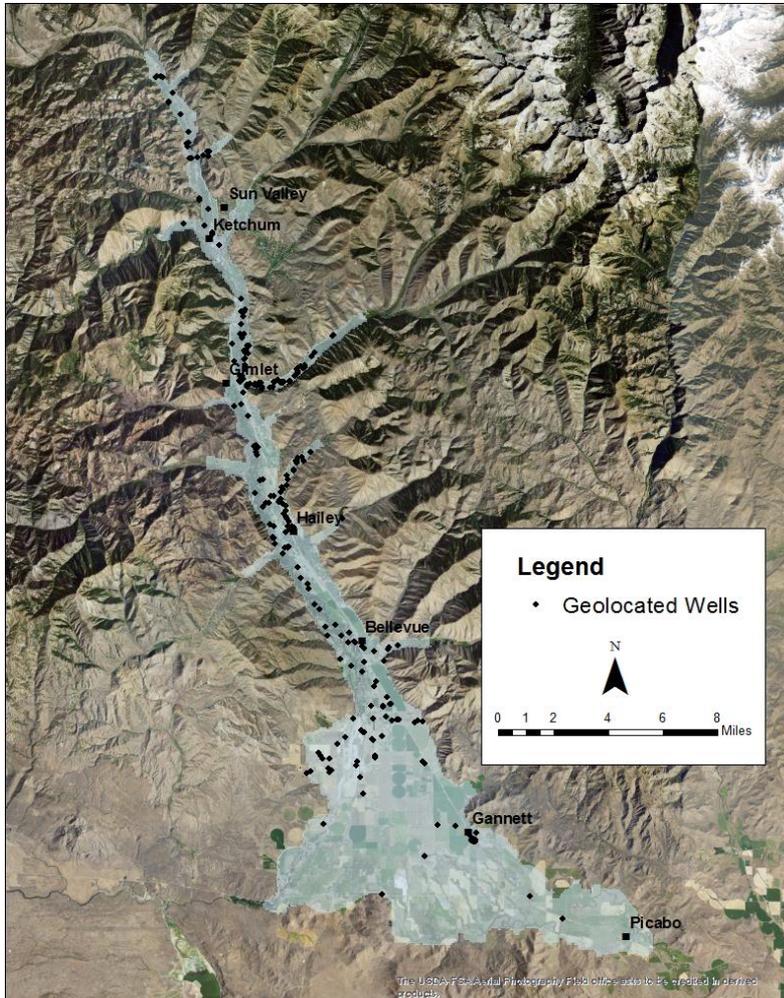


- Wells with GPS or surveyed location
- Measured by a trained technician
- 94 Wells
  - 387 measurements
  - 4.1 per well average

# Other Sources

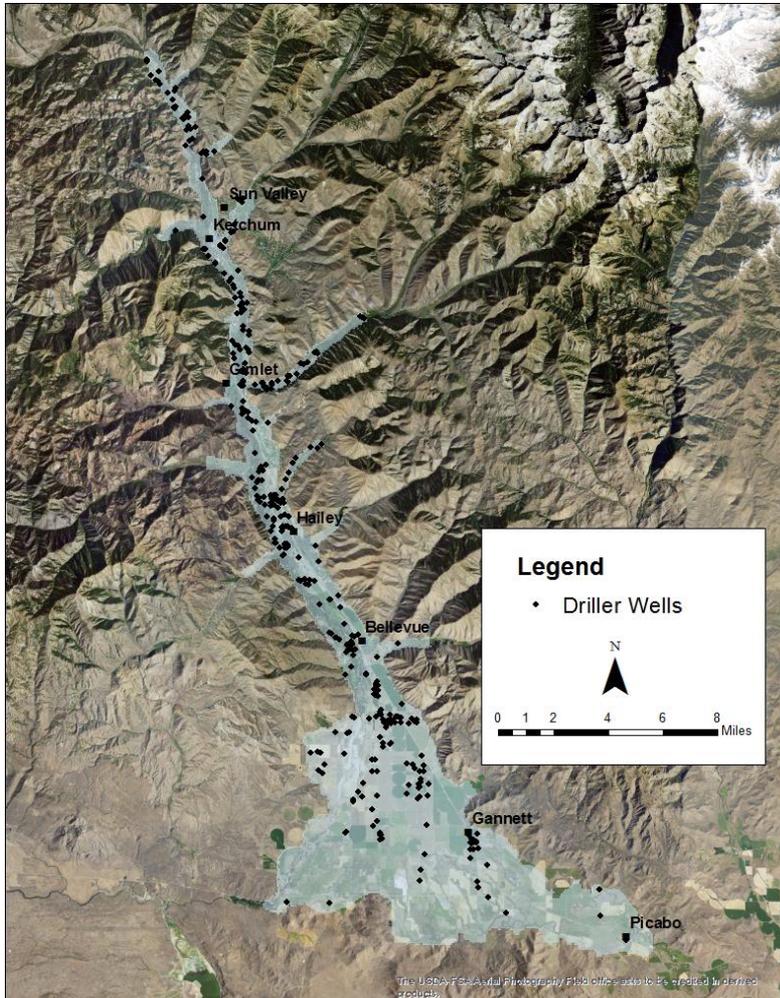
- Observation Wells
  - Collected by trained technician
  - Intent is to monitor resource
- Other Sources
  - Other reasons to collect the data

# Geo-located Wells



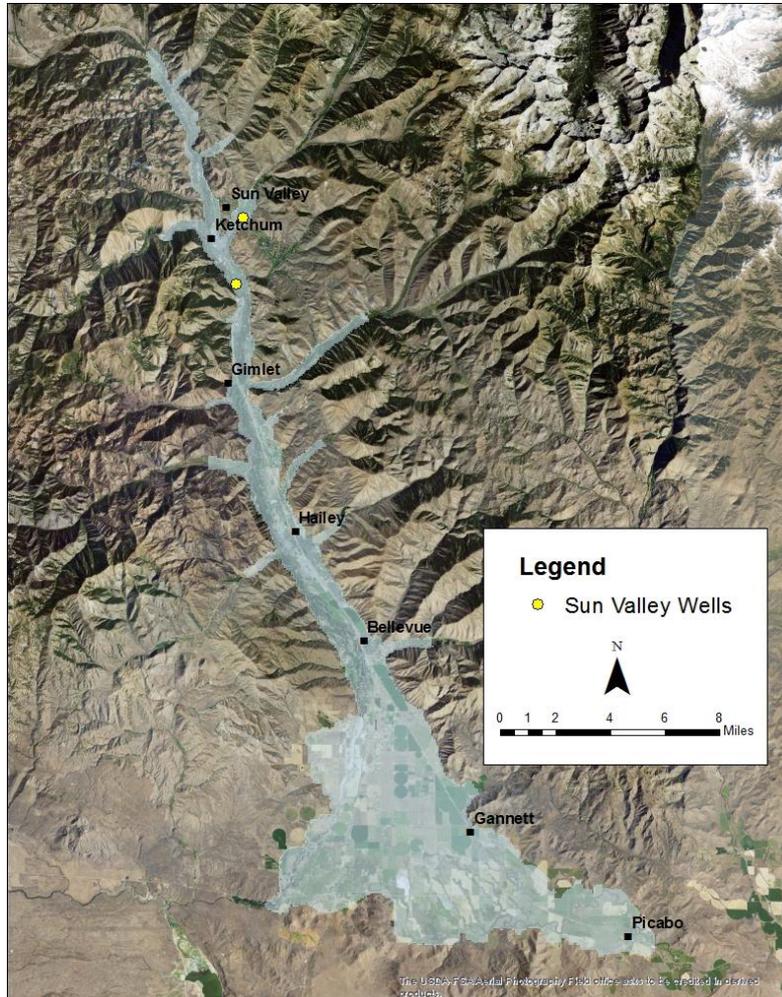
- Wells located by address
- Measured by driller
- 254 observations
- No repeated measurements

# Driller Wells



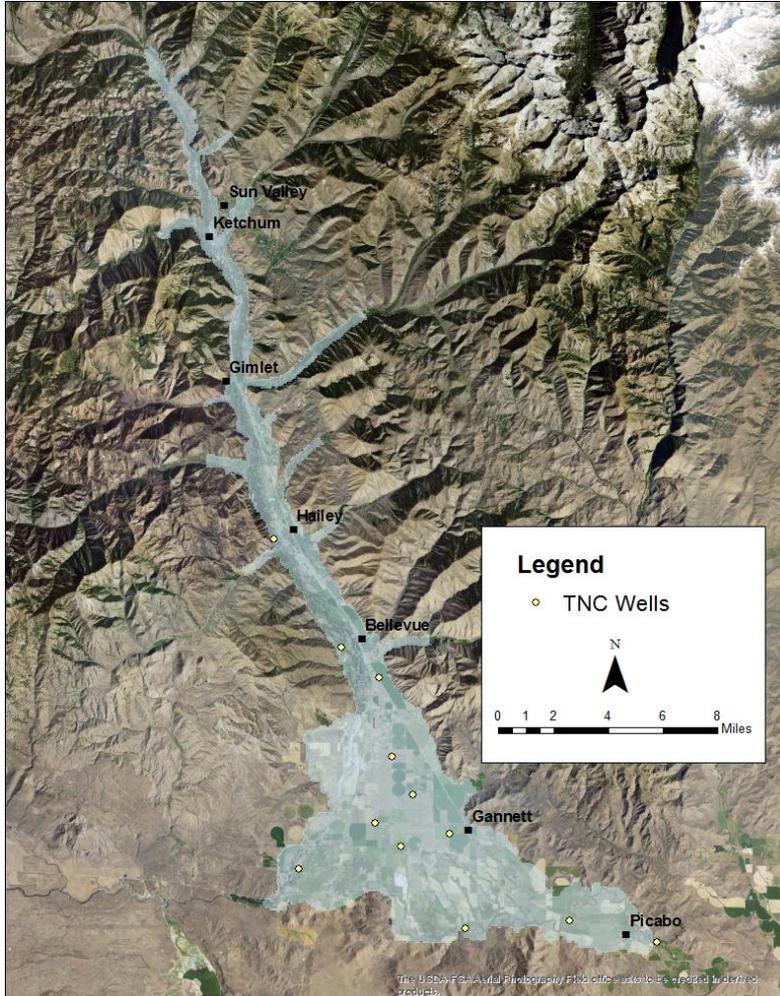
- Wells located by driller
- Measured by driller
- 416 Wells
- No repeated measurements

# Sun Valley Wells



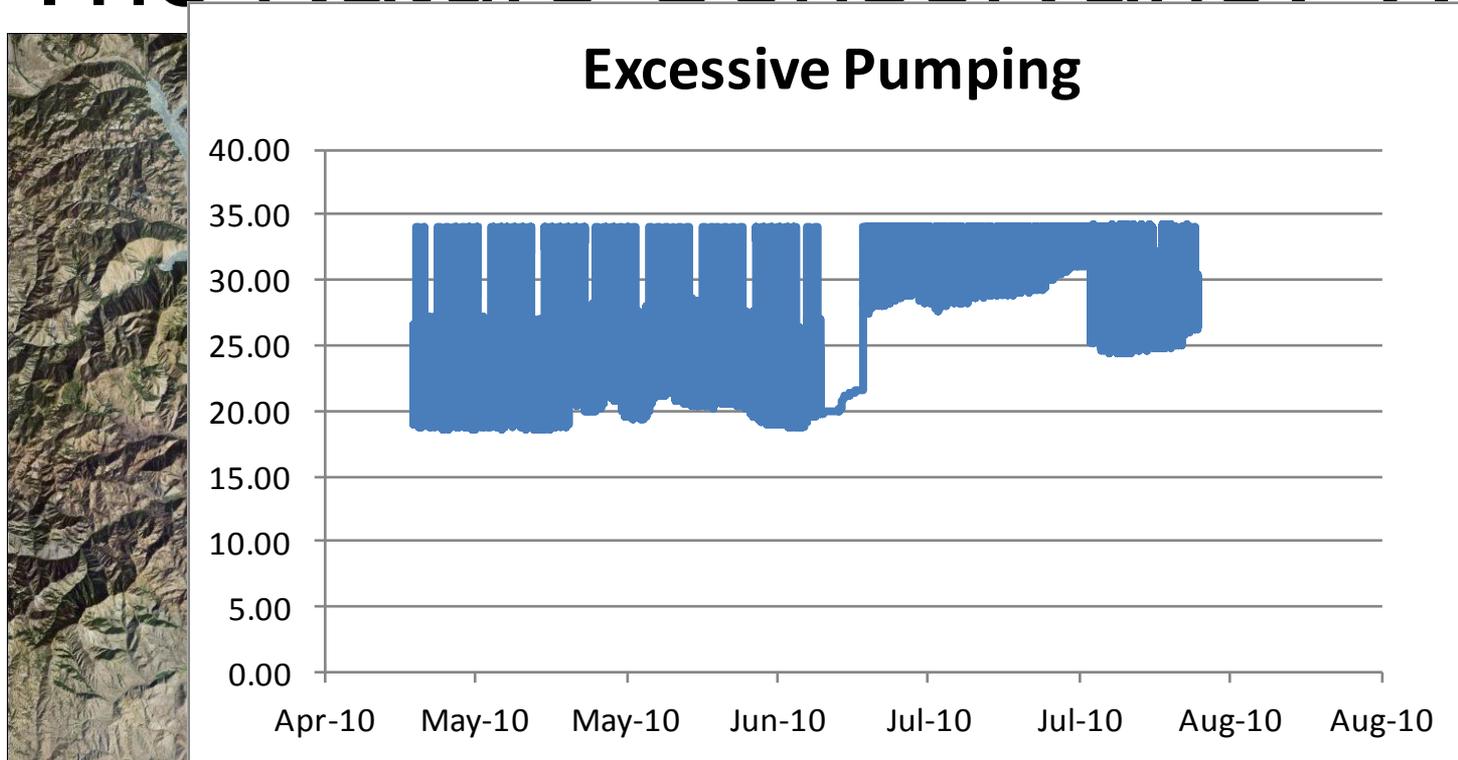
- Municipal wells
- Measured by city employees
- 9 wells in 2 well fields
  - Selected the wells with the most complete datasets
  - 393 observations in two wells

# The Nature Conservancy Wells



- Various wells
  - Domestic
  - Irrigation
  - Observation
  - USGS observation
- Transducer installed by graduate student
  - 15 min
- Spring 2010 – Spring 2011
- 12 wells

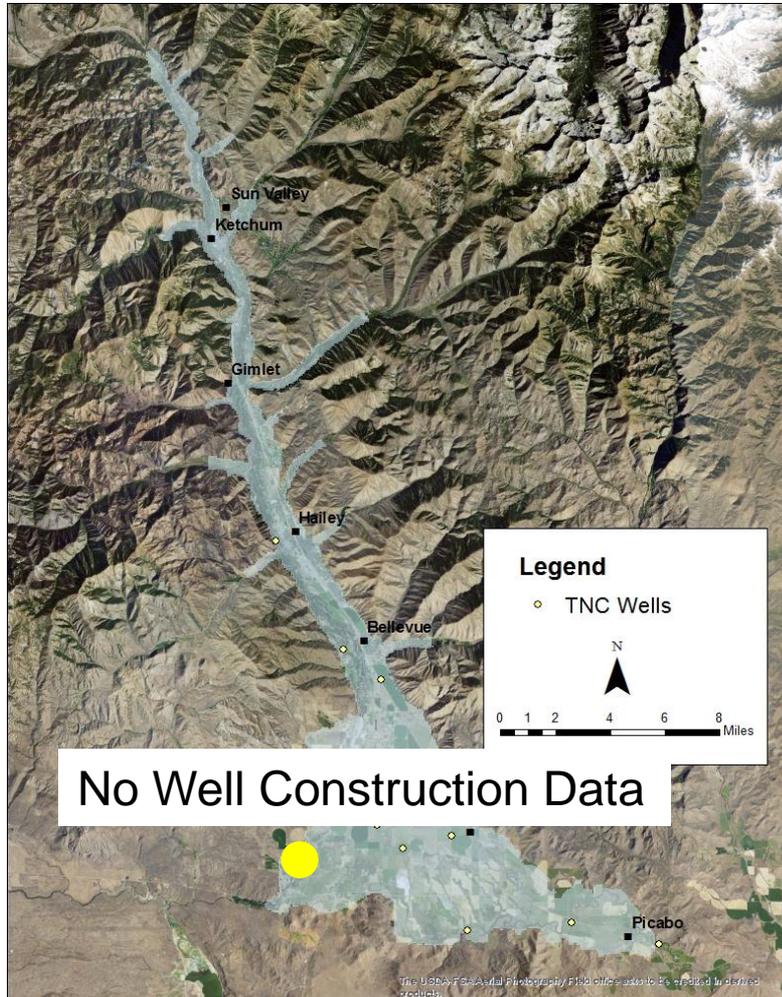
# The Nature Conservancy Wells



2011  
– 12 wells

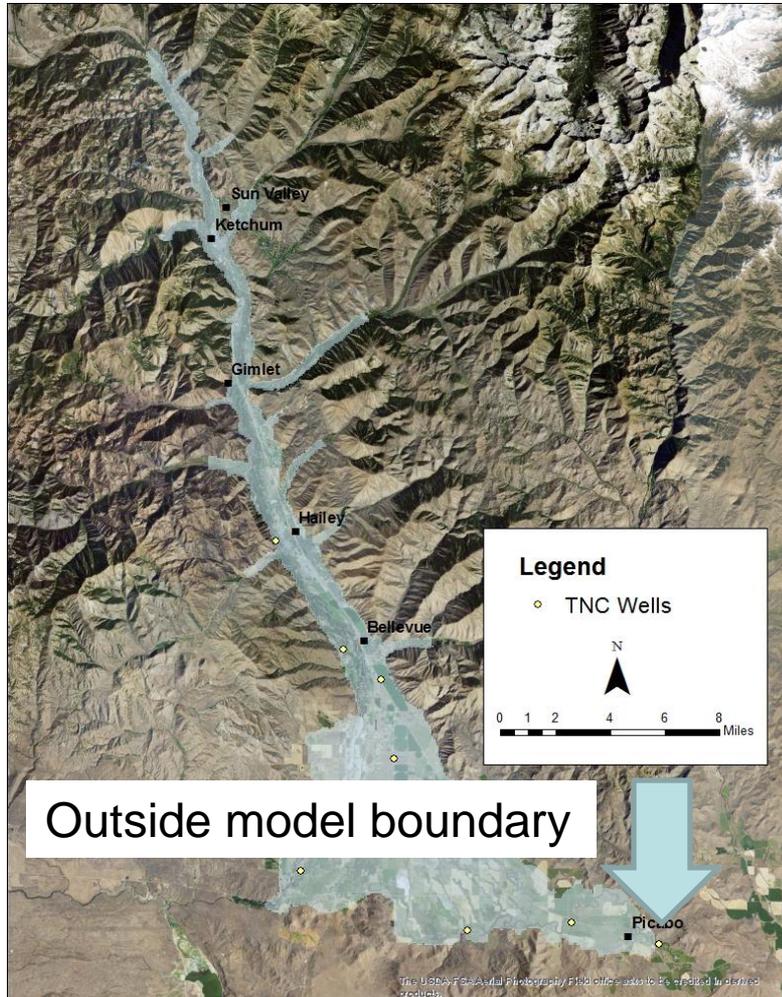
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# The Nature Conservancy Wells



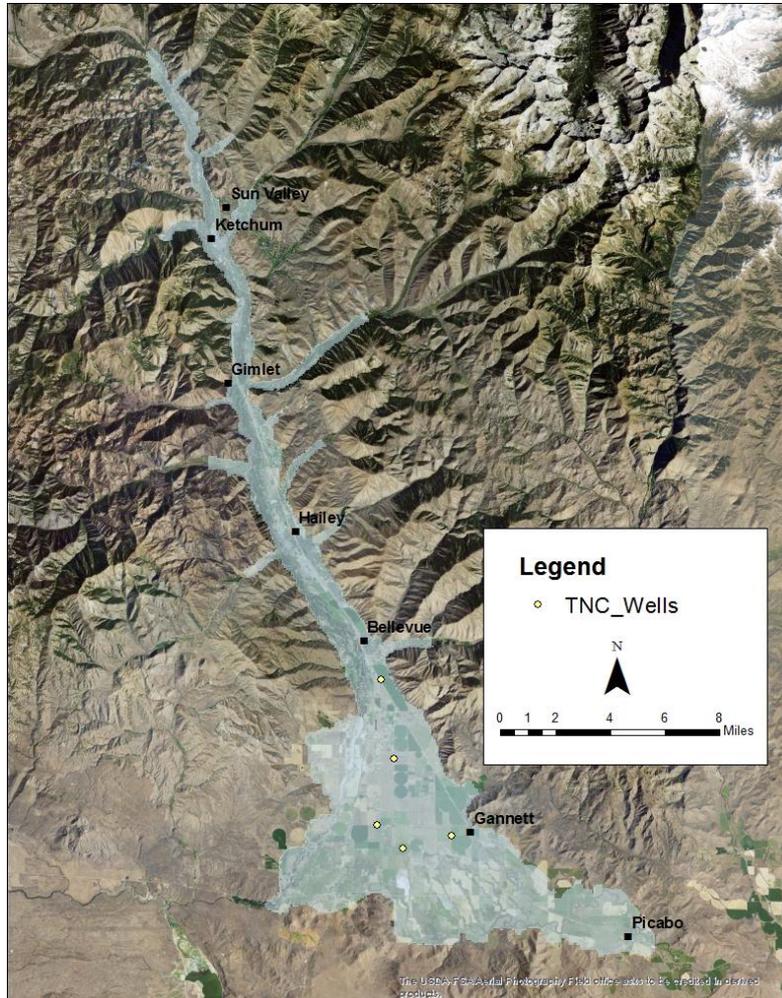
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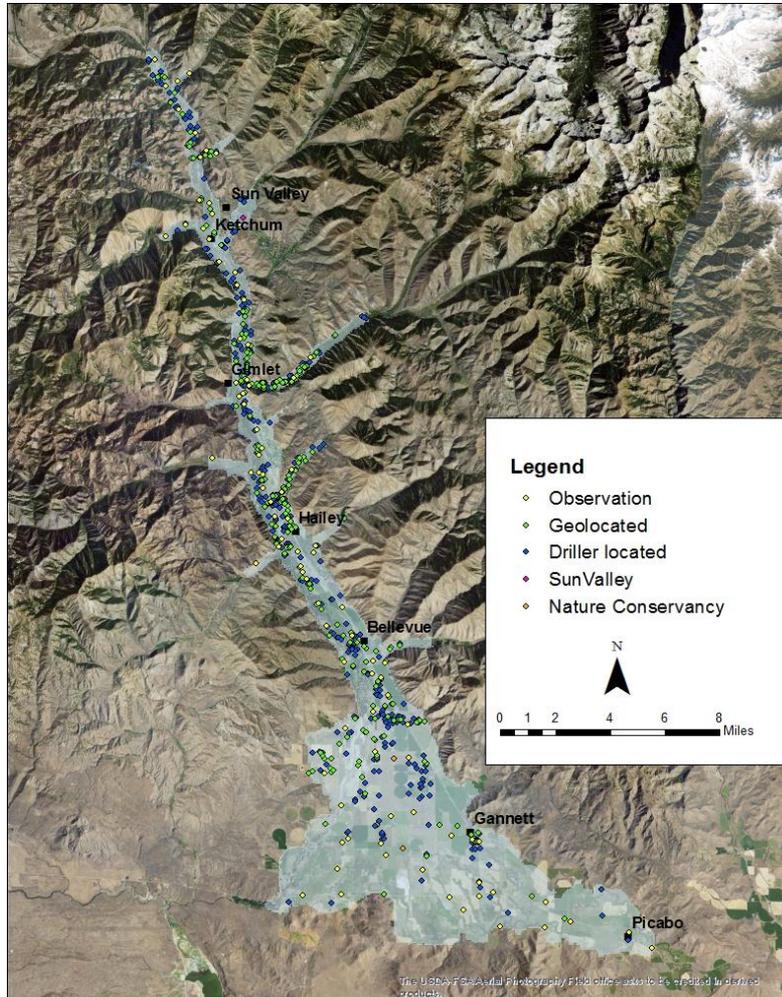
- Various wells
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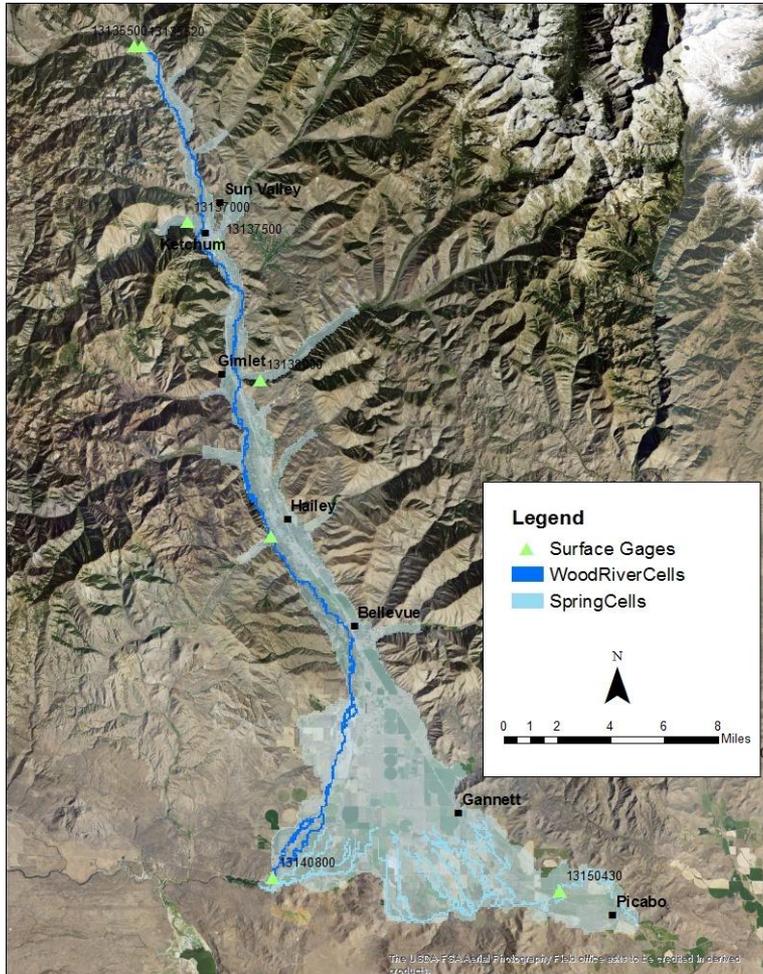
- Transducers set for 15 min data
- Converted to average daily
- Trimmed to calibration period
- Currently 5 wells
- Total of 995 observations

# Total Well Data



- Observation Wells
  - 94 Wells
    - 387 measurements
- Driller Wells
  - Geolocated
    - 254 measurements
  - Driller Located
    - 416 measurements
- Sun Valley
  - 2 wells
    - 393 measurements
- Nature Conservancy
  - 5 wells
    - 995 measurements

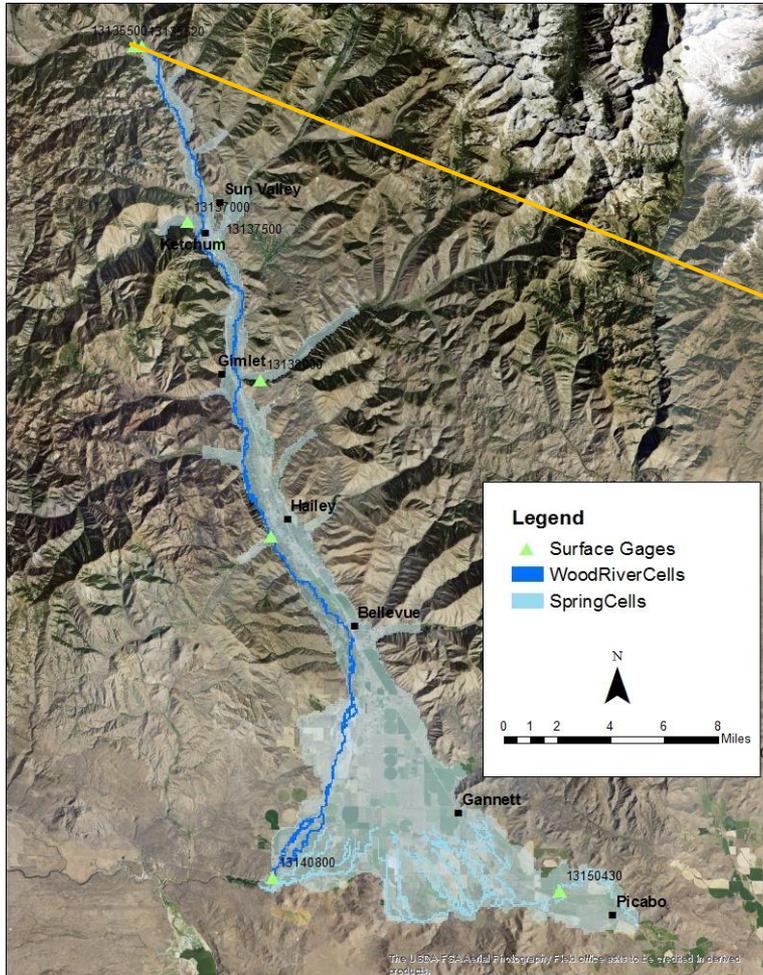
# River Gains



Station	Station Name	Period of Record
13135500	Big Wood River near Ketchum	May 1948 to September 1971; April 2011 to present
13135520	North Fork Big Wood River near Sawtooth NRA HQ	April 2011 to present
13137000	Warm Springs Creek near Ketchum	January 2011 to present
13137500	Trail Creek at Ketchum	November 2010 to present
13138000	East Fork Big Wood River at Gimlet	October 2010 to present
13139510	Big Wood River at Hailey, total flow	July 1915 to present
13140800	Big Wood River at Stanton Crossing	September 1996 to present
13140900	Willow Creek near Spring Creek Ranch	June 2000 to present
13150430	Silver Creek at Sportsman Access	October 1974 to September 2006; October 2007 to present

The USDA-FS-A&D Firetopography File files are to be applied to derived products.

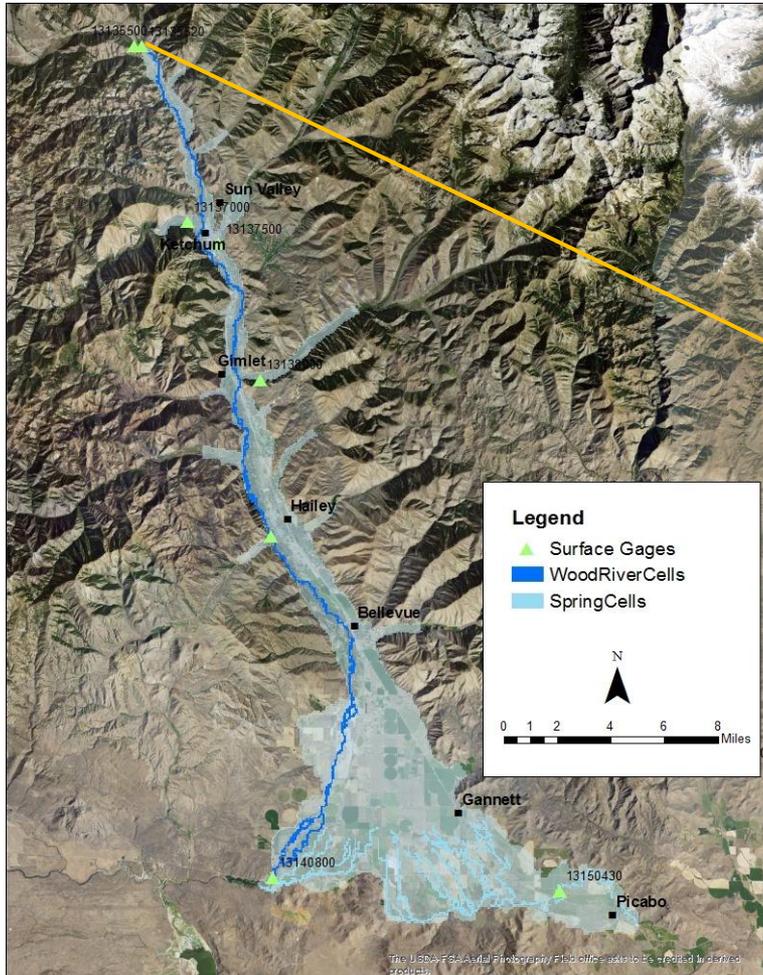
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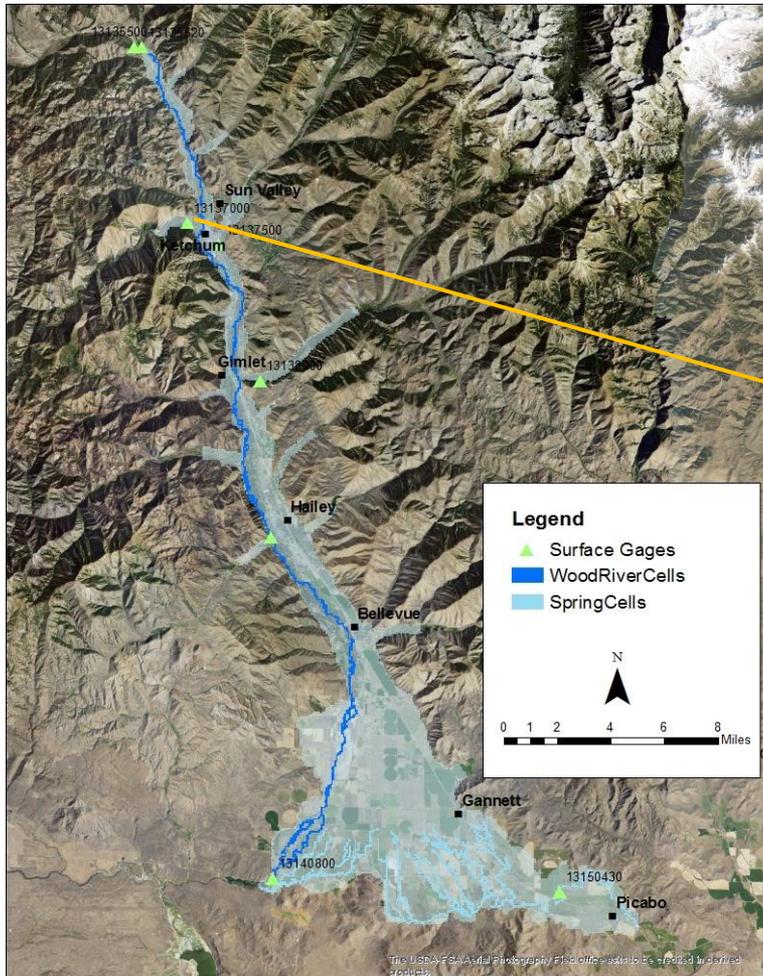
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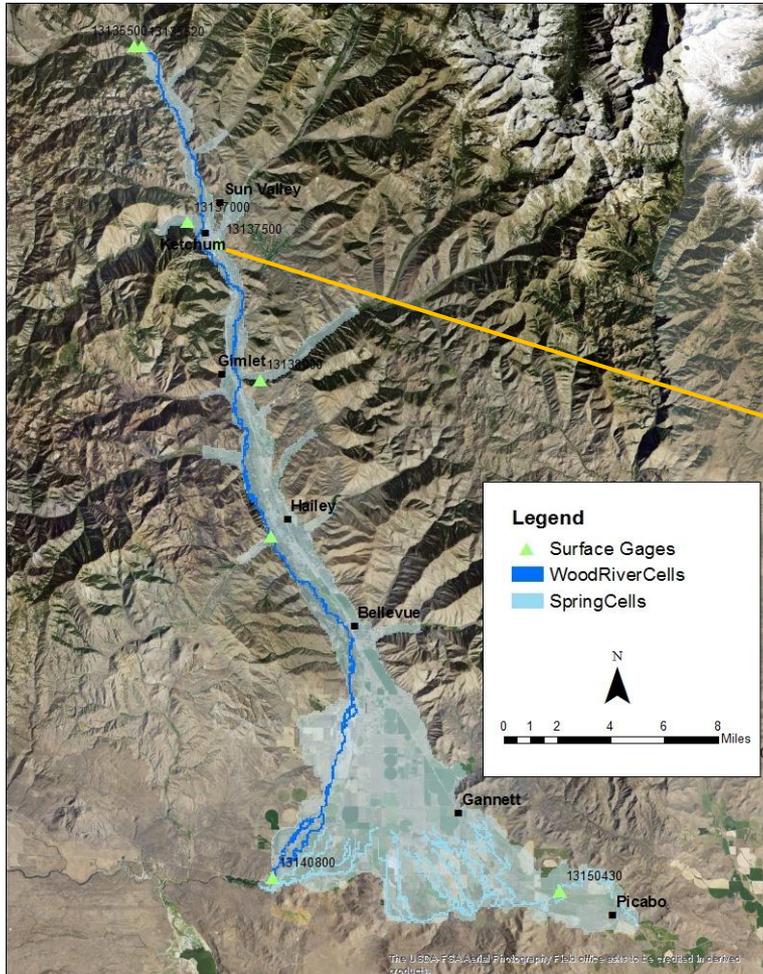
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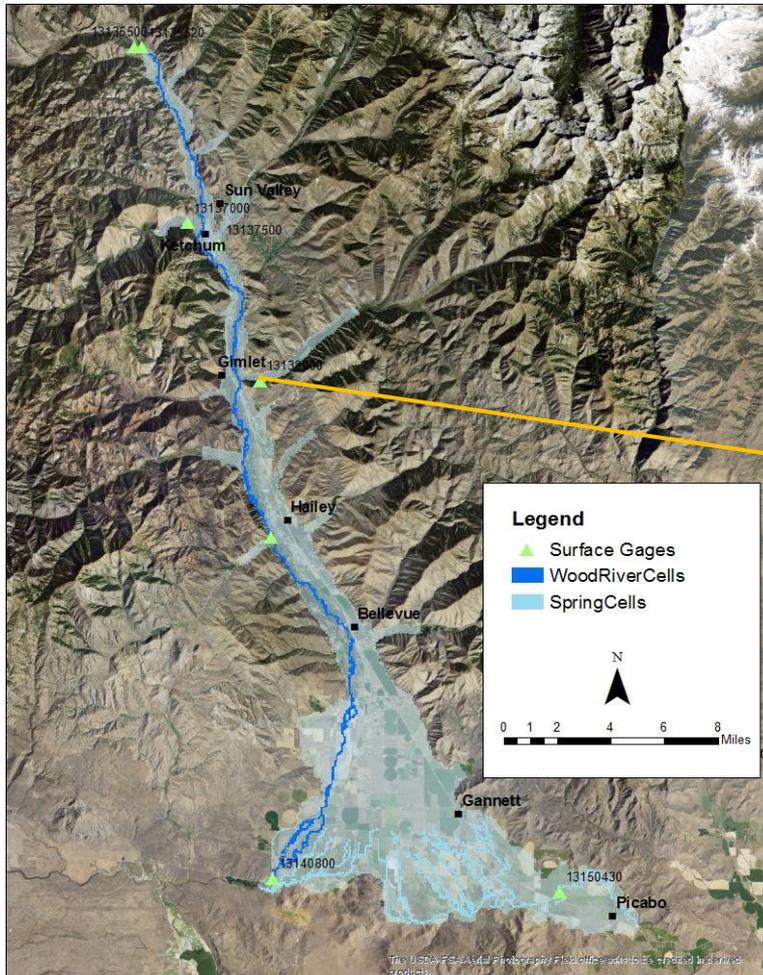
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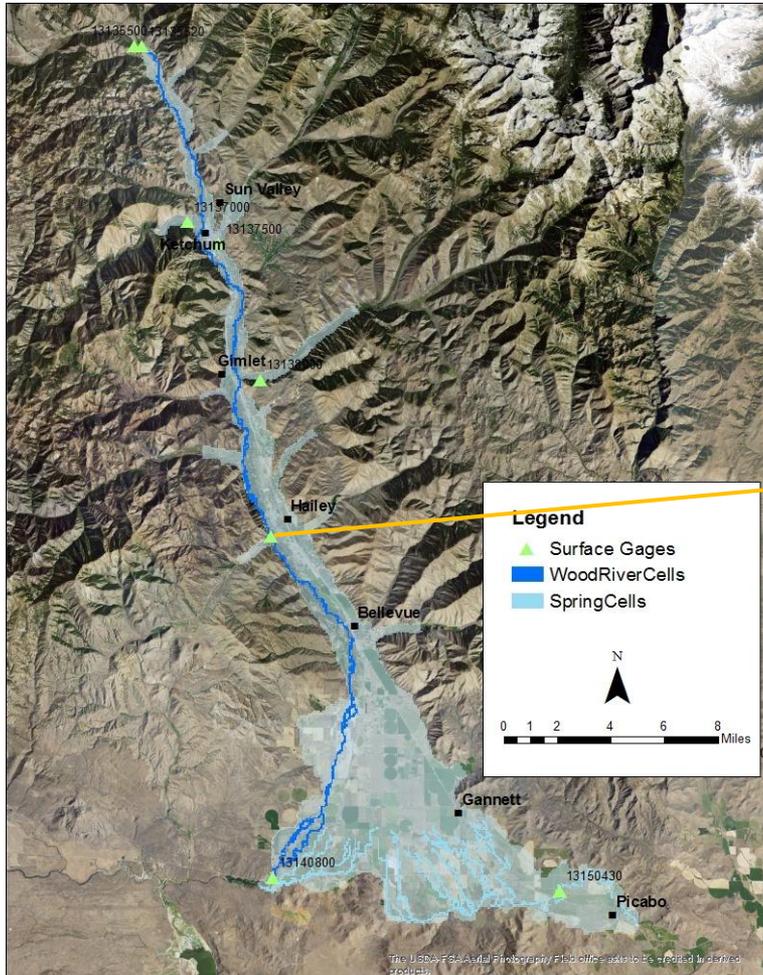
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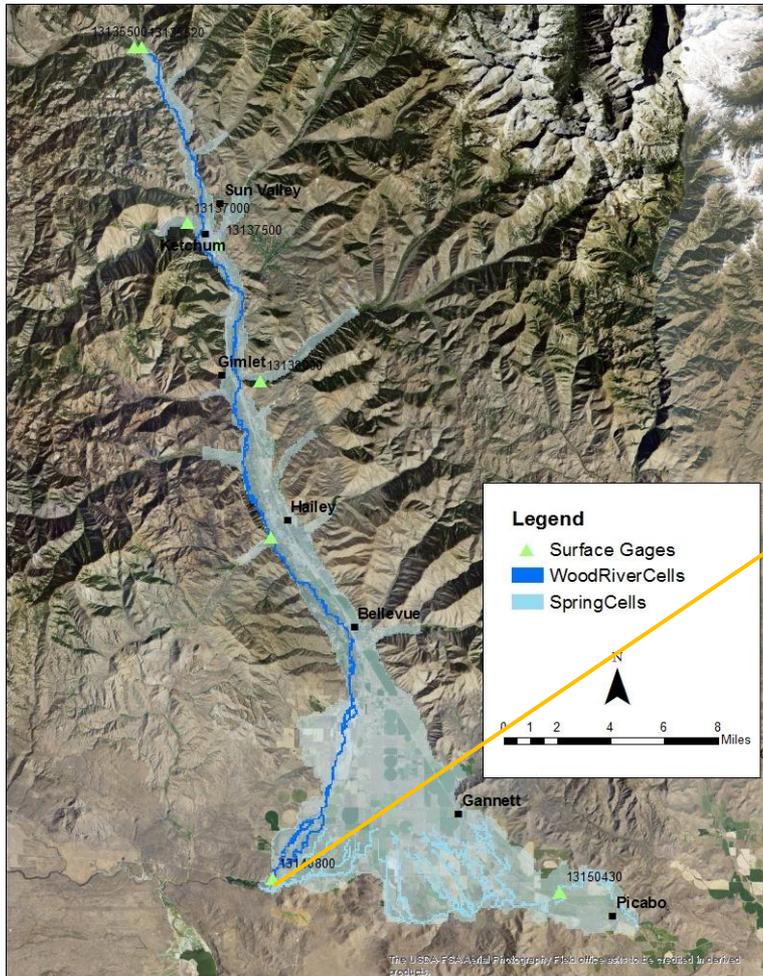
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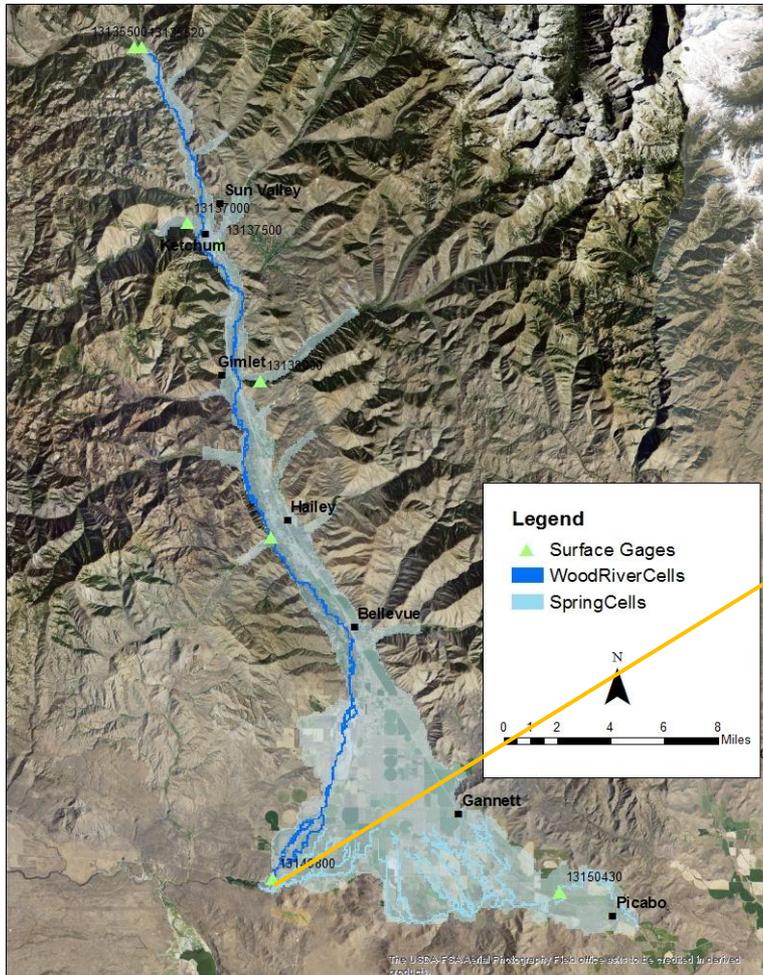
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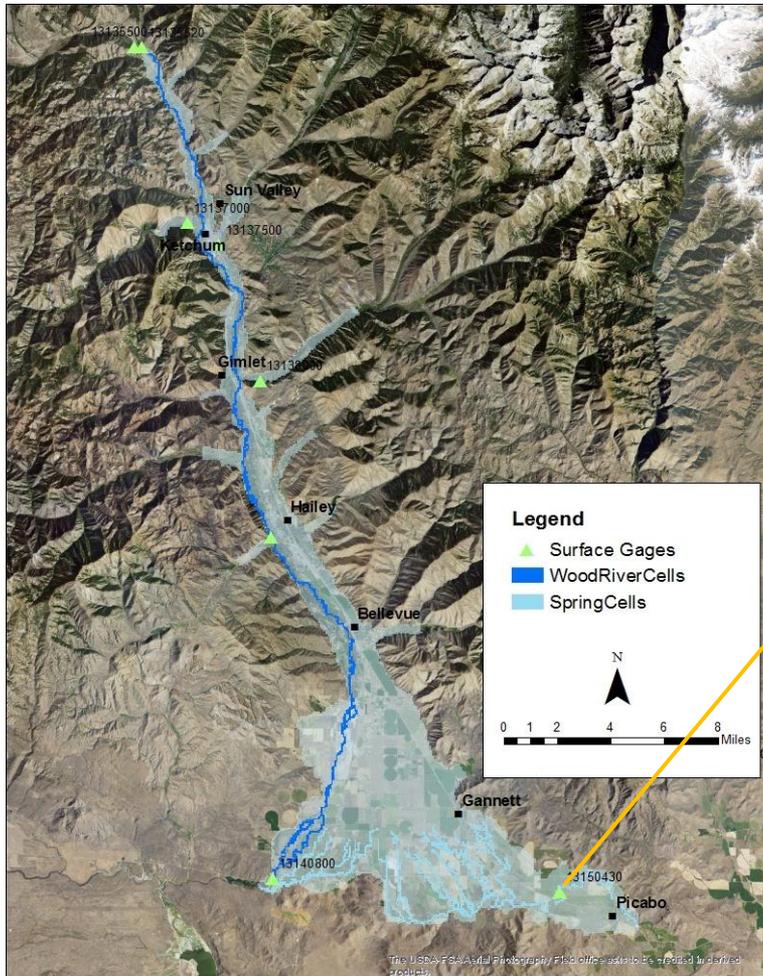
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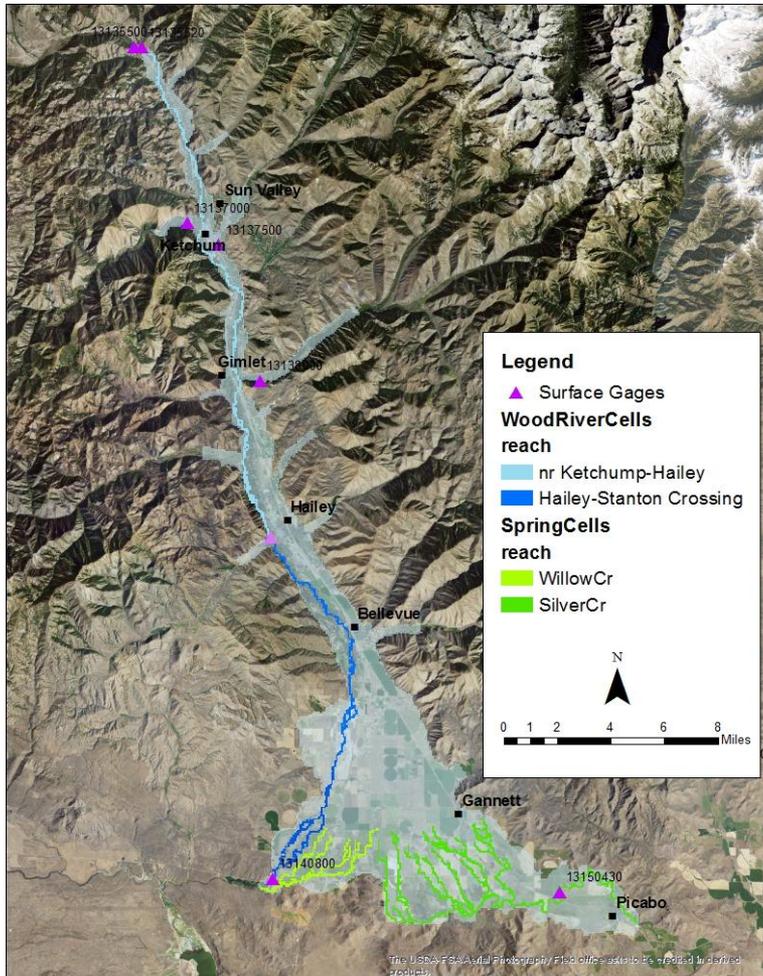
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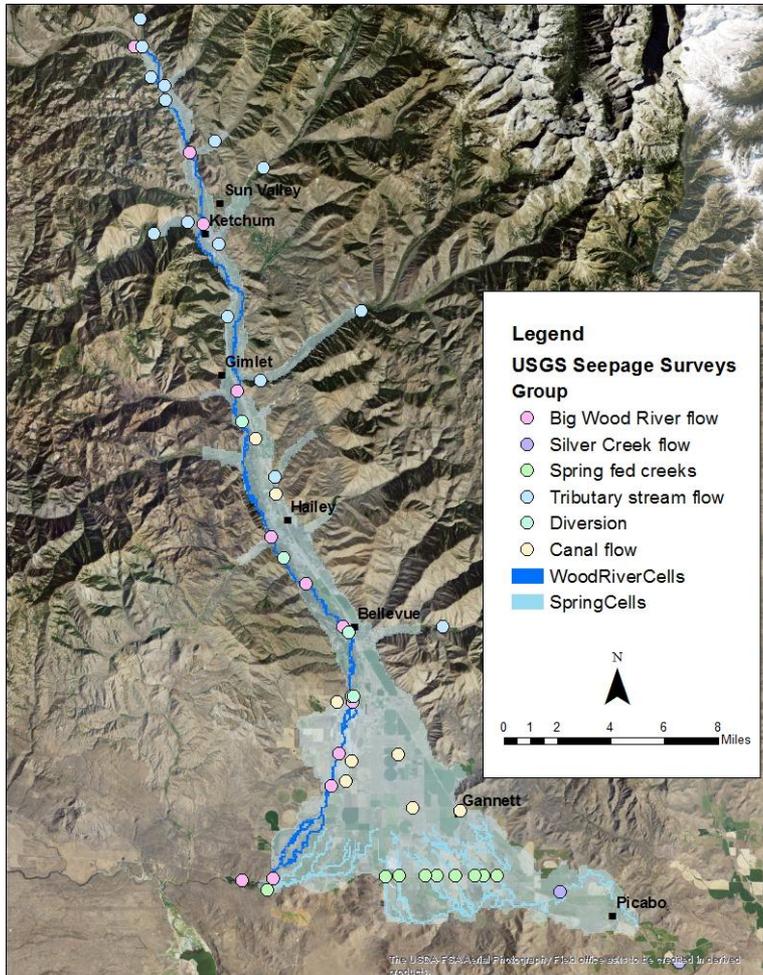
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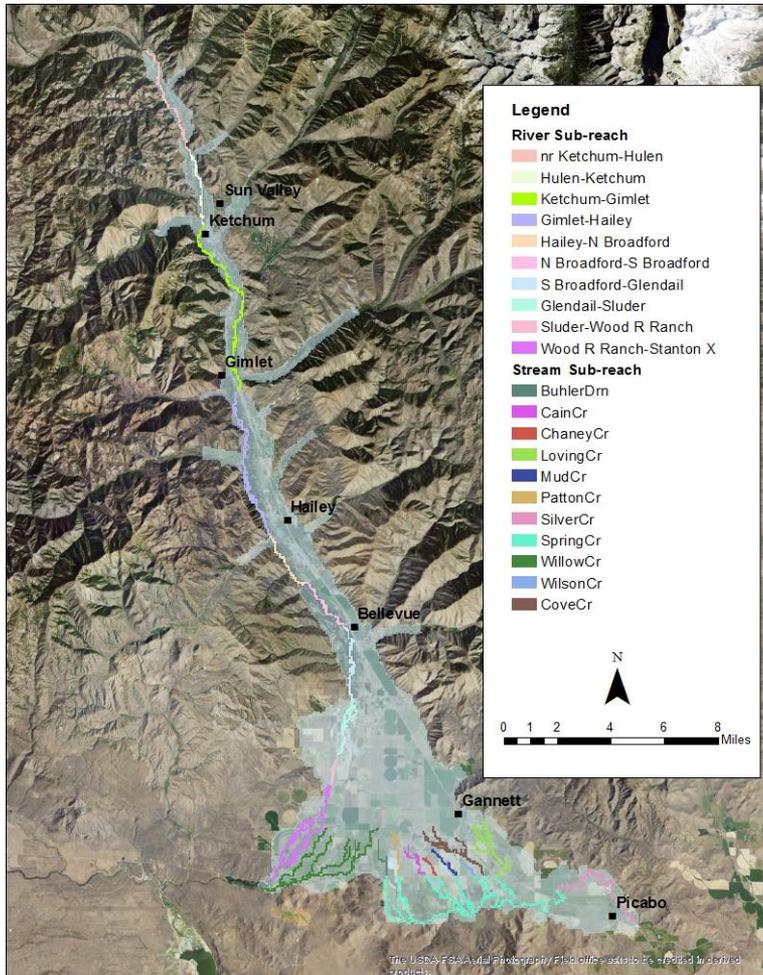
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# Seepage Surveys



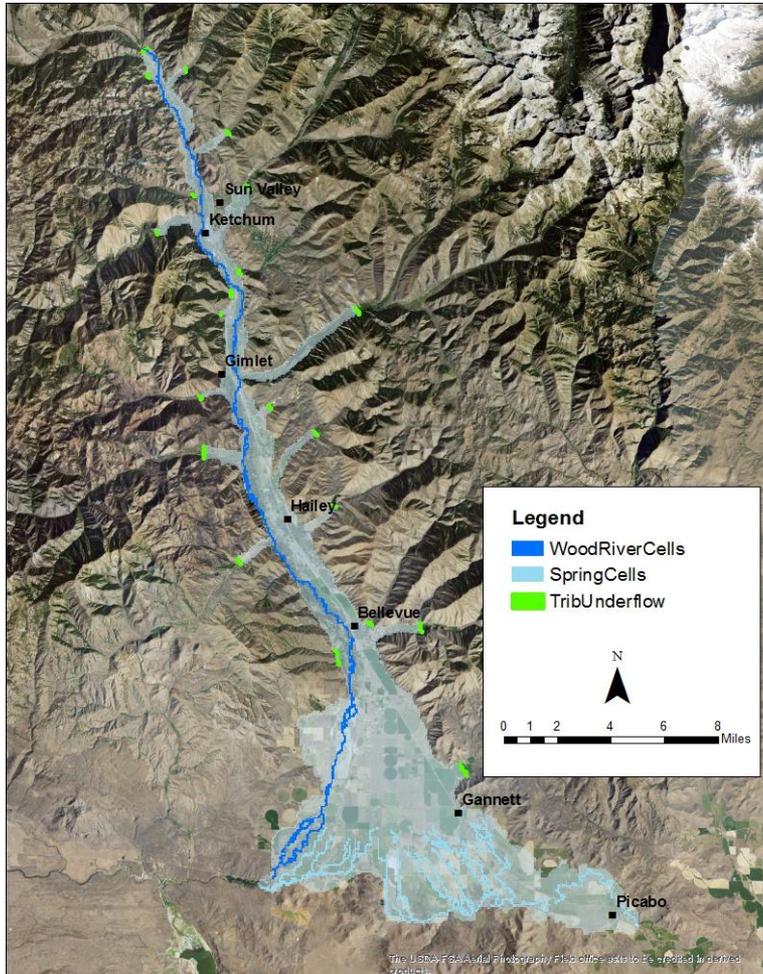
- USGS conducted 3 seepage surveys
  - August 2012
  - October 2012
  - March 2013
- Point measurements at 28 sites
  - Streamflow
  - Diversions

# Seepage Surveys



- Calculate field observed reach gains and sub-reach gains
- Calculate observed ratios for sub-reaches
- Match modeled average for August with August 2012 ratios
- Match modeled average for October with October 2012 ratios
- Match modeled average for March with March 2013 ratios

# Tributary Underflow



- 22 tributary valleys
- Most support ephemeral streams
- Initial tributary underflow based on Darcy flux
- Flux is adjustable

Tributary	Saturated	Tributary width (B) (ft)	Cross-sectional area ( $A_{trib}$ ) (ft <sup>2</sup> )	Land surface gradient ( $\nabla h_{trib}$ )	flux from	Basin area (mi <sup>2</sup> )	Average annual precipitation (in)	Precipitation volume ( $P_{trib}$ ) (acre-ft/yr)	volumetric	volumetric
	thickness (a) (ft)				Darcy equation ( $\bar{Q}_{tribini}$ ) (acre-ft/yr)				flux to precipitation volume ( $R_{triblarge}$ )	flux ( $\bar{Q}_{trib}$ ) ( $\bar{Q}_{triblarge}$ and $\bar{Q}_{tribsmall}$ ) (acre-ft/yr)
Adams Gulch (Adm)	48	650	24,694	0.0482	851	11	30	17,600	0.048	851
Chocolate Gulch (ChG) *	59	709	32,778	0.0727	1,703	0.75	21.6	864	--	43
Clear Creek (Clr) *	35	623	17,074	0.0795	971	2.2	19.5	2,288	--	114
Cold Springs Gulch (Cld) *	63	344	17,112	0.0576	705	2.9	21.6	3,341	--	167
Cove Canyon (Cov)	7	3,058	15,909	0.0127	145	14	15	11,200	0.013	145
Croy Creek (Cry)	40	1,391	43,660	0.0226	704	28	15.8	23,595	0.030	704
Deer Creek (DrC)	74	2,277	131,783	0.0155	1,462	55	25.3	74,213	0.020	1,462
Eagle Creek (Eag)	75	1,066	62,946	0.0226	1,015	11	29.4	17,248	0.059	1,015
East Fork (EstF)	43	1,414	48,259	0.0137	471	86	26.3	120,629	0.004	471
Elkhorn Gulch (Elk)	8	387	2,483	0.0289	51	13	18.4	12,757	0.004	51
Greenhorn Gulch (Gm)	78	860	52,395	0.0182	682	21	27.2	30,464	0.022	682
Indian Creek (InS)	83	1,070	69,452	0.0485	2,407	11	17.3	10,149	0.24	2,407
Lake Creek (Lak)	68	1,335	71,257	0.0472	2,406	12	27	17,280	0.14	2,406
Lees Gulch (Lee) *	57	827	37,328	0.0556	1,484	2.8	15	2,240	--	112
Ohio Gulch (OhG) *	85	1,243	83,032	0.0664	3,940	5.1	15.7	4,270	--	214
Quigley Creek (QgC)	60	1,325	62,378	0.0126	560	17	17.1	15,504	0.036	560
Seamans Creek (Sea)	156	1,391	170,357	0.0160	1,949	23	15.3	18,768	0.10	1,949
Slaughterhouse Gulch (Slh)	60	745	35,380	0.0200	506	13	16.6	11,509	0.044	506
Townsend Gulch (Twn) *	63	728	35,835	0.0476	1,218	1.2	15	960	--	48
Trail Creek (Trl)	125	2,152	212,020	0.0191	2,898	64	32.6	111,274	0.026	2,898
Upper Big Wood River (UBW)	118	940	87,037	0.0097	607	178	33	313,278	0.002	607
Warm Springs Creek (WmS)	46	1,617	58,006	0.0117	487	96	35.3	180,735	0.003	487

Tributary	Saturated thickness (a) (ft)	Tributary width (B) (ft)	Cross-sectional area ( $A_{trib}$ ) (ft <sup>2</sup> )	Land surface gradient ( $\nabla h_{trib}$ )	flux from Darcy equation ( $\bar{Q}_{tribini}$ ) (acre-ft/yr)	Basin area (mi <sup>2</sup> )	Average annual precipitation (in)	Precipitation volume ( $P_{trib}$ ) (acre-ft/yr)	volumetric flux to precipitation volume ( $R_{triblarge}$ )	volumetric flux ( $\bar{Q}_{trib}$ ) ( $\bar{Q}_{triblarge}$ and $\bar{Q}_{tribsmall}$ ) (acre-ft/yr)
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Cove Canyon (Cov)	7	3,058	15,909	0.0127	145	14	15	11,200	0.013	145
Croy Creek (Cry)	40	1,391	43,660	0.0226	704	28	15.8	23,595	0.030	704
Deer Creek (DrC)	74	2,277	131,783	0.0155	1,462	55	25.3	74,213	0.020	1,462
Eagle Creek (Eag)	75	1,066	62,946	0.0226	1,015	11	29.4	17,248	0.059	1,015
East Fork (EstF)	43	1,414	48,259	0.0137	471	86	26.3	120,629	0.004	471
Elkhorn Gulch (Elk)	8	387	2,483	0.0289	51	13	18.4	12,757	0.004	51
Greenhorn Gulch (Gm)	78	860	52,395	0.0182	682	21	27.2	30,464	0.022	682
Indian Creek (InS)	83	1,070	69,452	0.0485	2,407	11	17.3	10,149	0.24	2,407
Lake Creek (Lak)	68	1,335	71,257	0.0472	2,406	12	27	17,280	0.14	2,406
Lees Gulch (Lee) *	57	827	37,328	0.0556	1,484	2.8	15	2,240	--	112
Ohio Gulch (OhG) *	85	1,243	83,032	0.0664	3,940	5.1	15.7	4,270	--	214
Quigley Creek (QgC)	60	1,325	62,378	0.0126	560	17	17.1	15,504	0.036	560
Seamans Creek (Sea)	156	1,391	170,357	0.0160	1,949	23	15.3	18,768	0.10	1,949
Slaughterhouse Gulch (Slh)	60	745	35,380	0.0200	506	13	16.6	11,509	0.044	506
Townsend Gulch (Twn) *	63	728	35,835	0.0476	1,218	1.2	15	960	--	48
Trail Creek (Trl)	125	2,152	212,020	0.0191	2,898	64	32.6	111,274	0.026	2,898
Upper Big Wood River (UBW)	118	940	87,037	0.0097	607	178	33	313,278	0.002	607
Warm Springs Creek (WmS)	46	1,617	58,006	0.0117	487	96	35.3	180,735	0.003	487

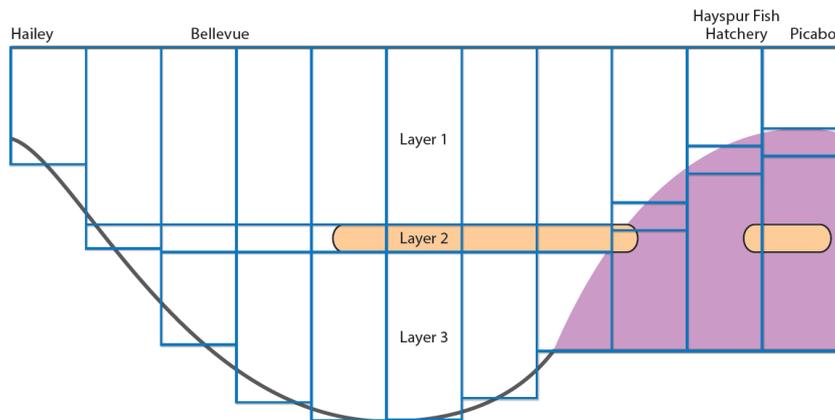
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	thickness (a) (ft)				Darcy equation ( $\bar{Q}_{tribini}$ ) (acre-ft/yr)					
Adams Gulch (Adm)	48	650	24,694	0.0482	851	11	30	17,600	0.048	851
Chocolate Gulch (ChG) *	59	709	32,778	0.0727	1,703	0.75	21.6	864	--	43
Clear Creek (Clr) *	35	623	17,074	0.0795	971	2.2	19.5	2,288	--	114
Cold Springs Gulch (Cld) *	63	344	17,112	0.0576	705	2.9	21.6	3,341	--	167
Cove Canyon (Cov)	7	3,058	15,909	0.0127	145	14	15	11,200	0.013	145
Croy Creek (Cry)	40	1,391	43,660	0.0226	704	28	15.8	23,595	0.030	704
Deer Creek (DrC)	74	2,277	131,783	0.0155	1,462	55	25.3	74,213	0.020	1,462
Eagle Creek (Eag)	75	1,066	62,946	0.0226	1,015	11	29.4	17,248	0.059	1,015
East Fork (EstF)	43	1,414	48,259	0.0137	471	86	26.3	120,629	0.004	471
Elkhorn Gulch (Elk)	8	387	2,483	0.0289	51	13	18.4	12,757	0.004	51
Greenhorn Gulch (Gm)	78	860	52,395	0.0182	682	21	27.2	30,464	0.022	682
Indian Creek (InS)	83	1,070	69,452	0.0485	2,407	11	17.3	10,149	0.24	2,407
Lake Creek (Lak)	68	1,335	71,257	0.0472	2,406	12	27	17,280	0.14	2,406
Lees Gulch (Lee) *	57	827	37,328	0.0556	1,484	2.8	15	2,240	--	112
Ohio Gulch (OhG) *	85	1,243	83,032	0.0664	3,940	5.1	15.7	4,270	--	214
Quigley Creek (QgC)	60	1,325	62,378	0.0126	560	17	17.1	15,504	0.036	560
Seamans Creek (Sea)	156	1,391	170,357	0.0160	1,949	23	15.3	18,768	0.10	1,949
Slaughterhouse Gulch (Slh)	60	745	35,380	0.0200	506	13	16.6	11,509	0.044	506
Townsend Gulch (Twn) *	63	728	35,835	0.0476	1,218	1.2	15	960	--	48
Trail Creek (Trl)	125	2,152	212,020	0.0191	2,898	64	32.6	111,274	0.026	2,898
Upper Big Wood River (UBW)	118	940	87,037	0.0097	607	178	33	313,278	0.002	607
Warm Springs Creek (WmS)	46	1,617	58,006	0.0117	487	96	35.3	180,735	0.003	487

Tributary	Saturated	Tributary width (B) (ft)	Cross-sectional area ( $A_{trib}$ ) (ft <sup>2</sup> )	Land surface gradient ( $\nabla h_{trib}$ )	flux from	Basin area (mi <sup>2</sup> )	Average annual precipitation (in)	Precipitation volume ( $P_{trib}$ ) (acre-ft/yr)	volumetric	volumetric
	thickness (a) (ft)				Darcy equation ( $\bar{Q}_{tribini}$ ) (acre-ft/yr)				flux to precipitation volume ( $R_{triblarge}$ )	flux ( $\bar{Q}_{trib}$ ) ( $\bar{Q}_{triblarge}$ and $\bar{Q}_{tribsmall}$ ) (acre-ft/yr)
Adams Gulch (Adm)	48	650	24,694	0.0482	851	11	30	17,600	0.048	851
Chocolate Gulch (ChG) *	59	709	32,778	0.0727	1,703	0.75	21.6	864	--	43
Clear Creek (Clr) *	35	623	17,074	0.0795	971	2.2	19.5	2,288	--	114
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Warm Springs Creek (WmS)	46	1,617	58,006	0.0117	487	96	35.3	180,735	0.003	487

# Tributary Underflow

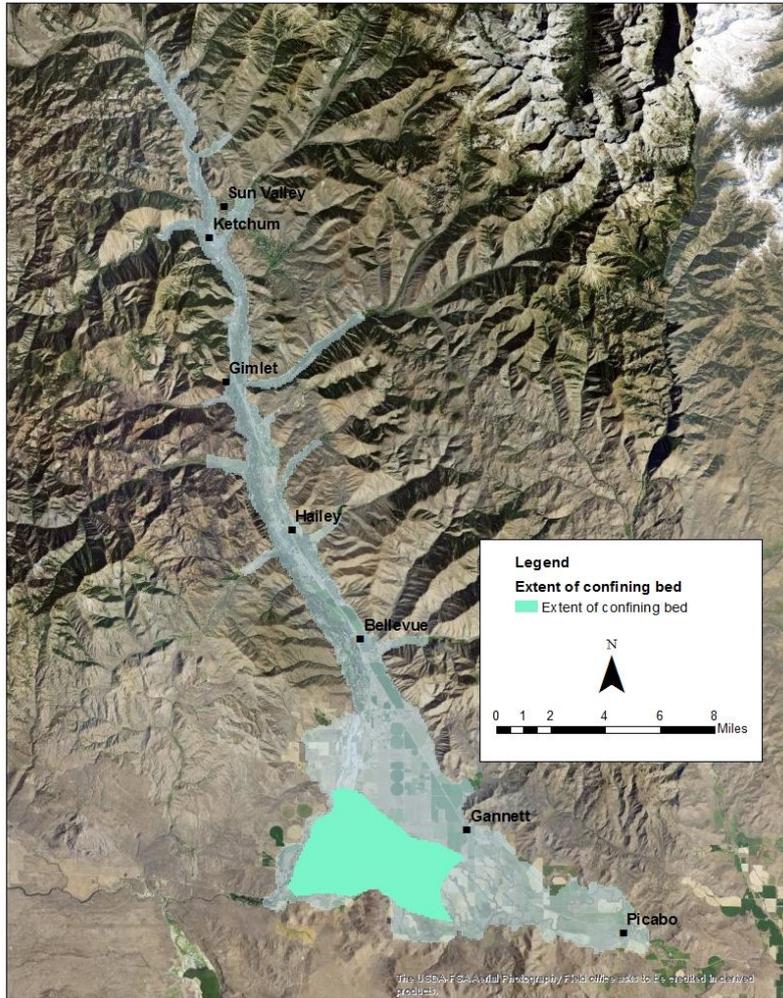
- Temporal variation based on streamflow gaged at Hailey
- Dampening factor
  - Does not change mean, changes seasonal amplitude
  - Adjustable
- 9 month moving average
  - Adjustable

# 3D Representation



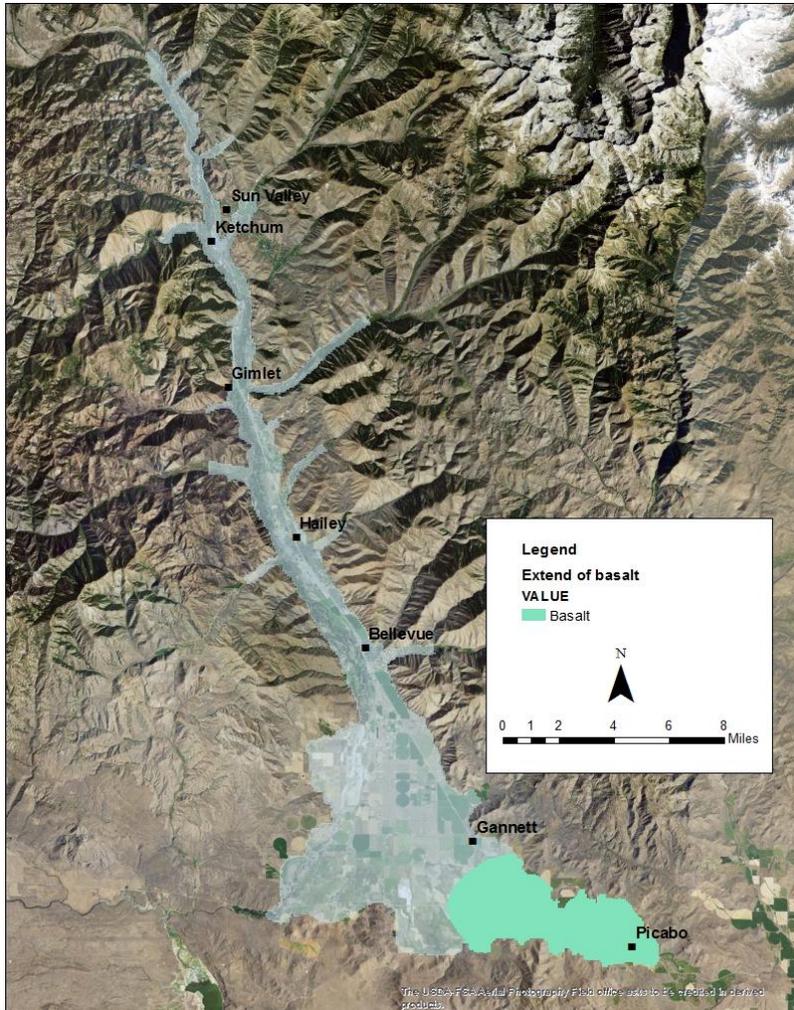
- Three layers south of Hailey
- Top layer is unconfined
- Second layer is confining
- Third layer is confined

# 3D Representation



- Location of confining bed

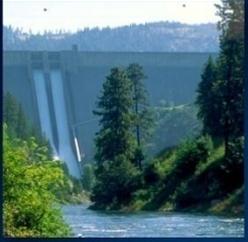
# 3D Representation



- Basalt

# Unconfined Representation

- Build Jacobian matrix using fixed transmissivity model
- Evaluate upgrade vector using unconfined representation



End